JUNE 1985/$2

AIR FORCE MAGAZINE

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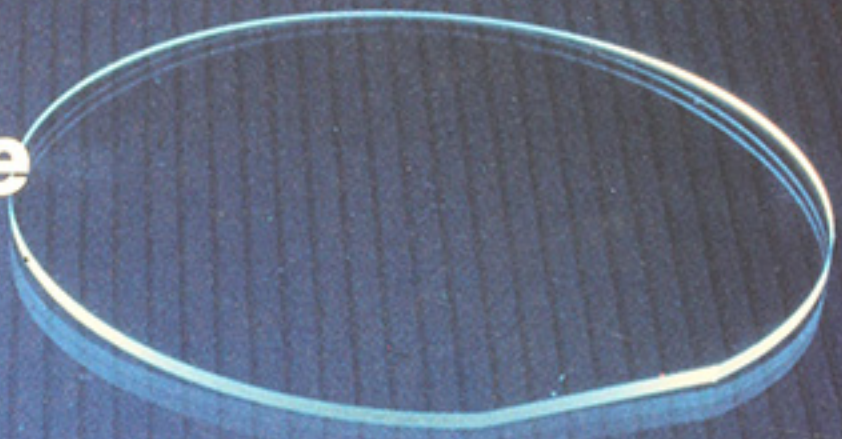

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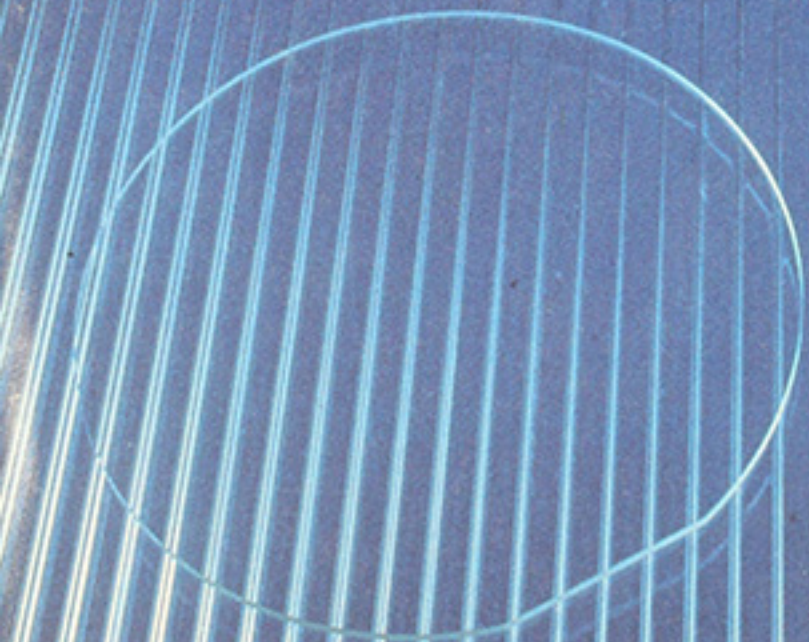

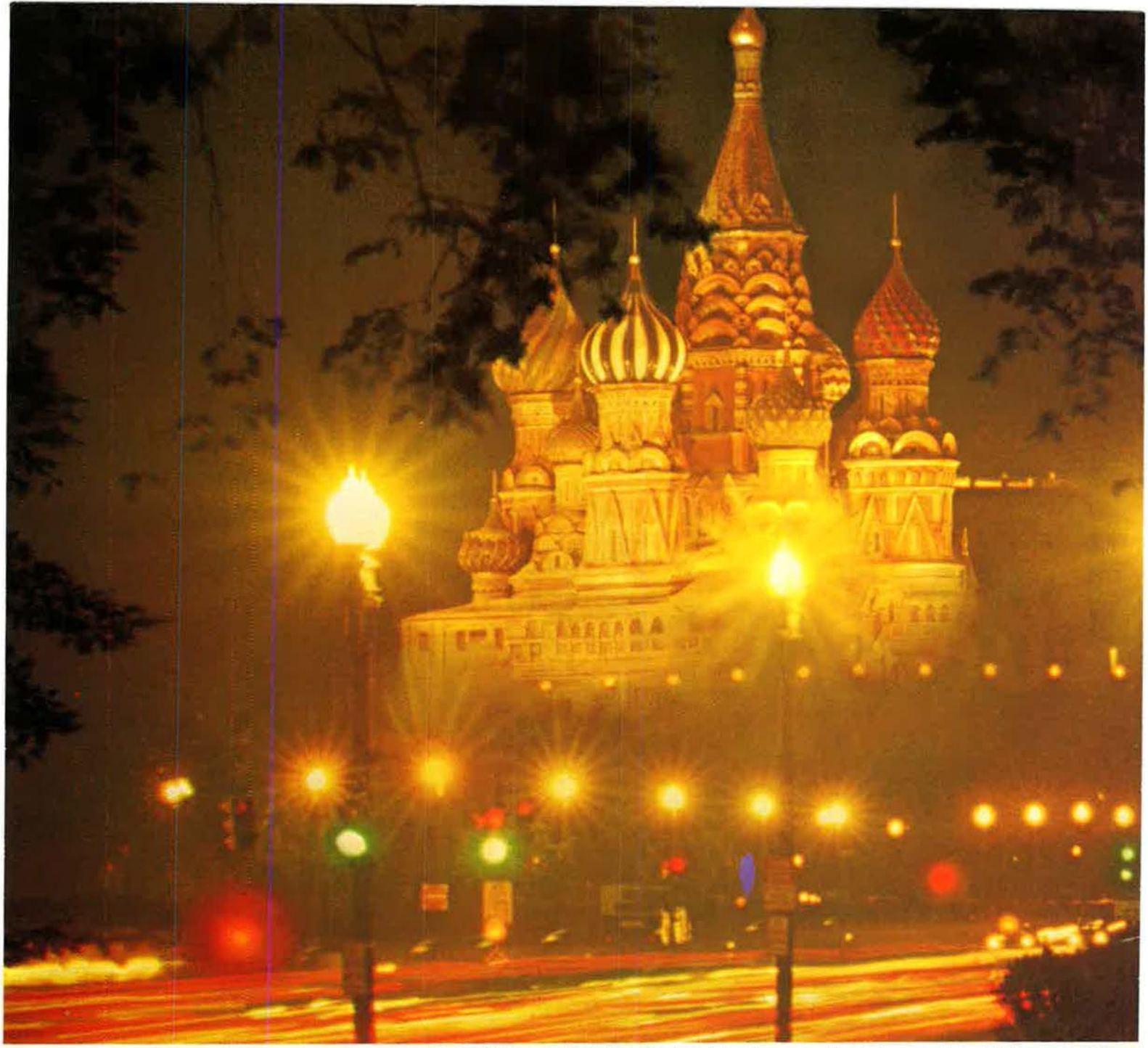

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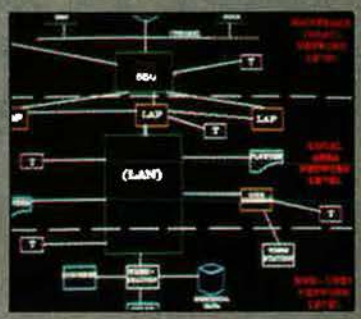

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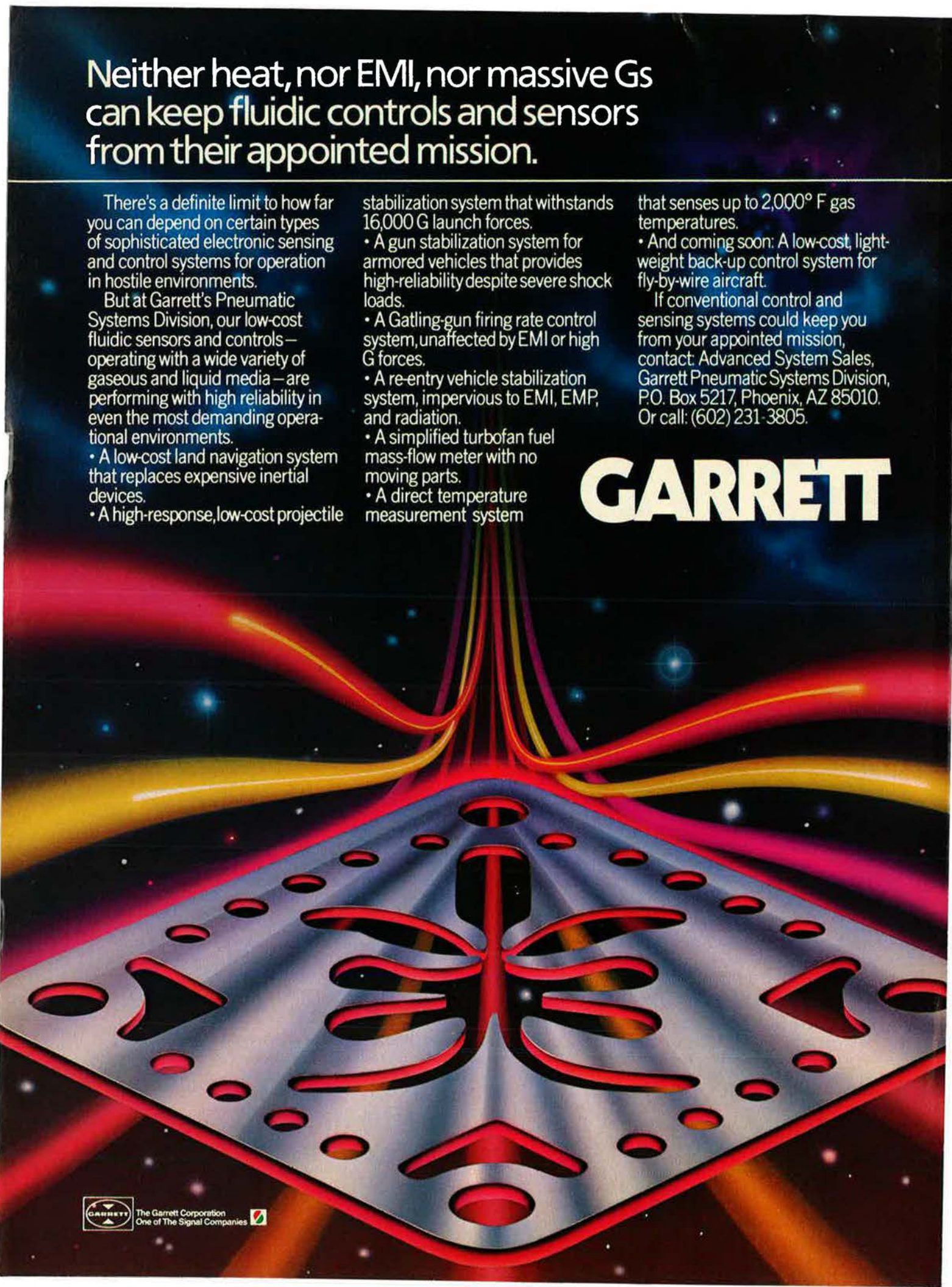

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JUNE 1985
VOLUME 68, NUMBER 6

AIR FORCE MAGAZINE

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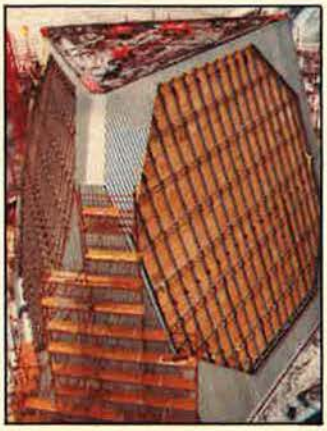

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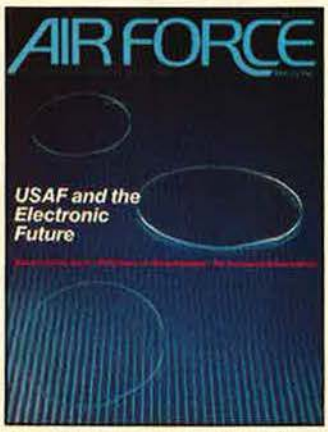

About the cover: Looking like contact lenses, these gallium arsenide wafers by Westinghouse symbolize the emerging technologies that promise to revolutionize electronic warfare. A special section, "USAF and the Electronic Future," begins on p. 54.

Special Section: USAF and the Electronic Future

Features

Departments

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AN EDITORIAL

The Russian Easter Overture

By John T. Correll, EDITOR IN CHIEF

EVEN before Mikhail Gorbachev ascended to top Soviet leadership in March, he had taken the fancy of many in the West. That favorable assessment, along with the incredibly tolerant standards the world uses to judge Soviet behavior, practically guaranteed Gorbachev an early advantage in the propaganda wars. He was quick in attempting to exploit it.

His opening round was his Easter speech, which fooled hardly anyone. In it, Gorbachev announced his willingness to freeze medium-range nuclear missiles in Europe at present levels, which would leave the Soviet Union ahead by a ten-to-one ratio. As the Washington *Post* said, "Some moratorium."

It took colossal gall for the Soviets to make such an offer, having previously availed themselves of a unilateral six-year head start on deployment of these missiles and now having more than 400 of them operational. That Gorbachev expected—and got—any serious attention by this ploy is difficult to understand.

The United States soon came under criticism for its prompt rejection of Gorbachev's moratorium. Some had seen a praiseworthy concession in his offer: It would allow NATO to keep in place the limited number of missiles it already has. Previously, the Soviet Union had insisted on an absolute monopoly for itself.

The content of what Gorbachev said, we are told by the editorial writer for the Hartford *Courant*, was less important than his conciliatory tone. "More gestures like Mr. Gorbachev's by both sides and—who knows—they might even start to get somewhere on nuclear arms control," the *Courant* said. The US rejection was "overwrought," in the opinion of the New York *Times*, which admonished us to remember "the context in which Mr. Gorbachev must operate." Since he had not yet had time to maneuver his own followers onto the Politburo, the *Times* proclaimed, it was "small wonder that in this first pitch to the West he sounded like his predecessors."

The Old Guard who put Gorbachev where he is have known him better and for longer than have we in the West. It seems unlikely that they would have elected him to power had they perceived his ultimate purpose to be dissolution of their system. Gorbachev, at fifty-four, is likely to continue as General Secretary for many years. We should not hurry to make too much of his style until we see some substance to go with it.

The Soviet Union that Gorbachev heads is the nation that still occupies Afghanistan and that is consolidating its resubjugation of Poland. It is the nation that shot down an unarmed airliner less than two years ago and the one that showed no remorse when a Soviet sentry killed an American officer two weeks before Gorbachev's Easter speech. It is the nation that persisted, throughout the era of détente, in a one-sided arms race. It is also the same Soviet Union that has engaged in wholesale violations of arms-control agreements.

This outrageous record in itself may be a major reason why the rest of the world is so reluctant to hold the Soviet Union to strict account. Gestures of appeasement indicate a fear of Soviet volatility and irresponsibility. This is something akin to giving a mad dog the wide part of the road—except that the Soviets do what they do with cold deliberation, not madness. When we make excuses for them or show ourselves eager to make unreciprocated concessions, we give them no motivation to act any differently.

The United States has made substantial reductions in its strategic forces without the compensation of matching reductions by the Soviet Union. While the Soviets have added relentlessly to their nuclear arsenal, we have tended to regard our strategic modernization programs as bargaining chips. Last year, the House of Representatives made its stand on further MX production contingent on perceived progress in arms-control negotiations. The MX vote carried this year only because a great many congressmen concluded that it would have barter value in Geneva.

"The Soviets can take pleasure in the expectation that if they stand pat, we will meanwhile negotiate with ourselves and probably change our position," observes Kenneth L. Adelman, Director of the US Arms Control and Disarmament Agency.

If there was any conciliatory note in Gorbachev's Easter overture, it is most likely attributable to NATO's steadfast stand on missile counterdeployments and to Moscow's perception that the US is serious about strategic modernization. If there is any hope for meaningful arms control, we will not achieve it by glossing over questions of reciprocity, verification, and compliance.

We must have more from Mr. Gorbachev than his winning smile. ■

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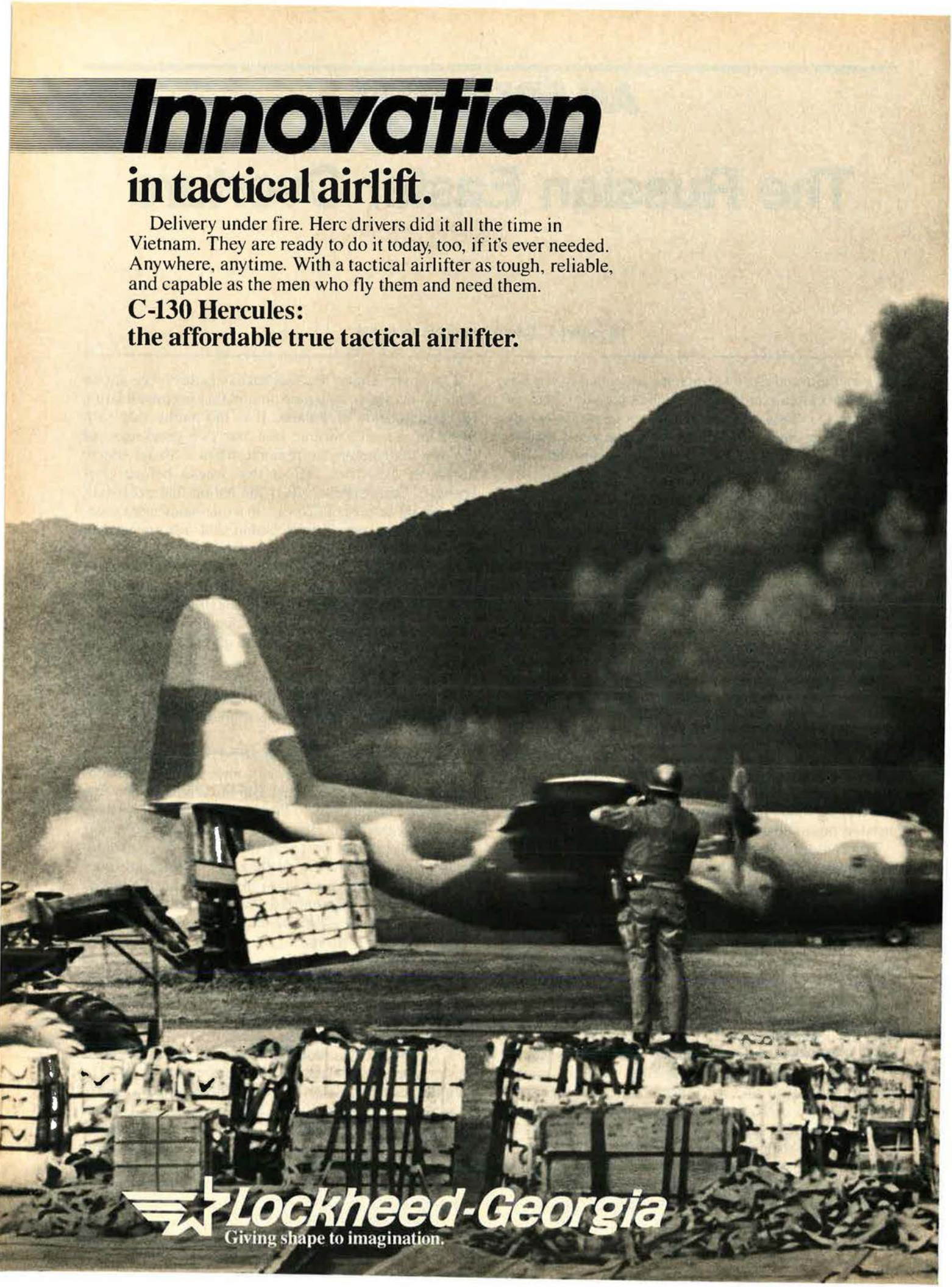

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AIRMAIL

Not So Great Danes?

Your previous articles on NATO air forces (the RAF, Turkish Air Force) were helpful contributions to understanding the problems and prospects for those forces. However, your recent article "The Danish Air Force Looks Ahead" falls far short of its predecessors *(see May '85 issue, p. 60).* The article is so unobjective that I found it misleading, at best.

Author B. Aalbaek-Nielsen presents a good picture of a nice little peacetime air force (aerial supply, limited air defense intercept, fishing zone patrol, air rescue), but what of combat capability? The sad truth is that the Danish military—air force included—will not fight effectively if confronted by the Soviets because it is both unable and unwilling to do so.

It is good that the RDAF will be able to squeeze out a fourth squadron with twelve new F-16s (plus spares from the previous buy). But the last F-104 squadron will be phased out this year, before the fourth F-16 squadron is brought on line, leaving only the F-16s plus a squadron of F-35 Drakens as the total combat air force. A suitable air-to-ground missile for the F-16s has not yet been decided on, so, at least for the next few years, this splendid aircraft will rely on 20-mm cannon and conventional bombs for the ground-attack mission it has been assigned.

Numerous official and unofficial reports warn that, because of its poor maintenance, faulty equipment, and lack of reserve stocks, the overall readiness of the Danish military falls short of supporting a credible fighting force. Although the Danish army is a component of NATO's BALTAP command, the only effective land forces in BALTAP are the German units stationed in Schleswig-Holstein. BALTAP's German naval Tornados and Luftwaffe Alpha Jets are equipped to conduct operations against a Warsaw Pact force in the Baltic—unlike the Danish Air Force.

What is the Warsaw Pact threat to Denmark and the vital straits? There seems to be a variety from which to choose. Perhaps it is the 10,000-man combined amphibious force comprising the Soviet Baltic Fleet naval infantry brigade, a Polish "sea landing" division, and an East German maritime landing regiment. Perhaps it is the Warsaw Pact's combined Baltic fleets themselves—major surface ships, submarines, patrol craft, and ASW-equipped aircraft. Maybe it is the ground forces of Poland's Pomeranian Military District—three motorized rifle divisions and two tank divisions, all at Category I readiness. Then there are elements of the Soviet 2d Guards Tank Army in northern East Germany. Perhaps the threat is an airborne force of at least one Soviet airborne division and one Polish airborne division. Maybe it is actually a combination of all of these that is the real threat to BALTAP.

The point is that the Danish military, size notwithstanding, is equipped, manned, and trained to face *none* of them.

Where are the ASW forces, where is a modern antiarmor capability, where is a sufficiently large sea-mining capability? An unwillingness by Copenhagen to fund defense is where they are. Despite your article's blurb—"high public approval of NATO participation"—that public approval has not been translated into funding that reflects a national will to fight.

The Danes will never come close to the hoped-for NATO goal of a three percent annual real increase in defense spending. Spending by Denmark for defense has actually *declined* in recent years, and 1985 is no exception to this trend. As the Danish defense minister said in 1981, "Eighty percent of the population is for defense, but if you ask them to sacrifice [more] for it, you get an entirely different response."

The Danes have hitched their wagon to the star of the welfare state and the good life. They do not feel threatened by the Russians; after all, the rest of NATO will be compelled to keep the Russians inside the Baltic anyway, so why bother?

After the Danish army reserve has failed to mobilize or is overrun and after the handful of operational F-16s has been attrited from the sky, perhaps only the quaint Ground Observer Corps will remain. The Danish Air Force is looking ahead, all right—right ahead toward 1940.

Maj. Dan Sibbet, USAF (Ret.)
Woodbridge, Va.

Defense and the Deficit

I refer to the editorial "Deficits and Defense" by Russell E. Dougherty in the April 1985 issue.

In responding to Captain Walsh's questions *(see "Airmail" March '85 issue, p. 17),* Mr. Dougherty states, if I may summarize, that we cannot afford an inadequate defense. I certainly agree. He further states that we cannot lay the blame for the deficit on DoD. I would also agree. When he states that the economy is in a more favorable posture than before, I also agree.

These are great and wonderful truths. But we do have a large and dangerous deficit. Even Congress finds bipartisan agreement on this issue. If the deficit is not affecting today's economy, then how about the economy our children will inherit? If we are all to help during this budget squeeze, why should DoD be exempt? Is DoD's budget so immaculate that anything other than minor adjustment would leave us with a perilous defense posture? I find that difficult to believe.

We hear constantly that personnel costs are budget-drivers. Rather than cut salaries, let us cut the size of force. These cuts need not be among the line troops, but could well be among the expanding headquar-

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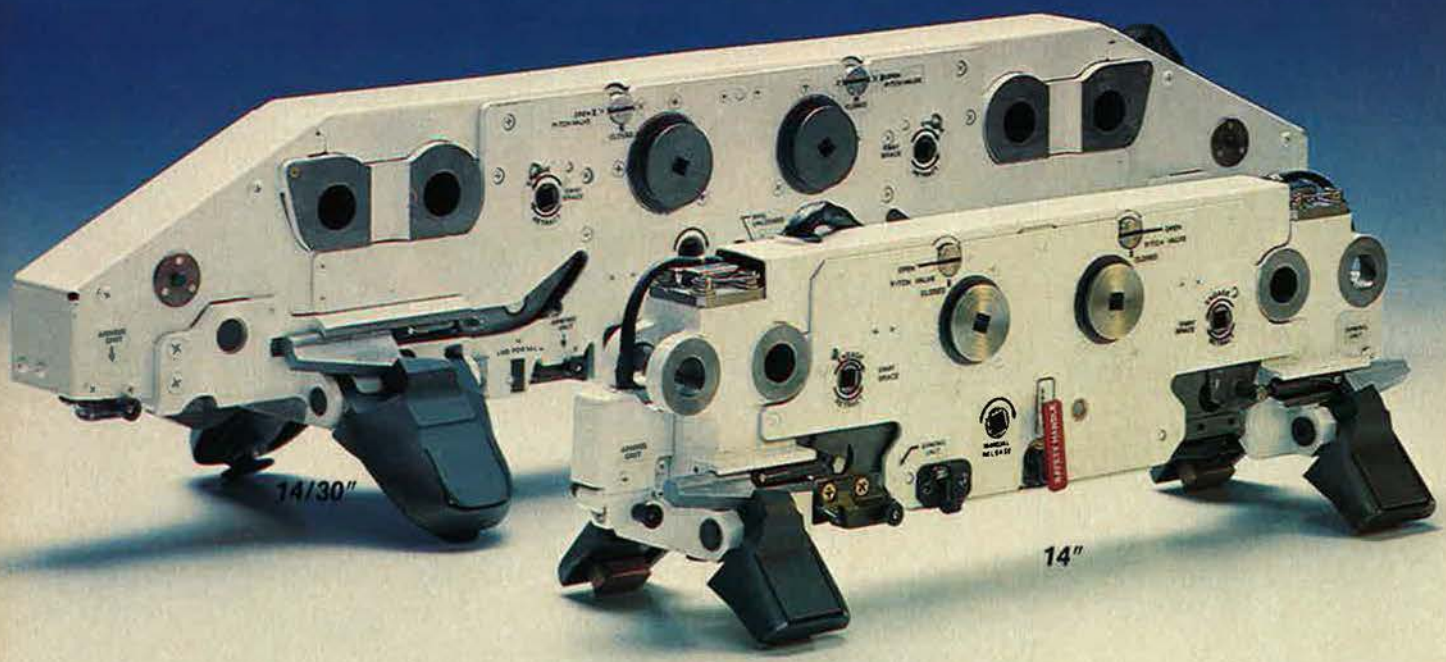

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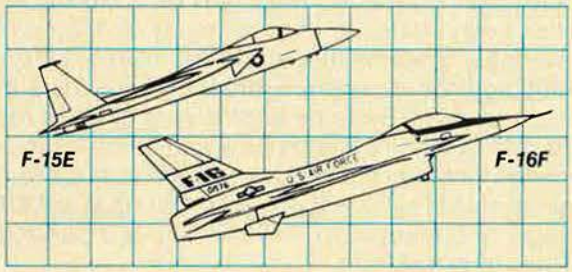

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How about hardware? Let's not challenge the B-1 or the MX. Are there no other programs that can be cut? Would we have been seriously imperiled without the FB-111 or B-58? Most assuredly not. I'm sure there are parallels in today's defense budget.

Perhaps if the Air Force took the lead, then the Navy would look seriously at its battleships.

For the Defense Department not "to do its part" in the budget reduction effort makes a mockery of the Department's participation in the government.

Irving Levin
Bellevue, Wash.

One of the biggest problems that DoD faces today is credibility with the US public. Many of the practices and procedures we use to accomplish the mission cannot be explained to the average citizen, who has little military experience. As a matter of fact, though, judging from many of the reports on the DoD budget request, some of the practices used widely in the military procurement business don't make much sense to those of us who do have military backgrounds.

Reports about General Electric and General Dynamics and their apparent efforts to pad bills on defense contracts are examples that come quickly to mind. Others include ridiculous prices for coffeemakers, tools, step ladders, toilet seats, flashlights, etc. I have an uneasy feeling that this is merely the tip of a large iceberg. Every American should be concerned about what it costs to defend our country and about how that money is spent.

Your response to Capt. Glenn Walsh in the April 1985 editorial seems to me a classic manifestation of our problem. He asked a legitimate question—and you stiffed him! Members of AFA should be concerned with what defense costs today. They should be asking questions—just as Captain Walsh has done. I cannot believe that you don't have any idea of where savings could be made or that you were unwilling to try. Captain Walsh deserved better!

Notwithstanding the editorial, I enjoyed the April '85 issue very much. The article "In Search of Yamamoto" was especially good.

Col. William H. Ramsey,
USAF (Ret.)
North Little Rock, Ark.

• *The Air Force Association is mightily concerned about the affordability of national defense and the problems of procuring major defense systems. We cannot, however, accept the popular notion that the defense budget is fat. The facts do not support such a conclusion. We agree that waste, fraud, and abuse are intolerable—but the extent to which they exist is often exaggerated.*—THE EDITORS

AIRMAIL

The Corsair *Could* Have?

I wish to take issue with Terry Gwynn-Jones and his article "In Search of Yamamoto" that appeared in the April 1985 issue *(p. 120)*. Specifically, I wish to dispute his statement that the P-38 was chosen to carry out the attack because it was "the only fighter aircraft available with sufficient range to make the 870-mile return flight to Bougainville."

F4U-1 Corsairs were based at Guadalcanal at that time and were capable of performing the Yamamoto mission without the necessity of mounting external tanks. I was a radio repairman then with Marine Fighter Squadron (VMF) 124. We arrived on Guadalcanal on February 11, 1943, and set up operations at Fighter Strip One. On February 13, our Corsairs escorted a flight of Navy PB4Ys (Navy version of the B-24) to Bougainville. On the next day, February 14, the F4Us went back to Kahili Field on Bougainville and tangled with fifty Zeros.

Robert Sherrod, in his book *History of Marine Corps Aviation in World War II,* seems to believe that the P-38s were chosen for their superior gunnery. We were greatly disappointed that our beloved Corsairs had not been chosen. We did rationalize the choice of the P-38 by conceding that its firepower was somewhat greater and that the pilots were experienced in shooting down Japanese Bettys. . . .

As if it were yesterday, I remember the P-38s leaving Henderson, and I remember their return vividly. They serenaded our Corsair flight line on Fighter One with the most dazzling display of extreme low-level aerial acrobatics that I had ever seen. We of the ground crew turned to one another in amazement and remarked that those "dogface flyboys" must have accomplished something extraordinary. This happened around noontime. By 3:00 p.m., the entire island of Guadalcanal knew that the P-38s had shot down Yamamoto.

When our pilots came back from

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By October, the Air Force will have taken delivery of 80 C-21As, and the remaining six bases will be operational. And Gates Learjet will continue staying close to all 80 aircraft, providing total logistics support. Our subsidiary, Gates Learjet Aircraft Services Corporation (GLASCO), will continue to ensure that C-21A maintenance manhours per flight hour and overall operating costs remain but a fraction of its USAF CT-39 predecessor.

The C-21A. A U.S. product proudly representing the high quality standards the U.S. Air Force demands of itself and its aircraft. At home and abroad. And ready to meet additional rigid requirements of future Air Force missions.

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those long four- and five-hour missions, we had to help them out of the cockpit and help them walk around. Those poor fellows had strap bruises on their legs and shoulders. What with malaria, dysentery, poor or no food, and constant air operations interspersed with night air raids, it's a wonder any of the Guadalcanal pilots could fly at all.

In retrospect, I have the greatest admiration for all those pilots—Army Air Forces, Navy, allied, and those magnificent Marines.

Leslie Davis
El Paso, Tex.

COMO No Better?

Re: James W. Canan's April 1985 article "The Shrinking Supply of Engine Spares" *(p. 54).*

Once again, you assert that the decentralized maintenance organization (COMO) is a major contributor to the tactical air forces' increased utilization rate. Many of us closely associated with the transition to COMO believe otherwise.

COMO is a different concept of maintenance, but there is no hard evidence that it is a better concept. A 1983 study that examined nine years of maintenance of the F-111 with and without COMO concluded that manhours per flying hour were virtually unchanged and that aborts per 100,000 flying hours had not increased or decreased. In other words, productivity and quality, reflected by two primary measures of merit, had remained static throughout the COMO experience. In the absence of evidence to the contrary, there must be other reasons for better utilization rates.

Utilization rates are influenced by myriad factors. A few worth mentioning are increased manpower, equipment, and spare parts; the acquisition of newer, more maintainable aircraft; and improved maintenance facilities. These factors, which accompanied COMO, are real reasons for improved rates and could have occurred under any maintenance concept.

Those who have worked under COMO and its predecessor see merits and demerits in both systems. Some advantages, such as control of maintenance and relative ease of training, accrue to the old system. The new system attempts to organize resources in self-contained, deployable elements, but it has not made maintenance any easier, nor does it deserve credit for mission accomplishments that could have been achieved under either maintenance system.

Lt. Col. William B. James,
USAF (Ret.)
Hampton, Va.

AIRMAIL

• *Before COMO, the fighter utilization rate in TAC had been dropping like a rock. After COMO, it rose steadily and dramatically. Our earlier report, "From Worst to First"* (June '84 issue, p. 64), *gives details on why the increase is not attributable to additional manpower, newer equipment, more spares available, or the experience level of the maintenance force. Improved facilities were instrumental and were part of the COMO approach.*—THE EDITORS

New Aggressor Aircraft?

Re: Capt. Napoleon B. Byars's article "Fighterology" in the April 1985 issue.

In his article, Captain Byars stated that the F-5E "cannot perform all the tricks of such newer Soviet fighters as the MiG-29 Fulcrum, the MiG-31 Foxhound, and the Su-27 Flanker."

Has TAC considered replacing or augmenting the F-5E Aggressor aircraft with the F-20?

Lt. David E. Crane, USAF
Kirtland AFB, N. M.

• *For more on the F-20, see "Trials of the Tigershark" in the January 1985 issue. Also, in this issue, see items on the F-20 in the "In Focus . . . " and "Capitol Hill" columns.*—THE EDITORS

F-15 Plus One

Things seem to change real fast once you retire from active duty.

Your picture on page 54 of the April 1985 issue serves to illustrate this fact. When I retired from the 48th FIS at Langley AFB, Va., less than a year ago, I knew of no plans in the mill for a major canopy modification on the F-15. When were the F-15s modified to accept the F-16 canopy system?

I'll bet this logistical maneuver is saving the Air Force millions!

David E. Aldrich
Richmond, Va.

Re: The picture on page 54 of the April 1985 issue of AIR FORCE Magazine.

The 1st Tactical Fighter Wing may put the crew chief's name on the side of the canopy (as do many other wings, including mine), and the picture may have been taken at Langley AFB, Va., but that's not a 1st TFW aircraft.

How do I know? Easy—the 1st TFW isn't equipped with F-16s.

Lt. Col. Hank Kramer, USAF
MacDill AFB, Fla.

I have had an interest in aviation since I was eight years old. My favorite fighter is the F-16 Fighting Falcon. As I was looking through the April 1985 issue of AIR FORCE Magazine, I noticed a photograph of an F-16 on page 54. However, your caption to the photo erroneously refers to the aircraft as an F-15.

I am now seventeen years old and will soon apply for an AFROTC scholarship. I hope that my strong academic background, my experience in flying sailplanes, and my participation in the Civil Air Patrol will lead to my acceptance into AFROTC and toward my dream of becoming an Air Force fighter pilot.

I would like to hear from any Air Force pilots who would be willing to correspond with me about my chances of becoming an Air Force fighter pilot.

Sgt. Eric Knitter, CAP
2305 High Ridge Parkway
Hillside, Ill. 60162

• *As many readers have noticed, we printed the wrong photo. We regret the error.*—THE EDITORS

Acronym Awry

The article "The State of the Force" by Edgar Ulsamer in the March 1985 AIR FORCE Magazine was, as usual, well written.

Unfortunately, I confused two USAF acronyms when speaking about "ATBMs" and their importance to USAFE. What I was thinking and intended to convey was the importance of JTACMs, or joint tactical missiles, to the European arena. For this error, I've been banished to "mobile" by my staff.

I did not intend to imply support for the ATBM (advanced tactical ballistic missile) concept. On the other hand, we do need the flexibility and capability provided by JTACMs to counter the Warsaw Pact's surface-to-surface missile threat. The JTACM capability, when coordinated with tactical aircraft operations, will enhance our offensive counterair efforts.

Again, my apologies for contributing to misinformation, not only to your article but to AIR FORCE Magazine readers as well. I request your assistance in setting the record straight.

Gen. Charles L. Donnelly, Jr.,
USAF
CINCUSAFE
Ramstein AB, Germany

AIRMAIL

Deadly Gs

After reading the "In Focus . . . " article "When Gs Get Deadly" in the March 1985 issue, I found it very difficult to believe that this is the same Air Force in which I served so proudly for many years. For the Air Force to require their pilots to fly under these adverse conditions, in my opinion, is bordering on the edge of gross negligence and pitiful management of resources.

I understand that an attempt is being made to correct this disgraceful situation, but only God knows how many potentially great Air Force leaders will not live to fulfill their potential. When I was in pilot training and fighter transition during World War II, our instructors constantly reminded us that the aircraft can be replaced. The safety of the pilot should be foremost in flying.

It seems to me, although I'm not an electronics engineer, that an immediate solution to this problem would be to reprogram the computers to reduce the magnitude of these high-G-causing maneuvers.

One hopes that the individual is still the primary concern in flying safety. Furthermore, I feel that the Air Force owes us, as parents of the men flying these aircraft and of those who may be in the near future, an explanation of why this inexcusable situation is being allowed to continue.

Col. Franklin E. Fields,
USAF (Ret.)
Hagerstown, Md.

Rates and Retention

Your item "USAF Personnel Plans and Problems" on page 59 of the February 1985 issue states that "the Air Force is becoming apprehensive about its ability to keep pilots . . . at the high retention rates of the past few years. Retention of pilots . . . with six to eleven years of service has begun to slip from the very high—three out of four—level enjoyed . . . from FY '82 through FY '84."

The item correctly conveys a continued Air Force concern about retention. However, it also conveys the idea that the "three out of four level" indicates the total number of pilots who remained on active duty in the pilot inventory. . . .

What that "three out of four" level, or seventy-five percent rate, represents is known as the six through eleven years of service (YOS) cumulative continuation rate (CCR). The rate serves as a "retention barometer" or trend indicator. The focus is on YOS six through eleven because that is the time frame during which most pilots will make their decisions about staying or leaving the Air Force. . . . To understand the CCR as a "barometer," consider the following hypothetical example.

Suppose at the beginning of a particular year that there were 7,000 pilots having between six and eleven YOS, distributed as follows: 1,400 in YOS six, 1,300 in YOS seven, 1,200 in YOS eight, 1,100 in YOS nine, 1,000 in YOS ten, and 1,000 in YOS eleven. Also, assume that, by the end of that year, those who remained totaled 1,288 (ninety-two percent) in YOS six, 1,222 (ninety-four percent) in YOS seven, 1,140 (ninety-five percent) in YOS eight, 1,056 (ninety-six percent) in YOS nine, 970 (ninety-seven percent) in YOS ten, and 980 (ninety-eight percent) in YOS eleven.

One interpretation of that hypothetical year's retention is that the probability of completing YOS six was ninety-two percent, the probability of completing YOS seven was ninety-four percent, and so on. Thus, the probability that a pilot in YOS six would complete YOS eleven is the product of the probabilities of completing each individual year. That product is seventy-five percent. That is exactly the way a six through eleven CCR is calculated, and that is what it means.

Notice, however, that nothing has been said about the stay or leave decisions of anyone except the YOS six pilots. What about the retention of the other 5,600 pilots with YOS seven through eleven? How many stayed? Those who stayed are still part of the pilot inventory.

The point is that the CCR alone cannot predict next year's pilot inventory or even the size of next year's six through eleven YOS population.

As a "how it goes" indicator, the CCR is useful. One period can be compared to another, and trends can be detected. However, the Air Force does not manage rates; it manages shortages and overages by specific skill and career category.

Such statistics as CCRs and reenlistment rates are useful yardsticks. However, they convey only part of the manning picture.

Maj. David M. Scott, USAF
Deputy Chief, Force Structure
and Policy Analysis Div.
Hq. USAF
Washington, D. C.

• *Major Scott is correct—the item in question gives the incorrect impression that the "three out of four" rate refers to the total number of pilots retained with six to eleven years of service. We should have made it more clear that the rate cited represented a cumulative rate, as he explains.*—THE EDITORS

Bands and Manning

When I suggested in my February 1985 "Airmail" letter that band authorizations be reduced in order to increase manning in primary weapon systems, I had hoped that a professional discourse on current manning problems in the All-Volunteer Force (AVF) would ensue. Instead, your readers have been treated to a poor defense of a sacred cow. Especially galling was the mindless emotionalism evident in Lt. Col. R. M. Wray's letter on page 13 of the April '85 issue.

In a professional forum, one expects certain standards of debate conduct. Foremost among these is to address all arguments in a logical manner. Colonel Wray failed on all counts.

Nowhere did he show that bands improve morale more than does adequate manning. Moreover, his reference to the Glenn Miller Band in World War II revealed that he could not grasp the obvious differences between a conscripted force and today's All-Volunteer Force. And contrary to Colonel Wray's assertion, bands have not always played an integral role in the military. . . .

Most importantly, Colonel Wray never proposed a solution to the manpower shortfalls afflicting critical weapon systems. Given our manpower constraints and the absence of a draft, the problem boils down to one of priorities. Can we afford to maintain a band of more than 1,000 members when key systems are undermanned?

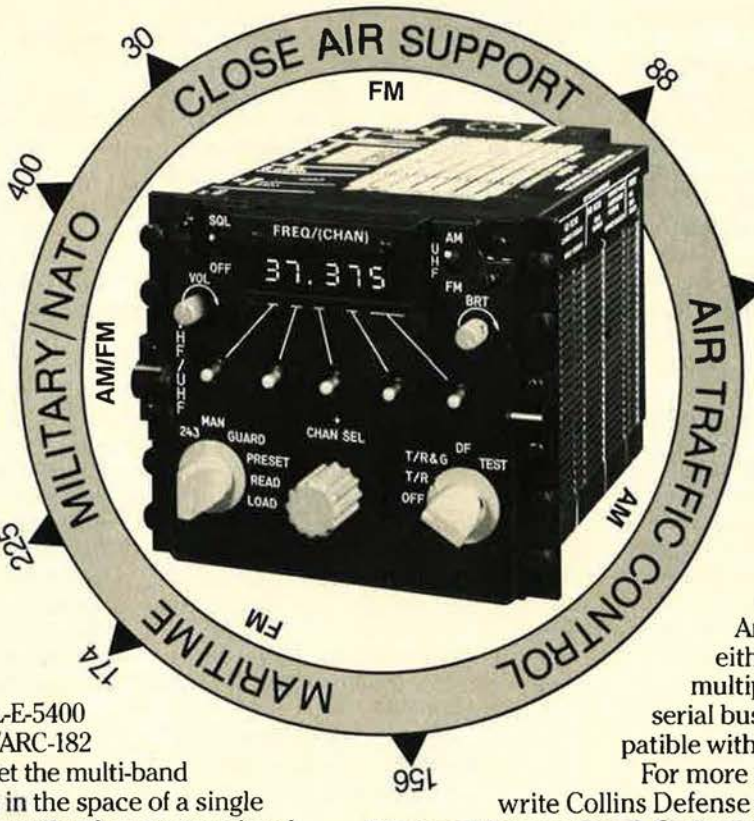
Your readers may not agree with my solution, but I challenge them to propose a better one before they condemn mine.

Capt. Paul G. Hough, USAF
Langley AFB, Va.

Re: Capt. Paul G. Hough's February 1985 "Airmail" letter concerning Air Force bands.

When armed conflict broke out in the South Atlantic between Britain and Argentina in 1982, the future of the Royal Marine Band was in question. Band members quickly reverted to their wartime role as stretcher bearers. Twenty-four bandsmen were assigned to the hospital ship *Uganda*,

Air, land and sea forces band together.



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where they removed casualties from the flight deck to the hospital complex and into surgery. They were also given instruction in basic nursing skills and assisted admirably as nursing auxiliaries while still finding time to give an occasional concert. Their contributions were praised by medical professionals in a medical journal article describing medical operations during the conflict.

The thirty-six-member Royal Marine Commando Forces Band was embarked on the *Canberra* as stretcher bearers and nursing aides. Although that ship had a hospital facility, it served chiefly as a troopship, exposed to air attack and unprotected as a hospital ship by the Geneva Convention. Their service in this necessary support role ensured that other marines were available to fill combat roles. Incidentally, they provided a ready source of fresh blood for treatment of casualties.

And besides their measurable contribution to medical care during the conflict, their fervent renditions of "Rule, Britannia" and the "1812 Overture"—with accompaniment by Bofors guns—undoubtedly boosted the morale of the combat-bound British forces.

I am confident that members of the US service bands have talents other than musical abilities. I do not know the wartime function of US bands, but I am sure that they are capable and willing to serve in some militarily useful role if called upon. As for those who feel that military bands' existence is not justified by their musical ability alone, they should consider the contributions that can be made by such teams when properly employed during a contingency.

Capt. William P. Thornton, USAF
San Antonio, Tex.

Museum Research Center

Due to the steadily increasing work load and limited manpower to support research requests at the US Air Force Museum's Research Center, access to the Museum's reference files by the general public is now by appointment only.

This new policy went into effect in January 1985. It will provide better service to patrons and will allow Museum personnel to maintain the files more efficiently.

Only written requests from the public for data will be honored, except under unusual circumstances. Appointment for access to these files may be made by letter or phone call. The USAF Museum Research Center is open from 9:00 a.m. to 4:00 p.m. Monday through Friday, except federal holidays.

Charles G. Worman
Chief, Research Division
USAF Museum
Wright-Patterson AFB, Ohio 45433
Phone: (513) 255-4644

AIRMAIL

Sheppard AFB

Officials here at Sheppard AFB, Tex., have announced plans for a base museum and are looking for items that portray Sheppard's past.

Such things as photographs, training devices, uniforms, documents, souvenirs, and other memorabilia of the base's colorful forty-four-year history are needed. Officials say they don't need the items yet. They only want to identify what is available.

Sheppard Technical Training Center has established a museum committee. People who have items that they wish to donate should contact the address below.

Lt. Col. Cecil F. Ross, USAF
Director of Public Affairs
STTC/PA
Sheppard AFB, Tex. 76311-5000

NCO Linguists

The Air Force Special Activities Center (AFSAC) needs fluent linguists. Noncommissioned officers possessing a native fluency in one or more foreign languages who are interested should read SDI description 99606 in AFR 39-1.

If you are interested in worldwide assignment opportunities, contact the address below.

CMSgt. Louis Vukich, USAF
HUMINT Enlisted Career Manager
Hq. AFSAC
Fort Belvoir, Va. 22060
Phone: (703) 664-2458
AUTOVON: 354-2458

410th Bomb Wing

The staff of the Legal Office, 410th Combat Support Group, has established a Project Warrior display in our building to exhibit model aircraft, squadron patches, flight helmets, photographs, and other Air Force memorabilia. The display is our way of showing pride in the heritage of the 410th Bombardment Wing and the Air Force.

We are currently seeking additional exhibits for display and would gratefully accept items relating to the role of airpower in our country's history, particularly any items from World War II, the Korean War, and the Vietnam conflict.

Anyone wishing to donate memorabilia to our Project Warrior display should contact the address below.

Capt. Robert L. Thomas, USAF
Deputy Staff Judge Advocate
410th CSG/JA
K. I. Sawyer AFB, Mich. 49843

55th TFS

The 55th Tactical Fighter Squadron has a long and proud history and would like to update its current historical file.

We would very much appreciate all inputs from former squadron members, especially during the period from 1974 to 1983. Newspaper clippings, photographs, and personal thoughts would help our effort greatly.

We will return any items if so asked. Please contact the address below.

1st Lt. Richard A. Shuff, USAF
History Project Officer
Box 6734
APO New York 09194-5422

P-61 Black Widow

A Northrop P-61B has been acquired and is presently being recovered by the Mid Atlantic Air Museum in Middletown, Pa.

This P-61, AAF serial #42-39445, was built in August 1944 and preserved and shipped to Australia in November 1944, where it was assembled and delivered to the Thirteenth Air Force's newly formed 550th Night Fighter Squadron based at Hollandia, New Guinea. On the morning of January 10, 1945, while on a local orientation flight, the P-61 stalled and made a forced landing with four aboard near the top of Mt. Cyclops.

The Mid Atlantic Air Museum is attempting to locate the pilot, Lt. Logan C. Southfield, and the other members of his crew. The aircraft is in remarkable condition and is complete, including diamond-tread tires, oil, hydraulic fluid, 20-mm cannons, and the radar unit.

The Museum intends to restore the P-61 to flying condition. We would appreciate hearing from anyone associated with or interested in P-61 aircraft or having information on P-61s, Hollandia, Middleburg Island, or the crew members of this Black Widow.

Ann Strine
Mid Atlantic Air Museum
Harrisburg IAP
Middletown, Pa. 17057
Phone: (717) 944-7667


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GENERAL DYNAMICS

AIRMAIL

Desert Training Center

I am helping the Bureau of Land Management in a research project to obtain information and photographs of the Desert Training Center located at sites covering thousands of square miles in California, Arizona, and Nevada during 1942–44. Camps were located on both sides of the Colorado River.

I am mainly interested in photos or personal memories of anyone who was stationed at Blythe AAF, the airfield at Rice, Calif., or the one at Camp Clipper, which was also known as Essex. Any information concerning AAF units assigned, type of aircraft used with the desert armored units, and type of mission flown, along with any photos, would be appreciated.

The Bureau of Land Management is in the process of trying to protect Camp Iron Mountain west of Rice AAF as a historic site. They would also like to open a visitors' center featuring photos and artifacts recovered from the different camps and to create a museum to the thousands who were stationed and trained in desert warfare at the camps.

The military history of this training center needs to be preserved. Any information and photos will be copied and returned to the sender with gratitude.

TSgt. E. W. Lippincott,
USAF (Ret.)
2103 Bermuda Dr.
Riviera, Ariz. 86442

Northwest Air Route

I need readers' help in researching the Northwest Air Route to Alaska, over which nearly 8,000 aircraft were ferried for delivery to the Soviet Union during World War II. The route stretched from Great Falls to Fairbanks, from where Soviet pilots flew the planes to Nome and then across Siberia.

There may be among readers many who were pilots, ground crew, base personnel, local civilians, or passengers and who have stories that they wish to share of those times. Of interest are anecdotes, photographs, and detailed recollections of activities along the route.

Any information about the operation—from factory to front—that readers can supply may be an important supplement to the official record. Please contact the address below.

Dr. Jay H. Moor
9175 Skywood Lane
Juneau, Alaska 99801

32d TFS

Though we have just completed a book about the history of the 32d Tactical Fighter Squadron at Camp New Amsterdam in the Netherlands, we are still looking for former members of the unit during World War II and during the years from 1955 to 1970. Many things about the unit are not yet known, and we are therefore continuing our research.

We are especially looking for Lt. Col. Richard E. Bolstad, who may now be retired. His last known address was in Litchfield Park, Ariz., but we got no response from him at that address. Does anyone know his current address?

G. H. J. Scharringa
Leliestraat 3
3732 DS De Bilt
The Netherlands

303d Bomb Group

I am seeking contact with 303d Bomb Group veterans who served from the middle of 1943 through early 1944 in order to gather supplementary information for an article now being prepared that will be based on the combat diary of Lt. Elmer L. Brown, an Eighth Air Force navigator who completed a twenty-five-mission tour during that time period.

I am especially interested in contacting members of Lt. Robert J. Hullar's and Capt. Edward M. Woddrup's crews, but any responses from 303d Bomb Group veterans would be greatly appreciated.

Please contact the address below.

Brian D. O'Neill
22 Jeffrey Lane
East Windsor, N. J. 08520

O-58B Defender

My son and I acquired our O-58B (L-3B) Defender, s/n 43-27053, in 1983 and painted it in military colors of desert sand and dove gray camouflage. In our research, we found that this aircraft was assigned during its military career to the 1st Motion Picture Unit from November 1943 to March 1945.

We wish to contact anyone who may know more about the history of this aircraft. Because we display it at many airshows, we would like to have information about it that is as accurate as possible.

Please contact the address below.

Leonard Dudicz
P. O. Box 4142
Hayward, Calif. 94540

44th Bomb Wing

I'm writing a book about the 44th Bomb Wing, which flew B-29s, B-47s, and KC-97s from March AFB, Calif., and later out of Lake Charles (Chennault) AFB, La., from 1951 to 1960.

I'd like to hear from anyone who was with the unit during those years or from anyone who knows the current whereabouts of anyone who served with the unit.

Please contact the address below.

David H. Klaus
1332 E. Pennsylvania Ave.
Redlands, Calif. 92374-2944
Phone: (714) 793-9477

Korean War

Let me congratulate you on your fine publication. As a student of US national defense and security policy (and an advisor to an active member of Congress), I find that AIR FORCE Magazine provides me with timely information on various issues of concern to all Americans.

I am undertaking an independent research project on various contingency plans for the use of atomic weapons by the United States during the Korean conflict. Anyone with information on this topic is urged to contact me at the address below.

Chris Williams
4414 Macomb St., N. W.
Washington, D. C. 20016

P-51D Mustang

Ever since serving in the Korean War, I have had a desire to own a P-51D Mustang.

I am still a qualified pilot and would like to hear from any readers who may know where I can locate one or more of this type of aircraft. The aircraft can be in original condition or one that has been converted to civil use.

If you have any information about such an aircraft, please contact me at the address below.

Col. J. W. Duffy,
USAF (Ret.)
Box 121
Essex Fells, N. J. 07021

Presidential VC-118A

I am a volunteer worker at the Pima Air Museum in Tucson, Ariz. I serve as a tour guide for a VC-118A, #53-3240, that is displayed at the Museum.

I am looking for any information about this plane during its use as a Presidential aircraft for Presidents Kennedy and Johnson. Any information at all would be appreciated.

Please contact the address below.

Robert B. Lumpkin, Jr.
NDCBU #84
5726 Chapter Dr.
Tucson, Ariz. 85708

AIRMAIL

Collectors' Corner

During World War II, the Army Air Forces produced a play titled *Winged Victory.* It was written and directed by Moss Hart, and it told the story of three young men going through the aviation cadet program. The play was published in paperback, and Twentieth Century Fox made it into a movie.

The play, the book, and the movie all played a part in my early decision to become an Air Force pilot. It took a while (I had to grow up), but I finally made it as part of Class 54-F.

Call it nostalgia or whatever you like, but I would appreciate any help I could get in obtaining a copy of the book or script, a copy of the record album (Decca 363-29M), or a videocassette of the movie.

John R. Costello
17746-4 Devonshire St.
Northridge, Calif. 91325

I need help. I was a photo recon pilot during World War II with the 12th Photo Group, Twelfth Air Force, in the Mediterranean theater. Do any readers know of any written materials about P-38s that flew reconnaissance missions in Italy?

Also, I was awarded the Air Medal five times. I have the medal, but I need the four oak leaf clusters, like we had during the war. Do any readers know where I can obtain them?

G. Howard Allred
P. O. Box 678
Madison, N. C. 27025

I would appreciate any help in starting up my Air Force patch collection. I have only a few to trade. I am willing to purchase patches, but sure would accept donations.

I am hoping to collect any and all active, Reserve, and Air Guard patches. Please contact me at the address below.

SSgt. Henry R. Harlow, USAFR
P. O. Box 54932
Lexington, Ky. 40505

I am looking for former 461st Tactical Fighter Training Squadron members who might be interested in a limited-edition, signed and numbered lithograph portraying the history of the 461st—from F-86s to F-100s to F-15s. These members would mainly be F-15 pilots who have gone through the squadron at Luke AFB, Ariz.

For more information about this print, please contact me at the address below.

Ray Martens
300 W. Lower Buckeye, #78
Avondale, Ariz. 85323

I am a serious collector of World War II Army Air Forces flying clothing—leather jackets, service uniforms, boots, goggles, hats, etc. I am looking for any memorabilia from the ETO, MTO, CBI, Pacific, etc.

I would like to give your mementos a good home. I do not resell any items! I am trying to put together an exhibit for my personal enjoyment and to display at unit reunions held by former AAF personnel.

Please contact me at the address below.

Michael Kellogg
5880 W. Pico Blvd., #201
Los Angeles, Calif. 90019

I have many thousand color slides of modern US combat planes (and some NATO ones). I am very interested in exchanging color slides for US military patches and badges.

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For example, the Air Force said the new aircraft had to be fully mission capable 85% of the time. The C-20A Gulfstream IIIs are currently working upwards from 95%.

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The Gulfstream III's performance not only meets the mission requirements of the C-140 program, it also fills many overseas travel demands for the Special Airlift Mission Fleet. This capability increases the flexibility and efficiency of the Air Force to meet high priority travel requests, yet the C-20As require only 7.5 maintenance man-hours per flight hour compared to 27 for the C-140s they replaced.

Finally, an example of the mission versatility and cost-effectiveness of the C-20A Gulfstream III in meeting the needs of the Special Airlift Mission Fleet:

One C-20A Gulfstream III departed Andrews AFB on a 13 day trip, logging 43 flight hours and traveling to locations in the Pacific. Upon its return to Andrews AFB, it was cleaned, refueled and put to work the next day flying missions in the United States. It required no maintenance for the entire period.

The U.S. Air Force demanded a lot in its new jet transports. By any measure, the C-20A Gulfstream IIIs are delivering everything it asked for.

And more.

Gulfstream Aerospace

For more information about the C-20A Gulfstream III or other mission capabilities of the Gulfstream III, contact Larry O. Oliver, Manager, Military Requirements, Gulfstream Aerospace Corporation, P.O. Box 2206, Savannah, Georgia 31402. Telephone: (912) 964-3246.

AIRMAIL

I would be very glad to hear from anyone interested in such an exchange.

Philippe Cauchi
4850 Cote des Neiges
#1111
Montreal H3V 1G5
Quebec, Canada

I am an Air Force brat and a ROTC cadet at North Texas State University. Recently, I became interested in collecting Air Force patches. I'm especially interested in acquiring as many different squadron and wing patches as possible.

My problem is that, on a college budget, I can't afford to buy many patches. Therefore, I would appreciate any donations to my collection.

Please contact me at the address below.

Steve Dalton
P. O. Box 8179
NT Station
Denton, Tex. 76203

I have been looking for a 1977 or 1978 calendar from the Link Div. of the Singer Co. It features paintings and cutaway drawings of World War I aircraft.

If any reader has such a calendar to spare, please contact me at the address below.

Fred W. Bruwelheide
209 Hillsboro Dr.
Silver Spring, Md. 20902

I am a serious adult collector of aerospace company and aviation unit decals and stickers. Any material of this type would be sincerely appreciated.

I am also greatly interested in aerospace company literature, lithos, etc.

Please contact me at the address below.

Steve Billings
2196 Bobolink Trail
Memphis, Tenn. 38134

I would like to trade my unit patch for any other unit patches. I am assigned to the 40th Tactical Group at Aviano AB, Italy. I am also interested in trading other unit patches.

Please contact me at the address below.

Capt. Michael F. Hebert, USAF
PSC Box 1932
APO New York 09293

I wish to purchase an intact copy of the World War II War Department technical manual TM E9-1983, published sometime between 1943 and 1945. It deals with Axis ordnance.

I will offer a good price for a good copy. Please contact me at the address below.

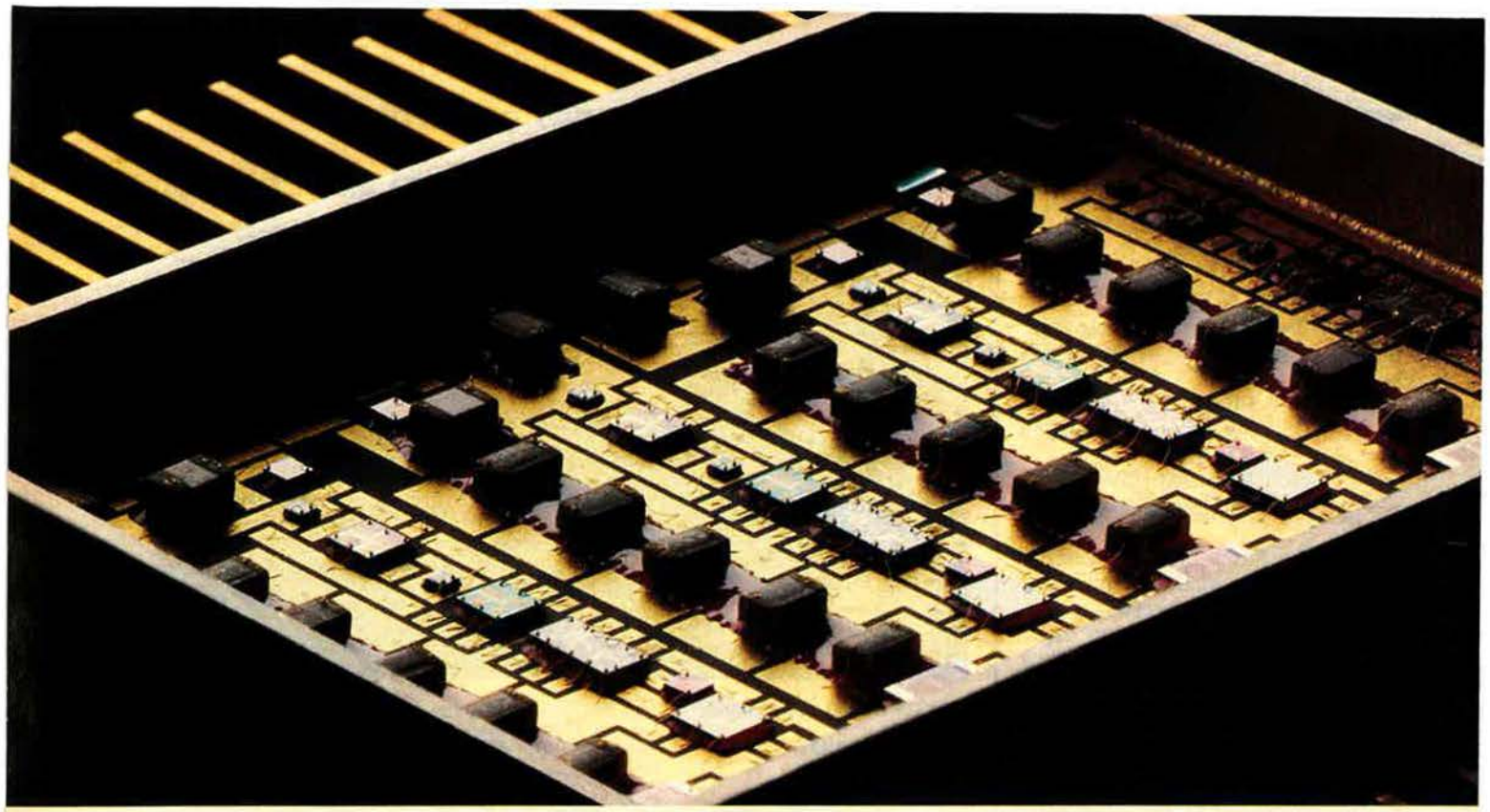
Mark Newton
27 Lafayette St.
Fairhaven, Mass. 02719
Phone: (617) 990-0543

AFROTC Det. 225

AFROTC Detachment 225 at the University of Notre Dame in Indiana is beginning an alumni research project. We are interested in finding out what past Notre Dame graduates have done and what they are doing now in order to facilitate our search for guest speakers who could serve as a special resource for the cadets in our program.

All alumni of AFROTC Detachment 225 are invited to send short biographies of themselves to the following address.

Alumni Search Project
Detachment 225
University of Notre Dame
Notre Dame, Ind. 46556



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IN FOCUS...

The B-1B Whisper Campaign

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

Derogatory tales about the B-1B are circulating in Washington. Behind them lie some half-truths and questionable motives, but the disinformation is having its effect.

Washington, D. C., May 6

A whisper campaign adversely affecting the B-1B is making the rounds of Capitol Hill. Before too long, it is bound to spill over into public debate. Whether the motives behind the gossip are politically inspired, driven by competitive pressures, result from misunderstandings, or are a combination of all three hardly matters. What does matter is that the "disinformation" making the rounds denigrates and undermines what is in fact one of the Air Force's and the Defense Department's most successful and conservatively managed programs—a program that continues to be under cost and ahead of schedule.

Some of the allegations being circulated center on misunderstandings—probably more disingenuous than real in nature—of the performance requirements and specifications associated with the B-1B. Questions about cruise and maximum altitudes play a role here. The aircraft's ability to operate with top efficiency on the deck for low-altitude penetration of enemy airspace has always been—and continues to be—the central performance standard that governs the B-1 program.

Because of the emphasis on low-altitude performance, the aircraft's cruise altitude is significantly below that of such aircraft as the B-52, the B-58, or the B-70. High altitude does not provide the B-1B with any kind of sanctuary; the factors that do are sustained high-subsonic penetration speeds on the deck, where the design capitalizes on terrain masking, and offensive and defensive electronic warfare features, low radar and infrared cross sections, and tactics that exploit this combination. Claims that the B-1 won't make altitude goals are not true. The aircraft never was meant to operate in the 40,000-foot range or above; its optimal cruise altitude was deliberately set significantly lower than that.

Because the aircraft is optimized for low-altitude, high-subsonic-speed operations, its cruise performance at altitude is maximized for range, not top speed. That speed is Mach 1.2, deemed more than sufficient by the Air Force for meeting all essential mission requirements. The initial notion of a top speed of about Mach 2.2 was dropped years ago during the early development phases of the B-1A as unnecessary and counterproductive to the on-deck penetration capability.

The third and potentially most "loaded" and insidious aspect of the sniping at the B-1B hinges on the claim that the aircraft won't meet critical gross takeoff weight and related takeoff and climb-out specifications. There is also the insinuation that the aircraft won't be tested adequately before the first B-1B is turned over to the Strategic Air Command later this spring or before the weapon system achieves initial operational capability (IOC) scheduled for the fall of 1986. These are essentially half-truths.

Because of the paramount importance of maintaining the B-1B program schedule—which, in turn, is closely tied to keeping the production airplanes at or below forecast cost—the Air Force will place some temporary constraints on how the aircraft can initially be operated. Curtailing the performance envelope of a new system until all RDT&E and operational tests are completed is commonplace. In the case of the B-1B, an additional circumstance mandates initial restrictions in terms of gross takeoff weight, maximum altitude and speed, as well as angle of attack. The reason for that is the expansion of the aircraft's flight envelope in terms of maximum altitude and gross weight. Pacing these performance boosts is validation of the modification of the B-1B's Stability and Control Augmentation System, or SCAS.

The aircraft's "baseline" SCAS is an electrical control system that provides desired stick force levels and damping about all axes by augmenting the primary hydromechanical system. Should the augmentation system fail, however, the aircraft can nevertheless be flown safely. This "baseline" configuration incorporates a device known as a stall warning stick shaker that is activated automatically when the aircraft is operated at eighty percent of the angle of attack (AOA) limit. (The limit AOA is the point at which the aircraft exhibits neutral longitudinal stability.) This eighty percent limit admittedly imposes operational constraints in terms of altitude, gross weight, and G loading. AOA testing under the original B-1A program was cut off in midstream when the program was canceled by President Carter. There had been indications of reduced stability as the limit AOA was approached.

When the flight-test program of the B-1B got under way in 1983, the Air Force decided to add a stall inhibitor system (SIS) to the design to counter the danger of pitch-up moments. This system is a modification of the SCAS. The SIS permits safe maneuvering up to the limit AOA through a graduated increase in the stick force required to command additional AOA as that limit is approached. It follows that, with a more usable AOA, safe operation is possible over a broader performance range. B-1B aircraft No. 1 will start SIS testing this summer, with validation to be completed by March 1986—in time to meet delivery of the ninth B-1B. Aircraft delivered earlier will have the SIS retrofitted in a depot-level modification.

Another element in the B-1B's envelope expansion effort involves a Stability Enhancement Function, or SEF, to further modify the SCAS to provide more usable AOA with artificial stability beyond the point of neutral sta-

bility. Once the SEF is installed and validated, the B-1B will achieve its design operating envelope at high as well as low altitudes.

Flight-testing of the SEF will begin on the ninth production aircraft in the summer of 1986. Validation of the stability enhancement system should be completed by March 1987, in time to meet the delivery of the forty-seventh production aircraft. The SEF will be installed on production aircraft numbers nineteen through forty-six, but kept deactivated until the flight-testing is completed. Aircraft delivered previously will be retrofitted with the SEF. With this system in operation, the B-1B will be able to perform 2.4-G pullups at high gross weight while in a terrain-following mode.

ERCS Future in Doubt

The Emergency Rocket Communications System (ERCS), a system involving communications packages carried aboard ten Minuteman ICBMs at Whiteman AFB, Mo., may be headed for extinction.

A key function of ERCS—among others—is to transmit the "go code," meaning the authority to release nuclear weapons, and other information of cardinal importance to the EC-130Q TACAMO aircraft. These are modified C-130s that serve as the strategic communications relays to the ballistic missile submarines at sea. Also, the individual ERCS packages can be programmed externally before launch of the missiles to broadcast messages to the strategic forces under nuclear war conditions.

Reportedly, there is no agreement within the civilian and military hierarchies in the Pentagon on whether or not ERCS should be modernized or dropped from the active inventory. One school of thought, according to Assistant Secretary of Defense for C^{3}I Donald C. Latham, holds that it makes no real sense to replace these obsolescent communications packages with more capable, modern units because ERCS wouldn't be available when it's needed—meaning after a Soviet nuclear strike.

The underlying logic is that it must be assumed that the Soviets would strike first and, concomitantly, might succeed in destroying most or all of these ten ERCS-carrying ICBMs, along with other missiles still in their silos. This scenario is predicated on the assumption that this country will probably choose to ride out a nuclear attack. This school of thought argues further that, in light of these conditions, the Air Force should phase out ERCS and instead put "real warheads" on the ten ERCS launchers.

IN FOCUS...

Secretary Latham points out, however, that the Soviets, "interestingly enough," seem to be developing a system similar to ERCS.

Other Pentagon experts are known to feel that modernization of ERCS is essential because this "last-ditch" C^3 system is of unique importance and makes enormous contributions to the credibility of the US strategic deterrent forces. The protagonists of this view claim that efforts to modernize ERCS have been thwarted in the past because all relevant proposals were burdened with "bell-and-whistle" features to the point where modernization became prohibitively expensive. The Joint Chiefs of Staff are known to have the ERCS requirement under review at this time.

Return of the Scramjet

The Defense Advanced Research Projects Agency's FY '86 budget request contains seed money for a number of technological efforts that are potentially capable of reshaping the conduct of war. One of the DARPA programs that could affect strategic nuclear warfare in a major way involves work on advanced, extremely fuel-efficient cruise missiles that combine low-observable features with intercontinental range. Eventually, these technologies might merge with hypersonic propulsion and advanced computers that would provide these weapons with "artificial intelligence," according to DARPA Director Dr. Robert S. Cooper.

The first step toward this family of advanced cruise missiles centers on efforts to increase range to about twice the present level by boosting propulsion and fuel efficiency. The second step involves supersonic combustion ram (SCRAM) jet technologies that could lead to both manned and unmanned vehicles capable of reaching speeds great enough to exit the earth's atmosphere and enter space.

In the case of manned Scramjets, Dr. Cooper told Congress, such vehicles would be able to take off from a conventional 10,000-foot runway and attain altitudes as high as 300,000 feet and speeds up to Mach 25. Scramjets of this type might have military utility as reconnaissance systems as well as interceptors that could provide either air defense or fleet defense by using kinetic munitions from standoff positions possibly up to 1,000 miles away from the target. Such systems, he suggested, might be able, for instance, to take off from a base in the US and, within less than thirty minutes, shoot down long-range aircraft threatening US naval units in the Indian Ocean. Other designs might loiter in space over lengthy periods—limited only by the endurance of their life-support and "housekeeping" systems—before performing their mission and returning to base.

While the notion of supersonic combustion ramjets goes back to the early 1960s, serious pursuit of this technology was halted after some limited efforts in the late 1960s, when the X-15 program was canceled. At that time, an X-15 retrofitted with a turboramjet—a stepping-stone to the Scramjet technology—was to have been tested. The attractiveness of Scramjets is that, unlike rockets, they don't have to carry along any oxidizers because they are "air-breathing systems."

In the past, both ramjets and Scramjets were thought to be burdened by traits that would have curtailed their operational utility. In the case of a turboramjet, it has to be accelerated to supersonic speeds before the ramjet can become operational. The system might then be able to accelerate to speeds as high as Mach 5 before the stagnation pressures in front of the engine become great enough to cancel out the thrust moment.

In the case of a Scramjet, which is predicated on burning fuels with an extremely high specific impulse in a supersonic airstream inside of the engine, the system can achieve and sustain far greater speeds. But unless special, innovative features are built into a Scramjet, such a vehicle will have to be accelerated to speeds in the Mach 6 range by other, possibly hybrid propulsion systems before the velocity of the air inside of the duct is uniformly supersonic, according to Dr. Cooper.

These factors have militated against the utility of such systems. But recent design advances involving variable-geometry features appear to make it possible to drive the air through the engine at supersonic speed even while the vehicle is still sitting on the runway. In practical terms, this holds out the promise of Scramjets that can operate at "zero velocity" and then, by various adjustments of their engine configuration, accelerate to about Mach 6, from there to about Mach 14, and finally all the way up to Mach 25.

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Liquid hydrogen is the likely fuel for such a vehicle. If such a vehicle is to be used in space, only limited amounts of rocket power are needed for maneuvering and deorbiting. A Centaur-type rocket motor using liquid hydrogen and liquid oxygen might provide the needed thrust for Scramjet space operations.

The first step that DARPA plans to take next year toward the development of Scramjet technology is to build two scale models of such a system and test them on the ground. While several technical problems have not yet been resolved, DARPA's recent assessments suggest that none of them is insurmountable and that this technology might be ready for actual application as early as the 1990s.

Teal Ruby and Beyond

Another major DARPA research effort of potentially pervasive importance is the Teal Ruby space-based experiment scheduled for launch by the Space Shuttle from the new Vandenberg AFB, Calif., launch complex early in 1986. Teal Ruby represents the first large-scale implementation of a two-dimensional staring mosaic infrared detector array and lightweight telescope optics that the agency has been working on for several years.

Teal Ruby's goal is to demonstrate and validate the technology base for future space-based infrared surveillance systems that can detect aircraft and even "low threshold" targets—presumably meaning stealthy air-breathing platforms—against the earth's ground clutter. Under this program, DARPA will also develop a comprehensive radiometric background data base as well as space-qualify the advanced technologies embodied in this design.

DARPA's Highly Calibrated Airborne Measurements Program (Hi-CAMP) complements the Teal Ruby experiment. Hi-CAMP is an aircraft-mounted stabilized platform fitted with a multiwavelength infrared sensor that provides precise ground clutter measurements needed by the Teal Ruby experiment. This program is important in its own right because infrared surveillance of aircraft is taking on increasing military significance.

But before Teal Ruby is ready for launch as the primary payload of the Air Force space test program satellite P80-1, DARPA will have to solve a sticky problem that crept up recently and that affects the IR sensor. Several heat leaks have been discovered in the cooling system required to deep-freeze the focal plane to cryogenic

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(near absolute zero) temperatures. Unless DARPA can come up with a fix, the system won't be able to function over its one-year nominal design life, and the focal plane's temperature won't get down low enough to operate with the specified sensitivity.

DARPA has been able to pinpoint all but one of the leaks and expects to achieve an adequate level of cooling to meet most of the critical criteria of the experiment. If that turns out to be correct, Dr. Cooper predicts that Teal Ruby will become a "spectacular success." The initial data generated by the sensor in radiometric test chambers suggests that the system's on-orbit performance will meet all essential goals and, thus, point the way toward systems that can "greatly enhance future military capabilities."

Associated with Teal Ruby and Hi-CAMP, another longer-range DARPA program known as the Strategic Air and Cruise Missile Defense Program is meant to extend these and other, classified efforts to make possible surveillance of "high-survivability air vehicles," meaning presumably stealthy and other sophisticated airborne platforms.

Another critically important program in the strategic area that DARPA is working on involves the development of materials to thwart high-energy laser weapons. The objective of this program is to determine just how resistant to laser radiation future strategic and space systems can be made, allowing for realistic weight and cost constraints. The main thrust of this work is directed specifically at thermal laser radiation weapons of the kind the Soviets apparently plan to field.

DARPA, according to Dr. Cooper, has already come up with special graphite derivatives that can withstand laser energy "an order of magnitude of two greater than can typical aerospace materials." These laser-resistant graphite compounds are effective against laser weapons operating in the infrared as well as the visible light bandwidths and impose only modest weight penalties on ballistic missiles and spacecraft. If the Soviets can replicate this technology over time, the effectiveness of directed-energy weapons under consideration by the Strategic Defense Initiative (SDI) might be put in question.

Yet another project with potentially high payoff that DARPA is funding involves an entirely new class of gallium arsenide integrated signal processor microelectronic devices called acoustic charge transport, or ACT, devices. Even the earliest laboratory devices of this type have demonstrated capabilities "never seen before." The upshot might be a whole new generation of single-chip processors that can perform operations that today require racks of the best available analog and digital computer equipment.

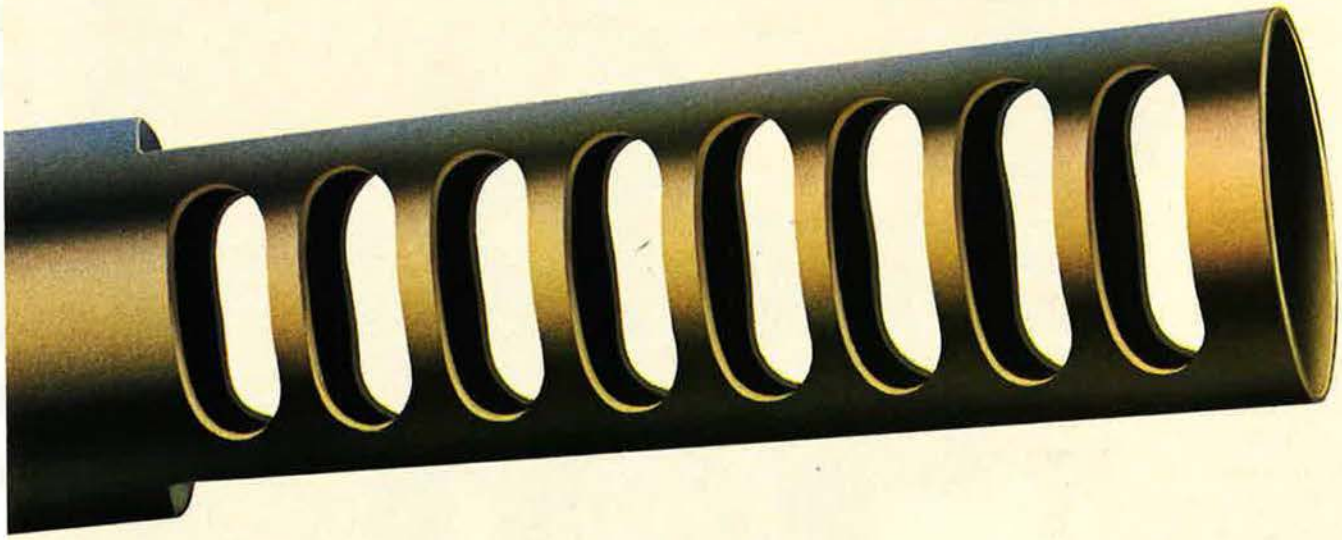
Washington Observations

★ Both Congress and the Air Force are moving closer to an acquisition decision on Northrop's F-20 Tigershark. The Air Force's tentative program objective memorandum (POM) allows for the acquisition of about thirty of these aircraft each year over the next five years, beginning in FY '87. Amendments proffered by members of the House Armed Services Committee, if carried forward by both houses of Congress, open the door to a brass-knuckle competition beginning that year between the F-16 and the F-20. These actions aim at terminating the F-16 multiyear procurement contract to pave the way for the concurrent acquisition of both types of aircraft, involving a limited number of each.

Additional acquisitions—beyond these base numbers—would be determined on a competitive basis. A key challenge in getting the F-20 program off the ground hinges on Northrop's ability to land the initial number of acquisitions to justify program go-ahead. In order to make a unit price of $15 million, Northrop is thought to require a start-up buy of at least 300 aircraft. The buy rate proposed by the Air Force does not come near that number, even in conjunction with South Korea's rumored intent to buy about 125 of these aircraft *after* the US Air Force starts acquiring the Northrop design. Tentative USAF missions for the F-20 include air defense and possibly close air support.

★ One of the most alarming technological scoops scored by the Soviet Union is the newfound ability to make their cruise missiles "invisible" to the Air Force's new over-the-horizon backscatter OTH-B radars. Exacerbating the problem is evidence that present US antisubmarine warfare (ASW) capabilities might not be adequate to detect Soviet submarines operating off the US shores at cruise-missile ranges in time to keep them from launching these weapons. ■

Looking at the business end.



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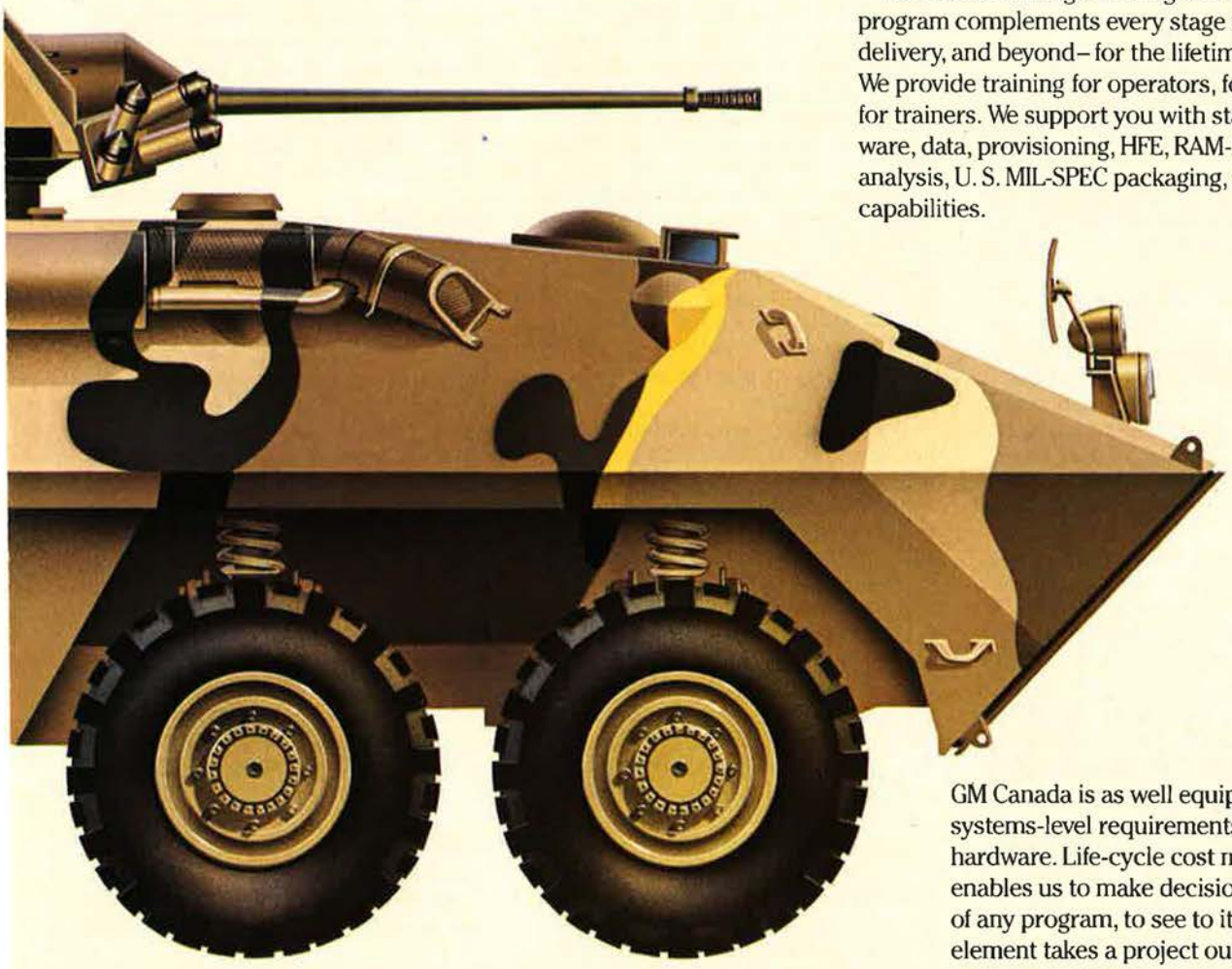

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CAPITOL HILL

By Kathleen G. McAuliffe, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., Apr. 30

Authorization Cuts

The Senate Armed Services Committee recommended reductions of $9.9 billion in the Administration's FY '86 defense budget, but still provided for three percent after-inflation growth, which is about half what was requested. The increase is in line with a White House-GOP deficit-reduction budget compromise.

Committee Chairman Sen. Barry Goldwater (R-Ariz.) said the three percent growth authorization would provide an adequate defense, although it would not keep up with the growing spending rate of the Soviets. He admitted that, with the budget-freeze climate in Congress, the committee would be lucky to hold its recommended level.

Numerous cuts were made in several areas, but no major programs were canceled. Procurement was hit the hardest, with a reduction of $4.6 billion, followed by R&D and O&M cuts of about $1.8 billion each. Strategic programs were reduced about $1.8 billion, due in large part to the limit of MX production to twenty-one missiles instead of the forty-eight requested. The funds provided for basing would allow only fifty MX ICBMs to be deployed in existing silos. The President's $3.7 billion Strategic Defense Initiative (SDI) request was pared by $300 million, but allocation of the cut was left to the program manager. Full funding for the advanced technology bomber, the advanced cruise missile, and the final buy of forty-eight B-1Bs was included.

Tactical programs were reduced by $2.8 billion, but a special effort was made to fund munitions, especially so-called "smart" munitions, at the level proposed. Forty-eight F-15s and 180 F-16s were included. In airlift, C-5B and KC-10 procurement was funded, and only minor cuts were made in funds for continued development of the C-17 airlifter.

Funds were approved for procurement of the antisatellite system. Initial production of binary chemical munitions, denied by Congress in recent years, was again recommended.

AMRAAM Savings Likely

Savings of $1 billion to $1.3 billion in the planned buy of the Advanced Medium-Range Air-to-Air Missile (AMRAAM) may be possible, according to a senior Air Force official charged with finding reductions in the program. The anticipated savings could be enough to get a DoD go-ahead for production of 17,000 missiles for USAF and 8,000 for the Navy. Secretary of Defense Caspar Weinberger earlier this year deferred the AMRAAM buy until costs—which rose from $6.7 billion to $8.4 billion—could be reduced.

The Air Force views the lightweight, active-radar AMRAAM as a top-priority program. Designed as a follow-on to the larger Sparrow, which the F-16 is not equipped to launch, AMRAAM would provide the F-16 with its first radar missile capability.

A modified tail-controlled Sparrow is supported by some influential congressional staff as an effective, cheaper alternative to AMRAAM. But the Air Force believes this would not solve the weight problem, leaving the bulk of its future fighter force—F-16s—without radar missile capability.

Front-line fighters will be able to launch several AMRAAMs simultaneously without putting themselves in range of Soviet missiles. The Air Force views this as a critical advantage to be exploited, since US aircraft would be grossly outnumbered in a conflict with the Warsaw Pact.

Small Missile on Hold

The Senate Armed Services Committee has recommended deferment of full-scale development of the small, single-warhead "Midgetman" missile, pending further study by the Air Force of alternate design options. Missiles weighing up to 80,000 pounds are to be considered, despite a limit of 30,000 pounds imposed by previous legislation. Full-scale development of the missile will be on hold until Congress reviews the Air Force findings in a report due September 1.

The recommendation for further study came at the urging of Sen. Pete Wilson (R-Calif.), who raised serious concerns about congressional restraints on the Midgetman design. The Senator termed these limits "questionable," saying Congress "ignored several factors that can critically affect the ability of the small missile to achieve its mission."

Adding F-20s?

The Air Force may add some F-20 aircraft to the fighter inventory in FY '87. USAF officials told a Senate subcommittee that Air Force Secretary Verne Orr wants to create as much competitive leverage as possible in the acquisition process, especially as far as the F-16 is concerned, and that USAF is looking seriously at buying F-20s next year. The F-20 would compete with the F-16. While the F-16 has far greater range and an acceleration advantage, the F-20 would be cheaper to acquire and operate, USAF officials believe. How much cheaper would depend on how much capability is added to the aircraft.

Regardless of the outcome of the Air Force's F-20 acquisition decision, it could end up with F-20s in the force as early as FY '86. Sen. Ted Stevens (R-Alaska), chairman of the Senate defense appropriations panel, told USAF that it would get some F-20s whether it wants them or not because Congress wants to return to competition of aircraft, not just components.

Cruise Missile Defense

A new program to defend against strategic air-launched cruise missiles is included in the $776 million request for FY '86 by the Defense Advanced Research Projects Agency (DARPA). The air defense program, according to DARPA Director Robert Cooper, is aimed at preparing to counter future Soviet cruise missiles that will have reduced radar signatures by virtue of Stealth technologies.

Dr. Cooper told a congressional panel to expect additional growth in this air defense area in future budgets because he envisioned an eventual SDI-type effort. Technologies associated with successful SDI demonstrations are expected to be applied to the cruise missile defense program. ■

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THE HF RADIO HEARD 'ROUND THE WORLD.

AEROSPACE WORLD
News, Views & Comments

By James P. Coyne, SENIOR EDITOR

Washington, D. C., May 2

★ One of the most productive and profitable Air Force activities and yet one of the least known provides a return against its operating budget of $20 for each $1 spent. The activity is the Military Aircraft Storage and Disposition Center (MASDC), which stores and preserves aircraft not currently needed by DoD. When aircraft are declared surplus, they are stripped of usable parts, which go back into the DoD inventory. Material no longer needed, such as aircraft fuselages, is sold or melted down so that the metal can be sold.

Total industrial output for the Center last year was almost $400 million on an operating budget of $20 million. Usable parts worth $174.5 million were returned to the DoD inventory—a return of almost $9 for each $1 spent.

Last year, MASDC, located at Davis-Monthan AFB, Ariz., reclaimed and returned to service a total of 51,467 parts. Most went to DoD, but some also went to such civilian agencies as the Department of the Interior, Department of Agriculture, and other federal agencies.

The returned spare parts help to increase USAF's combat capability. For example, a number of SAC's B-52s were nonflyable recently because of a valve problem. Only two valves were readily available in the supply system, but each aircraft requires six. MASDC was immediately able to remove sixty valves from aircraft stored there and deliver them directly to the users, returning the aircraft to service much sooner than would otherwise have been possible.

The unit has also struck gold by removing engines and components from used Boeing 707 aircraft purchased by the Air Force for the reengining of the KC-135. MASDC's 707 reclamation activities will yield an estimated $1.2 million per aircraft, $200,000 more than the purchase price of the 707s. About half of the items the Center removed from stored aircraft last year were shipped to satisfy priority requirements for operational aircraft or to preclude work stoppages on repair lines in Air Force Logistics Command's air logistics centers.

A ready source of engines and other spare parts, aircraft at the Military Aircraft Storage and Disposition Center (MASDC) at Davis-Monthan AFB, Ariz., await stripping and meltdown. MASDC yields a twenty-to-one return on its operating budget.

★ In a recent Pentagon ceremony at which plaques were presented to leading participants in the 1984 Suggestion Award Program, Secretary of the Air Force Verne Orr and Air Force Chief of Staff Gen. Charles A. Gabriel recognized four people who have saved the Air Force $10 million. The four received cash awards of $59,400 last year when their suggestions were accepted.

Honored were Ralph G. McNamara, a GM-13 at Hill AFB, Utah; retired CMSgt. Donald H. Holloman, now in a Civil Service position at Fort Bragg, N. C.; MSgt. Gary A. Lynch, Ramstein AB, Germany; and Army CWO Ronald W. Howell, who lives in Detroit, Mich. Mr. Howell is the first person from another service to win top Air Force suggestion honors.

Mr. McNamara saved USAF almost $4 million by suggesting that Mk 82 500-pound bombs used for practice did not have to have the same internal components or heat-treated casings as "live" bombs. He was awarded $10,000 for his idea. Fourteen of his suggestions have been accepted by the Air Force, saving an estimated $15 million.

Sergeant Lynch saved the Air Force $2.5 million by suggesting that damaged keel duct assemblies on F-4s be inspected and their parts repaired, if possible, rather than automatically replacing damaged parts with new parts. He received $16,000 for his suggestion.

Mr. Howell also saved the service about $2.5 million. While on a joint-service exercise, he discovered that the new, larger generators his unit was receiving could be accommodated on existing trailers that had been modified, thus obviating the need to procure new, larger trailers that would have increased airlift requirements. He was awarded $15,000.

Chief Holloman saved USAF $1 million a year by his suggestion to double the concentration of liquid used

to fight petroleum fires. Storage space and shipping costs for the liquid were cut in half, and fire-fighting capability was doubled. He received $18,400 for his suggestion.

According to General Gabriel, the Air Force suggestion program last year received more than 100,000 ideas that are expected to save about $94 million.

★ Air Force leaders are focusing on aircrew retention. Current overall retention rates are down two to three percentage points from the record-high marks in 1983. Air Force statisticians report that FY '83 and FY '84 saw the highest retention years in the history of USAF. So, despite the FY '85 downturn, retention is still very good. Lt. Gen. Duane H. Cassidy, Deputy Chief of Staff for Manpower and Personnel, said, "It was very unlikely that we would stay as high. We now have to make sure our losses are in the areas we can handle."

Nevertheless, the most crucial personnel losses are in "the principal part of our combat force, and that's our aviators." Aircrew losses, he said, "are steeper than in the overall force, but they are not alarming and not higher than we predicted."

Military Airlift Command, however, is taking direct action to cut transport crew losses by urging some aircrews who have left the Air Force to return. "Have you thought about returning to active duty?" reads the opening sentence of a letter from Gen. Thomas M. Ryan, Jr., MAC Commander in Chief. "I'm contacting a very small, select group of officers who have separated over the past four years. We identified you because of your excellent service record and potential for a full Air Force career."

The letter stresses modernization programs in MAC, such as the addition to the fleet of C-12Fs, C-21As, and C-23 Sherpa aircraft. It also discusses future programs that will enhance opportunities for MAC aircrews through the 1990s. General Ryan stresses the availability of new, challenging jobs throughout the world and promises "every effort to accommodate your choice of locations." The tone and content of replies to General Ryan's letter are not known.

★ Three new records set by the Lockheed C-5A Galaxy have been certified by the National Aeronautic Association (NAA) and the Fédération Aéronautique Internationale.

A world record for the greatest payload lifted to an altitude of 2,000 meters, a total of 245,731 pounds, was

Gen. Jerome F. O'Malley

The Loss of O'Malley

Gen. Jerome F. O'Malley, the highly respected commander of the Tactical Air Command, was killed in the April 20 crash of his CT-39 Sabreliner at Wilkes-Barre/Scranton International Airport in Pennsylvania. Killed in the crash also were his wife, Diane, and the three Air Force crew members, Lt. Col. Lester F. Newton, Capt. Harry L. Haugh, and TSgt. Robert A. Eberflus.

The O'Malleys were known, admired, and liked throughout the Air Force. General O'Malley, who was considered a likely candidate for US Air Force Chief of Staff at some point in the future, was respected in and out of the service. He was frequently requested to testify at congressional hearings and on many occasions gave private briefings to influential members of Congress, who had great confidence in him. He held top leadership positions in Strategic Air Command, Pacific Air Forces, Hq. US Air Force, and the Organization of the Joint Chiefs of Staff.

General O'Malley's career was outstanding from the start. After graduation from the US Military Academy and USAF jet pilot training, he became one of a carefully selected group of air training officers assigned to the fledgling US Air Force Academy, then located at Lowry AFB, Colo. From there, he went to a series of Strategic Air Command assignments, beginning with a tour as a B-47 bomber pilot and culminating in his selection as aide to the Vice CINCSAC.

He was a distinguished graduate of Air Command and Staff College and earned a master's degree in business administration from George Washington University. He was the first USAF pilot to fly an operational sortie in the SR-71, the free world's most advanced strategic reconnaissance aircraft. He was a graduate of the Naval War College.

In Southeast Asia, General O'Malley flew 116 combat missions in RF-4Cs and F-4Ds out of bases in South Vietnam and Thailand. Among his many important assignments later, he was Chief, Single Integrated Operational Plan Division, Joint Strategic Target Planning Staff; Vice Director, Operations, the Joint Staff; USAF Deputy Chief of Staff for Plans and Operations; USAF Vice Chief of Staff; Commander, Pacific Air Forces; and, finally, Commander, Tactical Air Command.

Among his forty-five awards and decorations, General O'Malley held the Distinguished Service Medal, Defense Superior Service Medal, Legion of Merit, Distinguished Flying Cross, Meritorious Service Medal, and the Air Medal.

Funeral services for General and Mrs. O'Malley were held at the New Chapel, Fort Myer, Va., on April 25. They are buried at Arlington Cemetery. Gen. Russell E. Dougherty, USAF (Ret.), Executive Director of AFA, said in his eulogy that the O'Malleys "showed us how to live—how to share the excitement of living, loving, and believing—in God, country, family, friends." They are survived by four children: Margaret Ann O'Malley Neal, whose husband is an Air Force captain, James Francis, John Thomas, and Sharon Kay.

—J.P.C.

set by a Galaxy at Dobbins AFB, Ga., on December 17, 1984. This eclipsed the old world record set by the Soviets of 154,590 pounds, established on July 4, 1975, by an Ilyushin Il-76 Candid-B, the Soviet counterpart to USAF's C-141.

The other two records are national records, since there are no international categories established for them. On the same December 17 flight, the C-5A was credited with the "greatest weight at which any aircraft has ever flown," with a gross weight of 920,836 pounds. And on January 16, 1985, at Edwards AFB, Calif., a Galaxy established a record for the heaviest aircraft ever to have landed, with a landing weight of 876,762 pounds.

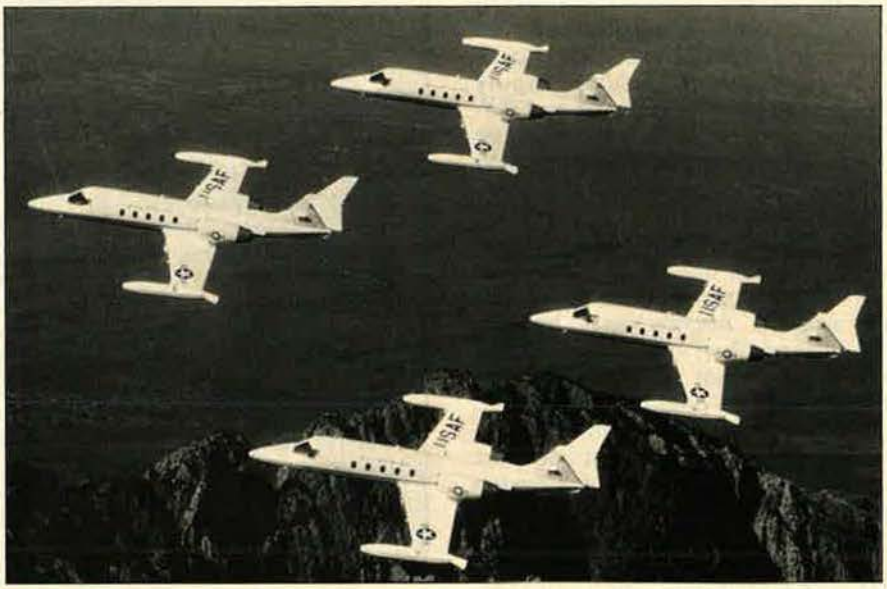
★ Three AIR FORCE Magazine editors have won important national awards in recognition of their writing talents.

Senior Editor James W. Canan won the Aviation/Space Writers Association's (AWA) top journalism award in the special interest publications category for the subject of space. His winning article, "Bold New Missions in Space," appeared in the June 1984 issue of AIR FORCE Magazine. He also won an honorable mention for the subject of aviation with his article "Toward the Totally Integrated Airplane" in the January 1984 issue. In 1981, while he was on the staff of *Business Week* magazine, Mr. Canan won the AWA national award and northeast regional awards. He was also a member of a reporting team that won a Pulitzer Prize for Gannett Newspapers in 1964.

AEROSPACE WORLD

Also in this year's AWA competition, Edgar Ulsamer, Senior Editor (Policy & Technology), won honorable mention in the special interest category for the subject of space for his "Charting a Course for SDI," which appeared in the September 1984 issue of AIR FORCE Magazine. Mr. Ulsamer has won nine writing awards, the most recent in 1982 from AWA for his August 1981 article, "The Long Leap Toward Space Laser Weapons." This year's awards were presented at the 1985 AWA News Conference in St. Louis, Mo., on April 17.

Gen. T. R. Milton, USAF (Ret.), Contributing Editor, was presented the Thomas D. White National Defense Award for his "outstanding contributions to the national defense and security of the United States," with special reference to his articles since his retirement in AIR FORCE Magazine and several major newspapers across the country as well as his service on the editorial boards of *Strategic Review* and *NATO's Sixteen Nations*. The Thomas D. White Award is presented by the US Air Force Academy each year to a US citizen who is adjudged to have contributed most significantly to the national defense and national security during the years preceding the award. The presentation was made at USAFA on May 4 during the Cadet Wing Parade by Academy Superintendent Lt. Gen. Winfield W. Scott, Jr.



The Gates Learjet C-21A, replacement for the CT-39 Sabreliner, is part of USAF's new operational support aircraft fleet. Here, four are seen in diamond formation.

Senior Editor James W. Canan (right) receives his Aviation/Space Writers Association (AWA) award from James A. Crandall, Journalism Awards Program General Chairman, as Awards Banquet Chairperson Kathi McDonald looks on. See item.

★ The fifty-sixth Gates Learjet C-21A was delivered to the Air Force in April, the aircraft manufacturer announced. A total of eighty will be provided to USAF by the end of October. Aircraft delivered so far are stationed at sixteen bases in the US and overseas. Deliveries to Military Airlift Command (MAC) began in April 1984.

During their first year of operation, the C-21As have accumulated more than 18,900 flying hours and have accounted for more than 20,000 takeoffs and landings. The aircraft has

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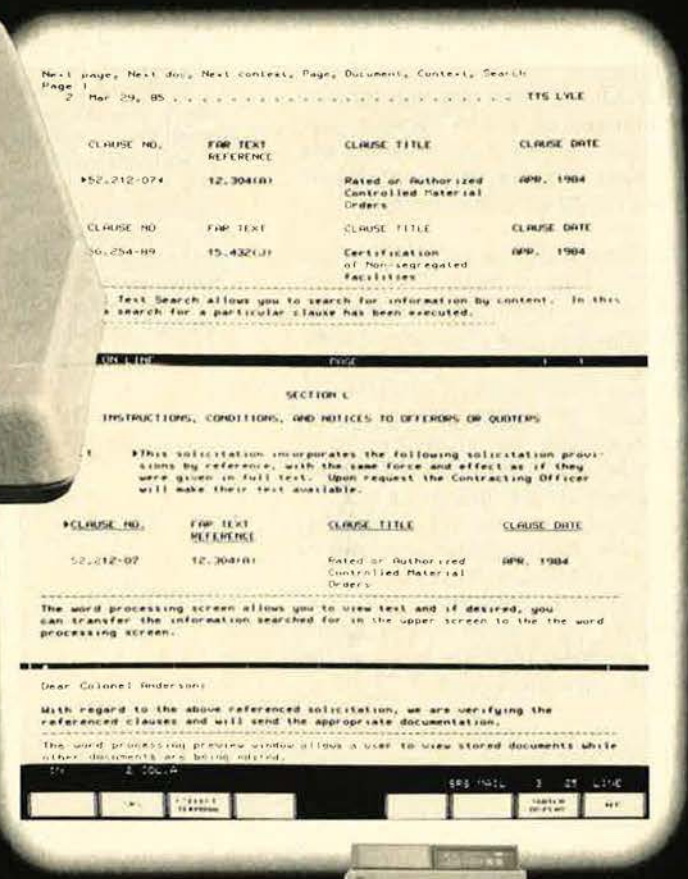

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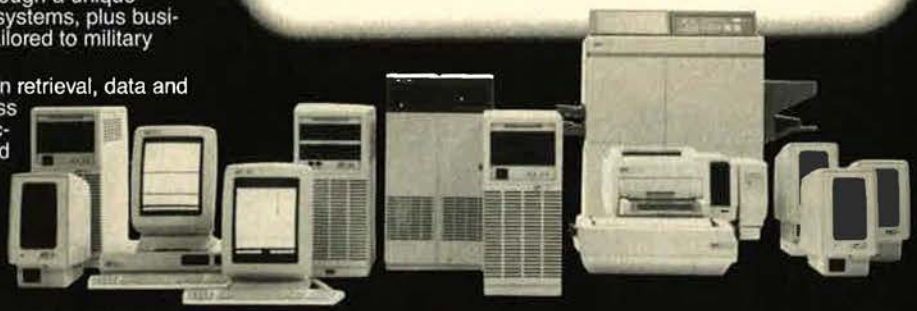

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achieved a mission-capable rate of more than ninety-five percent, well above the USAF-specified rate of eighty-five percent.

The C-21A, which is the military version of the commercial Learjet 35A business and utility aircraft, is used by the Air Force to transport personnel, deliver time-sensitive cargo, and provide training for new Air Force pilots. It can also be utilized for emergency medical airlift. It replaces the old CT-39 Sabreliner, which has less capability and is much more expensive to maintain and fly.

The aircraft are provided under a $175.4 million fixed-price lease contract for five years, with an option to renew for three additional years. Gates Learjet Aircraft Services Corp. (GLASCO), a wholly owned subsidiary, supplies all C-21A logistic support, with some 100 technicians providing maintenance at USAF bases in CONUS and overseas.

★ The fiftieth anniversary of the Boeing B-17—the famous Flying Fortress—will be celebrated at two major gatherings this year. The Boeing Management Association will sponsor a three-day celebration in July in Seattle, Wash., where the B-17 was first produced. Also, the eleventh annual Eighth Air Force reunion in October will center on the theme of the aircraft's anniversary during its meeting at Wichita, Kan., modern-day site of the Boeing Military Airplane Co.

The Boeing celebration will commemorate the Flying Fortress as well as the aircrews who flew in it and the workers who produced it. The first

AEROSPACE WORLD

B-17, originally designated Model 299, rolled out of the Boeing plant on July 28, 1935. It was the only four-engine candidate for a new Army Air Corps multiengine bomber. Another aircraft company won the production contract, but Boeing was also awarded a contract for thirteen of its new bombers. It was not long before the superior ability of a four-engine bomber to carry out the strategic bombing mission was proven. By the time World War II started, the winning 1935 design was no longer in production. But the B-17 was—and Boeing, Lockheed (Vega at that time), and Douglas manufactured 12,737 Forts by war's end. Boeing's production rate alone reached sixteen planes a day.

The Boeing celebration will be held on July 26–28. More than twenty bomb groups have scheduled reunions in Seattle to coincide with the fiftieth anniversary celebration. Surviving crew members who won the Medal of Honor on B-17 missions will be guests of honor. A number of restored Flying Fortresses will be flown to Seattle for the celebration, and several restored World War II fighter planes that escorted B-17s on bombing missions over Europe will appear.

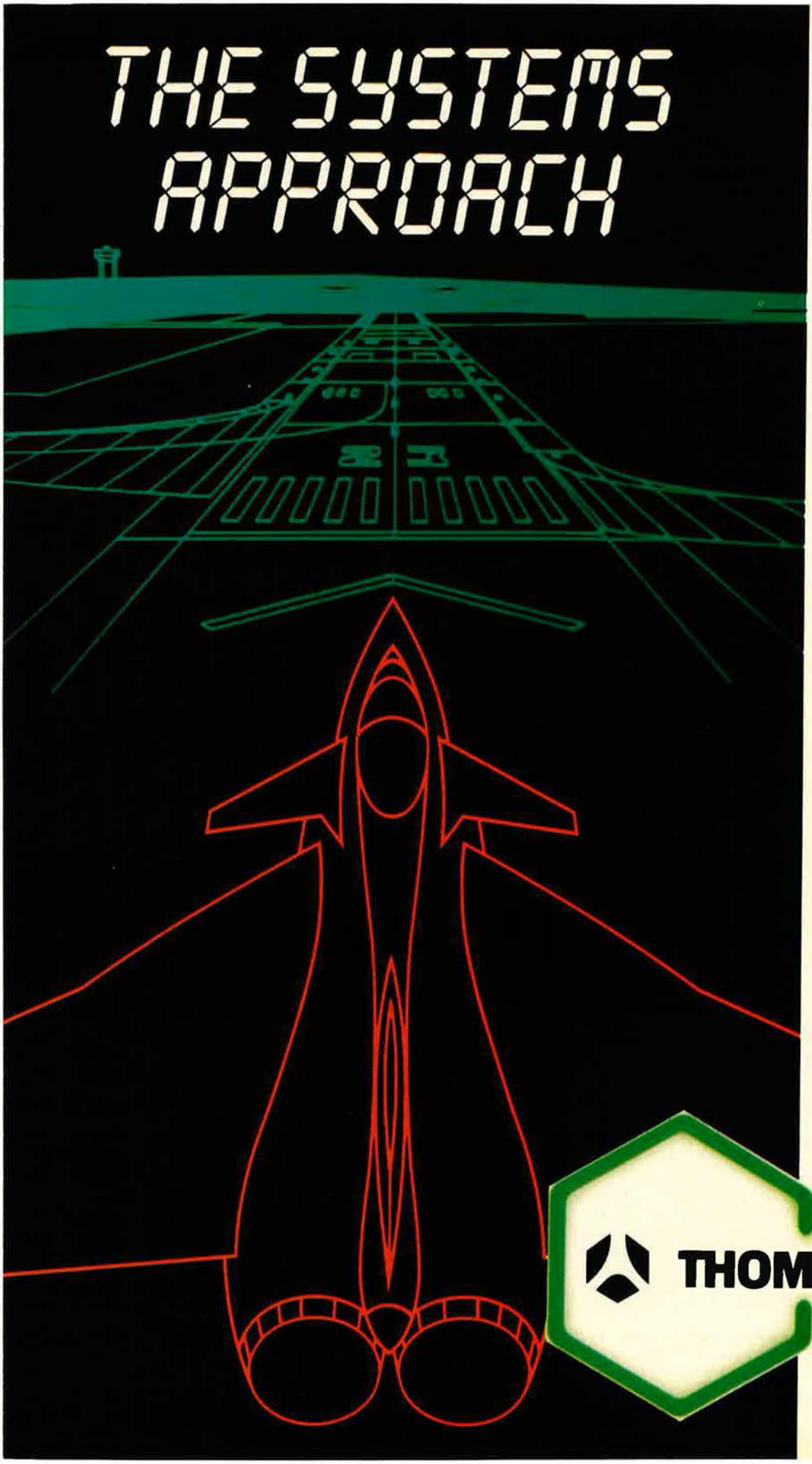
The warplanes and other exhibits will be at the Museum of Flight on Boeing Field in south Seattle, less than two miles from the factories where the Fortresses were built. Weekend activities will be open to the public.

The Eighth Air Force reunion will take place on October 17–20. The reunion program, sponsored by the 8th Air Force Historical Society, includes an open house at McConnell AFB, Kan., now part of Eighth Air Force, a USAF Thunderbirds Flight Demonstration, and an Air-War Symposium featuring noted World War II aces. B-17s and other WW II aircraft are expected to be at the celebration in Wichita.

Boeing's new Tactical Life Support System (TLSS) for aircrews, now in development, is scheduled for flight demonstration in 1986. TLSS generates oxygen-enriched air from engine bleed air and protects against forces up to nine Gs and pressure altitudes up to 60,000 feet.

The fiftieth anniversary of the Boeing B-17 Flying Fortress is being celebrated this year. In this famous photo, a Fort returns to base after being rammed by a German fighter over North Africa. The fighter was destroyed.

THE SYSTEMS APPROACH



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AEROSPACE WORLD

★ The Department of Defense is switching to a new microwave landing system (MLS) to replace precision approach radars and instrument landing systems (ILS) now operating at military bases worldwide. Air Force Systems Command's Electronic Systems Division (ESD) will manage the new conversion program.

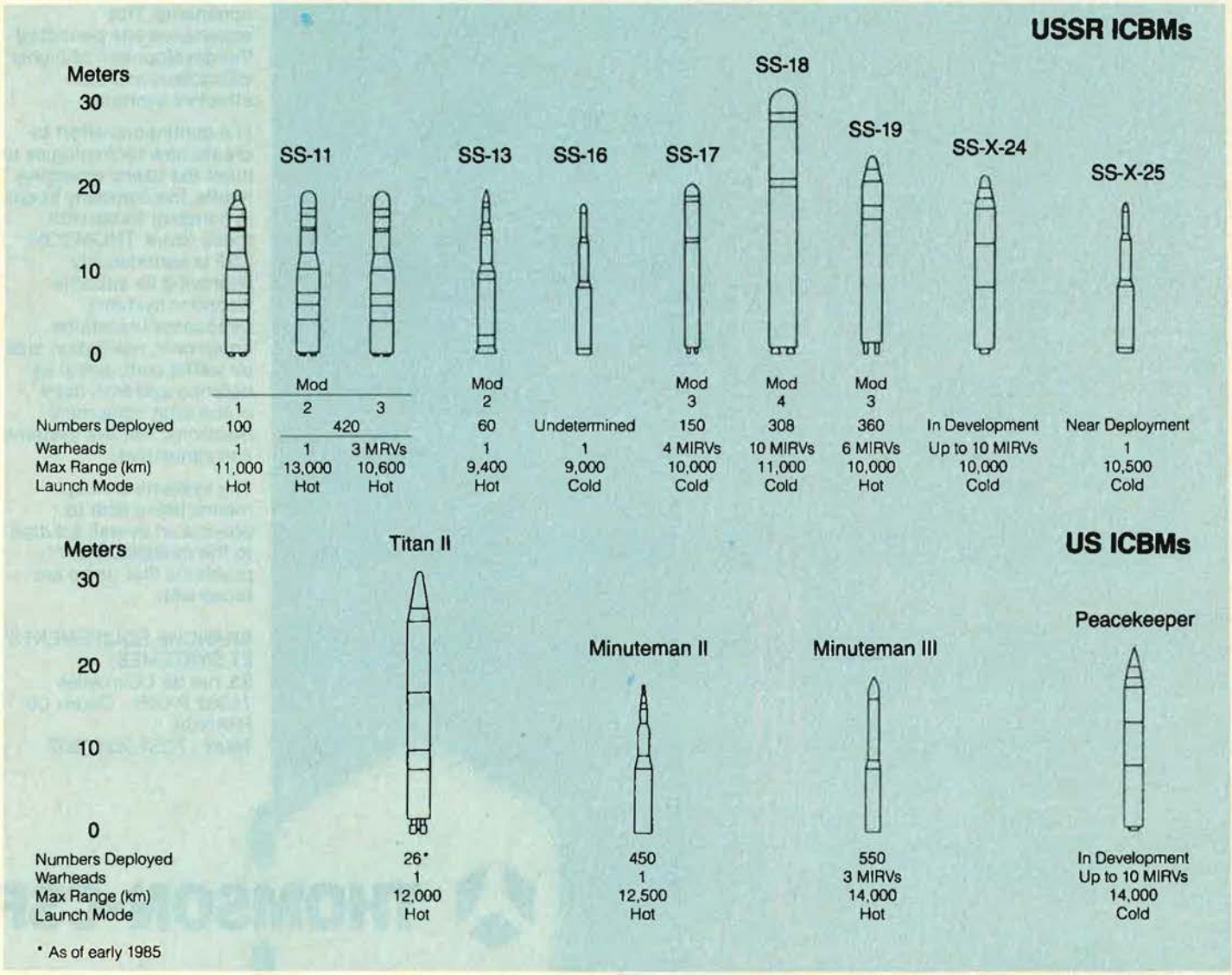
"Microwave landing systems will have a lot of advantages," says program director Lt. Col. Rod Sayles. "Instrument landing systems have reached the limit of their capabilities. Frequency congestion is becoming a serious problem, which microwave equipment will overcome. With the proper runway lighting and avionics, it can guide aircraft to landings when the visibility is nearly zero."

Another advantage to MLS is that a pilot can make an approach using a glide slope angle that is optimized for his aircraft—with ILS, all approaches to a given airfield must use the same glide slope. The pilot can also select a number of approach courses to the runway, while with ILS, there is only one. MLS does not require costly site preparation. The expense of leveling large areas in front of ILS antennas often exceeds the cost of the equipment itself.

Between 1986 and 1990, ESD will order about 300 microwave landing systems for USAF, Army, Navy, and Marine bases in the United States, develop and produce transportable, shelterized systems for overseas bases, and recommend to DoD the MLS avionics to be used in retrofitting military aircraft.

"The principal reason the Defense Department is converting to MLS is that it will become the new international standard landing system, and we must maintain compatibility with the civil sector," Colonel Sayles explains. The transition will take about twenty years.

★ A "Magic Helmet" to help tomorrow's pilot see his instruments as well as objects and events transpiring outside the cockpit when his head is immobilized by high G forces is under development at the Air Force Medical Research Laboratory. Conceived originally as a less expensive alternative to vision systems in existing flight simulators, the Visually Coupled Airborne Systems Simulator is now seen as a viable system for supersonic aircraft of the future, in which



* As of early 1985

The Soviet ICBM force grows ever stronger, as shown by this chart from* Soviet Military Power, 1985, *the booklet newly published by DoD. Some 818 Soviet silos have been hardened and contain the latest versions of the SS-17, SS-18, and SS-19, all deployed during the past six years. For more on this subject, see the article "Soviet Military Power 1985," starting on p. 120 of this issue.

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the pilot will probably sit in a reclining couch-like seat. In a high-G situation, he will be unable to see downward toward his instruments.

With the helmet on, the pilot can bring up before his eyes the scene in any direction he desires. An electromagnetic radiator behind the cockpit seat senses which way he is trying to move his head. A computer then brings up on the helmet's visual display system the view in the desired direction.

This is made possible by two electronics engineering breakthroughs developed by the system's creator, Dean Kocian. He devised a one-inch-diameter TV picture tube, which features a high-resolution, high-contrast, high-brightness picture, and new optics that relay images from the TV tube to the pilot's eyes. Computer-generated graphics are projected onto the small TV screen, transmitted through the optics, and transformed into a three-dimensional, panoramic scene in front of the pilot's eyes.

The Medical Research Laboratory people developing the system believe the pilot's helmet and visual display system can be combined in a package weighing no more than three pounds. The Army, which will test the helmet's application for helicopter flying, hopes to fly the test model in two years.

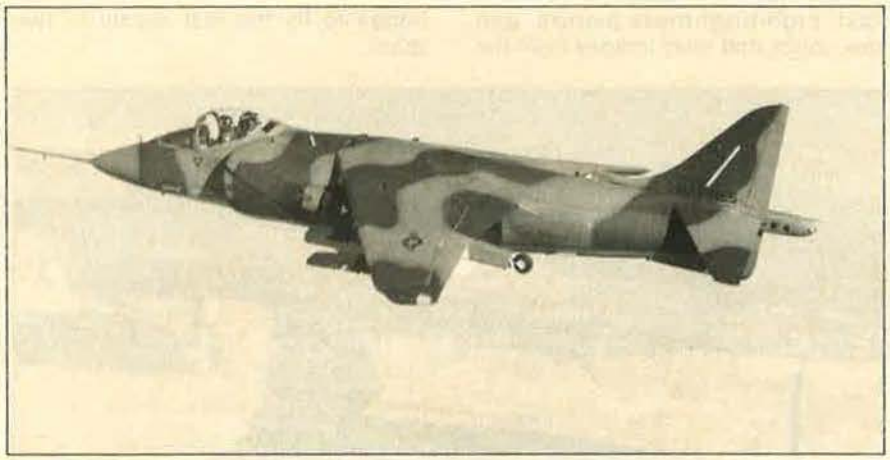
AEROSPACE WORLD

USAF has contracted for Cubic Corp.'s P4A Aircraft Instrumentation Subsystem (AIS) pod, which is used in airborne electronic combat training to score simulated missile attacks. The first forty-two will be delivered to Nellis AFB, Nev.

AEROSPACE WORLD

★ The F-106 Delta Dart, favorite of interceptor pilots for decades, will be converted to an aerial target drone for advanced weapon testing and combat crew training, the Armament Division of Air Force Systems Command has announced. The F-106, which will be phased out of the active Air Force inventory in 1987, will be redesignated QF-106.

Approximately 200 F-106 aircraft will be converted to drones by 1991. They will be targets for air-to-air and surface-to-air missiles fired by crews undergoing combat readiness training. The drones will fly at twice the speed of sound and as high as 55,000 feet.



A US Marine Corps McDonnell Douglas AV-8B, one of a total of 328 on order, is test-flown over Missouri. A McDonnell Douglas/British Aerospace version of the Harrier has been ordered by the RAF and the Spanish Navy.

New digital electronics and automatic takeoff and landing capabilities give the new drones better performance than their predecessors, but like other drones, Armament Division expects each to last only an average of ten missions. The drones will be launched from Tyndall AFB, Fla., or Holloman AFB, N. M. They will begin entering the inventory in 1989.

★ New Ultra Reliable Radar technology that will yield equipment with a mean-time-between-failure rate ten times greater than that of radars now in use is being developed under an Aeronautical Systems Division (ASD) contract awarded to Westinghouse Electric Corp., Baltimore, Md.

Current radars operate forty to fifty hours before requiring maintenance. The new radar will function 400 to 500 hours between failures, ASD believes. It will have an active element array antenna made up of about 2,000 individual modules, each generating its own power. Up to five percent of the active array modules can cease functioning without degrading the system.

The system will incorporate very-high-speed integrated circuit (VHSIC) technology. The major objective of using VHSIC, ASD says, is to provide

Bendix Microwave Landing Systems. Up and Running.

When the Bendix MLS was commissioned at Shemya AFB in Alaska on March 3, 1984, the Air Force wanted a system that would provide dependable approach and landing guidance.

What they got was an MLS system with a 99.28% operational availability including time for flight inspections and maintenance. They also got some severe storms in which to prove its dependability.

The Bendix system, which has a monitor tolerance of 0.05 degrees, remained operational during three consecutive storms which lashed Shemya with snow, sleet, ice, continuous winds of over 60 mph and, at times, gusts reaching 125 mph.

Through it all, the Bendix MLS system stayed up and running, providing the Air Force with an accurate and reliable landing guidance system.

If you have a need for a proven dependable MLS system, or want more information on the system at Shemya, contact Bill Reed at the Bendix Communications Division, 1300 East Joppa Road, Towson, MD 21204. Or call him at (301) 583-4000.

ALLIED Bendix Aerospace

Who is the bright light in Ring Laser Gyros? Singer's Kearfott Division...naturally.

Delivery of the first development Ring Laser Gyro inertial sensor assembly for Tomahawk II was accomplished in 1983. This was in accordance with a contract awarded by the Joint Cruise Missile Project, Washington, D.C.

Kearfott has also been awarded a full scale development contract for the U.S. Navy's second generation Carrier Aircraft Navigation Systems (CAINS II) based on Ring Laser Gyros and the U.S. Army for development of standard Ring Laser Gyro based Modular Azimuth Position System (MAPS) for use by the artillery and special purpose vehicles.

In addition, we received a contract for development of the Tri-Service RLG based Standard Attitude and Heading Reference System from the U.S. Navy.

To date, over 600 gyros have been delivered or are in production. Our production facility, currently capable of producing 100 gyros per month, is rapidly expanding to make possible the production of 400 units per month.

Systems have been delivered to the USAF Central Inertial Guidance Test Facility that are currently flying and surpass the USAF Standard Inertial System requirements.

The bright light in Ring Laser Gyros continues to be Kearfott, a division of The Singer Company.

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an increase of fifty to 100 times in information throughput speed while yielding a tenfold reduction in size, weight, power, failure rate, and life-cycle cost.

The new radar will have multimode capabilities including air-to-air search, track, track while scanning, identification, raid assessment, terrain following, terrain avoidance, ground moving target indication and location, position fixing velocity update, synthetic aperture radar mapping, and real beam mapping. It will be compatible with improved electronic counter-countermeasures equipment and techniques.

The Ultra Reliable Radar is a subsystem of an advanced integrated avionics architecture developed under a program called Pave Pillar. USAF expects to begin testing the new radar at the manufacturer's facility in April 1988.

★ After four test flights at Edwards AFB, Calif., the Grumman Aerospace Corp.'s X-29 Advanced Technology Demonstrator has been turned over to the Air Force. Following acceptance of the aircraft by Aeronautical Systems Division (ASD) of Air Force Systems Command, the Air Force loaned the aircraft to NASA. NASA will be responsible for further flight-testing and will assume day-to-day management. USAF will manage flight-test support.

AEROSPACE WORLD

Two X-29 flights a week are planned through July by both NASA and Air Force pilots. The first USAF pilot to fly the aircraft was Lt. Col. Ted Wierzbanowski, who called his maiden sixty-five-minute sortie "outstanding" and very productive in yielding test data. "It's going to be a very interesting research program," he said, "especially as we get into the more advanced phases."

All flights for this phase of the tests of the unconventional X-29, which is characterized by thin forward-swept wings and by closely coupled, very large movable canards near the nose, will take place at the NASA Ames Dryden Flight Research Facility near Edwards AFB, Calif.

In addition to testing the forward-swept, lightweight, graphite-and-epoxy wings and the canards, the X-29 will test the effectiveness of an advanced digital flight-control computer that stabilizes the inherently unstable aircraft by adjusting the position of the wing trailing edges, canards, and other control surfaces as often as forty times a second. The aircraft was designed for greater agility, decreased drag, and improved performance at high angles of attack. ■

Lt. Col. Ted Wierzbanowski is the first USAF pilot to fly the uniquely configured Grumman Aerospace X-29 forward-sweptwing research aircraft.

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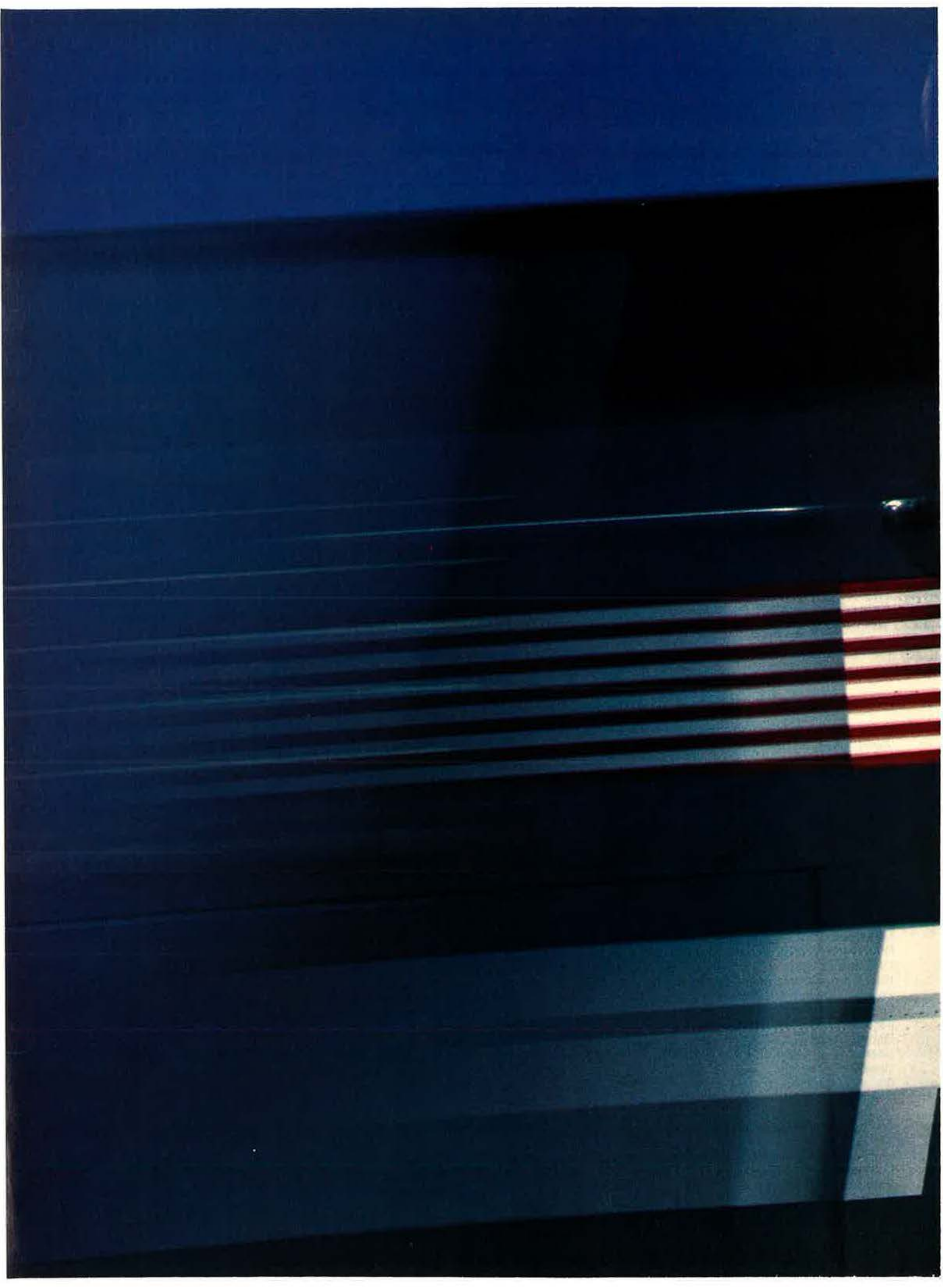

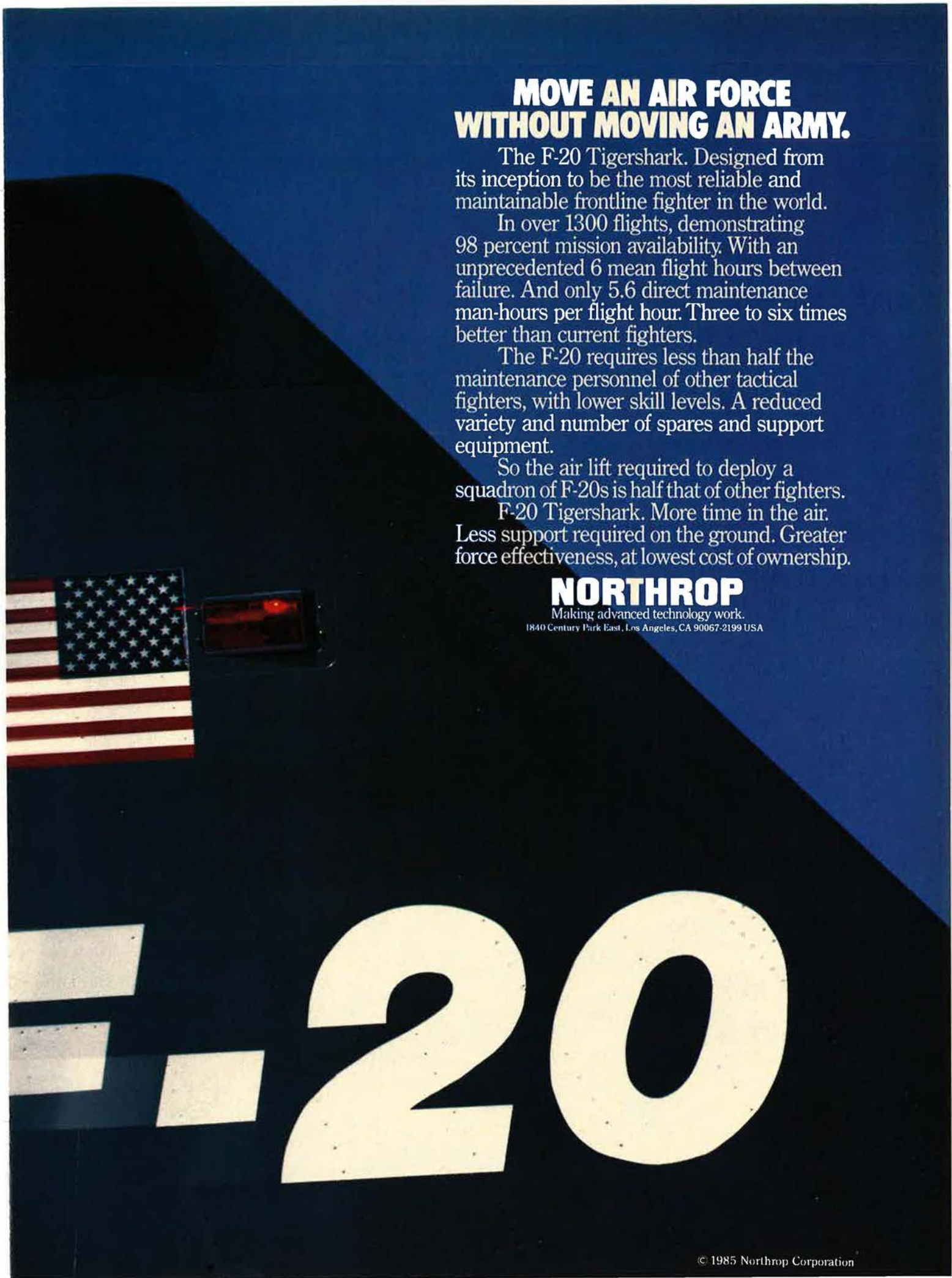
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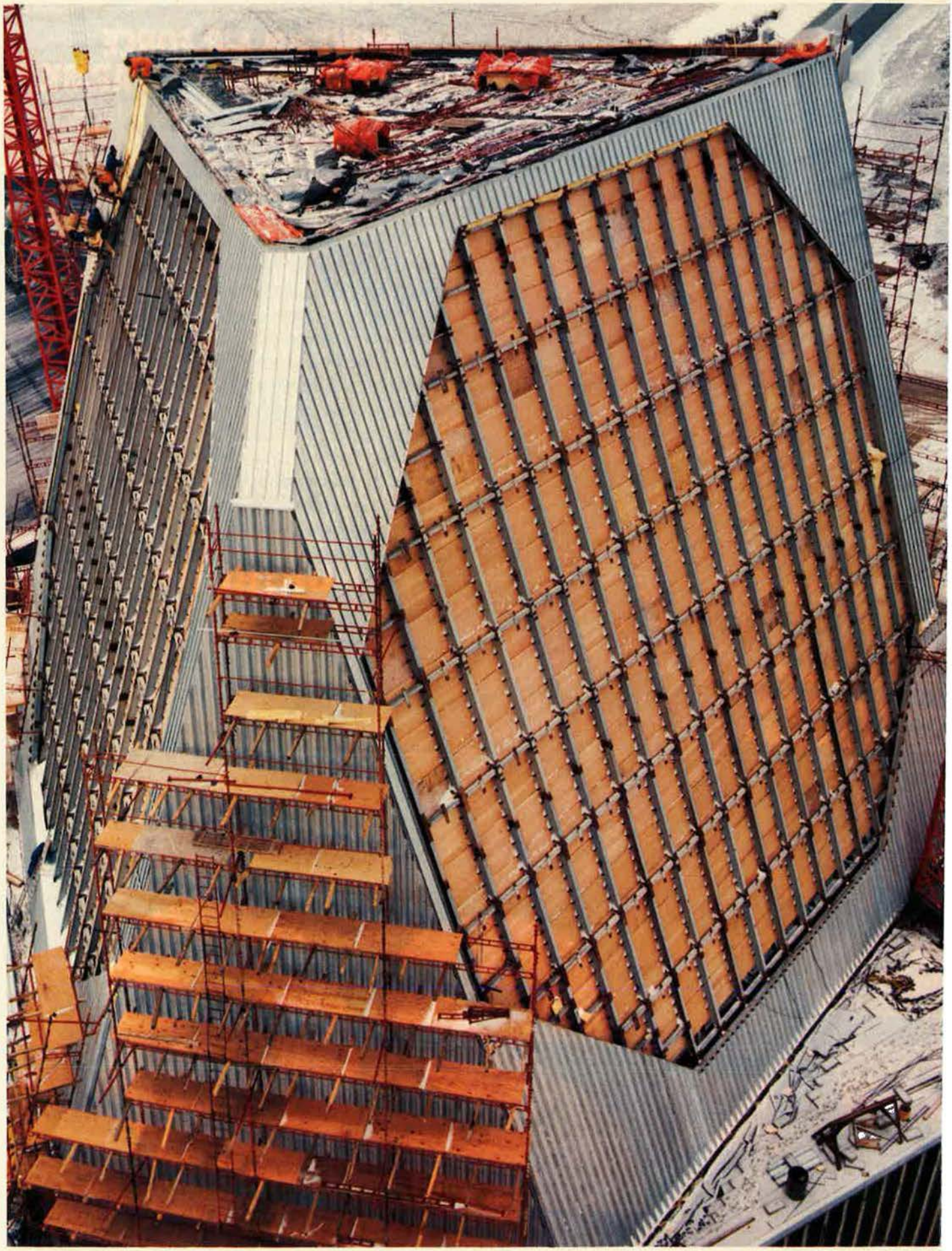


At ESD, impressive new systems are nearing deployment—and even more impressive ones are in development.

Harvest And Seedtime In C³I

BY JOHN T. CORRELL, EDITOR IN CHIEF

This is a time of remarkable progress for the Electronic Systems Division at Hanscom AFB, Mass. Pushed by favorable budget and technology trends, as well as by the urgency of national priorities, ESD is moving swiftly toward the next era in command control communications and intelligence (C^3I).

The division fairly throbs with activity, much of it on systems ready for or approaching operational deployment. An extraordinary number of programs are in advanced stages of acquisition.

Last month, ESD awarded a full-scale development contract for airborne terminals for the Milstar satellite communications system. Milstar is the Defense Department's top C^3 priority. Vastly improved radars—ranging from phased-array replacements at Ballistic Missile Early Warning System (BMEWS) sites to ultralow sidelobe antennas for tactical use—are coming on line. Fragile communications links are being superseded by new networks less vulnerable to degradation or destruction.

The final E-4B National Emergency Airborne Command Post (NEACP) aircraft was delivered in January. Action is under way on a command and control system that will finally rescue the Military Airlift Command from the age of grease pencils.

The United States and Canada have agreed to cooperate on modernization of the long-neglected North American air defense system. ESD's most heralded product since the 1950s, the E-3 AWACS, is about to become even better. And now that the Air Force and the Army have settled their differences about definition of the JSTARS tactical battle management system, ESD is pursuing that development with special vigor.

ESD's budget for FY '85, with foreign military sales factored out, is just over $3 billion—more than double the division's level of funding in FY '79 and up by $542 million since the FY '84 budget.

Sources of the Surge

In part, the surge reflects the unprecedented appreciation for C^3 in recent years, best exemplified in the priority accorded it in the strategic modernization plan announced by President Reagan in 1981. It is also a consequence, however, of the maturing of programs and technologies—particularly computational technologies—that have been in development for some time. A third factor driving the surge is the broad-based Strategic Defense Initiative (SDI) research effort. Battle management and command and control are critical to the feasibility of SDI. As ESD works on these problems in support of SDI, it will concurrently advance the general state of the art in military electronics.

"SDI pushes battle management as far as you can push it—in processing, in computers, displays, fusing of data, artificial intelligence, and more," says Lt. Gen. Melvin F. Chubb, Jr., ESD Commander. He predicts sweeping gains in tactical applications, for example, from "all the spinoff that SDI is going to give us in battle management."

ESD and its advanced research arm, the Rome Air Development Center (RADC), have been pioneers in such technologies as artificial intelligence, battlefield data fusion, and distributed command and control. Much of this work is still in the test-bed or laboratory demonstration stage, but its incorporation into opera-

This BMEWS radar at Thule will be operational in 1986. It is part of a major upgrade of the early warning network.

tional systems is no longer the distant goal it once was. Col. Carl G. O'Berry, RADC Commander, says that the next few years will see demonstrations of battle management capabilities that are "absolutely amazing."

The Department of Defense Software Engineering Institute—the first new federal contract research center to be set up in decades—has just been established at Carnegie-Mellon University in Pittsburgh. ESD will act as executive agent to oversee its functioning. This is a major step toward addressing the chronic software problems in military R&D. Meanwhile, the day is approaching fast when machines will take over much of the software-writing burden—and do it better than humans do it now.

Thus, ESD is engaged simultaneously in seedtime and in harvest, and the outlook is for a bumper crop in both fields.

Battle Management Initiatives

There is, of course, some overlap between seedtime and harvest, since force modernization is often a matter of modifying current systems rather than building all-new ones. The E-3 AWACS, which has been retrofitted with one improvement after another, is an example of this. In fact, General Chubb says, ESD thinks that an evolutionary, building-block approach is best for C^3I systems, which have always been tough to define completely at the beginning of an acquisition.

And since the basic tasks of battle management are much the same, regardless of level of conflict, some technologies now in early development could find a variety of operational applications, perhaps a lot sooner than someday.

The Optical Disk Jukebox, developed by RADC, is a prototype for packing vast amounts of data into a compact space and retrieving it quickly. This device stores ten trillion bits of data on 128 disks, and any bit in the box can be called up in less than six seconds. The throughput rate is fifty million bits per second. Within the next five years, RADC hopes to shrink the Jukebox to about 150 pounds without loss of capability. That would allow it to be deployed on aircraft. RADC has just taken delivery of the second Jukebox, its first one having been yielded up to NASA, which had pressing operational need for it.

Both RADC and ESD's development planners at Hanscom are working on the growing problem of difficult-to-detect targets. The expectation is that low observables, or Stealth-like features, will be a characteristic of many airborne platforms of the future.

One of RADC's leading efforts in this regard is the Advanced Airborne Surveillance Radar (AASR) program leading toward design and development of "a conformal array active radar with emphasis on detection and track of low-observable targets in a severe jamming environment."

The Atmospheric Surveillance Technology (AST) program was begun about six months ago by ESD Development Plans. It is to demonstrate technologies and build an architecture for detecting air-breathing craft, with emphasis on "detection and tracking of low-signature targets, to include air-launched and sea-launched cruise missiles." AST could have ground-based, airborne, or spaceborne applications.

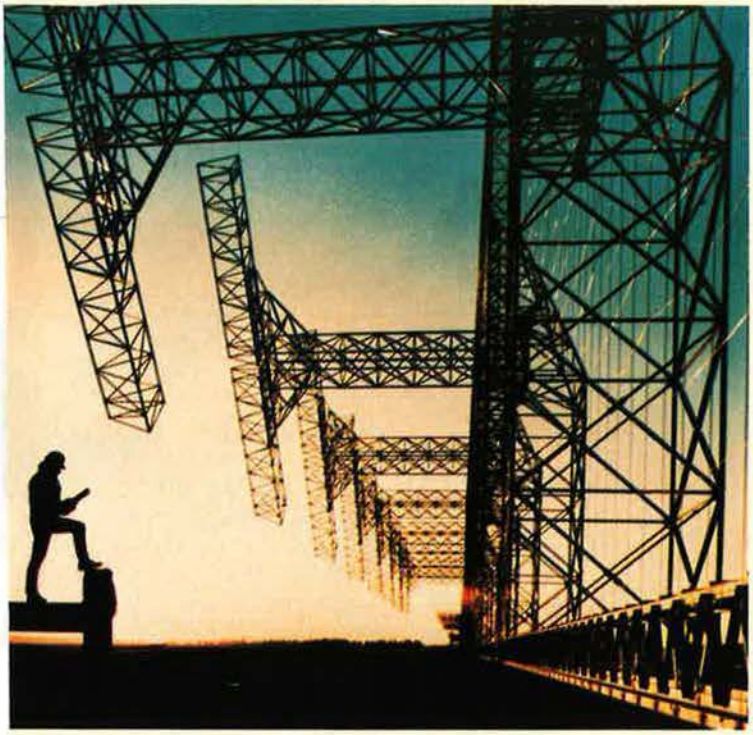
In the view of Gary Grann, technical director for Development Plans, the thrust in surveillance of low-observable targets will be toward combining and fusing inputs from multiple sources, including radar and other traditional technologies, rather than reliance on some single exotic sensor.

Until now, it has not been technically possible to exploit sensor information fully. As an example of what is feasible, however, Mr. Grann points to the "Analyst" test-bed being demonstrated by MITRE Washington. "Some of the preliminary work indicates that with as low as twenty percent of the battlefield observables, you can very clearly determine what units are there, their disposition, and so on. This is not using way-out sensors. This is with sensors and observables we're going to have with the systems we're developing now."

Another promising area of inquiry is finding new options for beyond-line-of-sight communications. Today, military C^3 is extremely dependent on satellites for such networks. Satellites are expensive and limited in the volume they can support. In addition, backup channels are desirable because satellites have vulnerability problems. Two interesting schemes are under investigation.

The Meteor Burst Communications program looks at bouncing signals off meteor trails rather than off the ionosphere. There are ample meteor trails at any time high in the atmosphere, and other federal agencies have been using meteor burst for some time for such functions as monitoring snowfall accumulations. It is only recently, though, that advances in data rates, signal processing, and other technology made this approach suitable for military application. A big question to be answered is how a nuclear-disturbed environment would

The TRC-170 sends more accurate messages over longer distances than do current battlefield radios. (USAF photo by Larry Rocco)



This OTH-B transmit antenna is 3,560 feet long and bounces its signals off the ionosphere. The system detects and tracks aircraft at ranges up to 1,800 miles.

affect meteor burst communications. Disturbance of the ionosphere, should a nuclear exchange begin, is one of the several endurance problems afflicting existing strategic communications.

ESD is also reevaluating high frequency (HF) communications, once scorned by the military as unreliable and difficult to use. Now it appears that many of HF's shortcomings can be resolved by new technologies in networking, signal processing, and adapting to changing path qualities. ESD is currently examining major command requirements for beyond-line-of-sight communications, with the idea that HF can satisfy some of them.

Strategic Programs

About half of ESD's acquisition budget is spent on strategic C^3 programs—the development of systems to provide warning and attack assessment and communications that will continue to function under nuclear assault. To preserve the deterrent value of US strategic forces, General Chubb says, it is essential "to make sure the Soviets know we have that survivability of command and control so they don't feel they might be able to disrupt it."

The lead strategic C^3 program is, of course, Milstar, the Military Strategic and Tactical satellite communications system. It will furnish secure, jam-resistant communications in both voice and data formats and can be employed at any level of conflict. ESD's piece of the action is to acquire all airborne terminals and some selected ground terminals for Milstar. Selection of a dual-source contractor team for full-scale development should have taken place by the time this appears in print. Anthony D. Salvucci, ESD's deputy assistant commander for strategic systems, says the first flightworthy prototype terminals will be ready in late 1987 or early 1988.

Survivable communications will be ensured by the Strategic Air Command Digital Network (SACDIN) and the Ground Wave Emergency Network (GWEN). SACDIN, already in production, is a secure teletype system to transmit printed messages. It replaces obsolete equipment now in use. GWEN, on the other hand, is intended to provide very secure, EMP-hardened communications through a proliferation of radio tower relays. It will carry low data-rate messages over low-frequency ground waves. The full-up system will have hundreds of nodes and numerous alternate transmission paths, so any enemy would have to take out a substantial number of towers to put GWEN off the air. An interim GWEN capability, termed Thin Line Connectivity, will be completed in 1986.

Initial contracts have been let for WIS, the Worldwide Military Command and Control System Information System. This program will replace computers and core software for WWMCCS, which is a confederation of data and communications links designated for use by the National Command Authorities in wartime. WIS will employ Ada, the standard Defense Department programming language.

ESD is replacing, almost totally, the network of radars that warns against attack by ballistic missiles, submarine-launched missiles, and bombers.

The new BMEWS radar at Thule, Greenland, is undergoing development test and evaluation and is scheduled to be operational in 1986. Work will begin soon after on a new radar for the Fylingdales BMEWS site in the United Kingdom. Phased-array systems will replace outmoded conventional radars at both locations. The Fylingdales radar will have three faces, which allows 360-degree scanning, while the Thule system will be dual-faced.

Two new Pave Paws installations are under construction. The one at Robins AFB, Ga., will be finished in November 1986 and the other, at Goodfellow AFB, Tex., in May 1987. Testing of the radars will begin subsequently. Pave Paws is designed primarily to detect sea-launched missiles, but has a number of collateral missions. The two operational Pave Paws radars on Cape Cod and in California are being upgraded to provide coverage at greater ranges and against smaller targets. The upgrade features are built into the two new radars.

The first of four Over-the-Horizon Backscatter (OTH-B) radars for long-range aircraft warning will be completed in Maine in 1987. OTH-B, which uses very long linear arrays and beams its signals off the ionosphere, will eventually be placed at four sites covering all transoceanic approaches to North America.

On watch for aircraft making a polar approach will be the North Warning System, which will replace the radars of the current Distant Early Warning (DEW) Line with thirty-nine unattended and thirteen minimally attended radars. The unattended radars will be designed to operate on their own for six weeks or so, which means

a considerable savings in personnel costs—and also less cold-weather wear and tear on personnel.

The feasibility of radars that operate with limited human service will be demonstrated by ESD's Seek Igloo program, which updates Alaskan Air Command radars. That program is now approaching completion, and ESD expects the minimally attended radars to demonstrate a better mean time between failure rate than called for in system specifications.

The North Warning System and OTH-B are major elements in the US-Canadian agreement to modernize the North American air defense system. Canada is paying for forty percent of the North Warning System, and, while the US will fund the entire OTH-B, Canada will contribute to manning of the sites.

Up the AWACS Alphabet

The E-3 Airborne Warning and Control System (AWACS), operational since 1977, is nearing the end of its production run. The E-3 development program, however, is shifting into higher gear as ESD prepares to upgrade this supremely successful system to handle the smaller targets and intensified countermeasures it must contend with in the future.

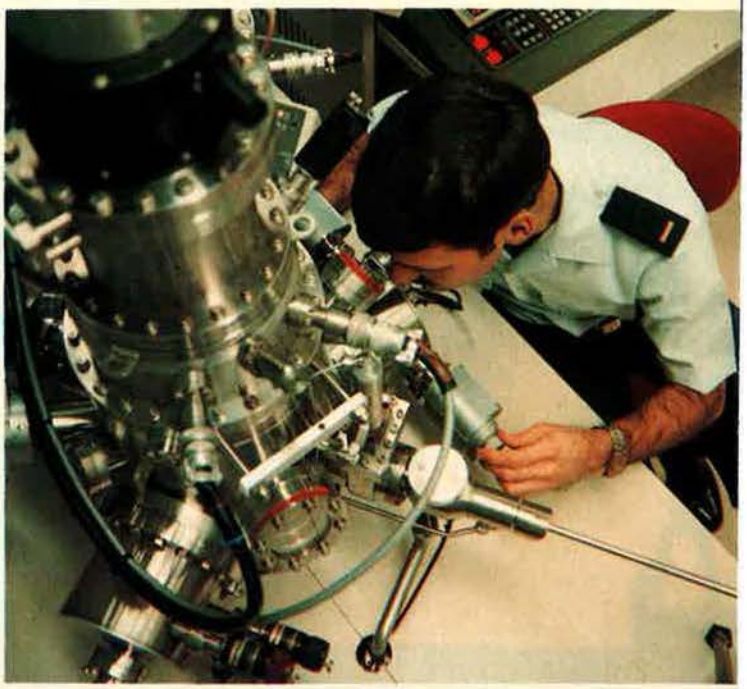
ESD has proposed a $425 million Multistage Improvement Program (MSIP) for the E-3 over the next five years. It seems likely that much of this will be approved because AWACS has repeatedly proved its value and now enjoys a good reputation with national policymakers.

"The AWACS still has a lot left in front of it," says Brig. Gen. Charles P. Cabell, Jr., ESD's deputy for airborne warning and control systems. "The threat has changed. We see a trend in decreasing radar cross sections that would make it more difficult for our radar to pick up fighters and cruise missiles. We face more jamming today than we did in 1977. We expect to find more jamming in the 1990s than we do today. The Russians recognize the value of the E-3 and the need to defeat it."

The E-3A has been upgraded several times already and is about to evolve into B and C models, even before the MSIP. A review of the E-3 inventory and production history helps in understanding the new system alphabet.

The US has thirty-four aircraft. The last one was delivered in 1984, and that procurement is now complete. The eighteenth and final NATO E-3 rolled off the line this spring. The remaining production will be aircraft for Saudi Arabia. The last ten US aircraft and all of the foreign aircraft were or will be built with improved radars and computers. The foreign aircraft, however, do not have several features incorporated into the last ten US aircraft.

- **E-3A.** This was the original designation of all the AWACS aircraft and will continue to be the configuration of the NATO and Saudi systems. This version has fewer crew stations and radios than do the B and C models.
- **E-3B.** This will be the upgrade of the first twenty-four US aircraft to near the level of the final ten. The modifications will include five more crew stations, additional radios, color display screens (easier to work with than the original green and amber displays), and improved computers. The original APY-1 radar, however, remains.



An Auger spectrometer is used to analyze integrated circuits. (USAF photo by Larry Rocco)

- **E-3C.** This is the new designation of the final ten US aircraft, identical to the E-3B except for an improved APY-2 radar.

All US and NATO E-3s will have the Joint Tactical Information Distribution System (JTIDS) for antijam communications. And with the new computers, General Cabell says, "we can track three times the number of targets we could before."

The MSIP, according to General Cabell, will enable the E-3 to deliver, well into the 1990s, the capability it is noted for. More antijam communications features will be added. The radar will have "greater detectability," and there will be passive sensors, too. Other modifications will make the aircraft even more reliable and maintainable than it already is, and it will be able to remain longer on station.

Tactical Systems

The Joint Surveillance and Target Attack Radar System (JSTARS) is ESD's top tactical program. There are two reasons for its high priority. One is the capability of the system itself, which will provide big-picture radar coverage of the ground war in the same way the E-3 AWACS does for the air war. The other reason is that JSTARS is the most visible symbol of the highly touted pledge of the Army and the Air Force to cooperate in true joint fashion in their prosecution of the "AirLand" battle. Should JSTARS falter, it is widely perceived that the AirLand concept would go down with it.

A year ago, it appeared that JSTARS might become the unintended casualty of a roundhouse family brawl among the services, Congress, and purple-suiters in OSD about how the program should be defined. Since then, the services have agreed on a modified Boeing 707 with the military designation C-18 as the JSTARS platform. That was the Air Force's choice all along. An idea

for separate radars to meet the differing needs of the two services has been dropped, too. A single multimode radar will serve both.

Standing off from the Forward Line of Troops (FLOT), the C-18 will use its radar to scan deep (basically the Air Force's requirement) and at closer ranges (the Army's main area of interest) for wheeled and tracked vehicles. The Air Force will convert radar returns into C^3I information aboard the aircraft. The Army, with the divergent needs of a great number of users to satisfy—all the way down to fire unit level—will beam raw and processed data to ground stations for conversion and dissemination. Both services, however, will have scope operators aboard the aircraft.

Air Force Col. Harry I. Gillogly, JSTARS program director, and his Army deputy, Col. G. Sidney Smith, agree that they now have "a prime example of a joint program that's working."

"Most of our systems are great at intelligence-gathering, but they're not on-the-spot target attack systems, which is what you get with JSTARS," General Chubb says. "As soon as this starts flying, people will know it's the greatest machine we've put out in years."

It has been a good year all around at ESD for joint tactical systems. TRC-170 troposcatter radios, developed as part of the Joint Tactical Communications (TRI-TAC) program, are now being delivered. This new battlefield radio has sixty channels (vs. twenty-four on older sets) and transmits reliably up to 150 miles (as compared to eighty miles for existing models). The first units off the line, according to Col. Charles E. Franklin, ESD deputy for tactical systems, were rushed to Europe to connect ground-launched cruise missile sites with the Defense Communications System.

This model serves to acquaint MITRE and military personnel with the Seek Igloo radar. (Photo by Walter Bibikow)

Midget in The Marketplace

The 1985 production base analysis of the electronics industry tells a disturbing tale.

The Defense Department has become a midget in the electronic marketplace that, ironically, it was so instrumental in nurturing to maturity and on which it is increasingly dependent.

Military sales today account for only seven percent of the US semiconductor market, and that share will decline to three percent by 1995. The industry is geared for low-cost consumer gadgets that it can mass-produce, and it is less and less responsive to the needs of the armed forces for specialized or tailored devices. As for surge production in a crisis, the possibility does not exist.

These are some of the observations that will be reported in "Pursuit 2000," the Air Force's 1985 production base analysis. Recommendations based on the study are now being prepared, and the final report will be published in September. Situation data already in, though, tells much of the story.

More than one-third of the Air Force procurement budget is spent on electronics, but prime system contractors pass along most of the electronic component work to subcontractors and vendors. In many cases, these sub-tier suppliers know little and care less about the defense business.

Consumer electronics sales are booming, and suppliers of consumer electronics design their products around industry standards rather than asking industry to conform to particular requirements—such as hardness against radiation, to cite one typical military specification. And whereas military users tend to request such features as ceramic packaging because their products will be in use for a long time, the toy industry is easier to satisfy. Its electronic wonders will have a shorter life.

Even the pace of technology is a problem. Military systems take years and years to develop and field. Consumer electronics may go through two or more generations of what's current in that period. The components designed into the military system may no longer be available. The choices are either to buy a lifetime supply at the beginning or to go back for small runs of custom production—thereby creating another "horror story" for the headlines about overpriced spare parts.

The increasing diversity of the electronics industry is making much of it unfamiliar territory for defense planners. Companies with alphabet-soup names are popping up all over, and Electronic Systems Division officials sometimes find themselves looking in source selection at company names they've never heard before.

"It's difficult to get your hands around and influence," says Robert B. Doane, ESD's senior technical director. "The government's business to any one of these companies is not a big driver in its total business base."

There seems to be no chance that the Defense Department will recapture its dominance of the electronics market, but it must do something to ameliorate the relentless trend. Most likely, it will search for new incentives to dangle before electronics suppliers. And it may have to become more involved with subassembly producers—something for which neither the Pentagon nor the small vendors have shown much enthusiasm in the past.

—J.T.C.

The TRC-170 bounces its signal off the troposphere. Thus operating without line-of-sight limitations, it enables battlefield forces to maintain communications, even when separated by unfavorable terrain or hostile troops.

The production line is also going for the Joint Tactical Information Distribution System (JTIDS), currently the best secure antijam data link there is. The plan is to field JTIDS with all four services by 1989. Enhanced JTIDS, now in full-scale development, will add substantial voice capability. The tactical air forces rank Enhanced JTIDS as their number-four priority among all requirements for new systems.

Have Quick II, a follow-on to the jam-resistant radio developed (as the name implies) on a hurry-up basis for tactical air forces, is coming along well. It will have greater jam resistance than the original Have Quick and other improvements, too.

An ultralow sidelobe antenna for the TPS-43 tactical radar is in production. This improvement concentrates the radar beam, reducing the antenna's "cross section" at the point of emission and making it more difficult for the enemy to pinpoint its location. The TPS-43 is a transportable system, used to detect both friendly and hostile aircraft at ranges up to 260 miles.

Production begins next year on Modular Control Equipment (MCE) replacements for the old 407L "Rubber Duck" Tactical Air Control System, increasing significantly the work load the facilities can handle. An even more capable facility—which will be substantially interoperable with MCE—is forthcoming in the Ground Attack Control Center (GACC) now in development. In these cubical structures, which can be towed about the battle area, ESD sees a ripe opportunity to distribute some of the working-level command and control function.

The idea of distributed C^2 is not new, the E-3 AWACS being one illustration of the concept in everyday use. The possibilities have hardly been exhausted, though. The problem with centralized C^2 assets is their vulnerability, which is growing all the time.

"If we're going to continue to operate with large, concentrated command centers, we have two options," says Development Planner Gary Grann. "You can remote them out of the immediate battle area, back to a sanctuary, or else you can harden them and bury them." Where possible, a better solution is to disperse the functions and to build in considerable redundancy among the nodes so that the loss of any single one is not incapacitating.

Ongoing demonstrations and experiments with the RADC Battle Management Laboratory are proving the applicability of distributed communications for both strategic and tactical users. The Battle Management Lab employs a combination of fixed and mobile nodes connected by a packet switch network. It is providing valuable proof of how well airborne relays can reconstitute communications links that have been lost or jammed.

AI and Software

"The most demanding and immediate problem in battle management is the inundation of the decision-maker with information from multiple sensors that are growing in capability, accuracy, and speed," says RADC's Colonel O'Berry. "He can find himself up to the eyebrows in bits and bytes of data in a matter of seconds in a crisis situation."

Over the years, ESD has labored with numerous initiatives for battle data fusion—the ability to combine and arrange information from various sensors rapidly in a way that decision-makers can use it. The results have been limited for several reasons, including the inherent difficulty of combining very precise data with information that is ambiguous or sketchy.

"It's tough, but we're gaining on it," says General Chubb. "The first couple of times we tried to do it, the job was so massive that we couldn't get there without levels of effort and dollars that couldn't be afforded. But now we've got machines that are a lot faster. We can write software more efficiently. We've got a lot more data available in better form."

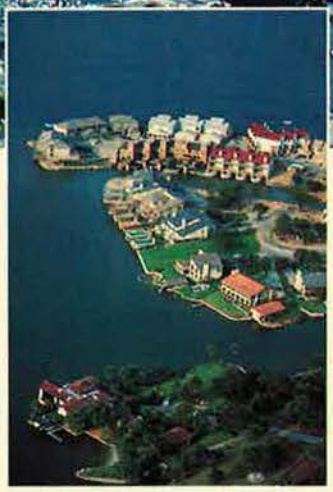
In the future, machines will do more of the number-crunching combining of sensor information and the sorting of it into a more refined form. Sheer computational capability is not much of a problem. The question is how well the logic of the operation can be captured in a computer. This is the area where artificial intelligence, the technology by which machines emulate some human decision-making processes, offers such promise. A classic problem in automating battle management functions has been that operations people don't understand software, and software people don't understand operations.

RADC is at work on improving man-machine interfaces, with one objective being to enable operations people in the field to interact directly with the software-writing computer. Laboratory demonstrations have shown that people using near-normal language can communicate effectively with machines about the simpler battle management tasks.

A high-payoff application, Colonel O'Berry says, is to cut "the twenty-four-hour frag cycle the operators are typically stuck with. We think we've got a way to shrink that down to minutes." The machine would perform

General Chubb says the JSTARS target attack system will be impressive.

Oh! Those Texas Hills . . .



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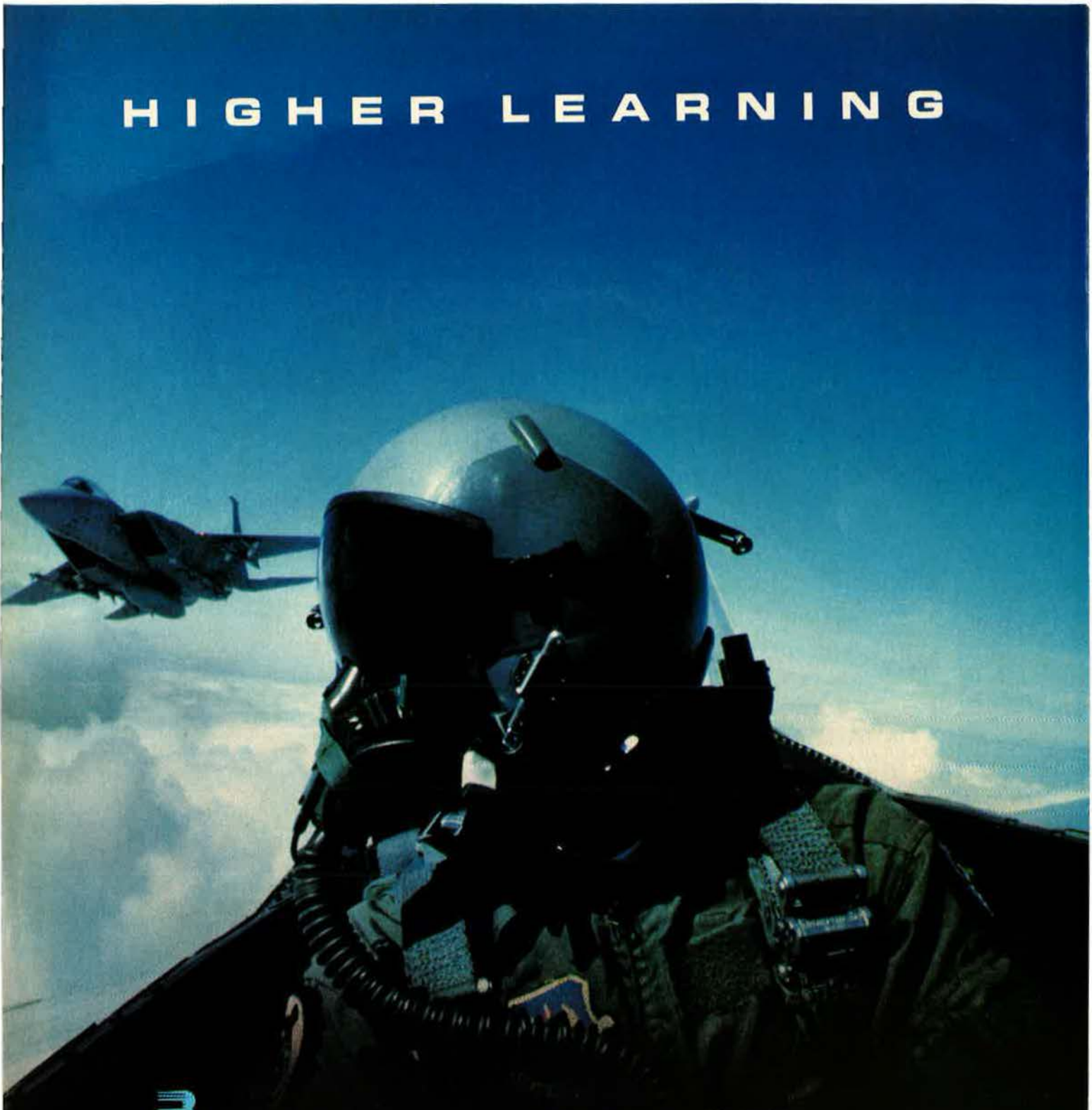

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A Rome engineer checks adaptive mirrors for space-based electro-optical surveillance programs. (USAF photo by Larry Rocco)

nearly all of the sifting of data—listing of candidate targets, checking for availability of munitions and sorties, identifying refueling needs, and so on—that must be done before the real planning for the air-tasking order can begin.

To advance the general state of the art in artificial intelligence, RADC has formed, in the past year, an AI consortium with neighboring universities. This gives the ESD community two new partner organizations in academia to help with chronic concerns about implementing AI technology. The charter for the Software Engineering Institute says, in part, that "a significant amount of new software technology exists and continues to emerge at a rapid rate from the research and development community, offering the potential to relieve the current software crisis. Unfortunately, very little of this technology is used in practice."

Robert B. Doane, ESD senior technical director, says the most important job of the Software Institute is "to ensure that this forefront, state-of-the-art technology is transitioned into the services and into the industries that build our systems. By reverse process, knowledge of the difficulties that these organizations have with software will get back into the Institute."

DoD wanted its newest federal contract research center to establish a connection with the educational world, and Carnegie-Mellon is rated highly in the fields of software and computer sciences. The Institute will conduct some fundamental research and, as its resources permit, provide some direct support in critical programs. The contract creating the Institute was let in November. Mr. Doane says that this is the first ever federal contract research center formed on a competitive-bid basis.

Airlift and Intelligence Systems

ESD is addressing with some urgency a number of command and control projects for the Military Airlift Command. "In wartime scenarios, it's assumed that forty-eight hours after the trouble starts, C-5s are going to land and begin delivering support," says Thomas P. O'Mahony, ESD deputy for intelligence, C^2CM, and support systems. Yet, he adds, MAC has not been provided the command and control tools it needs in a crisis to coordinate its operations smoothly.

Mr. O'Mahony (who, incidentally, is the only civilian deputy commander in AFSC) admits to a special interest in MAC. His son is a security policeman in MAC's special operations forces.

An automated information processing network, which will link all echelons of MAC to each other and, eventually, to the WWMCCS Information System, will be delivered in FY '88. The request for proposals to build it goes out to contractors next February. A program to give 300 UHF terminals to MAC to connect airborne and ground users by means of SATCOM is in development. And later this year, ESD will award the full-scale development contract for new radios for MAC.

Air traffic control is one of the deputate's oldest missions. In 1989, it will field a mobile survivability package that can put an airfield back in business after an attack has taken out its regular facilities. The package consists of a "restoral" control tower, a secondary surveillance radar, a power supply, and vehicles to move it all around.

Also in the works are two new formidable air traffic control radar projects. The candy-striped GPN-22 is being updated for two critical airports in Berlin. The MPN-XX is a replacement for the aging and oversized radars now available for tactical deployment. The current MPN-14, for example, is so huge that a C-5 is required to deliver it—and there are many places where a C-5 can't go. The MPN-XX can be deployed by C-130.

A good deal of ESD's work on intelligence and electronic countermeasures systems is classified, but general information on several high-interest programs can be discussed.

The Cobra Judy X-Band, which adds a surveillance dish with better resolution to track single objects, is almost complete. The basic Cobra Judy system is a phased-array radar that monitors Soviet ballistic missile tests from aboard a seagoing ship, and it has been doing a fine job of it. "Cobra Judy is collecting even more data than we had contracted for," says Mr. O'Mahony, who was program director for that system before assuming his present responsibilities. Among its other benefits, Cobra Judy data will assist the SDI effort in developing effective ballistic missile defenses.

The Space Operations Intelligence Center to be acquired for the North American air defense complex at Cheyenne Mountain in Colorado will be designed to fuse data from several sources and produce a meaningful order of battle for space. The result will be far more than a cataloging service, though. "We need to be able to perform damage assessment and answer questions about what has happened in space," says Mr. O'Mahony. "It's a big undertaking, but it can be done." This work is in conceptual development.

At an AFA symposium last year, Martin F. Chen, then the Air Force's principal deputy assistant secretary for research, development, and logistics, surveyed conceptual and technological advances in electronics and looked ahead to a "golden age" in C^3I.

Judging from what's happening at ESD right now, that golden age may have already begun. ■

What's Happening in Electronics at ESD

A CHECKLIST OF MAJOR ELECTRONICS PROJECTS

(As of April 1, 1985)

NAME AND MISSION	STATUS	CONTRACTOR
Deputy for Acquisition Logistics and Technical Operations (AL)		
Computer Resource Management Technology The goal of this program is to develop and transfer into active use the technology, tools, and techniques needed to cope with the explosive growth in Air Force systems using computer resources. Toward this end, this program provides for the transition of computer systems development in laboratories, industry, and academia to active Air Force systems; develops and applies software acquisition techniques to reduce life-cycle costs; provides improved software design tools; serves as the research and development area of the Air Force for computer security; and develops an information network that links existing and planned logistics engineering systems into an integrated Logistics Information Management Support System (LIMSS) architecture. In addition, this program has been designated by the Under Secretary of Defense for Research and Engineering (USDRE) Office as a special-interest program to provide Ada computer program development.	Engineering Development	University of Texas; DIGICOMP; Massachusetts Computer Ass'n; Computer Corp. of America; General Dynamics; Denver Research Institute; Input-Output Computer Services
DoD Software Engineering Institute The objective of the Software Engineering Institute is to provide the technology and means to improve the quality of software in DoD mission-critical systems. The Institute will reduce state-of-the-art software engineering technology to practical methods and will encourage the use of modern techniques and methods throughout the mission-critical computer systems community.	Ongoing	Carnegie-Mellon Institute
GET PRICE A program to reduce the production cost of Air Force electronic command control and communications systems by encouraging contractor capital investment in modern technology. Increased productivity and improved product quality are key objectives. Contractor direct and indirect manufacturing areas are analyzed; specific, required manufacturing technologies are demonstrated; and capital investment incentives for new technology acquisition are negotiated.	Continuing	Hazeltine; Rockwell Collins; Singer Kearfott; Westinghouse Electric Co., Defense & Electronic Systems Center; General Electric Co., Electronic Systems Div.
Pursuit 2000 (Electronics Sector Analysis) A continuing analysis project intended to identify projected needs for Air Force actions regarding the electronics sector of the US industrial base. The Electronic Systems Division is pursuing this effort under assigned responsibilities as the AFSC electronics sector manager. The full project title is "Pursuit 2000: Electronics—The Key to Deterrence."	Continuing	DHR, Inc.
Deputy Commander for International Programs (FA)		
Royal Saudi Air Force Alternate Command Operations Center (ACOC) Acquisition of a Royal Saudi Air Force Alternate Command Operations Center. The Center will use commercially available equipment and software.	Installation and Checkout	Hughes Aircraft Co.
Royal Saudi Air Force C^3 System Acquisition of a ground command control and communications system for the Royal Saudi Air Force. The system includes equipment, facilities, and support elements to interface existing tactical radars, the Saudi E-3A AWACS, and elements of other Saudi military organizations.	Acquisition	Boeing; General Electric
Royal Thai Air Defense System (RTADS) Automation and upgrading of the existing Royal Thai Air Force (RTAF) Air Defense System and upgrading and expansion of its supporting long-haul communications network.	Acquisition	None
Somali Command Control and Communications Programs (PEACE CUBE) Activation of the Somali Ministry of Defense Command and Control (C^2) Center and installation of large-screen displays as well as local and long-haul communications subsystems.	Acquisition	None
Sudan Air Defense System Repair or replacement of air defense radars, communications equipment, and support equipment.	Acquisition	EG&G
Deputy Commander for Intelligence, Countermeasures, and Support Systems (OC)		
Air Force Geophysics Laboratory Local Area Network (AFGL LAN) Procurement and installation of a LAN at AFGL will interconnect all AFGL computer resources. The AFGL LAN effort also includes the development of a Management Information System (MIS) to provide AFGL managers and scientific and technical staff with automated tools and capabilities to perform their work better.	Acquisition	None
Air Force SAFE Program Procurement and deployment of DoD BISS program-developed and commercially available physical security equipment to approximately seventy USAF bases and 210 sites worldwide. These systems will protect such mission-critical/high-value resources as stored weapons, strategic/tactical alert aircraft, open- and closed-sheltered alert aircraft, special mission aircraft located on parking areas, specified command posts, and other specifically identified strategic resources.	Procurement/Deployment	RACON
Air Traffic Control (ATC) Survivability The ATC program includes quick restoral equipment for control towers, survivability radar, and an ECCM capability to ASR radars to improve AFCC's ability to continue air traffic control services at USAF combat operating bases during a conventional war.	Predevelopment	None
Automated Weather Distribution System (AWDS) AWDS will enhance Air Weather Service's meteorological support for the Army and the Air Force. The system will reduce labor-intensive tasks by using advanced computer technology, color graphic displays, and sophisticated meteorological and graphic presentation software. A total of 165 automated Base Weather Stations worldwide and twenty transportable versions will interface with two communications networks for distribution of global alphanumeric and graphic meteorological data.	Development	MacDonald Dettwiler and Associates Ltd.

NAME AND MISSION	STATUS	CONTRACTOR
C^3 Countermeasures Support Data Base A C^3CM Support Data Base under construction to support Compass Call. The data base will also be used for studies and simulation. It will be made generally available to DoD users involved with electronic combat.	Continuing	PRC; ISN Corp.; BETAC Corp.
COBRA JUDY X-Band COBRA JUDY is a USAF shipborne phased-array radar system to collect data on foreign strategic ballistic missile tests. This modification will extend the capabilities of the basic system to allow it to gather and provide data vital to the development of other systems.	Production	Raytheon Co.
COMFY FOX A mobile, self-contained signal security assessment capability system that will collect and analyze friendly signals, determine vulnerability, and report the results for correction.	Concept Definition	None
COMFY SWORD A ground-based jamming and deception system for training friendly aircrews to operate in a hostile electronic environment.	Production	Flight Systems, Inc.
Digital BRITE (D-BRITE) The D-BRITE program will replace existing Air Force BRITE II display systems with new, more reliable equipment that can display alphanumeric beacon data, including Mode C altitude information.	Acquisition	None
DoD Base and Installation Security Systems (BISS) An evolutionary RDT&E program to provide a DoD-standard, electronic exterior physical security system for protecting DoD resources worldwide. The system's components include detection, assessment, 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 equipment (USAF developed/commercially available) that must be tailored to the unique physical characteristics of the location and to the threat.	Development	Teledyne; ASEC; Canadian Commercial Corp.; TERA Advanced Services; Sygnetron Protection Systems
Executive Information System (EIS) The system is a series of efforts to connect existing and planned automation management information systems into an integrated structure. The commander and his staff will have access to integrated programmatic, functional, and organizational information for key programs and other critical management information.	Operational	Booz-Allen & Hamilton
Hanscom Air Force Base Local Area Network (HANS LAN) Development and installation of a base-wide LAN at Hanscom AFB will provide interconnection of all base processors and an electronic gateway to other base tenants, such as the Air Force Geophysics Laboratory. Concurrent effort will be to integrate existing ESD management information functions onto the LAN.	Development and Acquistion	None
HQ Air Force Local Area Network (LAN) The HQ Air Force LAN program will provide a local area network to allow reliable, efficient, unclassified data, voice, and video communications between Air Staff offices in the Pentagon and at Bolling AFB, D. C. The program will also provide the computer that supports them.	Production/Implementation	Clarence B. McCullough; Booz-Allen & Hamilton
Intelligence Analysis Center (IAC) Automated assistance to the Marine Air/Ground Task Force Intelligence organizations to store data, correlate information with a master file, perform analyses on collected information, and prepare and disseminate intelligence reports to appropriate organizations. The IAC segment is to be contained in standard 8' × 8' × 20' mobile shelters capable of worldwide deployment.	Production	ADCOR
Intelligence Work Station (IWS) Intelligence Work Station (IWS) is a joint ESD/RADC project designed to replace the present standard intelligence terminal, the OJ-389. The modular, upgradable, stand-alone IWS will perform message handling, data base update, and mapping for intelligence users worldwide.	Definition	None
Local On-Line Network System (LONS) The objective of LONS is to provide a system for AFSC product divisions, laboratories, and SOAs to communicate command-directed information over the DDN by using standardized office automation hardware, software, and base communications facilities.	Development/Acquisition	None
Logistics C^3I System Capstone of the Logistics Force Structure Management System, this system will develop an architecture and provide an improved operational capability to support logistics command and control activities in both peacetime and wartime. Scope includes Hq. AFLC, each Air Logistics Center (ALC), the Aerospace Guidance and Metrology Center (AGMC), and the Military Aircraft Storage and Disposition Center (MASDC).	Conceptual	Booz-Allen & Hamilton
Logistics Information Management Support System (LIMSS) This program will provide a logistics command control and communications system to network logistics information at all required logistics levels.	Validation	None
MAC C^2 Upgrade Four of the more than fifteen programs to upgrade the MAC C^2 system are being prosecuted at ESD. The elements to be acquired are MAC UHF SATCOM Terminals (MUST), Tactical Data Stations (TDS) for digital data entry and receipt, Automated Communications Processors (ACP) to modernize HF frequency selection and communications, and the Information Processing System (IPS), which consists of hardware and software to automate airlift planning, execution, and control. These elements will significantly improve MAC's command and control of aircraft in peace and wartime.	Development and Acquisition	None
Manual Radar Reconnaissance Exploitation Systems (MARRES) Exploitation element of the AN/UPD-8 Side-Looking Airborne Radar System, MARRES uses equipment similar to the Imagery Interpretation System to provide automated aids that help the radar imagery interpreter perform target identification and location.	Production/Deployment	Texas Instruments
Microwave Landing System (MLS) Four-part program to supplement and eventually replace current Instrument Landing Systems (ILS) and Precision Approach Radars (PAR). Tactical MLS will support MAC/AFCC wartime missions. ESD is to procure FAA MLSs for DoD bases in the continental US under Fixed Base MLS, develop a Bare Base/Main Operating Base MLS for NATO and PACAF bases, and obtain modified civil avionics for cargo, transport, and tanker aircraft and a militarized version for other types of aircraft.	Development	None

NAME AND MISSION	STATUS	CONTRACTOR
Military Air Traffic Control Systems (MILTRACS) MILTRACS develops and acquires Air Force ground facilities and equipment and associated avionics to provide safe, orderly, and efficient movement of aircraft throughout the world in peacetime and under wartime conditions. NAVAIDS, Air Traffic Control Radar Equipment, Precision Landing Systems, and Air Traffic Control Training Devices are among the systems being acquired, often with the other services and the FAA.	Continuing Development and Acquisition	Many
MPN-XX Radar Approach Control System The MPN-XX, to replace the AN/MPN-14, will be an improved, low-capacity, easily deployable Ground Control Approach (GCA) radar that will be resistant to electronic countermeasures (ECM), CW, antiradiation missiles (ARM), and electromagnetic pulse (EMP). It will be designed for forward-area tactical operations in a hostile environment and consist of an Airport Surveillance Radar (ASR), a Precision Approach Radar (PAR), an Operations Center (OPS), and an Expansion OPS.	Predevelopment	None
Operations System Network (OPSNET) OPSNET is a proposed multilevel secure information management system for DCS/Plans and Operations, Hq. USAF. It will consist of a network of automated systems and equipment that will link together the entire DCS and provide for easier information flow and access. The purpose of the system is to increase the productivity of and reduce the work load on action officers.	Development	Booz-Allen & Hamilton
PACER Acquire Provides for the acquisition and implementation of selected Logistics Force Structure Management Systems (LFSMS) that support AFLC. Present systems under definition and development include the AFLC Local Area Network (LAN) and the Enhanced Transportation Automated Data System (ETADS).	Validation	None
Publication Information Processing and Printing System (PIPPS) Hq. USAF-directed program to develop and implement a state-of-the-art electronic Air Force-wide system to create, publish, distribute, and maintain standard USAF publications and forms. Includes electronic data base, computer terminal access, and high-speed print on demand.	Development	Booz-Allen & Hamilton
RF-4C Replacement Receive, Process, and Exploitation (RP&E) System A tactical softcopy imagery intelligence system to support new tactical reconnaissance platforms.	Concept Definition	None
Security Police Communications System (SCOPE SHIELD) SCOPE SHIELD addresses requirements to replace radios currently used by the USAF Security Police Forces in the mission areas of Air Base Defense, Weapon System Security, and Law Enforcement. These areas utilize fixed-base station, vehicular, and hand-held radios. SCOPE SHIELD will effect their replacement through implementation of a combined state-of-the-art acquisition/preplanned product improvement approach.	Development/Production	None
SEEK SCORE This program will develop and produce a replacement radar bomb-scoring system for SAC for realistic operational aircrew training and evaluation. Current equipment is obsolete and unsupportable. The new system incorporates visual tracking as well as radar and beacon tracking for improved low-altitude capability.	Production	Sierra Research
Sentinel Aspen This program will provide a General Imagery Intelligence Training System (GIITS) to Air Training Command. This generic trainer incorporates computer-aided instruction to prepare imagery analysts for operational hardcopy and softcopy exploitation systems.	Development	Goodyear Aerospace
Sentinel Bright This program is to design, develop, and acquire a Voice Processing Training System, a Classified Training System, and an Unclassified Training System. These systems will be used to train linguists, maintenance technicians, ELINT operators, communications analysts, and other cryptologic specialists to use modern operational systems. The systems will be installed at Goodfellow AFB, Tex.	Development and Acquisition	Logicon Inc.
Shelter Management Office (SMO) This office is the USAF focal point for tactical shelters and the overall USAF manager of research and development for acquiring new and modified tactical shelters. (Program manager for acquiring shelter systems to support F-15, F-16, A-10, and F/EF-111 avionics maintenance.) It provides technical support to all Air Force major commands and program offices procuring systems that employ tactical mobile shelters.	Development and Acquisition	None
SPACENET The SPACENET program will design and deliver a command-wide office information system for Hq. Space Command. The office information system is to grow in an evolutionary manner into a management information system, and, ultimately, a decision support system.	Development	Booz-Allen & Hamilton
Unified Local Area Network Architecture (ULANA) As an initial stage, this program will develop Air Force Local Area Network (LAN) standards and apply them to LANs being developed within ESD. The program will ultimately encompass all Air Force LANs under the same standard, with eventual transition of the finished products, as well as the SPO itself, to AFCC.	Development	Booz-Allen & Hamilton
USAFE Tactical Air Intelligence System (UTAIS) The UTAIS design program initial effort will develop a design architecture plan to consolidate, combine, improve, and interoperate a number of different USAFE intelligence systems. Correlation, fusion, and dissemination of intelligence information will receive particular attention.	Definition	None
Warrior Preparation Center (WPC) A joint USAFE/USAREUR computer-based training and simulation center to provide European battle commanders with opportunities to gain experience in force employment in the European C^2 environment.	Implementation	Computer Engineering Associates
Weapons Storage and Security System (Weapons Storage Vault) RDT&E and production planning to provide dispersed, unattended, tactical nuclear weapons storage. Weapons will be collocated with tactical aircraft and stored in hardened vaults beneath the floors of closed aircraft shelters.	Development	Analytical Systems Engineering Corp.
Wing Command and Control System (WCCS) Development of a standard, automated, secure, and distributed system to support USAFE wing commanders' command and control requirements. Application software will be developed to satisfy common USAFE wing requirements for status-of-force and resource information.	Concept Definition	None

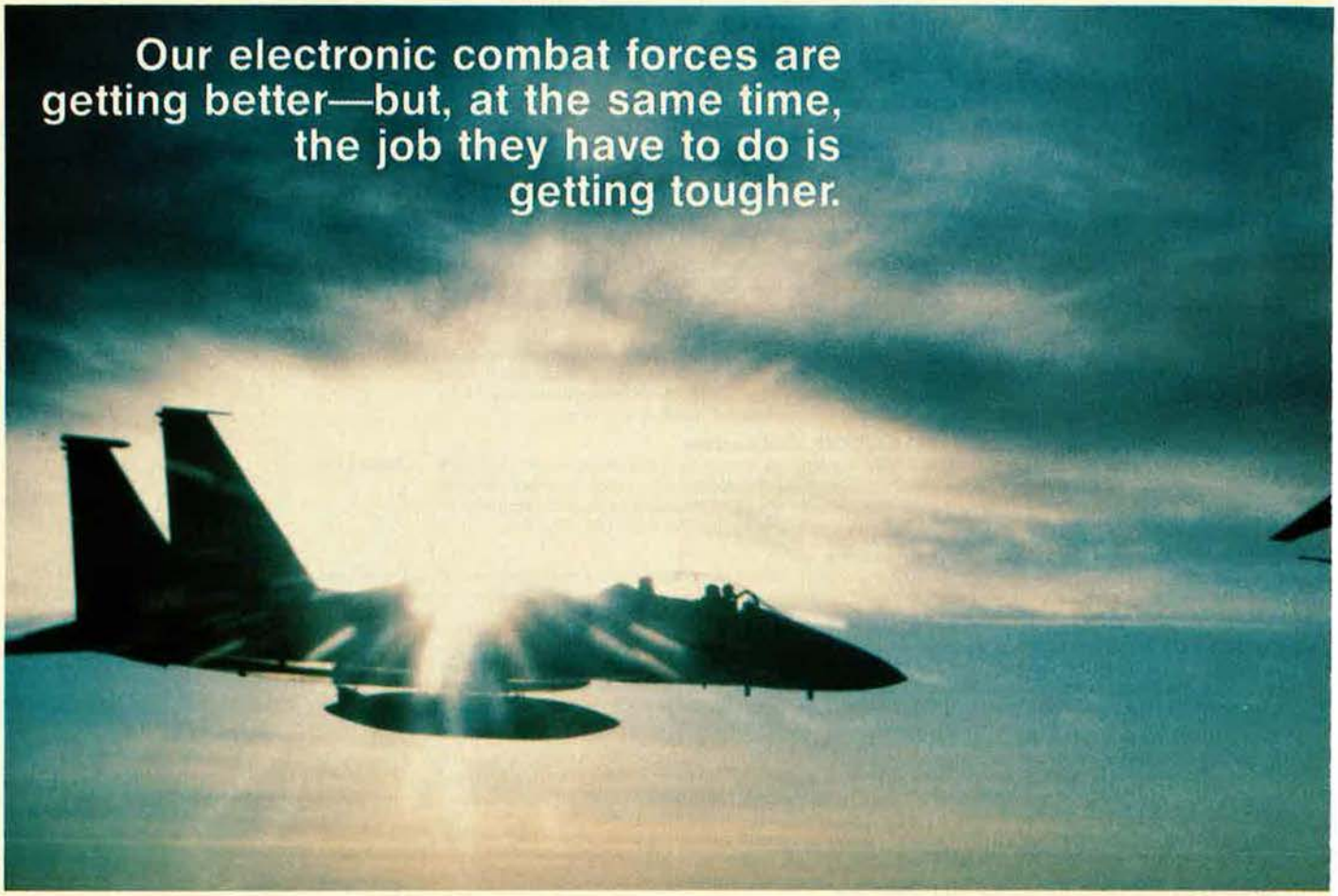
NAME AND MISSION	STATUS	CONTRACTOR
Deputy Commander for Strategic Systems (SC)		
Aircraft Alerting Communications EMP (AACE) Upgrade Program AACE Upgrade Program is to provide assured, electromagnetic pulse (EMP) hardened, end-to-end communications from the Commander in Chief of Strategic Air Command (CINCSAC) to his alert aircraft forces. It will also provide CINCSAC and the SAC Main Operating Base (MOB) Commanders with indications of an EMP event so that appropriate actions may be taken.	Full-Scale Development	None
Air Force Satellite Communications Systems Phase I, a UHF SATCOM system, is in the field serving the SIOP forces. Phase II, an enhancement of the UHF and SHF airborne/ground terminal to provide more reliable, jam-resistant, survivable satellite communications to the strategic forces, is being developed. Now in planning is Phase III, a new communications system operating at UHF and EHF with a common transmission format for maximum interoperability among all services.	Deployment, Development, Conceptual	Rockwell Collins; Linkabit Corp.
Air Force Support to MEECN Upgrades the Air Force Survivable Low Frequency Communications System (SLFCS) as part of the Minimum Essential Emergency Communications Network (MEECN). Major developments include a miniature LF/VLF receive terminal for bomber aircraft and an upgrade to the existing transmit and receive system for Airborne Command Post aircraft.	Validation, Development	Rockwell Collins; Sonicraft; ASEC
Berlin Radar System This program will modernize the Berlin Air Route Traffic Control System by consolidating Air Traffic Control Operations at Tempelhof Central Airport, replacing the current long-range radar system with a modern 3-D AN/FPS-117 radar, and automating the associated operations center.	Deployment	Sanders Associates
BMEWS Modernization Program This program will upgrade the three operational sites (Greenland, Alaska, England) operated by Space Command and the Royal Air Force. The Missile Impact Predictor is being upgraded by replacing the aging computers now in use with off-the-shelf computers and by translating software assembly language into a higher-order language. Radar improvements (Greenland and England) are planned that will meet the 1980s' threat and give the system an attack assessment capability to meet the needs of the National Command Authorities.	Acquisition	ITT, Federal Electric Corp.; Raytheon Co.
Command Center Processing and Display System Replacement (CCPDS-R) As part of the ballistic missile warning network, CCPDS-R will receive warning information from ballistic missile sensors and determine if a threat to national resources exists. This system will produce integrated warning and attack assessment displays for the Cheyenne Mountain Complex, SAC Headquarters, and other strategic military command centers.	Acquisition	Booz-Allen & Hamilton
Communications System Segment Replacement (CSSR) Improvement of the reliability, capacity, maintainability, and flexibility of the Cheyenne Mountain Complex communications processing function by replacement of the Communications System Segment (CSS) acquired through Program 427M. The CSS handles message processing, formatting, technical control, line code conversion, and routing of internal and external messages.	Full-Scale Engineering Development	GTE
CONUS Over-the-Horizon Backscatter Radar The CONUS OTH-B Radar System will provide NORAD with a capability for long-range tactical early warning and surveillance of aircraft and air-to-surface missiles approaching North America. The East Coast OTH-B radar is in development/production. OTH-B radars are also planned for the West Coast, North Central United States, and Alaska.	Full-Scale Engineering Development/Production	General Electric Co.; SRI
E-4 Airborne Command Post A survivable Airborne Command and Control System that will operate under the direction of the National Command Authorities and the Commander in Chief, Strategic Air Command, during the pre-, trans-, and postattack phases of a nuclear war. Used by OJCS/NEACP with Offutt AFB as the main operating base, the E-4B is a survivable emergency extension of NMCS and SAC ground command and control centers and provides high confidence in US ability to execute and control SIOP forces in a nuclear environment. ESD's current effort is directed toward upgrading the SHF communications to ensure aircraft compatibility with the existing and evolving Worldwide Military Command and Control System (WWMCCS).	Full-Scale Development, Production/Operational	Boeing Aircraft Co.
FAA/Air Force Radar Replacement (FARR) This program is a joint FAA and USAF effort to replace 1950s' technology, two-dimensional surveillance and height-finding radars with forty-seven modern, highly reliable, unattended three-dimensional radars. Forty-four radars will be located in CONUS, one will be used for training at the FAA Academy, and one each will be located on Guam and Hawaii. Once fully operational, the FAA will operate and maintain all sites, thus relieving TAC of extensive manpower requirements.	Conceptual/Development	None
Granite Sentry Granite Sentry is a program to acquire certain elements of the NORAD Command and Control System (NCCS) not included in other ongoing acquisition programs. Granite Sentry will replace the current NORAD Computer System (NCS) and Modular Display System (MDS) and upgrade the Command Post in the Cheyenne Mountain Complex (CMC) to increase its operational capability to meet multiple mission attack warning and defensive needs.	Conceptual	None
Ground-Based Electro-Optical Deep Space Surveillance System (GEODSS) The GEODSS system will extend Space Command's spacetrack capabilities for detecting and cataloging space objects in the 3,000–20,000-nautical-mile range. This will be a global network of five sites to detect optically, track, and identify satellites in earth orbit. Three sites are operational; two sites are being deployed.	Acquisition	TRW Inc.
Ground Wave Emergency Network (GWEN) GWEN will provide US strategic forces with the ability to maintain critical CONUS long-range command and control communications connectivity despite atmospheric disturbances present in both the trans- and postattack phases. Survivability for this system is achieved primarily by proliferated relay nodes, using unmanned, ground wave radio equipment collocated where possible with existing commercial/government broadcast towers. Strategic forces units, equipped with compatible radio equipment, will interface with nearby nodes for participation in the overall network.	Conceptual/Development	RCA; R&D Associates

NAME AND MISSION	STATUS	CONTRACTOR
MILSTAR Reliable, jam-resistant, survivable satellite communications for the three services' tactical and strategic users is being developed. A common transmission format will be employed to provide for interoperability among the services. The new system will operate at EHF. ESD is responsible for developing communications terminals for airborne platforms. As part of this development, the current AFSATCOM system is being upgraded to provide a transition for the SIOP forces from UHF to the EHF frequencies of MILSTAR.	Full-Scale Development	Raytheon Co.; Hughes Aircraft Co.
North Atlantic Defense System An automated command and control system and associated sensors in the North Atlantic. It will provide the capability to control air defense operations through a real-time command and control system. Interfaces will be provided to US and international agencies.	Conceptual	None
North Warning The North Warning program will replace the current DEW Line with a combination of long- and short-range radars for contiguous coverage from the northern slopes of Alaska across Canada and down the east coast of Labrador. Thirteen long-range radars and thirty-nine unattended gapfiller radars will be required. A new communications network will link the North Warning sensors with the Canadian and Alaskan JSS ROCCs.	Full-Scale Engineering Development	None
PAVE PAWS Primary mission of PAVE PAWS is credible warning and attack characterization of sea-launched ballistic missiles penetrating the PAVE PAWS coverage. The warning and attack characterization data include estimations of launch and impact points and times. Radars are operational at Otis ANGB, Mass., and Beale AFB, Calif. Others are planned for Robins AFB, Ga., and near Goodfellow AFB, Tex.	Operational/Full-Scale Engineering Development	Raytheon Co.
SAC Command Post Upgrade Alternatives for both near-term and long-term corrections to Hq. SAC Command Post C^3 performance deficiencies will be developed and presented to SAC. Technical analyses, system engineering, and contract interfacing to support near-term, low-cost corrections and their implementation will be provided.	Conceptual/Development	TRW Inc.
SEEK IGLOO Replacement of all thirteen Air Force long-range radar sites in Alaska with solid-state, highly reliable radars that provide range, azimuth, height, and beacon data on all detected targets. Implements a Minimally Attended Radar concept: maintenance by not 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.	Production/Deployment	General Electric Co.
Space Defense Operations Center (SPADOC) SPADOC, to be located in the Cheyenne Mountain Complex, is the central command control communications and intelligence element of the Space Defense Command and Control System. 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. SPADOC will collect and disseminate real-time information on space status, warning, and operations direction.	Development	Ford Aerospace
Strategic Air Command Digital Network (SACDIN) A program to modernize Strategic Air Command's Control and Communications Systems from both the operational and maintenance standpoints, SACDIN will provide two-way, direct, secure data communications with enhanced survivability from the National Command Authorities to the nuclear strike forces through the Commander in Chief, SAC. It will replace parts of the SAC Automated Command and Control System.	Production	ITT Defense Communications Div.
WWMCCS Airborne Resource Modernization WWMCCS Airborne Resource Modernization is to develop and integrate a survivable and enduring command control and communications suite into a new aircraft that will replace aircraft of the WWABNCP EC-135 fleet.	Conceptual	None
WWMCCS Information System (WIS) This total information system planned for the post-1985 time frame will replace, modernize, and enhance the current WWMCCS Automatic Data Processing. WIS encompasses the information collection, processing, and display system that includes WWMCCS ADP and related software systems, procedures, and supporting telecommunications. The modernization focus is on the backbone of standard WWMCCS ADP, which supports command and control functions on Honeywell H6000-based systems.	Acquisition/Development	GTE
Deputy Command for Tactical Systems (TC)		
AF Joint Interoperability of Tactical Command and Control Systems (JINTACCS) JINTACCS is a JCS-directed joint program to improve the operational effectiveness of the services' tactical C^2 systems used in support of joint tactical operations through the 1980s. JINTACCS will develop and test an interoperable system architecture and will standardize message structure, message language, and operation procedures. The USAF program ensures that Air Force requirements are reflected in the developed and tested standards.	Acquisition/Development	None
Antiradiation Missile (ARM) Alarm Sensor The ARM Alarm Sensor is a special-purpose, small, solid-state, pulse-Doppler radar used to detect approaching antiradiation missiles as part of the ground radar Electronic Counter-Countermeasures program. This radar will continuously monitor the threat environment of the AN/TPS-43 radar.	Development	Sanders Associates Federal Systems Group
Combat Identification System—Indirect Subsystem (CIS-ISS) A joint program to develop and deploy a worldwide, NATO-compatible system for accurate and timely target identification for battle commanders and weapons controllers. The program objective is to develop automated correlation and fusion of information from multiple ID sources and to develop a tactical electronic support measures (ESM) sensor to serve as a high-quality source of aircraft identification information.	Prototype Test & Evaluation	General Dynamics Fort Worth Div.; Watkins-Johnson Corp.
Commando Torii The Commando Torii program has been established to satisfy a Pacific Air Forces (PACAF) operational need. The program provides for the design, system engineering, procurement, installation, and testing of a control communications system.	Definition/Development, Production	None
Communications Nodal Control Element (CNCE) The CNCE is a segment of the TRI-TAC family of ground-based tactical digital communications equipment. The CNCE is a technical control facility used at communications nodes to provide performance monitoring of communications equipment, rapid restoral capability for essential communications in the event of failure or battle damage, and the capability to reconfigure communications assets rapidly when deployed to meet changing user requirements.	Production	Martin Marietta Aerospace

NAME AND MISSION	STATUS	CONTRACTOR
Digital European Backbone 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, wideband, digital, bulk-encrypted capability with increased capacity between Defense Satellite Communications System earth terminals and major commands.	Acquisition and Deployment	None
Digital Nonsecure Voice Terminal (DNVT) The DNVT is a low-cost, nonsecure digital telephone instrument that will interface directly with the TRI-TAC Army circuit switches to satisfy a variety of user needs and TRI-TAC system architectural requirements. The TA-954-( )-TT DNVT is a "ruggedized" model designed for field use.	Production	General Atronics Corp.
Enhanced JTIDS System (EJS) A high antijam voice air-air and air-ground communication capability for the Tactical Air Forces (TAF) through application of a combination of techniques: pseudo noise spread spectrum modulation, fast frequency hopping, pulsed JTIDS-like waveform, and high transmit power level. Two-band operation includes L-band and an alternate band. In L-band, EJS voice and limited data interoperate with Army, Navy, and allied JTIDS users via TDMA and TADIL-J. Other features include simple push-to-talk operation, multiple user conferencing, high net capacity, and rapid signal acquisition. Preplanned Product Improvement for data capability. Slated for integration into twenty-four different air and ground platforms of the TAF. System also includes miniaturized TACAN capability for fighter radio application.	Development	Hazeltine Corp.
Ground Attack Control Center (GACC) The Ground Attack Control Center will provide the TACS with a capability to control air attacks against time-sensitive (moving and stationary) ground targets. The GACC will use the MCE operations module as the hardware equipment baseline.	Development	None
Ground Mobile Forces Satellite Communications (GMFSC) Terminal Program The GMFSC program provides the Tactical Air Forces with highly mobile satellite communications terminals. The program will also provide equipment to Air Force Communications Command for support of rapid deployment forces and Air Force contingency missions. The GMF program is multiservice, with the Army as lead service. The GMFSC terminals operate through the Defense Satellite Communications System (DSCS) satellites located in synchronous orbits for continuous worldwide coverage.	Development, Acquisition, and Production	RCA; Lincoln Laboratories; Raytheon Co.
HAVE QUICK Provides an improved near-term air-air and air-ground-air jam-resistant UHF voice communications capability that will allow TAF mission accomplishment against the current threat.	Development and Production	Magnavox; Rockwell Collins
HAVE QUICK II A follow-on improvement to the HAVE QUICK modification program, HAVE QUICK II will improve the jam resistance of HAVE QUICK against the evolving threat and will also improve the operational utility of the radio.	Development/Production	Magnavox
Intra-Theater Imagery Transmission Systems (IITS) A hardcopy imagery-dissemination system utilizing the Tactical Digital Facsimile equipment being developed by ESD under the TRI-TAC program. The IITS program will give the Tactical Air Forces the capability to transmit photographs and other intelligence information rapidly to high-priority users via electronic means.	Development, Production	None
Joint Surveillance Target Attack Radar System (JSTARS) An Air Force/Army program to acquire an electronic scan, multimode radar that will satisfy the services' need to detect, track, and direct weapons against stationary and/or moving ground targets. The system consists of an airborne radar, the operations and control subsystems on board a C-18 aircraft, Ground Station Modules, and Weapon Interface Units. Radar information is transmitted directly to the ground stations and other C^3I elements through secure data links.	Full-Scale Development	None
Joint Tactical Communications (TRI-TAC) Acquisition of ground-based tactical digital communications equipment for the multiservice area under the auspices of the DoD Joint Tactical Communications (TRI-TAC) program. This includes all trunking, access transmission and switching equipment for mobile and transportable tactical multichannel systems, associated systems control and technical control facilities, local distribution equipment, and voice, record, data, and ancillary terminal and COMSEC devices.	Definition, Acquisition, Production, and Deployment	Martin Marietta; Raytheon Co.; General Atronics Corp.
Joint Tactical Information Distribution System (JTIDS) A program to develop a high-capacity, reliable, jam-protected, secure, digital information distribution system that will give a high degree of interoperability among data collection elements, combat elements, and command and control centers within a military theater of operations.	Full-Scale Development/Production	Hughes Aircraft Co.; Singer Kearfott; IBM, Federal Systems Div.
Modular Control Equipment (MCE) The MCE is a transportable, modularized, software-intensive automated air command and control system. It will interface with the AN/TPS-43E radar for local area air surveillance and other TACS elements via tactical data links for remote sensor data. The MCE will contain sufficient data processing, display, and communication equipment to fulfill the air surveillance and airspace management functions of the TACS.	Development	Litton Data Systems
NATO Air Base SATCOM (NABS) Terminal Program The NABS terminals will enhance the survivability of critical wartime communications between and among NATO Air Operations Centers (AOCs) and allied airfields where USAF elements would deploy in their NATO wartime role.	Acquisition and Production	None
SINCGARS This program is to develop airborne SINCGARS systems for jam-resistant, secure, voice tactical VHF/FM/AM communications that will interoperate with the US Army-developed equipment and be a direct form, fit, and functional replacement of the AN/ARC-186 radio. Also, ground SINCGARS systems for jam-resistant, secure, voice tactical VHF/FM communications will be acquired from the US Army.	Development	ITT, Aerospace Optical Div.
Spanish Systems Assistance to the Spanish Air Force for maintenance and operation of Spain's 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 communications links.	Acquisition	Hughes Aircraft Co.
Speakeasy Secure Voice Terminal Secure voice terminals for triservice use over normal AUTOVON. These terminals provide good-sounding voice quality and can be used in the normal office environment. The terminals will be delivered to AFCC for deployment. The terminals will expand the number of users having access to the existing defense automatic secure voice system and will provide secure voice to selected C^2 and other high-priority triservice agencies with a need for secure voice that have not had this service in the past.	Production	Harris Corp.

NAME AND MISSION	STATUS	CONTRACTOR
System Trainer and Exercise Module (STEM) The STEM is a deployable trainer and exerciser utilized to train CRC/CRPAN/TSQ-91(v) operations personnel in various mission functions. The STEM will provide capability to prepare exercise scenarios containing simulated flights of aircraft performing various types of tactical missions.	Production	GTE Communications Systems Division
Tactical Digital Facsimile (TDF) The TDF provides rapid, high-quality transmission and reception of hardcopy documents. It is designed to operate over existing analog and wideband tactical wire and radio circuits. It provides black and white and up to sixteen shades of gray.	Production	Litton Amecom Division
Tactical Digital Troposcatter Radio Terminal A family of tactical digital troposcatter radio terminals to provide secure transmission and reception of analog and digital voice and digital data by means of line-of-sight and tropospheric modes of propagation over distances up to 200 miles.	Production	Raytheon Co.
Ultra Low Sidelobe Antenna (ULSA) The ULSA is an electronic counter-countermeasures improvement to the AN/TPS-43E Tactical Radar System. It is designed to minimize the vulnerability of the radar to jamming and to maximize the survivability of the transmitter system in the presence of an antiradiation missile (ARM) attack. The low transmitting sidelobes not only offer jamming resistance but also permit the use of low-power decoys to misdirect the ARM.	Production	Westinghouse Defense and Electronics Center
Deputy for Development Plans (XR)		
Adaptive Planning This effort analyzes certain strategic planning functions for the applicability of artificial intelligence techniques. It will provide a system specification for development and acquisition of an "expert system," should the planning functions be found suitable.	Planning	MITRE Corp.
Advanced Air Traffic Control (ATC) Concepts Definition of concepts to support survivable military air traffic control systems for the pre-, trans-, and postattack periods, including proposed technical alternatives and long lead-time developments.	Planning	MITRE Corp.
Advanced Tactical Battle Management System Advanced Tactical Battle Management System planning identifies alternatives to satisfy future tactical command control and communications needs. The program will assist in controlling tactical C^3 acquisitions by focusing the expenditures on a system solution rather than on a piecemeal approach. The resultant increased capability will be incorporated through an evolutionary systems upgrade.	Planning	MITRE Corp.
AFCC Base Support Communications Planning Development of a comprehensive Air Force base communications architecture for the 1990s. This architecture provides general guidance and specific implementation plans for an evolutionary upgrading of base communications facilities. It will cover telephone service, local area networks, land mobile radios, video, graphics, and sensor/alarm systems, and interfaces to such external long-haul systems as DDN.	Planning	MITRE Corp.
Air Force Worldwide Military Command and Control System This effort is to provide system planning and engineering activities for the Air Force elements of the Worldwide Military Command and Control System (WWMCCS), accomplish intersystem planning and engineering tasks according to validated WWMCCS requirements, and compare user requirements with existing capabilities in order to establish deficiencies and recommend solutions that use state-of-the-art or emerging technologies.	Conceptual/Validation	MITRE Corp.
Alaskan Air Command (AAC) C^3 This program will identify the scope of and provide an implementation plan for an AAC C^3 Architecture. This study will complement the DCA Command Center Upgrade work with an analysis of theater-wide C^3I requirements, capabilities, and communications upgrade alternatives.	Planning	MITRE Corp.
Atmospheric Surveillance Technology This is an advanced development program that will demonstrate sensor technologies and synthesize an architecture for an advanced surveillance system capable of detecting all air-breathing threats to North America. The emphasis is on detection and tracking of low-signature targets, including air-launched and sea-launched cruise missiles (ALCMs and SLCMs). System survivability through all phases of conflict is a necessary adjunct.	Conceptual	MITRE Corp.
C^3 for Advanced Weapons This project looks at C^3 implications and requirements of advanced weapon systems. Areas of investigation include strategic connectivity enhancements, exploiting expert systems for command center processing, and technology road maps for advanced C^3 capabilities. It also includes planning activity for holding relocatable targets at risk.	Planning	MITRE Corp.
C^3 for the Small ICBM A joint project with the Ballistic Missile Office to develop a C^3 Systems Architecture for the Small ICBM. The initial effort analyzes the C^3 environment for interoperability problems and assesses the capabilities of current, programmed, and planned systems to meet the interface requirements. Additionally, it includes a study of candidate launch-control platforms and gateway communications.	Planning	MITRE Corp.
Civil Reserve Air Fleet (CRAF) C^2 Architecture Study This study will analyze the current and future capabilities needed by MAC to manage CRAF resources effectively in all stages of activation. The resulting implementation plan will provide the recommendations and implementation strategy necessary to achieve these capabilities.	Planning	ASEC
HAVE VIEW This program will demonstrate the performance of noncooperative multistatics utilizing Passive Coherent Location Technology for Atmospheric Surveillance and establish a data base for military appraisal of this technology. This program will acquire an initial performance data base and provide a near real-time demonstration of the surveillance concept using TV broadcast illumination and Doppler-only processing. The data will then be used to define military utility potentials and determine operational applications. The ultimate goal is a field demonstration of HAVE VIEW technology.	Conceptual	MITRE Corp.
HF Communications This effort will formulate a development program for a survivable HF radio terminal with capabilities needed to satisfy the unresolved beyond-line-of-sight communications requirements of the strategic and tactical air forces. The goal is to design a new-generation HF radio that will be capable of surviving and operating in a naturally disturbed, jamming, or nuclear-disturbed environment.	Conceptual	MITRE Corp.

NAME AND MISSION	STATUS	CONTRACTOR
Joint Operational Interface Simulation Training System (JOISTS) JOISTS will develop a simulation system that will provide cost-effective training for command and control units capable of participating in joint tactical air operations. Air Force, Navy, Army, and Marine Corps operational units or training facilities are envisioned as participants in this program.	Planning	DRC
Long-Range Planning This effort promotes long-range thinking in the C^3I development and acquisition community. The emphasis is on identifying new system concepts while planning for and developing analysis tools and decision aids.	Planning	Many
MAC C^2 Implementation Plan Update This will update the current MAC C^2 Airlift Implementation Plan to reflect changes and additions in mission area architectures and a purge of programmatic issues. The Special Operations Forces C^2 Architecture will also be reflected in the updated implementation plan.	Planning	MITRE Corp.
Military Airlift Command (MAC) 21 This study will assess the impact of changing technology, new equipment, and environments on MAC operations in the 2000 time period and beyond. The resulting command and control requirements and recommendations will support the concepts in the Airlift Master Plan. The goal is to provide a framework for incremental improvement in the efficient use of MAC resources into the twenty-first century.	Conceptual	SRI International
Military Satellite Communications (MILSATCOM) Architecture A broad systems-level evaluation of all MILSATCOM systems, including such constellations as MILSTAR, FLTSAT, SDS, and DSCS, emphasizing the terminal segment and associated Air Force user requirements compilation and analysis. This in-depth examination analyzes MILSATCOM deficiencies and offers recommendations to assist Air Force managers with both near-term and far-term MILSATCOM decisions.	Conceptual	MITRE Corp.
Millimeter Wave for Strategic Communications An initial assessment and system design of a millimeter wave communications system is being performed. The objective is to determine the operational utility and some initial engineering details of such a system for meeting strategic low-probability-of-intercept communications requirements.	Conceptual	TRW
Strategic Defense Initiative Planning This program supports the Presidentially mandated research effort for a ballistic missile defense. Work includes systems concept investigations to define Battle Management/C^3 architectures and to implement a Development Evaluation Facility for evaluating alternative architectures and technology concepts.	Planning	Infotech
Tactical C^3I Interoperability This study is to analyze the interface and interoperability requirements of selected C^3I system groups. The current effort includes analyzing the integration into the European Central Region of the Precision Location Strike System (PLSS), Tactical Reconnaissance System (TRS), Joint Surveillance Target Attack Radar System (JSTARS), Ground Attack Control Center (GACC), and appropriate intelligence-processing centers. The interoperability requirements analysis will result in detailed descriptions of interface capabilities, requirements, problems, issues, and potential solutions.	Planning	MITRE Corp.
Technology Planning Guidance and Transition The ESD Technology Planning Guide provides technology investment guidance for Air Force and DoD laboratories, research centers, and contractors who support ESD C^3I systems acquisition. The objective of this document is to translate ESD development planning results (Vanguard Plans, Architectures, Mission Area Analysis, SONs, Technology Needs) into Technology Planning Guidance. Technology Transition Planning is the mechanism for moving technologies from laboratories to operational Air Force systems. Current technologies being examined are very-high-speed integrated circuits (VHSIC), fiber optic components, software products, and signal processing. Technology Applications Studies are designed to identify emerging technologies that can be applied to a specific system. Current study areas are artificial intelligence (AI) and signal processing.	Planning	MITRE Corp.
Transatmospheric Vehicle C^3 This project, in coordination with Aeronautical Systems Division, looks at the C^3 implications of future strategic vehicles. The effort focuses on the unique demands of the vehicles on future C^3 systems and on the on-board C^3 systems.	Conceptual	ISN
United States Air Forces in Europe Command and Control Architecture This project examines future command and control systems and procedures to support European tactical air operations. In FY '85, the Architecture will focus on analysis of fighter tactical reconnaissance operations in the 5th Allied Tactical Air Force (5ATAF), NATO Southern Flank. High-priority needs affecting US and NATO will be identified. The analysis will provide alternatives to be considered for meeting these needs.	Planning	MITRE Corp.
Vanguard Vanguard is an Hq. AFSC project to assess existing, planned, and needed warfighting capability for a twenty-year planning horizon. The ESD portion of Vanguard shows the contributions and interrelationships of C^3I (command control communications and intelligence) systems.	Planning	MITRE Corp.
Deputy Commander for Airborne Warning and Control Systems (YW)		
E-3 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 Tactical Air Command, with Tinker AFB, Okla., as the main operating base, these aircraft 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; Westinghouse
NATO E-3A Acquisition of E-3A Sentry aircraft for the North Atlantic Treaty Organization (NATO), with special modifications to meet NATO requirements.	Acquisition and Operational	Boeing; Westinghouse
Saudi Arabia E-3A/Tanker This effort involves development and acquisition of five modified E-3As and eight derivative tankers to fulfill United States government commitments to the Saudi Arabian government.	Development and Acquisition	Boeing; Westinghouse



Our electronic combat forces are getting better—but, at the same time, the job they have to do is getting tougher.

Electronics For the Shooting War

BY JAMES P. COYNE, SENIOR EDITOR

MARCONI'S invention of a practical wireless radio system in 1897 was followed almost immediately by development of ways to jam and spoof radio signals, and electronic warfare began. Both American and British naval forces began to include radio operations in fleet exercises.

The first known application of jamming in war took place on April 14, 1904, during the Russo-Japanese War, when the Japanese used radio on board small patrol vessels to direct the bombardment of Port Arthur. A Russian operator heard the Japanese signals and used his "spark transmitter" to jam them. Electronic countermeasures (ECM) were born. The bombardment, by the way, was ineffective.

Before World War I, the British developed direction-finding stations for determining the bearing of ships or aircraft that were in range. And during the war, radio-equipped aircraft were utilized for reconnaissance and artillery spotting, but the Germans quickly learned they could "jam" the British transmissions by broadcasting on the same frequen-

Symbolizing close coordination between an attack force and its combat support aircraft, an F-15A Eagle air-superiority fighter and an F-4G "Wild Weasel" electronic combat platform return home at sunset after a day of escorting strike forces in an exercise over Norway.

cy. In 1916, during the Battle of the Somme, the British discovered they could avoid the jamming by using a "clapper break," which varied the pitch or tone of the signal being sent from their aircraft to ground receivers. Electronic counter-countermeasures (ECCM) were a reality.

Following the war, many nations experimented with radio-controlled aircraft. The Naval Research Laboratory (NRL) in Washington, D. C., developed a device to sweep continuously across the band of signals used for radio control and indicate when it had identified a frequency that was being used. Once that frequency had been identified, it could be jammed, or a more powerful signal could take control of the aircraft. This is believed to be the first continuously scanning visual display intercept receiver ever built.

Early on, even before the turn of the century, Heinrich Hertz had demonstrated that metal plates would reflect electromagnetic waves. In May 1904, the German scientist Christian Hulsmeyer patented a crude radar-like device that indicated, by means of an electrically actuated bell, when ships passed up and down the Rhine.

There seems to have been very little interest in this work until the 1930s, when several nations, including the US, Great Britain, France, Germany, the Netherlands, Japan, and the Soviet Union, developed working radars. In 1934, NRL developed a device able to detect an aircraft at fifty miles, but technical problems rendered it impractical for everyday use. In the meantime, both Great Britain and Germany recognized the threat of war and pressed on with their own systems. The British developed a version that could detect aircraft seventy-five miles away.

By the time World War II began, the US had deployed a radar system to control coastal and antiaircraft artillery, and the British had put radar sites in position to detect aircraft approaching from the Continent. The Germans developed their own radar, and both sides soon developed systems, usually not too effective, for jamming radar.

One very effective approach—chaff—was developed and employed by the Allied forces during bombing raids over Germany. Chaff is still in use today.

Vital Factor Today

The growth of electronic warfare and electronic combat has been phenomenal since the end of World War II. "Today," according to USAF Col. David Gingery, Director of Electronic Combat Requirements for Tactical Air Command, "it would be fatal for a nation to try to fight an air war without a viable electronic warfare capability. Even more than in Vietnam, electronic capabilities will determine the effectiveness of the force." Col. Richard Moore, TAC's Director of Reconnaissance and Electronic Combat Operations, agrees. "Today's aircrew must depend on TAC's support systems, such as the EF-111, Compass Call, and F-4G 'Wild Weasel,' to neutralize, suppress, and kill and on self-protection equipment and tactics to defeat the end-game engagement. Both electronic combat support and self-protection are keys to survival while putting bombs on the target."

In recognition of the electronic threat and the requirement to employ electronic weaponry successfully in almost any combat environment, TAC emphasizes electronic combat in all training situations. In addition to everyday training at home air bases, TAC leaders and aircrews also undergo intensive electronic-oriented training during three major exercises—Red Flag, Green Flag, and Blue Flag.

Red Flag takes place several times a year over the instrumented air-to-air and air-to-ground ranges near Nellis AFB, Nev. Operating under varying real war scenarios, aircrews and aircraft fly as opposing "Red Forces" or "Blue Forces," participating in strikes and air-to-air engagements that include as few as four and as many as hundreds of aircraft on each side. Attackers are subject to interception by opposing aircraft and attack by surface-to-air missiles (SAMs) and antiaircraft artillery (AAA). Electronic combat is a part of each scenario. Aircraft are "shot down," targets are hit, and results are scored electronically.

Green Flag is another giant exercise flown at Nellis, but its thousands of sorties overwhelmingly emphasize electronic warfare. Jamming and electronic countermeasures are much more intense than in Red Flag. Green Flag also provides an opportunity for the collection of data on the operation of electronic warfare systems and methods for their employment. During a Green Flag exercise, tactical aircrews are opposed by a greater variety and greater numbers of EW systems than in Red Flag.

Blue Flag is aimed at training decision-makers who will direct combat operations in wartime. It is not simply a command post exercise (CPX), because real exercise forces are employed, but the emphasis in Blue Flag is on the decision-making process that takes place in a headquarters from which an air war is being run. While, like Red Flag, the emphasis is on tactical operations, electronic combat training is a significant part of the scenario.

Three Electronic Tasks

These exercises emphasize that, in real combat, commanders must accomplish three electronic warfare tasks. The first is to find and identify the enemy's electronic order of battle (EOB)—that is, his radar sites, SAMs, AAA sites, and other defenses. Second, he must suppress (jam) or negate the enemy's electronic EOB capability so that the strike forces can hit their targets effectively. Third, he must destroy the enemy electronic capability.

An EC-130H Compass Call, an electronic version of the Lockheed Hercules, uses a powerful antenna array to jam enemy command control and communications capabilities. It can be effective over wide battlefield areas.

Before the battle starts, the commander will have a "picture" of known EOB locations that is assembled from information provided by a number of reconnaissance assets. These include observation satellites in space, RC-135s—electronic intelligence-gathering versions of the KC-135 airframe—the SR-71 Blackbird supersonic reconnaissance aircraft, and the high-flying U-2/TR-1 aircraft.

Such photoreconnaissance aircraft as the RF-4 can also provide inputs, but modern SAM sites are mostly mobile and self-contained. They are not set up in the easily recognizable "Star of David" configuration so familiar to pilots who flew against the SA-2 in Vietnam. Their locations are thus not so apparent in photos.

When assembling the strike force, the commander includes a number of aircraft whose mission is finding, disrupting, and identifying (and, in some cases, destroying) the electronic threats to the force. There are literally dozens of devices, some carried externally in pods and some carried internally, available for electronic combat aircrews to use in these roles. They cannot all be discussed here.

In locating enemy electronic emitters, all the devices use a number of antennas arranged in a pattern on the skin of the aircraft. When an enemy emission strikes the antennas, it differs in its modulation and intensity at each antenna because they are mounted separately and in different places on the receiving aircraft. These slight differences are translated by amplifiers and computers into directional information displayed in the cockpit. If the receiver is one of the more sophisticated ones, it also identifies the emitter, measures the strength of its signal, compares it with the known strength (stored in its software) of that emitter's signal, and computes the distance to it.

Specific Sensors

One of the newer warning sensors is the Litton AN/ALQ-125 TEREC (Tactical Electronic Reconnaissance), which is carried internally on the RF-4C. It is designed for rapid threat recognition in the battle zone. Fully automated, it can identify the threat, its direction of arrival, and the site of ground-based transmitters. The system then transmits the information by data link to tactical commanders equipped to receive it. It has an option for operator readout in the cockpit so that the information can be passed by radio to other aircraft in the area. (The advantages of data link are that it

transmits information in much greater volume much faster than voice transmissions and is harder to jam. These can be tremendous advantages in a multithreat area.) The information gathered by the TEREC is recorded on magnetic tape on board the aircraft.

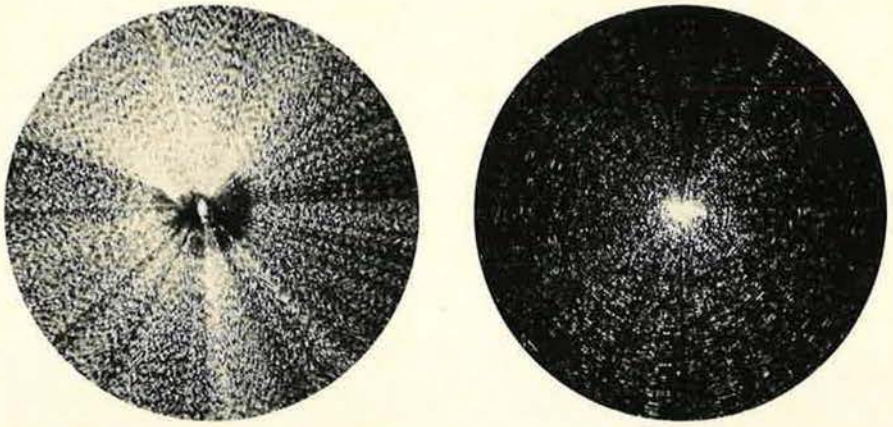
A critical part of the F-4G "Wild Weasel" system *(see below)* is the AN/APR-38 RAWS (Radar Attack and Warning System), which receives, displays, and transmits threat data. This internal system can receive many emitters at the same time and classify them according to type, range, bearing, and the level of threat. This is an invaluable tool for the F-4G aircrew, whose mission is to locate the threat and destroy it.

The Litton AN/ALR-69 Radar Warning Receiver (RWR) is one of several systems installed on such fighters as the F-16. This digital system not only detects and analyzes airborne radar and SAM guidance emissions and provides identification and directional information to the pilot, but it can also interface with devices that automatically activate countermeasures equipment, such as chaff and flares. This system was developed from the AN/ALR-46, designed for earlier generation aircraft, and was the principal RWR in use ten years ago.

These systems represent a quantum leap over the capability of such Vietnam-era equipment as the AN/APS-107, which was carried on aircraft like the F-4D. In addition to the equipment described above, such aircraft as the F-15 and the EF-111 carry their own specialized radar warning receivers.

Jamming and Deception

Once threats have been identified, they must be nullified or destroyed. There have been a number of jamming and deception devices developed for carriage on fighters. Except for the most recent, which have the advantage of miniaturization, they have been designed for external carriage in pods. One reason for this is that the power and coverage required for jamming and deception could only be produced by relatively large equipment, and there simply isn't much space available in most fighters. The tradeoffs for the power are loss of a station for carrying ordnance and the pod's increased drag, requiring more fuel for a given distance and airspeed.



The EF-111A Raven's ALQ-99 jamming system can blind hostile radars to all aircraft movements out to a range of more than 100 miles, enabling a strike force to attack, withdraw, refuel, regroup, and reattack.

These devices work by "noise" jamming, which is accomplished by finding the frequency of the enemy emitter and "flooding" it with powerful emissions, or by electronically modulating the return the enemy emitter gets back so that he thinks the target is where it isn't.

Currently, the most widely used ECM pod is the Westinghouse AN/ALQ-119, which is carried principally on the F-4, but which could also be carried on the A-7, A-10, F-15, F-16, or F-111. It is classified as a dual-mode jamming pod, which means it uses both noise and modulated jamming. Since it was initiated in 1970, it has been modified several times. Fighter pilots call it the first "smart pod," because by reprogramming its software, it can be made to react to different threats. Most earlier pods were built to counter a specific threat.

Westinghouse also produces the AN/ALQ-131 ECM pod. This is one of the most advanced USAF jamming pods. A dual-mode jammer built around a digital computer, it is more easily reprogrammed than the AN/ALQ-119 and can cover a wider variety of threats. It features a receiver-processor that detects radar threats and automatically initiates the appropriate jamming technique.

The Northrop AN/ALQ-135 Internal Countermeasures Set has been developed for the F-15. This equipment operates as part of the aircraft's on-board Tactical Electronic Warfare Suite (TEWS). It jams threat radars automatically, and a digital computer catalogs enemy ECM frequencies and automatically adapts the system to the changing threat array.

Operating Deep

As the attacking force penetrates deep into enemy territory, the ground-to-air and air-to-air threat grows. Weapons will be launched against ECM and SAM-killer aircraft from different sites at, or near, the same time. For this sort of situation, aircraft can carry the Tracor AN/ALE-40 Countermeasures Dispenser System. Developed originally for the F-4, these dispensers can be carried on such newer fighters as the F-16. On some, such as the F-15, a version of the system is carried internally.

The system dispenses chaff if the attacking missile is radar-controlled or flares if the attacking missile is a heat-seeker. In an advanced version of this system, the pilot can control it manually or set it to respond to the threat automatically. It can respond to a radar and a heat threat at the same time. In either case, deception diverts the attacking missile to attack the expendable objects that are dispensed by the system.

Supporting the ingressing attack force are combat-support aircraft designed for specific roles. The E-3 Airborne Warning and Control System (AWACS) is optimized to provide early warning of low- and high-

level attacking forces over land or sea and to control large numbers of aircraft in an air-to-air battle.

In direct support will be the EC-130H Compass Call aircraft and their powerful arrays of antennas for jamming enemy command control and communications capability. This electronic version of the C-130 Hercules has proven in exercises to be an extremely effective communications jammer. It would be a vital asset in a shooting war.

An 81st Tactical Fighter Squadron F-4G "Wild Weasel" electronic combat aircraft roars over its home base at Spangdahlem AB, Germany. Its mission is to seek out and neutralize enemy electronic installations.

Suppressing enemy air defenses would be the EF-111A Raven, a specially modified version of the F-111 for supporting tactical strike forces. Its effectiveness is enhanced by its ability to penetrate and escape enemy airspace at supersonic speed. The Raven can operate with the strike force or outside the battle area as a standoff jammer.

This aircraft utilizes an improved version of the US Navy's ALQ-99 jamming system that has ten transmitters, expanded computer capability, and greater automation to provide optimum flexibility and more jamming options. Countermeasures can be initiated automatically. New threat information can be fed into the system by the electronic warfare officer through his cockpit keyboard or by a change in software.

The EF-111A can loiter outside the battle area for as long as four hours as a standoff jammer, where it can screen the routes of friendly forces attacking deep into enemy territory. In its penetration role, the Raven can stay with the strike force, employing countermeasures aids as required. Pairs or groups of EF-111s could mask from enemy radars the movements of attacking forces for long periods of time, allowing those forces to refuel, regroup, and reattack.

Going along with the strike force in a hunter-killer role would be the F-4G "Wild Weasel," which has replaced the F-105 as the primary destroyer of enemy air defenses. Converted from F-4Es, the Weasels are two-place, supersonic, long-range fighter-bombers. The internally mounted 20-mm Gatling gun in the nose has been replaced by sophisticated electronic equipment. The aircraft have been optimized to find enemy SAM and AAA sites and destroy them.

Electronic Combat Weapons

There are several weapons designed especially for use in electronic combat. The main ones, now and for some time to come, are the AGM-45 Shrike and the AGM-88A HARM.

The first version of the Shrike entered service in 1965 in Vietnam. It became the primary weapon for use against enemy radar installations, including, of course, SAM sites. More than 13,000 were delivered to USAF between 1965 and 1978. Designed to home automatically on enemy radar emissions, the Shrike proved to be deadly when released near targets. Because state-of-the-art technology at that time did not permit equipping the missile with a memory, the Shrike's homing capabilities were sometimes degraded when the enemy radar site stopped transmitting while the Shrike was still homing in.

The Texas Instruments AGM-88A HARM (High-speed Antiradiation Missile) was designed to do what the Shrike couldn't do—continue to home in on the target even if it stopped transmitting. Covering a wide range of frequencies through programmable digital processors in both the launching aircraft and the missile itself, HARM greatly improves the US antiradiation capability. The missile was designed for use on Wild Weasel aircraft.

In addition to missiles designed specifically for antiradiation work, the AGM-65 Maverick is useful for attacking radar installations. Designed to attack all kinds of point targets, Maverick is a "launch-and-leave" missile. A television screen in the cockpit with a magnified image allows the pilot to identify and lock on to small targets. Guided by heat emissions, the imaging infrared version of Maverick is very effective in marginal weather conditions and at night.

USAF is well set up to go into electronic combat. But the situation is far from perfect. An Air Force integrated electronic combat system, which would combine the capabilities of long-range acquisition radars, a communications network, and over-the-battlefield electronic capabilities together in one coherent whole, does not exist.

USAF continues to emphasize improvement in the electronic combat arena. "Electronic combat is, and will continue to be, a key element of USAF warfighting capabilities," says Col. Richard P. Wallace, Deputy Director, Electronic Combat, Hq. USAF. "However, to be effective, electronic combat must keep pace with the evolving threat. In this regard, we are making a major effort to improve our disruptive and destructive capabilities. Nevertheless, even by 1990, we will still face a shortfall in electronic combat assets required to fully implement our strategy." ■

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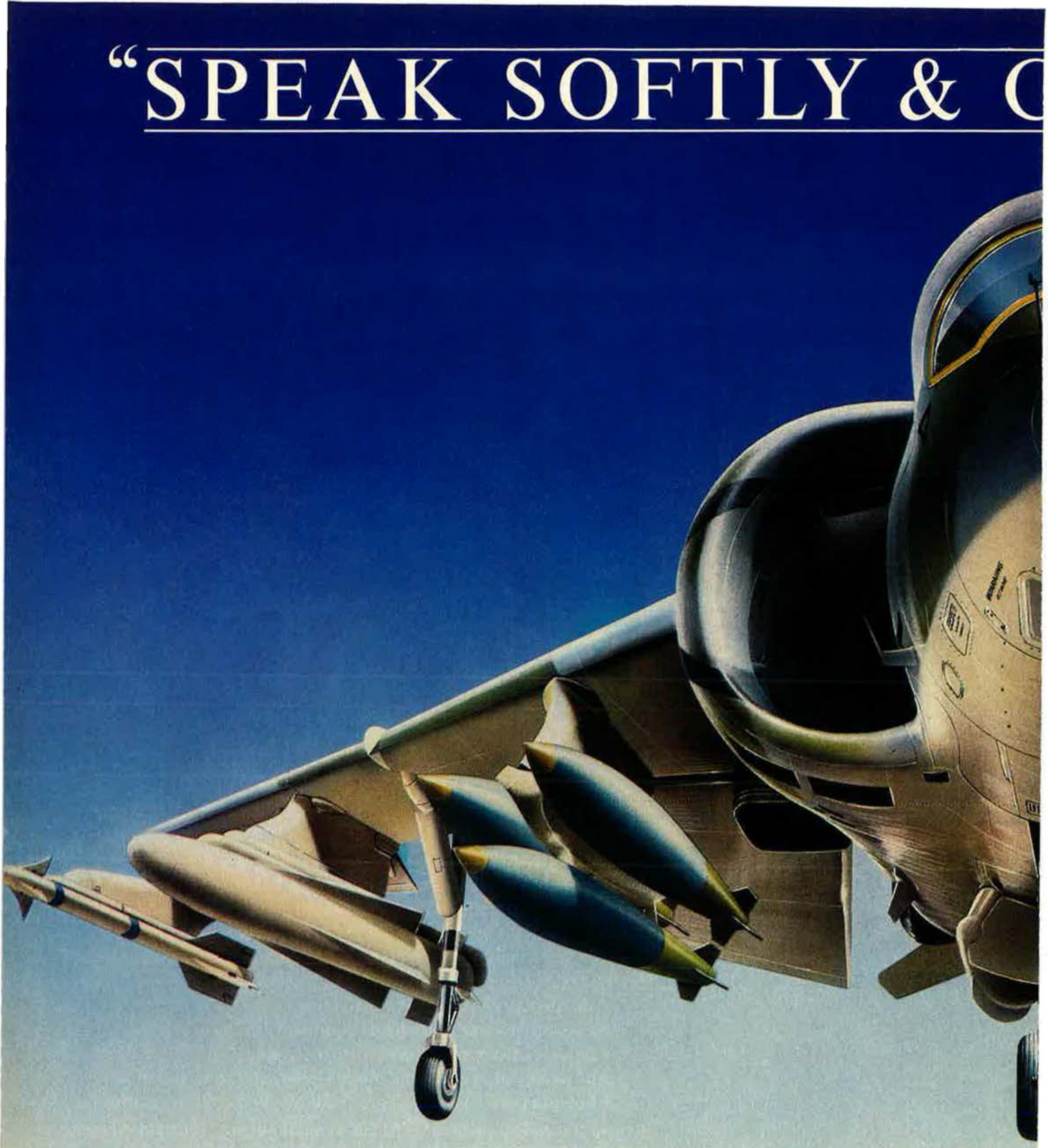

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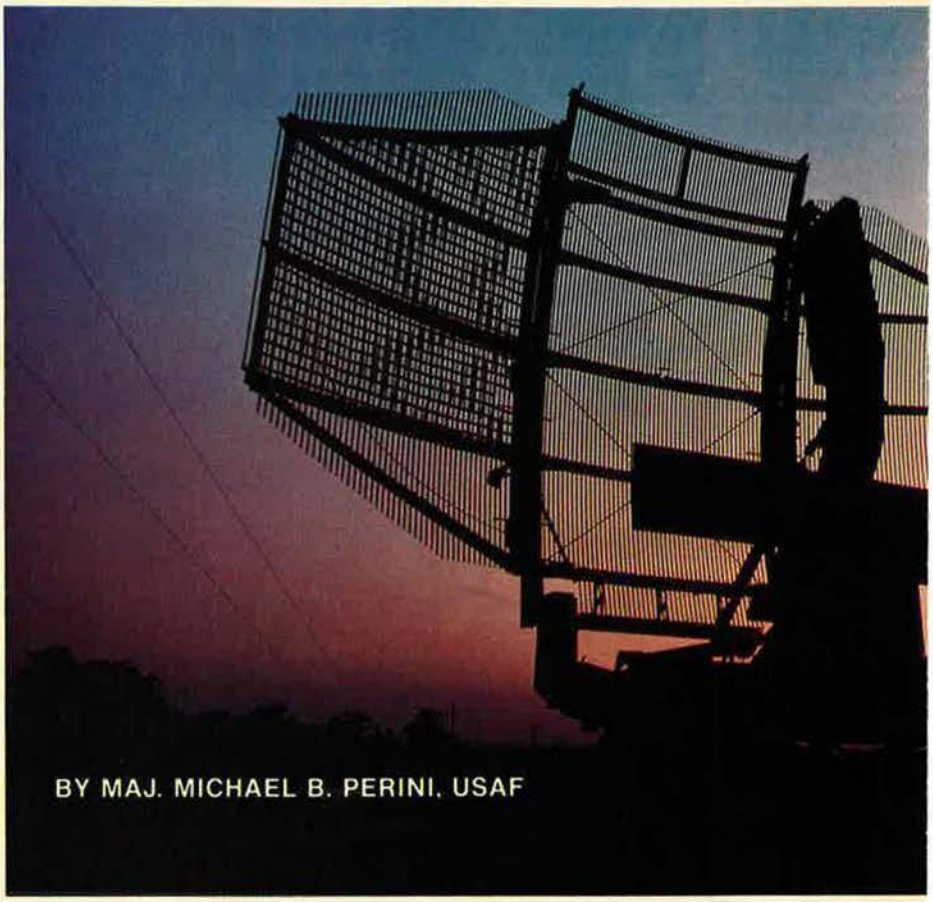
Germany has agreed on the D-band for IFF, at last clearing the way for development of the NATO Identification System.

Telling Ours From Theirs



BY MAJ. MICHAEL B. PERINI, USAF

AFTER more than ten years of talking, NATO is finally positioned to proceed with a common IFF (identification, friend or foe) system. The breakthrough came April 1, when Germany agreed to accept the D-band, long advocated by the United States, as the operating frequency for combat identification.

While a great many details are still to be negotiated, this action clears the major impasse to development of the NATO Identification System (NIS). There has always been accord that the system was desperately needed. The problem was in achieving consensus about the bandwidth.

Distinguishing friends from foes in modern conflict is not easy. The process is made more difficult by the large numbers of air, land, and sea forces that will require reliable identification of each other as well as by the enemy jammers and other factors that threaten to confound and confuse identification. Without such a capability, allied aircrews might find it as difficult to return home safely as it was to penetrate Warsaw Pact defenses in the first parts of their missions.

A number of studies have pegged the lack of a rapid, interference-free, long-range identification capability as one of the most critical deficiencies of the current NATO Air Command and Control System.

Much of the IFF equipment used within NATO is outdated, unreliable, and not interoperable. In fact, NATO exercises have proven that the lack of a common IFF is a significant factor in combat "losses." Of all the pressing needs of USAFE, an improved common IFF system is probably uppermost. *(See also "Resurgence and Reservations," p. 80, October '84 issue.)*

The Mark X, which has been in service for several decades, is the most widely used system. In 1959, the US added some cryptographic capability and changed the system designation to Mark XII. The Mark XII offers the highest performance available, but it, too, uses relatively old technology and operates with a simple question-and-answer technique.

NATO's Air Defense Planning Group has proposed the NATO Identification System (NIS). NIS represents US/NATO efforts to provide improved, interoperable identification capabilities for the Alliance. The system has two subsystems—indirect (embedded in the C^3 structure) and direct (interoperable, secure, jam-resistant, cooperative Q-and-A identification).

Agreement in NATO on the indirect subsystem is proceeding well, with little controversy. Until recently, however, progress on the direct subsystem had been extremely slow.

The US System: CIS

The US Air Force, Navy, and Army are developing the Combat Identification System (CIS). "CIS is a collection of identification techniques that allows us to sort out airborne and vehicle targets," says Col. David L. Ewing, Director of the Combat Identification System program office at Wright-Patterson AFB, Ohio.

"The CIS works to improve and expand ID systems and make them more reliable," Colonel Ewing says. Most of the work going on in CIS is in service and industry labs, though. "We are monitoring more than twenty-five activities, [most classified], and are attempting to get a focus on which techniques will

The TPS-43 radar (left) is one element of the indirect subsystem of the US Combat Identification System (CIS). Employment of the new Mark XV IFF system will enhance the effectiveness of the direct subsystem segment of the CIS and will thereby enable US and allied forces to distinguish more accurately such friendly aircraft as the USAF F-15 (top) from such foes as the Soviet MiG-25.

have the most promise in combat," Colonel Ewing says. "There is no one ID technique out there that is going to satisfy all our requirements."

Today, the pilot with only a direct question-and-answer system on board faces a major dilemma when an unidentified target does not reply to his IFF challenge. "We will overcome this problem by using data obtained from a variety of other sources to complement information received by on-board aircraft equipment," Colonel Ewing says.

The Air Force plans to use $22 million requested in FY '86 to continue developing identification techniques. "Ninety-nine percent probability of correct ID is possible, using a combination of identification techniques," Colonel Ewing says.

Currently, service and industrial scientists are developing identification systems that would inhibit weapon release until the system has confirmed the target as friend or foe. These systems would identify enemies positively rather than pinpoint them by default. With this approach, sometimes called "noncooperative," the target does not knowingly participate in the ID process. Publicly announced examples of the noncooperative approach include using special techniques to determine the shape and type of unidentified aircraft and listening to the electromagnetic emissions of aircraft to identify particular avionics equipment.

Laboratory efforts include successful simulation of a radar warning receiver/fire control computer interface software (RFIS) system. "We have started a one-year preliminary design assessment, leading to a production decision in early FY '86," says Colonel Ewing.

The Air Force is also studying Multi-Source Integration (MSI), a fusion technique that correlates inputs from various identification sensors in order to reduce pilot work load and improve the probability of correct identification. "MSI combines information from a number of sources," says Colonel Ewing. "These merge and make a single ID determination."

Other techniques under study employ third parties—the command and control net—to receive, analyze, and pass along to proper platforms any relevant identification information gathered by sensors. Sources of indirect data would be direct Q-and-A systems, radar and electronic support measures data, flight and mission plan information, communications systems with navigation capabilities (*e.g.*, JTIDS), and intelligence data from various sources.

Air Force officials are cooperating with NATO to improve the indirect identification capability in Europe. The US developed a new processor during the past year that will automate some of the manual ID functions currently being performed in the ground Tactical Air Control System (TACS). Demonstrations are planned in the United States and in Germany.

Birth of the Mark XV

This month, the Air Force is moving even closer to testing a US version of a system that will distinguish friendly aircraft from enemy ones.

The new US system is called Mark XV. Its development is an Air Force-led, triservice program managed by Aeronautical Systems Division's Deputy for Aeronautical Equipment at Wright-Patterson AFB.

"The Mark XV is an electronic identification system that will use encrypted challenges and replies to cooperatively identify friendly aircraft and ships similarly equipped," according to Maj. Mark Lacaillade, Mark XV Program Element Monitor in the Avionics and Armament Division at Hq. USAF.

The system has been the US candidate for the direct subsystem of the NIS. In 1983, the US proposed a compromise approach, in which the NATO allies would use the Mark XV with a radar mode (*i.e.*, performing interrogations by using radar pulses modulated with identification information).

The Mark XV program is in the demonstration/validation phase, with full-scale development planned for FY '88 and production in FY '91. Industrial teams led by Bendix and Texas Instruments have won contracts of $13.2 million and $18.9 million, respectively, to test their versions of the Mark XV system in laboratories and aboard USAF C-135 and T-39 aircraft. Since 1983, the firms have been developing advanced development models of identification systems that will allow aircraft and ground-based air defense posts to identify aircraft through a query-and-response password. This would avoid the nasty prospect of having friendly aircraft shot down by friendly forces.

Work is now in progress on advanced development models, nineteen inches wide and six feet tall, to put on test aircraft late in 1986. "We will, of course, have to shrink the equipment down to about the size of two loaves of bread in order to fit it in our platforms," Colonel Ewing says.

Projected total program cost is approximately $6.4 billion in 1982 dollars. Service shares for research, development, test, and evaluation are forty percent for the Air Force and thirty percent each for the Army and Navy. The high costs are attributable mainly to the large number of weapon systems—150 different types of platforms—in the air, sea, and land forces that must be equipped with the IFF system. Cost estimates are based on a one-for-one replacement of equipment. The Army, however, is looking at its Mark XV requirement and may not replace all of its Mark XIIs. The Air Force projects that 17,000 interrogators and 24,000 transponders will be needed for all three services if a one-for-one replacement occurs.

The Mark XV design was selected as the most cost-effective solution to the Joint Staff requirements. It also satisfies the need for a system usable by all NATO forces. The Mark XV corrects the deficiencies of the existing system by incorporating a new secure IFF mode, the new civil air traffic control function, and the old IFF modes. It will have the following design features:

- A new, electronically keyed cryptographic unit.
- Short code-validity intervals to counter exploitation.
- Spread-spectrum waveforms for jam-resistance.
- A size compatible with the space allotted for the Mark XII.

Operational range is platform-dependent, but will be equal to or greater than weapon system primary sensor range.

The Congress, however, cut the Air Force FY '85 budget by $3.7 million and the Navy FY '85 budget by $7.2 million. DoD has asked key congressional leaders to allow reprogramming of the reductions in order to keep the program on track. "It is imperative that the US show resolve to demonstrate our commitment to the Mark XV," says one Air Force official.

The Frequency Problem

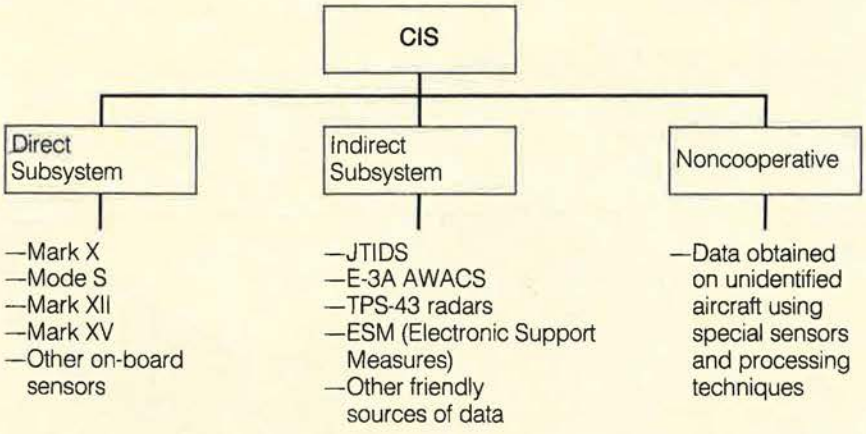
Defense experts on both sides of the Atlantic agree that a common NATO IFF system is essential. The major problem blocking a new Q-and-A system was selection of the operational frequency. The US position has been that the new system should operate in the same frequency band (D-band) as the current Mark X and Mark XII systems and that it should use some of the existing equipment.

A counterproposal made by the Germans was to go to a different frequency band (E/F-band), which would have required all new equipment and antennas. The Germans argued that the D-band is already crowded, with TACAN, DME, civil air traffic control networks, and present IFF equipment all using it. US authorities estimated that installation of E/F-band equipment in their helicopters, tactical aircraft, and defense systems would cost between $5 billion to $10 billion more than would the installation of a new D-band system.

The US is determined to field the D-band Mark XV system and has informed the Germans that their E/F-band proposal would be too expensive for serious consideration.

Allied Bendix Aerospace designer Bill Lins uses computer-aided design to transition circuits to the large-scale-integration (LSI) packaging required for the Mark XV IFF system, which must be made to fit into the space allocated for the current Mark XII system. (Allied Bendix photo by Bill Perich)

Organization of the US Combat Identification System



An eighteen-month technical study undertaken independently by Germany, France, the UK, and the US was completed in December 1984. The study focused on the frequency-band question and might have resolved the technical issues in the controversy. Instead, the study results became an issue.

According to press reports, recent tests demonstrated that German technical objections centering on the Mark XV's potential to interfere with German civil aviation radios and on its inability to perform to perfection in the face of enemy jamming were insufficient to make the vastly higher cost of an E/F-band radio worthwhile. "You get more performance from the E/F-band, but it's not worth the additional dollars," says one Air Force official familiar with CIS.

Other reported conclusions were:

- Interference caused by the Mark XV will be less than that from an equivalent use of the Mark X.
- Interference caused by the Mark XV is small compared to that caused by other factors, such as civil systems' self-interference.
- In those situations where the civil system does not meet desired standards, use of the E/F-band by the military would not solve the problem.
- Upgraded signal processors for the German civil system would improve the performance of the civil air traffic control system far more than moving the military systems to the E/F-band.

Additionally, there has been an underlying fear that a solution based on the US approach would allow US defense contractors to take over the program and leave European companies as subcontractors or second-source suppliers. In response to these concerns, the US cited the possibility of codevelopment and coproduction. A provision of the April 1 agreement is that Germany will receive "adequate compensation" for its previous work on an E/F-band system.

BVR Employment

To achieve air superiority through the 1990s and beyond, reliable IFF and beyond-visual-range (BVR) weapons that are capable of handling multiple targets are required. Aerial combat effectiveness can be improved if the identification capability extends beyond visual range, but still within range of advanced air-to-air missiles.

There is no other choice. The Air Force position is that the numerical superiority of the adversary demands that we be able to engage the enemy at long distance with our BVR weapons.

Part of the CIS program includes engineering development of techniques for reliable long-range identification of noncooperative targets in all weather and electronic countermeasures environments. "We will try to place some of the noncooperative techniques on aircraft as soon as possible," Colonel Ewing says.

The Air Force BVR employment concept against a numerically superior enemy is to use technologically superior, all-weather aircraft to launch air-to-air missiles when at the maximum employment range of the missiles but while still outside of a foe's missile employment envelope. The Air Force and Navy have such missiles for BVR work as the AIM-7F and AIM-7M, and they are also developing the AIM-120 (AMRAAM).

In the past, visual identification (VID) was the only positive means to differentiate between friendly, hostile, and neutral aircraft. VID had been acceptable because the enemy needed to get within a sixty-degree cone of a friendly's tail to shoot his IR weapons. With this constraint, good tactics and maneuverability would allow US fighter crews to engage a numerically superior force and attain favorable kill ratios. However, with the advent of all-aspect IR missiles, a within-visual-range air-to-air encounter is much more dangerous.

Absent a standard, reliable IFF system for all NATO aircraft, AMRAAM and even the Sparrow radar missiles now aboard USAFE air-superiority fighters would have limited utility in clear-sky engagements—and even less in combat at night or in weather.

"Our ultimate objective," says Colonel Ewing, "is to use our weapons more effectively by improving our target ID capabilities. After all, there are a lot more bad guys than good guys, and we can't afford to waste our weapons."

NATO is moving toward common IFF none too soon. ■

Maj. Michael B. Perini is Deputy Chief of the Operational Forces Branch in the Secretary of the Air Force's Office of Public Affairs. An Education With Industry officer with AIR FORCE *Magazine in 1982–83, Major Perini holds a bachelor's in social studies from Washington State University and a master's in social studies/education from the University of Southern Mississippi. He served as Chief of the Public Affairs Division of the 1st Tactical Fighter Wing at Langley AFB, Va., and has also served as a public affairs officer at Hill AFB, Utah, and Keesler AFB, Miss. He joined the Air Force in 1972 after receiving his commission through the AFROTC program.*

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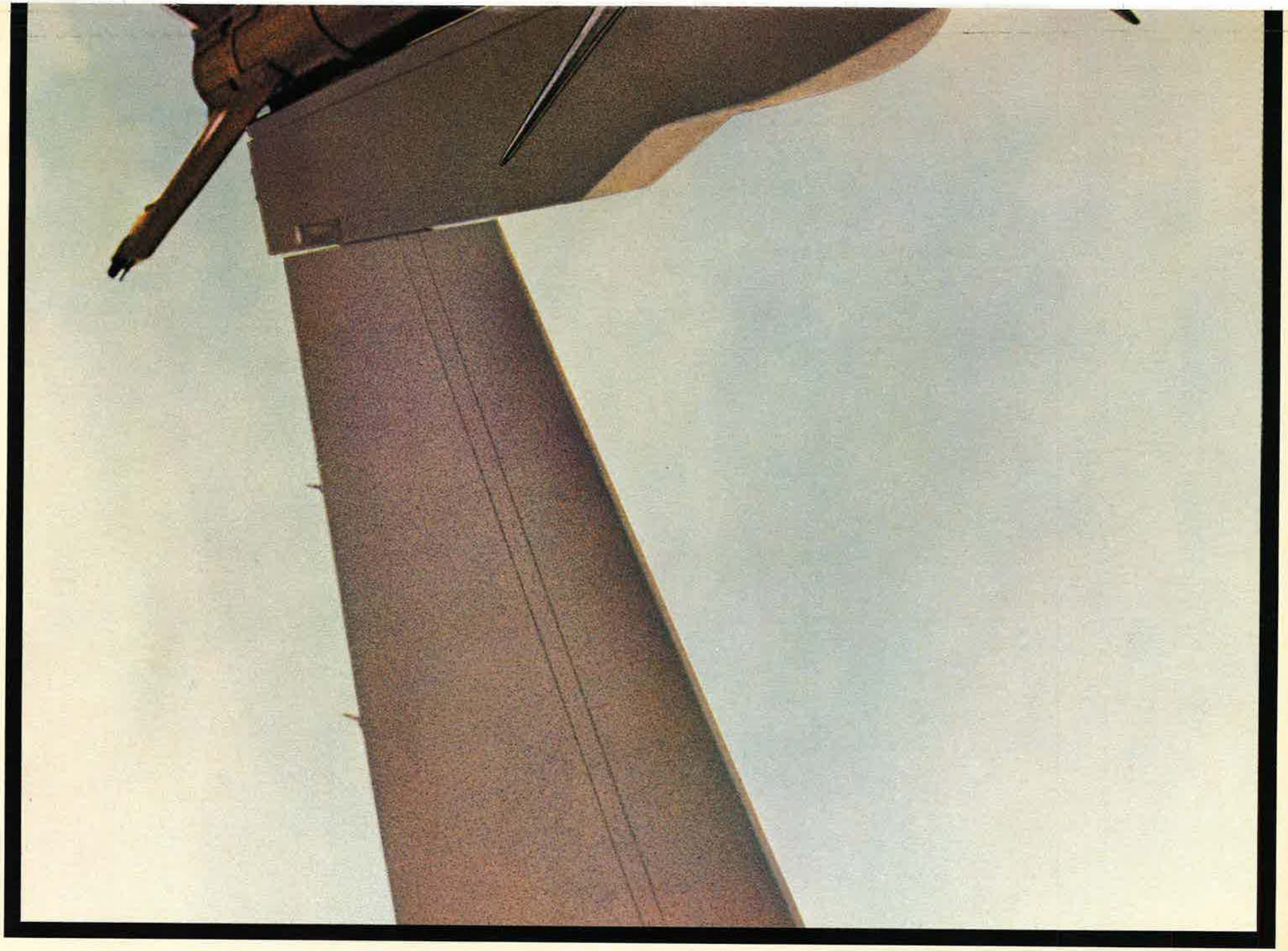
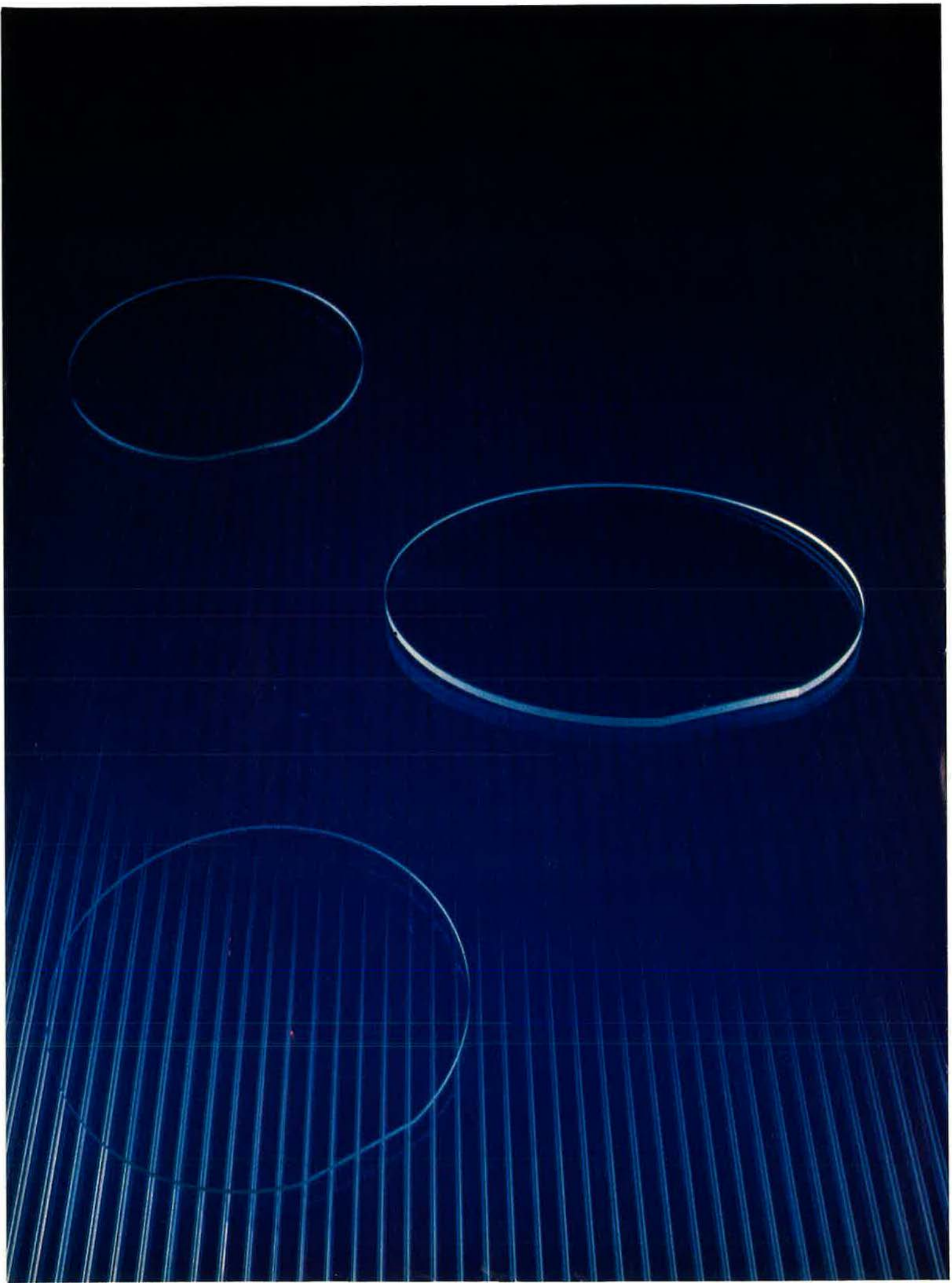




Tomorrow's machines will combine artificial intelligence with a great leap in processing power.

The Next Computer Generation

BY EDGAR ULSAMER
SENIOR EDITOR (POLICY & TECHNOLOGY)

THE prospects for advanced computers serving national security are clearly in the "you-ain't-seen-nothin'-yet" category. On the planning horizon of the Defense Advanced Research Projects Agency (DARPA) are computer systems with processing power up to 10,000 times as great as the largest current-generation computers. This coming generation of supercomputers, DARPA Director Dr. Robert S. Cooper predicts, will exhibit almost human-like capabilities to sense, reason, plan, and navigate. Above all, they will be able to react intelligently in the face of unexpected and unforeseen circumstances.

Such systems will be able to draw on human experience and expertise stored in massive memories called knowledge bases and will be able to interpret sensor and situational information, much as a human does, to determine what actions should be taken. As this supercomputer capability evolves, people and computers will operate as collaborative entities to control complex weapon systems.

As an example of such a "collaborative system," Dr. Cooper cites a "pilot's associate," which can respond to spoken commands by a pilot and carry them out without error by drawing on prodigious computer power and specific aircraft, sensor, and tactical knowledge stored in memory. Such a capability could free pilots to concentrate on tactics, leaving the computer to activate surveillance sensors, interpret radar, optical, and electronic intelligence, and prepare appropriate weapon systems to counter hostile aircraft or missiles—all automatically. This kind of man-machine collaboration could change the role of the human pilot from that of button-and-switch technician to that of aircraft commander who concentrates on the strategy for carrying out the overall mission.

DARPA's visionaries are also working toward super-intelligent computers that feature reasoning ability and natural-language communications so that military commanders can exploit these systems for military assess-

An abstract representation of gallium arsenide (GaAs) wafers produced by Westinghouse. Compared to silicon circuits, GaAs circuits offer higher radiation tolerance and a wider operating temperature range.

ment work. Machines of this type are expected to be able to simulate and predict the consequences of various proposed courses of military action. Commanders and their staffs, as a result, will be able to focus on the larger strategic issues rather than be inundated by the information flow from increasingly prolific sensor systems, according to Dr. Cooper.

Strategic Computing Program

At the root of DARPA's rosy view of next-generation computers is its Strategic Computing Program, which, over the first five years of its life, will cost about $600 million.

While the past decade has been marked by massive growth in defense computers—quantitatively as well as qualitatively—these machines are hobbled by inflexible program logic and limited in their ability to adapt to unanticipated enemy actions in the field. Exacerbating these weaknesses are the increasing pace and complexity of modern warfare.

The Strategic Computing Program tackles this problem with adaptive, intelligent computers that use parallel processing to cope with critical military applications. These new machines will be tailored to solve complex problems in reasoning. DARPA is working on symbolic processors that employ human knowledge stored in radically new memory systems in order to aid man in controlling the operation of complex military systems.

The next-generation computers understand connected human speech conveyed to them in straightforward language as well as "see" and understand optical images from TV and other sensors. Dr. Cooper is quick to point out that his agency has already demonstrated a limited voice message system, in which a computer recognized and understood human speech to receive its command. The computer was able to respond verbally, using synthesized speech, although it possessed only a limited vocabulary.

The Strategic Computing Program includes the development of several experimental high-performance computing machines in concert with low-power, radiation-hard, gallium arsenide microcircuit technology. Also, a new generation of hyperfast computer test-beds will be developed and demonstrated, including advanced speech understanding, vision systems, "expert" systems, natural-language man-machine interfaces, high-performance graphics, and defense applications of machine intelligence. Specific defense applications for machine intelligence planned by DARPA include such demanding tasks as battle management and the control of autonomous vehicles. Associated challenges include signal interpretation.

Autonomous Land Vehicle

One of the more startling facets of the DARPA program is the autonomous land vehicle (ALV). This scheme involves a technology demonstration vehicle that can operate independently and intelligently in complex terrain. Upon receiving general instructions, the vehicle—by using vision systems, image understanding, and expert route-planning capabilities—will execute a navigation plan to accomplish its mission.

Martin Marietta of Denver has been selected on a competitive basis as the ALV integration contractor. This entails integration of the work of several universities and industries.

The ALV, according to Dr. Cooper, at first will test the ability of a roving unmanned vehicle to travel on roads—and then across rough terrain—at reasonably high speeds by virtue of artificial intelligence and advanced computational capabilities. The vehicle is about to undergo field tests near Denver at speeds of about five kilometers per hour. Within a year, these operations will be carried out at speeds of about ten kilometers per hour. Eventually, this true robotic device will operate at speeds of up to sixty kilometers per hour.

The complexity of replicating the "intelligence" associated with driving a vehicle over rough and changing terrain is truly staggering. The operational rationale for such a vehicle includes autonomous deep penetration reconnaissance, rear-area resupply, ammunition handling, and weapons delivery—all of which are contingent on the ability to navigate up to fifty kilometers cross-country from one point to another.

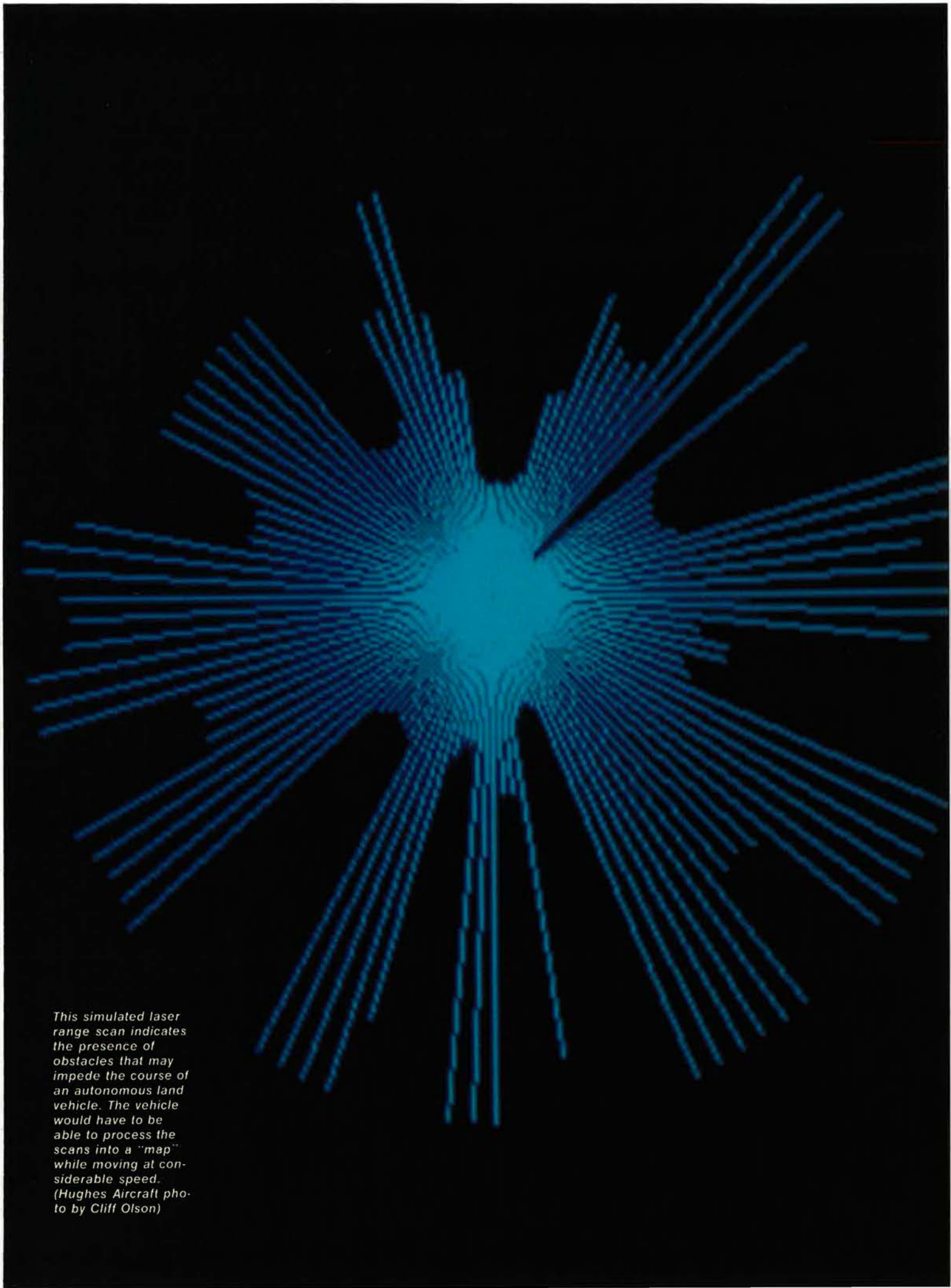
The ALV will have to be able to plan an initial route from digital terrain data and adjust its route according to real-time sensor information. This, in turn, entails resolving ambiguities between sensed and stored terrain data as well as incorporating landmark prediction and identification to aid in navigation. By assimilating advanced image sensing, the reconnaissance elements of the ALV will be able to perform such tasks as target identification and to report its findings and interpretations.

AI Requirements

In terms of "artificial intelligence," there arises the requirement for an "expert system" and a "vision system." The expert system must plan routes by using digital terrain and environmental data, plot strategies to avoid unanticipated obstacles, estimate the ALV's position, update the on-board digital terrain data base, generate moment-to-moment steering and speed commands, and monitor vehicle performance and on-board systems. Obviously, all these functions must be accomplished in real time or near real time.

This task—which would be routine for a human operator—becomes monumental for even tomorrow's advanced "intelligent" computers. DARPA's current assessment is that such an expert system demonstration would require on the order of 6,500 "rules firing at a rate of 7,000 rules per second." "Rules" represent the codification of an expert system process, and a "firing" indicates the examination, interpretation, and response to one rule in a particular context. In present-generation systems, the firing of one rule can require the execution of tens of thousands of instructions, and as tasks become more complex, the number of instructions for rule-firing increases.

The task of the autonomous vehicle's vision system is no cinch, either, for it must take in data from imaging sensors and interpret the information in real time to produce a symbolic description of the vehicle's environment. The system, for instance, must recognize roads and road boundaries, select, locate, and gauge fixed and moving obstacles in open or forested terrain, locate and identify man-made and natural landmarks, and produce thematic maps of the local environment while moving at



This simulated laser range scan indicates the presence of obstacles that may impede the course of an autonomous land vehicle. The vehicle would have to be able to process the scans into a "map" while moving at considerable speed. (Hughes Aircraft photo by Cliff Olson)

considerable speed. In the aggregate, the computational task of such a system goes up almost a thousandfold over what today's most powerful computers can handle.

What makes the problem even tougher is the need to hold down the weight, space, and power requirements of such computing systems. In the case of the ALV, the computers should occupy no more than a few cubic feet, should weigh less than 500 pounds, and should consume less than one kilowatt of power, including environmental support. This boils down to an across-the-board reduction by several orders of magnitude over the best current systems, according to DARPA.

Even if all this artificial intelligence were in hand, its capabilities would pale pitifully compared to what the human brain can do with far less space, weight, and "power consumption."

There is general agreement in the scientific community that the relatively massive, steady progress in increasing computing power at decreasing costs that was achieved over the past thirty years or so will run up against ineluctable limits by the end of this decade unless radically new concepts, materials, and fabrication and design methods are brought into play.

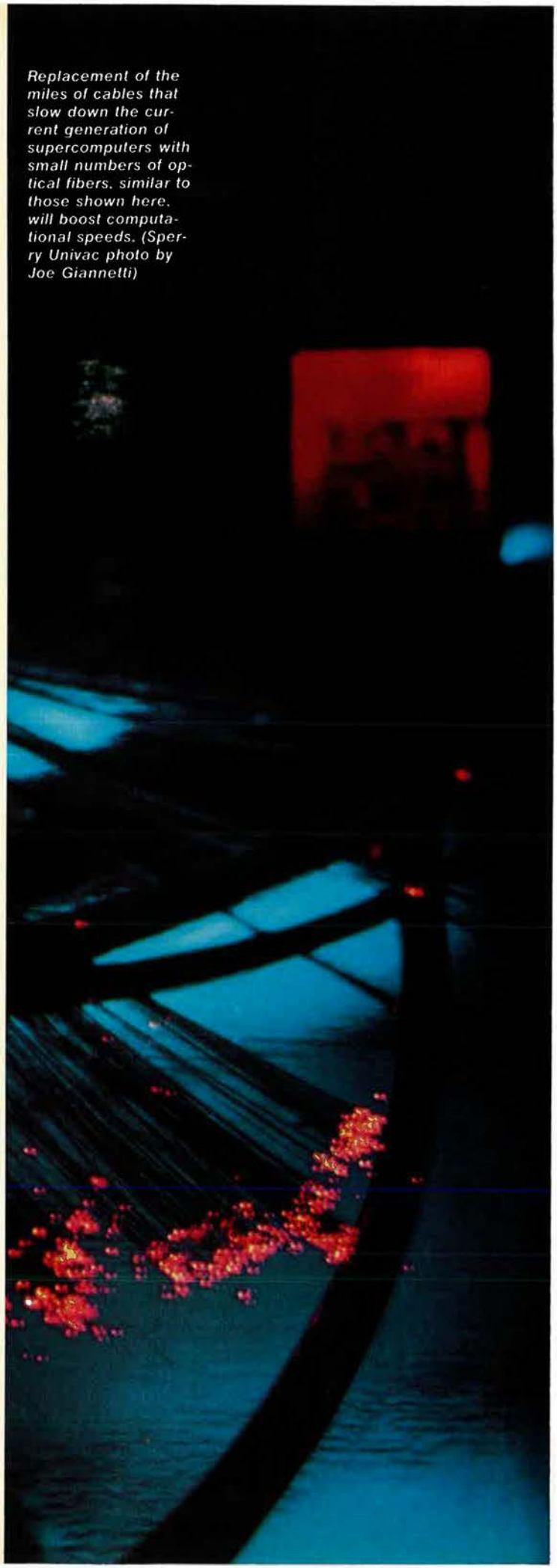
Around the Impasse

One route around the predicted impasse involves the replacement of wire cables with optical fibers and laser point-to-point communications for board-to-board and even chip-to-chip communications. DARPA is working on schemes that seek to replace the miles of cable that clutter up and slow down the current generation of supercomputers with a small number of optical fibers that step up computational speeds dramatically and, at the same time, make possible high-bandwidth communications. Hand in glove with this work goes pioneering research in "wafer-scale" computing structures that greatly increase the density of computing circuitry as well as make possible quicker access to secondary storage systems.

Another key facet of DARPA's work in support of the Strategic Computing Program centers on gallium arsenide (GaAs) and gallium aluminum arsenide (GaAlAs) technology. One major benefit of GaAs circuits compared to even the most sophisticated silicon technology is that their tolerance of radiation produced by nuclear weapons is about two orders of magnitude above that of the presently used technology.

In addition to the primary advantage of high radiation tolerance—a central requirement for space-based battle management and other strategic applications—GaAs-based microelectronics technologies produce circuits with a wider operating temperature range—meaning both higher and lower temperature capabilities than silicon—and faster switching speeds within a given chip at a given power level.

GaAs-based microelectronics are deemed essential for high speed and very low power very-large-scale integrated (VLSI) circuits that, in turn, are demanded by the rapid information processing rates associated with artificial intelligence. Two contractors—Rockwell and Honeywell—are working on GaAs pilot-line facilities. Responsibility for this work was transferred recently from DARPA to the Strategic Defense Initiative Organization (SDIO).



Replacement of the miles of cables that slow down the current generation of supercomputers with small numbers of optical fibers, similar to those shown here, will boost computational speeds. (Sperry Univac photo by Joe Giannetti)

TI's HARM missile keeps Air Force pilots out of harm's way

When you scramble off that runway in your F-4G Wild Weasel it's nice to know that those HARM missiles under your wing can truly make you the hunter rather than the hunted.

With HARM's long range, high speed, broad frequency coverage, and onboard software adaptability against existing and future radar threats, the tactical potential of the missile is limited only by the imagination.

The range of the missile and the sensitivity of the seeker, coupled with the programming and control of the missile by the highly effective APR-38 Receiver Set, make HARM an excellent hunter killer asset to keep you out of harm's way.

TI, as Weapon System Integrator for this joint U.S. Navy/U.S. Air Force program, is in full-scale production and is delivering missiles to F-4G Wild Weasel squadrons where HARM has proven extraordinarily reliable in the completion of defense suppression missions.

Texas Instruments is proud of its long association with the U.S. Air Force and proud to be able to add this highly reliable defense suppression weapon to the Air Force Inventory.

TEXAS INSTRUMENTS

27-3455

Which company explores new technologies for weapon system support?

The Integrated Diagnostic Support System termed "IDSS" represents a major technological achievement for the next generation of test systems. This new concept incorporates methods of collecting knowledge about the weapon system and processes it in a way that resembles human reasoning. Once established, the IDSS knowledge base is used to detect and diagnose weapon systems failures.

Harris is consistently exploring new and innovative ways of improving test technology, and the IDSS is just one example. Harris Corporation, Government Support Systems Division, 6801 Jericho Turnpike, Syosset, Long Island, NY 11791. 516-364-0400.

HARRIS

For your information, our name is Harris.

Complementing the fast pulse response of GaAs-based large-scale integrated components are new chip-packaging concepts, according to Dr. Cooper. Eventually, however, DARPA hopes to eliminate chip packaging altogether so that high-speed chips can be placed directly onto low dielectric, constant electronic boards.

Thinking Harder and Faster

These advanced support technologies, DARPA expects, will lead to wafer-level circuits containing more than 1,000,000 transistors. They will be stepping-stones to so-called "coarse-mesh" machines that consist of multiple microprocessors, or multiprocessors, that are able to work on the same problem simultaneously. The result is an increase in computational power by a factor of 100 over current systems.

By creating special VLSI chip designs containing multiple "fine-mesh" processors, by populating entire wafers with hundreds of such chips, and by using high-bandwidth opto-electronic cables to interconnect groups of wafers, increases of three or four orders of magnitude in symbol processing and rule-firing rates appear feasible. These architectures, which are designed for concurrency and faster, denser VLSI microelectronics, enable the DARPA computer to "think harder and faster," according to Dr. Cooper.

But artificial intelligence can't get by with machines that merely mimic—at a very primitive level—human thought and heuristic—or learning—processes. Equally important are sensory devices that perform the functions of eyes and ears. Clearly, enormous computer processing rates will be required to provide effective machine vision and machine understanding of natural language.

By squeezing a multitude of tiny special processors on a single chip, DARPA is creating a form of simple machine vision that is similar to that in the retina of the eye. Instead of each image picture element (pixel) being processed sequentially—as is the case with conventional computers—the new processor arrays allow thousands of pixels to be assimilated simultaneously. Each image pixel is processed by just a few transistor switches located close together in a processor cell that communicates over short distances with neighboring cells. The number of transistors required to process each pixel can probably be driven down to about one one-thousandth of that employed in a conventional, von Neumann-type computer. Also, the short communications distances lead to much faster processing rates per pixel.

These vast gains stem largely from concurrency. Within a few years, DARPA predicts that it will have in operation vision subsystems with rates as high as one trillion von Neumann-equivalent operations per second.

At the computer architecture level, DARPA recently initiated exploratory development work on a wide range of dual-use machine architectures capable of high-speed multiprocessing for both massive "number-crunching" as well as artificial intelligence applications. One of the prototypes of this advanced approach that DARPA expects to begin testing later this year is the WARP machine. This machine contains ten cells that together will be able to perform 100 MFLOPS (million floating-point operations per second).

Another DARPA-funded multiprocessor prototype that is an essential element of the Strategic Computing Program is the Butterfly Multiprocessor built by Bolt, Beranek, and Neuman Inc. This 128-node machine uses commercial multiprocessors and custom-designed VLSI switching circuits. Butterfly is the first large-scale multiprocessor architecture germinated by the Strategic Computing Program and is suited equally for numerical and symbolic processing.

Yet a third multiprocessor prototype funded by DARPA is known as the "Connection Machine"—a very fine-grain parallel computer architecture designed for machine-intelligence applications requiring processing capabilities several orders of magnitude greater than those of current state-of-the-art computers. The 64,000-processor prototype connection machine will have approximately a thousand times the logical inference performance capability of current systems. Future connection machines will be designed with a custom VLSI circuit capable of tying together one million processors, according to Dr. Cooper. DARPA recently picked six other different designs for further analysis and test. All are prototypes of multiuse machines suitable for both numerical and symbolic processing.

Stoking the Technological Fires

DARPA treats the Strategic Computing Program as a cooperative effort among American industry, universities, other research organizations, and government. As Dr. Cooper points out, DARPA is using a competitive process to encourage universities and mainframe (large computer) manufacturers to team in a fashion that will generate both innovative design approaches as well as "manufacturable" computers.

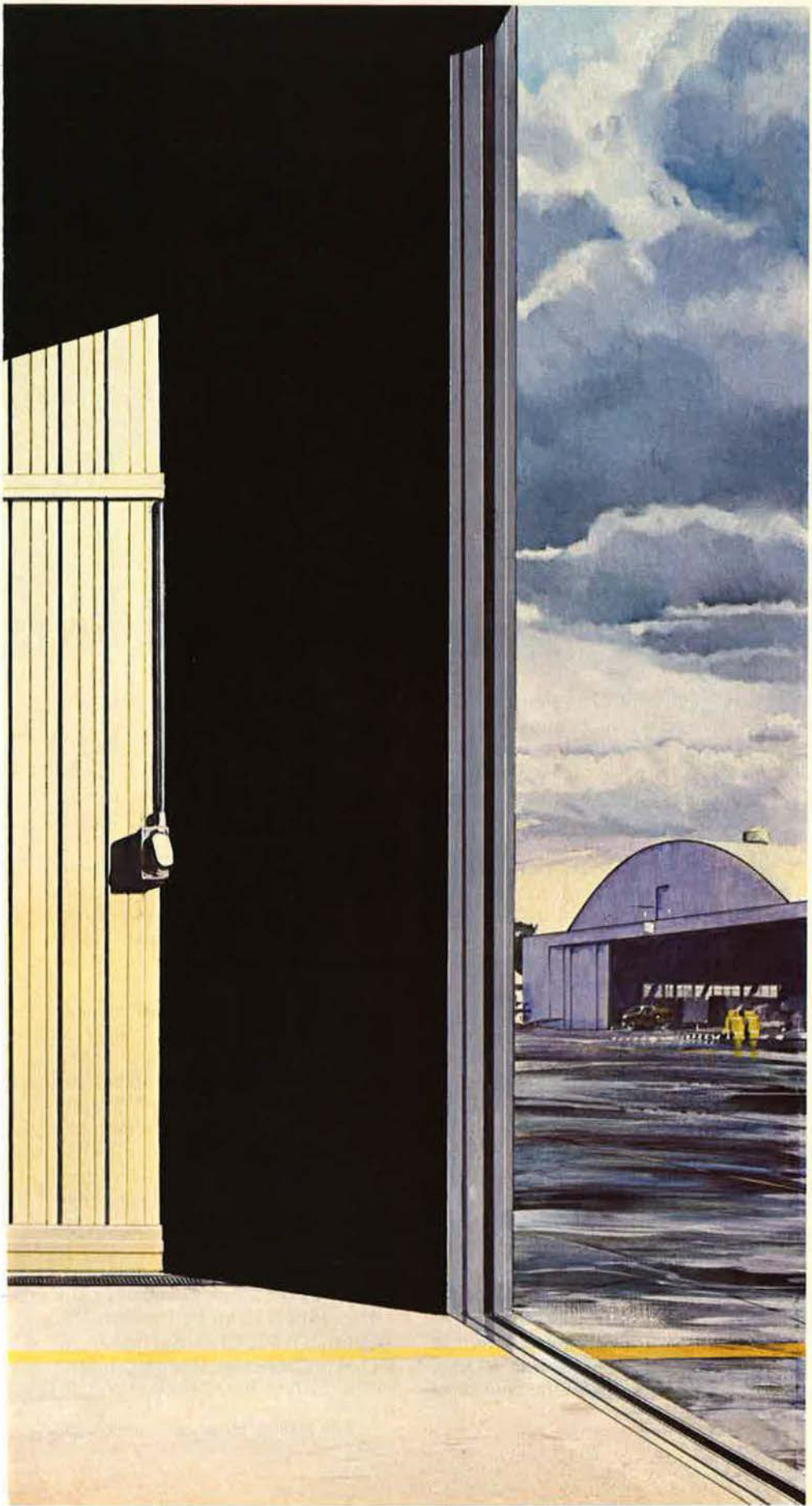
The program's increased 1986 funding—about $200 million—is, as the DARPA Director told Congress, "particularly critical in this area, because without it, these teams will dissolve as the senior and most able people are reabsorbed into their organizations." Of similar importance is DARPA's ability to widen participation in the Strategic Computing Program by attracting creative new talent from among graduate students and faculty. The Agency hopes to double the number of graduate students working on this and related DARPA research projects in each of the next two fiscal years.

As Dr. Cooper readily admits, "Developing a well integrated program which spans the range from microelectronics to machine architectures to artificial intelligence and then demonstrations has not been easy. The program is still a risky one, with planned invention and interlocked milestones, but one which is aggressive and forward-looking in an area in which the Defense Department can exploit a substantial technical advantage over the Soviet Union."

Aside from the overarching national security considerations that make the Strategic Computing Program so essential, this DARPA effort also affects America's future competitive stance in microelectronics and computer technology across the board, especially in the new, pervasive area of artificial intelligence. In Dr. Cooper's view, Japan and Western Europe will have "a number of years of learning to do" before they will be able to duplicate DARPA's Strategic Computing Program, which should prove the key to new generations of "intelligent machines." ■

THE BOEING ATF CAN KEEP OUR

DEFENSE SYSTEM IN THE AIR. NOT ON THE GROUND.



If a fighter is grounded for maintenance, our country could be left scrambling for defense.

The advanced tactical fighter (ATF) can change that. Because it's designed to be more reliable. To be flight-ready time after time.

But for the ATF to be an ultra-reliable aircraft, it must go beyond today's technology. That's why Boeing is the one contractor that's too valuable to ignore.

Our strength is the tremendous resources of our company. Resources responsible for winning and performing 325 advanced fighter technology contracts in the last ten years.

Resources that are already hard at work on composite plastics for a lighter, stronger airframe with 50% fewer fasteners and parts.

Resources that have put Boeing at the forefront of built-in test equipment, which will provide the ATF with onboard diagnostic capability.

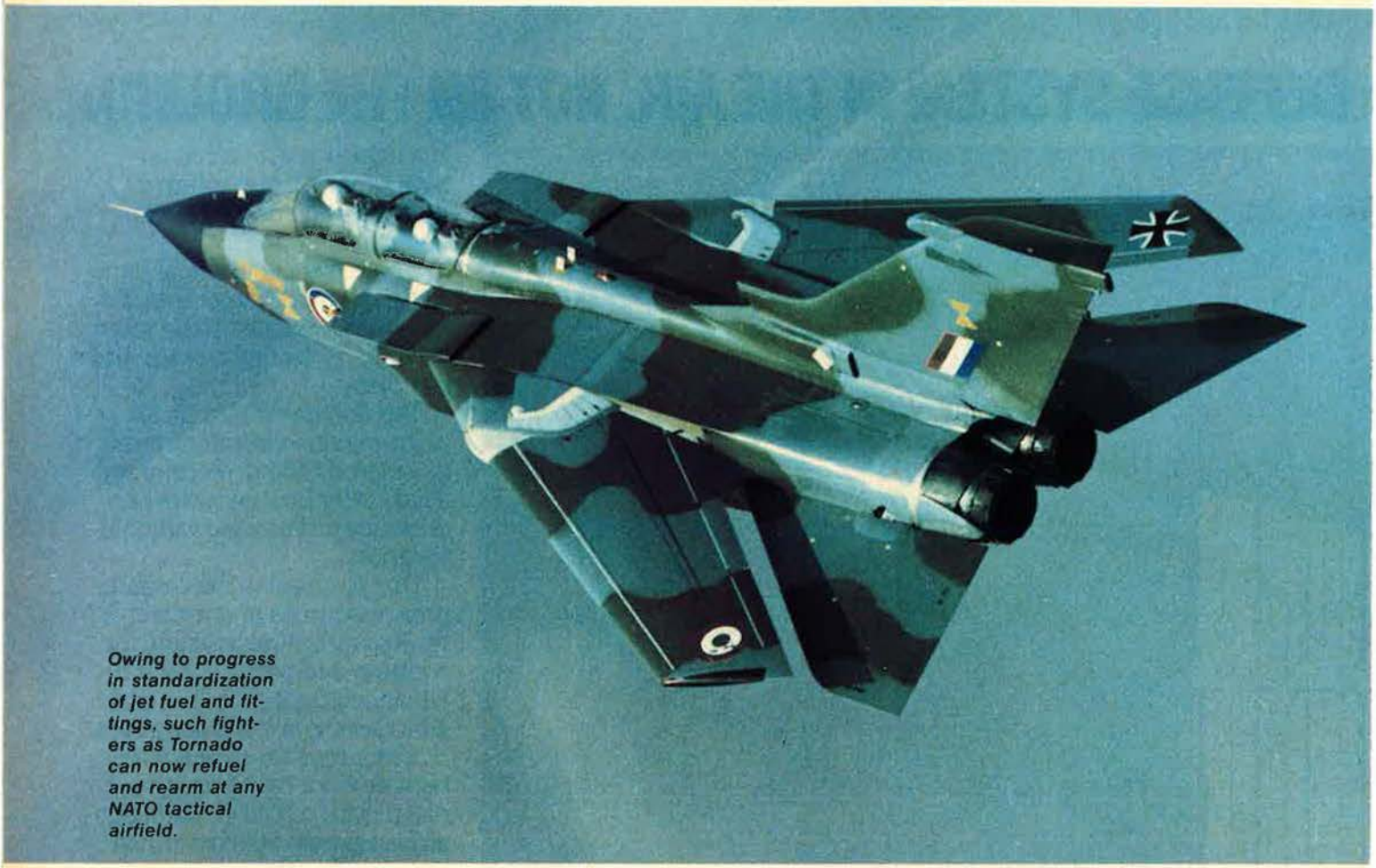
Resources that have combined electronic functions into fewer microchips, which require less maintenance.

All of which will help the ATF have 40% of the maintenance requirements on its airframe and avionics compared to current fighters. Sixty percent of the maintenance on mechanical and electrical equipment.

In fact, in 1995, with its improved reliability and greater performance, the Boeing ATF will be four times as effective as our current fighters.

With our country's defense at stake, we need the most reliable fighter available. And the most reliable contractor to build it. The ATF and Boeing.

BOEING



Owing to progress in standardization of jet fuel and fittings, such fighters as Tornado can now refuel and rearm at any NATO tactical airfield.

"NATO standardization" has become such a timeworn old saw that all progress toward it is met with reflexive skepticism and goes widely unremarked, even when the Pentagon is at pains to point it out. Such is currently the case.

In fact, evidence of such progress is building all the while. There is not a great mass of it, but enough to raise hopes for fairly extensive operational compatibility by the 1990s among the weapons, communications, munitions, and other gear of NATO's multinational military forces.

For example, NATO fighters can now refuel and rearm, thanks to standardized jet fuel and fittings, at any NATO tactical airfield. Just a few years ago, they couldn't. All NATO warships now use interchangeable fuel.

Moreover, the US and its NATO allies have been working hard to integrate command control and communications (C^3) networks step by step and have embarked on the dead-serious task of devising a completely common NATO air command and control system (ACCS) by the end of this century.

These are important developments. They get at the nitty-gritty of improving NATO's efficiency and effectiveness as a confederation of national fighting forces. But they are usually overlooked in the context of standardization, which is often regarded as more synonymous with transatlantic trade in—and multinational deployment of—major weapon systems.

A prime example of such deployment is the relatively new and highly integrated NATO Airborne Early Warning (NAEW) force composed of US E-3A AWACS aircraft and updated British Nimrod aircraft. Indicative of an increasingly noticeable movement toward Alliance-wide procurement programs, the AWACS procurement was funded by NATO as a whole, including the US, and not willy-nilly by its individual nations, as was too often the case in the past. In economic terms, it clearly was of greatest benefit to Boeing, which builds the E-3As, and to the US. But in the context of standardization, it was a great boon to the Alliance at large.

US participation in NATO AWACS procurement is, in fact, part of the evidence of increasing evenhandedness in transatlantic trade.

Although still far from rush-hour proportions, traffic is picking up in the Europe-to-America lane of the so-called (and often derided) "two-way street" of armaments exchange.

The US armed forces are buying and evaluating a widening range of weapons, munitions, and other equipment designed and manufactured in Western Europe. US companies are producing more military systems for US forces under licensing arrangements with Western European companies, with increasingly favorable terms for those companies.

Early this year, in his rather upbeat report to Congress on "Standardization of Equipment Within NATO," US Secretary of Defense Caspar W. Weinberger emphasized that multinational collab-

Amid skepticism and without much fanfare, the Alliance is finally making real gains in standardization.

Increasingly Interoperable NATO

BY JAMES W. CANAN, SENIOR EDITOR

oration on armaments is "a major factor in enhancing standardization within NATO." Claiming "progress" in this, he went on to say:

"We must sustain our armaments cooperation initiative by developing broader support for such efforts here at home and by convincing our allies that we are serious about addressing the problems of equitable transatlantic trade."

Recalculating the Ratio

The signs of such seriousness are showing up. US officials now claim, for example, that the dollar value of US-made military equipment being bought by the European allies is only three to four times greater than that of European-made equipment being bought by the US. This is in sharp contrast to the pro-US exchange ratios—ranging anywhere from six to one to nine to one—that are usually cited in Europe, perhaps out of habit, as proof of US military and economic parochialism.

In addition, US officials point out that the US dollar, persistently very strong, has given Western Europe a big advantage—and an overwhelmingly favorable balance—in overall trade with the US.

Even so, concedes a Pentagon NATO specialist, "It is true that the equipment they [the Europeans] buy from us tends to be big and expensive, but not the other way around." An examination of transatlantic procurement in the past, strictly in terms of its impact on standardization, bears this out.

Attempts to standardize NATO weapons in a major way have usually succeeded only when the Europeans bought such high-dollar US systems as F-104 and F-4 fighters, Hawk surface-to-air missiles, and Harpoon antiship missiles or coproduced such items as AIM-9L Sidewinder air-to-air missiles and F-16 fighters.

On the other hand, when standardization-enhancing deals have failed, it has usually been a case of the US rejecting European-made systems. Prime examples are the West German Leopard II main battle tank, the German-French Roland surface-to-air missile system, the British-German-Italian Tornado aircraft, and the British JP-233 airfield-attack system.

This track record is the reason for the Western European industrial nations' growing determination to cooperate among themselves, to the exclusion of the US, in developing and producing major weapon systems for their common deployment.

They see this shoulder-to-shoulder tactic—evident in such programs as the five-nation European Fighter Aircraft (EFA) and in the evolution of all-European industrial consortia for making missiles—as the way for them to find homes for their very good military technologies. They also see it as their only means of producing weapon systems embodying those technologies on a scale large enough to make the systems affordable to their military services. Finally, they hope that such cooperative, Europe-only arrangements will have more marketing muscle in the Third World and in the US itself.

For instance, France's Aerospatiale and West Germany's Mes-

serschmitt-Bölkow-Blohm (MBB) formed the Euromissile consortium in the 1970s to build and market the Milan and HOT antitank missiles and the Roland. Euromissile is currently trying hard to sell the Milan to the US Army and the US Marines as a replacement for the Dragon antitank missile.

Five years ago, Britain's Aerospace Dynamics Group joined Aerospatiale and MBB in the newly formed Euromissile Dynamics Group (EMDG) consortium to take part in the Milan program and also, more importantly, to share in the development and production of an advanced antitank missile called Trigat.

Trigat is designed to satisfy an urgent military requirement jointly articulated by the UK, France, and West Germany, and having nothing to do with the US.

This Europeans-together trend is almost certain to continue. It will surely make for greater standardization among European systems and will just as surely make European and US systems all the more disparate.

From the purely military standpoint, neither NATO Europe nor the US wants to see this happen. Economics will drive it to happen, however, unless Washington works harder to stop it. This is why the US armed forces—at the prodding of the Office of the Secretary of Defense—are increasingly in the market for European military products.

One key to this is OSD's Foreign Weapons Evaluation (FWE) program.

Since its inception five years ago, the FWE program has elicited US purchases of eighteen items of European-made equipment with an off-the-shelf procurement value of $1 billion. Nearly one-third of such equipment was ordered last year alone.

All those buys saved the US big dollars because of R&D already done in Europe—an important consideration for the Pentagon at a time of soaring US R&D costs and of tightening constraints on US defense spending.

Examples of European-made weapons and supporting equipment now firmly destined for or actually entering US inventories are more and more numerous. The US Air Force can lay claim to some big ones that greatly helped narrow the gap in transatlantic arms sales.

USAF is buying thirty-two British Aerospace Rapier short-range all-weather missile systems and supporting equipment to provide for the defense of US air bases in the UK. This is a good deal for Britain in more ways than one. The Royal Air Force will man and maintain the missiles in return for a cut in the price the UK pays for US-built Trident submarine-launched ballistic missiles.

The first USAF Rapier squadron went operational in the UK last November. Also at that time, the US and Turkey signed an agreement under which the US will buy Rapier fire units to be operated by the Turkish air force in defending US air bases in Turkey. At this writing, the numbers of such fire units had yet to be worked out, but were said to be significant. Turkey already fields Rapiers to defend its own air bases.

The air defense arena is a fruitful one for arms collaboration. Last summer, the US agreed to provide Germany with twelve Raytheon-built Patriot missile fire units for operational deployment, plus two more units for training, in return for Germany's outright purchase of an equal number of such units.

Moreover, Germany has agreed to operate twenty-seven Euromissile-built Roland fire units on two USAF main operating bases and one forward operating location in Germany. Germany also will buy and man sixty-eight Roland fire units to defend German air bases—six of which are USAF collocated air bases.

Airfield-attack munitions also command greater cross-Atlantic attention. Two years ago, USAF began ordering Durandal—a rocket-assisted, runway-cratering munition—from France's Matra as a first step in improving its capability to destroy enemy air bases. It plans to buy about 4,500 Durandal units by the end of the current fiscal year and anticipates buying 18,000 more in future years at a total price of about $500 million.

Meanwhile, USAF is earnestly evaluating several other European-made munitions. They include German STABO and British SG-357 runway-cratering munitions, German MUSPA and British HB 876 area-denial mines, the German Low-Altitude Dispensing System (LADS), and Norwegian 30-mm multipurpose ammunition.

A dozen other European products are also being considered by USAF and range from German millimeter-wave communications equipment to German, French, British, Norwegian, and Dutch chemical defense equipment. USAF is presently installing British Marconi wide-angle head-up displays (HUDs) in its new F-16C/D aircraft and plans to buy about 1,200 of them through 1993. It also plans to buy Marconi wide-angle raster HUDs for F-16s that will be equipped with the Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) system.

Progress With EIFEL

To the gratification of US Air Forces in Europe (USAFE) and the West German Air Force, the US Department of Defense and the West German Defense Ministry have joined in upgrading and standardizing the air command and control system used by all four Allied Tactical Operations Centers (ATOCs) in NATO's Central Region.

Called EIFEL, it is a German-developed data-management system that automates tactical-air C^2 functions. The new US-German "EIFEL Follow-On" program, being supervised by Air Force Systems Command's Electronic Systems Division in Europe, will result in "a completely standardized system based on the most advanced technology," Secretary Weinberger reported to Congress this year.

A big, nagging problem for allied air forces in Europe has been the NATO nations' inability to cooperate in deciding upon a common, reliable identification friend or foe (IFF) system for their tactical air arms *(see p. 80)*. Not long ago, however, Pentagon officials were hinting that a solution to the IFF impasse was drawing nearer. When it happens, it will mark a major step forward in the NATO standardization process and, concomitantly, in the combat effectiveness of allied air forces.

USAF's moves in recent years toward greater cooperation with the European allies are underscored by

its decision to reengine its KC-135 tanker aircraft with engines jointly produced by General Electric Co. and France's SNECMA. USAF's sister services are showing that they, too, are increasingly active in tapping the European market for defense equipment.

Next August, the first US Army M1 Abrams main battle tank equipped with a German-made smooth-bore 120-mm gun is scheduled to roll off the General Dynamics tank production line, with many more to follow. Since NATO's combined armored force is preponderantly German and American, the eventual introduction in Europe of US tanks with the same guns and ammunition now used by German tanks will mark a major milestone in the advancement of NATO weapons interoperability.

A German company is under contract to build ten-ton trucks for US Pershing II missiles and ground-launched cruise missiles (GLCMs) in Europe. The US Army has also studied a British 105-mm "light gun" artillery piece for possible future deployment with infantry, airborne, and airmobile divisions.

The Army is already buying Belgian 7.62-mm machine guns for its Abrams tanks, Bradley Fighting Vehicles, and older M60 and M48 tanks. It has also contracted for the Belgian Squad Automatic Weapon (SAW), a man-portable machine gun that fires 5.56-mm rounds (now the standard for NATO infantry weapons), and for Italian 9-mm Beretta pistols to replace its large inventory of .45-caliber and .38-caliber sidearms.

The US Marine Corps is scrutinizing European medium and light antiarmor weapons. Among them is Euromissile's Milan shoulder-fired missile.

Navy Shops Busily

In shopping for aircraft of European origin, the US Navy has been the busiest. It has signed up to buy 300 British Aerospace T-45A Hawk trainer aircraft and for 328 BAe AV-8B Harrier V/STOL fighters to be used by the US Marines.

The Hawks and Harriers are being assembled by McDonnell Douglas under license to BAe. However, the British company's work on both, and thus its proceeds, is extensive. It is building all Hawk and Harrier fuselages. Moreover, the US Navy's participation in the Harrier program expands its scale and thus lowers the unit costs of the 100 Harriers that BAe is also scheduled to build for the RAF.

Subcontractors on both programs are extensively British as well. For example, Rolls-Royce will provide all engines. Total acquisition costs for the Hawks and Harriers are expected to approach $8 billion.

Under yet another noteworthy transatlantic licensing arrangement, FMC Corp. is turning out 75-mm, rapid-fire shipboard gun mounts developed by Italy's OTO Melara. Customers are the US Navy and the US Coast Guard.

The Coast Guard has also contracted for ninety French Aerospatiale helicopters. This $290 million program shows up on the US Department of Transportation's ledgers, not on the Pentagon's. Thus, it is not reflected in Department of Defense evaluations of US-Europe weapons-trade ratios.

Looking to the future, the US Navy is taking part in a NATO project to design a standardized major weapon system from scratch. Called the NATO Frigate Replacement (NFR) project, it is a joint effort by Canada, France, Germany, Italy, the Netherlands, Spain, the UK, and the US to design and build a frigate-class combatant to meet the maritime threat foreseen for NATO in the final decade of this century.

The eight nations formally agreed on a feasibility study in April 1984. It is being carried out by a Hamburg-based naval design group and is scheduled for completion next October.

The NATO frigate is expected to carry electronics and weapons suites of largely European origin and of greater sophistication than those now aboard the warships of individual NATO fleets.

It is in the naval context, too, that an especially striking "buy European" breakthrough has now come about. Norway's Penguin antiship missile is the star player.

An infrared missile with advanced seekers and a range of about eighteen nautical miles, the Penguin is deployed by the fleets of Norway, Greece, Sweden, and Turkey. Norway began trying to sell it to the US Navy as far back as the late 1970s. Now it has succeeded.

At this writing, the Navy has agreed to buy about 200 Penguin missiles at a price—in 1985 dollars—of about $300,000 apiece. They will be variants designed by

The F-16 is truly a multinational fighter. USAF is presently installing British Marconi wide-angle head-up displays (HUDs) in its new F-16C/Ds.

Norway's Kongsberg Vaapenfabrikk for carriage by helicopters. The Navy will take them to sea aboard its new IBM/Sikorsky Seahawk antisubmarine-warfare (ASW) choppers.

Much bigger US buys of Penguin missiles may be in the offing. The Norwegian company has developed yet another variant of the Penguin, which started out as strictly a shipboard weapon many years ago, for carriage aboard Norwegian F-16 fighters. In fact, all 450 operational F-16s in the Norwegian, Danish, Belgian, and Dutch air forces are outfitted for Penguins—and the US Air Force is interested in the missiles for its F-16s.

At this writing, USAF had completed a draft of a Memorandum of Understanding (MOU) with Norway to conduct a joint evaluation of the Penguin at Eglin AFB, Fla. Should USAF wind up buying Penguins, they would probably be assembled in the US by Grumman Corp. under license to Kongsberg Vaapenfabrikk.

Family of Missiles

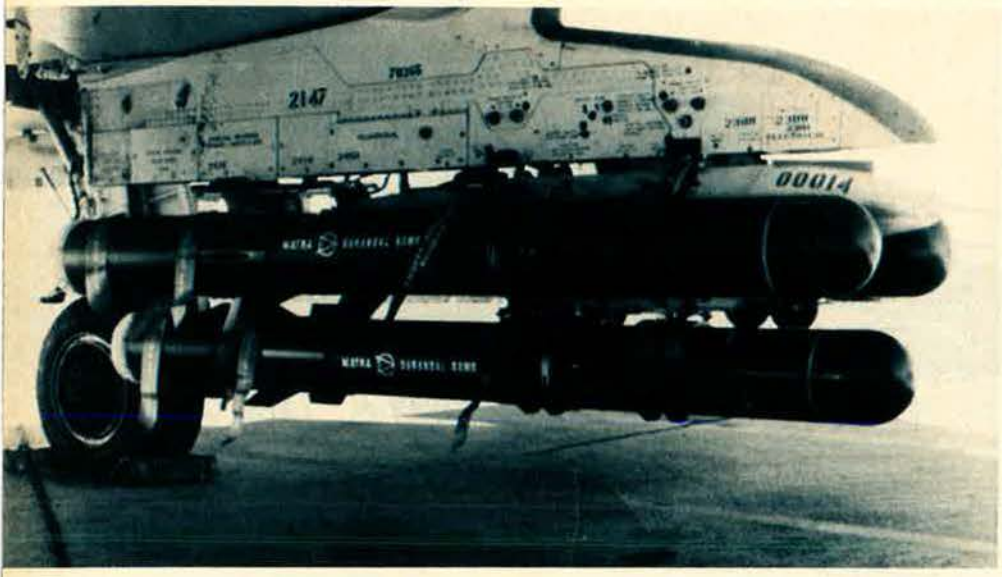
Missiles of many varieties are major players in the unfolding story of transatlantic arms collaboration in "families of weapons"—a story that began in a big way five years ago.

In August 1980, the US signed an MOU with France, Germany, and the UK for a "family of advanced air-to-air missiles." Under it, the US is developing the radar-guided, beyond-visual-range (BVR) Advanced Medium-Range Air-to-Air Missile (AMRAAM) for eventual use by all four signatory nations and by any others that may want to buy it off the shelf, coproduce it, or assemble it in Europe.

At the same time, Germany and the UK agreed to join in developing the infrared Advanced Short-Range Air-to-Air Missile (ASRAAM) on comparable terms, with the US a potential coproducer.

Even though AMRAAM has encountered problems of cost and scheduling, it seems almost a sure bet for production, sooner or later, because the need for it in NATO has become so dire in the face of the Soviet threat. USAF is proposing to begin low-level production in FY '86, which begins next October 1.

Last summer, British Aerospace was selected as the lead contractor in a consortium of four European companies studying the potential for European manufacture of AMRAAM. The other companies are the UK's Marconi Space and Defence Systems and Germany's MBB and AEG-Telefunken.



French-built Matra Durandal runway-busting munitions hang from an F-4. USAF plans to purchase about 4,500 Durandal units by the end of the fiscal year.

All are involved one way or another in the ASRAAM program, too. A Pentagon NATO expert claims that even though it "ran slowly for a time, like AMRAAM," the UK and Germany have now plunged into its formal development and have put it "back on track."

In a classically collaborative program of high promise, not only for standardization but for ground combat capability as well, the US, the UK, France, Germany, and Italy are moving forward fast on codevelopment of the NATO Multiple-Launch Rocket System (MLRS). It is an all-weather, rapid-fire, nonnuclear weapon designed, as the Pentagon puts it, "to supplement other weapons available to the division or corps commander for the delivery of a large volume of fire in a very short time against critical, time-sensitive targets."

The armies of all nations in the MLRS program have formally agreed that their combined, increasingly exacting tactical requirements on the ground in Europe demand common deployment of the weapon system as soon as possible. They have divided the program into three manageable phases.

In the first, the US Army is developing the basic MLRS system, which is integrated by LTV Aerospace and Defense and consists of free-flying rockets and conventional warheads.

In the second, Germany is developing the AT II "scatterable" antitank warhead for the rocket.

In the third, a terminally guided warhead (TGW) is being developed by a four-nation consortium. Called the MDTT Joint Venture, it consists of the US's Martin Marietta, the United Kingdom's Thorn EMI Electronics, France's Brandt Armements, and Germany's Diehl GmbH & Co.

The TGW program has done well and entered its demonstration validation phase last September.

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For the US, this exigency is the *raison d'être* of the Army-Air Force Joint Surveillance and Target Attack Radar System (JSTARS) program. It has very high priority in both services.

Meanwhile, however, France is developing Orchidee, a moving-target-indicator (MTI) surveillance radar system to be carried on helicopters. The UK is evaluating proposals for yet another MTI system, called Castor.

NATO's military leaders have decided that they had better make sure of the future interoperability of JSTARS, Orchidee, and Castor. The NATO Army Armaments Group has formed a staff team to size up the situation. It will set forth NATO's surveillance and target-attack requirements in relation to the various national programs aimed at satisfying national requirements.

This makes a major point with respect to NATO standardization and interoperability. As a Pentagon NATO analyst expressed it:

"In the past, technology wagged strategy and tactics in NATO on a nation-by-nation basis. Now it's the other way around. SACEUR [the Supreme Allied Commander Europe, US Army Gen. Bernard W. Rogers] has done a good job of getting the nations together on NATO-wide military mission requirements. From these come NATO long-term planning guidelines and mission-needs documents, explained in [NATO's] Allied Tactical Publications.

"So what you now have is the combined NATO military defining how it plans to fight the war, stating military requirements, and ordering up the technologies to meet those requirements."

General Rogers's relatively new Follow-On Forces Attack (FOFA) tactical concept, now rapidly firming up as NATO's tactical doctrine, is the driver in this turnaround of the technology-mission relationship in the NATO Alliance's way of operating.

Reliant on very fast, very precise intelligence on enemy infantry, armor, and air movements not only at the front but also far behind it in enemy territory, the FOFA doctrine would have NATO air forces and land-based missiles interdict enemy second-echelon and third-echelon elements with nonnuclear munitions and submunitions before they can reinforce front-line assault units trying to move westward.

The whole idea behind FOFA is to give SACEUR's combat forces a great deal more nonnuclear capability to withstand a Warsaw Pact attack, thus raising the nuclear threshold in Europe.

The problem right now is that the surveillance-targeting systems and the nonnuclear interdiction weapons available to SACEUR, while better than ever, won't hack it in executing FOFA.

This is why such systems as JSTARS and the MLRS are so urgently needed. It is also why SACEUR and the US Department of Defense are putting a very high premium on the speedy development and deployment of a wide range of precision-guided delivery systems, munitions, and submunitions embodying the so-called "emerging technologies" (ET) in propulsion, guidance, and nonnuclear punch.

At first, SACEUR's missionary work in Europe on behalf of FOFA and ET weapons met resistance. Among other reservations, some European political and military leaders suspected that the FOFA-ET structure framed by SACEUR and the Pentagon was a Trojan horse full of US-grown weapons technologies meant to invade and overwhelm Western Europe's defense technology base.

Opportunity and Optimism

Now, however, it appears that such suspicion has waned. NATO's defense ministers and combat commanders have embraced the FOFA and ET concepts, according to Secretary Weinberger, and have come to regard them as tactical and technological opportunities, not drawbacks.

"I am pleased to report," Secretary Weinberger told Congress early this year, "that the NATO program to exploit emerging technologies is progressing steadily toward its objective of codevelopment and coproduction of selected high-military-priority, high-payoff systems to be fielded by the end of this decade."

General Rogers has claimed for some time that NATO exploitation of emerging technologies could very well result in a much higher degree of weapons standardization and industrial cooperation than was ever believed possible. How? By having certain companies in each NATO industrial nation take the lead in producing particular ET weapons for all the nations and then by arranging multinational coproduction of most or all such weapons for all NATO forces.

Great industrial and military advantages are implicit in all this, and it is gathering political support in high places in the US.

For example, Sen. Sam Nunn of Georgia, the Senate Armed Services Committee's senior Democrat and a thoughtful analyst of NATO affairs, believes "there is more potential for increasing NATO's effectiveness and efficiency through cooperation in procurement and in R&D than there is through [NATO defense] budget increases."

A few years ago, Senator Nunn helped to frame legislation that prodded the Pentagon to collaborate more closely with the European allies in arms procurement and standardization. For example, it required the Pentagon to give an annual accounting of progress in such collaboration and of standardization potential inherent in US weapons-development programs.

Last year, Senator Nunn introduced legislation to cut US troop strength in Europe unless the European allies live up to their collective promise of a yearly three percent increase, in inflation-discounted terms, of their defense budgets. It failed in the Senate, but attracted much support nonetheless.

At this writing, the Senator had not decided whether or not to reintroduce such legislation this year. He seemed, however, to be taking a different tack. Noting that "economics are working against defense budgets" in Western Europe and the US alike, Senator Nunn declared:

"We can all make our defense budgets go much further if we have the will to do it. The ingredients are there for quantum leaps ahead in standardization and interoperability. We have very good leadership in NATO. If the Alliance is ever going to move forward, now's the time. I'm not saying it will. But I am saying it *can*." ■

Taiwan's Lo

This one-time ally is a passive factor in our Pacific strategy. There are grave dangers in letting Taiwan drift away or fall into unfriendly hands.

nely Stand

BY GEN. T. R. MILTON, USAF (RET.)
CONTRIBUTING EDITOR

At precisely 0900 hours, the great bronze doors of the Chiang Kai-shek Memorial quietly roll open to reveal a heroic statue of the late Generalissimo. The throng of visitors must wait a few minutes longer while the honor guard, an immaculate platoon of tall young men, goes through an elaborate manual of arms. And if a suitable visiting dignitary is on hand, there is the further ritual of a wreath-laying ceremony at the base of the statue where the Generalissimo is buried.

The Memorial, a glittering white building in Chinese modern style, sits atop a high mound in the center of an elaborate park. After climbing the hundred or so steps that lead to the bronze doors and passing around the Generalissimo's statue, the visitor enters a museum filled with mementos of the old days on the mainland, World War II photos, and various other reminders of the Chiang Kai-shek era. There is nothing, however, to commemorate those grim days in 1949 when the remnants of the Nationalist Army straggled ashore on Taiwan for what looked like a last stand. It has been some last stand.

Looking back on that period, one recalls how bleak the prognosis was for the survival of the Nationalists. Our strange wartime allies, the Soviets, had engaged our full attention by blockading Berlin, thus putting a severe strain on America's demobilized military resources, and Secretary of Defense Louis Johnson was swinging his meat axe at what was left. Had the Korean War not intervened, US military resources would have been mainly strategic, which is to say, nuclear bombs and the means to deliver them. And if that had happened, a US defense of Taiwan would have been either all or nothing, with the odds heavily in favor of the latter.

Korea did erupt, however, before Secretary Johnson could do in the conventional forces. That war also engaged the Communist Chinese, giving Chiang Kai-shek and his forces a chance to regroup on Taiwan. When the Korean War ended in a stalemate three years later, the Republic of China (ROC) was firmly established in Taipei, backed up by stout support from its close friend, the United States.

An invasion of Taiwan from the mainland had now become too risky for the PRC to contemplate. Chiang even talked of invading the mainland and overthrowing the Communist usurpers in Peking. The Nationalists, in fact, never said Peking, which meant "Northern Capital," but spoke instead of Peiping, or "Northern City." The true government of China was temporarily in Taipei. When it returned to the mainland, Peiping would once again become Peking. Perhaps the new Pinyin spelling, in which Peking has become Beijing, has confused this dictum, but that is the way it once went.

The Way It Was

In those days, when the Generalissimo was still in full command and the United States was Taiwan's protector, one of the great sights of the Orient was the annual Double Ten Day parade. October 10 is the anniversary of Sun Yat-sen's revolution, and the parade was nominally a celebration of that event by his legitimate heirs, a statement contested by the other Chinese government across the water. Anyway, the parade was a stirring event. The Generalissimo would be on the reviewing stand, flanked by Madame and his senior officials, while

the might of the Republic of China's forces passed in review. There were tanks, goose-stepping soldiers, formations of elegant young uniformed women, frogmen, commandos, artillery, and, overhead, a procession of fighter aircraft. Once past the audience, the marchers gathered in the square facing the reviewing stands and, in answer to President Chiang's exhortation, gave off thunderous shouts. It all had to do with going back to the mainland.

Those were the days when Red China, as we then called it, was the nearest thing to an enemy and the ROC our very close friend. We had an embassy in Taipei, of course, and a large military assistance and advisory group headed by a major general. Just to make things absolutely clear to the Communist Chinese, we had a

An indication of ROC capability to build new aircraft if they cannot be procured overseas is the AT-3, produced by the Aero Industry Development Center.

Taiwan Defense Command with a vice admiral—usually amiable, for his duties were not onerous—at the helm. From time to time, the US Seventh Fleet would steam through the Formosa Strait as evidence of US resolve.

USAF maintained a few fighters on nuclear alert in southern Taiwan, a posture that left no doubt about who was being threatened. There were various other close arrangements between the ROC Air Force (ROCAF) and USAF. When the danger either to Taiwan or the offshore islands appeared to increase, the US sent in reinforcements. The world was to understand that Taiwan was a touchy place as far as the United States was concerned.

The Vietnam War cemented the bond with Taiwan, or at least it should have, for the ROC provided bases for bombers and airlift, superb heavy maintenance, and an air force contingent in Vietnam itself that did a dangerous and almost anonymous job on our behalf.

That was the way it was. Meanwhile, our European allies moved their embassies to Beijing, viewing our attachment to the Taipei government as slightly irrational. In the dusty provincial city of Taipei, the Nationalists talked less and less of regaining the mainland, concentrating instead on developing Taiwan. The Communist regime, went the new line, would eventually come apart, overthrown by a disenchanted populace. It was enough to keep Taiwan well defended until the day they could make a return by popular acclaim.

An Uncertain Acquaintance

The key to Taiwan's defense lies in air superiority over the Formosa Strait. Everything else is secondary to that. Without air superiority over that bit of ocean, the People's Republic of China (PRC) would risk disaster in an invasion attempt.

Over the years, the ROC has made a convincing case for air superiority. In the only actual test, which came during the crisis of 1958, the ROC downed eight PRC aircraft for every one it lost. The Mainlanders have not made a challenge since. How much longer they will concede air superiority to the ROC is the question that is becoming an intense worry in Taipei, for Uncle Sam, the reliable friend and weapons supplier for thirty years, has become an uncertain acquaintance.

December 31, 1978, marked the official end of the bilateral security treaty between the United States and the Republic of China, although the end had been in sight since the Shanghai Communiqué of February 1972. When the security treaty was renounced by the US, the ROC lost not only its protector, but a considerable bit of its remaining diplomatic stature. Only twenty-three nations now officially recognize the ROC, none of them major powers. Curiously, one of these is Nicaragua.

Following the abrogation of the security treaty, there was a good deal of confusion as to future American responsibilities toward the defense of Taiwan. Because the Carter Administration was vague in this regard, Congress passed the Taiwan Relations Act in 1979. The intent of this law was to provide for Taiwan's continuing security "in the absence of diplomatic relations and a defense treaty."

A trickle of F-5Es—one or two a month—coming out of the small plant at Ching Chuan Kang (CCK) Airbase is the most visible result of the Taiwan Relations Act, along with a purchase of 103 Starfighters from the Luftwaffe, for which the US acted as broker. The Starfighters—refurbished and armed with AIM-9 Sidewinders—still command respect, but so does a 1953 Corvette. The fact remains that both are nearing their time as museum pieces. The F-5E is, of course, a good clear-air fighter, especially against Third World opposition, but the air force across the Formosa Strait is moving up in class.

Within the next few years, the PRC will have a substantial number of new fighters—F-8s, F-10s, and F-12s—equal to or better than the ROCAF's F-5Es and F-104s. What's more, there are enough PRC air bases near the Formosa Strait to give the Mainlanders a great numerical advantage. Any prospective battle for air superiority will thus put a high premium on qualitative superiority by the outnumbered ROCAF. The outlook for that, as matters now stand, is not bright.

Taiwan-Developed Fighter

The ROC had wanted the F-16, or, failing that, the F-20, but that hope is almost gone. Continuing production of the F-5E seems to be the most they can expect, which is another way of saying they are headed toward planned obsolescence and vulnerability. With that unhappy prospect if they continue to base their hopes on

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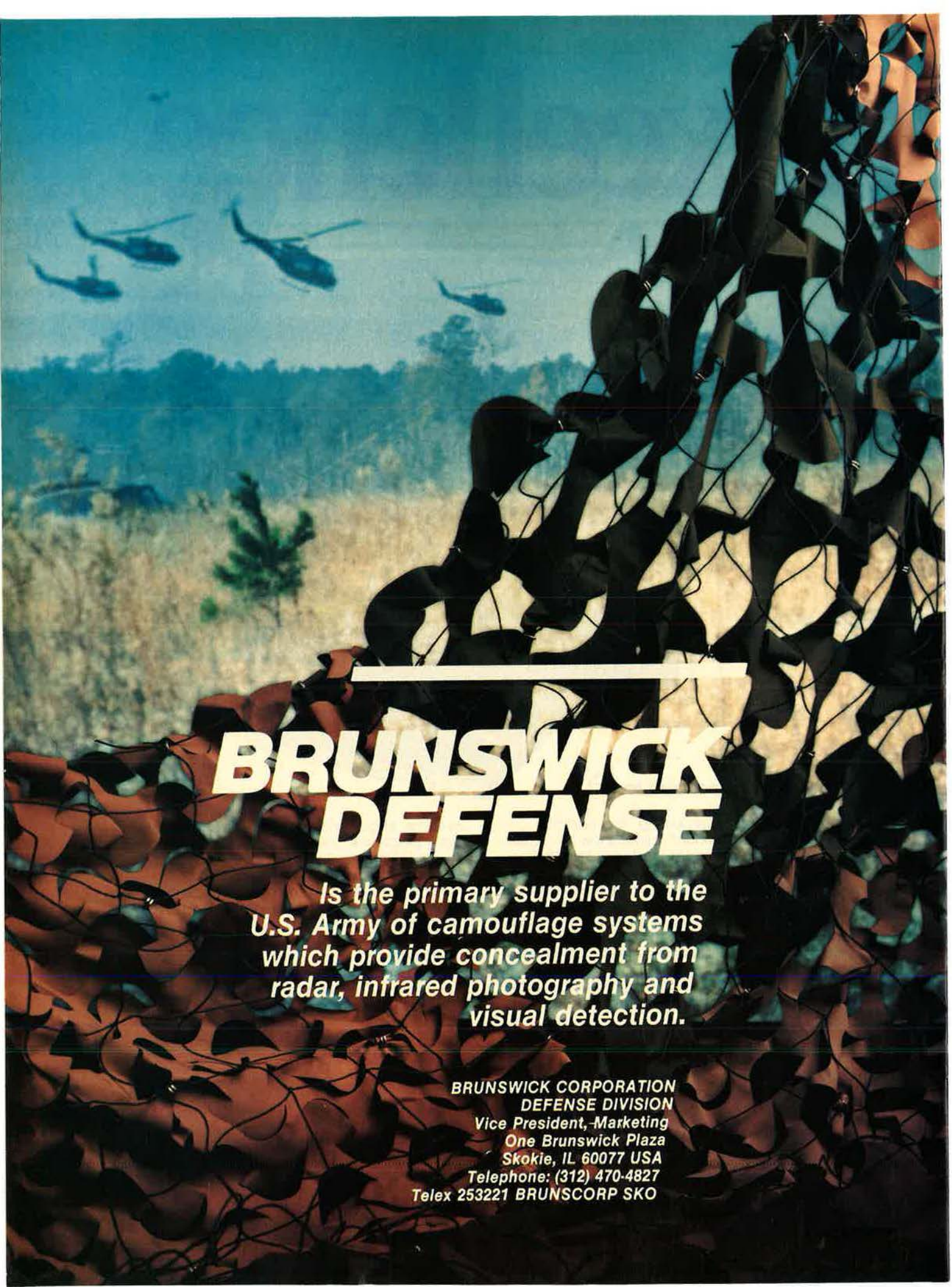
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Washington, they are in the early stages of developing their own fighter.

The Aero Industry Development Center (AIDC) at Taichung, adjacent to CCK, has already designed and produced a twin turbofan—the AT-3—and other lesser aircraft. By US standards, it is a small facility, although when one walks around the place, there is something reminiscent of the Israel Aircraft Industries plant in Tel Aviv. The heads bent over the drawing boards, the intensity of work on the factory floor, the ingenuity and high quality all tend to make up for the smallness.

A new fighter would be an enormous challenge, but the people at AIDC think they are up to it, if that's the only way out. They would obviously need a lot of help—engine, avionics—but they are assuming that. And so, if the US will not sell them a new airplane, they will build their own. ROC leaders reject the notion of buying one from the Soviets even though they share, at the moment, a common enemy. The ROC's dependence on Saudi oil makes an Israeli airplane out of the question.

In the view of men like Admiral Soong Chang-chih, the Minister of Defense, the coolness between Beijing and Moscow is only for the moment. In his opinion, the Communist powers will never really be enemies, certainly not to the point of actual hostilities. In the long run, they will get back together. In fact, there are already signs of a reconciliation. For the present, according to Admiral Soong, the Mainlanders want the sort of help we can give them. For the next few years, therefore, they will be accommodating. But once they get what they are after, they will revert to type. Communists, in his view, do not change into something else, certainly not into exponents of democracy. And when the PRC is modernized with our help, asks Admiral Soong, what then? If we have so much trouble with one Communist superpower, what will we do with two? All things considered, including the advanced age of our current friends in Beijing, these questions are at least provocative.

The basic difficulty in this complicated business of the two Chinas is that they both claim to be the legitimate government of China, and they both insist Taiwan is merely a province of China. Hence, any talk of an independent Taiwan is as treasonous in Taipei as it is in Beijing.

The Diplomatic Muddle

The diplomatic muddle is reflected in the arrangements the world has made for dealing with this government in exile. In addition to the remaining forlorn little embassies, mostly Latin American, along with a few, like Saudi Arabia, from the oil states, there are some 140 organizations that are embassies in all but name. They are there in recognition of Taiwan's enormous importance in the commercial world. The ROC, with its 19,000,000 people, exports goods worth $2 billion more than those exported by the PRC with its population of one billion.

The American Institute serves as our embassy. Situated in the old MAAG compound, it is staffed with Foreign Service officers on leave from the State Department—China experts, for the most part. The Director, also a career diplomat on leave, is currently Harry E. T. Thayer, formerly US Ambassador to Singapore. The Institute performs the working functions of an embassy admirably. What it does not have is the protocol accorded an ambassador, a matter of no real importance except that it does serve as a constant reminder of how we have drifted away from our old friends.

Military assistance functions are carried out by retired military officers on contract. To prevent homesteading, these officers are limited to a maximum of four years in Taipei. This restriction causes some wistfulness, for life in Taiwan, given certain amenities, is pleasant.

Aside from the fact that the ROC's military equipment is approaching obsolescence, the arrangements for weapon systems support work well enough. But obsolescence is a hard thing to put aside. The ROC and its mainstay, the ROCAF, will not, on their present course, have a credible defensive capability by the middle of the next decade, if not sooner. There is only so much that can be done with superior training and motivation. Besides, as the leaders in Taipei observe, they are all the same people. If the pilots on Taiwan are good—and they are—then there is no reason why the pilots on the mainland will not also be good. And if the mainland pilots have better aircraft, let alone more of them, then the conflict becomes one-sided.

Appearance of Prosperity

It is easy to forget this uneasiness about the future. Life on Taiwan is good by any standard and superior when measured against that of most of Asia. The government is stable and only autocratic toward its enemies. As long as a citizen stays away from open opposition to the regime, his existence is that of a resident of any free-enterprise country.

There is, of course, the fact that the Republic of China has had only two Presidents in its fifty-eight years—Chiang Kai-shek and his son Chiang Ching-kuo—and, while there is no reason to make too much of it, the fact is that Chiang Ching-kuo is getting on. One of these days, the Republic of China will have to select a new President outside the family. There is still another son, Chiang Wei-kuo, but he has never been involved in the political side of things, apparently having been content with his duties as an army major general. Besides, he, too, is now elderly.

One million people came to Taiwan with Chiang Kai-shek in 1949, and they have dominated the island ever since. Although a good many of that million are now old or dead, it is a mistake to believe that the Mainlanders are fading out of the picture. The strong men in the ROC are still from mainland China and will almost certainly continue to hold the power in Taiwan for at least the next decade.

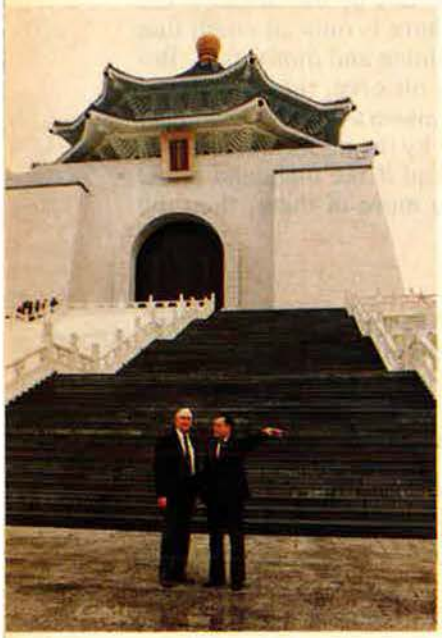
These men do not like the inference that there are Mainlanders and Taiwanese. Their own sons and daughters, after all, have been born and have grown up on Taiwan. There is no distinction, they insist. They are all Chinese, citizens of the Republic of China, with the same loyalties and the same opportunities.

So far as any outsider can tell, this is true. Certainly, the young pilots in the fighter squadrons were born on Taiwan, as were the not-so-young squadron commanders, and they all appear to be the same high-spirited aviators we knew long ago.

There is no way, however, for a casual visitor to know

what strains there may be in this integration of Mainlanders and native Taiwanese. While the government of China, either the one in Beijing or the one in Taipei, considers Taiwan an integral part of China, there are those who would like to see it independent. Taiwan has, after all, belonged variously to the Dutch, to Chinese pirates, and, for forty years in this century, to Japan.

The people are ethnic Chinese, but their allegiance to mainland China is on shaky historic ground. Certainly, no one on that prosperous island wants Taiwan to become a Communist province, but that is not the issue. The Republic of China would lose any remaining legitimacy as China's proper government if it declared itself independent. Any such declaration would also cause repercussions in Beijing and a diplomatic crisis for nations that have agreed on the one-China proposition.



A visit to the imposing Chiang Kai-shek. Memorial (background) impresses visitors with the ROC's mainland China heritage and accomplishments under the Generalissimo. General Milton, author of this article, is on the left in this photo.

The ugly incident of Henry Liu, the Chinese-American writer murdered in San Francisco, was evidently precipitated by Liu's criticism of President Chiang Ching-kuo. The ROC government fired Vice Admiral Wang Hsi-ling, former head of Defense Ministry Intelligence, and a military tribunal convicted him of plotting the murder and sentenced him to life imprisonment. His two deputies were found guilty as accessories to murder and were given lesser sentences. The killing of Liu has done damage to the ROC's image because of the inference some will wish to draw of an authoritarian regime that brooks no criticism.

Many people, in this country as well as in others, will take pleasure in such an inference. They would like the whole matter of the Republic of China to go away, leaving the road clear for Beijing. It would be convenient if diplomatic niceties were all that were at stake. Unfortunately for convenience, there are other considerations that must be taken into account before we settle irrevocably for one China.

The Importance of Taiwan

Even if Taiwan were a small backward island inhabited by aborigines, it would still be essential to any nation with pretensions as a Western Pacific power. Japan understood this in the 1930s, and we understood it until 1979. Doubtless, the Soviets understand it as they make their way past Taiwan en route to the base we thoughtfully provided them at Cam Ranh Bay.

More than sixty large ships pass by Taiwan every day, according to the Commander in Chief of the ROC Navy, Admiral Liu Ho-chien. Many of them are tankers en route to and from Japan, keeping that resource-poor nation in business. A Taiwan in unfriendly hands must surely be a worst-case scenario for Japanese planners.

Right now, Taiwan is a passive factor in Western Pacific strategy. The bases and ports are there, together with a highly developed industrial structure, but the ROC is not playing a role in any alliance. Our new infatuation with the government in Beijing has further diminished the ROC, notwithstanding the fact that there is no real evidence the Beijing affair will last. The Chinese Communists remain Communists, disciples of a system that puts severe limits on cooperation with democracies. To the south, the situation in the Philippines makes one wish we were still using the Taiwan bases.

An American admiral once said that Taiwan is worth ten aircraft carriers—high praise from an admiral, although a gross understatement. Taiwan, as a base for tanker- and AWACS-supported fighters, B-52s, and reconnaissance airplanes, would have a value beyond calculation.

It is all there, ready to be used, along with a friendly government, solidly on our side despite the past six years. Obviously, this is not the time to stir things up, but it is equally not the time to forget that the ROC is still in Taipei. It would be a severe strategic mistake to allow the solid asset of Taiwan to drift away, either through hopeless vulnerability or, in desperation, to some arrangement with the USSR.

While there is no likelihood that the latter will happen as long as the heirs to Chiang Kai-shek remain in power, there is real danger of hopeless vulnerability. The PRC is already producing in quantity airplanes—F-6s and F-7s—that are comparable to the F-5E. Egypt has, in fact, ordered 100 F-6s, a sign of both PRC production capability and the F-6's performance.

The Reagan Administration has increased sales to the ROC, with FY '83 and FY '84 figures well in excess of the low point following 1979's withdrawal of diplomatic recognition. The quantity, then, is up, but not the quality. Taipei may proceed with a new fighter, but it will be a last resort.

A far more sensible solution, and one in keeping with the apparent intent of the Taiwan Relations Act, is the sale of a modern American airplane. PRC leaders would object, but their capacity for retaliation is limited. They need us, it would seem, more than we need them. ■

Gen. T. R. Milton's by-line is one familiar to AIR FORCE *Magazine readers from his regular "Viewpoint" column and his periodic feature articles. His forty-year military career included combat service with Eighth Air Force in World War II, participation in the Berlin Airlift, command of Thirteenth Air Force, service as Air Force Inspector General and as USAF Comptroller, and duty as the US Representative to the NATO Military Committee. He retired from active duty in 1974. This article is based on General Milton's recent trip through the Far East.*

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BY JOHN HOYT WILLIAMS

This Emb-312 Tucano is one of three new types of aircraft introduced by Embraer, a Brazilian government company, over the past two years. A world-class turboprop trainer/combat aircraft, the Tucano upholds Brazil's long aeronautical tradition.

ALTHOUGH we tend to forget it, Brazil has a long aeronautical tradition, dating back to pioneer aviator Alberto Santos-Dumont, whose 1908 Demoiselle is considered the prototype of all later monoplanes.

Some twenty years ago, science-fiction writer L. Sprague de Camp wrote a sleeper story predicated on future Brazilian control of space. Even hard-core sci-fi readers thought the idea too bizarre to be credible.

In November 1984, outgoing Brazilian President João Baptista Figueiredo expressed in a speech his belief that Brazil would, in the near future, "dominate and control aerospace technology"—hyperbole, of course, yet no one snickered. He had just witnessed the launch of Sonda IV, a wholly Brazilian-made rocket that had soared 611 kilometers into space. Future Sonda launches will take place from a modern base just completed at Altamira, in the state of Maranhão. In 1989, the Institute for Space Activities (IAE) expects to place a 200-kilogram indigenous satellite in orbit, and it probably will. It is also worth noting that Latin America's first satellite, Brasilsat I, went into orbit on February 8, 1985, with Brasilsat II to follow in August.

Barely making even local newspapers at Brasilia was the flight on October 23, 1984, of a Brazilian Bandeirante fueled by Prosene, which was made entirely out of local vegetable oils by a private Brazilian company. In the same period, Avibras introduced its 500-kg cluster bomb and announced the 1985 debut of its Barracuda MM-70 Exocet-type ship-killing missile and a new runway-destruct bomb; Embraer unveiled its AMX jet fighter, built jointly with Aermacchi of Italy; the Aerospace Technical Center (CTA), which makes the Mach 2+ Piranha air-to-air missile, was testing its new variable-speed, pilotless drone; and, in a stunning reversal of the standard "two-way street," Short Brothers of Belfast announced that it would produce Embraer's Tucano trainer under license in Northern Ireland.

The Brazilian Air Force (Forca Aerea Brasileira, or FAB), while increasingly flying Brazilian machines, was not the spark plug of the local aerospace industry. Long starved for funds, FAB pilots were flying antique B-26s and Gloster Meteors into the mid-1970s.


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Beginning of the Boom

What caused Brazil's dramatic emergence was a concatenation of events, the most important of which were:

- The military take-over of 1964, with its notable nationalist thrust (a civilian took office as President on March 15, 1985).
- The oil crunch of the mid-1970s and the resultant need to increase exports to pay for petroleum.
- Sagacious long-term planning and research and development by both private and public aeronautical companies.
- Rave reviews of Brazilian equipment from early foreign customers.

In the 1960s, several Brazilian companies began producing inexpensive, light aircraft for both military and commercial roles: trainers, transports, crop sprayers, reconnaissance platforms, and general-purpose airplanes. But even as these companies were building small aircraft for the 1960s, they were also planning, designing, and investing for the 1970s. A large number of experimental airplanes and helicopters were developed at great cost. Most of them were discarded, but a great deal was learned.

When the oil shock came in the 1970s, these companies were ready to answer the government's frantic call for exports (as well as to take advantage of Brasilia's generous tax breaks and export credits), and the aerospace industry took off.

To understand the phenomenon, it is best to look at the companies that are causing it.

Embraer's Success Story

Empresa Brasileira de Aeronautica, or Embraer, a government company founded in 1968 (private individuals now hold almost half the voting stock), is one of modern aviation's greatest success stories. Embraer's 6,700 employees—most of them at the São José dos Campos plants, ninety kilometers from the megacity of São Paulo—are working three shifts, largely to meet foreign orders. So many orders pour in from Egypt, Iraq, Saudi Arabia, Libya, South Korea, Togo, Somalia, Paraguay, and other countries that, ironically, Embraer has put the FAB's own requirements on the back burner!

The only non-US general aviation company among the free world's top ten, Embraer sold an astonishing 2,748 aircraft in its first twelve years. These included 450 Emb-201 Ipanema crop-sprayer/transport/observation planes, some 300 Emb-121 Xingu twin-turboprop transport/trainers, and more than 500 Emb-110 and -111 Bandeirantes (170 to American commuter airlines). A twenty-seat turboprop of legendary fuel efficiency, the Bandeirante comes in six military and civil variants. Also bolstering both reputation and exports were models built under license from Piper, such as the Emb-810 Seneca III and Emb-712 Tupi. Under license from Aermacchi of Italy, Embraer modified and builds the twin-turbojet Emb-326 Xavante, a ground-attack vehicle with six hardpoints capable of carrying up to 1,814 kg of ordnance.

As successful as these aircraft were, Embraer broke all previous records in the 1983–85 period with three new aircraft.

The Emb-121 Xingu twin-turboprop trainer/transport found a big market outside of Brazil. As the only non-US general aviation company among the world's top ten, Embraer sold 2,748 aircraft in its first twelve years, including 170 Bandeirantes to US commuter airlines and 500 of them all told.

The World-Class Tucano

First came the versatile Emb-312 Tucano, a trainer/weapons platform of genuine world class. The FAB will have a long wait for the 118 copies it has ordered, because foreign customers have rushed to purchase the new turboprop. Egypt quickly ordered 120, with a further sixty options, Iraq ordered eighty, South Korea twenty, Honduras eight, Libya a reported 100, Britain twenty-five, and Saudi Arabia an undisclosed but large number. Further, in 1984, Embraer signed a contract with Short Brothers to produce under license a slightly modified Tucano, designated the PT 6. Serious rumors circulate today that manufacturing or at least assembly plants for Tucanos will be established in Saudi Arabia, Portugal, and perhaps Egypt.

The Tucano is powered by a Pratt & Whitney of Canada PT6A-25C turboprop, rated at 750 shp but degraded to 585 shp for the Tucano. It has a rate of climb of 2,570 feet per minute, a top speed of 284 mph, a cruising speed of 274 mph, a ceiling of 28,700 feet, and a landing run of 1,065 feet. With normal fuel tanks, Tucano has an endurance of five hours and a range estimated at 1,100 miles. It has staggered tandem seats, a unique canopy-severance system, and an unrivaled field of view. Tucano has four underwing hardpoints, each capable of carrying up to 550 pounds of weaponry.

The Shorts version—which in late March 1985 won the competition to become the RAF's advanced trainer—will be fitted with a four-blade prop, additional, jettisonable fuel tanks doubling capacity, retractable tricycle landing gear, a ventral airbrake, some airframe changes, and a cockpit arrangement compatible with British systems. The RAF has placed a firm order for at least 130 aircraft, with delivery to begin next year and end in 1991. It is assumed that more will be ordered in the future. The RAF trainer version of the Tucano will be powered by an 820kW Garrett TTE331-12 engine rated at 1,100 shp. Embraer is almost ready to market a flight simulator for Tucano, and with hun-

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SCIENCE/SCOPE

A new radar can map military targets with high resolution equal to that of infrared devices, even in rain and other bad weather. The Advanced Synthetic Aperture Radar System (ASARS-2), designed to complement electro-optic sensors, is flown on a U.S. Air Force TR-1 reconnaissance aircraft and provides real-time radar imagery to a ground station. ASARS-2 operates in all weather at ranges far exceeding the capabilities of infrared and other electro-optic devices, thanks to new state-of-the-art signal processing and other advances. The Air Force gave the system an excellent rating after it underwent strict operational performance tests as part of a "fly-before-buy" program. Hughes Aircraft Company is producing the system under a development and production contract. Eventually ASARS-2 is expected to be adapted for tactical aircraft and mobile tactical stations.

Infrared-guided Maverick missiles scored 11 direct hits in 11 launches over a seven-day period as the U.S. Air Force tested the air-to-surface weapon under typical combat conditions. Ten launches were part of the Follow-On Test and Evaluation (FOT&E) series, designed to determine whether missiles off a production line are ready for operational deployment. The other was a telemetry round not counted as part of the FOT&E series. The Mavericks were fired from F-111 and F-16 aircraft against a variety of moving and stationary targets, including tanks and armored personnel carriers. Three launches occurred at night. In other evaluations conducted by the Air Force, the Hughes missiles met or surpassed reliability and maintainability standards.

Building blocks for what will become an electronics factory of the future are being set in place at Hughes to cut costs in manufacturing airborne radars and other avionics programs. Lasers, fiber optics, remote fiber fluorometry, and advanced optics play a part in an Industrial Modernization Incentive Program (IMIP) contract awarded by the U.S. Navy with Air Force participation. IMIP is a share-the-savings concept to reduce costs of the F-14, F-15, and F/A-18 radar programs by more than $10 million, while improving the quality and reliability of the systems. Three projects employing new manufacturing technology focus on solder joint inspection, metal fabrication inspection, and continuous chemical analysis of solutions used in electroplating printed wiring boards.

Jam-resistant communications have been introduced into NATO by a new terminal for AWACS early-warning aircraft. The Joint Tactical Information Distribution System (JTIDS) Class 1 terminal is designed to combat the formidable and growing electronic countermeasures threat to tactical communications. JTIDS uses principles of time division multiple access to provide secure, high-capacity communications for AWACS radar planes and ground stations. The system relays a wide variety of information, such as command and control, surveillance, intelligence, force status, target assignments, warnings and alerts, weather, and logistics. Software filtering lets each participant select data pertinent to his own needs. Hughes is producing the JTIDS terminal for use with NATO's Airborne Early Warning/Ground Environment Integration Segment (AEGIS).

The Amraam missile uses a new high-power traveling-wave tube transmitter to guide itself toward a target. The TWT and its power supplies were designed to fit into the missile's 7-inch diameter. The power supplies are vacuum encapsulated using materials with high dielectric strength to provide high voltage protection and long storage life. Automated production techniques are being used to assemble and test the TWT and power supplies. Hughes designed and developed the advanced medium-range air-to-air missile for the U.S. Air Force and Navy.

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Embraer builds this new AMX jet fighter aircraft jointly with Italy's Aermacchi. Its recent unveiling coincided with the introduction of a 500-kg cluster bomb and the Barracuda MM-70 Exocet-type antiship missile, both made by Avibras.

dreds of them already sold, the company has a clear winner.

The Brasilia and AMX

Another winner appears to be the multipurpose Emb-120 Brasilia, which attracted 120 options three years before it was test-flown! The Brasilia, a thirty-seater, is being marketed at a moderate price. Embraer says this plane is aimed basically at a military requirement, especially in antisubmarine patrol, sea surveillance, and electronic intelligence. An ASW/maritime surveillance variant is already available and on order by several countries, including Saudi Arabia.

The twin-engine turboprop (which compares directly and favorably with the Fairchild 240) is powered by Pratt & Whitney of Canada PW115 powerplants. It has a lightweight alloy airframe and a cruising speed well above the norm for its class. Four underwing hardpoints, a sophisticated computerized flight-control system, pictorial navigational displays, and a paratroop door option make the Brasilia an aircraft for all seasons.

Finally, after years of development, Embraer introduced its AMX Mach 0.9 fighter/trainer/ground support aircraft to the public. Built and developed in Brazil and Italy by Embraer and Aermacchi, the Saudis have already shown serious interest in the plane.

A general-purpose airplane for air forces that cannot afford specialization, the AMX is powered by a Brazilian-made Rolls-Royce Spey Mk 807 jet. It can carry a heavy ordnance load on its five external hardpoints, and General Electric's 20-mm M61 Gatling gun (just qualified in government tests) is the most likely internally mounted weapon system. It is expected to carry Brazilian Piranha infrared air-to-air missiles and Avibras rocket pods. Italy will take 150 AMXs and the FAB at least 100 (the first to be delivered in 1987). AMX is also said to boast excellent electronic countermeasures (ECM) and low radar-detection characteristics. It had been rumored that a carrier version of the AMX will be built, but in conversations with the author, a leading Brazilian admiral discounted that possibility because of insufficient demand.

Embraer is busy along other lines. In 1980, it bought out a rival, Sociedade Construtora Aeronautica Neiva, or Neiva as it is commonly known. Now a subsidiary, Neiva is charged with producing Embraer and Embraer/Piper lightplanes as well as its own designs, permitting the parent company to focus its attention on the larger projects, including designs for a supersonic fighter-interceptor for the 1990s.

Embraer is also now working on a pressurized version of the Bandeirante, the projected Emb-110P3, and an advanced version of the Xingu, the Emb-121B. Embraer also produces a line of air-to-ground rockets and, under pressure from the Army, is said to be planning its first helicopters.

CTA and Avibras

Government-run CTA is a multifaceted company. It is divided into four major institutes. The Technical Aeronautical Institute (ITA) is essentially an aeronautical engineering college; the Research and Development Institute (IPD) not only does what its name implies, but also shares its progress with both civilian and government companies; the Institute for Space Activities functions as the Brazilian version of NASA; and the Institute for Industrial Coordination and Growth (IFI) works directly to stimulate the private aerospace industry. CTA, which designs such things as airfield-destruction bombs, cluster bombs, and rockets, often turns over actual production to major private arms industries, such as Tupān, CEV, and D. F. Vasconcelos.

Avibras, a government operation founded in 1961, also often works with or through private companies and CTA to produce an exceedingly wide variety of weapons.

Neiva of São Paulo, now a subsidiary of Embraer, produced some very successful aircraft before the merger. A private firm, it produced for domestic consumption, but soon found foreign orders piling up. Its first successful venture was a general-purpose transport, the 591 Regente, eighty of which were acquired by the FAB. A liaison and observation version, the 592 Regente, was also purchased by the FAB and several other air forces. Neiva's major success, however, was its Universal trainer in 1968. With hardpoints for bombs and two 7.62-mm machine-gun pods, the Universal—an inexpensive aircraft—appealed to Third World generals and was widely exported.

Aerotec Trainers

Another private aircraft manufacturer is Aerotec of São José dos Campos, best known for a pair of trainers that have been exported to a score of nations. These are the Aerotec 122 and the better-known 160 Uirapuru, which became the FAB standard primary trainer. The company occasionally works with Embraer (mainly on components).

Just now, Aerotec is introducing

its A-132 Tangará, 100 of which have been ordered by the FAB to replace the Uirapuru. It is rated at 148 mph top speed, has a 14,760-foot ceiling, and boasts a four-hour, eighteen-minute endurance. Further, it appears that Aerotec will soon sign a major agreement with Italy's SIAI-Marchetti. The deal would entail building under license a large number of SIAI SM-1019 single-engine scout/liaison aircraft. Rumors abound in Brazil that a corollary of this prospective contract will call also for Aerotec to manufacture Marchetti's S-700 Cormorano amphibious airplane and some of the Italian company's other designs. If so, perhaps Aerotec will become another Brazilian giant.

This Emb-111 Bandeirante is a twenty-seat turboprop aircraft of "legendary fuel efficiency," available in six military and civil variants. Now Embraer is marketing its thirty-seat Emb-120 Brasilia, primarily for antisubmarine patrol, sea surveillance, and electronic intelligence.

While fixed-wing aircraft represent a shining facet of the Brazilian aerospace miracle, helicopters decidedly do not. Today, the FAB relies on foreign helicopters: Bell 205 UH-1Hs and UH-1Ds and Bell 206 JetRangers, plus various French Aerospatiale models. The latter includes helicopters "assembled" in Brazil.

Helibras and Helicopters

In hopes of lessening dependence on foreign helicopters, Helibras was created in 1980. It is funded uniquely—fifty-one percent by the state government of Minas Gerais, the remainder by Brasilia and private investors. That same year, Helibras signed an agreement with Aerospatiale to assemble the SA 315B Lama, with some local modifications. The result is the HB 315B Gavião, most commonly in SAR configuration. Highly placed sources in Rio de Janeiro, however, have said that Helibras does little more than paint already assembled Lamas shipped from France. Regardless, Gaviãos have already been sold to Bolivia, Venezuela, and Uruguay.

Helibras also "assembles" the AS 350B Ecureuil, under the designation HB 350B Esquilo, and these, too, have been exported in limited numbers. Still, Helibras was barely kept afloat through 1984, one authority noting that it "faces closure for lack of orders."

Late in that year, with government financial guarantees, the company announced that it would review competition for another helicopter, some to be purchased outright, with others to be assembled at its Minas Gerais plant. The winner in that competition (over Sikorsky) was Aerospatiale again, and, in January 1985, the French giant and the Brazilian dwarf signed a contract calling for at least fifteen AS 332 Super Pumas to be bought and/or assembled.

Helibras has also been working on its own designs, however, and rumor has it that it will unveil a genuine Helibras product in 1987. Recently, it should be noted, Rolls-Royce of Brazil signed an agreement with Turboméca of France to assemble and service turbines for future Helibras projects. Over the next decade, however, Brasilia will likely rely for the most part on foreign helicopters. Recent orders have been placed with Britain's Westland and Italy's Agusta. Sikorsky recently signed an agreement with Embraer to work on a revolutionary helicopter made largely of new plastic alloys.

Some 200 Brazilian companies are involved to some extent in aerospace activities, as is a bewildering variety of research groups.

Relations With US

The rise of Brazil as an armaments and aviation power creates conflicting emotions in Washington. A conservative President in the United States and a phased democratization in Brazil (which culminated in the January 1985 election of a civilian President) have eased relations that were strained for a decade.

In February 1984, the US Secretary of State and Brazilian Foreign Minister initialed in Brasilia a Memorandum of Understanding aimed at loosening US restrictions on transfer of technology and promoting general military cooperation. This was a step forward—as was the announcement that a Brazilian astronaut would fly on a 1987 Space Shuttle flight.

But Brazil's leading arms customers, now and for the foreseeable future, are Iraq and Libya (many of whose purchases are transhipped to Iran)—nations unfriendly to the US. Technology transfers upgrading Brazilian weaponry would thus benefit countries overtly hostile to the United States. The State Department and Pentagon are understandably upset at the prospect, and Brasilia is upset at possible sales restrictions that would compromise its commercial "neutrality." A substantial portion of Brazil's record trade surplus, after all, came from armaments sales—principally to Mideast customers.

The long-term relationship of the US and the emerging Colossus of the South remains uncertain. ■

John Hoyt Williams is a professor of history at Indiana State University. He holds a doctorate from the University of Florida in Latin American studies and history and is currently writing a book about the Brazilian Expeditionary Force in Italy during World War II. A longtime student of Latin Amercan political and military affairs, he has authored a number of articles on military topics for various professional publications.

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Moscow's global ambitions are seen in its evolving doctrine as well as in its expanding arsenal.

SOVIET MILITARY POWER 1985

BY EDGAR ULSAMER
SENIOR EDITOR (POLICY & TECHNOLOGY)

THE military forces of the Soviet Union and of its allies "continue to expand, modernize, and deploy . . . increasingly capable weapon systems designed for the entire spectrum of strategic, theater-nuclear, and conventional conflict," Defense Secretary Caspar W. Weinberger asserted in the preface to the just-released fourth edition of *Soviet Military Power,* the free world's most authoritative and comprehensive analysis of the growing military might of the USSR.

The new *Soviet Military Power* edition enumerates in detail the latest dazzling achievements of Moscow's technology programs: at least three new high-energy laser weapons for air defense, an array of new strategic weapons, and marked advances in particle-beam weapons and radio-frequency (RF) systems that could not only put out of commission critical electronic components of US weapons but could also inflict disorientation or physical injury on personnel. But perhaps more illustrative of Moscow's global ambitions than a catalog of the expansion of the Soviet arsenal is the report's description of evolving Soviet doctrine.

That doctrine posits that the next global war would be a decisive clash "between two diametrically opposed socioeconomic systems"—socialism and capitalism. Such a conflict would force most of the world's nations to take sides and thus is bound to evolve into a coalition war, fought by two major groupings of nations, each pursuing specific political and military objectives. In line with this thinking, the Soviets are developing and implementing a single strategic policy for all Warsaw Pact forces. To back up this contention, the new US intelligence document points out that the USSR openly refers to the Warsaw Pact as "a unified command formation."

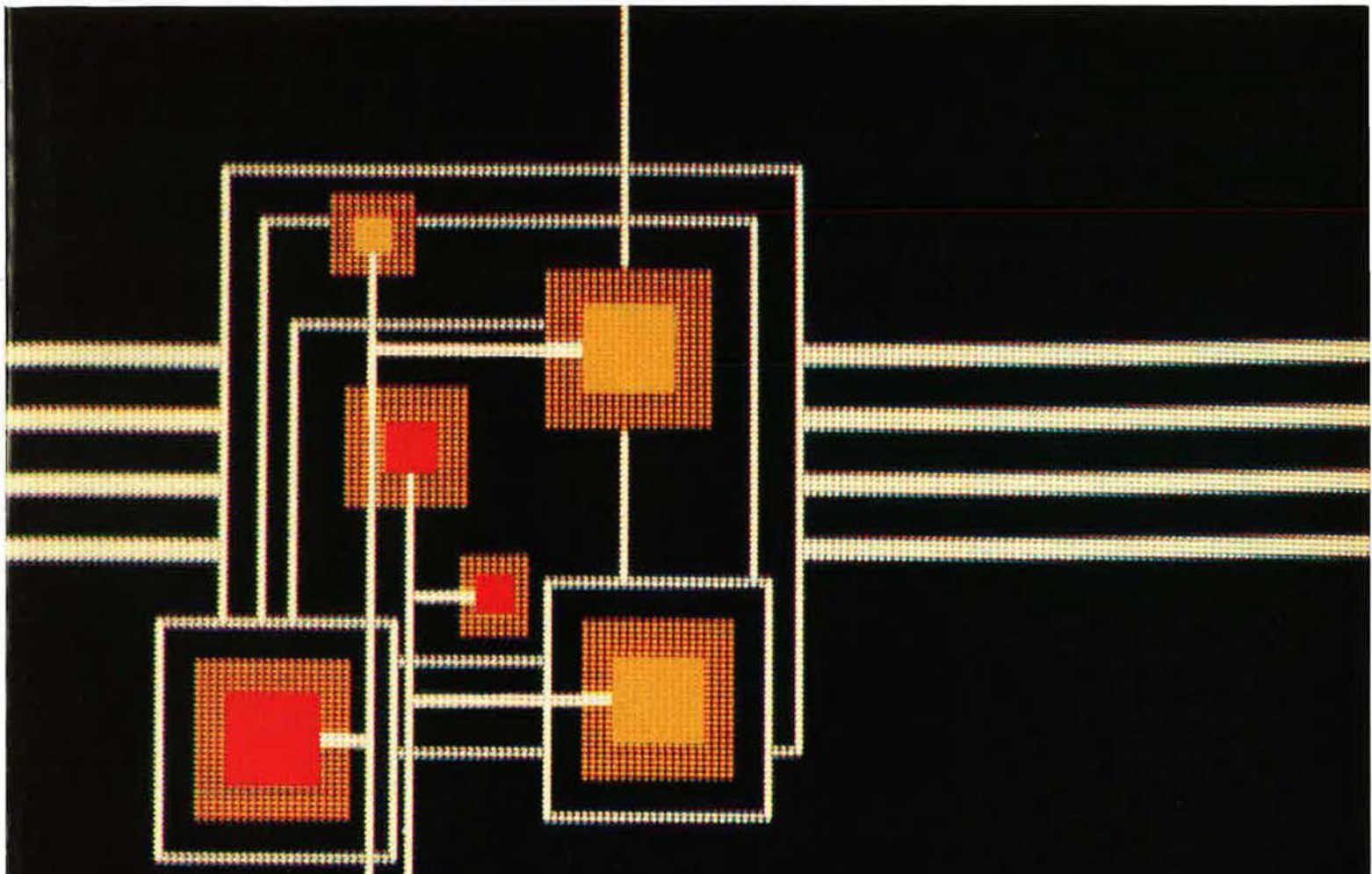
Conventional and Nuclear

The Soviets are now thought to believe that a world war might begin and be waged for an undefined period with only conventional weapons. The US intelligence community still ascribes to Moscow the presumption that, while general nuclear war should not be considered inevitable, the possibility of escalation to global nuclear war cannot be ruled out. But the new US document goes on to suggest that "despite the fact that strategic nuclear forces would play the dominant role in such a war, the Soviets recognize the crucial function of ground armies in seizing and occupying their ultimate objectives."

Further, though the Soviets are unsure about how long a future global conflict might last, there is evidence that they attach major importance to the initial phase of conflict. They seemingly reason that what happens at the outset would, to a major extent, determine the course of all subsequent combat actions. In line with this assumption, overall mobilization capabilities and smooth transition from peacetime to wartime operations become top-priority concerns.

Because of the global perspective of Moscow's military doctrine, Soviet force structure and doctrine gravitate toward a kinetic, highly mobile form of strategy that puts little stock in continuous fronts. Instead, the emphasis is on rapid and sharp changes in the strategic situation and deep penetrations into the rear areas of enemy forces. Soviet forces, the US believes, "would rely on mobility and maneuver to wage an intense struggle to seize and maintain the initiative."

In extension of these precepts, the Soviets emphasize the primacy of the offensive, stating that military and political objectives are ultimately achieved only through aggressive and continuous offensive actions. Reduced



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to tangible, practical terms, this Soviet doctrine leads to a thoroughly integrated approach to warfare: "The Soviet concept of combined-arms warfare specifies that the various services and independent units must be brought together under a single unified commander at the army, front, and theater of military operations levels."

Boiled down to bedrock specifics, Soviet aims in a global war are thought to be:

- The defeat of NATO forces at any level of conflict, the occupation of Western Europe, and the use of Europe's economic assets to assist Soviet recovery.
- The neutralization of the United States and China by disorganizing or destroying their military forces.
- The domination of the postwar world and the replacement of "capitalism" by "socialism" as the basic politico-economic system of all nations.

Seeking Nuclear Superiority

In line with the global scope of Soviet policy, Moscow has consistently and relentlessly followed plans over the past quarter century for the development of superior nuclear attack forces. This commitment is seemingly not in conflict with Moscow's belief that the consequences of nuclear war would be catastrophic. The grand strategy of the Soviet Union, therefore, is to attain its objectives, if possible, by means short of war. This means exploiting the coercive leverage inherent in superior forces, especially nuclear forces, to the fullest—instilling fear, eroding the West's collective security arrangements, and supporting subversion. The primal role of Soviet military power is to provide the essential underpinnings for the step-by-step extension of Soviet influence and control.

In a worst-case scenario, Soviet strategic policy would be to destroy Western nuclear forces before launch or while in flight to their targets. The Soviets believe that preemption would be essential to ensure national survival and to support and sustain combined-arms combat in several theaters of military operations.

This grand strategy, according to the new US assessment, translates into several primary wartime missions. Included here are disruption and destruction of the West's essential command control and communications capabilities as well as destruction or neutralization of the West's nuclear forces on the ground or at sea, *before* they could be launched. Protection of the Soviet leadership and cadres, military forces, and military and economic assets necessary to sustain the war is treated as a categoric imperative.

The tools for carrying out this strategy are the Soviet offensive forces—ICBMs, longer-range intermediate-range nuclear forces, SLBMs, short-range ballistic missiles (SRBMs), cruise missiles, and bombers—as well as antisatellite weapons. The nuclear forces are charged with fulfilling their missions under all circumstances. In a nuclear exchange, the Soviets believe the most favorable circumstance would be a preemptive strike; the least favorable would be a follow-on strike after nuclear weapons had hit the USSR. Keys to success in preemption would be effective coordination of the strike and sound intelligence on Western intentions.

To cope with the second contingency—that of launch under attack—the Soviets have deployed a satellite-based ICBM launch-detection system, have built an over-the-horizon radar missile launch-detection system to back up the satellites, and have ringed the USSR with large phased-array radars. These sensor systems enable the Soviets to launch their nuclear forces very quickly.

New ICBMs

Follow-on strikes obviously require survivable weapons as well as robust command and control systems. For that reason, the Soviets shelter their ICBMs in the world's hardest silos. The same is true for Soviet antiballistic missile systems. In addition, new Soviet ICBMs are being designed for mobile basing.

According to *Soviet Military Power,* two new solid-propellant ICBMs, the SS-X-24—comparable in size to MX—and the SS-X-25—about the size of Minuteman—are being readied for mobile deployment. These two weapon systems are "well along in their flight-test programs from the range head at Plesetsk in the Soviet north." The SS-X-24 is expected to be rail-mobile, while the SS-X-25 is going to be road-mobile in a manner similar to that of the 414 SS-20s deployed in various regions of the USSR. As a result, these new weapons will be highly survivable and have an "inherent refire capability."

The US report discloses that two bases—probably serving the SS-X-25 system—are nearing completion. They consist of launcher garages with sliding roofs and several support buildings to house the necessary mobile support equipment.

Other recent activities at Soviet ICBM test sites have caused US intelligence to conclude that two other new ICBMs are under development. One of them—thought to be a replacement of the SS-18 and thus prohibited by SALT II—is nearing the flight-test stage, while the other—a solid-propellant missile apparently larger than MX and thus also outlawed by that accord—will begin flight-testing in a few years, according to US intelligence. Both of these new ICBMs are expected to be more accurate and to provide more throw-weight than their predecessors.

Modernization of the Soviet submarine-launched ballistic missile forces has culminated in the deployment of three *Typhoons*—the world's largest SSBN, whose 25,000-ton displacement exceeds that of the new US Trident by about one-third. Three or four additional boats are under construction, according to US intelligence. As of the start of this year, there were sixty-two modern Soviet SSBNs in operation, carrying a total of 928 SLBMs. More than two-thirds of these SSBNs are fitted with long-range SLBMs, meaning that these submarines can fire on targets in the US while in home port or while patrolling waters close to the Soviet Union, where they are basically out of reach of US attack submarines.

Over the longer term, US intelligence sees evidence that the Soviet Navy is working toward modification of its most modern and capable SLBMs—the SS-N-20 and SS-NX-23—to boost the accuracy of these weapons, presumably to gain hard-target kill capabilities similar to those sought by the US Navy for its new D-5 SLBM.

Strategic Aviation

Among recent advances in Soviet strategic aviation reported by the latest edition of *Soviet Military Power* is the deployment of about twenty-five new Bear-H strategic bombers as carriers for the AS-15 air-launched cruise missile. This missile has a range of about 3,000 kilometers and is similar to the US Tomahawk cruise missile in size and performance.

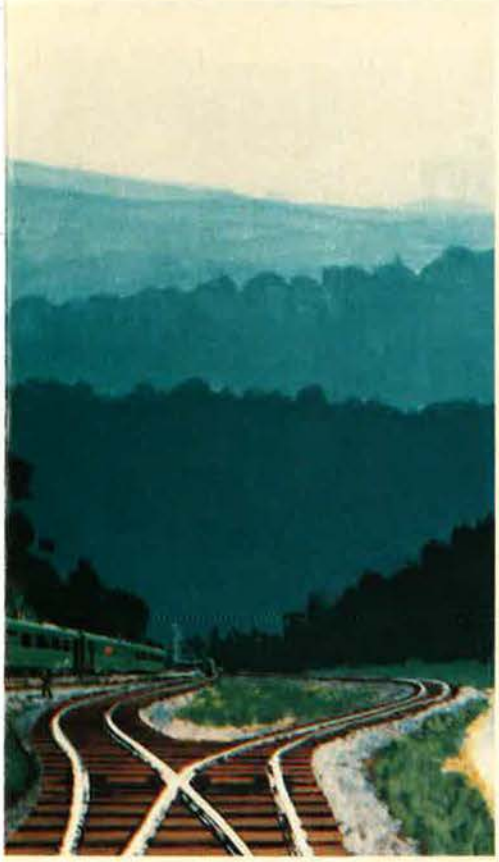
Four other long-range cruise missile systems are known to be under development. Two of them appear to be variants of the AS-15, while the other two are significantly larger and capable of operating over great distances. The two smaller designs can be launched from sea- as well as ground-based platforms.

The sea-based variant, designated the SS-NX-21, is small enough to be fired from standard Soviet torpedo tubes. According to the US report, the SS-NX-21 is about to achieve operational status and "could be deployed on submarines near US coasts." Candidate launch platforms for the SS-NX-21 include the nuclear-powered *Victor III* attack submarine (SSN), a new *Yankee*-class SSN, and the new *Akula, Mike,* and *Sierra*-class SSNs.

One of the two new ultra-large cruise missiles, the SS-NX-24, is expected to reach operational status in about two years. These advanced cruise missiles, US intelligence experts believe, will be deployed initially with nuclear warheads. Eventually, these weapons are expected to attain sufficient accuracies to permit the use of conventional warheads. Conventionally armed, highly accurate cruise missiles, according to the new US threat assessment, "would pose a significant nonnuclear threat to US and NATO airfields and nuclear weapons in a nonnuclear conflict."

Radio-Frequency Weapons

Evidence over the past year of major Soviet progress in directed-energy weapons R&D has been comprehensive, according to US intelligence. In the emerging field of radio-frequency weapons—an area the Soviets are thought to have pursued more vigorously than the US—the new issue of *Soviet Military Power* finds that the



Soviet emphasis on strategic modernization is exemplified by the soon-to-be-deployed SS-X-24, left, and the Typhoon, right, the world's largest ballistic missile submarine. The SS-X-24 will begin deployment in 1986 and will be based eventually on railways. Three Typhoons are already deployed; each carries twenty SS-N-20 MIRVed SLBMs.

USSR is conducting research on strong RF signals "that have the potential to interfere with or destroy components of missiles, satellites, and reentry vehicles."

In the 1990s, the US intelligence community fears, the Soviets could test a ground-based RF weapon capable of damaging satellites. By the late 1980s, the Soviets might be able to test prototypes of ground-based laser weapons for ballistic missile defense. Also, they have started development of at least three types of high-energy weapons for air defense. Included here are "lasers intended for defense of high-value strategic targets in the USSR, for point defense of ships at sea, and for air defense of theater forces," according to the new US assessment.

There is also evidence that the Soviets are working on airborne lasers that might reach operational status in the early 1990s. These systems could be used for such missions as "antisatellite operations, protection of high-value airborne assets, and cruise missile defense." The USSR's high-energy laser program has mushroomed to a point where it now involves more than 10,000 scientists and engineers and several R&D facilities and test ranges. Prototype weapon systems are being tested, and existing ground-based systems can be used to interfere with US satellites.

Current efforts have reached a point where the Soviets could start construction of ground-based laser ASAT facilities at operational sites immediately. While the Soviets are devoting major efforts to research involving particle-beam weapons, it does not appear probable that they could test ASATs of this type before the mid-1990s.

Early Warning Sensors

According to US intelligence, the Soviet Union has built the world's most extensive early warning system for ballistic missile and air defense. As a result, the Soviets are assured of about a thirty-minute warning of any US ICBM launch and of determining the general area of such a launch by using two independent sensor systems. One is a satellite-based warning system, and the other comprises two over-the-horizon radars that monitor the US ICBM fields.

Another layer of warning sensors—consisting of eleven large detection and tracking radars at six locations on the periphery of the USSR—"can distinguish the size of an attack, confirm the warning from the satellite and over-the-horizon radar systems, and provide target-tracking data in support of antiballistic missile [ABM] deployments," according to *Soviet Military Power.*

In the space arena, the US has "no counterpart" to Soviet ocean reconnaissance satellites known as Electronic Intelligence Ocean Reconnaissance Satellites (EORSATs) and nuclear-powered Radar Ocean Reconnaissance Satellites (RORSATs). These are designed "to detect, locate, and target US and allied naval forces for destruction by antiship weapons" launched from various platforms. Four satellites of this type—two RORSATs and two EORSATs—were launched by the Soviets in 1984.

The Soviets have also put into operation a new radar-carrying satellite system that greatly enhances the Soviet Navy's ability to operate in icebound areas. The system maps ice formation in polar regions. Overall, the new issue of *Soviet Military Power* reports Soviet weapons procurement ran ahead of procurement by this country by fifty percent over the past decade. Military spending by the Soviet Union now absorbs between fifteen to seventeen percent of the USSR's estimated GNP—roughly double the US rate. ■

VIEWPOINT

Dominoes Again

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

No one in his right mind wants another Vietnam. To some, however, that means no United States involvement at all in the turbulent region to the south.

The rites of spring, 1985 version, were a stranger than usual mixture of solemn remembrances, of mindless demonstrations, and of disturbing signs that there might still be fire in the ashes of the 1970s. On the happy side, we have the reassuring evidence of a new baseball season, proof of an underlying national stability. Pete Rose, a member of the almost extinct player-manager species, is after Ty Cobb's record. Billy Martin came back, reassuring us that, with the Yankees, the more things change, the more they stay the same. Yogi Berra's Delphic pronouncements will now come from the bleachers.

April also saw Vietnam remembered. For one reason or another, that unhappy experience is now being reexamined in a more objective manner. The funerary monument on the Washington Mall makes one lasting commentary: Vietnam was simply the place where 58,000 Americans died. Other views are beginning to emerge, however, that are not so simplistic.

Vietnam, according to one school of thought, was a noble if mismanaged effort to preserve the freedom of an alien people on the other side of the world. Our failure—and it was never a military defeat—became a catastrophe for millions of Indochinese. We will never know how many thousands have died in the perilous saga of the boat people—probably half of those who made the attempt—but the fact that they willingly took the risk rather than remain in a land under Communist rule would seem to indicate that we were on the right track. We just didn't understand how to go about it.

Vietnam is over, a sad page in our history. In the aftermath of the debacle, the domino theory, long the basis for jokes, is gaining a certain reluctant credibility as Hanoi consolidates its gains in Indochina and turns toward Thailand. There was never a timetable attached to the domino theory, only the conviction that an aggressive and victorious Hanoi would inevitably expand its reach.

Vietnam was as far away from the United States as it is possible to get, on this planet, at least. Perhaps that can be, in part, an excuse for the hash we made of that adventure. But today we are faced with a situation that is close to home, and the distance alibi won't wash. It is a situation in which, if we were not precisely one of the dominoes, we could still be mightily bruised by their falling. And as predictably as the thirteen-year cicada, the usual crowd is lining up on the side of the opposition. This time, although it is a case of Havana and Managua instead of Hanoi, we are beginning to hear the same old noises: No more Vietnams; US out of Central America. No doubt Sandinista bumper stickers will soon appear.

As to the first dictum, fair enough. No one in his right mind wants another Vietnam, but that, I am afraid, is not what they really mean. What this strange mix of churchmen, entertainers, academics, and plain agitators wants is no US involvement at all in the turbulent region next door—in other words, a free ride for the USSR toward gaining a permanent base on our continent. As Jeane Kirkpatrick has observed, the position reminds one of Munich rather than Vietnam.

A few years ago, the doomsayers had written off El Salvador. An intelligent, restrained US policy of aid and training has given El Salvador new hope. The FMLN, for all its boasts of a popular base, has been powerless to stop free Salvadoran elections. Along with support for President José Napoleón Duarte and the reformed Salvadoran military under General Vides Casanova, the US has soft-pedaled insistence on misguided social experiments, such as those we sponsored in the late 1970s. First things first seems to be the motto behind our present Central American policy, and the first thing is to halt the Leninists, who have their own social experiments in mind.

There can be no doubt about the military buildup in Nicaragua. In 1979, the Sandinistas had a 5,000-man, lightly armed force. That force has grown to 62,000 in the regular army, with 57,000 more in the reserves and militia. Soviet military shipments have risen from 850 tons in 1980 to 18,000 tons in 1984 and include such handy little items as 110 T-55 tanks, bridge-crossing gear, and seventy long-range artillery pieces—scarcely the sort of weaponry a small, backward country can manage. Therefore, Fidel Castro has thoughtfully provided 10,000 Cubans, and, in case the Cubans can't handle everything, there appear to be a hundred or so Soviet and East German military advisors, together with a few Libyans, on hand. All in all, it would be a discouraging prospect for Nicaragua's neighbors were it not for the Reagan Administration's firm stand.

Still, there is reason to worry about the rising opposition to this Central American policy, the first coherent one we have had in, certainly, the last forty years. Daniel Ortega, Nicaragua's president chosen in what the Sandinistas claim, with straight faces, to have been a free election, is a new hero of the radical chic. His prospective opponent and former junta member, Arturo Cruz, left Nicaragua in disillusionment when he discovered that the game was rigged. It takes more than Marxism-Leninism, however, to dismay the limousine liberals in this country, although thirty million refugees pouring across our southern border might possibly do the trick. ■

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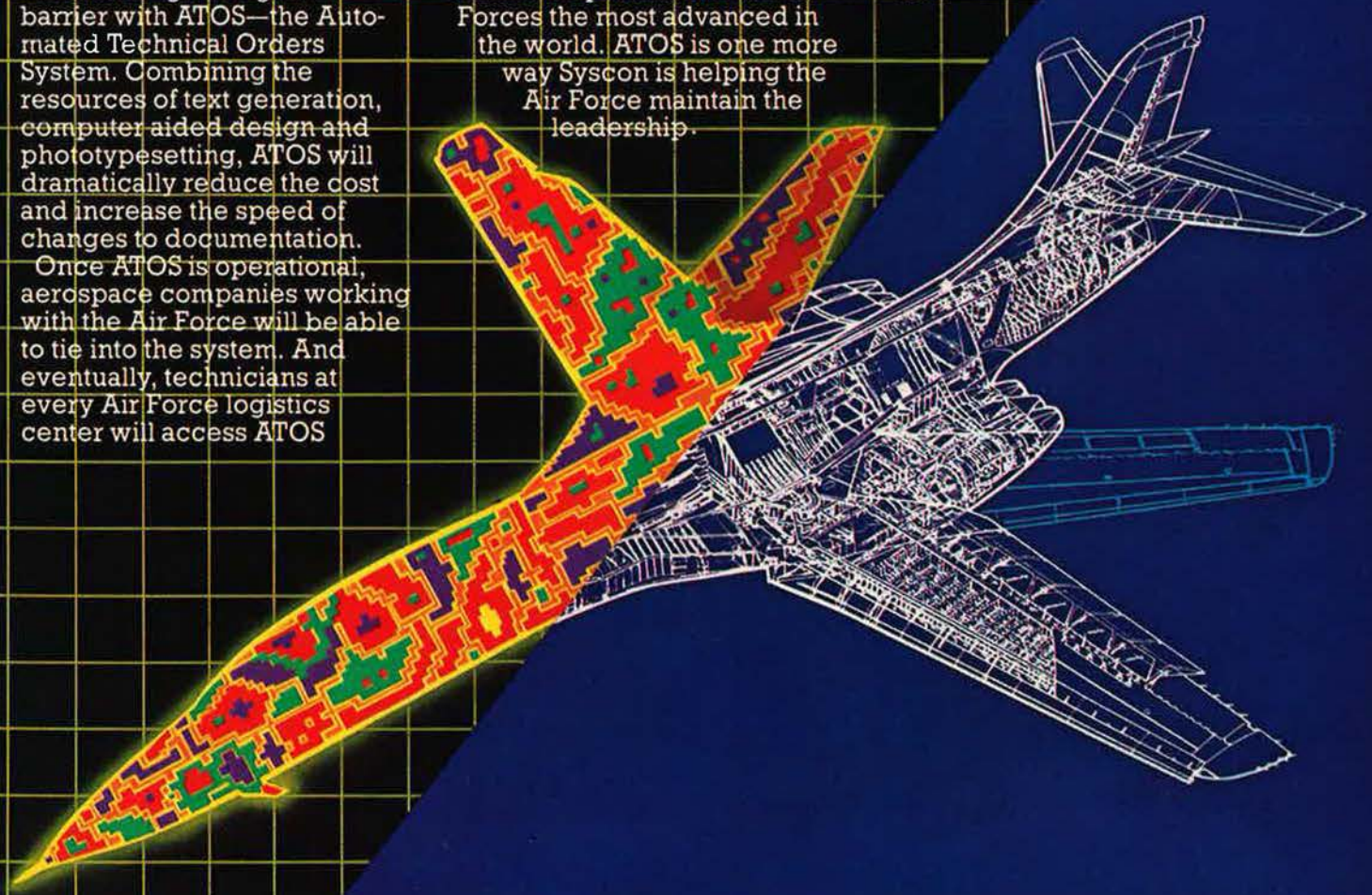

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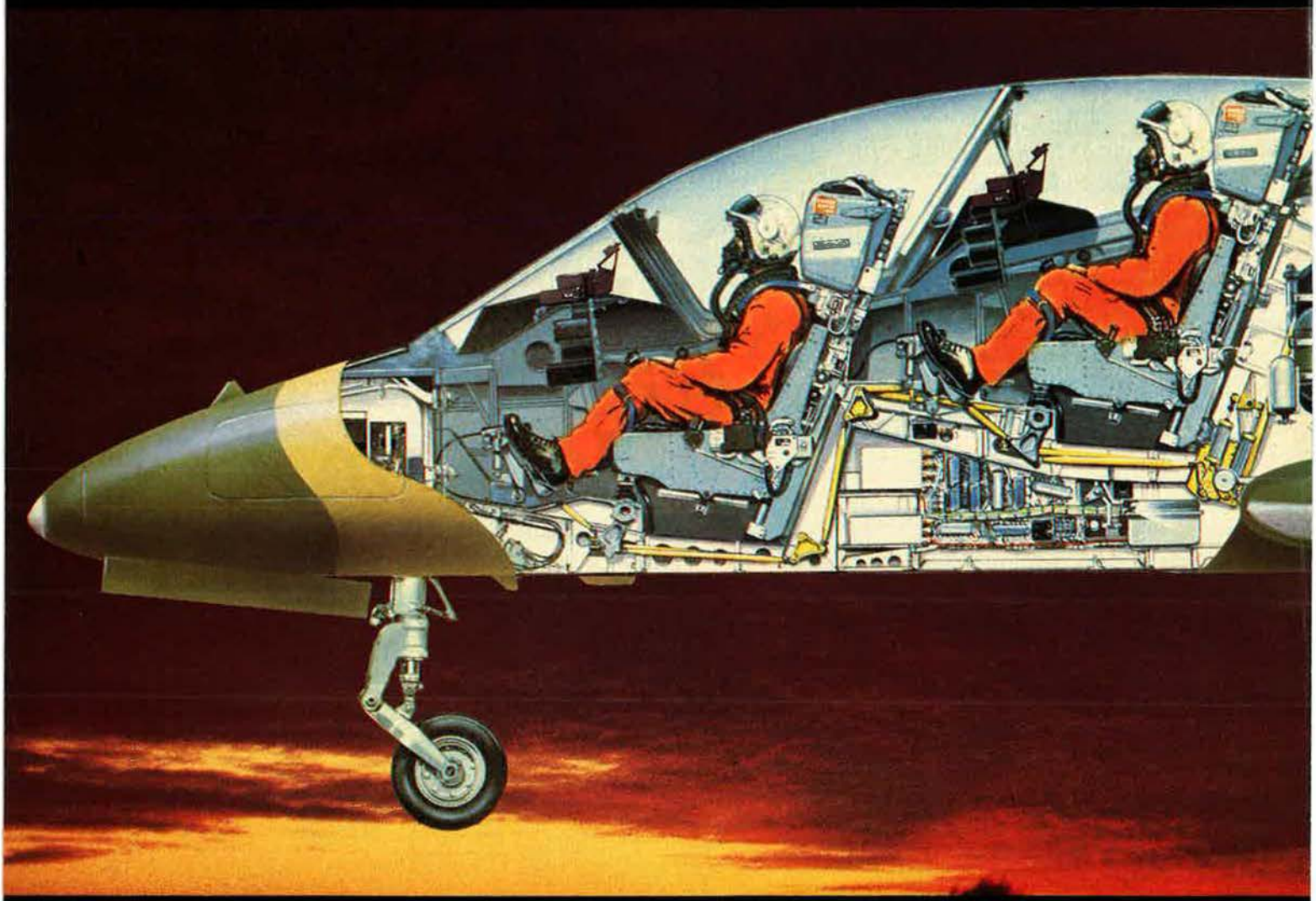

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JUNE 1985

Take-off shot of Mirage 2000C1, with flight refuelling probe and underwing Magic missiles

DASSAULT-BREGUET

AVIONS MARCEL DASSAULT-BREGUET AVIATION: BP 32, 33 rue du Professeur Victor Pauchet, 92420 Vaucresson, France

DASSAULT-BREGUET MIRAGE 2000

The Mirage 2000 was selected on 18 December 1975 as the primary combat aircraft of the French Air Force from the mid-1980s. Under French government contract, it was developed initially as an interceptor and air superiority fighter, powered by a single SNECMA M53 turbofan engine and with Thomson-CSF RDM (Radar Doppler Multifonctions) multi-mode X band radar. The Mirage 2000 is equally suitable for reconnaissance, close support, and low altitude attack missions in areas to the rear of a battlefield.

Reversion to a Mirage III/5 type of delta wing design, without horizontal tail surfaces, caused some surprise after Dassault's choice of a tailed sweptwing configuration for the Mirage F1 and the advanced, but abandoned, ACF fighter project. It resulted from study of the requirements of a smaller and less ambitious aircraft than the ACF. This showed that a delta wing embodying the latest aerodynamic concepts offers an excellent compromise between structural simplicity, light weight, and high speed characteristics and the demands of rapid acceleration, high rate of climb, and manoeuvrability for an aeroplane of relatively modest size and installed power. In particular, a delta layout offers low drag over a wide range of angles of attack in flight, while providing the largest practicable wing area, with attendant benefits in terms of tight turning capability and high service ceiling.

Automatic leading-edge flaps provide the advantages of a variable camber wing. At the same time, the adoption of fly by wire control for the wing surfaces and rudder, with artificial stability, permits acceptance of a far-aft centre of gravity. This makes possible a much reduced landing speed for the Mirage 2000 and improves its manoeuvrability for combat.

Having tested successfully a carbonfibre rudder on a Mirage III, and boron horizontal tail surfaces

Two-seat Mirage 2000TH of the Indian Air Force

on a Mirage F1 throughout the flight regime to Mach 2.2. Dassault-Breguet decided to utilise both materials in the Mirage 2000, achieving a weight saving of 15–20 per cent in the components so constructed.

Five prototypes were built, of which four single-seat multi-role models were funded by the French Air Force and one two-seater by the manufacturers. The first single-seater made its first flight, at Istres, on 10 March 1978, only 27 months after programme launch in December 1975. The second flew on 18 September 1978, the third on 26 April 1979, and the fourth on 12 May 1980. The **Mirage 2000B** two-seat trainer version flew on 11 October 1980 and, like its four predecessors, achieved supersonic speed (between Mach 1.3 and 1.5) during its first flight. Initial flight of a production 2000B took place on 7 October 1983. On the basis of structural testing, the Mirage 2000 airframe has been approved for a load factor of +9*g* and rate of roll of 270°/s in subsonic and supersonic flight, 'clean' or with four air-to-air missiles.

A SNECMA M53-2 engine, rated at 83.4 kN (18,740 lb st), was fitted for early prototype testing and was replaced in 1980 by the uprated M53-5, which also powers initial production aircraft. The first prototype was re-engined subsequently with a more powerful M53-P2, as intended for later production aircraft, and made its first flight in this revised form on 1 July 1983. Meanwhile, the manufacturers' prototype is being used to develop equipment and other changes proposed for future variants and for export models of the Mirage 2000. Further airframes were built for static and fatigue testing.

The first production **Mirage 2000C1** made its first flight on 20 November 1982, on schedule, and deliveries began in 1983. On 2 July 1984 Escadre de Chasse 1/2 'Cigognes' at Dijon was the first French Air Force unit to become operational, with ten Mirage 2000C1s and four 2000Bs. EC 3/2 'Alsace' is due to follow in 1985, and Escadre de Chasse Tactique (ECT) 2/2 'Côte d'Or' in early 1987.

Following a mid-1979 go-ahead, the first of two prototypes of the **Mirage 2000N** two-seat low-altitude penetration version made its first flight on 3 February 1983; the second flew on 21 September 1983. Strengthened for flight at a typical 600 knots (1,110 km/h; 690 mph) at 60 m (200 ft) above the terrain, this version is intended as a vehicle for the ASMP medium-range air-to-surface nuclear missile and has ESD Antilope V terrain following radar, two Sagem inertial platforms, improved TRT AHV-12 radio altimeter, Thomson-CSF colour CRT, an Omera vertical camera, and special ECM. Production deliveries are scheduled to start in 1986, and 36 will be in service by 1988, when the 2000N will become operational as a replacement for Mirage III-E and Jaguar nuclear attack aircraft. Five tactical squadrons are to receive this version, beginning with the 4th Escadre at Luxeuil followed by the 7th at Saint-Dizier.

Funding approved under the 1984 defence budget brought the total number of aircraft ordered to 106 (56 C1s, 19 Bs, and 31 Ns, of which more than 30 Cs and Bs had been completed by the beginning of 1985), excluding the seven prototypes. By the end of the current 1984–88 defence programme, the totals are planned to increase to 139 C1s, 19 Bs, and 85 Ns, out of an eventual requirement of 300 to 400 Mirage 2000s of various versions for the French Air Force. Production is being increased progressively to seven aircraft a month in 1986, to satisfy the present level of domestic and export orders. Wings are manufactured at Martignas, fuselages at Argenteuil; final assembly and flight testing take place at Mérignac.

First export customers for the Mirage 2000 are Abu Dhabi, Egypt, India, and Peru. The Egyptians placed an initial firm contract for 20 (16 2000EM and 4 BM, all with M53-P2 engines) in January 1982. India ordered 40 in October 1982 (36 2000H and 4 TH), which are being delivered from October 1984. All four THs and 26 of the Hs have M53-5 engines temporarily; the final 10 Hs will be powered from the start by the M53-P2. First flight by a 2000H (KF-101) was made on 21 September 1984, followed in early 1985 by the first TH (KT-201). Peru ordered 26 aircraft in December 1982 (24 2000P and 2 DP); in May 1983 Abu Dhabi placed an initial order for 18 (12 2000EAD, 3 RAD and 3 DAD) and has since confirmed a repeat order for 18 more. Deliveries of the first batch are due to begin in 1985. The RAD reconnaissance versions for this customer will be able to carry a COR 2 or Harold surveillance equipment pod; the second 18 for Abu Dhabi will be fitted with Elettronica (Italy) ECM, comprising threat warning receivers and self-protection jammers. Most recent customer is Greece, which in March 1985 signed a letter of intent for 40 (36 2000EGM and 4 BGM), with options on a further 20.

The following description applies to the single-seat Mirage 2000C, except where indicated:

TYPE: Single-seat interceptor, air superiority, and multi-role fighter.

WINGS: Cantilever multi-spar low-wing monoplane of delta planform, with cambered profile. Leading-edge sweepback 58°. Large radius root fairings. Full span two-segment automatic leading-edge flaps operate in conjunction with two-section elevons that form entire trailing-edge of each wing, to provide variable camber in combat. Leading-edge flaps are retracted during all phases of acceleration and low altitude cruise, to reduce drag. Elevons have carbonfibre skin, with AG5 light alloy honeycomb core. Fly by wire control system for elevons and flaps, with surfaces actuated by hydraulic servo units. No tabs. Retractable airbrake above and below each wing.

FUSELAGE: Conventional semi-monocoque structure, 'waisted' in accordance with area rule; of conventional all-metal construction except for glassfibre radome and carbonfibre/light alloy honeycomb panel over avionics compartment, immediately aft of canopy. Small fixed strake, with marked dihedral, near leading-edge of each air intake trunk.

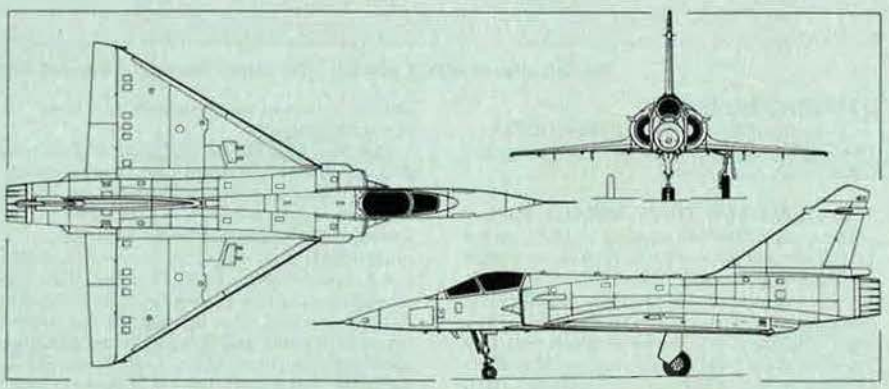
TAIL UNIT: Cantilever fin and inset rudder only; latter actuated by fly by wire control system via hydraulic servo units. Much of fin skin and all rudder skin of boron/epoxy/carbon composite with honeycomb core of Nomex (fin) or light alloy (rudder). Sweepback on fin leading-edge 45°. No tab.

LANDING GEAR: Retractable tricycle type by Messier-Hispano-Bugatti, with twin nosewheels, and single wheel on each main unit. Hydraulic retraction, nosewheels rearward, main units inward. Oleo-pneumatic shock absorbers. Electro-hydraulic nosewheel steering, through 45° to each side. Manual disconnect permits nosewheel unit to castor through 360° for ground towing. Light alloy wheels and tubeless tyres, size 360 × 135-6 on nosewheels, 750 × 230-15 on mainwheels. Messier-Hispano-Bugatti hydraulically actuated carbon composite disc brakes on mainwheels, with anti-skid units. Runway arrester gear standard. Brake-chute in canister above jet nozzle.

POWER PLANT: One SNECMA M53-5 turbofan engine, rated at 53.9 kN (12,125 lb st) dry and 88.3 kN (19,841 lb st) with afterburning, in initial production aircraft. Under development for subsequent use is the M53-P2, rated at 64.3 kN (14,462 lb st) dry and 95.1 kN (21,385 lb st) with afterburning. Movable half-cone centrebody in each air intake. Internal fuel capacity 3,980 litres (875 Imp gallons) in 2000C, 3,870 litres (851 Imp gallons) in 2000B. Provision for one jettisonable 1,300 litre (286 Imp gallon) fuel tank under centre of fuselage, and a 1,700 litre (374 Imp gallon) drop tank under each wing. Total internal/external fuel capacity 8,680 litres (1,909 Imp gallons) in 2000C, 8,570 litres (1,885 Imp gallons) in 2000B. Detachable flight refuelling probe forward of cockpit on starboard side.

ACCOMMODATION: Pilot only in 2000C, on Martin-Baker F10Q zero/zero ejection seat, under transparent canopy, in air-conditioned and pressurised cockpit. Canopy hinged at rear to open upward.

SYSTEMS: ABG-Semca air-conditioning and pressurisation system. Two independent hydraulic systems, each at pressure of 280 bars (4,000 lb/sq in), to actuate flying control servo units, landing gear, and brakes. Electrical system includes two Auxilec 20110 aircooled 20kVA 400Hz constant



Dassault-Breguet Mirage 2000C1 (SNECMA M53-5 afterburning turbofan engine) *(Pilot Press)*

frequency alternators, two Bronzavia DC transformers, a SAFT 40Ah battery and ATEI static inverter. Fly by wire flight control system. Eros oxygen system.

AVIONICS AND EQUIPMENT: Thomson-CSF RDM multi-mode radar, with operating range of 54 nm (100 km; 62 miles). (Mirage 2000N will have ESD/Thomson-CSF Antilope V ground-scan radar.) Sagem Uliss 52 inertial platform, ESD Type 2084 central digital computer and Digibus digital data bus, Thomson-CSF TMV-980 data display system (VE-130 head-up and VHC-180 head-down) (two head-down in 2000N), Sfena 605 autopilot, Thomson-CSF/ESD ECM with VCM-65 display, Matra Spirale passive countermeasures, LMT Deltac Tacan, LMT NRAI-7A IFF transponder, Socrat 8900 solid state VOR/ILS and IO-300-A marker beacon receiver, TRT radio altimeter (AHV-6 in 2000B and C, AHV-9 in export aircraft, AHV-12 in 2000N), TRT ERA 7000 or EAS BCU 750 V/UHF com transceiver, TRT ERA 7200 UHF secure voice com, Thomson-CSF Serval radar warning receiver, SAT DDM infra-red alerting system, Sfena UMP 7800 air data computer, and Thomson-CSF Atlis laser designator and marked target seeker (in pod on forward starboard underfuselage station). Omera vertical camera in 2000N.

ARMAMENT: Two 30 mm DEFA 554 cannon in 2000C (not fitted in B or N), with 125 rds/gun. Nine attachments for external stores, five under fuselage and two under each wing. Fuselage centreline and inboard wing stations each stressed for 1,800 kg (3,968 lb) loads; other four fuselage points for 400 kg (882 lb) each, and outboard wing points for 300 kg (661 lb) each. Typical interception weapons comprise two Matra Super 530 or 530D missiles (inboard) and two Matra 550 Magic or Magic 2 missiles (outboard) under wings. Alternatively, each of the four underwing hardpoints can carry a Magic. Primary weapon for 2000N is ASMP tactical nuclear missile. In an air-to-surface role, the Mirage 2000C can carry up to 6,300 kg (13,890 lb) of external stores, including eighteen Matra 250 kg retarded bombs or Thomson-Brandt BAP 100 anti-runway bombs; sixteen Durandal penetration bombs; three Matra BGL 1,000 kg laser guided bombs; seven Matra Belouga cluster bombs or Thomson-Brandt BM 400 400 kg modular bombs; one Rafaut F2 practice bomb launcher; two Aérospatiale AS 30L, Matra Armat anti-radar, or Aérospatiale AM39 Exocet anti-ship, air-to-surface missiles; four Matra LR F4 rocket launchers, each with eighteen 68 mm rockets; two packs of 100 mm rockets; two Dassault-Breguet CC 630 gun pods, each with two 30 mm cannon and ammunition; a Dassault-Breguet COR 2 multi-camera pod or Dassault-Breguet AA-3-38 Harold long-range oblique photographic (Lorop) pod; a Thomson-CSF Atlis laser designator/marked target seeker pod; two Thomson-CSF DB 3141/3163 self-defence ECM pods; one Thomson-CSF Caiman offensive or intelligence ECM pod; or an Intertechnique 231-300 'buddy' type in-flight refuelling pod. Fuselage centreline and inboard underwing stations are 'wet' for carriage of auxiliary fuel tanks *(see 'Power Plant' paragraph for details)*. For air defence weapon training, a Cubic Corpn AIS (airborne instrumentation subsystem) pod, externally resembling a Magic missile, can replace the Magic on its launch rail, enabling pilot to simulate a firing without carrying the actual missile.

DIMENSIONS, EXTERNAL:

Wing span	9.13 m (29 ft 11½ in)
Wing aspect ratio	2.03
Length overall: 2000C	14.36 m (47 ft 1¼ in)
2000B	14.55 m (47 ft 9 in)
Height overall: 2000C	5.20 m (17 ft 0¾ in)
2000B	5.15 m (16 ft 10¾ in)
Wheel track	3.40 m (11 ft 1¾ in)
Wheelbase	5.00 m (16 ft 4¾ in)

AREA:

Wings, gross	41.0 m² (441.3 sq ft)

WEIGHTS AND LOADINGS (A with M53-5 engine, B with M53-P2):

Weight empty (A):	
2000C	7,400 kg (16,315 lb)
Weight empty (B):	
2000C	7,500 kg (16,534 lb)
2000B	7,600 kg (16,755 lb)
Max internal fuel:	
2000C	3,145 kg (6,933 lb)
2000B	3,055 kg (6,735 lb)
Max external fuel:	
2000C	3,720 kg (8,201 lb)
2000B	3,715 kg (8,190 lb)
Max external stores load	6,300 kg (13,890 lb)
T-O weight 'clean' (B):	
2000C	10,860 kg (23,940 lb)
2000B	10,960 kg (24,165 lb)
Max T-O weight (A):	
2000C and B	16,500 kg (36,375 lb)
Max T-O weight (B):	
2000C and B	17,000 kg (37,480 lb)
Max wing loading (A):	
2000C and B	402.44 kg/m² (82.47 lb/sq ft)
Max wing loading (B):	
2000C and B	414.63 kg/m² (84.97 lb/sq ft)

PERFORMANCE (Mirage 2000C: A with M53-5 engine, B with M53-P2):

Max level speed: A, B	over Mach 2.3
Max continuous speed: A, B	Mach 2.2 (800 knots; 1,482 km/h; 921 mph IAS)
Max speed at low altitude without afterburning, carrying eight 250 kg bombs and two Magic missiles:	
A, B	over 600 knots (1,110 km/h; 690 mph)
Approach speed:	
A	140 knots (260 km/h; 162 mph)
Landing speed:	
A	125 knots (232 km/h; 144 mph)
Min speed in stable flight:	
A	90 knots (167 km/h; 104 mph)
B	100 knots (185 km/h; 115 mph)
Max rate of climb at S/L:	
A	15,000 m (49,200 ft)/min
B	18,300 m (60,040 ft)/min
Time to 15,000 m (49,200 ft) and Mach 2:	
A	4 min
Time from brake release to intercept target flying at Mach 3 at 24,400 m (80,000 ft):	
A	less than 5 min
Service ceiling:	
A	18,000 m (59,000 ft)
T-O run with full military load:	
A	approx 1,200 m (3,940 ft)
Range (A):	
with four 250 kg bombs	more than 800 nm (1,480 km; 920 miles)
with two 1,700 litre drop tanks	more than 1,000 nm (1,850 km; 1,150 miles)
with one 1,300 litre and two 1,700 litre drop tanks	1,800 nm (3,335 km; 2,073 miles)
g limits: normal	+9
ultimate	+13.5

GULFSTREAM

GULFSTREAM AEROSPACE CORPORATION: PO Box 2206, Savannah, Georgia 31402-2206, USA

GULFSTREAM AEROSPACE GULFSTREAM III (SPECIAL MISSIONS VERSIONS)

USAF designation: C-20A

Grumman American (now Gulfstream Aerospace) announced the resumption of the Gulfstream III executive jet programme in the Spring of 1978. A prototype, converted from a production Grumman Gulfstream II, made its first flight on 2 December 1979, followed by a second prototype on 24 December 1979. FAA certification was received on 22 September 1980. By early 1985 the company had a backlog of three orders for the Gulfstream III, production of which will continue at least until deliveries of the Gulfstream IV begin in 1986.

The United States Air Force announced on 7 June 1983 that it had awarded Gulfstream Aerospace Corporation a firm fixed-price contract covering the lease of standard off-the-shelf Gulfstream III transports for USAF's airlift requirements, with accommodation for four crew and 14 passengers, as replacements for Lockheed C-140 aircraft under the Air Force Special Air Missions task (C-SAM). Valued at approximately $3.2 million for FY 1983, the contract covered the lease of three aircraft during fiscal years 1983 and 1984. These aircraft have now been purchased outright, and funds are being requested for an additional eight aircraft. If approved, the overall value of the contract to Gulfstream Aerospace will be some $300 million. The first aircraft (designated **C-20A**) was delivered to the US Air Force on 16 September 1983, with the remaining two following in October. Gulfstream Aerospace is providing logistics and contract support at Andrews AFB, Maryland, and Ramstein AB, Germany. During the first year of USAF operations, the C-20A achieved a 99.2 per cent mission completion success rate.

In late 1979 Gulfstream Aerospace began work with the Royal Danish Air Force to adapt the Gulfstream III to the special needs posed by Denmark's fishery patrols, covering some 160,000 nm² (549,500 km²; 212,155 sq miles) around Greenland, and 85,000 nm² (291,912 km²; 112,708 sq miles) around the Faeroe Islands. Consideration had to be given to the possibility of bad weather preventing a landing at either of these places, necessitating an 800 nm (1,482 km; 921 mile) flight to an alternative landing field. In addition to this primary role, the chosen aircraft was required to be suitable for air-drop, medevac (including airborne surgery), SAR, tactical air transport, and other special duties, including VIP transportation for members of the Danish Royal Family. The RDAF ordered three

One of USAF's C-20A (C-SAM) off-the-shelf Gulfstream III transports

Gulfstream IIIs to replace eight Douglas C-47s then in use, and to supplement the activities of three Lockheed C-130s. Allocated to No. 721 Squadron, they are based at Vaerløse, near Copenhagen, and detach in rotation for one-month periods of duty at Søndrestrøm AB, Greenland. Designated Gulfstream SMA-3 (Special Missions Aircraft), the aircraft were delivered in late 1981 and early 1982.

In its primary role for fishery patrol, the RDAF operates the Gulfstream III with a crew of seven, comprising pilot, co-pilot, flight engineer, navigator, observer, photographer, and radio operator. The radio operator's station is on the port side of the cabin, immediately aft of the door, and his equipment includes dual HF and VHF/UHF com. This equipment is easily removed, and the seat can be turned 90° to port so that the position may be used alternatively by an observer, who also has a purpose-built station on the starboard side opposite. Standard Gulfstream III windows are retained, as adequate field of view is provided without the need for drag-producing bubble windows. The navigator's station is aft of the radio operator's position on the port side. This position is equipped with a master console for the Texas Instruments APS-127 sea surveillance radar, dual control display units for the Litton 72R INS, a VHF navigation system, and basic flight instrumentation, including rate of climb and airspeed indicators. Provision has been made for later installation of a VHF/Omega nav system if this is considered necessary.

The RDAF Gulfstream III has some structural differences to provide essential multi-role capability. These include a 1.60 × 2.11 m (63 × 83 in) cargo door on the starboard side of the fuselage, forward of the wing; a cargo roller conveyor system in the cabin floor aft; an overhead cable system for the attachment of drop-load parachute lanyards; and a flare launch system in the rear fuselage, on the port side just aft of the wing trailing-edge. This last feature permits the launch of various pyrotechnic and/or signalling devices, including parachute flares as large as the LAU-2B. The existing 0.72 × 0.91 m (28.5 × 35.75 in) baggage door on the port side of the fuselage, aft of the wing, is flight-openable for the airdrop of emergency supplies and/or survival equipment. The installation of an AN/APS-127 radar antenna in the nose of the aircraft represents no more than an alternative to the weather radar carried by commercial Gulfstream IIIs, but substitution of the radar display for the weather radar display in the instrument panel has necessitated some movement of the surrounding instruments and the inclusion of four sub-panels below the main pilot and co-pilot instrument panels. Standby airspeed, altitude, and attitude indicators have been installed on the glareshield panel, and other non-standard instrumentation includes dual Sperry AD650 Series attitude and RD650 horizontal situation indicators, an SPZ-800 autopilot, and a Teledyne angle of attack indicator.

Experience with the RDAF Gulfstream IIIs led Gulfstream to announce in September 1983 development of a dedicated multi-mission version of the aircraft, designated **SRA-1** (Surveillance and Reconnaissance Aircraft). The prototype SRA-1 (N47449) was first flown on 14 August 1984, following a rollout ceremony at Savannah, Georgia, which was attended by representatives from 32 nations. The aircraft was introduced publicly at the Farnborough Air Show in England in September 1984. As rolled out, the SRA-1 prototype featured wingtip mounted antenna pods, but these were replaced subsequently by standard Gulfstream III winglets, which will be fitted on all production aircraft unless customer specifications dictate otherwise. The SRA-1 can be supplied with fully integrated or stand-alone systems, according to customer requirements, for electronic surveillance, command control, stand-off high altitude reconnaissance, maritime patrol and surface surveillance, and anti-submarine warfare missions, or combinations of those roles. In addition, the aircraft can be reconfigured rapidly for VIP transportation, as a personnel/administrative transport with 18 passengers plus one attendant, for medical evacuation with 15 litter patients and two medical staff, or as a freight transport with provision for up to 3,220 kg (7,100 lb) of priority cargo.

Gulfstream SRA-1 demonstrator with underbelly SLAMMR (side looking airborne multi-mode radar) pod

Gulfstream's rationale in developing the SRA-1 points to the lack of development costs (although no flight testing with external stores will be done until individual customer requirements have been defined); low acquisition and operating costs compared with current aircraft offering similar capabilities; availability of integrated or stand-alone systems as required by the customer; availability of off-the-shelf systems, with minimal R&D costs; and the provision of readily exportable and supportable systems. The company's marketing associates for the SRA-1 programme include: Grumman Aerospace (systems integration work); CAI Division of Recon Optical (long-range cameras); California Microwave (communications collection systems); EM Systems (electronic support measures system); Goodyear Aerospace (synthetic aperture radar); Itek Optical Systems (long-range cameras); Motorola (sideways looking airborne multi-mode radar); Texas Instruments (maritime surveillance radar); and Tracor Applied Sciences (systems integration). Gulfstream Aerospace is also in discussion with a number of other potential suppliers/contractors. In early 1985 the company reported that sales discussions were under way with at least six governments from among some 25–30 civilian and military agencies that had expressed strong interest in the SRA-1. These are believed to include the government of China and the government of West Germany.

The SRA-1 is externally similar to the RDAF Gulfstream III, but has six wing stations for external stores (907 kg; 2,000 lb at each inboard station, 680 kg; 1,500 lb at each mid-span station, and 272 kg; 600 lb at each outboard station). When exhibited at Farnborough, the prototype was equipped with a 5.8 m (19 ft) long Motorola sideways looking airborne multi-mode radar (SLAMMR) pod mounted on a pylon beneath the forward fuselage; a 1.60 m (5 ft 3 in) high by 2.11 m (6 ft 11 in) wide upward hinged cargo door at the front of the cabin on the starboard side; a flight-openable baggage door for airdropping flares and rescue equipment; and an optically flat window replacing the standard port side front cabin window for use with infra-red imagers or a panoramic camera. The cabin interior was configured for five console positions for communications collection, ESM (two), and ASW/maritime sensor and tactical co-ordination operators, plus an Itek 76 cm (30 in) bar panoramic camera. The aircraft has since been reconfigured for presentation at the Paris Air Show in June 1985 with a Goodyear VPD 8 synthetic aperture radar in place of the SLAMMR; long-range optical camera (Lorop); chaff dispenser system; tail-mounted infra-red countermeasures; and four consoles for systems operators.

In electronic surveillance configuration the SRA-1 is equipped with a 20MHz to 1,200MHz communications intercept system; a 0.5GHz to 40GHz electronic support measures (ESM) system; and VHF/UHF/HF communications for C^3 functions; permitting accurate detection, location, analysis, and classification of electronic signals. Operational capabilities include computer data bases to provide automatic signal analysis. A typ-

LEFT: SRA-1, mid-cabin, looking forward, with mission director's display at left, SLAMMR console at right.
RIGHT: Inside the SRA-1 demonstrator: Lorop camera in right foreground

ical electronic surveillance mission for the SRA-1 with a crew of ten would have a gross weight of 31,743 kg (69,981 lb), providing a long-range patrol endurance of 8.8 hours and a range of 3,565 nm (6,607 km; 4,105 miles) with 1,361 kg (3,000 lb) fuel reserves (ISA, zero wind). For a high altitude loiter mission at the same mission gross weight and reserves, the SRA-1 could remain airborne for 9.6 hours, with a range of 3,257 nm (6,036 km; 3,750 miles).

In the maritime patrol role the SRA-1 is equipped with high definition, all-weather, real-time search radar in a hinged nosecone; a forward looking infrared system (FLIR); ESM systems; and stowage and manual launch systems for survival/rescue equipment, marine markers, and flares. With a crew of five, mission gross weight of 30,810 kg (67,924 lb), and a fuel reserve of 1,361 kg (3,000 lb), ISA zero wind, the SRA-1 thus equipped has a mission duration of 9.2 hours and a range of 3,017 nm (5,591 km; 3,474 miles) at a 9,140 m (30,000 ft) patrol altitude. For SAR missions, at a gross weight of 31,842 kg (70,200 lb) including a 1,032 kg (2,276 lb) retained payload, the SRA-1 can operate within a 1,000 nm (1,853 km; 1,151 mile) radius of action and fly an 8-hour mission.

In reconnaissance configuration the SRA-1 is equipped with real-time, all-weather, moving target indicator SLAR; long-range oblique photographic cameras, which may include electro-optical capability; and an ESM system. With a crew of seven the aircraft has a loiter endurance of 9.7 hours at altitudes above 7,620 m (25,000 ft).

For anti-submarine warfare missions the SRA-1 can be equipped with a high definition maritime surveillance radar with periscope/snort detection; FLIR; a boom mounted magnetic anomaly detector (MAD) extending from the rear fuselage beneath the fin/rudder; ESM; acoustic processing equipment; sonobuoys; and automated data recording for post-flight mission analysis. Weapons can include Harpoon anti-shipping missiles and Sting Ray torpedoes.

The following description applies to the standard Gulfstream SRA-1:

TYPE: Twin-turbofan multi-role military aircraft.

WINGS: Cantilever low-wing monoplane of light alloy construction. Wing section NACA 0012 (modified) at wing station 50; NACA 63A009.5 (modified) at wing station 145; NACA 64 series (modified) at wing station 385. Dihedral 3°. Incidence 3° 30′ at wing station 50; 1° 30′ at wing station 145; and −0° 30′ at wing station 414. Sweepback 27° 40′ at quarter-chord. NASA (Whitcomb) wingtip winglets. One-piece single-slotted Fowler trailing-edge flaps. Spoilers forward of flaps, to assist in lateral control, can be extended for use as airbrakes. All control surfaces actuated hydraulically, with manual reversion. Trim tab in port aileron. Anti-icing by engine bleed air.

FUSELAGE: Conventional semi-monocoque structure of light alloy. Glassfibre nosecone hinged for access.

TAIL UNIT: Cantilever T tail structure of light alloy, with composite rudder. Sweptback horizontal and vertical surfaces. Trim tab in rudder and each elevator. Powered controls.

LANDING GEAR: Retractable tricycle type, with twin wheels on each unit. Inward retracting main units; steerable nosewheel unit retracts forward. Mainwheel tyres size 34 × 9.25-16, pressure 12.0 bars (175 lb/sq in). Nosewheel tyres size 21 × 7.25-10, pressure 7.9 bars (115 lb/sq in). Goodyear aircooled carbon brakes, with Goodyear fully modulating anti-skid units.

POWER PLANT: Two Rolls-Royce Spey Mk 511-8 turbofan engines, each 50.7 kN (11,400 lb st), pod mounted on sides of rear fuselage. Rohr target type thrust reverser forms rear part of each nacelle when in the stowed position. All fuel in integral tanks in wings, with total capacity of 15,868 litres (4,192 US gallons).

ACCOMMODATION: Flight deck crew of two or three. Cabin interior configurations as described in introductory paragraphs, with maximum seating capacity for 19 passengers in pressurised and air-conditioned cabin. Galley and toilet standard. Large baggage compartment at rear of cabin, capacity 907 kg (2,000 lb). Upward opening cargo door on starboard side at front of cabin. Integral airstair door at front of cabin on port side. Electrically heated wraparound windscreen.

SYSTEMS: Cabin pressurisation system with max differential of 0.65 bars (9.45 lb/sq in). Two independent hydraulic systems, each 103.5 bars (1,500 lb/sq in), each with own bootstrap reservoir. Emergency pressure provided by nitrogen system rated at 207 bars (3,000 lb/sq in). All flying controls powered hydraulically, with manual reversion. APU in tail compartment. Electrical system is basically of 115/200V AC at 400Hz, provided by three three-phase variable speed alternators each rated at 36kVA, two engine-driven, the third by the APU. Each engine driven alternator is provided with a 30kVA solid state converter to give 25kVA 115/200V three-phase AC at 400Hz, but the alternator of the controlled speed APU does not need a converter. The capacity of a single converter is sufficient for the entire AC requirement of the aircraft. The system also includes a 300A 28V DC transformer-rectifier, an 800VA 115V 400Hz single-phase, solid state battery powered inverter for emergency AC power, two 24V nickel-cadmium storage batteries, and an external power socket.

AVIONICS AND EQUIPMENT: Standard communications and navigation systems include dual HF com and dual VHF/UHF com; dual VHF navigation, ILS, and marker beacon receivers; dual LF/ADF; IFF/ATC system; dual DME; weather radar; radio altimeter; intercom; dual INS; Tacan; VHF/UHF DF system; and cabin paging system. Mission avionics and equipment according to customer requirements and as detailed in earlier part of description.

DIMENSIONS, EXTERNAL:

Wing span	23.72 m (77 ft 10 in)
Wing aspect ratio	6.0
Wing chord at root (fuselage centreline)	5.94 m (19 ft 5⅞ in)
Winglet height	1.63 m (5 ft 4¼ in)
Length overall	25.32 m (83 ft 1 in)
Fuselage length	22.66 m (74 ft 4 in)
Height overall	7.43 m (24 ft 4½ in)
Tailplane span	8.23 m (27 ft 0 in)
Wheelbase	10.72 m (35 ft 2 in)
Passenger door (fwd, port):	
Height	1.57 m (5 ft 2 in)
Width	0.91 m (3 ft 0 in)
Cargo door (fwd, stbd):	
Height	1.60 m (5 ft 3 in)
Width	2.11 m (6 ft 11 in)
Baggage door (rear):	
Height	0.72 m (2 ft 4½ in)
Width	0.90 m (2 ft 11¼ in)

DIMENSIONS, INTERNAL:

Flight deck volume	3.51 m³ (124 cu ft)
Cabin (excl flight deck):	
Length	12.60 m (41 ft 4 in)
Width	2.24 m (7 ft 4 in)
Height	1.85 m (6 ft 1 in)
Volume	42.53 m³ (1,502 cu ft)
Rear baggage compartment volume	4.44 m³ (157 cu ft)

AREAS:

Wings, gross	86.83 m² (934.6 sq ft)
Ailerons, incl tabs (total)	2.68 m² (28.86 sq ft)
Trailing-edge flaps (total)	11.97 m² (128.84 sq ft)
Flight spoilers (total)	2.87 m² (30.88 sq ft)
Ground spoilers (total)	4.59 m² (49.39 sq ft)
Winglets (total)	2.38 m² (25.60 sq ft)
Fin	10.92 m² (117.53 sq ft)
Rudder	4.16 m² (44.75 sq ft)
Horizontal tail surfaces (total)	12.70 m² (136.69 sq ft)
Elevators (total)	5.22 m² (56.22 sq ft)

WEIGHTS:

Manufacturer's bare weight	14,834 kg (32,703 lb)
Basic weight empty (excl mission equipment)	16,408 kg (36,173 lb)
Max fuel load	12,836 kg (28,300 lb)
Max payload (cargo)	3,220 kg (7,100 lb)
Max T-O weight	31,615 kg (69,700 lb)
Max ramp weight	31,842 kg (70,200 lb)
Max zero-fuel weight	19,958 kg (44,000 lb)
Max landing weight	26,535 kg (58,500 lb)

*PERFORMANCE (at max T-O weight except where indicated):

Max cruising speed	Mach 0.85 (501 knots; 928 km/h; 576 mph)
Long-range cruising speed	Mach 0.77 (442 knots; 818 km/h; 508 mph)
Approach speed at max landing weight	136 knots (252 km/h; 157 mph)
Stalling speed at max landing weight	105 knots (195 km/h; 121 mph)
Max rate of climb at S/L	1,158 m (3,800 ft)/min
Rate of climb at S/L, one engine out	365 m (1,200 ft)/min
Max operating altitude	13,720 m (45,000 ft)
FAA balanced T-O field length	1,554 m (5,100 ft)
FAA landing distance	975 m (3,200 ft)
NBAA range at Mach 0.77, with three crew, 726 kg (1,600 lb) payload:	
IFR reserves	3,500 nm (6,486 km; 4,030 miles)
VFR reserves	3,940 nm (7,302 km; 4,537 miles)

* *See also introductory text for typical SRA-1 mission performances.*

NDN

NDN AIRCRAFT LTD: Isle of Wight Airport, Sandown, Isle of Wight, UK

NAC1 FREELANCE

The NAC1 Freelance retains many features of the BN-3 Nymph light aircraft (G-AXFB) designed by Mr N. D. Norman and the late Mr John Britten, first flown on 17 May 1969 and last described fully in the 1972–73 *Jane's*. Mr Norman, now the Managing Director of NDN Aircraft Ltd, acquired that prototype, together with design drawings and design data. The overall dimensions of the Freelance are not greatly changed, but the entire design has been updated and now has a new wing section, redesigned ailerons and flaps, a longer cabin, integral fuel tanks, and the latest available instruments and avionics.

The Freelance is intended to be suitable for a wide range of specialised tasks including air ambulance, glider and banner towing, agricultural spraying and dusting, aerial photography, and parachutist transport. Wing folding is offered as an optional feature for production aircraft, which are to be marketed by a new (1984) company known as The Norman Aeroplane Company Ltd (NAC). The aircraft can also be fitted with interchangeable wheel, ski, and float landing gear.

Construction is mainly of metal, and is described as being at least as lightweight and efficient as the best-selling US counterparts, but with fewer parts, to simplify production. The prototype (G-NAC1), which made its first flight on 29 September 1984, is powered by a 134 kW (180 hp) Avco Lycoming O-360-A flat-four engine; flight testing towards certification was continuing in early 1985.

TYPE: Four-seat multi-purpose utility aircraft.

WINGS: Strut braced high-wing monoplane. Wing section NACA 23012 (modified). Dihedral 1° 30′ from roots. Incidence 3° 30′. No sweepback. Constant chord conventional two-spar all-metal structure of Alclad light alloy, including trailing-edge flaps and ailerons, braced on each side by single strut from fuselage floor line. No tabs. Optional wing folding enables wings to be swung back within 30 s of engine shutdown, permitting aircraft to be stored within a 4 × 9 m (13 ft 1 in × 29 ft 6 in) space.

FUSELAGE: Conventional semi-monocoque structure of basically rectangular section, with frames, stringers, and Alclad light alloy sheet covering. Glassfibre engine cowling.

TAIL UNIT: Cantilever all-metal structure, with sweptback vertical surfaces and non-swept rectangular horizontal surfaces. Small dorsal fin. No tabs in rudder or elevators.

Prototype NDN NAC1 Freelance four-seat multi-purpose utility aircraft

LANDING GEAR: Non-retractable tricycle gear standard. Wheel/ski and float gear, and balloon tyres, available optionally.

POWER PLANT: One 134 kW (180 hp) Avco Lycoming O-360-A flat-four engine, driving a Sensenich two-blade fixed-pitch (optionally constant-speed) metal propeller with spinner. Two fuel tanks in each wing, combined capacity 227 litres (50 Imp gallons). Refuelling point above each wing.

ACCOMMODATION: Side by side individual seats, in pairs, for pilot and up to three passengers in fully enclosed cabin, access to which is via a forward opening door on the port side. Similar door optional on starboard side. Baggage space behind rear seats, with loading door on port side of fuselage. Rear (sliding) door optional, for paradropping. Cabin can be configured for one specially designed full-length stretcher, plus medical attendant, in addition to pilot.

SYSTEMS: Hydraulic system, pressure 34.5 bars (500 lb/sq in), for mainwheel brakes. DC electrical system includes 28V 60A alternator and 25Ah battery. Exhaust muff heater with punka louvres for cabin ventilation.

AVIONICS: Normal instrumentation for VFR and IFR flying. General Aviation Class 1 radio equipment optional.

EQUIPMENT: Wide variety of equipment options, according to role. These can include towing gear for sailplane (up to 907 kg: 2,000 lb AUW) or banners; passengers' ski carrying bin in rear fuselage; a 378.5 litre (100 US gallon) detachable belly spraytank, plus boom and nozzles or Micronair atomisers; outward opening cabin windows for aerial photography; rear (sliding) door for paradropping; and ambulance kit *(see 'Accommodation' paragraph)*.

DIMENSIONS, EXTERNAL:

Wing span	11.99 m (39 ft 3.9 in)
Wing chord, constant	1.32 m (4 ft 4 in)
Wing aspect ratio	9.15
Width, wings folded	3.66 m (12 ft 0 in)
Length overall	7.21 m (23 ft 7.7 in)
Height overall	2.90 m (9 ft 6 in)
Tailplane span	3.66 m (12 ft 0 in)
Wheel track	2.18 m (7 ft 2 in)
Wheelbase	2.08 m (6 ft 10 in)
Propeller diameter	1.93 m (6 ft 4 in)
Passenger door (port):	
Height	0.91 m (3 ft 0 in)
Width	0.86 m (2 ft 10 in)
Height to sill	0.76 m (2 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin:	
Length	2.69 m (8 ft 10 in)
Max width	1.04 m (3 ft 5 in)
Max height	1.22 m (4 ft 0 in)

AREAS:

Wings, gross	15.70 m² (169.0 sq ft)
Ailerons (total)	1.38 m² (14.9 sq ft)
Trailing-edge flaps (total)	1.86 m² (20.0 sq ft)
Fin	0.72 m² (7.74 sq ft)
Rudder	0.53 m² (5.66 sq ft)
Tailplane	2.01 m² (21.6 sq ft)
Elevators (total)	1.24 m² (13.4 sq ft)

WEIGHTS AND LOADINGS:

Basic weight empty, equipped	635 kg (1,400 lb)
Max T-O and landing weight	1,111 kg (2,450 lb)
Max wing loading	70.74 kg/m² (14.50 lb/sq ft)
Max power loading	8.28 kg/kW (13.61 lb/hp)

PERFORMANCE (estimated at max T-O weight):

Max level speed at S/L	121 knots (225 km/h; 140 mph)
Cruising speed at S/L (75% power)	117 knots (217 km/h; 135 mph)
Stalling speed, power off:	
flaps up	52 knots (95 km/h; 59 mph)
flaps down	49 knots (91 km/h; 56 mph)
Max rate of climb at S/L	244 m (800 ft)/min
Service ceiling	5,180 m (17,000 ft)
T-O to 15 m (50 ft)	421 m (1,380 ft)
Landing from 15 m (50 ft)	342 m (1,120 ft)
Max range at 75% power, no reserves	834 nm (1,545 km; 960 miles)

Major customer for the BAe 146 airliner is Pacific Southwest Airlines of the USA

BAe

BRITISH AEROSPACE (Aircraft Group, Civil Division): Hatfield, Hertfordshire AL10 9TL, UK

BAe 146

First flown on 3 September 1981, the BAe 146 entered service (with Dan-Air) on 27 May 1983 and is in production in two basic passenger versions, the Series 100 and Series 200, as described in the 1984–85 *Jane's*. Orders and options totalled 79 by the beginning of 1985, at which time about 20 were in service. Customers were then as follows:

	Orders	Options
AirPac (Alaska)	1	1
Air Wisconsin	7	4
Ansett (Airlines of Western Australia)	2	6
Aspen Airways	2	—
Dan-Air	2	2
Mali government	1	—
*Ministry of Defence (Royal Air Force)	2	—
Pacific Southwest Airlines	20	25
TABA (Brazil)	2	—
The Queen's Flight (Royal Air Force)	2	—

**For evaluation prior to order for The Queen's Flight; returned in 1984 and leased to Dan-Air and PSA*

The following additional variants were announced in the Autumn of 1984:

BAe 146-300

Launch of the design and engineering phase of this 'stretched' version of the BAe 146 regional airliner was announced on 3 September 1984. First flight is planned for 1987, and first deliveries for 1988.

The 146-300 will have a fuselage 3.15 m (10 ft 4 in) longer than that of the existing Series 200, and will seat 122 passengers at 81 cm (32 in) pitch or up to 130 at 74 cm (29 in) pitch. To cater for the increased weights, modifications will be made to the wing aerodynamics and the ALF 502 turbofan engines. The outer wings will embody new technology derived from BAe work on developments of the Airbus A300/310/320 family, and will have a small winglet above and below each tip. Power plant will comprise four ALF 502R-7 turbofans, each developing 33.36 kN (7,500 lb st), and internal fuel capacity will be increased from 11,547 litres (2,540 Imp gallons) to 12,901 litres (2,838 Imp gallons) by using additional tanks in the wing root fairings. This modest increase in fuel capacity will enable the 146-300 to carry about 20 per cent more payload than the 146-200. Other changes will include a new, fully digital autopilot, and an avionics suite with either EFIS (electronic flight instrumentation system) or conventional instrument displays.

DIMENSIONS, EXTERNAL:

Wing span	26.34 m (86 ft 5 in)
Wing area, gross	77.30 m² (832.0 sq ft)
Wing aspect ratio	8.97
Length overall	31.75 m (104 ft 2 in)
Height overall	8.56 m (28 ft 1 in)
Fuselage diameter (max)	3.56 m (11 ft 8 in)
Tailplane span	11.09 m (36 ft 5 in)
Wheel track	4.72 m (15 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin (excl flight deck, incl galley and toilets):	
Length	20.95 m (68 ft 9 in)
Max width	3.38 m (11 ft 1 in)
Max height	2.02 m (6 ft 7½ in)
Baggage/freight holds, underfloor	24.54 m³ (860 cu ft)

WEIGHTS AND LOADINGS (estimated):

Typical operating weight empty	24,721 kg (54,500 lb)

Max T-O weight	45,360 kg (100,000 lb)
Max zero-fuel weight	37,648 kg (83,000 lb)
Max landing weight	40,823 kg (90,000 lb)
Max wing loading	586.5 kg/m² (120.2 lb/sq ft)
Max power loading	340.1 kg/kN (3.33 lb/lb st)

BAe 146 (FREIGHTER VERSIONS)

Simultaneously with its announcement of the BAe 146 Series 300, British Aerospace revealed plans to introduce freighter versions of the Series 100 and 200. Cabin volume will allow the 146-200 freighter to carry six standard 2.74 × 2.24 m (108 × 88 in) pallets, with space for an extra half pallet. Minor modifications to the standard floor make possible a maximum freight payload of 9,979 kg (22,000 lb), and the floor stressing will permit a maximum individual pallet load of 2,721 kg (6,000 lb). Later versions, making use of further structural developments, will enable payloads of up to 12,973 kg (28,600 lb) to be carried.

The freight door will be located in the rear fuselage, allowing normal passenger facilities to be retained at the front of the cabin for use in a Combi configuration; the rear passenger door is retained separately.

DIMENSIONS, EXTERNAL: As for 146-300 except:

Length overall:	
Series 100	26.16 m (85 ft 10 in)
Series 200	28.55 m (93 ft 8 in)
Passenger doors (port, fwd and rear):	
Height	1.83 m (6 ft 0 in)
Width	0.85 m (2 ft 9½ in)
Height to sill:	
fwd	1.88 m (6 ft 2 in)
rear	1.98 m (6 ft 6 in)
Freight door (rear):	
Height	1.98 m (6 ft 6 in)
Width:	
146-100	2.92 m (9 ft 7 in)
146-200	3.30 m (10 ft 10 in)

CASA

CONSTRUCCIONES AERONAUTICAS SA: Rey Francisco 4, Apartado 193, Madrid 8, Spain

CASA C-101 AVIOJET

Spanish Air Force designation: E.25 Mirlo (Blackbird)

Chilean Air Force designation: T-36 Halcón (Hawk)

CASA and the Spanish Ministerio del Aire signed a contract for this basic and advanced military jet trainer on 16 September 1975. The contract covered construction of four flying prototypes (first flights 27 June and 30 September 1977, 26 January and 17 April 1978) and two airframes for static and fatigue testing. MBB (West Germany) and Northrop (USA) collaborated in the design, the latter company providing assistance with the inlet design and that of the 'Norcasa' wing section.

To minimise cost and maintenance, the C-101 is built on modular lines, with ample space within the airframe for equipment for any training mission likely to be required. The C-101 is fully aerobatic, and is able to carry out such additional duties as ground attack, reconnaissance, escort, weapons training, electronic countermeasures (ECM), and photographic missions. Manufacture is entirely by CASA except for the nosewheel unit, which is produced in the UK by Dowty Rotol. Wings and main landing gear units are built at Getafe and fuselages at Seville. Aircraft for Chile are assembled and partially manufactured locally by ENAER. Spanish production started at the beginning of 1978, and the first production aircraft made its initial flight on 8 November 1979.

The following versions have been announced:

C-101EB. Initial production trainer version for Spanish Air Force, with 15.57 kN (3,500 lb st) TFE731-2-2J engine. Total of 88 delivered from 17 March 1980; now in service with the Academia General del Aire of the Fuerza Aérea Española at San Javier and the 41° Grupo at Zaragoza. Described in 1983–84 *Jane's*.

C-101BB. Armed export version, with 16.46 kN (3,700 lb st) TFE731-3-1J engine, ordered by air forces of Chile (17 **BB-02**) and Honduras (four **BB-03**, with options on eight more), similar except for avionics. All except first four BB-02s are for licence assembly and partial local manufacture by ENAER in Chile.

C-101CC. Light attack version, with more powerful TFE731-5-1J engine (normal rating 19.13 kN; 4,300 lb st, military power reserve (MPR) rating 20.91 kN; 4,700 lb st) and other modifications. First of two prototypes flown on 16 November 1983. Twenty **CC-02** ordered by Chile as **A-36 Halcón.**

C-101DD. Enhanced training version, announced in 1984. Additional avionics include Ferranti FD 4500 all-digital head-up display and weapon aiming computer, Ferranti FIN 1100 strapdown inertial attitude and heading reference system, GEC Avionics AD 6601-11 Doppler velocity sensor, TRT AHV-8 radio altimeter, and Collins AN/ARC-182(V) UHF/VHF. Power plant as for C-101CC. Due to fly in Spring 1985.

The following description applies to the standard C-101BB except where indicated:

TYPE: Tandem two-seat basic and advanced trainer and light tactical aircraft.

WINGS: Cantilever low-wing monoplane. Wing section Norcasa 15, thickness/chord ratio 15%. Dihedral 5°. Incidence 1°. Sweepback at quarter-chord 1° 53'. All-metal (aluminium alloy) three-spar fail-safe stressed-skin structure, with six-bolt attachment to fuselage. Plain ailerons and slotted trailing-edge flaps, of glassfibre/honeycomb sandwich construction. Flap track guides of titanium. Ailerons actuated hydraulically, with electrically actuated artificial spring feel and manual backup. Ground adjustable tab on port aileron.

FUSELAGE: All-metal semi-monocoque fail-safe structure. Hydraulically operated aluminium honeycomb airbrake under centre of fuselage.

TAIL UNIT: Cantilever all-metal structure, with electrically actuated variable incidence tailplane. Aluminium honeycomb rudder and elevators, actuated manually via push/pull rods. Electrically actuated trim tab in rudder. Twin ventral strakes under jetpipe on armed versions.

LANDING GEAR: Hydraulically retractable tricycle type, with single wheel and oleo-pneumatic shock absorber on each unit. Forward retracting Dowty Rotol nose unit, with non-steerable nosewheel and chined tubeless tyre size 457 × 146 (18 × 5.75-8). Inward retracting mainwheels with tubeless tyres size 622 × 216 (24.5 × 8.5-10) and hydraulically actuated multi-disc brakes.

POWER PLANT: One Garrett TFE731 non-afterburning turbofan engine (see model listings for details), with lateral intake on each side of fuselage abreast of second cockpit. Fuel in one 1,155 litre (254 Imp gallon) fuselage bag tank, one 575 litre (126.5 Imp gallon) integral tank in wing centre-section, and two outer wing integral tanks, for ferry missions, each of 342 litres (75.25 Imp gallons). Total usable internal fuel capacity 1,730 litres (380.5 Imp gallons) normal, 2,414 litres (531 Imp gallons) maximum. Fuel system permits up to 30 s of inverted flight. Pressure refuelling point beneath port air intake; gravity fuelling point for each tank. No provision for external fuel tanks. Oil capacity 8.5 litres (1.8 Imp gallons).

ACCOMMODATION: Crew of two in tandem, on Martin-Baker 10L zero/zero ejection seats, under individual canopies which open sideways to starboard and are separated by internal screen. Rear (instructor's) seat elevated 32.5 cm (12¾ in). Cockpit pressurised and air-conditioned by engine bleed air. Dual controls standard.

SYSTEMS: Hamilton Standard three-wheel bootstrap type air-conditioning and pressurisation system, differential 0.28 bars (4.07 lb/sq in), using engine bleed air. Single hydraulic system, pressure 207 bars (3,000 lb/sq in), for landing gear, ailerons, flaps, airbrake, anti-skid units, and wheel brakes. Backup system comprising compressed nitrogen bottle for landing gear extension and accumulator for aileron boosters and emergency braking. Pneumatic system for air-conditioning, pressurisation, and canopy seal. Electrical system includes 28V 9kW DC starter/generator, two 700VA static inverters for 115/26V single phase AC power, and two 24V 23Ah nickel-cadmium batteries for emergency DC power and engine starting. High pressure gaseous oxygen system.

AVIONICS AND EQUIPMENT: Standard C-101BB equipped with Magnavox RT-1168/ARC-164 UHF com; Wilcox AN/ARC-134 VHF; Bendix AN/ARN-127 VOR/ILS/marker beacon receiver; Collins AN/ARN-118 Tacan; Teledyne Electronic RT-1063B/APX-101 IFF/SIF; Sperry SPI-402 flight director system, including Tarsyn vertical and directional gyro package, dual HZ-444 attitude director indicators, RD-500A horizontal situation indicators with remote course selection, RH-405 radio magnetic indicators and 807A com transceivers. Wide range of alternative avionics and equipment available for export versions, including a Maverick pod, and (in the DD) a Ferranti FD 4500 head-up display and weapon aiming computer, Ferranti FIN 1100 AHRS, GEC Avionics AD 6601-11 Doppler velocity sensor, TRT AHV-8 radio altimeter, Collins AN/ARC-182(V) UHF/VHF, radar warning receiver, video camera, and rear seat monitor.

ARMAMENT AND OPERATIONAL EQUIPMENT: Large bay below rear cockpit suitable for quick-change packages, including 30 mm DEFA cannon pod, a twin 12.7 mm M3 machine-gun pod, reconnaissance camera, ECM package, or laser designator. Six underwing hardpoints, capacities 500 kg (1,102 lb) inboard, 375 kg (827 lb) centre, and 250 kg (551 lb) outboard; total external stores load

C-101EB Aviojet basic/advanced trainers of the Fuerza Aérea Española

2,250 kg (4,960 lb). Typical armament can include one 30 mm cannon with up to 130 rds, or two 12.7 mm guns, in the fuselage; six 125 kg or four 250 kg bombs; four LAU-3/A, LAU-10 or LAU-32 rocket launchers; four 125 kg BR125 bombs and two LAU-3/A launchers; two AGM-65 Maverick missiles; or four BIN200 napalm bombs.

DIMENSIONS, EXTERNAL:

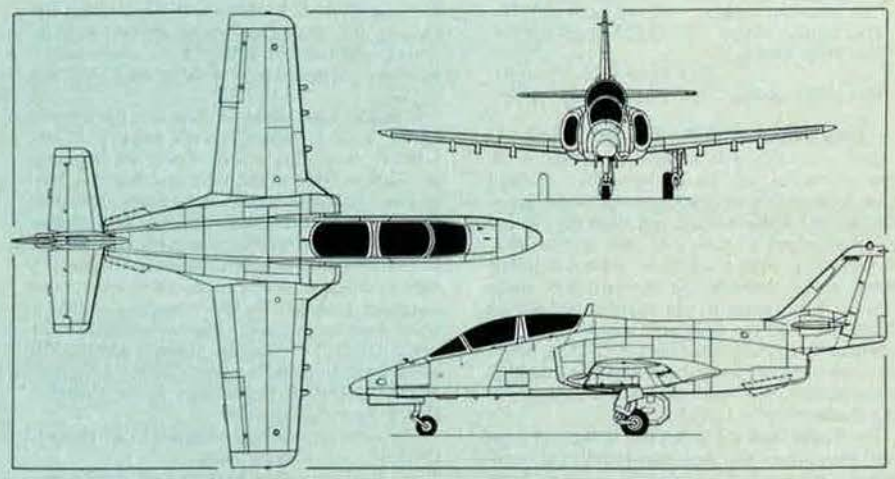
Wing span	10.60 m (34 ft 9⅜ in)
Wing chord: at c/l	2.36 m (7 ft 9 in)
at tip	1.41 m (4 ft 7½ in)
Wing aspect ratio	5.6
Length overall	12.50 m (41 ft 0 in)
Height overall	4.25 m (13 ft 11¼ in)
Tailplane span	4.32 m (14 ft 2 in)
Wheel track	3.18 m (10 ft 5¼ in)
Wheelbase	4.77 m (15 ft 7¾ in)

AREAS:

Wings, gross	20.00 m² (215.3 sq ft)
Ailerons (total)	1.18 m² (12.70 sq ft)
Trailing-edge flaps (total)	2.50 m² (26.91 sq ft)
Fin	2.10 m² (22.6 sq ft)
Rudder	1.10 m² (11.84 sq ft)
Tailplane	3.44 m² (37.03 sq ft)
Elevators	1.00 m² (10.76 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped:	
BB, CC	3,340 kg (7,666 lb)
DD	3,500 kg (7,716 lb)
Max fuel weight (all)	1,881 kg (4,148 lb)
Max external stores load (all)	2,250 kg (4,960 lb)
T-O weight:	
trainer, 'clean':	
BB, CC	4,850 kg (10,692 lb)
DD	4,570 kg (10,075 lb)
ground attack:	
BB	5,600 kg (12,345 lb)
CC, DD	6,300 kg (13,890 lb)
Max landing weight (BB):	
3.66 m (12 ft)/s sink rate	4,700 kg (10,361 lb)
3.05 m (10 ft)/s sink rate	5,400 kg (11,905 lb)
Wing loading:	
trainer, 'clean':	
BB, CC	242.5 kg/m² (46.69 lb/sq ft)
DD	228.5 kg/m² (46.82 lb/sq ft)
ground attack:	
BB	280.0 kg/m² (57.38 lb/sq ft)
CC, DD	315.0 kg/m² (64.55 lb/sq ft)
Power loading:	
trainer, 'clean':	
BB	294.9 kg/kN (2.89 lb/lb st)
CC (normal)	254.1 kg/kN (2.49 lb/lb st)
CC (with MPR)	231.6 kg/kN (2.27 lb/lb st)
DD (normal)	238.8 kg/kN (2.34 lb/lb st)
DD (with MPR)	218.4 kg/kN (2.14 lb/lb st)
ground attack:	
BB	340.8 kg/kN (3.34 lb/lb st)
CC, DD (normal)	329.6 kg/kN (3.23 lb/lb st)
CC, DD (with MPR)	301.0 kg/kN (2.95 lb/lb st)



CASA C-101CC light attack version of the Aviojet *(Pilot Press)*

PERFORMANCE (BB at 4,400 kg; 9,700 lb AUW, CC and DD at 4,500 kg; 9,921 lb):

Max limiting Mach number (all)	0.80
Never-exceed speed (all)	450 knots (834 km/h; 518 mph) IAS
Max level speed at S/L:	
BB	373 knots (691 km/h; 430 mph)
Max level speed at height:	
BB at 7,620 m (25,000 ft)	430 knots (797 km/h; 495 mph)
CC and DD at 6,100 m (20,000 ft) with MPR	435 knots (806 km/h; 501 mph)
CC and DD at 4,575 m (15,000 ft) with MPR	450 knots (834 km/h; 518 mph)
Econ cruising speed at 9,145 m (30,000 ft) (all)	Mach 0.60 (354 knots; 656 km/h; 407 mph)
Unstick speed (all)	115 knots (213 km/h; 132 mph)
Touchdown speed (all)	95 knots (176 km/h; 109 mph)
Stalling speed (all):	
flaps up	99 knots (183 km/h; 114 mph) IAS
flaps down	88 knots (164 km/h; 102 mph) IAS
Max rate of climb at S/L:	
BB	1,152 m (3,780 ft)/min
CC and DD (normal)	1,370 m (4,500 ft)/min
CC and DD (with MPR)	1,615 m (5,300 ft)/min
Time to 7,620 m (25,000 ft):	
BB	8 min 30 s
CC, DD	7 min 30 s
Service ceiling:	
BB	12,200 m (40,000 ft)
CC, DD	12,800 m (42,000 ft)
T-O run:	
BB	630 m (2,065 ft)
CC, DD	560 m (1,835 ft)
T-O to 15 m (50 ft):	
BB	850 m (2,790 ft)
CC, DD	750 m (2,460 ft)
Landing from 15 m (50 ft):	
all	800 m (2,625 ft)
Landing run:	
all	480 m (1,575 ft)

Typical interdiction radius (lo-lo-lo) with four 250 kg bombs and 30 mm gun:
- BB and CC, 3 min over target, 30 min reserves 280 nm (519 km; 322 miles)
- DD, 5 min attack (MPR thrust), 7% reserves 275 nm (510 km; 316 miles)

Typical close air support radius (lo-lo-lo):
- BB and CC with four 19 × 2.75 in rocket launchers and 30 mm gun, 50 min loiter over battle area, 8 min over target, 30 min reserves 200 nm (371 km; 230 miles)
- DD, load as above plus two 125 kg bombs, 30 min loiter, 10 min attack (MPR thrust) and 7% reserves 170 nm (315 km; 196 miles)
- BB and CC with two Maverick missiles and 30 mm gun, 8 min over target, 30 min reserves 325 nm (602 km; 374 miles)

Typical ECM radius:
- BB and CC, 3 h 15 min loiter over target, 30 min reserves 330 nm (611 km; 380 miles)

Typical photo-reconnaissance radius (hi-lo-lo):
- BB and CC, 30 min reserves 520 nm (964 km; 599 miles)

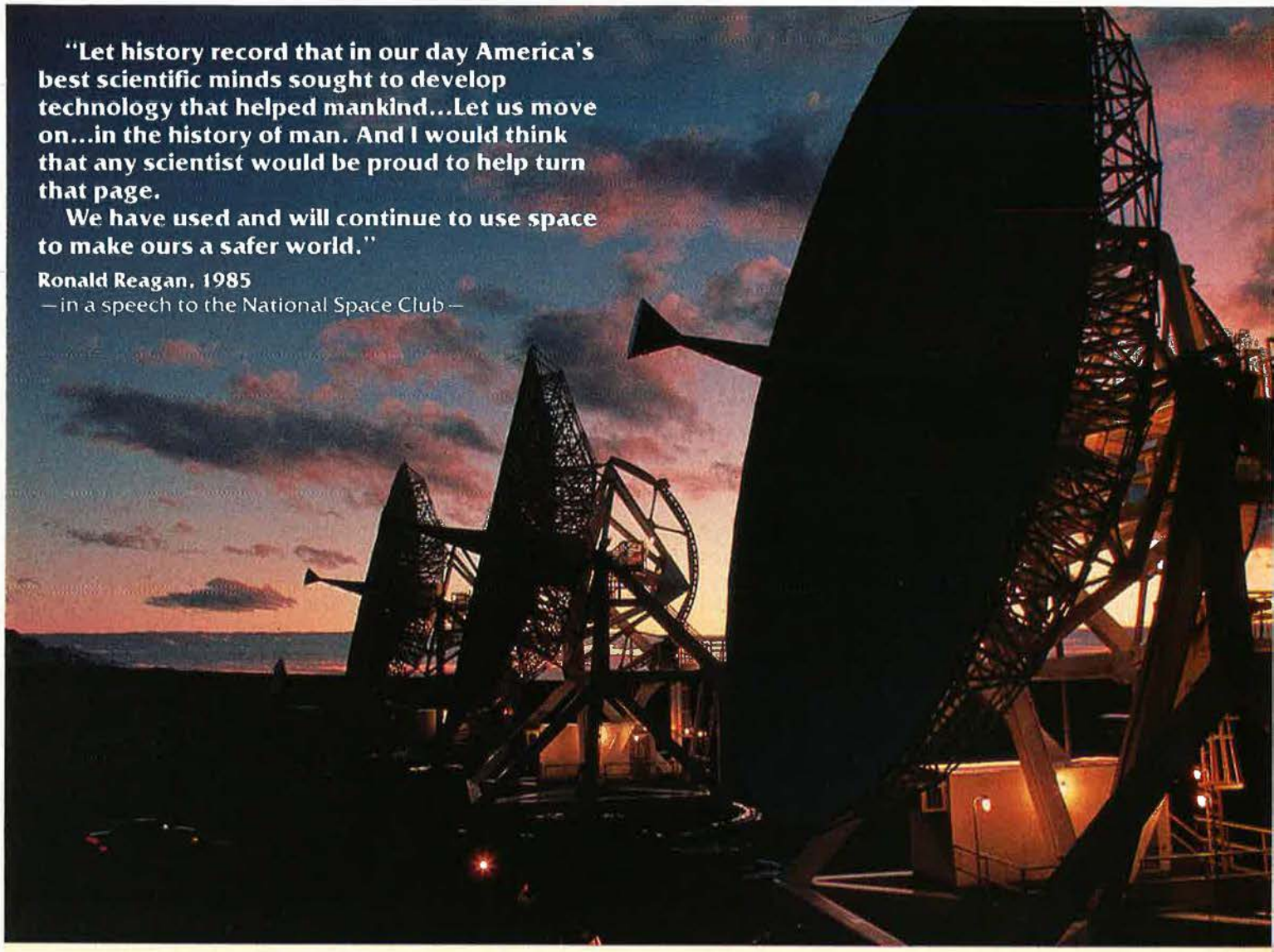
Armed patrol, no underwing stores, 100 nm (185 km; 115 mile) transit from base to patrol area:
- BB and CC with one 30 mm or two 12.7 mm guns, 45 min reserves 3 h 30 min at 205 knots (380 km/h; 236 mph) at S/L
- DD with one 30 mm gun and 10% reserves, otherwise as above 3 h 30 min at 200 knots (370 km/h; 230 mph) at S/L

Ferry range (all), 30 min reserves 2,000 nm (3,706 km; 2,303 miles)

Typical training mission endurance (all) two 1 h 10 min general handling missions, including aerobatics, with 20 min reserves remaining after second mission

Max endurance (all)	7 h
g limits (all):	
at 4,800 kg (10,582 lb) AUW	+7.5/−3.9
at 6,300 kg (13,890 lb) AUW	+5.5/−1.0

A C-101CC Aviojet displays its agility with a heavy load of underwing stores



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Our schools are teaching the past, talking about the present, and ignoring the future. It's not an easy problem to solve.

Educating for The Technical Tomorrow

AMERICA is in the midst of an "information age." Computers, science, and technology are increasing the pace of change in communications, industry, and defense. Continued US success in these areas depends in large part on the ability of the nation's education system to produce quality teachers.

Concomitantly, schools need to change their current emphasis on content and memorization. They should concentrate more on enabling students to develop and master critical thinking skills, according to panelists at the March 6 Aerospace Education Center Roundtable titled "Teachers of the Future—Where Are They and Their Students Going?"

Despite society's increasing dependence on computers to process data and solve problems, educators must continue to stress and raise standards for students in reading, writing, and math, the panelists said. To help students function in a society with computers, schools should provide a *general* orientation to technology. The burden of introducing graduates to specific applications and updating them on new technology will shift, more and more, to industry and government.

Dr. Albert C. Pierce, professor of military strategy at the National War College, said careful thought should be given to the use of computers in schools. Educators should be wary of salesmen promoting the latest technology. As technology becomes more expensive and changes come more rapidly, school systems will incur a phenomenal expense if they try to stay current with the latest hardware, he warned.

James C. Moulton, Jr., an intermediate school principal from Fairfax, Va., called attention to the critical shortage of math and science teachers. He noted that the higher salaries offered by private industry continue to divert the best students from teaching careers.

Emphasizing the severity of the teacher shortage, Dr. Audrey B. Champagne of the American Association for the Advancement of Science pointed out that universities in the state of New York last year produced only two graduates with degrees to teach physics. Dr. Champagne cautioned that if science education continues along its current path, it will not prepare the nation's citizens adequately for the technological society of the future.

"There is a need to return to the basics, but there is a greater need to extend beyond this," said Dr. Eleanor P. Wynne, Vice President of the Aerospace Education Foundation and professor at the University of California at Irvine. "We're teaching the past, talking about the present, and ignoring the future. We need to predict what we will need to equip us to live in the world of the future."

Noting that progress is being made in updating teaching techniques, Dr. Jon A. Quitslund of George Washington University said that educators are learning to apply technology to the learning process. He said that computers are already helping students to master reading and writing skills.

Dr. Peter H. Wagschal of the University of Massachusetts at Amherst noted that teachers who taught the baby-boom generation are beginning to retire. Their retirement, coupled with indications that a new baby boom is under way, will greatly increase the demand for teachers over the next ten years. The quality of teacher training institutions, he emphasized, will greatly influence the course of future education.

Lt. Col. William S. Pine, Director for Education and Training for USAF Space Command, said the Air Force wants people with the aptitude and the technical "smarts" to perform its space mission. He pointed out that the Air Force is very much concerned with the future of education and has established space curriculum programs at the USAF Academy and Air Force Institute of Technology. Colonel Pine also announced that the Air Force plans to develop a master's degree program in Space Systems Mangagement. It will be offered at the Air University.

Panelists recognized the merit of the "magnet school" concept, wherein the resources of a school system are pooled to create specialized programs in science and technology. However, they cautioned, magnet schools must not develop at the expense of excellence in science instruction throughout an entire school system.

Quoting from a US Department of Education report, Dr. Pierce echoed the concerns of government officials, educators, and the public regarding students passing through the nation's school systems. The report found that:

- From 1962 to 1980, average verbal Scholastic Aptitude Test scores declined more than fifty points. Math scores declined thirty-six points.
- Only a third of today's seventeen-year-old students can solve math problems involving several steps.
- Forty percent of all seventeen-year-olds can't draw inferences from simple written material. Only twenty percent can write a persuasive essay.

—By Capt. Napoleon B. Byars, USAF, Contributing Editor.

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USAF explores advanced fighter technologies for the future.

Working *Now* for Air Superiority *Then*

IN defining tomorrow's tactical fighters, the central job is "to deal effectively with the air-to-air threat posed by the all-aspect, look-down/shoot-down capability of new Soviet fighters," USAF's Assistant Vice Chief of Staff, Lt. Gen. Robert H. Reed, told a Roundtable on "Advanced Tactical Fighter Technologies" sponsored recently by AFA's Aerospace Education Center. The time for nailing down the technological groundwork for an air-superiority fighter that can counter the air-to-air threat of the 1990s and beyond is *now*, he stressed.

Gen. Lawrence A. Skantze, the head of Air Force Systems Command and another panelist at the Roundtable, agreed with General Reed that the Air Force's proposed Advanced Tactical Fighter (ATF)—a principal means for meeting that threat—must not be degraded to a "pursuit of technology for the sake of technology," but must instead serve the central task of "preserving the effectiveness of the tactical air forces of the 1990s and beyond, thus ensuring the success of air-land operations."

Anthony R. Battista, the highly regarded, influential staff expert of the House Armed Services Committee, stressed that he had "absolutely no disagreement with the requirement" for ATF. On the other hand, he faulted the Air Force for what he termed a lack of "cohesiveness" in the roadmap leading to the proposed new aircraft.

He also was critical of USAF's alleged failure to "capitalize on the developments that the other services and agencies have [brought close to fruition, such as the Defense Advanced Research Projects Agency's work on] emerging technologies," which is a sophisticated concept for tactical standoff and precision-guided systems. He urged the Air Force to break through what he claimed is "the cultural barrier" keeping USAF and other services from taking full advantage of very-high-speed integrated circuits (VHSIC) and such other advanced, proven technologies as terminally guided submunitions.

RPVs and Standoff Munitions

Mr. Battista, pointing out that the first experimental remotely piloted vehicle (RPV) was flown in 1914, asserted that "seventy-one years is a long time for an advanced development" and suggested that the Air Force's alleged reluctance to acquire RPVs may be impelled by concerns that unmanned systems could threaten plans for expanding the tactical air forces to forty wings. He added that Congress has a hard time understanding why the Air Force recently canceled the Pave Tiger RPV. Pave Tiger, he alleged, costs only $35,000 a copy and does "a fine job" of attacking and shutting down hostile radar emitters.

He contended that neither RPVs nor sophisticated standoff munitions threaten USAF's plans for a forty-wing fighter force structure—or even a forty-four wing force—because, "frankly, I think we need more than forty-four [wings]," as well as improved standoff weapons delivery. He claimed the Air Force's decision to cancel Pave Tiger came in response to congressional requests to streamline certain "high-cost" classified programs.

General Skantze rejected the "myth" that fighter pilots prefer to go directly after highly defended targets rather than do the job with standoff weapons: "We recognize the contributions of standoff, [but] we feel that it can only be useful if we have an effective and affordable mix." Stressing that the amount of firepower a fighter aircraft can bring to bear on the enemy in sortie after sortie is "awesome," he pointed out that, on a sustained basis, standoff weapons that are not reusable and that may cost anywhere from $200,000 to $2 million each are usually not a cost-effective match for manned systems.

General Skantze also argued that "once-to-the-target standoff" weapons lack the flexibility that is immanent in multirole manned combat aircraft that can shift freely from air-to-air to air-to-ground missions and that are reusable time and time again. It must be remembered, he said, that such targets as airfields are resilient and reparable: "We are going to have to attack them over and over again." The Air Force, the AFSC Commander pointed out, is buying GBU-15 boost-glide bombs, HARM missiles, and other "smart" standoff weapons as part of an affordable mix that capitalizes on and complements the "huge amount of firepower we can deliver very accurately with aircraft."

The Need for ATF

The ATF requirement, as limned by General Reed, was spawned by the demanding task of defending Western Europe against conventional attack by the Warsaw Pact. Especially in the Central Region, where "NATO's ground and air forces are at a numerical disadvantage, a significant qualitative edge in

equipment and training" is the key to deterrence. If, on the other hand, an attack does occur, that technological edge—in concert with strategies and tactics that maximize it—is imperative in halting an incursion and preserving the territorial integrity of NATO.

This requirement, in turn, creates the need for an air-land battle doctrine for attack of deeper battlefield targets and second-echelon follow-on forces: "In short, this aspect of the air-land campaign harmonizes Army and Air Force efforts to deal with the target-rich environment of the second echelon in such a way as to have a profound and decisive effect on the outcome of the battle at the front." It follows that tactical airpower must be able to take the fight well into the enemy's rear and to operate effectively in a dense, layered, and belted air defense system.

To date, the Air Force has been able to cope with this challenge by operating at low altitudes, thereby reducing attrition sharply. For a while, low-altitude operations bolstered by electronic warfare support and self-protection devices should remain successful, according to General Reed. The aircraft now in operation, as well as the multistage improvements of the F-15 and F-16 along with the acquisition of the F-15E and certain upgrades in electronic warfare capability, are all oriented toward exploiting the low-altitude environment and enabling the force to "fight and survive deep in the enemy's territory," according to General Reed.

Also, the pending acquisition of the Joint Surveillance Target Attack Radar System (JSTARS), along with the Precision Location Strike System (PLSS) designed for near real-time targeting of both fixed and mobile time-urgent targets in the enemy's second echelon, will help solve the targeting problem for fighter aircraft operating at low altitude in hostile airspace.

Within about ten years, however, the "relative security of the low-altitude environment" will be negated by true look-down/shoot-down Soviet fighters, such as the Su-27 Flanker and MiG-29 Fulcrum that are now entering the inventory, General Reed told the Roundtable. Moreover, "We can expect by 1995 that a next generation of look-down/shoot-down fighters will come into the Soviet inventory. . . . When one looks at future directions for applying advanced fighter technologies, there is one urgent and overarching need . . . to develop an advanced tactical fighter to deal effectively with the air-to-air threat posed by the all-aspect, look-down/shoot-down capability of new Soviet fighters," according to General Reed.

No Margin for Poor Performance

The Commander of AFSC's Aeronautical Systems Division, Lt. Gen. Thomas H. McMullen, stressed that, in terms of future fighter requirements, "we really have no margin for low-capability, low-quality systems, no matter what the number," because whenever and wherever the tactical air forces will be called upon to fight, "we will have to deploy over great distances, we will have to do it on short notice, and we will have to be ready to fight when we get there."

The Air Force, he said, wants its next-generation fighter to be "simple to fly, simple to fight [with], and simple to maintain." Stressing that technological sophistication and reliability need not be mutually exclusive "if we do our job right," he said the Air Force is tying ATF to more emerging technologies on a broader front "than I think we have ever done with any airplane development."

Because the Air Force will concentrate on technologies that offer a high return on investment in combat capability yet that are affordable, ATF "will be better at getting in and out of damaged airfields, will be able to stay supersonic longer, and will be lots more difficult to detect than our current breed of fighters." Also, the next-generation fighter will be easier to keep in the air, since its engine is expected to be three times as reliable as the best existing engines.

A key characteristic of ATF, according to General Skantze, will be the pilot's ability to "talk" to the airplane. General McMullen explained that ATF will have an avionics suite that is fully integrated and that orchestrates all flight-control and other avionics functions. This means application of new technologies on a broad scale, including the nascent VHSIC technology, which "will give us the capability to put some fifty to a hundred times more circuitry [on a given chip size than today]. Then, we will operate it some ten times faster than current performance."

In discussing the so-called fighter roadmap, Brig. Gen. Jimmie V. Adams, the Air Staff's special assistant for tactical modernization, stressed recent progress in both standoff and look-down/shoot-down capabilities. In the case of the Durandal airfield-busting munition, for instance, the Air Force gained an eightfold increase in effectiveness, meaning that one aircraft carrying Durandal is as effective as eight that use conventional bombs to close down enemy runways.

Congressional Qualms

Dr. Wayne A. Schroeder, a professional staff member of the Senate Appropriations Committee's Defense Subcommittee, believes that an austere budget environment will likely lead to curtailment of the acquisition plans of all the services. In the case of the Air Force, he warned, the choices might boil down to limiting force modernization, limiting growth in force structure, or accepting greater aging of the tactical force. Congress, he suggested, might have problems appropriating the funds for 228 tactical fighters annually over the next two years and funding a buildup to 276 fighters a year by 1988, as envisioned by USAF's fighter roadmap.

Dr. Schroeder said there is strong sentiment in the Senate to encourage the Air Force toward development of higher-thrust fighter engines. The notion is that the Air Force ought to baseline the engines of its first-line fighters at about 30,000 pounds of thrust to compensate for the fact that "our aircraft are getting heavier. Both the F-15E and the F-16F will be heavier than their C and D predecessors, and failure to develop increased-thrust versions for both of them could result in declining air-to-air capabilities, thrust-to-weight ratios, and excess power available for maneuver."

In response to allegations that the Air Force is delaying the ATF program, General Reed explained that

the service was carefully phasing that program in relation to requirements for a replacement or follow-on of current close air support aircraft. The Air Force, by law and other commitments, is obligated to provide close air support to the Army. He said that the request to the Defense Systems Acquisition Review Council (DSARC) for program go-ahead on ATF had been canceled by the Air Force leadership, but that a request for a DSARC decision on ATF will be resurrected when the Air Force is ready to go forward with this program.

From a programmatic point of view, the Air Force is ready to release a request for proposal for ATF's "DEMO/VAL" (demonstration and validation phase), according to General Skantze. He explained that the DEMO/VAL phase is meant to provide enough information to support decisions on the exact nature and cost of the design. Once program go-ahead is authorized, the Air Force plans to pick three of the seven contractors who participated in the ATF program's conceptual phase and to have them compete in the DEMO/VAL phase.

The format for full-scale development, the AFSC Commander stressed, has not been decided, but it appears probable that all options will be kept open "in terms of whether we mix and match [contractors]—and in what form we do it—because we are strong advocates of the Competition and Contracting Act, and we intend to apply it across the board."

Mr. Battista warned that the Advanced Tactical Fighter technology program—in fact a conglomeration of projects—"is not home free on Capitol Hill." The Air Force, he predicted, will have to prove that ATF "is going to represent a quantum improvement over the preplanned product improved F-16s and F-15s." There also is apprehension that the timing of the initial operational capability may not be compatible with a technology the aircraft depends on, to wit, VHSIC Phase II, which revolves around a chip architecture with a thirty-two-bit mainframe. This technology, he asserted, won't become available until 1990. If VHSIC Phase I technology has to be substituted, the performance of ATF might be impaired, he said.

AMRAAM and LANTIRN

Also, Mr. Battista said, some elements of Congress feel uneasy about "the entire roadmap," including the state of AMRAAM, the Advanced Medium-Range Air-to-Air Missile, as well as alternatives to LANTIRN: "I would much rather see us equip the entire tactical air force with forward-looking infrared laser designators than I would just 700 aircraft [with LANTIRN] at $5 million a throw."

Generals Skantze and McMullen heatedly disputed Mr. Battista's contention that LANTIRN's costs were out of control. In the case of AMRAAM, General Skantze emphasized that the program is not in technical trouble: "In fact, from all we can see, it's going to be a great performer." AMRAAM's troubles are "schedule problems." The Air Force, therefore, decided to restructure the program, and "that's the process we are going through right now. We haven't let the contractor off the hook. He is still responsible [for doing] the total program. Very frankly, he is going to complete it, and it's going to cost him quite a bit out of his own pocket."

In discussing a new tactical air warfare program, the Advanced Tactical Reconnaissance System (ATRS), General Adams explained that it might be either a manned or an unmanned vehicle, depending on the outcome of current analyses of the proper mix of manned and unmanned reconnaissance.

Turning to the proposed hypervelocity antiarmor missile, General Skantze said the Air Force would welcome restoration of funding of this program, which Congress had earlier zeroed. Terming the proposed weapon a "force multiplier," he said the hypervelocity missile is expected to cost between $5,000 and $10,000 each and would constitute an "extremely effective round."

—By Edgar Ulsamer, Senior Editor (Policy & Technology).

The eight men who have served as Chief Master Sergeant of the Air Force talk about leadership, management, and responsibility.

Evolving Role Of the NCO

THE long-held military tradition that the officer provides leadership and the noncommissioned officer takes care of technical details is dead, as far as the Air Force is concerned.

That message came across loud and clear at an Aerospace Education Center Roundtable titled "Focus on: The Chiefs" and held on March 18. Speaking out on the subject were the eight men who have held the Air Force's top enlisted position—Chief Master Sergeant of the Air Force.

Incumbent CMSAF Sam E. Parish, who chaired the discussion, credited NCO leadership as "a key factor in the development of the Air Force. We can no longer afford the luxury of just being technicians or functional managers." Real and direct leadership rests with NCOs, he said.

Retired CMSAF Thomas N. Barnes cited the "complexity of today's force. [It] demands nothing less than sophisticated leadership capability on the part of those people entrusted with the leadership." He noted that this responsibility extends beyond the base perimeter. "There is a need for competent, intelligent response to the community—an interface with neighbors, doubters, dissenters."

Cautioning against complacency, retired CMSAF Robert D. Gaylor said there are some who feel that "because we have good people, they no longer need the guidance, the direction, the discipline, and the influence." Today's airmen look for these attributes from a leader, he said, warning that "the next step after abdication of leadership is anarchy."

Questions about the effectiveness of inexperienced officers as supervisors also drew a response from Chief Gaylor. He described three categories of officers known best by the enlisted force. The egotist says, "Boy, are you lucky to have me here. I'm going to straighten this mess out." Then there is Lieutenant Modesty: "I don't know nothing. You're going to have to show me everything." This pair makes up the minority, Chief Gaylor said. He suggested that the third—ideal—officer wants to make a contribution and says, "Together, we can do that."

Chief Gaylor pointed out that leadership and management are not incompatible objectives, though they are often thought of that way. "You don't have to make a choice. We don't want leadership at the expense of management," he said. "We don't want missions accomplished by wasting money and time and space. What we're looking for is a blend of the two."

Heavy enrollment in off-duty education programs, according to retired CMSAF James M. McCoy, is a prime example of how today's NCOs "want to become better leaders and want to become better informed of what's going on in the world around them."

When he succeeded Chief Gaylor in 1979, Chief McCoy recalled, he found that the Air Force had failed to meet its enlistment quota for the first time in the all-volunteer era. Retention was down, as was enlisted morale. "The one thing that probably pulled us through was [that] we did provide the training and the education, both in the professional area as well as off duty," he said.

"Leadership is probably one of the most misunderstood concepts in our society," said retired CMSAF Arthur L. Andrews. "Leaders are not born. They're molded by a multitude of things—people, teachers, parents, to name a few."

Chief Andrews attributed much of the confusion about leadership to those who equate it with management: "Managers manage things . . . [but] leaders lead people." He suggested "four Cs" as a key to a good leader: "Caring, Concern, Courage, Commitment. If you've got those qualities, you're leadership material."

Responding to a question on risks taken in leadership decisions and the stigma of failure, retired CMSAF Paul W. Airey contended that "our bosses expect us to fail in certain things, but they don't expect those failures to be repeated." Chief McCoy added, "It's important that we learn from our mistakes. That's how we become much better leaders."

Supporting an unpalatable or disagreeable position can be a true test of leadership, according to retired CMSAF Donald L. Harlow. "We've got to understand the whole, the big picture, not just that particular item." He also cited the value of communication in such instances. "Things are being changed in our society that have an influence on the military. Unless we can accept and fully understand and communicate effectively with our people, then we're going to be the losers."

Evoking the most active exchange was a response to a question from the audience asking whether any of the Chiefs had "ever worked for a good female leader." Each of the panelists jumped at the opportunity to relate personal experiences. Retired CMSAF Richard D. Kisling said that he had twice worked "for Lt. Col. Norma Brown. She was an outstanding leader, as evidenced by her retirement in the grade of major general."

Chief Gaylor summed up the consensus of the panel. "It doesn't matter whether the person is old or young, short or tall, male or female, black or white. The question is do they know how to lead."

—By CMSgt. Charles E. Lucas, USAF (Ret.). Chief Lucas is a public affairs officer with the Veterans Administration.

AIRMAN'S BOOKSHELF

What Went Wrong

The 25-Year War: America's Military Role in Vietnam, by Gen. Bruce Palmer, Jr., USA (Ret.). The University Press of Kentucky, Lexington, Ky., 1984. 236 pages with photos, notes, selected bibliography, and index. $24.

This is the finest book yet, from a military viewpoint, on what happened and why in the war in Southeast Asia. Gen. Bruce Palmer, Jr., who was Commanding General, Field Force II, Vietnam, and later Deputy Commanding General, Hq. US Army in Vietnam, provides an insider's view of the people who directed the war—from the White House on through the National Security Council, the Secretaries of State and Defense, the Joint Chiefs of Staff, the unified and specified military commanders, to the Commander, US Military Assistance Command, Vietnam, and his subordinate commanders. General Palmer analyzes what they tried to do and how well they succeeded—or failed.

General Palmer faults, first of all, the US strategy for fighting the war—there wasn't any, except to fight a war of attrition against an enemy who could put forces in the field faster than we could kill them. There was "escalation," which, under White House direction, was so gradual that the enemy was able to keep pace. There was the one-year tour rule, which, in many cases, found leaders exercising command for only six months, thus subjecting units to a constant turnover of personnel not only in the ranks but in critical leadership positions as well. There was the at-first inept military intelligence apparatus, which depended on communications interceptions rather than human sources; US civilian intelligence organizations did a much better job. There was Washington's obsession with the air war against the North to the detriment of the "real" war in the South.

General Palmer questions the military, including the Joint Chiefs of Staff, for not surfacing internal doubts about the conduct of the war and the prospects for winning. Secretary of Defense Robert McNamara, he points out, figured out for himself that the war was not proceeding as it should have.

In this regard—the JCS role in running the war—Palmer concentrates on the Joint Chiefs under Adm. Thomas Moorer as Chairman. Yet Moorer did not become Chairman until 1970, following Army Gen. Earle G. Wheeler, who served an unprecedented six years as JCS Chairman during the crucial years when the American involvement increased twenty-fivefold and when the strategy (such as it was), tactics, and policies for fighting the war were established. General Wheeler died before writing his memoirs, and one cannot help but wonder what would have been revealed in them.

General Palmer's description of how the JCS operated—sometimes, it seemed, protecting the interests of their individual services and making sure each was involved in the next step of the war—gives one pause. He does not propose doing away with the JCS or even changing the system much. He does advocate putting the Chiefs in the operational chain of command, taking the Secretary of Defense out of it, and making the Chairman a member of the National Security Council rather than an advisor to it.

He charges the Chiefs, as well as the civilian leadership, with placing too much confidence in airpower—especially considering the way it was used—and with using Navy carrier air forces too much. He repeats what has become a standard statement by Army "experts" on airpower: the incorrect assertion that the Strategic Bombing Survey of World War II concluded that strategic airpower fell short of its objectives. We might therefore, he suggests, have expected the same in Vietnam.

He fails to acknowledge that the only real applications of something close to strategic bombing in Southeast Asia were the Linebacker B-52 strikes in the Hanoi-Haiphong area. In both instances, the North Vietnamese and their allies quickly acquiesced to US requests. General Palmer does state that the military effort on the ground and in the air should have concentrated on enemy supply and infiltration routes throughout the war, not in just the latter years. Hanoi's conviction that the US lacked resolve, he points out, was strengthened over and over again by President Johnson's sixteen bombing pauses and seventy peace initiatives.

The personalities involved in fighting the war get varying marks from General Palmer, although he obviously respects most of the men he discusses. President Johnson allowed domestic concerns to dominate strategic decision-making. Henry Kissinger's Machiavellian maneuvering throughout all aspects of the war, at times acting as the Chairman of the JCS, distracted attention from the overall effort. JCS Chairman Moorer couldn't keep straight the names of Vietnamese leaders and often kept the JCS and higher authorities in the dark. Gen. William Westmoreland and Gen. Creighton Abrams emerge as less than brilliant, although their motives are never questioned. Gen. Maxwell Taylor, who advocated the enclave concept, is faulted for his judgment. Alexander Haig was "driven by an insatiable personal ambition." On the other hand, Melvin Laird, who succeeded McNamara as Secretary of Defense, gets high marks for supporting Vietnamization and for refusing to knuckle under to pressure from Kissinger.

This is a fascinating book. But General Palmer falters slightly in the latter section when he proposes some fixes. He is clearly dissatisfied with the JCS system, but he does not propose many concrete ways to change it—principally the suggestion to put the Chiefs in the chain of command. After describing the weaknesses of the JCS system and how parochial service interests can dominate the Chiefs' decision-making process and color advice given (or withheld), he concludes only that this is a function

of the character of the men who occupy those positions.

The Vietnam War, General Palmer concludes, was undertaken by civilians caught up in President Kennedy's New Frontier optimism and mired in President Johnson's Great Society myopia, with a military leadership that was at best unimaginative and at worst compliant. Perhaps the greatest mistake was trying to fight a limited war against an enemy who considered it total.

—Reviewed by James P. Coyne, Senior Editor.

The Other "Veterans"

Sunshine Patriots: Punishment and the Vietnam Offender, by G. David Curry. University of Notre Dame Press, Notre Dame, Ind., 1985. 146 pages with statistical tables, bibliography, and index. $14.95.

A decade after the last American troops left Vietnam, the wounds of a nation torn by an unpopular war—and the tragic loss of more than 58,000 men who were killed or are missing in action—are finally showing evidence of healing. Across the US, in ceremonies recognizing the sacrifice and heroism of those who fought in the war, Vietnam veterans are getting a belated welcome home. Recent public opinion polls bear out the fact that an overwhelming majority of Americans is once again proud of and supporting the men and women who serve in the military.

Perhaps the most evident sign of healing is that the news media, which brought Vietnam to the doorsteps and into the living rooms of America, has begun to rethink and reevaluate its role in reporting the war. Scores of books by authors seeking to shed light on the Vietnam experience and on what combat was like for the GIs who fought and sometimes died are also making their ways onto bookshelves. One of these books, *Sunshine Patriots: Punishment and the Vietnam Offender,* is an exceptionally well-done study of the young men who refused to do military service and of those who wore the uniform only later to join the ranks of deserters.

Author G. David Curry, a former US Army captain who served in Vietnam, develops a detailed statistical profile of Vietnam offenders. His profile shatters the widely held belief that these men were cowards who, rather than face combat, simply turned and ran. He documents the little-known fact that many deserters went AWOL *after* having completed their tours.

In his analysis, author Curry does not seek to establish a carte blanche excuse for Vietnam offenders. Instead, he searches skillfully through data collected on these men in order to illuminate their backgrounds and motivations. The all-too-publicized image of draft evaders as, by and large, ideological resisters and social activists committed to opposing the war fades when measured against statistical data on this group.

The author goes to great lengths to establish an accurate profile of Vietnam offenders. He portrays these men as being largely young, poor, members of minorities, or "mentally unfit" for military service. The last category refers to the high incidence of deserters who were soldiers inducted into service under Project 100,000.

Project 100,000, which began in 1966, brought 240,000 "marginally qualified" persons—men who scored as low as ten percent on the Armed Forces Qualification Test (AFQT)—onto active duty. Although intended in part to help integrate disadvantaged young men into the American mainstream by way of military service, the author is more than skeptical about what the program accomplished. He notes that, compared to other soldiers, Project 100,000 draftees were three times as likely to desert from basic training, twice as likely not to complete their tours, and more than twice as likely to be court-martialed. The program was discontinued in 1972.

Armed with his updated profile of the Vietnam offender, author Curry writes: "Going to war can be the greatest test of human social character, and the men least likely to cope with this test were frequently those members of the Vietnam generation called upon to fight."

The first two chapters of the book give readers the theoretical perspectives and foundations from which data on Vietnam offenders can be viewed. The next three chapters examine several aspects involving the dynamics of desertion—crime and punishment, Vietnam service and absence offenses, and four special types of offenders. Chapter Six focuses on the Selective Service System and details the process of avoiding the draft legally by obtaining deferments and exemptions. Chapter Seven examines the process of avoiding combat through manipulation of the assignment process and the personnel structure. The final chapter contains a list of "dos and don'ts" for policymakers to consider when designing a future Selective Service System. It also contains a number of sociological variables to take into account before placing men into combat.

The statistical tables that follow the text are easy to read and comprehend. The tables are arranged according to their order of discussion in the book.

The value of this book on Vietnam offenders is immense. Morris Janowitz, a noted scholar from the University of Chicago, comments on *Sunshine Patriots* in the book's Foreword: "David Curry's study is an important contribution to the writing on the Vietnam conflict. He is a careful and self-critical scholar who has sought to put into sharp perspective the types and magnitudes of offenses involved against the Selective Service System. He has also described the scope of the government's enforcement effort. He has thoroughly and carefully worked over the official and documentary statistics."

Many of the statistics, reports, and surveys included in *Sunshine Patriots* are drawn from studies conducted by the Center for Civil Rights at the University of Notre Dame. In reexamining the Center's work, author Curry does a fine job of establishing the link between social research and social public policy.

This book should dispel several misconceptions about Vietnam offenders. In doing that, it will allow readers to understand another part of the Vietnam experience more fully.

—Reviewed by Capt. Napoleon B. Byars, USAF, Contributing Editor.

New Book in Brief

Vietnam: The War in the Air, by Col. Gene Gurney, USAF (Ret.). A pictorial history featuring more than 300 photos, this collection of articles by various authors follows the air war over Vietnam from the first US strikes in Indochina during World War II to Operation Homecoming—the release of American POWs, mostly airmen, in early 1973. Army, Navy, Marine, and Air Force operations, as well as operations by the South Vietnamese Air Force, are covered, along with examinations of the extension of the air war into Laos and Cambodia. Though perhaps not the definitive text on air operations in Vietnam, this broad overview will provide a solid footing for those coming to the subject for the first time. With a foreword by Gen. William C. Westmoreland, USA (Ret.), glossary, and index. Crown Publishers, Inc., New York, N. Y., 1985. 277 pages. $17.95.

—Reviewed by Hugh Winkler, Assistant Managing Editor.

THE BULLETIN BOARD

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

Four Stars for Two Pioneers

On April 4, following President Reagan's nomination and Senate confirmation, two Air Force pioneers—Lt. Gens. Ira C. Eaker and James H. Doolittle—were advanced on the retired list to the grade of general.

Both men played key roles in the establishment of the Air Force as a separate service. General Eaker's promotion is his second since his retirement as a major general in 1947. He had served as a lieutenant general on active duty, but retired as a two-star.

He was born in 1896 and commissioned in 1917. During his thirty-year career, he established a flight-endurance record, made the first transcontinental flight using in-flight refueling, logged more than 12,000 flying hours, and served as Chief of the Air Staff.

Always a talented writer, he coauthored some of the earliest books on military aviation with Gen. H. H. (Hap) Arnold. Among these was the 1937 case for a separate Air Force, *Winged Warfare*.

General Doolittle, also born in 1896 but commissioned in 1918, received his third star in 1944. He is credited with assisting in the development of horizontal and directional gyroscopes—used in navigation—and made the first "blind" flight completely by navigational instruments. Known for setting speed records in both landplanes and seaplanes, he flew the first cross-country flight—with one refueling stop—in twenty-one hours and nineteen minutes.

He is perhaps best known by the general public as the World War II hero who spent "thirty seconds over Tokyo" in the first aerial raid on the Japanese homeland—an accomplishment that did so much for the morale of home-front America. At the end of the April 1942 mission, he was forced to bail out of his B-25 over China. For his planning acumen, leadership, bravery, and daring on this mission, President Franklin D. Roosevelt presented him with the Medal of Honor.

General Doolittle was, as AFAers know, the first President of the Air Force Association. Both he and General Eaker are commemorated by the Doolittle and Eaker Fellowship programs of AFA's Aerospace Education Foundation.

CMSAF's Tour Extended

Chief Master Sergeant of the Air Force Sam E. Parish has been extended in that job for an additional year by Air Force Chief of Staff Gen. Charles A. Gabriel. It's an unusual but not unprecedented move; CMSAF Tom Barnes, the fourth CMSAF, was also extended.

Chief Parish was slated to retire August 1. In announcing the extension, General Gabriel cited the Chief's "key role in shaping Air Force policy for the enlisted force." Chief Parish assumed the Air Force's top enlisted position on August 1, 1983. At a recent AFA dinner meeting, held in conjunction with a meeting of the Air Force's major command Senior Enlisted Advisors *(see photo)*, the Chief said that he was "pleased and honored" to be extended. He noted that he had several items on his "still-to-be-done" list and was glad to have the extra year to work on them.

Chief Master Sergeant of the Air Force Sam E. Parish has been extended as USAF's top EM for another year by Chief of Staff Gen. Charles A. Gabriel. (Staff photo by William Belanger)

Air Force Village West

Planners of the Air Force Village West, a proposed retirement community for officers of all services, are finalizing land-use plans and working on floor plans. Construction of the 300-unit first phase, near March AFB, Calif., is slated to start this summer, with a late 1986 planned completion date.

Two hundred and seventy of these units have already been applied for, according to corporation officials. "We planned on 300 units in this first phase," said Dan Seymour, public relations director, "but the way applications and deposits are coming in, it looks like we may have to build more—possibly 400—to satisfy the immediate demand."

The project, being built by Air Force Village West, Inc., a nonprofit corporation, will provide homes and a life-care program for retired officers from all services, their widows or widowers, and qualified dependents. "However, once it's built," said Mr. Seymour, "we'll give Air Force retirees priority on any waiting list."

The overall plan calls for one-, two-, and three-bedroom garden cottage-type homes and mid-rise apartments on 150 acres of surplus Air Force land set aside by Congress for this purpose. Eventually, builders plan 600 units with considerable green areas, walking and jogging trails, and other common areas and facilities. Also planned are a sixty-eight-bed health-care unit, dining facilities, a chapel, barber and beauty shops, music, craft, and game rooms, meeting rooms, swimming and therapeutic pools, and other amenities. The community will be fenced and have security gates.

Information is available from Air Force Village West, Inc., P. O. Box 6455, March AFB, Calif. 92518, or by calling (714) 655-4902.

Siamese Twin Operation Successful

Male Siamese twins were successfully delivered and separated recently at the Air Force's Wilford Hall USAF Medical Center at Lackland AFB, Tex.

The parents are Army sergeants assigned to Fort Hood, Tex. The twins were separated by two surgical teams consisting of twenty-one people and led by Air Force Dr. (Col.) Melvin Smith, chief of pediatrics surgery at Wilford Hall. The infants were joined at the abdomen, and their individual livers were also joined. Doctors said they did not share any other single vital organs.

Wilford Hall's neonatal-care unit is one of three such facilities in the Air Force. It uses state-of-the-art technology to cope with life-threatening problems, according to hospital officials. For example, through the use of a special ventilator developed at Wilford Hall, the survival rate for premature infants during the past few years has gone from thirty percent to more than ninety percent. Infants from DoD facilities around the world are admitted to the unit.

Gen. B. L. Davis, the Commander in Chief of Strategic Air Command, congratulates Capt. Joseph Saad, right, on his selection as one of the US Jaycees' Ten Outstanding Young Men of America for 1985. See item.

Jaycees Honor Offutt Captain

Capt. Joseph Saad, an Offutt AFB, Neb., computer systems officer, has been named as one of the United States Jaycees' Ten Outstanding Young Men of America for 1985 *(see photo).*

Captain Saad, a native of Lebanon, came to this country with his parents in 1965 and became a citizen in 1970. He currently works with the design, testing, and coding of new programs for the Joint Strategic Target Planning Staff. Active in community service, he is currently chairman of the Offutt AFB Chapter of the Nebraska Special Olympics. In 1983, he helped raise more than $14,000, or forty-five percent of the entire amount collected in the Omaha area.

AFA's Assistant Executive Director for Defense Manpower and Reserve Affairs, Benjamin S. Catlin, recently testified before Congress on military retirement. See item.

The Jaycees have been selecting outstanding young men since 1938. Winners are selected on the basis of their achievements in a number of different areas, including personal improvement, financial success and economic innovation, and overall leadership ability. Captain Saad was selected for his "outstanding service to country and community."

AFA Official Testifies on Retirement

Benjamin S. Catlin, AFA's Assistant Executive Director for Defense Manpower and Reserve Affairs, recently testified before the Senate Armed Services Committee's Subcommittee on Manpower and Personnel in support of the current military retirement system *(see photo).*

Pointing out that the Air Force is "a high-technology business," Mr. Catlin stressed that "without the right kinds of material resources, weapon systems cannot be built; likewise, without the right kinds of human resources, weapon systems cannot be operated." He went on to link the quality of Air Force readiness to the quality of people attracted to serve in the military for full careers, stressing the importance of the retirement system as the "bedrock of strong, institutional support and the service's primary career incentive."

He concluded his presentation by reminding the lawmakers that it is almost impossible to compare the military retirement system with any other, public or private, since the nature of military service is so radically different from that of any other calling. He also noted that today's retirement system works well in allowing the Air Force to manage the force and ensure a combat-ready force—in short, if it ain't broke, don't fix it.

AFA's current policy, adopted by the delegates at last September's AFA Convention, notes that AFA supports the current retirement system and that if "changes are mandated, they must be the result of thoughtful, deliberate, and thorough study of the system, taking into account the impact of such changes on military force management and readiness." AFA also supports honoring the commitments already made to both those on active duty and those now retired by "grandfathering" these individuals to protect them from the effects of any changes.

Meanwhile, Rep. Les Aspin (D-Wis.), Chairman of the House Armed Services Committee, announced that he will propose cutting a minimum of $4 billion from the military retirement program in order "to force a change in the Pentagon's pension system. Congress and the Pentagon have dickered over the retirement issue for two decades," Mr. Aspin said, adding, "It's time to bring matters to a head." He said that he would not propose detailed legislation to accomplish the savings, but would "simply remove money from the requested budget for military pay and benefits," thus, in his view, forcing the services either to change the retirement system or to fail to meet current payrolls.

The proposal has not been coordinated with the Senate, nor, at press time, had any of the services had any comment on the proposal. Some Capitol Hill observers note that the Congressman may merely be "firing for range." Nonetheless, given his critical House assignment, his proposal is receiving serious evaluation, and AFA is watching closely to see what developments arise from it.

CAP Cadets Honored

Members of the Bronx, N. Y., Squadron of the Civil Air Patrol re-

ceived the 1984 Chief of Staff Sweepstakes Trophy recently from Air Force Chief of Staff Gen. Charles A. Gabriel in a Pentagon ceremony.

The trophy is presented annually to the squadron that wins the Civil Air Patrol national cadet competition. The winners, representing the Northeast Region, competed against seven other teams for the national championship. The Bronx unit resoundingly defeated their competition in marching, a one-mile run, volleyball, a panel quiz, and a written examination on aerospace subjects.

One of the honors that goes with winning the award is the opportunity to deliver the annual Civil Air Patrol Report to Congress, and the unit did so. The Report for 1985, which wraps up 1984's accomplishments, is just off press and highlights the achievements of the 65,505-member volunteer group as it fulfills its role as the civilian auxiliary of the US Air Force.

In 1984, CAP participated in 1,979 Air Force authorized search and rescue missions, flew 17,351 hours, and was credited with locating 1,204 search objectives and saving 128 lives. For the thirteenth consecutive year, the number of CAP "finds"—of missing aircraft and survivors or victims—has increased. In 1984 alone, that number increased by some twelve percent. CAP is the primary resource available to the Air Force for inland search and rescue.

THE BULLETIN BOARD

Air Force Pushes Citizenship

The Air Force has launched a concerted drive to convince airmen who are not US citizens to move vigorously toward attaining that status.

Almost 5,500 airmen are not US citizens. This causes numerous personnel problems, such as restrictions on assignments, retention, and the like. The Air Force's Manpower and Personnel Center (AFMPC) at Randolph AFB, Tex., has set up a special office, the Airmen Citizenship Effort (ACE), to rectify this situation by helping airmen gain their citizenship.

According to SMSgt. Joe Beck, ACE coordinator, most Air Force jobs require at least a secret security clearance. In general, the Air Force will not conduct a background check on a non-US citizen, which means the clearance can't be issued. This severely limits the jobs and assignments that the noncitizen airman can hold. Also, noncitizens without clearances aren't normally allowed to retrain into career fields requiring flight-line access.

US laws allow initial enlistment of immigrant aliens and provide special provision for them to apply for citizenship two years earlier than other legal immigrants. Airmen who enlisted after November 1, 1984, will not be allowed to reenlist unless they become US citizens, although waivers, on a case-by-case basis, will be considered for those actively pursuing citizenship.

AFROTC at UT Honored

Recently, at the University of Texas at San Antonio, Air Force ROTC was

SENIOR STAFF CHANGES

PROMOTIONS: To be **Lieutenant General:** Alfred G. **Hansen.**

RETIREMENTS: M/G Carl N. **Beer;** B/G Pintard M. **Dyer** III; L/G Lincoln D. **Faurer;** L/G Richard K. **Saxer;** L/G Herman O. **Thomson.**

CHANGES: M/G Leon W. Babcock, Jr., from Dep. Cmdr., 6ATAF, Izmir, Turkey, to Dir., Plans & Policy, & IG, Hq. USREDCOM, MacDill AFB, Fla., replacing M/G Archer L. Durham . . . **B/G Larry D. Church,** from Dep. Ass't C/S for Intel., Combined Forces Command, Korea, Yongsan, Korea, to DCS/Intel., Hq. USAFE, Ramstein AB, Germany, replacing M/G Leonard H. Perroots . . . **Col. (B/G selectee) James R. Clapper, Jr.,** from Cmdr., Hq. AFTAC, Patrick AFB, Fla., to Dep. Ass't C/S for Intel., Combined Forces Command, Korea, Yongsan, Korea, replacing B/G Larry D. Church . . . **B/G Gaylord W. Clark,** from Ass't DCS/Plans, Hq. SPACECMD, Peterson AFB, Colo., to Ass't DCS/Plans, Hq. NORAD, & DCS/Plans, Hq. SPACECMD, Peterson AFB, Colo., replacing retiring M/G Carl N. Beer . . . **Col. (B/G selectee) Keith B. Connolly,** from Cmdr., 15th ABW, Hq. PACAF, Hickam AFB, Hawaii, to IG, Hq. PACAF, Hickam AFB, Hawaii.

M/G Archer L. Durham, from Dir., Plans & Policy, & IG, Hq. USREDCOM, MacDill AFB, Fla., to Dir. of Deployment, JDA, MacDill AFB, Fla., replacing retired M/G James I. Baginski . . . **B/G Edsel R. Field,** from Dep. Cmdr., JSOC, OJCS, Fort Bragg, N. C., to Ass't DCS/Plans, Hq. MAC, Scott AFB, Ill., replacing B/G Frank J. Kelly, Jr. . . . **L/G Jack I. Gregory,** from Cmdr., 12th AF, TAC, Bergstrom AFB, Tex., to Dep. Cmdr., US Forces, Korea, Dep. CINC, UN Command, Korea, & C/S, Combined Forces Command, Seoul, Korea, replacing L/G John L. Pickitt . . . **B/G John E. Griffith,** from Dir. of Transportation, DCS/L&E, Hq. USAF, Washington, D. C., to Cmdr., Defense Fuel Supply Ctr., Cameron Station, Va. . . . **M/G (L/G selectee) Alfred G. Hansen,** from Dir., Log. Plans & Prgms., DCS/L&E, Hq. USAF, Washington, D. C., to Dir., J-4, OJCS, Washington, D. C.

B/G Frank J. Kelly, Jr., from Ass't DCS/Plans, Hq. MAC, Scott AFB, Ill., to Dep. Cmdr., JSOC, OJCS, Fort Bragg, N. C., replacing B/G Edsel R. Field . . . **B/G Clarence H. Lindsey, Jr.,** from DCS/Air Transportation, Hq. MAC, Scott AFB, Ill., to Dir. of Transportation, DCS/L&E, Hq. USAF, Washington, D. C., replacing B/G John E. Griffith . . . **B/G Robert P. McCoy,** from DCS/Maintenance, Hq. AFLC, Wright-Patterson AFB, Ohio, to DCS/Materiel Mgmt., Hq. AFLC, Wright-Patterson AFB, Ohio, replacing M/G Charles P. Skipton . . . **Col. (B/G selectee) Gary W. O'Shaughnessy,** from Cmdr., Electronic Security Europe, ESC, Ramstein AB, Germany, to Assoc. Dep. Dir. of Ops. for Mil. Support, NSA, Fort Meade, Md. . . . **L/G John L. Pickitt,** from Dep. Cmdr., US Forces, Korea, Dep. CINC, UN Command, Korea, & C/S, Combined Forces Command, Seoul, Korea, to Dir., DNA, Washington, D. C., replacing retiring L/G Richard K. Saxer.

Col. (B/G selectee) David H. Roe, from Spec. Ass't to the Dir., Joint Staff for Joint Matters, OJCS, Washington, D. C., to Principal Dir., Eur-NATO Policy, OSD, Washington, D. C. . . . **B/G Roger P. Scheer,** from Dep. to the Chief, AFRES, Hq. USAF, Washington, D. C., to Cmdr., 10th AF, AFRES, Bergstrom AFB, Tex., replacing M/G James C. Wahleithner . . . **M/G Charles P. Skipton,** from DCS/Materiel Mgmt., Hq. AFLC, Wright-Patterson AFB, Ohio, to Dir., Log. Plans & Prgms., DCS/L&E, Hq. USAF, Washington, D. C., replacing M/G (L/G selectee) Alfred G. Hansen . . . **Col. (B/G selectee) Roger C. Smith,** from Ass't C/S, Hq. SAC, Offutt AFB, Neb., to Command Dir., NORAD Combat Ops., J-31, NORAD, Cheyenne Mountain Complex, Colo., replacing B/G Billy J. Rhoten . . . **Col. (B/G selectee) Joseph K. Stapleton,** from Cmdr., 554th Ops. Support Wing, TAC, Nellis AFB, Nev., to Dep. Dir., Ops., Hq. USREDCOM, MacDill AFB, Fla.

Col. (B/G selectee) Walter E. Webb III, from Cmdr., 416th Bomb Wg., SAC, Griffiss AFB, N. Y., to Cmdr., 12th AD, SAC, Dyess AFB, Tex., replacing retiring B/G Pintard M. Dyer III . . . **B/G C. Norman Wood,** from Dep. Dir., Nat'l Strat. Target List, JSTPS, Offutt AFB, Neb., to Dep. Ass't C/S for Intel., Hq. USAF, Washington, D. C., replacing B/G Paul H. Martin. ■

selected as the Best Professional Organization of the Year. In addition, the Corps Commander, Cadet Col. John Attebury, was selected as Senior of the Year. The Commander of the John D. Ryan Squadron of the Arnold Air Society (an AFA-affiliated group), Cadet Lt. Col. Victor Icenogle, was chosen as Graduate Student of the Year.

Having three of these year-end awards go to one organization is, as far as is known, unprecedented, especially since AFROTC represents only about three-quarters of one percent of the total enrollment at UTSA. AFROTC is only in its fourth year of existence at UTSA, but this is the second time it has won the award as the Best Professional Organization.

Short Bursts

Although DoD stoutly maintains that it has no plans actually **to close any bases,** it reluctantly acceded to a request from the Senate Armed Services Committee to identify some potential less-needed sites and selected twenty-two installations. Included are **four Air Force facilities:** McConnell AFB, Kan., Blytheville AFB, Ark., O'Hare International Airport, Ill., and W. K. Kellogg Regional Airport, at Battle Creek, Mich.

Spec4 Charles A. Hayes III, US Army, has been selected as the **Military Newsfilm Photographer of the Year** for 1984 by a panel of professional civilian photojournalists. He was assigned to the Army and Air Force Hometown News Directorate when he shot his four first-place videonews stories. Air Force photographers took six of the twenty-two awards in the competition.

The Senate has designated the week beginning November 10, 1985, as **"National Women Veterans Recognition Week."** Sen. Alan Cranston (D-Calif.) noted that "much remains to be done to make the public more aware of the many contributions of women veterans over the years . . . and to make the women veterans themselves aware of the many benefits available to them because of their service."

Dartmouth College President David T. McLaughlin has opted **to bring ROTC back to that campus** after an absence of eight years, in spite of a faculty vote of 113 to thirty-nine against reinstatement. According to the *Chronicle of Higher Education,* the student government body voted for it unanimously, and President McLaughlin said that while he respected the faculty's opinion, he thought ROTC had "positive potential and should be accommodated." It's anticipated that somewhere between 100–150 students will enroll in the program.

Responding to many inquiries, the VA emphasizes that education benefits paid under the **Vietnam-era GI Bill** are intended for the veteran only and cannot be used by dependents.

The **Air Force Surgeon General** has announced that, effective next month, family members of active-duty people will begin receiving **military dental care,** on a space-available basis, **at all military facilities.** Heretofore, this privilege was restricted to overseas locations and a few specifically designated US sites. **Lt. Gen. Max B. Bralliar** hopes that "this legislation is the first step toward an insurance program that would provide for the dental needs of dependents and retirees." The Air Force and AFA both champion the establishment of a dental-insurance program for active-duty families and retired members.

DoD has selected a base from each service to receive the Commander in Chief's **Annual Award for Installation Excellence,** based on outstanding support of the mission while providing excellent working and living areas. President Reagan established the award to recognize those who labor to maintain military installations around the globe. **Kadena AB, Japan,** is the Air Force winner.

The Treasury Department has delayed, at least until January 1, 1987, any further action on the **proposal to reduce military homeowners' current income tax deductions for mortgage interest and property taxes.** The question arises because of the tax-free housing allowance military members get. IRS wants to do away with the deduction—DoD has asked for legislative relief.

Because of a recent **rise in precedence of the Purple Heart** *(see "The Bulletin Board," January '85 issue),* the Air Force has upped the number of points awarded for the medal in the Airman Promotion System from one to five.

The General Accounting Office wants Congress to **pass a law allowing the VA to bill private insurance companies for the costs of care provided to privately insured veterans for nonservice-connected medical conditions.** Currently, most health insurance policies have exclusionary clauses that state that they will not pay for care provided in VA hospitals. GAO would like to make this illegal and figures that the government might collect as much as $284 million in currently unreimbursed costs. ■

The Longest Leap

Heroism is not limited to combat, but the valor of only a few, like Joe Kittinger, is tested in both peace and war.

BY JOHN L. FRISBEE
CONTRIBUTING EDITOR

IN 1934, the Air Force abandoned, seemingly for all time, its lighter-than-air program that included both balloons and airships. Two decades later, the tremendous advances that had been made in aviation technology called back to active duty a technologically obsolete form of military aeronautics—the balloon.

There may have been a few active-duty Air Force officers who wore balloonist wings, but certainly none young enough for the balloon-borne experiments the Air Force had in mind. By the mid-1950s, high-altitude supersonic fighters were rapidly coming into operational units. The Air Force needed to know whether crew members could parachute safely from disabled aircraft flying in the stratosphere. The balloon was an ideal platform for very-high-altitude parachute jumps that would answer that question and point the way for development of new emergency equipment. A young test pilot, Capt. Joseph W. Kittinger, Jr., was one of those selected to train for experiments under USAF's Project Man High.

On June 2, 1957, Kittinger made the first Man High flight to an altitude of 96,000 feet in a sealed gondola, setting a record for manned balloon flights. He was then named director of Project Excelsior, an investigation of human exposure to stratospheric conditions and of parachute descent from extreme altitude. No one knew with certainty if a man could survive a bailout from several miles above the earth until it was tried.

Kittinger's first high-altitude parachute jump, supported by elaborate technology and a team of experts in several fields, came close to being his last. In November 1959, he bailed out of a balloon at 76,000 feet, the highest anyone had been in an open gondola. His small stabilizing chute, which was to prevent a flat spin that could be fatal at rotation speeds of 150 to 200 rpm, malfunctioned and wrapped around his neck. He dropped unconscious to 12,000 feet, where his main chute saved the day. Three weeks later, he jumped without incident from 74,000 feet. In September 1960, President Eisenhower presented the Harmon International Trophy (Aeronaut) for 1959 to Joe Kittinger.

August 16, 1960, was set for the ultimate test. Kittinger rode a four-and-a-half-foot open gondola to 102,800 feet. The ascent, through temperatures that fell to ninety-four degrees below zero, took an hour and a half. Failure of his life-support system above 60,000 feet would have meant almost instant death.

With that and other hazards in mind, he stepped out of the gondola and plunged through the stratosphere, reaching supersonic speed in the rarified atmosphere. Between 90,000 and 70,000 feet, he experienced great difficulty in breathing. At about 50,000 feet, his free-fall speed had dropped to 250 miles an hour in the denser atmosphere. He was suffering extreme pain in his right hand that was caused by partial failure of pressure in that glove during the ascent.

At the start of his record jump, Joe Kittinger takes that first big step from his gondola at 102,800 feet up.

After he had fallen for four minutes and thirty-seven seconds, Kittinger's main chute opened, and some eight minutes later he landed at the White Sands Missile Range in New Mexico with no permanent injuries but with three world records: the highest open-gondola balloon ascent, the longest free-fall, and the longest parachute descent. He was also the first man to go supersonic in a free-fall. Joe Kittinger had proved that man could function in near-space and that parachuting from very high altitudes was feasible.

For another two years, Kittinger continued balloon-borne experiments for the Air Force before joining the Air Commando Wing at Hurlburt Field, Fla. He flew 483 missions during three combat tours in Vietnam—two in A-26s and the last as vice commander of an F-4 wing. Four days before completing that tour, Kittinger, then a lieutenant colonel and with one MiG-21 to his credit, was shot down over North Vietnam and spent eleven months as senior officer of the "new guy" POWs—those captured after 1970.

Col. Joseph Kittinger retired from the Air Force in 1978, but not from flying either airplanes or balloons. After winning a number of races, including the Gordon Bennett Balloon Race in 1982 and 1984, the fifty-six-year-old Kittinger made the first solo balloon crossing of the Atlantic. *(See* National Geographic, *February 1985 issue.)* His eighty-three-hour flight from Caribou, Me., to near Genoa, Italy, ended when he was forced down by thunderstorms, breaking a foot as the balloon crashed in trees.

Joe Kittinger—high-altitude research pioneer, combat pilot, and POW leader—is one of those rare people whose skill and heroism in peace and in war have earned them a place in the Air Force hall of valor. ■

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Without the Osprey, *our mission would have required two days and refueling stops. With the CV-22A we only needed half a day. And we had enough range for the entire round trip.*

We arrived fast and unannounced. After the strike team freed the hostages, we evacuated everybody from a rooftop in the compound and headed home — at 250 knots.

That's a fast, furious response — which is the name of this game.

Which is also the precise reason for the U.S. Air Force's CV-22A *Osprey.* They need the capabilities and mission responsiveness the V-22 offers. For the U.S. Air Force, previously impossible missions are about to be quite possible.

The concept is proven: an aircraft that can take off, land and maneuver like a helicopter, yet cruise at turboprop speeds. No other airplane works like it, or is as efficient. Payload and range are what you'd expect from a cargo plane. And it can reach up high or streak across the terrain at treetop level.

After two years of extensive predesign work, this Dept. of the Navy program is bringing the JVX into Full Scale Development (FSD) as the joint-service V-22 *Osprey.* The team of Bell Helicopter Textron Inc. and Boeing Vertol are leaders in this new era of combat aviation.

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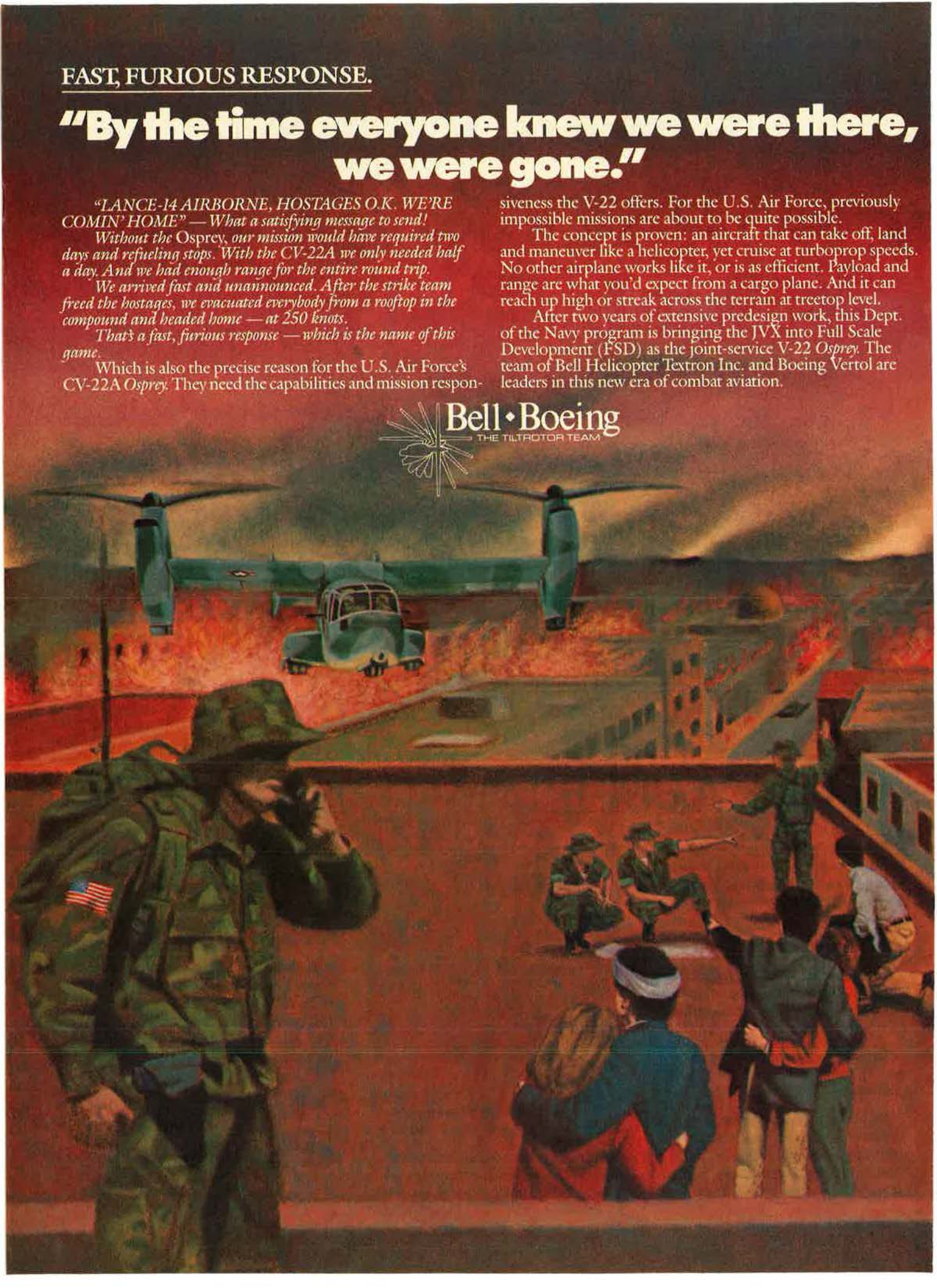
THE TILTROTOR TEAM



AFA INTERCOM

By Robin L. Whittle, AFA DIRECTOR OF COMMUNICATIONS

California AFA and Its Chapters Honor CMSAFs as AEF Fellows

California State AFA and the David J. Price/Beale, Fresno, General Curtis E. LeMay, General Doolittle/Los Angeles Area, General Robert F. Travis, Golden Gate, Greater Los Angeles Airpower, High Desert, Merced County, Riverside County, Robert H. Goddard, Sacramento, San Bernardino Area, and Tennessee Ernie Ford Chapters have provided the funds to invest all eight of the individuals who have served as Chief Master Sergeant of the Air Force as Jimmy Doolittle Fellows of AFA's affiliate, the Aerospace Education Foundation.

The Doolittle Fellowship program, named in honor of famed aviation pioneer and World War II Medal of Honor recipient Gen. James H. Doolittle, USAF (Ret.), generates funds to support the Foundation's active and varied educational efforts, including its Aerospace Education Center. The Center conducts in-depth Roundtable discussions featuring key military, congressional, and news officials as well as educators and business leaders. Topics include important aerospace, defense, and national security matters.

California State AFA President Dave Graham says the response throughout California "has been very good," with nearly 100 percent participation from California's nineteen chapters.

The San Bernardino Area Chapter, for example, contributed money from its 1984 Bob Hope AFA Charity Golf Tournament to underwrite the cost of one Fellowship. Chapter President Frank DePhillippo explained that a minimum fair share from each chapter would be approximately thirty-five cents per member.

In a recent issue of *Contrails,* the San Bernardino Area Chapter newsletter, Mr. DePhillippo explained the rationale behind the California effort. First, the CMSAFs "have been and continue to be effective champions of the Air Force's noncommissioned officers and its more than 500,000 enlisted men and women—serving as their official spokesmen in the upper echelons of the Air Force command structure." He also noted that AFA recognition of their efforts is overdue. Second, he cited the move to involve AFA field units more fully with the Aerospace Education Foundation, "which in turn is being redirected to better serve our regional, state, and chapter organizations." Third, Mr. DePhillippo underscored the Chiefs' leadership and dedication in the effort to improve public understanding of the importance of aerospace power. He called their work "synonymous with the Foundation's goals" and "worthy of this high recognition."

The Chiefs, from left: (front) CMSAF James M. McCoy (Ret.), CMSAF Paul W. Airey (Ret.), CMSAF Donald L. Harlow (Ret.), (standing) CMSAF Thomas N. Barnes (Ret.), AEF President George Hardy, CMSAF Sam E. Parish, CMSAF Richard D. Kisling (Ret.), CMSAF Arthur L. Andrews (Ret.), and CMSAF Robert D. Gaylor (Ret.).

In fact, the eight men who have served as CMSAF joined forces with the Foundation to further mutual goals at the Foundation's sixth Aerospace Education Center Roundtable held on March 18 at AFA headquarters. The event was made possible by a grant from the Anheuser-Busch Co., St. Louis, Mo.

A lively and informative discussion of "leadership," moderated by current CMSAF Sam Parish, was videotaped for distribution through AFA's field network and for use at NCO academies and throughout the Air Force. Two one-hour videotapes, in either the three-quarter-inch (commercial-size) format or the more popular one-half-inch VHS format, are available on loan to AFA units from AFA's Communications Department. A fifteen-minute edited version is also available from the Department in both videotape formats. *(For more on "The Chiefs" Roundtable, see "The Evolving Role of the NCO" on p. 143 of this issue.)*

At the conclusion of the Roundtable, AFA and Foundation Executive Director Russell E. Dougherty and Foundation President George Hardy presented Jimmy Doolittle Fellowship plaques to the eight Chiefs "for their distinctive and collective accomplishments . . . which have been a source of pride to all of us." Executive Director Dougherty continued, "I am proud to call them my friends and more proud of the opportunity that's been mine for professional and personal association with them and their families."

The Chiefs will be recognized at the Aerospace Education Foundation luncheon at AFA's 1985 convention. In a related matter, the Aerospace Education Foundation's magazine-style book entitled *The Chiefs* is Volume I, Number I, in the Foundation's "Aero-

space Heritage" series. Some 100,000 copies were printed, with thousands distributed throughout the Air Force and to interested organizations and individuals. *The Chiefs* was made possible by a grant from United Technologies Corp. The volume details the lives and careers of the eight men who have served as Chief Master Sergeant of the Air Force.

Oregon AFA, Tacoma Chapter Latest to Use Roundtable Videos

Oregon State AFA and the Tacoma Chapter in Washington state are the latest AFA units to use Roundtable videotapes to further AFA's goals. Oregon State AFA President Zane Harper made arrangements with the public access channels of several cable television networks in the Portland area to show videotapes of the Aerospace Education Foundation's Roundtable entitled "Focus on Spare Parts—A Balanced Perspective." The videotapes were shown on Liberty Cable, Channel 7, from 10:00 p.m. to 11:00 p.m., April 17 and 18. Mr. Harper is making similar arrangements with the Rogers cable network.

"There is really no limit to the possibilities these Roundtable tapes afford AFA states and chapters around the country," Mr. Harper said.

AFA's Tacoma Chapter worked with several area universities to get Roundtable videos aired in ROTC classrooms. Chapter President Eugene Nuss and Treasurer Ron Cowell are working on several other possibilities, including airing the tapes at special meetings locally.

Thus far, field "users" of the Foundation Roundtable videotapes include the Ak-Sar-Ben Chapter, Omaha, Neb.; Wright Memorial Chapter, Dayton, Ohio; Minnesota State AFA; Genessee Valley Chapter, Webster, N. Y.; Pennsylvania State AFA; AFA National Directors Tom Bigger and George Douglas; Hedley Donovan, former Editor in Chief of *Time* Magazine; USAF's Air University; Secretary of the Air Force Office of Public Affairs in the Pentagon; Armed Forces Radio and Television Service; Strategic Air Command; and the American Security Council.

Roundtable videotapes, which run approximately two hours, are available on loan exclusively to AFA field units through AFA's Communications Department. When ordering, please specify either three-quarter-inch or one-half-inch VHS format.

Proceedings of the following Roundtables are currently available on videotape:

- Focus on the MX Peacekeeper—Key to Strategic Force Modernization.
- Focus on SDI—Opening A New Era of Deterrence?
- Focus on Spare Parts—A Balanced Perspective.
- Military Retirement and Its Impact on the Vitality of the Armed Forces.
- Teachers of the Future—Where Are They and Their Students Going?
- Focus on: "The Chiefs."
- Focus on: Advanced Tactical Fighter Technologies.
- 1985—NATO's First Thirty-six Years.
- Deterrence—What Is It? What Does It Mean to Me and My Generation?
- Focus on the B-1—Its Testing, Its Production—Its Future.

INTERCOM

Alamo Chapter Honors Blue-suiters During Awards Banquet

In one of the most extensive awards programs conducted by an AFA unit, the Alamo Chapter honored fifty-seven local Air Force members at its annual Blue-suit Awards Banquet on March 14 at the Lackland AFB, Tex., Airmen's Open Mess. Participating in this year's competition were the Air Force Military Training Center and Wilford Hall USAF Medical Center at Lackland AFB; the Aerospace Medical Division at Brooks AFB; the San Antonio Real Property Maintenance Agency and San Antonio Contracting Center at Fort Sam Houston; the 12th Flying Training Wing, Air Force Recruiting Service, Air Force Manpower and Personnel Center, and Air Training Command at Randolph AFB; and the Air Force Service Information and News Center, San Antonio Air Logistics Center, Electronic Security Command, and Air Force Commissary Service at Kelly AFB.

"Recipients—active-duty, Reserve, and Guard—were honored for outstanding on-the-job performance and active community involvement," said Chapter President E. F. "Sandy" Faust.

The evening provided the opportunity to recognize outstanding chapter leaders and members as well. Also honored was Leslie Helene Siegel of Churchill High School, the local finalist in Texas State AFA's Earle North Parker Scholarship competition. Miss Siegel submitted the best essay among fifty local entries on "The Statue of Liberty—What It Means to Me." Her essay now competes at the statewide level. Tim Glasgow, AFA National Vice President/Southwest Region, presented a number of AFA national awards, Medals of Merit, and Exceptional Service Awards to local AFA recipients.

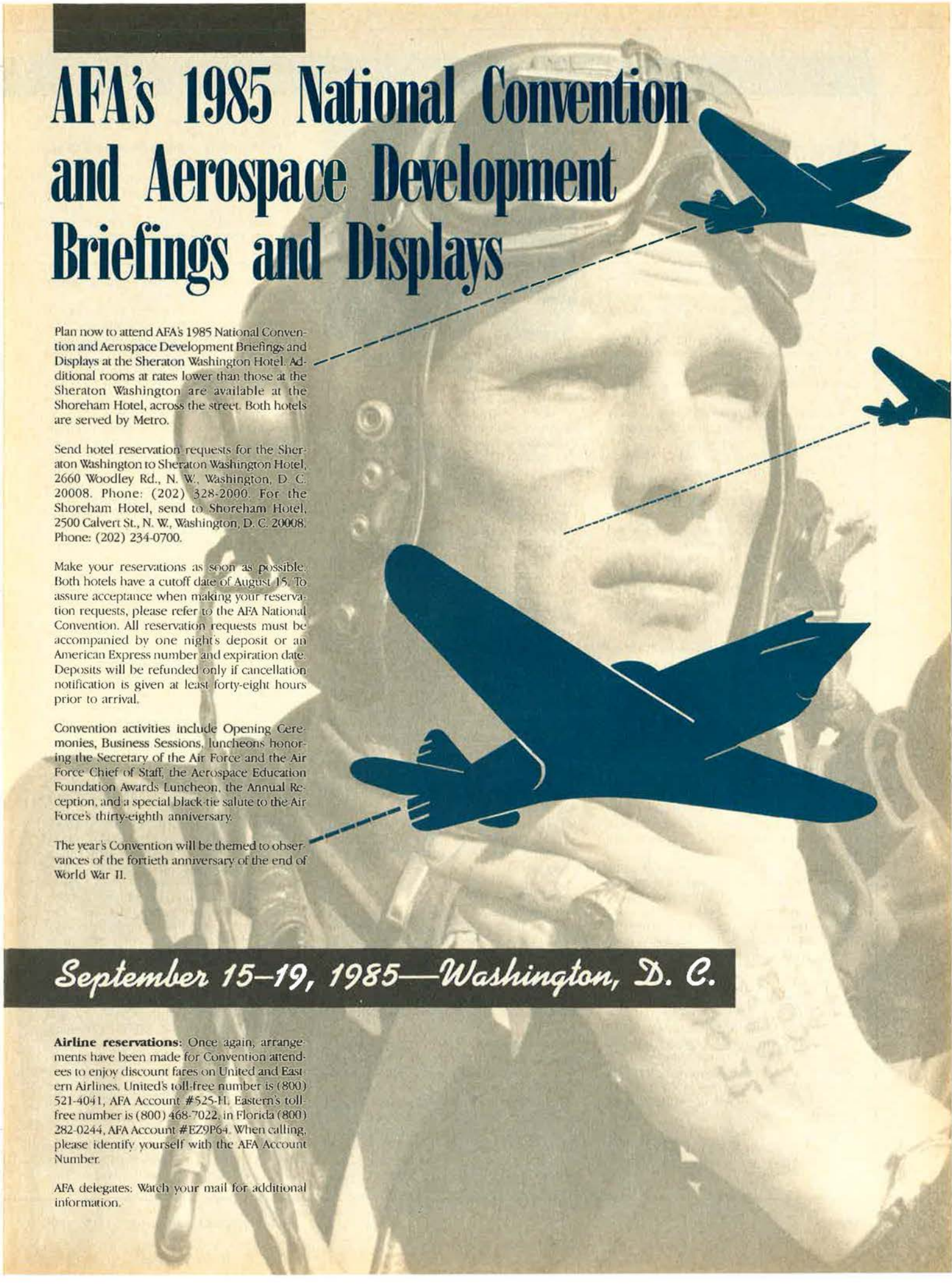
Alamo Chapter President E. F. "Sandy" Faust, left, presents a Chapter award to Brig. Gen. Fredric F. Doppelt, Commander of AFSC's Aerospace Medical Division, Brooks AFB, Tex. The award recognized the base community's outstanding support of local AFA units.

Harry S. Truman Chapter Honors Astronaut Bluford

Early in March, Harry S. Truman Chapter officials hosted a banquet featuring as guest speaker highly decorated Col. Guion S. "Guy" Bluford, Jr., USAF, the first black astronaut to travel in space. Colonel Bluford offered "a fascinating look at life aboard the Space Shuttle *Challenger,*" according to Chapter President Raymond W. Peterman. Colonel

(Continued on p. 158)

AFA's 1985 National Convention and Aerospace Development Briefings and Displays



Plan now to attend AFA's 1985 National Convention and Aerospace Development Briefings and Displays at the Sheraton Washington Hotel. Additional rooms at rates lower than those at the Sheraton Washington are available at the Shoreham Hotel, across the street. Both hotels are served by Metro.

Send hotel reservation requests for the Sheraton Washington to Sheraton Washington Hotel, 2660 Woodley Rd., N. W., Washington, D. C. 20008. Phone: (202) 328-2000. For the Shoreham Hotel, send to Shoreham Hotel, 2500 Calvert St., N. W., Washington, D. C. 20008. Phone: (202) 234-0700.

Make your reservations as soon as possible. Both hotels have a cutoff date of August 15. To assure acceptance when making your reservation requests, please refer to the AFA National Convention. All reservation requests must be accompanied by one night's deposit or an American Express number and expiration date. Deposits will be refunded only if cancellation notification is given at least forty-eight hours prior to arrival.

Convention activities include Opening Ceremonies, Business Sessions, luncheons honoring the Secretary of the Air Force and the Air Force Chief of Staff, the Aerospace Education Foundation Awards Luncheon, the Annual Reception, and a special black-tie salute to the Air Force's thirty-eighth anniversary.

The year's Convention will be themed to observances of the fortieth anniversary of the end of World War II.

September 15–19, 1985—Washington, D. C.

Airline reservations: Once again, arrangements have been made for Convention attendees to enjoy discount fares on United and Eastern Airlines. United's toll-free number is (800) 521-4041, AFA Account #525-H. Eastern's toll-free number is (800) 468-7022, in Florida (800) 282-0244, AFA Account #EZ9P64. When calling, please identify yourself with the AFA Account Number.

AFA delegates: Watch your mail for additional information.

Great Lakes—The Proud One!

Pride in self, job, and organization is one of the most important attributes a person can possess. AFA's Great Lakes Region is proud of AFA's many accomplishments on behalf of our nation and the Air Force. And we are extremely proud of the many contributions made to our nation, Air Force, and AFA by individuals and organizations, past and present, from the Great Lakes Region:

- The Wright brothers of Dayton, Ohio, gave mankind wings and the inspiration to soar.
- William "Billy" Mitchell of Milwaukee, Wis., saw the potential for military aviation and helped make it happen.
- AFA held its first National Convention in Columbus, Ohio, in 1947.
- Lawrence D. Bell devoted forty-four years to the aircraft industry. From a barefoot boy in Mentone, Ind., he became chairman of the board of one of the nation's foremost aircraft firms.
- More than one and a half million "Chanuters" have passed through the gates at Chanute AFB near Rantoul, Ill., since 1917.
- Scott AFB, Ill., is the only Air Force base named for an enlisted man, Cpl. Frank S. Scott.
- The Ford Motor Co. assembly line near Detroit, Mich., turned out thousands of B-24 Liberators in World War II. Also, Michigan hosts the World Hot-Air Balloon Championships.
- A young man from Wisconsin named Richard I. Bong was the leading American ace of World War II. With a total of forty kills, he received the Medal of Honor. Eleven other Medal of Honor recipients hail from our Great Lakes Region.
- Indiana's Virgil "Gus" Grissom, for whom two AFA chapters are named, gave his life in furthering America's conquest of space.

In fact, if you look at the names of some of the chapters in our region—O'Hare, Scott, Grissom, Bell, Johnston, Chennault, Vandenberg, Straubel, Leavitt, Mitchell, Rickenbacker, and Wright—you'll find that they reflect what AFA is all about: pride in the past and faith in the future.

And lastly, four recipients of AFA's "Man of the Year" Award—Richard H. Becker, Illinois (1983); Alexander C. Field, Jr., Illinois (1979); Marjorie O. Hunt, Michigan (1968); and George A. Anderl, Illinois (1954)—are from the Great Lakes Region.

If the names and accomplishments mentioned above strike a responsive chord, then you know why we are proud. We're the proud ones!

—Hugh L. Enyart, National Vice President/Great Lakes Region.

Hugh L. Enyart, National Vice President/ Great Lakes Region.

Illinois State AFA

"The Coming Revolution in Military Technology" was the theme of the **Chicagoland-O'Hare Chapter's** 1985 defense symposium. The event was the eighth in an annual series of highly successful symposia sponsored by the Chapter to focus public attention on critical defense issues in the Midwest.

AFA's **Illini Chapter,** located near Chanute AFB, sponsors a number of activities in support of the Chanute training mission, which, reports base historian and Illini Membership Chairman Don Weckhorst, marked its sixty-eighth consecutive year on May 21.

Located near Scott AFB, AFA's **Scott Memorial Chapter** held a meeting in December with Missouri's Spirit of St. Louis Chapter. The meeting featured AFA President Marty Harris, who discussed the realities of security, the causes of Soviet aggression, and the need for AFA to recruit civilians, reports Corinna Petrella, Chapter Secretary. In February, the Chapter hosted a dinner with Medal of Honor recipient Col. George "Bud" Day, USAF (Ret.), as guest of honor and speaker. The Chapter will sponsor its annual "Air Force Ball of Mid-America" this month. The highly successful event raises funds for Air Force charities and the Aerospace Education Foundation.

Indiana State AFA

"Indiana has an interesting mix of chapters," reports State President John Kagel. AFA units range from the Lawrence D. Bell Museum Chapter, nestled in a small farming community of about 900, to the Grissom Memorial Chapter, the state's largest. A state goal is to charter new chapters in Terre Haute, Evansville, and Peru.

Established in 1975 to help support a lasting tribute to native son Lawrence D. Bell, aviation pioneer and founder of Bell Aircraft (now Bell Aerospace Textron), AFA's **Lawrence D. Bell Museum Chapter** in Mentone witnessed the dedication of the Bell Museum in 1982, reports Chapter founder and President Robert Whetstone. Since then, the Chapter has worked closely with the Bell Museum Board to raise funds for an addition to the museum to house Bell aircraft.

The **Fort Wayne-Baer Field Area Chapter** dates back to 1946, but it was dormant until 1982, when an infusion of new members under the leadership of Tom Hissem revitalized the Chapter, reports current Chapter President Bill Cummings. Chapter activities include meetings with key groups, strong support for the Civil Air Patrol, fund-raising for 1982 flood victims, an annual Air Force ball, and an active Community Partner program.

March 26 marked the fifth anniversary of AFA's **Southern Indiana Chapter,** and a fitting celebration took place, reports Chapter President Marcus Oliphant. In 1983, the Chapter, under the leadership of then President Leroy Sherrill, received an AFA Membership Achievement Award for reaching its membership goals.

In 1971, AFA's **Gus Grissom Chapter** was formed by ROTC cadets from Purdue University and remained active for two years. It was dormant until 1977, when local Air Force retirees got it going, and it has remained active ever since. The Chapter's area of operation lies deep in the farm belt in the north-central part of the state, says Chapter President Donald K. James. The area is also home to Purdue University, which has one of the finest aviation technology schools in the country. Chapter members provide counseling and work with the aviation program at Purdue.

Chartered in June 1973, AFA's **Grissom Memorial Chapter** has grown from forty-eight members to some 700. The Chapter supports the Grissom AFB mission through an extensive awards program, works closely with the Civil Air Patrol, and has supported the Vietnam Memorial Fund and the SAC Bombing Competition, says Chapter President Don McKellar. Awards received by the Chapter include the 1984 Arthur C. Storz, Sr., Award for outstanding chapter membership recruiting.

Activities sponsored by AFA's **South Bend Chapter** include orientation and informational flights to Scott AFB for local civic leaders, sponsorship of a fly-in by a pilot's club, and an Air Force Museum tour. The Chapter annually participates in Veterans Day festivities, Armed Forces Day Observances, and the South Bend Annual Winter Holiday Festival, reports William Wilhelm, Chapter Secretary.

Michigan State AFA

"In the 1950s, Michigan chapters included Detroit, Vandenberg, Grand Rapids, Battle Creek, Mount Clemens, Lansing, Dearborn, Kalamazoo, and Orchard Lake," reports Michigan State AFA President Robert J. Schaetzl. "Later in the 1970s, some of these chapters became inactive, and new chapters took seed in Sault Sainte Marie, Oscoda, Marquette, Southfield, and Petoskey."

AFA's **James H. Straubel Chapter,** named for the former AFA and Foundation Executive Director, "was formed to sup-

Pictured at a Scott Memorial Chapter meeting are, from left, AFCC Commander Maj. Gen. Gerald L. Prather, Medal of Honor recipient Col. George Day, USAF (Ret.), AFA National Vice President Hugh Enyart, and Chapter President Ron Temple.

Pictured at Wisconsin State AFA's Billy Mitchell Award banquet are, from left, State Advisor Don Adams, Billy Mitchell Chapter President Gary Parker, Mitchell Award recipient Daniel Brandenstein, and past State President Ken Kuenn.

Wright Memorial Chapter President Clyde Autio views a display at the Air Force Museum in Dayton, Ohio, with Janine Quinn, a participant in the Young Astronaut Program.

The Lawrence D. Bell Museum Chapter is working to raise funds for an addition to the Bell Museum, which opened in 1982.

port aerospace education and the Air Force Academy," Mr. Schaetzl reports.

At one time the largest chapter in the state, the **Mount Clemens Chapter** has been "successful in its work on behalf of the POW/MIA campaign," Mr. Schaetzl reports. Some 5,000 pamphlets were printed and distributed by Chapter leaders and members to churches and civic organizations. For this effort, Marjorie Hunt, who is the only woman to hold the title of "AFA Man of the Year," received a national Citation of Honor. Further, the Chapter originated an annual meeting for current and prospective Academy cadets and their parents. The event is now hosted by the Straubel Chapter.

Ohio State AFA

Ohio State AFA President Chester A. Richardson reports that the **Cleveland Chapter** sponsored a booth at the Cleveland Air Show last fall, and members distributed membership applications and more than 500 copies of AIR FORCE Magazine.

The **Steel Valley Chapter** sponsored its Military Ball on March 9, with Civil Air Patrol and junior and senior ROTC cadets participating.

Cited at a recent White House Executive Briefing on the Young Astronaut Program was AFA's **Wright Memorial Chapter** in Dayton. The Chapter was recognized as being the first success story for the Young Astronaut Program—a private-sector initiative to channel schoolchildren's interest in space into improvement of their skills in mathematics, science, and technology at both elementary and junior high-school levels. Since October, the Chapter has been able to establish "Young Astronaut Chapters" in thirty-seven schools, and there are plans to establish more, according to Chapter President Clyde Autio. The Chapter's Aerospace Education Committee, headed by Phil Woodruff, is spearheading the effort.

Other Chapter activities included a joint meeting with the American Defense Preparedness Association that featured AFLC Commander Gen. Earl T. O'Loughlin as speaker and a joint program with the Wright Brothers Tri-State Chapter of the American Defense Preparedness Association, the Society of American Engineers, and the Dayton World Affairs Council that featured SDIO Director Lt. Gen. James A. Abrahamson as speaker.

Wisconsin State AFA

Wisconsin State AFA presents military achievement awards to Air Force active-duty, Reserve, and Guard members as well as to outstanding recruiters and Civil Air Patrol and junior and senior ROTC cadets. By far the most outstanding state event, according to State President Charles Marotske, is the annual Billy Mitchell Memorial Award banquet, first held in 1956. The award honors a Wisconsin native who has made an outstanding contribution in the aerospace field. Shuttle astronaut Daniel C. Brandenstein was the 1984 recipient.

Bluford, a mission specialist on the eighth Shuttle mission (STS-8), was responsible for launching into orbit a $45 million Indian communications and weather satellite and for conducting highly technical experiments.

Colonel Bluford is now training for Space Shuttle flight 61-A, scheduled for this October with European Spacelab operations as one of its key missions.

The well-attended event, held at the Kansas City Royals Stadium Club in Kansas City, Mo., attracted prominent community leaders, including Kansas City Mayor Richard Berkley, Councilwoman Joanne Collins, Chief of Police Larry Joiner, Tuskegee Airmen Association President Charles E. McKee, and Lucile Bluford, the honoree's aunt and editor of the Kansas City *Call* newspaper. AFA guests included Charles Church, Jr., National Vice President/Midwest Region and Chairman of AFA's Long-Range Planning Committee, and Missouri State AFA President Orville Blair.

"Colonel Bluford's flight was the third for the 100-ton *Challenger*, and it was the first Space Shuttle flight to take off and land at night," said Floyd H. Pinkston, Chairman of the Truman Chapter Publicity Committee.

Travis Chapter Hosts Fourth Annual Defense Roundtable

One reporter called it akin to a lamb in a lion's den as Rep. Vic Fazio (D-Calif.) "told it like he saw it" at the General Robert F. Travis Chapter's fourth annual Defense Roundtable, which attracted members and guests to the Vacaville Chamber of Commerce for an informative give-and-take on the issues on February 16.

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The Solano Democrat said that the Reagan Administration's domestic spending cuts were not enough and that other programs, including military spending, must be included in the cuts. He predicted the military budget would receive a three percent spending boost when the political dust settles following the budget debate. AFA leaders reported that he expressed support for current B-1 production, but said that buying any more simply because the production line is already running isn't sound. He prefers the Advanced Technology Bomber (ATB) to the B-1 and called the highly classified ATB "a monumental breakthrough that is unlike any other aircraft we've ever procured." He noted that the Soviets have nothing comparable on the drawing boards.

Travis Chapter leaders said Representative Fazio praised the maneuverability and flexibility of the C-17 airlifter, was undecided on MX (he voted for it in the key March votes), questioned the merits of the Strategic Defense Initiative (SDI), and praised the concept of deterrence because it has worked since the end of World War II. In response to a question by AFA member Earl von Kaenel, who asked how one could trust a nation that shoots down an unarmed civil airliner, Representative Fazio said that caution mixed with communication is necessary in arms talks. As for military retirement, AFA leaders reported that the Congressman said pensions for military retirees could be frozen—an action he doesn't support.

Participants included Chapter President Bob Hazeleaf, who served as moderator; Art Littman, Roundtable coordinator; Walt Scott, panelist; Andrew K. Popenoe, Chapter Executive Vice President; Betty Hazeleaf, Executive Secretary; Barbara Pansby, Treasurer; and Don Disbrow, Travis Chapter Board Chairman. The event was well-covered by the Dixon *Tribune*, thanks to Sue Katz, editor and AFA member, as well as by the Vacaville *Reporter* and the Vacaville *Daily Republic*.

Gen. Robert T. Herres, USAF, second from right, addressed a recent meeting of AFA's Lake Superior Northland Chapter in Marquette, Mich. With General Herres are, from left, Chapter Vice President Matt Surrell, Chapter President Neil Nystrom, 40th Air Division Commander Brig. Gen. Richard Goetze, Chapter Treasurer Jim Grundstrom, and Chapter Secretary Guy Spitsberg.

Space Shuttle astronaut Col. Guion S. Bluford, Jr., USAF, second from left, was the guest speaker at a recent Harry S. Truman Chapter meeting in Kansas City, Mo. With Colonel Bluford are, from left, Chapter President Raymond W. Peterman, Tuskegee Airmen Association President Col. Charles E. McKee, USAF (Ret.), and Chapter Secretary Jasper Indelicato. (Photo by CMSgt. Curtis L. Gist, USAF)

Best Defense Is Technology Edge, Says General Herres

Gen. Robert T. Herres, Commander, Air Force Space Command, and Commander in Chief, North American Aerospace Defense Command, told members and guests of AFA's Lake Superior Northland Chapter in Michigan that America's military might lies not in sheer numbers of weapons but in high-technology developments,

according to an article by Craig Swanson, who, as managing editor of the *Mining Journal,* covered the event.

An important part of America's high-tech edge, according to General Herres, is its ability to use satellites for a variety of defense-related purposes. "Space-based warning systems are essential to deterrence," General Herres said. He scoffed at claims that the United States is attempting to militarize space through the Strategic Defense Initiative.

"Space won't be militarized in 1985, and it won't be militarized in 1986. Space was militarized some twenty years ago," he said. Space has become a critical element of effectiveness in everyday operational deployment, and space platforms are very important in putting the right amount of firepower in the right place at the right time, the Commander noted.

The Chapter dinner meeting was held at the Northern Michigan University campus in Marquette on January 24. Organizers of the event included Neil Nystrom, Chapter President; Matt Surrell, Vice President; Guy Spitsberg, Secretary; and Jim Grundstrom, Treasurer.

On the Scene in AFA's Busy and Active Grass Roots

Claiming that news reports about military retirement "hit the nail right on the thumb," **Gen. Andrew P. Iosue,** Commander, Air Training Command, took on those news reports in an editorial that appeared in the San Antonio, Tex., *Express-News* in March. He criticized a front-page article headlined "Study: Military Pensions Rip-off" and chided the paper's Washington bureau for not contacting defense authorities "or such organizations as the Air Force Association" on the issue . . . "Your name is becoming very well-known among the 115th Cadet Corps," **Col. John R. Kuester,** Commander of the ROTC detachment at the University of Connecticut, told AFA National Director **Joe Falcone.** In recent months, Joe has sponsored cadets as AFA members, briefed the detachment on the Air Force Museum, and donated an AFA flag to the detachment at a March 28 meeting of the Northern Connecticut Chapter . . . *Allegiance,* the Thomas W. Anthony Chapter's newsletter, is an attractive eight-page self-mailer with photos, artwork, ads, patrons, and good, solid news of interest to members and others. Congratulations to editor **T. J. duCellier** and the editorial

Florida AFA's "Salute to the Tactical Air Forces," held in January in Orlando, Fla., was attended by, from left, Howard Peckham, Cape Canaveral Chapter past President and AFA Medal of Merit recipient; AFA President Martin H. Harris; Col. Joseph W. Kittinger, Jr., USAF (Ret.), Doolittle Fellowship recipient; John G. Brosky, immediate past AFA Board Chairman; and John Combs, Central Florida Chapter President.

review board, which includes **Col. Kenneth Brown,** USAF, **Robert Beatson,** Chapter President **Spann Watson, Dana Spencer, Natalie Desmond, Maj. Paul Kelly,** USAF, and others who contributed.

For the twenty-fifth consecutive year, AFA's Tucson Chapter in Arizona sponsored an Air Force Appreciation Luncheon to allow AFA and community leaders to express appreciation to Air Force personnel in the Tucson area. This year's event was held March 15 and featured **Lt. Gen. Leo Marquez,** Deputy Chief of Staff for Logistics and Engineering, Hq. USAF, as guest speaker . . . Carl Vinson Memorial Chapter President **Joe Sherrill Stafford** presented a mounted copy of the article "Valor: The Battle of Bunker Hill 10" from AIR FORCE Magazine's January 1985 issue to **MSgt. William Piazza,** USAF, whose achievements in Vietnam were featured in the piece, authored by Contributing Editor **John Frisbee.** Sergeant Piazza, currently assigned to the 2853d Security Police Squadron at Robins AFB, Ga., was honored at the Vinson Chapter board meeting in February. Also, a front-page article on Sergeant Piazza appeared in the *Daily Sun* . . . **Jan Laitos,** National Vice President/North Central Region, has been named a member of the Rapid City, S. D., Mayor's B-1 Task Force, which was set up to publicize the need for a strong national defense and to highlight the economic and other benefits provided to the community by nearby Ellsworth AFB. An announcement of Mr. Laitos's appointment appeared in the Rapid City, S. D., *Journal.*

A letter to "missing persons" is what it amounted to when Spokane Chapter President **Andy Kelly** wrote to Chapter members whom he hadn't

Carl Vinson Memorial Chapter President Joe Sherrill Stafford, left, presents mounted copy of AIR FORCE Magazine article to MSgt. William Piazza. Looking on are, from right, Capt. Mark Strother, USAF, and Sergeant Piazza's wife Gloria.

AFA State Contacts

Following each state name, in parentheses, are the names of the communities in which AFA Chapters are located. Information regarding these Chapters, or any place of AFA's activities within the state, may be obtained from the appropriate contact.

ALABAMA (Auburn, Birmingham, Huntsville, Mobile, Montgomery, Selma): **Jim Patterson,** 802 Brickell Rd., N.W., Huntsville, Ala. 35805 (phone 205-837-5087).

ALASKA (Anchorage, Fairbanks): **Michael T. Cook,** P. O. Box 25, Fairbanks, Alaska 99707 (phone 907-456-7762).

ARIZONA (Green Valley, Phoenix, Sedona, Sun City, Tucson): **Meryll Frost,** 7426 E. Random Ridge Drive, Tucson, Ariz. 85710 (phone 602-298-1580).

ARKANSAS (Blytheville, Fayetteville, Fort Smith, Little Rock): **Aaron E. Dickerson,** 710 S. 12th, Rogers, Ark. 72756 (phone 501-636-7460).

CALIFORNIA (Apple Valley, Edwards, Fairfield, Fresno, Hermosa Beach, Los Angeles, Merced, Monterey, Novato, Orange County, Pasadena, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, San Jose, Santa Barbara, Santa Monica, Sunnyvale, Vandenberg AFB, Yuba City): **David Graham,** 29611 Vista Plaza Drive, Laguna Niguel, Calif. 92677 (phone 714-495-4622).

COLORADO (Boulder, Colorado Springs, Denver, Fort Collins, Grand Junction, Greeley, Littleton, Pueblo, Waterton): **Thomas W. Ratterree,** P. O. Box 26029, Colorado Springs, Colo. 80936 (phone 303-599-0143).

CONNECTICUT (East Hartford, Middletown, North Haven, Storrs, Stratford, Westport, Windsor Locks): **Raymond E. Choquette,** 16 Tonica Springs Trail, Manchester, Conn. 06040 (phone 203-646-4818).

DELAWARE (Dover, Wilmington): **Joseph H. Allen, Jr.,** 31 Muirfield Court, Dover, Del. 19901 (phone 302-674-3400).

DISTRICT OF COLUMBIA (Washington, D. C.): **Howard W. Cannon,** 1501 Lee Highway, Arlington, Va. 22209-1198 (phone 703-247-5820).

FLORIDA (Avon Park, Brandon, Cape Coral, Daytona Beach, Fort Walton Beach, Gainesville, Homestead, Jacksonville, Leesburg, Naples, Neptune Beach, New Port Richey, Orlando, Panama City, Patrick AFB, Redington Beach, Sarasota, Tallahassee, Tampa, West Palm Beach, Winter Haven): **H. Lake Hamrick,** 206 Sotir Ave., N. W., Fort Walton Beach, Fla. 32548 (phone 904-862-5067).

GEORGIA (Athens, Atlanta, Columbus, Rome, Savannah, St. Simons Island, Valdosta, Warner Robins): **Wilbur H. Keck,** 116 Stillwood Drive, Warner Robins, Ga. 31093 (phone 912-922-0655).

GUAM (Agana): **Joe Gyulavics,** P. O. Box 21543, Guam 96921 (phone 671-734-2369).

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ILLINOIS (Belleville, Champaign, Chicago, Elmhurst, Peoria, Springfield-Decatur): **Kyle Robeson,** P. O. Box 697, Champaign, Ill. 61820 (phone 217-352-3936).

INDIANA (Bloomfield, Fort Wayne, Indianapolis, Lafayette, Logansport, Marion, Mentone, South Bend): **John Kagel,** 1029 Riverside Drive, South Bend, Ind. 46616 (phone 219-234-8855).

IOWA (Des Moines, Sioux City): **Carl B. Zimmerman,** 608 Waterloo Bldg., Waterloo, Iowa 50701 (phone 319-232-2650).

KANSAS (Garden City, Topeka, Wichita): **Cletus J. Pottebaum,** 6503 E. Murdock, Wichita, Kan. 67206 (phone 316-683-3963).

KENTUCKY (Lexington, Louisville): **Jo Brendel,** 726 Fairhill Drive, Louisville, Ky. 40207 (phone 502-897-7647).

LOUISIANA (Alexandria, Baton Rouge, Bossier City, Monroe, New Orleans, Shreveport): **James P. LeBlanc,** 3645 Monroe St., Mandeville, La. 70448 (phone 504-626-4516).

MAINE (Bangor, Limestone, N. Berwick): **Alban E. Cyr, Sr.,** P. O. Box 160, Caribou, Me. 04736 (phone 207-496-3331).

MARYLAND (Andrews AFB area, Baltimore, Rockville): **James M. Kennedy,** 304 Tantallon Drive, Fort Washington, Md. 20744 (phone 301-292-6066).

MASSACHUSETTS (Bedford, Boston, Falmouth, Florence, Hanscom AFB, Lexington, Taunton, West Springfield, Worcester): **John F. White,** 49 West Eagle St., East Boston, Mass. 02128 (phone 617-567-1592).

MICHIGAN (Alpena, Battle Creek, Detroit, Kalamazoo, Marquette, Mount Clemens, Oscoda, Petoskey, Southfield): **Robert J. Schaetzl,** 42247 Trotwood Court, Canton, Mich. 48187 (phone 313-552-3280).

MINNESOTA (Duluth, Minneapolis-St. Paul): **Paul G. Markgraf,** 2101 E. 3d St., St. Paul, Minn. 55119 (phone 612-735-4411).

MISSISSIPPI (Biloxi, Columbus, Jackson): **R. E. Smith,** Route 3, Box 282, Columbus, Miss. 39701 (phone 601-327-4422).

MISSOURI (Kansas City, Knob Noster, Springfield, St. Louis): **Orville R. Blair,** 1504 Golden Drive, St. Louis, Mo. 63137 (phone 314-867-0285).

MONTANA (Great Falls): **Ed White,** 2333 6th Ave., South, Great Falls, Mont. 59405 (phone 406-453-2054).

NEBRASKA (Lincoln, Omaha): **Donald D. Adams,** FirsTier Inc., 17th & Farnam, Omaha, Neb. 68102 (phone: 402-348-7905).

NEVADA (Las Vegas, Reno): **Vern Frye,** 4665 Rio Encantado Lane, Reno, Nev. 89502 (phone 702-825-1125).

NEW HAMPSHIRE (Manchester, Pease AFB) **Robert N. McChesney,** Scruton Pond Rd., Barrington, N. H. 03825 (phone 603-664-5090).

NEW JERSEY (Andover, Atlantic City, Belleville, Camden, Chatham, Cherry Hill, E. Rutherford, Forked River, Fort Monmouth, Jersey City, McGuire AFB, Middlesex County, Newark, Old Bridge, Trenton, Wallington, West Orange, Whitehouse Station): **Gilbert Freeman,** 42 Weirimus Lane, Hillsdale, N. J. 07642 (phone 201-666-5379).

NEW MEXICO (Alamogordo, Albuquerque, Clovis): **Louie T. Evers,** P. O. Box 1946, Clovis, N. M. 88101 (phone 505-762-1798).

NEW YORK (Albany, Brooklyn, Buffalo, Chautauqua, Garden City, Hempstead, Hudson Valley, New York City, Niagara Falls, Plattsburgh, Queens, Rochester, Rome/Utica, Southern Tier, Staten Island, Suffolk County, Syosset, Syracuse, Westchester): **Robert H. Root,** 57 Wynnwood Ave., Tonawanda, N. Y. 14150 (phone 716-692-2100).

NORTH CAROLINA (Asheville, Charlotte, Fayetteville, Goldsboro, Greensboro, Kitty Hawk, Raleigh): **Bobby G. Suggs,** 501 Bloomfield Drive, Fayetteville, N. C. 28301 (phone 919-323-5281).

NORTH DAKOTA (Concrete, Fargo, Grand Forks, Minot): **James M. Crawford,** 1720 9th St., S. W., Minot, N. D. 58701 (phone 701-838-0010).

OHIO (Akron, Cincinnati, Cleveland, Columbus, Dayton, Newark, Youngstown): **Chester Richardson,** 1271 Woodledge Ave., Mineral, Ohio 44440 (phone 216-652-5116).

OKLAHOMA (Altus, Enid, Oklahoma City, Tulsa): **G. G. Atkinson,** P. O. Box 25858, Oklahoma City, Okla. 73125 (phone 405-231-6213).

OREGON (Eugene, Portland): **Zane R. Harper,** 5360 SW Dover Lane, Portland, Ore. 97225 (phone 503-244-4561).

PENNSYLVANIA (Allentown, Altoona, Beaver Falls, Coraopolis, Drexel Hill, Erie, Harrisburg, Homestead, Johnstown, Lewistown, Mon-Valley, Philadelphia, Pittsburgh, Scranton, State College, Willow Grove, York): **Jack B. Flaig,** P. O. Box 375, Lemont, Pa. 16851 (phone 814-238-4212).

PUERTO RICO (San Juan): **Fred Brown,** 1991 Jose F. Diaz, Rio Piedras, P. R. 00928 (phone 809-790-5288).

RHODE ISLAND (Warwick): **King Odell,** 413 Atlantic Ave., Warwick, R. I. 02888 (phone 401-941-5472).

SOUTH CAROLINA (Charleston, Clemson, Columbia, Myrtle Beach, Sumter): **James Catington,** 2122 Gin Branch Rd., Sumter, S. C. 29154 (phone 803-481-2634).

SOUTH DAKOTA (Rapid City, Sioux Falls): **John E. Kittelson,** 141 N. Main, Suite 308, Sioux Falls, S. D. 57102 (phone 605-336-2498).

TENNESSEE (Chattanooga, Knoxville, Memphis, Nashville, Tri-Cities Area, Tullahoma): **Jack K. Westbrook,** P. O. Box 1801, Knoxville, Tenn. 37901 (phone 615-523-6000).

TEXAS (Abilene, Amarillo, Austin, Big Spring, College Station, Commerce, Corpus Christi, Dallas, Del Rio, Denton, El Paso, Fort Worth, Harlingen, Houston, Kerrville, Laredo, Lubbock, San Angelo, San Antonio, Waco, Wichita Falls): **Bryan L. Murphy, Jr.,** General Dynamics, P. O. Box 748 MZ 1221, Fort Worth, Tex. 76101 (phone 817-429-0693).

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WEST VIRGINIA (Huntington): **David Bush,** 2317 S. Walnut Drive, St. Albans, W. Va. 25177 (phone 304-722-3583).

WISCONSIN (Madison, Milwaukee): **Charles Marotske,** 7945 S. Verdev Drive, Oak Creek, Wis. 53154 (phone 414-762-4383).

WYOMING (Cheyenne): **William Helms,** 808 Shoshoni, Cheyenne, Wyo. 82009 (phone 307-638-3114).

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seen for a while. "Your membership has been of great benefit to us, so to express our thanks, we have scheduled three outstanding programs for you." The Chapter leader included a list of the next three meetings and featured speakers . . . AFA's San Bernardino Area Chapter, the Ballistic Missile Office Recognition Program, the San Bernardino Chamber of Commerce, and the Redlands Chamber of Commerce joined forces to sponsor a luncheon meeting on April 9 featuring **Rep. Jerry Lewis** (R-Calif.) as speaker . . . An American flag, an AFA banner, and a special chapter gavel made of orangewood were the gifts presented to the Beaches of Jacksonville Chapter when it was chartered by AFA President **Marty Harris** at the Southeast Regional workshop in March. Also, fourteen new AFA overseas chapters were chartered on the European continent by AFA President Harris in April.

The National Security Briefing Team from the Air War College at Air University headlined the Col. Stuart E. Kane, Jr., Chapter's March 26 meeting held on the Penn State campus at State College, Pa. Topics ranged from the Soviet military buildup to defense spending and force modernization issues, says Chapter President **W. Daniel Douthitt III** . . . Honored for nearly fifty years of AFA service were **Joe Sesto,** Chairman of the Santa Maria Chamber of Commerce Military Affairs Committee, and **Bill Leary,** Chairman of the Lompoc Chamber of Commerce Military Affairs Committee. The two charter AFA members and past Robert H. Goddard Chapter Presidents were presented California State AFA Meritorious Service Awards from current Goddard Chapter President **R. L. "Bob" Griffin** . . . More than 350 people heard **Maj. Gen. Richard A. Burpee,** Commander of the Oklahoma City Air Logistics Center, speak at a recent Tulsa Chapter meeting. Attendees included **Rep. James R. Jones** (D-Okla.) and AFA Board Chairman **Dave Blankenship** . . . Kitty Hawk Chapter President **Gordon Cruickshanks** was inducted into the Order of Daedalians recently, and Gordon and his wife, **Gwenn,** wore matching airplane jackets just for the occasion.

"Speaker Warns Against Complacency" was the headline on an article in the Abilene, Tex., *Evening Reporter-News* that reported on AFA President **Marty Harris's** address to more than 300 people at the Abilene Chapter's annual awards banquet at the Dyess AFB Officers' Club in February . . . More than thirty aviation books have been donated to the Lake Placid, Fla., High School library by AFA's Florida Highlands Chapter. Chapter President **Roy Whitton** says other chapters may want to consider this idea because "it seems senseless to let books accumulate dust on shelves and end up in a garage sale when schools and public libraries can put them to good use" . . . AFA's **Junior Officer Advisory** and **Enlisted Councils** were written up in the March issue of *Airman* Magazine.

It was AFA Appreciation Night for the Colin P. Kelly Chapter in New York recently when Chapter President **Gino Frate** accepted a painting of World War II hero Colin P. Kelly, for whom the AFA Chapter is named, from the 416th Bombardment Wing at Griffiss AFB. The painting was presented "as a tribute to the Colin P. Kelly Chapter's exceptional support

At a recent Paul Revere Chapter meeting in Massachusetts, Chapter President William Lewis, center, met with guest speaker Brig. Gen. Charles P. Cabell, Jr., left, and Hanscom AFB Commander Col. William E. Gernert. (USAF photo by Sgt. Beverly Warner)

Displaying the painting of Colin P. Kelly that was presented to AFA's Colin P. Kelly Chapter by the 416th Bomb Wing, Griffiss AFB, N. Y., are, from left, Chapter President Gino Frate, Lt. Jay Englert, USAF, and Wing Commander Col. (Brig. Gen. selectee) Walter E. Webb III.

A recent Tulsa Chapter meeting featured Oklahoma City ALC Commander Maj. Gen. Richard A. Burpee, center, as guest speaker. With General Burpee are, from left, Chapter President John G. Loerch and AFA Board Chairman Dave Blankenship.

for Griffiss AFB and the community," said Wing Commander **Col. (Brig. Gen. selectee) Walter E. Webb III. Lt. Jay Englert,** 41st Air Refueling Squadron project officer, originated the idea to honor the Colin P. Kelly Chapter. The program included remarks by **Charles Getty,** a World War II B-24 pilot who discussed the raids on Ploesti and their impact on the aircrews involved . . . "Engineer of the Year—1985" was the honor bestowed on AFA National Director **H. B. "Buzz" Henderson** by eighteen technical societies in the Newport News, Va., area. Mr. Henderson is a former test pilot and current corporate manager of General Dynamics Corp.'s field office in Tidewater . . . FAA Deputy Administrator **Richard Jones** wrote a letter to Virginia **Gov. Charles S. Robb** recently informing him "of the high regard in which **Ken Rowe** is held by the Federal Aviation Administration." The FAA official flew with Ken—who is director of the Virginia department of aviation, AFA's Civil Air Patrol Advisor, and a longtime Virginia AFA leader—to New York City where Ken received the first FAA Eastern Region Director of the Year award. Said Mr. Jones, "It is largely through Ken's efforts that Virginia enjoys such an outstanding reputation in the aviation community." ■

UNIT REUNIONS

Deming Army Airfield
Members of Deming Army Airfield will hold a reunion on September 6–8, 1985. **Contact:** Reunion Coordinators, 402 S. Tin, Deming, N. M. 88030.

Roswell AAF Ass'n
Members of Roswell Army Airfield Veterans Association (Walker AFB, N. M.) will hold their reunion on September 27–29, 1985, at the Roswell Inn in Roswell, N. M. **Contact:** RAAF Veterans Association, P. O. Box 8092 (Linda Vista Station), Roswell, N. M. 88201.

Submarine Veterans
The Submarine Veterans of World War II (a Presidentially chartered organization) will hold their annual convention on August 14–18, 1985, in Portland, Ore. **Contact:** Bob Barker, P. O. Box 1112, Watford City, N. D. 58854. Phone: (701) 842-3737. Doyle Lester, 128 S. Beaty, Manzanola, Colo. 81058. Phone: (303) 462-5570.

Vietnam Helicopter Pilots Ass'n
The Vietnam Helicopter Pilots Association will hold its annual reunion on July 4–6, 1985, in Houston, Tex. **Contact:** Larry Clark, P. O. Box 35699, Phoenix, Ariz. 85069.

INTERCOM

1st Strategic Air Depot Ass'n
The 1st Strategic Air Depot Association will hold its reunion on September 19–22, 1985, in St. Louis, Mo. **Contact:** Earl A. Dosey, 7336 Mikesell Dr., Indianapolis, Ind. 46260.

2d Air Division Ass'n
Members of the 2d Air Division will hold their reunion on September 5–8, 1985, at the Americana Great Gorge Resort in McAfee, N. J. **Contact:** Howard C. "Pete" Henry, 164B Portland Lane, Jamesburg, N. J. 08831. Phone: (609) 655-0982.

7th Combat Cargo Squadron
The 7th Combat Cargo Squadron will hold its reunion on October 17–20, 1985, in Orlando, Fla. **Contact:** Curtis Krogh, 601 Indiana St., Racine, Wis. 53405. Phone: (414) 633-4373.

12th Bomb Group
Members of the 12th Bomb Group "Earthquakers" will hold their reunion on September 12–15, 1985, in Vancouver, B. C., Canada. **Contact:** Alex Adair, 817 N. E. 91st St., Seattle, Wash. 98115. Bob Wilson, 2380 Duckabush Rd., Brinnon, Wash. 98320. Phone: (817) 265-9513 or (504) 395-6238.

12th Observation Squadron
The 12th Observation Squadron, including the 12th Tactical Reconnaissance and 12th Photo Reconnaissance Squadrons, will hold a reunion on September 19–21, 1985, in Dayton, Ohio. **Contact:** David Sopko, 3644 Irma Ave., Youngstown, Ohio 44502. Phone: (216) 788-4734. John Florence, 4849 Delores Pl., Orlando, Fla. 32806. Phone: (305) 851-7243.

17th Bomb Group
The 17th Bomb Group, along with the 34th, 37th, 73d, 89th, 95th, and 432d Squadrons, will hold a reunion on September 19–23, 1985, in Chattanooga, Tenn. **Contact:** W. D. Baird, 6776 E. Northwest Hwy., Dallas, Tex. 75231. Phone: (214) 348-9124.

20th Tactical Fighter Wing
The 20th Tactical Fighter Wing will hold its reunion on September 19–22, 1985, at the Holiday Inn in Fort Walton Beach, Fla. **Contact:** J. J. Kropenick, 7 Maple Ave., Shalimar, Fla. 32579. Phone: (904) 651-0559.

22d Air Depot Supply Squadron
Members of the 22d Air Depot Supply Squadron will hold their reunion on September 10–12, 1985, at the Ramada Inn-Northwest in Oklahoma City, Okla. **Contact:** Russell J. Hansen, 1125 Oak St., West Chicago, Ill. 60185. Phone: (312) 231-2014.

25th Bomb Group
The 25th Bomb Group will hold a reunion in July 1985. **Contact:** Robert S. Herzog, 4 Colonial Lane, Larchmont, N. Y. 10538.

26th Fighter Squadron
Members of the 26th Fighter Squadron, 51st Fighter Group, will hold their reunion on August 29–September 1, 1985, at the Loew's Ventana Canyon Resort in Tucson, Ariz. **Contact:** Gordon F. Spence, 1464 W. Beverly Dr., Anaheim, Calif. 92801. Phone: (714) 535-9630.

27th Bomb Group
The 27th Bomb Group will hold its reunion on October 25–27, 1985, in Fort Worth, Tex. **Contact:** Charles Cook, 3822 Cumberland Way, Lithonia, Ga. 30058. Phone: (404) 981-3945.

29th Bomb Group Ass'n
Veterans of the 29th Bomb Group will hold their first reunion on July 26–28, 1985, in Dayton, Ohio. **Contact:** R. W. Polleys, 1619 Schirm Dr., Middletown, Ohio 45042.

34th Bomb Group
Veterans of the 34th Bomb Group will rendezvous with the 8th Air Force Historical Society on October 17–20, 1985, in Wichita, Kan. **Contact:** Ray L. Summa, 2910 Bittersweet Lane, Anderson, Ind. 46011. Phone: (317) 644-6027.

Class 40-E
Graduates of Flying School Class 40-E will hold their reunion on September 18–23, 1985, at the US Air Force Academy in Colorado Springs, Colo. **Contact:** Lt. Col. D. B. Depmore, USAF (Ret.), 4729 Barnes Rd., Colorado Springs, Colo. 80917.

Class 41-B
Members of Cadet Flying Class 41-B (Maxwell Airfield) will hold a reunion on June 25–27, 1985, in Bemus Point, N. Y. **Contact:** Maj. Robert F. Post, USAF (Ret.), 144 Winch Rd., Lakewood, N. Y. 14750. Phone: (716) 763-9113.

46th Materiel Squadron
The 46th Materiel Squadron will hold its reunion on September 12–15, 1985, in Everett, Wash. **Contact:** Leonard Leitzke, 14515 W. Lake Goodwin Rd., Stanwood, Wash. 98292.

P-51 Mustang Pilots Ass'n
The P-51 Mustang Pilots Association and the 530th Fighter Squadron will hold a reunion on September 5–8, 1985, at the Mission Inn Resort in Howey-in-the-Hills, Fla. **Contact:** Frank Grenon, 81 Park St., Wilmington, Mass. 01887. Phone: (617) 658-9846. Ron Peters, 210 Shady Hollow, Casselberry, Fla. 32707. Phone: (305) 834-4855. Don Bennett, P. O. Box 552, Newport, N. H. 03773.

57th Fighter Group
Members of the 57th Fighter Group will hold their reunion on September 5–8, 1985, in Colorado Springs, Colo. **Contact:**

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Plan to attend . . . this month . . . a major AFA National Symposium, being conducted in conjunction with the Strategic Air Command.

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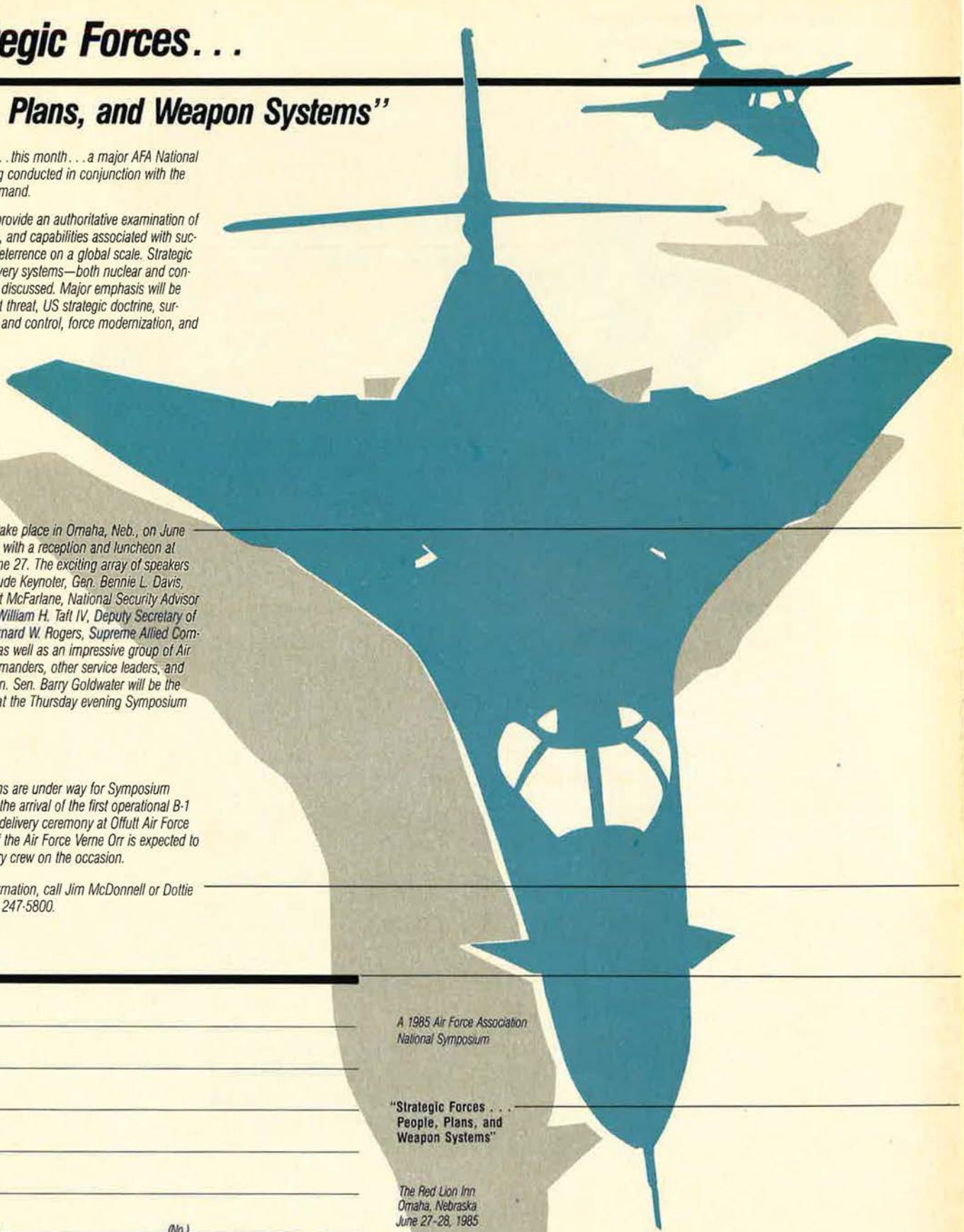

This event will take place in Omaha, Neb., on June 27-28, beginning with a reception and luncheon at 11:30 a.m. on June 27. The exciting array of speakers is planned to include Keynoter, Gen. Bennie L. Davis, CINC SAC; Robert McFarlane, National Security Advisor to the President; William H. Taft IV, Deputy Secretary of Defense; Gen. Bernard W. Rogers, Supreme Allied Commander, Europe; as well as an impressive group of Air Force Major Commanders, other service leaders, and an SDI spokesman. Sen. Barry Goldwater will be the featured speaker at the Thursday evening Symposium Dinner.

Preliminary plans are under way for Symposium attendees to view the arrival of the first operational B-1 and to attend the delivery ceremony at Offutt Air Force Base. Secretary of the Air Force Verne Orr is expected to be with the delivery crew on the occasion.

For further information, call Jim McDonnell or Dottie Flanagan at (703) 247-5800.

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Enclosed is check in the amount of $175, payable to Air Force Association, to cover the Symposium fee for an AFA individual member or Industrial Associate member. (Note: The fee for a nonmember of AFA is $200.)

Each registrant receives one ticket to the reception/dinner. One extra guest ticket may be purchased for $50.

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Dinner Speaker: Sen. Barry Goldwater

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For exhibit information, call Charles E. Cruze at (703) 247-5851.

Thomas M. Tilley, 1638 Collins Rd., Colorado Springs, Colo. 80918. Phone: (303) 598-5322.

59th Air Police Squadron
Members of the 59th Air Police Squadron stationed (1951–55) at RAF Burtonwood, England, will hold their reunion on August 8–10, 1985, in Denver, Colo. **Contact:** R. M. "Mick" Shropshire, 5725½ Teller St., Arvada, Colo. 80002. Herb Swanson, 655 Marlou Pkwy., Des Moines, Iowa 50315.

61st Troop Carrier Squadron
The 61st Troop Carrier Squadron, 314th Troop Carrier Group, will hold its reunion on August 29–September 2, 1985. **Contact:** Lew Johnston, 2665 Chestnut St., San Francisco, Calif. 94123.

62d Troop Carrier Group
The 62d Troop Carrier Group will hold its second annual reunion on September 26–28, 1985, at the Quality Inn in Cincinnati, Ohio. **Contact:** Virgil Preston, 1507 Aster Pl., Cincinnati, Ohio 45224.

64th Troop Carrier Group
Members of the 64th Troop Carrier Group will hold their reunion on September 26–28, 1985, at the Americana Hotel in Fort Worth, Tex. **Contact:** James L. Kent, 1812 Dakar Rd. East, Fort Worth, Tex. 76116. Phone: (817) 732-0890.

F-86 Sabre Pilots Ass'n
The F-86 Sabre Pilots Association will hold a reunion on July 26–28, 1985, in Dayton, Ohio. **Contact:** Richard B. Keener, 1821 S. Washington St., #318-A, Naperville, Ill. 60565. Phone: (312) 983-5533.

Coming Events

June 14–16, **Georgia State Convention,** Savannah . . . June 14–16, **Michigan State Convention,** Selfridge ANGB . . . June 15, **Illinois State Convention,** Chanute AFB . . . June 21–22, **Ohio State Convention,** Cleveland . . . June 28–29, **New Jersey State Convention,** Cape May . . . July 12–13, **Colorado State Convention,** Air Force Academy . . . July 12–13, **Pennsylvania State Convention,** Pittsburgh . . . July 19–21, **Texas State Convention,** Austin . . . July 26–28, **Florida State Convention,** Orlando . . . August 2–4, **New York State Convention,** Niagara Falls . . . August 2–3, **Utah State Convention,** Park City . . . August 2–4, **Washington State Convention,** Bellevue . . . August 9–10, **Arkansas State Convention,** Blytheville AFB . . . August 22–24, **California State Convention,** San Diego . . . August 23–24, **North Dakota State Convention,** Minot . . . September 6–7, **Arizona State Convention,** Sedona . . . September 15–19, **AFA National Convention and Aerospace Development Briefings and Displays,** Washington, D. C.

INTERCOM

91st Troop Carrier Squadron
The 91st Troop Carrier Squadron, 439th Troop Carrier Group, is planning to hold a reunion in Dayton, Ohio, in September 1985. **Contact:** Milton Dank, 1022 Serpentine Lane, Wyncote, Pa. 19095.

312th Bomb Group
The 312th Bomb Group, "The Roarin' '20s," will hold its reunion on August 3–5, 1985, at the Niagara Hilton in Niagara Falls, N. Y. **Contact:** Dr. Russell L. Sturzebecker, West Chester University, West Chester, Pa. 19380.

325th Fighter Group
The 325th Fighter Group "Checkertail Clan" will hold its reunion on September 12–15, 1985, in St. Joseph, Mo. **Contact:** Dan Penrod, 69 Keswick Ave., Pittsburgh, Pa. 15202. Phone: (412) 766-6190. George W. Liston, 13655 N. E. 10th Ave., North Miami, Fla. 33161. Phone: (305) 891-6917.

330th Bomb Group
Members of the 330th Bomb Group will hold their reunion on September 5–8, 1985, in Dayton, Ohio. **Contact:** Robert M. Woliver, 8704 Point West Dr., Austin, Tex. 78759.

336th Air Service Squadron
The 336th Air Service Squadron, Fifth Air Force, is planning to hold a reunion on October 11–13, 1985, in Winter Haven, Fla. **Contact:** Giles A. Lakeman, 3993 Simpson Ave., Cincinnati, Ohio 45227. Phone: (513) 271-8191.

339th Fighter Group Ass'n
The 339th Fighter Group Association will hold its reunion on September 12–15, 1985, in Norfolk, Va. A unit rendezvous with the 8th Air Force Historical Society is also planned for October 17–20, 1985, in Wichita, Kan. **Contact:** Chet Malarz, 2405 Kings Point Dr., Atlanta, Ga. 30338.

341st Fighter Squadron
The 341st Fighter Squadron, Fifth Air Force, will hold its reunion on September 26–29, 1985, at the Catamaran Hotel in San Diego, Calif. **Contact:** John McAllister, 1437 Coble Ave., Hacienda Heights, Calif. 91745. Phone: (818) 968-2535.

367th Fighter Group
Members of the 367th Fighter Group, which includes the 392d, 393d, and 394th Fighter Squadrons, will hold their reunion on July 25–28, 1985, in Chicago, Ill. **Contact:** Jack T. Curtis, 437 Cedar Dr., Beaver Shores, Rogers, Ark. 72756.

380th Bomb Group Ass'n
The 380th Bomb Group "Flying Circus" reunion will be held on September 11–15, 1985, in Omaha, Neb. **Contact:** Forrest "Tommy" Thompson, 2401 Lakeview Dr., Heber Springs, Ark. 72543.

INTERCOM

385th Bomb Group
Members of the 385th Bomb Group will hold their reunion on September 11–14, 1985, at the Hyatt Hotel at Los Angeles International Airport, Los Angeles, Calif. **Contact:** Allan B. Chealander, 10491 Barbara Anne St., Cypress, Calif. 90630. Phone: (714) 761-1682. Forrest V. Poore, 23253 Westwood St., Grand Terrace, Calif. 92324. Phone: (714) 825-2465.

446th Bomb Group
The 446th Bomb Group is planning to hold a reunion on September 5–8, 1985, at the Great Gorge Hotel in McAfee, N. J. **Contact:** William F. Davenport, 13762 Loretta Dr., Santa Ana, Calif. 92705.

451st Bomb Squadron Ass'n
The 451st Bomb Squadron Association will hold its reunion on September 27–29, 1985, in Detroit, Mich. **Contact:** James J. Crumbliss, 2014 Shady Grove Dr., Bossier City, La. 71112. Phone: (318) 742-1225.

455th Bomb Squadron
Members of the 455th Bomb Squadron "Whitetail Marauders" will hold their reunion on September 25–28, 1985, in Rockport, Me. **Contact:** Ben Goldsmith, P. O. Box 162, Camden, Me. 04843.

457th Bomb Group Ass'n
Members of the 457th Bomb Group and attached units stationed in Glatton, England, will hold their reunion on September 19–22, 1985, in Rapid City, S. D. **Contact:** Homer Briggs, 811 N. W. "B" St., Bentonville, Ark. 72712. Phone: (501) 273-3908.

483d Bomb Group Ass'n
Members of the 483d Bomb Group will hold their reunion on September 4–8, 1985, at the Marriott Hotel in Albuquerque, N. M. **Contact:** M. L. "Bob" Hottman, R4 1414 Sherri Lane, Fort Dodge, Iowa 50501. Phone: (515) 955-3428.

496th Fighter Interceptor Squadron
Members of the 496th Fighter Interceptor Squadron will hold their reunion on August 14–16, 1985, on a San Juan island cruise. **Contact:** Maj. Jan W. Barmore, USAF (Ret.), 4208 Arbordale W., Tacoma, Wash. 98466. Phone: (206) 564-9040.

504th Bomb Group
Veterans of the 504th Bomb Group will hold their first reunion in September 1985 in Minneapolis, Minn. **Contact:** Arthur C. Tomes, 2409 Oakwood Dr., Burnsville, Minn. 55337. Phone: (612) 435-5406.

507th Fighter Group
The 507th Fighter Group, including the 463d, 464th, and 465th Fighter Squadrons, will hold a reunion on August 30–September 2, 1985, at the Choo-Choo Hilton in Chattanooga, Tenn. **Contact:** J. T. Layne, P. O. Box L, Copperhill, Tenn. 37317. Phone: (615) 496-7247.

585th Bomb Squadron
Members of the 585th Bomb Squadron will hold their reunion on September 20–21, 1985, in Denver, Colo. **Contact:** Tom O'Brien, 1907 Rio Vista Dr., Fort Pierce, Fla. 33449. Phone: (305) 465-7974.

780th Bomb Squadron
The 780th Bomb Squadron will hold its reunion on September 12–14, 1985, in Seattle, Wash. **Contact:** George Kuckenbecker, 802 N. W. 193d, Seattle, Wash. 98177.

Cannon AFB
A reunion is in the planning stages for all former members of the 271st Tactical Fighter Wing, the 474th Tactical Fighter Wing, the 832d Air Division, and all tenant units that were stationed at Cannon AFB, N. M.

For additional information, please contact the address below.

Cannon Reunion
12609 Viewcrest N. E.
Albuquerque, N. M. 87112
Phone: (505) 266-6621 (evenings)

Mesa del Rey
I would like to hear from cadets who were stationed at Mesa del Rey, King City, Calif., from 1941 to 1945. We are planning a reunion to be held in 1986.

Please contact the address below.

Jack A. Hays
King City Reunion Group
226 Rio Vista Dr.
King City, Calif. 93930

Class 44-C
I would like to hear from members of Class 44-C who would be interested in planning a reunion or forming the Aviation Cadet Class 44-C Association. I have put in the first $5.

Please contact the address below.

Lt. Col. Robert K. Early, USAF (Ret.)
12005 E. Alaska Ave.
Aurora, Colo. 80012

Class 50-F
I would like to hear from members of Aviation Cadet Class 50-F (Perrin and Reese AFBs, Tex.) regarding any reunion plans that might be in the works.

Please contact the address below.

Maj. Brian Power-Waters XIII, USAF (Ret.)
Rte. 1, Box 53E
Church Hill, Md. 21623-9754
Phone: (301) 758-2622

Class 67-C
I am trying to locate members of undergraduate pilot training (UPT) Class 67-C for the purpose of holding a reunion.

Please contact the address below.

Lt. Col. Tom McCay, USAF
Hq. USAF/SAX
Washington, D. C. 20330-5420
Phone: (202) 697-6518

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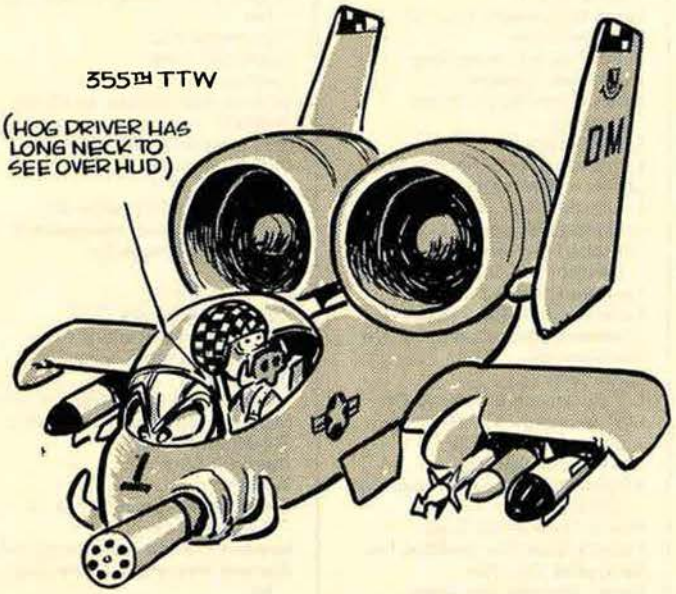
Xerox Corp.

Bob Stevens'

"There I was..."

A-10 PILOTS-HOG DRIVERS-AS THEY SEE THEMSELVES.

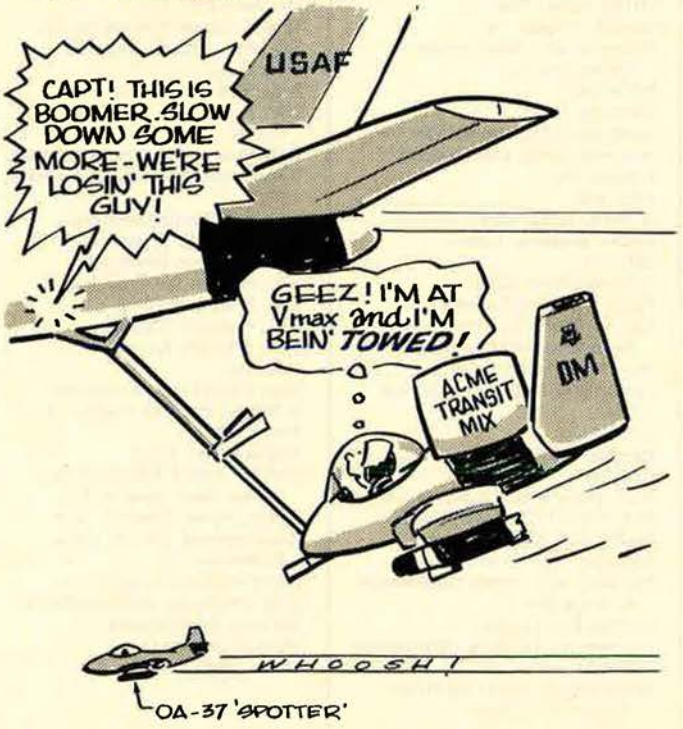


COURTESY HANK CARUSO
GLEN BURNIE, MD.

...AT SUNNY DAVIS-MONTHAN AFB, AZ. "D-M" HAS 28 UNITS REPRESENTING 6 MAJOR COMMANDS! THE 836TH AIR DIVISION HEADS UP THE WHOLE WORKS, WHICH INCLUDES A-10's, OA-37's, EC-130H's AND VARIOUS SUPPORT UNITS. OF ALL THESE SYSTEMS, THE A-10 IS PROBABLY THE ONE THAT COULD BEST BE DESCRIBED AS... AH... ..WELL, *DIFFERENT!*

FLYING THE "THUNDERBOLT II" IS LIKE BEING IN A TIME WARP BACK TO WW II-

HOW SLOW IS THE WART HOG? IT'S **SO** SLOW THAT...



SPEAKING OF REFUELING, FAMILY ORIENTATION RIDES ARE STILL GIVEN IN THE A.F. ONE A-10 PILOT WAS HOOKED UP TO A KC-135 THAT CONTAINED-AMONG OTHERS - HIS WIFE.

Tough!

ONE TOUGH JOB The U.S. Air Force has a tough job: Global C³ for tactical aviation demands a powerful, flexible, survivable system to support an extreme range of operational requirements... tough requirements... for a tough force.

ONE TOUGH SYSTEM Litton Data Systems' AN/TYQ-23 Modular Control Equipment (MCE) is ready for operational test. MCE supports defensive counterair operations (such as CRC and FACP) or offensive counterair operations like the Ground Attack Control Center (GACC) *with just a change of software.* Transportable, modularized, with automated system maintenance and training — the MCE system is ready NOW. To meet tough requirements.

ONE TOUGH COMPANY Litton Data Systems turns tough requirements into tough systems. Reliably. Resourcefully. And with uncompromising dedication. We can help you do a tough job. Call us. Marketing Director, Litton Data Systems, 8000 Woodley Avenue, Van Nuys, CA 91409. (818) 902-4401.

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THE F-15: KEY PLAYER ON THE USAF TEAM.

THE MISSION: AIR SUPERIORITY. SWEEP HOSTILE AIRCRAFT FROM A DESIGNATED AREA. Air superiority is a crucial Air Force mission. Because who controls the skies often controls the outcome of a conflict.

To keep America's defenses strong, the Air Force must be able to maintain air superiority against any adversary. It must be better than any challenge posed in the air, anywhere in the world.

That's why the Air Force relies on the F-15 Eagle, the plane that's earned its reputation as the world's foremost air superiority fighter. The Eagle has the speed and range to reach any destination in the world fast, with a payload to accomplish the mission.

In air-to-air combat, the Eagle's score is 58-0. It has never lost in combat, and has the lowest peacetime loss rate of any U.S. fighter. The Eagle can find and identify enemy aircraft before the enemy knows it is close. Eagle pilots can see targets more quickly and use their weapons with greater accuracy because all attack information is on the head-up display. The F-15 Eagle is the only plane that is fully equipped to meet or beat any threat in the sky–now and through the 1990s.

For a strong defense, America counts on the Air Force. And the Air Force counts on the F-15 Eagle.

SWEEP.

MCDONNELL DOUGLAS