JULY 1988/$2

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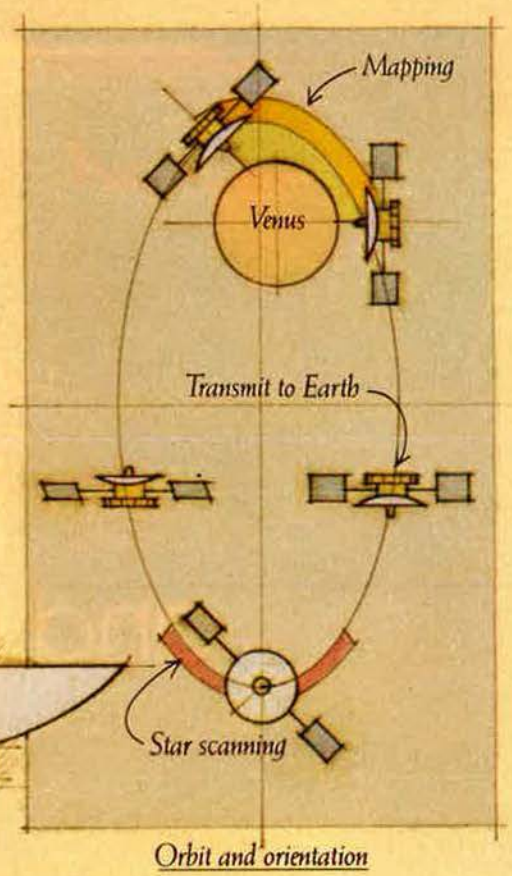
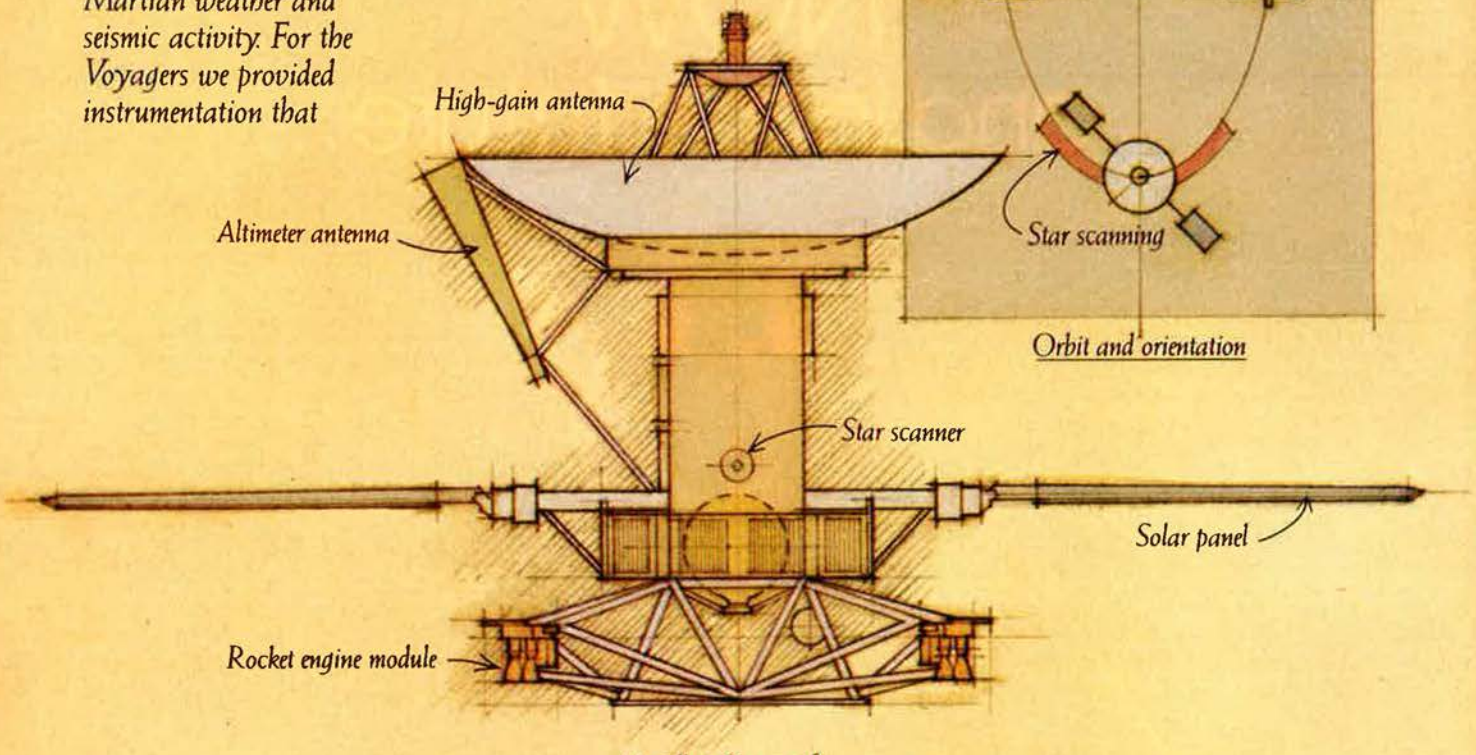


Orbit and orientation



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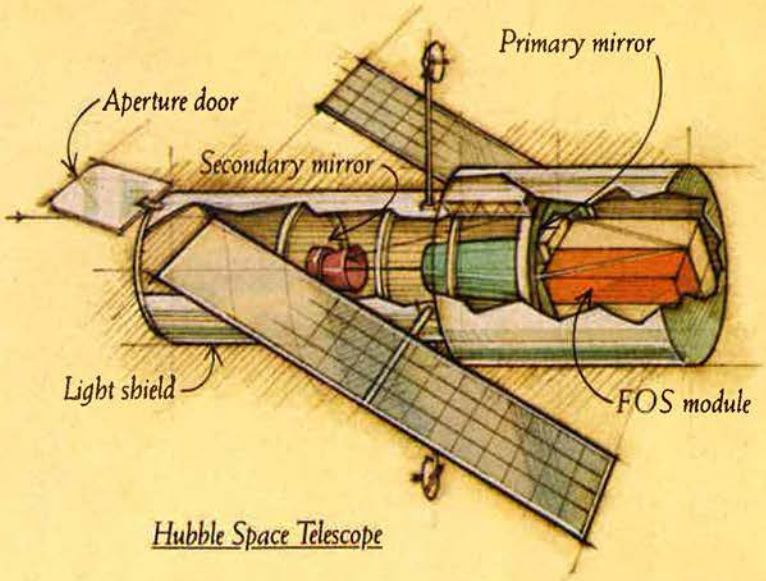

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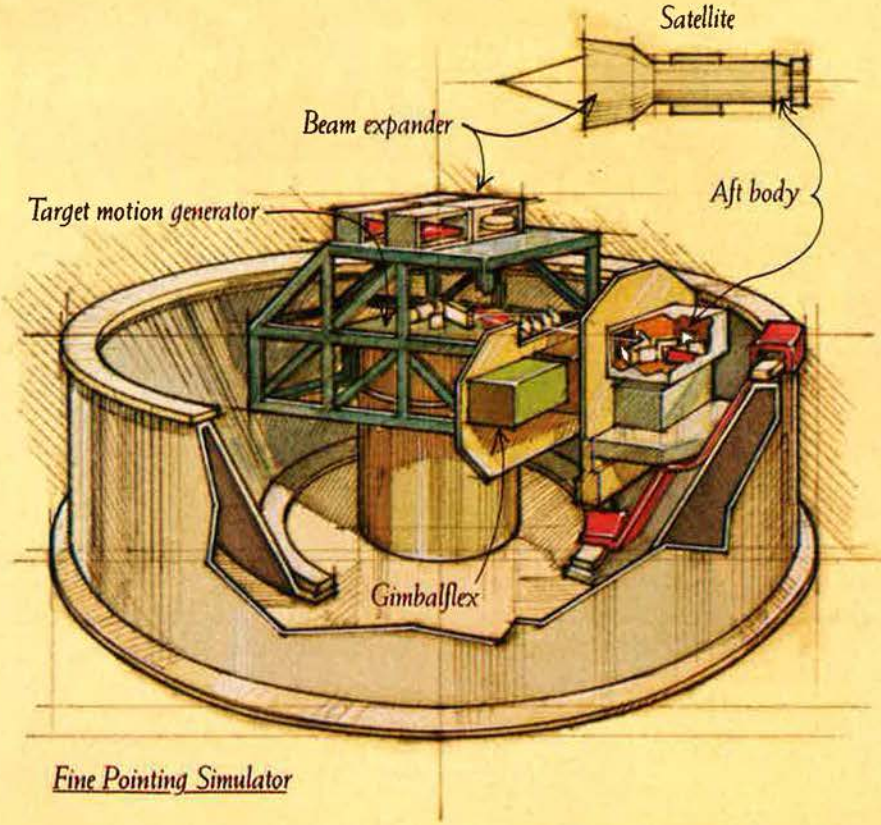

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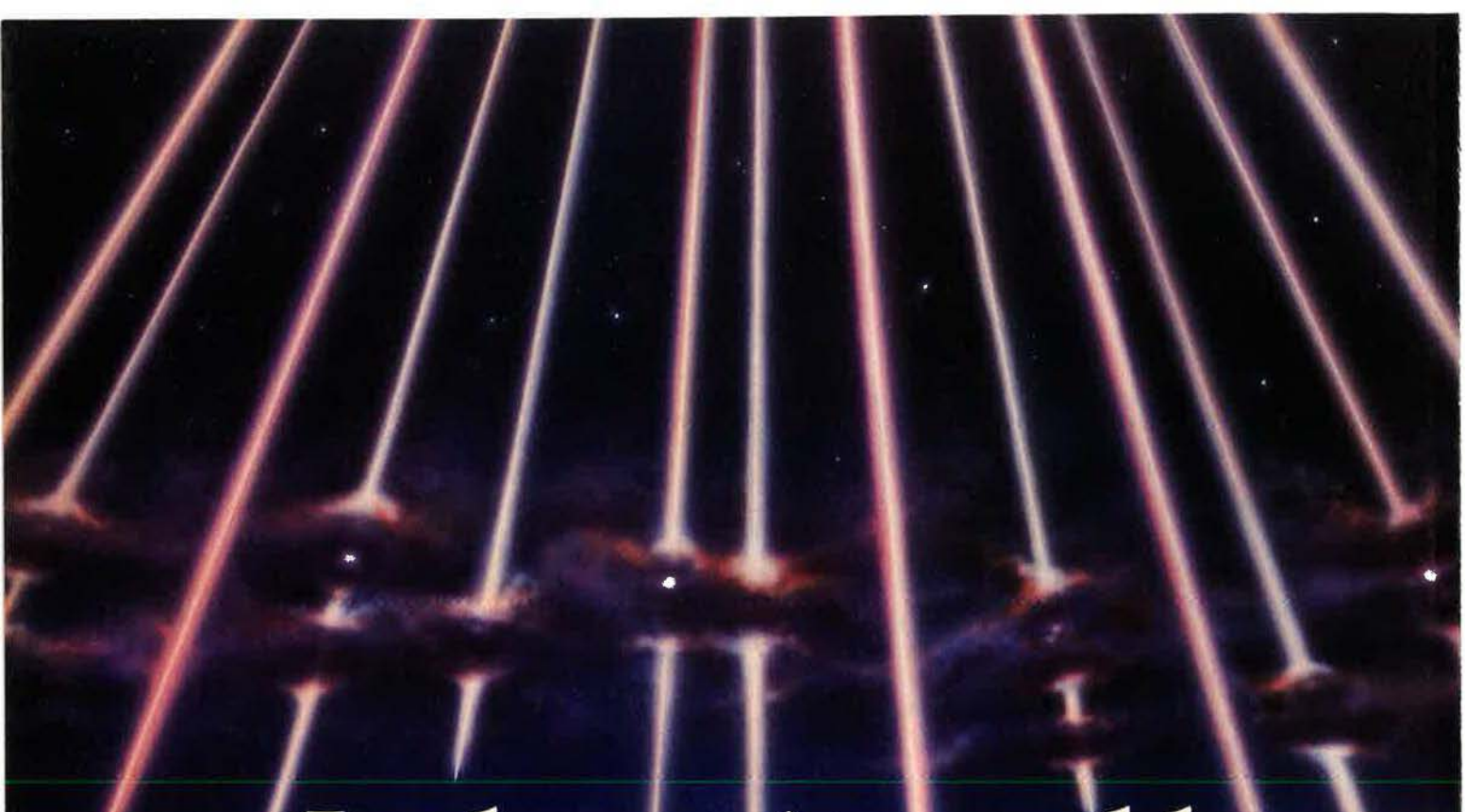

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JULY 1988
VOLUME 71, NUMBER 7

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Page 64

Page 82

About the cover: In this Paul Kennedy photo taken at Andrews AFB, Md., members of the 963d AWCS from Tinker AFB, Okla., preflight one of their E-3s. A special section on "Electronics and Technology" begins on p. 48.

Special Section: Electronics and Technology

Features

Departments

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An Editorial

Military Drugbusters

By John T. Correll, EDITOR IN CHIEF

ON PATROL off the southern coast of Florida, an E-3 AWACS may be tracking 300 or more aircraft with its radar. Some of these are almost surely drug smugglers. Most of the cocaine entering the United States comes in through Florida, and about one-third of it is carried aboard light aircraft.

The aircrews know the typical flight profile of drug runners. This is of marginal benefit only. Sometimes, US authorities get a tip that helps them spot a smuggler amid the other air traffic, but that is unusual.

The odds are with the druggies. Last year, AWACS flew 591 hours of surveillance—at a cost of $2.6 million—against drug traffic for a net result of ten arrests and six seizures of illegal substances. It is improbable that any given surveillance intercept will be followed by successful identification, pursuit, and capture by Customs agents or other lawmen.

The druggies regard the risks as acceptable. Most of their shipments will get through, with profits ample to cover the losses. Only about twenty percent of those arrested for importing or distributing drugs are convicted in the courts, and of those found guilty, only twenty-nine percent spend more than five years in jail.

It is impossible to quantify the social and economic damage being done to the United States by the rampant sale and use of drugs. The public is alarmed, so in this election year, the politicians are scrambling to take action that will be visible to the voters. Thus, Congress has decided to draft the armed forces for the war on drugs.

At this writing, it is not clear what Congress expects the military to do. Thoughtful legislators know that calls to "seal the borders" amount to asking the impossible. Each year, more than 200,000,000 people cross our land borders. In addition, 330,000 vessels bring 4,000,000 passengers into US ports. Some 30,000,000 people land at US airports aboard 421,000 commercial aircraft.

Effective screening of that traffic would strain a police state. For a nation that bends over backward to ensure individual liberties, it is probably impossible. The druggies are very good at concealing their contraband.

For 200 years, the law of posse comitatus has wisely forbidden US armed forces to engage in civil search, seizure, or arrest. The law was modified recently to allow the military to "assist" civil authorities with surveillance and lending of equipment, but the basic provisions still stand. The Coast Guard, under control of the Transportation Department in peacetime, can take a more direct role, but it has had to scale back its operations since Congress and the Administration agreed six months ago to cut the budget.

The next step might be to loosen posse comitatus further so that military sniffer dogs and their handlers can work the borders and points of entry. They cannot do this now because of legal restrictions on civil search by the armed forces.

Military drugbusting is not a good idea for three reasons.

First, the military is not well suited for this mission. Armed forces are organized and equipped to fight wars, and warfare is an exercise in maximum force. Law enforcement, on the other hand, requires restraint, conceding suspects the benefit of doubt, and the use of minimum force. The military is not and should not be trained to operate that way.

Second, military drugbusting diverts resources from primary mission functions that have been weakened too much already. After last winter's budget cuts, the services are finding it difficult to maintain combat readiness, and they have no assets to spare. Congress currently does not plan to provide any additional money for the drug mission.

The assumption seems to be that it can be handled as "incidental to normal training." The military has gone about as far as it can in this regard. E-3 crews, for example, need training for surveillance and intercept of multiple fast-moving targets with the objective of vectoring fighters against them. They do not get the right kind of exercise by watching light, slow-moving aircraft on their scopes.

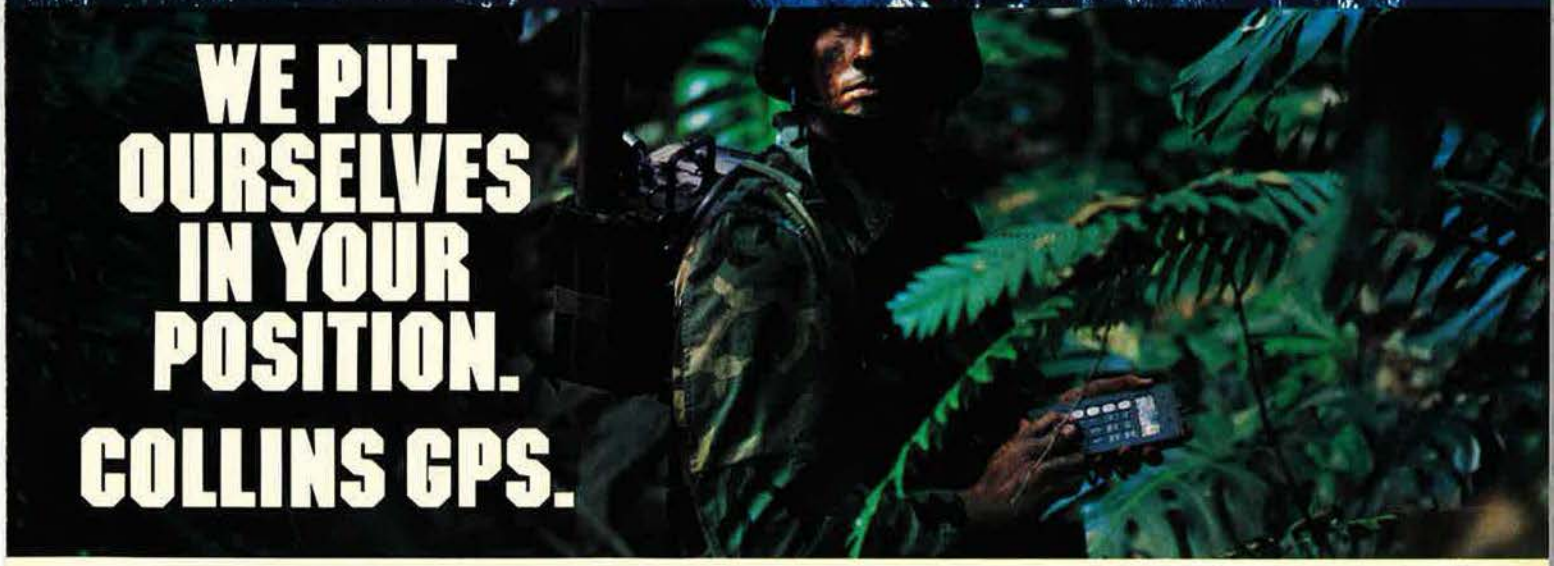
Third, the political and social implications are all wrong. Americans would soon realize that it is alien to their values to have the armed forces chasing down and arresting civilians. Should real military power ever be exerted, the uproar would be deafening.

Impressive efforts to eradicate illegal substances and halt the traffic in them have not led to much. In 1987, the United States—in cooperation with twenty-three other nations—destroyed 283 metric tons of opium, 5,046 metric tons of coca leaf, and 17,585 tons of cannabis. In 1986, US authorities seized $479,200,000 in assets from the druggies. The bad guys barely felt the blow. The supply of drugs was unabated, and the street price of cocaine even fell a bit.

The fundamental problem is the booming market for drugs. According to survey data, thirty-seven percent of adult Americans have used illegal drugs at one time or another. Twelve percent had used drugs within a month of the survey. Ten percent of the US population is believed to be impaired to some degree by illegal drug use. The drug traffic will continue so long as this demand persists.

Voices as diverse as the Washington *Post*, the *Wall Street Journal*, and former Secretary of Defense Caspar W. Weinberger have warned that this is no job for the military. Congress and citizens expressing their views in opinion polls think otherwise. So does columnist James J. Kilpatrick, who blusters that "our soldiers, sailors, and airmen are being paid to protect the national security. Let them earn their pay."

Turning the armed forces loose on the druggies may sound, in the abstract, like a good idea to people with a limited understanding of how military power is applied. They may even get satisfaction from fantasies in which drug runners go down under the avenging fire of an F-15. They would find the reality a different thing altogether. ■



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Airmail

Air Force Almanac

I was impressed with the article about Air Force Communications Command that led off the "Reports From the Major Commands" section of your May 1988 Air Force Almanac issue.

As a proud communicator, I prefer to think that AFCC was chosen to lead not strictly because of alphabetical reasons but because of the overall performance of AFCC. My squadron's motto, "Number One With Pride," sums it up for 49,000 AFCC members worldwide.

Incidentally, one of our newest, Maj. Gen. James S. Cassity, Jr., returned to AFCC to accept the "Reins of Command" from Maj. Gen. John T. Stihl during change of command ceremonies on March 29, 1988.

Capt. William A. Malec, USAF
Lowry AFB, Colo.

• *Captain Malec and other readers will be interested in the special report on AFCC by General Cassity on page 64 of this issue.*—THE EDITORS

In your May 1988 issue, the "Guide to USAF's Major Installations" incorrectly stated on page 196 that the citizens of Grand Forks, N. D., bought the property for Grand Forks AFB and donated it to the Air Force. The city leaders did offer to donate to the government the land at a cheaper site in the county in the Levant Township area. This site was the first choice of the Air Force, but after additional surveys of the land were made, the site was discarded.

The present-day site in Mekinock Township was then seriously considered and eventually chosen. This site was much more expensive, and the city modified its offer by donating only $65,000 toward the purchase of the land. The final cost of the land was more than half a million dollars.

Rich Nolan
Grand Forks AFB, N. D.

The Air Force Almanac in the May 1988 issue is, as usual, informative, timely, and a boon to us "infomaniacs." But I did note the need for at least one small correction, however.

In your catalog of Air Force bases, you mention the 3902d Air Base Wing at Offutt AFB, Neb. For shame! The "Fightin' Fifty-fifth" has been the host wing for more than a year now. The 3902d was deactivated in March 1987.

A minor glitch, perhaps, but one that we in the 55th Strategic Reconnaissance Wing feel needs correction. We're proud of our role, not only in providing worldwide reconnaissance but also in providing the necessary support for that vital mission.

Keep up the good work!

Capt. Darrell D. Hayes, USAF
Bellevue, Neb.

I am writing to commend you on the excellent May 1988 Air Force Almanac issue. It is a very informative publication and one that everyone should read.

I thought that the 36th Tactical Fighter Wing at Bitburg AB, Germany, possessed F-15C/D models. In the Seventeenth Air Force chart that accompanies the major command report on USAFE in the last two Air Force Almanacs, you list the 36th TFW as being equipped with F-15A/B models.

I am curious about the discrepancy. Perhaps I am wrong.

Keep up the good work!

James H. Loque
San Antonio, Tex.

On page 169 of the May 1988 Air Force Almanac, you have a listing of the Air National Guard OA-37 Dragonfly units. In that list, you mistakenly show the 110th Tactical Air Support Group's location as Kellogg, Mich.

While the name Kellogg has had a long and honorable association with the city of Battle Creek, I feel it's only fair to give credit where credit is due.

Thank you for your excellent publication. If you would make the correction from Kellogg to Battle Creek, then I'm sure the citizens of Battle Creek will rest assured that their ANG unit has not been relocated to a fictitious town in Michigan.

Lt. Col. John L. Bradley III,
MichANG
Battle Creek, Mich.

Did I miss something? When was Kadena AB moved from Okinawa to Japan?

I am referring to items in the May 1988 Air Force Almanac issue—specifically, to the organizational charts for MAC's Twenty-second Air Force on page 124 and SAC's Fifteenth Air Force on page 139 and to the TAC chart on page 142.

Please explain.

Lt. Col. Don W. Disbrow,
USAF (Ret.)
Vacaville, Calif.

Once again, your Air Force Almanac issue is superb. It continues to be the best source of information about the United States Air Force.

There is, however, one point that I would like to clarify. The F-15 Eagle featured in the photo on page 143 belongs to the 71st Tactical Fighter *Squadron,* which is assigned to the 1st Tactical Fighter Wing at Langley AFB, Va. It is not the 71st Tactical Fighter Wing, as you mistakenly state in the accompanying caption.

Keep up your outstanding coverage.

Col. H. E. Robertson, USAF
Langley AFB, Va.

• *Mr. Nolan's version of how the Air Force came to acquire the land for Grand Forks AFB, N. D., is correct.*

The 55th Strategic Reconnaissance Wing is indeed the host unit for Offutt AFB, Neb., as Captain Hayes points out.

The 36th Tactical Fighter Wing at

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

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Charles E. Cruze, Richard M. Skinner

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John T. Correll

Senior Editors
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Charles E. Cruze
1501 Lee Highway
Arlington, Va. 22209-1198
Tel: 703/247-5800
Telex: 44-0487 COURTESY
Telefax: 703/247-5855

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David Harrison
Overseas Publicity Ltd.
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Airmail

Bitburg AB, Germany, is equipped with F-15C/D models, not A and B models. Mr. Loque is correct in his guess that we have misreported this in the past two Air Force Almanacs.

The location of the 110th Tactical Air Support Group is Battle Creek, Mich. Colonel Bradley is right in pointing out that there is no city of Kellogg in Michigan.

Okinawa reverted to Japanese sovereignty in 1972. Thus, it is not a case of Kadena AB moving from Okinawa to Japan, but of Japan "moving" to Okinawa and Kadena AB.

Lastly, Colonel Robertson is correct in noting that we should have said 71st Tactical Fighter Squadron instead of 71st Tactical Fighter Wing. The 71st TFS is part of the 1st Tactical Fighter Wing at Langley AFB, Va.

We'll keep trying!—THE EDITORS

Revolt of the Admirals

I must take issue with several of the statements and implications made or drawn by Herman S. Wolk in the article "Revolt of the Admirals" in the May 1988 issue.

First, the Navy did not begin to build its carrier fleet "following Brig. Gen. William (Billy) Mitchell's destruction of warships off the Virginia capes in 1922." The carrier program, in fact, dates from the close of World War I, when proposals for the conversion of a fleet auxiliary to a carrier were first made. They led to the conversion of the collier *Jupiter* to the carrier *Langley* (CV-1), which entered the fleet in 1921.

The interest in carriers was provoked not by the desire to introduce naval aviation into support of land campaigns but to counter the then superiority of the British Royal Navy in naval aviation, carriers in particular. Although it is a little-known fact, the principal potential adversary in the opinion of most of the top US naval leadership up to about 1930 was Britain, not Japan.

While it is true that the US carrier force developed tactics in the 1930s for assaulting land targets, these were always maritime objectives (the targets "assaulted" in fleet exercises were Pearl Harbor and the Panama Canal locks).

Second, the war in the 1950s did not resemble in the least what had been envisaged by the Air Force staff—or by the Navy staff either, for that matter. The carriers proved their worth in the Korean conflict, which led directly to the construction of the *Forrestal* class. In this respect, it is probably well that the *United States* (the carrier alluded to in the article) was canceled since the *Forrestals* were vastly superior ships (flush deck was a bad design).

As a footnote, it is worth remarking that the principal naval aviation protagonist in the 1920s and early 1930s was Rear Adm. William A. Moffett, a former battleship captain. Despite stiff opposition from the "gun club" on occasion, Moffett was able to steer the Navy on an aviation course that bore fruit during World War II. His tools were tact, an ability to find outstanding subordinates, vision, and old-fashioned leadership.

Robert C. Whitten
Moffett Field, Calif.

The AFA Mission

I would like to respond to the May 1988 editorial, "What You Can Do," by then AFA Executive Director John O. Gray.

Our small AFA chapter hidden away in the Laurel Highlands of Pennsylvania, far from any Air Force installation, cosponsors "Aviation Awareness Days" at the local airport with the local Experimental Aircraft Association chapter. We attempt to bring to the people of our area some aircraft for static display that are not often seen by the public here. Our biggest problem is luring military aircraft to this event.

We do have runway length restrictions, but there are plenty of Air Force aircraft that can land here. Last year, we had many civil aircraft, experimental aircraft, homebuilts, etc., but we were able to attract only one C-130H from a Reserve unit and one A-10 from a Massachusetts Air Guard unit, and it had to return to its base only a few hours after arriving here the first day of the show. We also had two Marine Corps and three Army National Guard helicopters.

We managed to have a flyover by a C-141B, but only on the first day of our event. The people were interested in the civil aircraft, but after seeing the endless line at the C-130H and the excitement on the faces of the spectators during the C-141B flyover, I know what the citizens are really interested in—the "heavy metal."

We will try it again on the first weekend in June, but so far, all we have on our schedule is the C-130H again, possibly a T-37, and three Army National Guard helicopters. We use all the proper DoD and FAA forms and go through all the correct channels, make hundreds of phone calls and write an endless number of letters, and promise to pay all flight crew ex-

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penses (food, lodging, etc.). But I guess we don't know what the magic word is, if there is one, that will attract the support we need to accomplish the AFA mission—to educate the members and the public at large about advanced aerospace technology.

Robert C. Rutledge
Laurel Highlands Chapter
Johnstown, Pa.

Fifth Service?

Re: The "Washington Watch" column by Senior Editor Robert S. Dudney in the May 1988 issue entitled "Toward a Fifth Armed Service?"

While the article's view of special operations may have been accurate, that title was certainly in error.

There are already five armed services and have been for more than four decades since the junior service, the United States Air Force, joined the ranks of the (then) other four armed services—the Army, Navy, Marine Corps, and Coast Guard.

Rear Adm. Bennett S. Sparks, USCGR
Hollywood, Calif.

A Prime Beef

Your article "Eagles 17, Bean Counters 4" in the April 1988 issue was a fine account of the Coronet Warrior exercise conducted at Langley AFB, Va., by the 94th Tactical Fighter Squadron.

I take one exception to the article, and that is that the 1st Civil Engineering Squadron's Prime BEEF personnel deserved more credit than was given in the article. I am not cutting down all of those maintenance individuals who participated in the exercise. But they were not out there when the tents were being set up, the electrical wire was being laid, or the generators were being hooked up so that they could have air conditioners in their trailers during the exercise.

Without all of the support given by the civil engineering squadrons, the exercise would not have been such a great success, in my opinion. I was the project officer for that exercise from the civil engineering/Prime BEEF office. Sure, the other squadrons supported the exercise, but without civil engineering, the exercise would not have gotten off the ground.

Next time you are out getting facts about a certain exercise, ask who set up the exercise. I mean, who actually did the manual work, who did all the sweating out in the sun and humidity? Don't be surprised when they tell you that civil engineering did all of this.

All I am asking is that some credit be given to the 1st Civil Engineering Squadron's Prime BEEF personnel for a job well done. Civil engineering makes it happen.

Sgt. James E. Dutcher, USAF
Moody AFB, Ga.

No Show-Stopper

John T. Cody, in his letter "The Trouble With Mobiles" in "Airmail" in the April 1988 issue, argued that antinuclear protesters would so interfere with the operations of US mobile ICBMs as to make them infeasible. *(See also Mr. Schneider's article "The Case for Mobile ICBMs" in the February '88 issue of this magazine.)* I believe Mr. Cody greatly overestimates the public interface problem that might be faced by the Peacekeeper rail-garrison system or the mobile Small ICBM forces.

Antinuclear protesters will have very limited power to interfere with mobile US ICBMs. Militant activists are few in number. They can mobilize large groups of demonstrators only around specific events preceded by a lot of advance planning, usually only in warm weather and just for a short time. Such events are unsuccessful unless the media pays attention. Once the Peacekeeper trains or mobile Small ICBMs are deployed, US officials can expect a few disruptions at first, but opposition will be spotty and eventually will fade away as interest wanes and as the public grows accustomed to the new missiles.

Try to imagine the problems facing antinuclear protesters in stopping the dispersion of Peacekeeper trains or Midgetman ICBMs from their bases.

First, militants would need enough people to surround seven to eleven

Air Force Association Balance Sheet

	December 31, 1987			December 31, 1986		
Assets	**General Fund**	**Life Membership Fund**	**Total**	**General Fund**	**Life Membership Fund**	**Total**
Current Assets						
Cash plus marketable securities at lower of cost or market	$ 8,006,920	$6,272,721	$14,279,641	$ 7,619,010	$5,391,149	$13,010,159
Receivables, prepaid expenses, etc.	2,001,090	722,196	2,723,286	1,996,832	1,033,707	3,030,539
Fixed Assets (land, building, etc.)	7,017,156		7,017,156	7,030,406		7,030,406
Funds on Deposit and Other Assets	2,123,812		2,123,812	2,200,062		2,200,062
Total Assets	$19,148,978	$6,994,917	$26,143,895	$18,846,310	$6,424,856	$25,271,166
Liabilities and Fund Balances						
Current Liabilities (including payables, accrued expenses, etc.)	$ 3,204,446		$ 3,204,446	$ 2,967,975		$ 2,967,975
Deferred Revenue (including advance membership dues and magazine subscriptions)	1,300,153		1,300,153	1,863,128		1,863,128
Long-Term Debt	4,589,000		4,589,000	4,743,375		4,743,375
Fund Balance						
Unrestricted	7,790,802		7,790,802	7,118,780		7,118,780
Designated	2,264,577		2,264,577	2,153,052		2,153,052
Restricted		$6,994,917	6,994,917		$6,424,856	6,424,856
Total Liabilities and Fund Balances	$19,148,978	$6,994,917	$26,143,895	$18,846,310	$6,424,856	$25,271,166

SAC bases twenty-four hours a day, 365 days a year, for years at a time. Some bases like Malmstrom AFB occupy an area the size of the state of West Virginia. Activists would have to be willing to block the roads, fields, and rails leading out of bases not only in the warm summer days but also in the harsh subzero winter days typical of such places as North Dakota, Montana, or Wyoming. Yet, activists may never see a missile train or HML for days, months, or years—boring work with no media value or personal satisfaction.

Since Peacekeeper trains will be unmarked, activists would have trouble discerning a missile train from any other train going to or from a SAC base. Militants would also face harsh judicial penalties for interference during a crisis or training exercise.

Militants also may be deterred by the knowledge that US troops will clear the tracks quickly in a crisis, that blocking train tracks or other exit points is dangerous, and that the public is likely to side with the military during a crisis.

Finally, all but the most unreasonable critics should also be persuaded by the argument that dispersed ICBMs are better deterrents to war than is a more vulnerable force confined to bases. Greater public awareness of this should undercut opposition in time.

For all these reasons, the public interface problem associated with mobile ICBMs is no show-stopper and offers no valid reason for terminating the missile programs.

Barry R. Schneider
Reston, Va.

Air Force Association Comparative Statement of Revenues and Expenses

General Fund	Year Ended December 31 1987	1986
Revenues		
Membership	$ 3,162,881	$ 3,049,931
Patronship	262,861	254,913
Magazine	2,903,747	3,279,213
Industrial Associates Program	197,670	201,182
Data Processing Services	38,949	74,667
Insurance Programs—Administration	2,007,036	1,941,110
"Gathering of Eagles"		1,858,371
Annual Convention	394,503	368,052
Aerospace Development Briefings	1,084,846	916,899
Other Income and (Expenses)—Net	604,078	589,059
Total Revenues	10,656,571	12,533,397
Expenses		
Membership	3,589,506	3,818,471
Patronship	285,146	289,485
Magazine	2,591,720	2,903,679
Industrial Associates Program	109,532	169,876
Data Processing Services	210,295	320,318
Insurance Programs—Administration	2,849,156	3,101,410
"Gathering of Eagles"		1,792,200
Annual Convention	517,780	493,435
Aerospace Development Briefings	530,636	464,386
Total Expenses	10,683,771	13,353,260
Net (Loss) from Operations	(27,200)	(819,863)
Non-Operating Revenues and (Expenses)		
Investment Income	397,202	788,457
Insurance Programs—experience credits and interest on reserves	406,795	1,894,951
Total Nonoperating Revenues	803,997	2,683,408
Net Income—General Fund	$ 776,797	$ 1,863,545

Expenses include chapter commissions, state commissions, and other direct support for field units totaling $653,398 in 1987 and $666,464 in 1986.

Life Membership Fund		
Revenues from Investments	$ 448,447	$ 425,402
Less: Transfer to General Fund for annual dues and other costs	518,029	478,455
Net Income or (Loss)—Life Membership Fund	$ (69,582)	$ (53,053)

Treasurer's Note: The figures reflected herein have been extracted from audited financial statements submitted previously to the Board of Directors of the Air Force Association.

Remember the Rotorheads!

The reactivation of the 301st Air Refueling Wing scheduled for this year at Malmstrom AFB, Mont., does not in fact mark "the return of a flying mission to Malmstrom" as was erroneously reported in "Aerospace World" in the April 1988 issue. USAF helicopters have had a vital and active flying mission at Malmstrom for well over twenty years and will continue to have such a mission in the future.

First operated by SAC aircrews, the venerable U/TH-1F Hueys were turned over to Detachment 5 of MAC's 37th Aerospace Rescue and Recovery Squadron in 1974. These were finally cashed in last year for newer-model UH-1Ns. Helicopter operators and maintainers at Malmstrom have accounted for hundreds of life-saving rescues, have faithfully supported the 341st Strategic Missile Wing, and have compiled an outstanding safety record along the way.

Even so, during my three and a half years at Detachment 5, I was alarmed at how many Malmstrom people insisted that the base had no flying mission! It seemed we were better known in the civilian community, where our rescue work had a very favorable impact.

So please, set the record straight. The reactivation of the 301st AREFW will mark the return of a *fixed-wing* flying mission to Malmstrom.

Capt. William T. LeMenager, USAF
Sembach AB, Germany

• *Consider it straightened! We apologize for the oversight.*—THE EDITORS

453d FTS

The 453d Flying Training Squadron is collecting memorabilia illustrative of the history of electronic warfare (EW). Since Air Force electronic warfare begins at Mather AFB, Calif., with the training of electronic warfare officers, this is the perfect place to display our history.

We plan to show much of the history of EW through pictures, models, and actual hardware. A major portion of this collection will be the "black boxes" that have been used for EW by aircrews. The squadron is interested in any equipment associated with EW (faceplates, pods, radar warning receivers, chaff dispensers, equipment tech orders, etc.). Some specific examples of desired equipment are ALT-13, ALT-6B, APR-9, APR-25, ALR-18, APS-54, and ALT-15.

We are also looking for photographs of EW aircraft and other items, such as plaques and patches. The

453d FTS will appreciate any help in obtaining materials that will make for a dynamic display.

1st Lt. Bob Baker, USAF
453d FTS
Mather AFB, Calif. 95655
Phone: (916) 364-3265

47th TFS

We are in the process of assembling a comprehensive history of the 47th Tactical Fighter Squadron from its origin in 1940 to the present. The unit started as the 47th Pursuit Squadron and was stationed at Wheeler Field, Hawaii. For most of World War II, the unit was assigned to the defense of the Hawaiian Islands, later moving to Iwo Jima in 1945.

The unit has flown a large number of different types of aircraft and currently flies the A-10 as an AFRES squadron. We are looking for any pictures of aircraft, personnel, and facilities. Any official or unofficial documents would also be welcome.

All items will be copied and returned to the sender. Any help will be appreciated.

1st Lt. Mike Herculson, USAFR
47th TFS/DOT
Barksdale AFB, La. 71110-5000

Postwar Shemya

I am writing a history paper about the island of Shemya. I am interested in corresponding with anyone who can tell me anything about events on Shemya during the years 1945–58.

I am specifically interested in finding answers to the following questions:

How and when was Birchwood Hangar 6 destroyed?

What was the purpose of the three mine shafts in the north shore cliffs?

How and when did the barge (#18 of San Francisco) become beached in Alcan Bay?

What was the source of the mountain of Coke bottles on the north beach?

Capt. Stephen Morrisette, USAF
5246-F Broadway
Eielson AFB, Alaska 99702

Seymchan Airfield

I am writing on behalf of Silvio J. (Scotty) Sclocchini. For those who didn't see his bio in *People* magazine, he is a loyal US citizen currently residing in the Soviet Union.

Scotty is doing research on an airfield in Siberia at a settlement known as Seymchan. This airfield was built by the US during World War II as a fuel stop for airplanes delivered to the Soviets under the Lend-Lease program.

Scotty is seeking any information on this airfield. He can be reached through the address below.

Silvio J. Sclocchini
℅ Warren S. Rees
105 Ivy Lane
Glen Mills, Pa. 19342

F-102s in Europe

I would like to contact any former members of the 497th Fighter Interceptor Squadron who were assigned to this unit when it was based in Spain from 1960 to 1964. I urgently need photographs of F-102s from this period for a book that is scheduled to be published in September 1989.

Please contact me at the address below.

Johan D. Ragay
Ln. v. d. Mensenrechten 151
2552 NR 's-Gravenhage
The Netherlands

Roll Call

I am seeking any information on my father, Lt. Col. Onner Duncan Davis, also known as O. D. "Dick" Davis. I am

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An infrared sensor system for the joint services' V-22 Osprey aircraft will help crews navigate and land in darkness and during periods of poor visibility. The Infrared Detection Set (IDS), developed by Hughes Aircraft Company, senses small differences in radiated heat and provides a TV-like image of the surrounding area. The V-22, the first of the new tilt-rotor aircraft for the U.S. Armed Forces, is able to take off and land like a helicopter, but fly like a plane. Hughes will start flight testing the IDS in early 1989, with flight test support continuing through 1991.

Improved TOW missile Weapon System Test Sets (WSTS) offer enhanced capabilities based on proven design and field experience, and improved reliability. Built for the U.S. Marine Corps AH-1W Super Cobra attack helicopter, the Hughes WSTS will let Marine Corps technicians verify operations functions and isolate failures of the TOW missile's launcher in field environments. Hughes will also provide the U.S. Navy with eight extended system test sets with enhanced self-test capability. The WSTS design is in full compliance with the Naval Air Systems Command's common support equipment policy, using government-approved standard parts, which enables greater cost efficiency in both the manufacture and maintenance of such systems.

Heat pipe technology will be used to cool future nuclear-powered space systems for the first time. Heat pipes are passive thermal control devices that are used to cool computers, signal processors, communications devices, and various other equipment in military and commercial applications. Under development by Hughes for NASA's SP-100 Advanced Radiator Program, the heat pipe's radiators will be as large as 8,881 square feet and will take on exotic shapes. Because they must be able to unfold after deployment from the Space Shuttle, the radiators will require the first-time use of heat pipes with rotating or flexible joints. The heat pipes' projected cooling medium will be a liquid metal, such as cesium, mercury, or potassium, and will operate at either 600 or 950 degrees Kelvin.

A new satellite is providing domestic communications to most of the South Pacific and added coverage to Australia. Aussat 3, designed and built by Hughes, is the last in a fleet of three communications satellites for AUSSAT Pty., Ltd., Australia's national satellite company. The satellite will augment voice, video, and data services currently provided by the first two satellites in Australia, its offshore islands, and New Guinea. Aussat 3 has a three-reflector antenna to produce seven transmit beams for regional and national coverage. Additionally, two horn antennas provide coverage to New Zealand and South Pacific islands. The Aussat satellites tie together the nation's 101 air traffic control stations, provide business communication networks, and are used in medical emergencies through aids such as slow-scan television for diagnostic purposes.

Detection and tracking of incoming enemy intercontinental ballistic missiles (ICBMs) will be provided by the most elaborate electro-optical sensor ever conceived. The device, under development by Hughes for the U.S. Army's Strategic Defense Command's Airborne Optical Adjunct Program, will detect the heat emanations of a wide range of objects as they reenter Earth's atmosphere, discriminating ICBM warheads from decoys, debris, and chaff that may reenter with them. Hughes' latest generation of sensors is capable of detecting the heat of a human body over 1,000 miles away in deep space. The sensor will operate from an airborne platform stabilized by a Hughes pointing-stabilization system, which will hold the system's eye on a steady line-of-sight. Testing of the sensor will conclude in the 1990s.

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

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especially interested in any information concerning his final mission in the B-17 *Mission Belle* on April 11, 1944. He was then a second lieutenant and was signed out as copilot on the mission.

Any of the following individuals may have known him at that time: Sam I. Kaiser, Duane Pangle, W. H. Troop, Brooke R. Baier, Byrl Robinson, Frank R. Anderson, Jack Losee, Art W. Thomas, Charles H. Harbin, Merritt Wheeler, Lou Clemens, Grady B. Williams, and Dick Floyd.

Please contact me at the address below.

Rick Davis
211 Shellar Dr.
Charleston, W. Va. 25325
Phone: (304) 348-6002

We at the Combat Jets Flying Museum are trying to locate a Korean War pilot by the name of Jim Thompson. Among our seven flying examples of vintage military jets is a Canadian Sabre. We have restored and painted this aircraft exactly like Lieutenant Thompson's F-86.

So far as we can tell, Lieutenant Thompson was attached to the 51st Fighter Interceptor Wing and had two MiGs to his credit. His aircraft sported elaborate nose art in the form of a large green dragon with the name *The Huff* painted beneath it.

We would like to contact Lieutenant Thompson or anyone who knew him during the Korean War.

Combat Jets Flying Museum
8802 Travelair
Houston, Tex. 77061
Phone: (713) 645-0549

We are trying to locate the survivors of one of the larger World War II pilot classes, Pilot Class 43-D.

The 9,896-strong class entered training in August 1942 and was graduated from twenty-nine advanced flying schools nationwide in April 1943. A total of 5,275 received their wings. We would like to find those who made it, those who didn't, and the fate of those who made the supreme sacrifice.

Please contact the address below.

Pilot Class 43-D Ass'n
P. O. Box 14572
North Palm Beach, Fla.
33408-0572
Phone: (305) 622-6852

I am interested in corresponding with some World War II buddies who served in the Army Air Forces in the China-Burma-India theater with Air Transport Command.

They are Joe Rogus, Arthur R. Sass, Joe Petrosky, Marion F. Nalley, and "Shorty" Neid. Others for whom I have only last names are Nodgard, Nedvid, and Neighburger.

Please contact the address below.

Earnest O. Norton
1129 Glenda Dr.
Bedford, Tex. 76022
Phone: (817) 282-6853

We would like to hear from anyone who served with the Air Force Office of Special Investigations and who would like to affiliate with the National Association of Former Special Agents of AFOSI.

If you were or if you know of someone who was an AFOSI special agent, please contact us at the address below.

Col. James L. Doyle, USAF (Ret.)
2678 Clubhouse Dr., N.
Clearwater, Fla. 34621
Phone: (813) 796-0192

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Airmail

During this past year, the 556th Bomb Squadron, a B-26 unit from the World War II Ninth Air Force, added many former members to its rolls. My crew is still searching for our last two missing members. They are Garrett G. Matthews and Edward G. Gordon.

Any information regarding their whereabouts will be greatly appreciated.

Tom Steele
309 Roosevelt Ct., N. E.
Vienna, Va. 22180
Phone: (703) 938-6960

I would like to locate anyone who was stationed at France Field in the Panama Canal Zone from 1936 to 1938. I am looking especially for former members of the 25th Bomb Squadron.

I would also like to hear from anyone who served with the 738th Bomb Squadron, 454th Bomb Group, based at San Giovanni Airfield near Cerignola, Italy, during World War II.

Harry A. Arnold
9033 Station Rd.
North East, Pa. 16428

I am trying to locate Robert "Bob" Woodrow Nance. He was a USAF enlisted airman stationed at England AFB, La., during 1954–56. He was about age twenty-five at that time.

Bob is a family member, and it is imperative that I locate him. If anyone knows how I might get in touch with him, please contact me at the address below.

Jim Tarver
P. O. Box 1840
Magnolia, Ark. 71753
Phone: (501) 234-3991

I am seeking information on Army Air Forces veterans who served with my uncle, SSgt. Julius K. Atkins, during his thirty-six combat missions over Japan in 1945. He served in the 882d Bomb Squadron, 500th Bomb Group, Twentieth Air Force.

Among his crewmates were Lieutenant Ferrell, William J. Brown, Jacob Shupak, Thomas J. Mockler, Jr., Sidney E. Long, and Ray Lowes.

Please contact me at the address below.

T. R. Williams, Jr.
6400 Middle Ridge Lane
Chattanooga, Tenn. 37343

I would like to contact any persons who flew with my father, Col. William D. "Bill" Garner, USAF (Ret.), in Southeast Asia and during tours at MacDill AFB, Fla., Bitburg AB, Germany, and Aviano AB, Italy. In SEA, he was a weapons/tactics and stan eval chief, flying the F-4 with the 435th Tactical Fighter Squadron and the 497th TFS.

Dean Garner
Valkyrie Fighter Images
9903 Santa Monica Blvd.
Suite 342
Beverly Hills, Calif. 90212
Phone: (213) 746-5039

I am looking for anyone who knew my brother, Lt. Jim Badley, when he was in ROTC, pilot training (at Williams AFB or Davis-Monthan AFB), PACAF Jungle Survival School (Clark AB in September 1967), or with the 480th Tactical Fighter Squadron at Danang in 1968. Information, no matter how minor, is needed for a book about his life.

Please contact the address below.

Bonnie Badley Gregg
2501 N. W. Pendleton Pl.
Corvallis, Ore. 97330
Phone: (503) 757-1718

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In the near future, we will be applying the technology to the Standard-2 shipboard missile, the Tartar missile fire-control system, and other programs for which Raytheon is the prime or second source contractor.

These applications reflect our committed approach to VHSIC technology. From the beginning, our objective has been to produce reliable, high-yield devices for insertion into major systems.

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technology is going.

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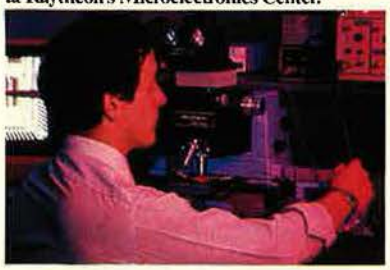
For more information, write: Raytheon Company, Government Marketing, 141 Spring Street, Lexington, MA 02173.

A technician works with automatic equipment at Raytheon's Microelectronics Center.



Raytheon

Where quality starts with fundamentals

The Chart Page

Edited by Colleen A. Bollard, STAFF EDITOR

DoD's Top Weapon Programs

(millions of dollars)

	Procurement	R&D	Quantity
Strategic Defense Initiative*	—	$4,830.9	—
F-16 Fighting Falcon	$3,705.1	26.5	180
Trident II missile	1,873.5	573.3	66
F/A-18 Hornet	2,359.3	13.2	72
DDG-51-class destroyer	2,207.3	37.8	3
C-17 cargo aircraft	1,107.7	961.1	4
SSN-21-class fast attack submarine	1,488.0	239.0	1
F-15C/D/E Eagle	1,505.9	89.1	36
M1 tank**	1,462.9	45.8	559
SSN-688-class attack submarine	1,493.6	10.9	2
Trident strategic submarine	1,368.1	7.6	1
F-14A/D Tomcat	910.0	167.7	12
Mobile Subscriber Communications Equipment	995.7	—	—
AH-64 Apache attack helicopter	891.2	4.8	72
Titan spacelaunch vehicle	376.2	488.8	3
Patriot missile	858.0	23.1	815
Peacekeeper missile (MX)	808.7	40.0	12
Standard missile	700.5	152.8	1,635
AMRAAM missile	831.0	—	1,470
Tomahawk missile	733.4	60.3	510
Bradley fighting vehicle	730.0	21.8	581
LHD-1 amphibious assault ship	737.5	2.5	1
LANTIRN night precision attack system	724.7	4.7	—
Advanced Tactical Fighter	—	702.3	—
V-22 Osprey tilt-rotor aircraft	335.3	306.7	—
TOTALS	**$28,203.6**	**$8,810.7**	

* Includes funding in Department of Energy.
**Procurement number includes Army and Marine Corps.
Source of Data: House Armed Services Committee.

These are the twenty-five largest weapon systems in the Administration's FY '89 budget request. The table contains thirty-five percent of the total request for procurement and twenty-three percent of the total request for R&D.

Trends in "Positive Propensity"

	1981	1982	1983	1984	1985	1986	1987
Air Force	20.9	18.7	18.8	15.3	14.9	16.0	18.2
Army	15.0	16.0	17.5	14.3	14.7	15.8	15.5
Navy	15.4	14.4	13.0	10.9	10.6	11.1	12.3
Marine Corps	12.4	11.7	12.1	9.6	10.2	11.2	11.4

Source of Data: DoD.

The Youth Attitude Tracking Study (YATS) measures the propensity, attitudes, and motivation of young adults toward military service. Respondents had no previous military experience and were not serving in the military at the time of the poll. According to this table, the Air Force has consistently maintained the highest positive propensity levels of any of the services.

Dangerous Waves in Electronic Combat

By James W. Canan, SENIOR EDITOR

Blinding lasers are giving electronic warriors the shivers. In addition, stealth and antiradiation missiles are posing big problems for radars in the RF range.

Washington, D. C.

Late last year, the Pentagon revealed that a Soviet ship had beamed a laser at two US military aircraft flying over the Pacific Ocean near where a Soviet test-launched ICBM had splashed down. By all accounts, the laser did not damage either the US Navy P-3C antisubmarine patrol plane or the US Air Force WC-135 weather-monitoring aircraft that it illuminated. But something else happened that sent shivers through the military community for what it signified about electronic combat to come.

The Soviet laser temporarily blinded the copilot of the Air Force plane. She had inadvertently intercepted its beam along her line of sight. Her vision was impaired for quite some time.

Luckily for the copilot, the Soviet laser was a low-energy type used as a target designator and not one of the high-energy lasers that are powerful enough to burn through metal and to blind—instantly and permanently—anyone who looks its way.

Just such powerful lasers are being developed for blinding on battlefields, however, and the Pentagon says that the Soviets may be deploying them rather soon.

As the incident over the Pacific showed, it does not require a high-energy laser to disrupt optical systems, be they biological or electronic.

Even a low-power laser striking the eye creates "a dazzle effect—like a bunch of flashbulbs going off for a long time," as Donald N. Fredericksen described it at an Air Force Association symposium shortly after the Pacific incident.

Mr. Fredericksen, Deputy Under Secretary of Defense for Tactical Warfare Programs, also had this to say: "I think the first use of lasers as weapons will be in blinding optics. The laser designator is a serious problem. It puts anyone sitting in a cockpit totally out of commission. We have to worry about that. We have a thrust going on now—looking at defenses and protection against low-energy lasers."

Mr. Fredericksen also noted that high-powered microwaves will have to be reckoned with as well in the electronic combat of the 1990s and beyond. He described the effect of such microwaves as "like electromagnetic pulse, only different," in that they "burn out electronics," but in not quite the same way as EMP.

The US and the USSR are working on lasers and microwaves that would play hob with optical and electronic systems, which these days cover just about all military systems. In keeping with the cat-and-mouse nature of electronic combat (EC) and its protection/suppression subset, electronic warfare (EW), the two superpowers are also developing countermeasures against laser and microwave weapons.

The problem for the US these days lies in finding enough money in a straitened defense budget to begin and sustain programs that are necessary to keep pace in EC and EW.

Falling behind in those fields could well be fatal in the electromagnetic military era now fully dawned.

Brig. Gen. Noah E. Loy, director of EC acquisition programs in the Office of the Secretary of the Air Force, is concerned about that.

"We all understand," he says, "that we have to operate in an electromagnetic environment. No one doubts that anymore. And our priorities and strategies for doing so are right.

"But it's very expensive. And we haven't got enough assets right now to do the job that we're supposed to do."

This is particularly true, says General Loy, with respect to assets for suppressing the formidable Soviet air defenses, a prime EW mission.

The lion's share of USAF's EW funding is being devoted to programs in operational or developmental difficulties or to those in the process of being upgraded to keep pace with worsening threats. Many or most of these programs have to do with detecting, spoofing, and jamming enemy radar signals—those in the radio-frequency (RF) range of the spectrum.

A major case in point is the program for bringing the troubled ALQ-161 defensive avionics suite on the B-1B bomber up to specifications. This will probably not happen for another couple of years or so, and even after it does, there will still be the problem of modernizing the system to keep pace with Soviet advances in bomber detection and targeting.

Given USAF's concentration on production and upgrading of contemporary radar-oriented EW systems, its work on technologies for EW systems of the future—many of them involving the nonradar portions of the electromagnetic spectrum—is being slighted.

In this, USAF may well be mortgaging its future capability for electronic combat and thus (there no longer being any other kind of combat) mortgaging its future—period.

Congress has been pressing the services for several years to consolidate their plethora of EW programs wherever possible and has been flinty about funding many of them until it sees results in this regard.

This is exacerbated by the latter-day tendency of the services themselves to skimp on funding some EW programs in order to accommodate the receding defense budget.

The upshot, says General Loy, is that "we're being forced to cut major EW science and technology programs, and this could hurt us in the future." For example, he says: "There is a lot of work on infrared and laser

EW technologies that is going wanting for lack of funds."

This could turn out to be extremely dangerous for the US. The Soviet Union is moving to catch up in low-observables (LO) technologies and to deploy LO—"stealthy"—aircraft and missiles that will be difficult for radar to detect.

The day may come when IR and laser systems are the US's last-ditch means of detecting radar-resistant Soviet stealth bombers, fighters, and missiles—if indeed the US is in possession of such IR and laser systems by the time it may need them the worst.

A major point that is often overlooked in addressing the topic of low observables is the natal connection between LO technologies and those inherent in EC and EW systems and tactics.

Such USAF stealth platforms as the B-2 bomber, the advanced cruise missile, and at least one other tactical system that remains totally classified even though widely publicized are EW systems by their very nature.

They are designed and built to escape detection by electromagnetic signals—whether RF, IR, or EO—courtesy of their configurations, coatings, and materials.

In fact, says General Loy: "One of the two major technological leads that we have in electronic warfare today is in low observables, or stealth. The other is in computer technology—data-processing and signal-processing capabilities."

For all their elusiveness amid radar signals seeking them out, stealth aircraft still need electronic countermeasures on board. The reason: Just as there is no such thing as an invisible man, there can be no such thing as a totally "invisible" aircraft, and ECM can never be done without.

An LO aircraft may be invisible in some, or most, RF frequencies, but not in all. It may also be susceptible to IR detection under some circumstances, such as from the tail-chase aspect. And there will almost certainly be times when stealth aircraft are eyeballed from air and ground, camouflage paint notwithstanding.

The ECM aboard stealth aircraft will work somewhat differently and will probably carry a lesser load than do the ECM aboard aircraft of ordinary observability.

For example, it is said that a major function of the ECM system aboard USAF's B-2 bomber is "deception jamming"—seducing enemy radar into seeing the bomber, if it sees it at all, in a part of the sky at far remove from its actual position.

This involves electronic sleight-of-hand in the reception, processing, and retransmission of those enemy radar signals.

It is highly unlikely that the B-2's ECM system is set up for hair-trigger emission of noise-jamming signals, which would give away the bomber's presence, unless the crew knows for sure that the aircraft has been acquired by radar—and maybe not even then.

Of course, the B-2 needs radar warning receivers (RWRs), just as all combat airplanes do.

"The best way to sum up the relationship of LO and ECM is that LO reduces the burden on ECM," says a knowledgeable industry source. "LO shifts the focus of ECM more away from the long-range, lower-frequency surveillance radars—the early-warning GCI [ground-control intercept] radars—and more toward the higher-frequency, short-range AI [airborne intercept] radars on the other guy's interceptors.

The USSR is coming along in low-observables technologies and may soon begin limited operational deployment of LO systems.

"Low-observable aircraft ought to at least be able to beat the early-warning and GCI radars, but not necessarily the close-in AI radars. So it will be important to have terminal-threat protection ECM on stealth aircraft."

USAF's successful efforts to reduce the radar cross section (RCS) of the B-1B bomber greatly below that of the B-52, with its barn-like RCS, and even well below that of the B-1A prototypes of the mid-1970s were predicated on just these goals—defying detection from afar by long-range radars and, in consequence, cutting the reaction time of Soviet airborne interceptors once they are alerted to the bombers by their late-starting GCI.

In the context of US and USSR work on LO, the Pentagon's 1988 edition of *Soviet Military Power* says that the US "probably has a significant lead in the practical application of signature reduction to military systems," but that the USSR is coming along in LO technologies and "may soon begin limited operational deployment" of some of them.

The US cannot afford to leave well enough alone, the document asserts. "Due to advances in the Soviet air defense threat, reduction in the visibility of platforms is a high-priority goal for the United States," it says.

As the Pentagon's Mr. Fredericksen puts it, stealth "has tremendous application in the tactical world" as well as in the strategic. Noting that USAF's Advanced Tactical Fighter is being built to combine LO with high speed and great maneuverability, he told an AFA audience:

"If you can't detect the ATF until you're within its visual range, you're in big trouble, because he'll detect *you* way outside of that visual range."

Stealth doesn't go it alone, not by a long shot. As General Loy explains: "The whole idea is to hide your stealthy platforms behind the [electromagnetic] noise that's in the area. As you raise the noise level—putting greater numbers of electrons into the air—the probability of a stealthy aircraft going undetected becomes even greater."

In such circumstances, the "noise level" is created by area jammers on such platforms as the EF-111 Raven and EC-130 Compass Call aircraft, by "local" self-defensive jammers on attack aircraft, and even by sunspot activity.

Proper power management of radar on stealth aircraft is highly important to keeping them covert. The power output of their radars must be tightly controlled so that it is adequate to the task but never excessive.

For example, using fifty miles' worth of power in sending out radar signals would be unnecessary if the radar's target, once spotted, is only ten miles ahead. This would be foolhardy, too—risking detection of the radar's signals at overshot distances where they need not reach.

This is why a great deal of emphasis has been placed in recent years on developing and deploying noncontinuous radar that can be turned on and off in flight, remembers what it sees every time it is on, and retrieves

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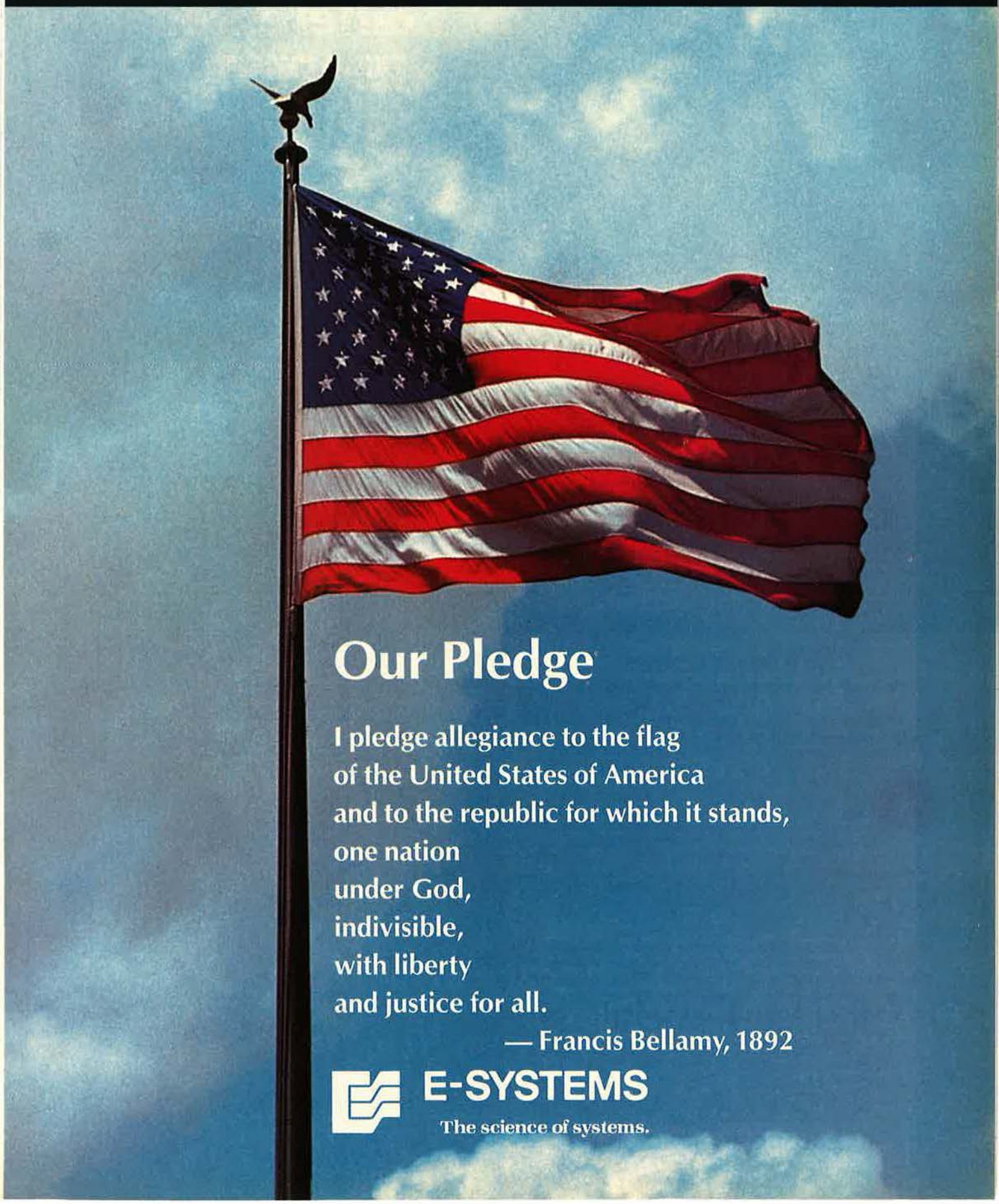

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E-SYSTEMS

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Capitol Hill

By Brian Green, CONGRESSIONAL EDITOR

Washington, D. C.

House, Senate OK Defense Bill

The Senate and House of Representatives have approved their respective versions of the Fiscal Year '89 defense authorization bill. Both versions provide $299.5 billion in budget authority (the amount that DoD is permitted to obligate in the current and future fiscal years) and $294 billion in outlays (the amount that will actually be spent in the fiscal year). Defense BA in the House and Senate bills is ten percent below the original January 1987 DoD request and one percent lower than in FY '88.

Differences in the bills will have to be resolved in conference.

Strategic Programs and Arms Control

The House, as usual, passed several arms-control amendments over Administration opposition. These amendments would: (1) prohibit funding for SDI experiments that violate the "narrow" interpretation of the ABM Treaty (the "broad" interpretation permits more latitude in SDI R&D), (2) require US compliance with the SALT II Treaty numerical sublimits on multiwarhead weapon systems, (3) limit US underground nuclear tests to one kiloton, and (4) ban tests of depressed-trajectory ballistic missiles.

The House failed, however, to renew its ban on testing of the F-15-launched miniature homing vehicle antisatellite (ASAT) system against objects in space. The Air Force canceled the program because of the ban, which has been in effect for three years.

The Senate defeated amendments to require SALT II compliance and to limit underground nuclear tests to five kilotons and failed to act on an ASAT ban and SDI test restrictions.

The House approved a bare $100 million for R&D on rail-garrison MX basing (in which two MX ICBMs would be carried on a train based on existing military facilities) and $600 million for the Midgetman Small ICBM. The Senate approved $700 million for rail-garrison R&D and $50 million for the SICBM. DoD considers the SICBM terminated, a move favored by the Air Force. The Air Force request was $793 million for rail-garrison R&D and $200 million for the SICBM.

The House approved an amendment to reduce DoD's SDI spending to $3.5 billion, the same level as last year. This is a $568 million cut from the House Armed Services Committee (HASC) level and down $1.4 billion from DoD's request. The Senate approved $4.5 billion for SDI.

SASC on CAS

The Senate Armed Services Committee (SASC) authorization bill report is critical of the Air Force's inclination to favor an F-16 variant as a follow-on close air support (CAS) plane. The report charges the Air Force with seeking to redefine the CAS mission so that it need not procure a new CAS-dedicated aircraft, questions the Air Force commitment to CAS, and emphasizes the need to balance the modernization of forces that support different missions.

The Air Force notes that more than a quarter of its tactical forces are dedicated solely to CAS, and nearly three-fourths of its tactical forces are able to conduct ground-support missions.

Drug Interdiction

Both the House and Senate overwhelmingly approved amendments that will involve the military in drug interdiction. The House bill mandates that the Secretary of Defense "substantially halt the unlawful penetration of the United States borders by aircraft and vessels carrying narcotics within forty-five days" of enactment. The Senate bill provides for additional use of surveillance aircraft and $30 million to the Air and Army National Guard to assist in the interdiction of illegal drugs.

The Air Force is concerned that engaging in police duties will expend already scarce resources and result in reduced readiness.

Base Closures

The Senate passed an amendment that would create a special, one-time, independent commission that would be free from partisan pressures from DoD and Congress and that would have the power to recommend base closings.

The measure would create a commission (appointed by the Secretary of Defense in consultation with Congress) that would prepare a list of base closings and submit the list to the Secretary. He could only accept or reject the entire list.

The measure also provides for an expedited process by which either the Senate or House could block the closings by a majority vote rejecting the commission's list.

A similar bill is pending in the House.

Pay Raise

The House bill provides for a four percent military pay raise. A 4.3 percent raise was requested. The difference would be put toward increasing the household goods weight allowance to reduce out-of-pocket expenses for required moves and for a seven percent raise in basic allowance for quarters. The Senate bill provides the full 4.3 percent raise and funds for the increased weight limit.

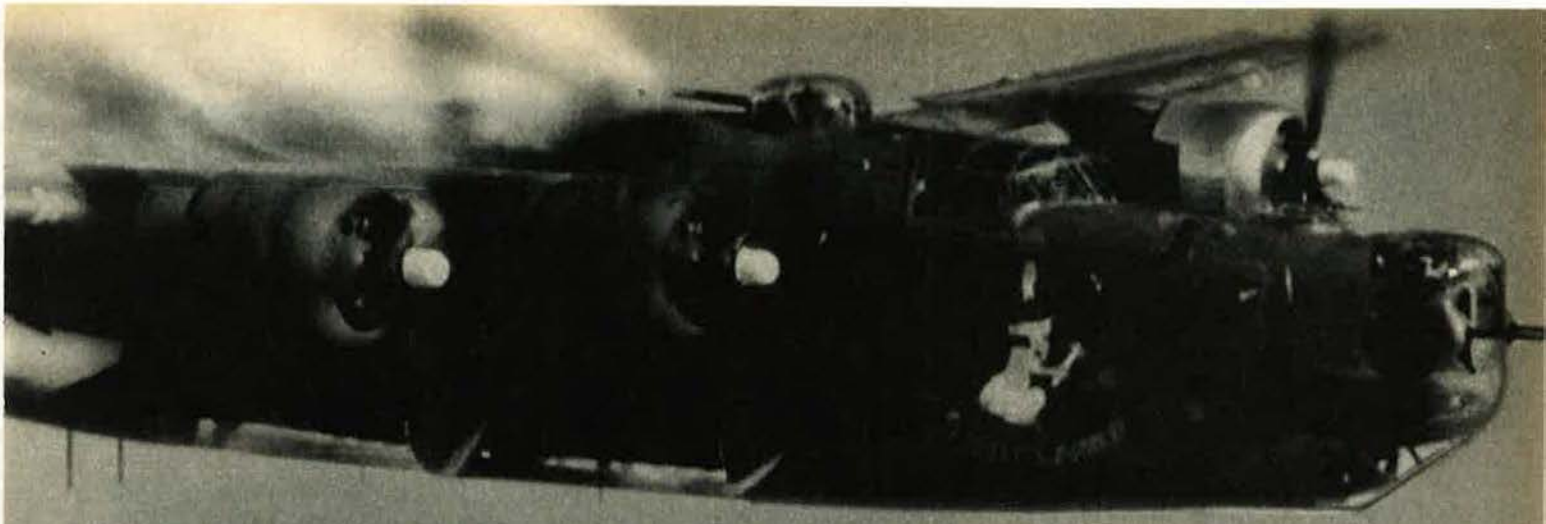
The $54 million pilot bonus program proposed by the Air Force to stem a growing pilot-retention problem was cut to $36 million by the House and to $30 million by the Senate.

Both the House and Senate approved amendments increasing DoD reprogramming authority. This authority would allow DoD to shift enough funds to avoid threatened furloughs of civilian personnel. The possibility of furloughs arose as a result of deep cuts in civilian personnel accounts in FY '88.

INF Approved

The Senate finally consented, by a vote of 93–5, to the Intermediate-range Nuclear Forces (INF) Treaty. An amendment to the resolution of ratification that would require Senate approval of any change in INF Treaty interpretation was adopted.

Senate approval was delayed by a group of conservative Senators concerned over verification, Soviet violations of other treaties, and a diminished US deterrent in Europe. ■



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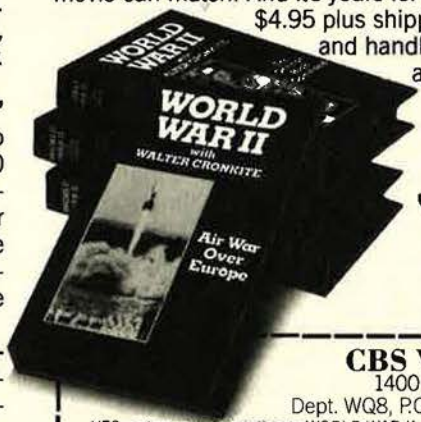

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Aerospace World

By Jeffrey P. Rhodes, AERONAUTICS EDITOR

Washington, D. C.

★ Calling it a "forward-thinking concept for the future," Marine Corps Commandant Gen. Alfred M. Gray, Jr., keynoted the dazzling rollout ceremony on May 23 for the Bell-Boeing V-22 Osprey, the world's first production tilt-rotor aircraft. Indeed, the V-22 does promise to be a significant milestone in aviation.

The V-22, which combines many of the features of a helicopter and a fixed-wing aircraft, has already achieved a number of firsts. In addition to being the first full-scale tilt-rotor development effort, the V-22 is also the first military aircraft designed from the outset to meet the needs of all four services. Moreover, the Osprey is the first major weapon system procurement program in which the contractor is required to finance and own a majority of the production tooling for the aircraft.

The Marines will be the first customer for the Osprey. The Corps will use its 522 MV-22As for amphibious troop assault and assault support, and the aircraft will replace their fleet of aging CH-46 Sea Knight helicopters. The Navy will need fifty HV-22As for combat search and rescue and for fleet logistics support, and the Air Force will use its CV-22As for special operations missions. The Air Force order was originally for eighty aircraft, but budget pressures have reduced the number to fifty-five.

The budget has also taken its toll in other areas. In order to fund several ongoing programs and the new-generation LHX helicopter, the Army has dropped out of the V-22 program for the time being. The service still has a need for 231 MV-22s for medical evacuation and special operations, though, and is expected back in the program at some point in the future. The Navy has also temporarily suspended its work on an SV-22 antisubmarine warfare variant because of budget constraints.

The V-22, in development since 1981, will be able to carry twenty-four troops or up to 20,000 pounds of cargo internally on short-range missions. The Osprey also has two external cargo hooks, from which up to 15,000 pounds can be suspended when there is no internal cargo. The instrumentation in the cockpit comprises four large multifunction displays with one conventional gauge used as a backup. The V-22s will be crewed by a pilot, copilot, and one loadmaster.

Eager crowds thronged around the Bell-Boeing V-22 Osprey at a dazzling rollout ceremony in Arlington, Tex. This first-ever full-scale-production tilt-rotor aircraft will combine the advantages of helicopters and fixed-wing aircraft. Its first customers, the Marine Corps, will use it for amphibious troop assault and assault support.

Fifty-nine percent of the airframe of the V-22 is composite materials, and the aircraft is rugged and should be survivable. Pieces of the Osprey have been shot at, and during one test at the Naval Weapons Center at China Lake, Calif., a wing, in a 4-G attitude, was shot at with a 23-mm cannon. A fuel cell was blown out, but the wing's integrity remained. The V-22 will also float in the event of a ditching.

The first V-22 was dramatically backlit when it was unveiled in the May 23 ceremony at Bell Helicopter Textron's plant in Arlington, Tex. As the lights came up, the aircraft's engines and rotors were tilted up to show graphically how the Osprey will be able to take off and land vertically as well as to hover.

After the unveiling, the V-22 was towed out of the hangar. Various dignitaries, including Navy Secretary William Ball and former Air Force Secretary Hans Mark, as well as a crowd of more than 2,000 were then able to view the aircraft up close.

Bell is building the wings and integrating the Allison T406-AD-400 engines into the aircraft, while Boeing Helicopter Co. is responsible for fuselage construction, the overwing fairing, and empennage integration. Each of the companies will assemble three of the six flight-test aircraft. Once full-rate production is under way, the two companies will compete for a majority share of the yearly procurement contracts.

First flight of the V-22 is scheduled

for August 15. Testing will be conducted at both Bell's Flight Test Center and at Boeing's plant near Philadelphia. The first V-22 aircraft will be delivered to the Naval Air Test Center at NAS Patuxent River, Md., in mid-1989, and the Marines will receive their first MV-22 in late 1991.

★ In recent testimony before the Senate Committee on Veterans' Affairs, Maj. Gen. (Dr.) Alexander M. Sloan, the Air Force's Deputy Surgeon General, gave a status report on the findings of the latest study of the Operation Ranch Hand participants and the effects of Agent Orange, the defoliant widely used in Southeast Asia.

Dr. Sloan said, "In summary, the 1987 morbidity report concludes there is insufficient evidence to support a cause-and-effect relationship between herbicide exposure and adverse health in the Ranch Hand [study] group at this time. The study has revealed a number of minor medical findings that require continued surveillance.

"In full context, the results of this study are encouraging evidence that, at this time, the current state of health of the Ranch Hand participants appears unrelated to herbicide exposure in Southeast Asia," concluded Dr. Sloan. "However, we still cannot exonerate the herbicide at this time."

Dr. Sloan also reported that as of December 31, 1984, the 4.4 percent overall mortality rate of the 1,257 known people in the Ranch Hand group was nearly identical to the 4.6 percent rate for the 6,171 people in the comparison group. He also said that "Ranch Hand officers have experienced fewer deaths than comparison officers, while more Ranch Hand enlisted personnel have died than their matched comparison, but none of the differences are significant." An updated mortality rate report is expected this year.

During the recently held Beverly Morning exercises in Japan, Capt. Tim Mearig, right, discussed strategy with TSgt. Robert White from the 475th Civil Engineers Prime BEEF unit while aggressors made their approach during one of their repeated attacks on the engineers' encampment. The exercise simulated combat conditions complete with lack of amenities, limited ammunition, and ambushes. Hospital personnel were rigorously tested in such skills as triage and handling combat stress.

On a less somber note, Maj. Gen. John B. Conaway, the Director of the Air National Guard, offered some significant statistics in his recent testimony before the House Appropriations Committee.

General Conaway said that by the end of FY '89, the Air National Guard will possess eighty-six percent of the Air Force's total air defense interceptor force, half of the tactical reconnaissance force, thirty-six percent of both the theater airlift and tactical airborne command and control force, twenty-six percent of the rescue and recovery force, seventeen percent of the strategic aerial refueling force, eight percent of the electronic combat force, and six percent of the Air Force's strategic airlift force.

Furthermore, in the mission support area, General Conaway noted that the Guard will possess seventy percent of the Air Force's aircraft control and warning force, sixty-eight percent of the engineering and installation force, sixty-seven percent of the combat communications force, fifty-four percent of the tactical weapons control force, twenty-four percent of the civil engineering force, thirteen percent of medical support units, and twelve percent of the Air Force's aerial port units.

★ The final link in the Air Force's spacelaunch recovery chain was put into place on May 3 when the General Dynamics Atlas/Centaur II was named as the winner of the Medium Launch Vehicle (MLV) II competition. The

This Lockheed engineer is monitoring the performance of a Cybotech five-axis gantry robot as it cuts honeycomb-core composite material at Lockheed Aeronautical Systems Co.'s Composite Development Center, which opened last April. Composites will be invaluable in helping manufacturers attain the weight limits that USAF seeks for such future mainstays as the Advanced Tactical Fighter.

Atlas/Centaur II proposal was selected over the Delta IIA configuration proposed by the team of McDonnell Douglas and Martin Marietta.

When Congress releases the funds, General Dynamics' Space Systems Division in San Diego will be given a contract worth more than $500 million for eleven Atlas/Centaur IIs. The boosters will be used to launch ten Defense Satellite Communication System (DSCS) III satellites and one Space Test Program satellite in the period from January 1991 to mid- to late 1997.

The Atlas/Centaur II will feature lower-cost advanced avionics, a newer flight computer, booster engines with greater thrust, and longer propellant tanks than the equipment used on the current Atlas/Centaur. The engine and tank changes will be made to both the Atlas and Centaur stages. General Dynamics is also offering a commercial version of the rocket, which will be called Atlas/Centaur IIA.

The Atlas/Centaur II will be able to lift 6,100 pounds of payload into geosynchronous transfer orbit (GTO). The new rockets will fill a gap in capability between the 4,000-pound payload the Delta II (MLV I) will put into GTO and the 10,200-pound payloads the Martin Marietta Titan IV will take directly to geosynchronous orbit. Twenty Delta IIs and twenty-three Titan IVs are currently on order.

In a related note, the last HGM-16 Atlas intercontinental ballistic missile modified to Atlas-E standard for space operations was returned to the Air Force inventory after refurbishment in early spring. Since 1970, General Dynamics has modified fifty of the missiles for space operations.

Col. Bruce Smith, left, and Arkansas AFA State President Bernard A. Walters unveil the photo-print of Jim Sharpe's portrait of Gen. Ira C. Eaker donated by AFA to the base to salute the late airpower pioneer at the ceremony renaming Blytheville AFB in his honor.

And Now It's Eaker AFB

The airpower pioneer who served as the first commander of the World War II Eighth Air Force, Gen. Ira C. Eaker (1896–1987), was honored on May 26 when Blytheville AFB, Ark., was officially renamed Eaker AFB. Air Force Chief of Staff Gen. Larry D. Welch and Strategic Air Command Commander in Chief Gen. John T. Chain spoke at the ceremony, as did the guest of honor, Mrs. Ruth Eaker, the General's widow.

It was appropriate that Blytheville was chosen to be renamed. The base's assigned unit is the 97th Bomb Wing, a lineal descendant of the 97th Bomb Group that then-Brigadier General Eaker flew with on the first US mission over occupied Europe in 1942.

The ceremony was highlighted by a flyby of one of each of the aircraft types flown by today's Eighth Air Force (B-1, B-52, FB-111, KC-10, and KC-135). Afterward, a large, framed print of the Jim Sharpe painting that appeared as the cover of the October '87 issue of AIR FORCE Magazine was presented to the base on behalf of the Air Force Association.

★ If Strategic Air Command's "Olympic Arena" missile competition had been a horse race, a photo finish would have been needed to determine the winner. This year's champion, the 91st Strategic Missile Wing at Minot AFB, N. D., nosed out the 44th SMW at Ellsworth AFB, S. D., by a single point to claim the Blanchard Trophy for highest competition effectiveness.

The competition was extremely close, with only four points separating the top three teams and only eighty-eight points separating first place from sixth. The 91st SMW scored a total of 2,786 points (of 3,000 possible) to the 2,785 garnered by the 44th SMW. Third place went to the 90th SMW at F. E. Warren AFB, Wyo. (2,782 points), while the 351st SMW at Whiteman AFB, Mo. (2,736), was fourth. The 341st SMW at Malmstrom AFB, Mont. (2,707), finished fifth, and the 321st SMW at Grand Forks AFB, N. D. (2,698 points), was sixth.

Both the Minot and Ellsworth teams took top honors in three categories. Ellsworth won trophies for Best Missile Operations, Best Pneudraulics Team, and for the Security Police Confidence Course. The Minot team claimed the awards for Best Missile Maintenance, Best Electronics Laboratory Team, and for Security Police Combined Tactics. In addition, the 91st SMW was named the Most Improved Wing.

F. E. Warren AFB, which competed with both Minuteman and Peacekeeper missile crews for the first time, took the Best Communications Team and Best Munitions Team awards. Grand Forks won the Best Civil Engineer Team award. Malmstrom's Security Police team scored a perfect sixty out of sixty points on combat marksmanship and was named Best Missile Security Police Team. Crew S-341 from Malmstrom won Best Crew Single Exercise and scored 286 of a possible 300 total points to earn the Best Missile Crew award.

The week-long competition, held at Vandenberg AFB, Calif., ended April

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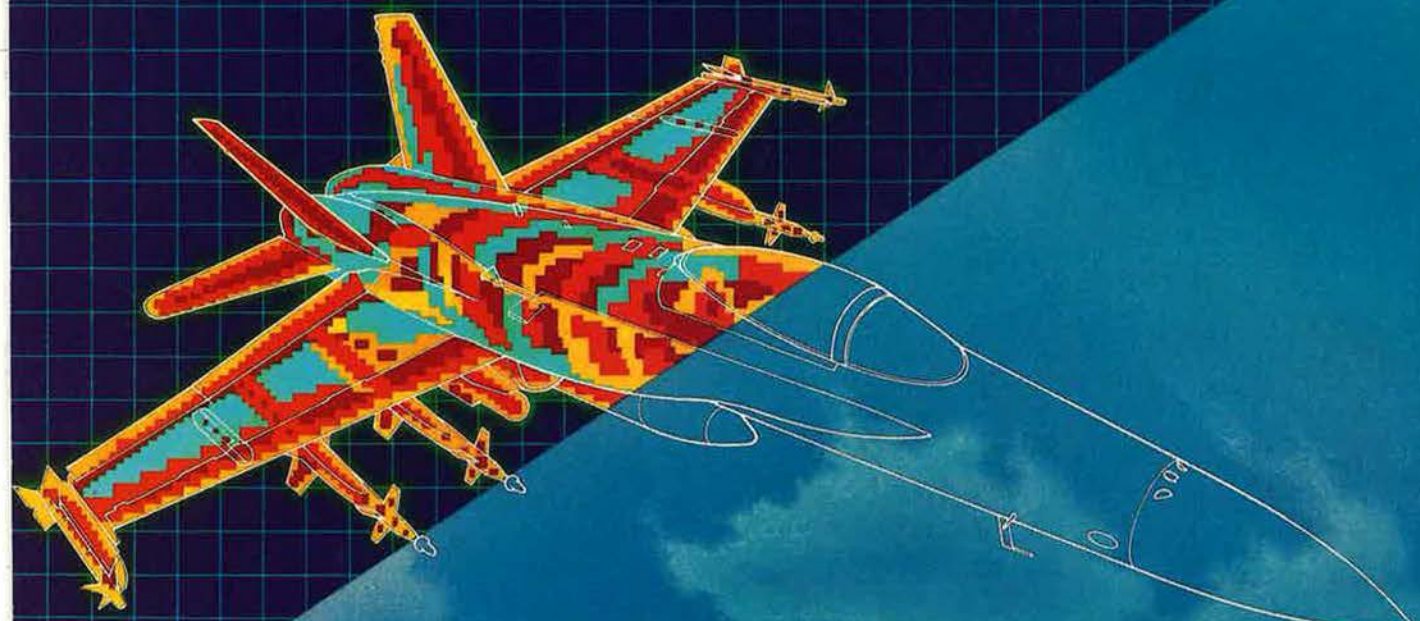

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GENERAL DYNAMICS

A Strong Company For A Strong Country

—USAF photo by MSgt. Sam Hotton

The members of the 81st Tactical Fighter Wing gather with pride around two of their A-10s. The unit, based at RAF Bentwaters and RAF Woodbridge, UK, recently set a safety record that is nothing short of amazing. Their 200,000 flying hours without a major accident are doubly impressive because the A-10 flies at low level in crowded airspace, and the 81st must also contend with the usually poor English weather.

27. This was the twenty-first competition held, and it also marked the first time women crew members from the Minuteman wings had taken part in the event.

★ For many years, the first thing visitors saw when driving up to the US Air Force Museum at Wright-Patterson AFB, Ohio, was the sleek shape of the North American XB-70 research aircraft.

The XB-70 is no longer standing gate guard, though. It is now one of the centerpieces inside the Museum's $10.8 million building addition.

The addition, which opened April 30 with little fanfare, nearly doubles the primary display space of the Museum. It runs the length of the existing building, has the same hangar-like shape, and is connected to the old building by a central hall.

Called the Modern Flight Gallery, the addition mainly features more than fifty aircraft that had been stored outside or in the Museum Annex, but plans are under way to add other exhibits. Besides the XB-70, the Museum's "X" series planes—X-1B, X-3, X-4, X-13, and X-15A-2—are in the addition.

Also on display are a Boeing B-52D, a Lockheed YF-12A (forerunner to the SR-71), a McDonnell Douglas F-4C, a Douglas C-47 and C-124, a North American F-100D used by the Thunderbirds, the Convair B-58 used in the last Bendix Trophy race in 1962, and a Consolidated OA-10A (PBY-5A) amphibian.

Funding for the addition was shared by the federal government and the Air Force Museum Foundation. Construction started in February 1986, and the building was delivered to the Air Force on December 31, 1987, under cost and slightly behind schedule because of weather delays. The Army Corps of Engineers monitored construction.

In May, the Museum received another addition—this time to its collection. The Boeing NKC-135 Airborne Laser Laboratory (ALL) aircraft used by the Air Force Weapons Laboratory at Kirtland AFB, N. M., was flown to Wright Field on May 4, and the testbed was presented to the Museum on May 20.

The NKC-135 was used in an eleven-year, $300 million experiment that proved that a high-energy laser could be put in an aircraft and successfully used against airborne targets. The plane's laser was housed in a rotating ball on the aircraft's spine.

During one flight on July 26, 1983, the laser's operators successfully engaged and defeated five AIM-9 Sidewinder air-to-air missiles aimed at the ALL, and on September 26, 1983, the laser was used to destroy an airborne BQM-34A target drone off the California coast.

The laser burned through the

—Air Force Museum photo by Harry Elliott

Staff members from the United States Air Force Museum at Wright-Patterson AFB, Ohio, maneuver a Boeing B-52D into the new wing of the Museum. This behemoth is now part of the recently opened addition, which houses the Modern Flight Gallery, containing more than fifty aircraft.

Raytheon Co. delivered its 100th Imaging Infrared (IIR) Maverick missile under its contract as a second-source producer with USAF. The company, which builds the missile in Bristol, Tenn., and performs final assembly in Chattanooga, Tenn., will deliver the lion's share of this year's Maverick buy. In a head-to-head competition with Hughes, Raytheon won the right to produce sixty-four percent of the missile buy. Hughes will produce the rest.

March 14 with Capt. Bruce McDuff serving as pilot and with the aircraft's crew chief, SSgt. Mark Delehantz, flying in the back seat. The aircraft will be put on display at Homestead.

The **562d Tactical Fighter Training Squadron** at George AFB, Calif., recently passed the 30,000-flight-hour plateau **without a Class A mishap.** More than 900 students graduating from five different F-4 courses were trained during this accident-free period.

★ **PURCHASES—Kuwait** notified the State Department on May 11 of its intention to **buy forty McDonnell Douglas F/A-18 Hornet** multirole aircraft through the Foreign Military Sales (FMS) program. If Congress does not block the sale, the deal is expected to be worth upward of $1 billion, counting spares and support. The sale would be the first F/A-18 purchase by a Middle Eastern country. Other than the US Navy and Marine Corps, the air forces of Australia, Canada, and Spain also fly Hornets.

Lockheed Aeronautical Systems Co. in Burbank, Calif., recently received a $66 million Navy contract to develop over the next four years an **electronic reconnaissance version of the S-3A Viking** carrier-based antisubmarine aircraft. A contract option worth $88 million could provide for modifying fifteen more aircraft to the ES-3A standard. The ES-3As will replace the 1960s-vintage EA-3B Skywarriors. The EA-3Bs, nicknamed "Whales," were restricted to shore operations just several months ago.

Raytheon got the lion's share of the **FY '88 buy of AGM-65D** Imaging Infrared (IIR) Maverick missiles. Raytheon, which had qualified as a second-source manufacturer in 1986, will build 1,889 missiles (sixty-four percent of the buy) under a $150.2 million contract, while Hughes, the company that developed the missile, will build 1,077 Mavericks (thirty-six percent) under a $132.2 million contract. This was the second head-to-head competition between the two companies. Hughes got sixty-six percent of the FY '87 buy.

★ **NEWS NOTES**—Space Shuttle astronauts and firefighters will now have something in common. After several months of design and testing, the National Aeronautics and Space Administration (NASA) has selected **a telescoping pole as the new method of escape for Shuttle crews.** The nearly ten-foot-long, downward curved, spring-loaded pole will be

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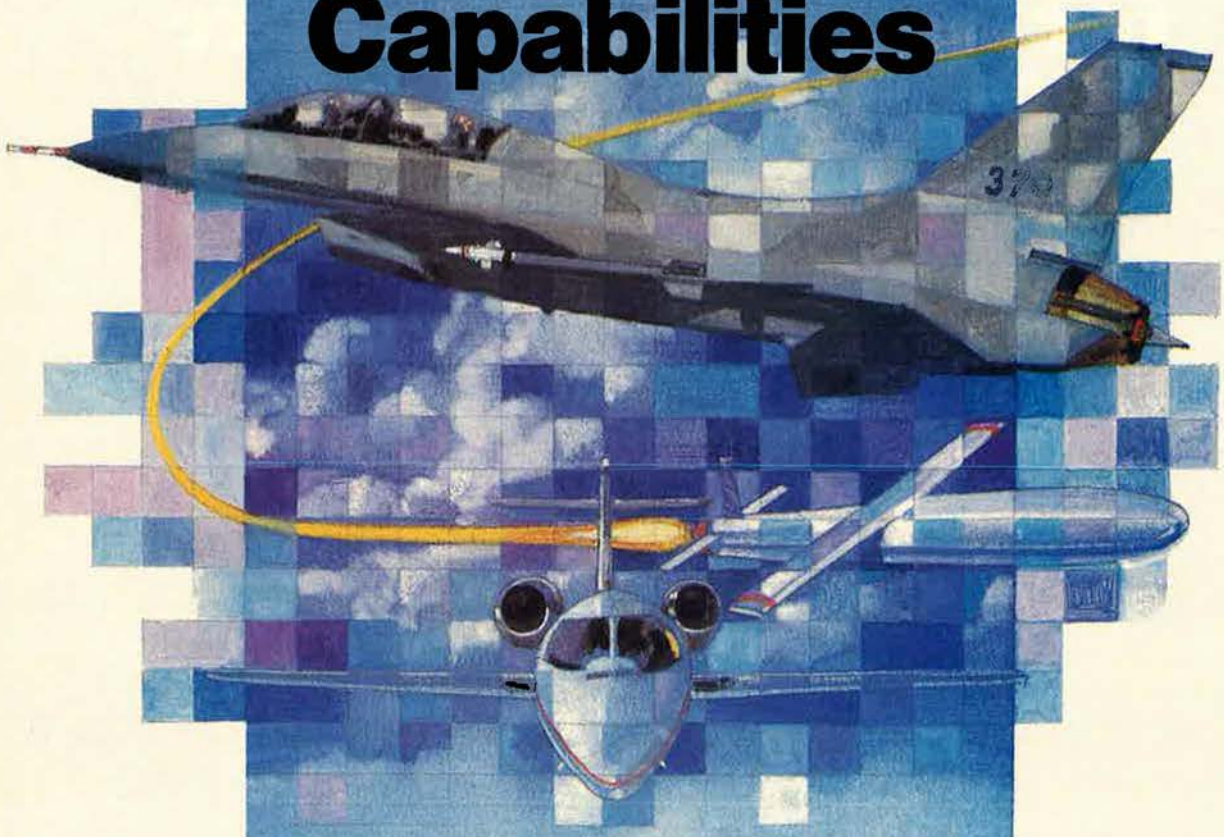

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stored in the Shuttle's middeck and will enable astronauts to clear the Orbiter's wings and tail during bailout under controlled gliding conditions only. The pole was tested by Navy parachutists jumping from a modified Air Force C-141B at Edwards AFB, Calif. The pole was chosen over a tractor rocket system.

The Air Force's **plan to close or merge Reserve Officer Training Corps (ROTC) units at thirty-seven colleges** *(see "Aerospace World," April '88)* **has been suspended** until at least 1990. Secretary of the Air Force Edward C. Aldridge, Jr., said in a memorandum that since many schools were not aware of Air Force's new judging criteria, the closings and consolidations would be suspended "out of fairness." The number of cadets in the Air Force ROTC program will be scaled back by fifteen percent over the next two years.

The United Kingdom's research and development center, the **Royal Aircraft Establishment** at Farnborough, **changed its name on May 1.** The highly respected RAE won't have to change its monogram, though, because the new name will be the **Royal Aerospace Establishment,** which better reflects the variety of work done there.

The **64th and 65th Aggressor Squadrons** at Nellis AFB, Nev., are phasing out their Northrop F-5E aircraft and **modernizing with General Dynamics F-16A aircraft** transferred from the 474th Tactical Fighter Wing at the base. The F-5Es are getting old and harder to support, and the F-16s better represent the capabilities of current Soviet bloc aircraft. The Red Flag program of providing US pilots with realistic adversary training began with the F-5s in 1972.

The **Navy,** meanwhile, is **preparing to return its thirteen leased** Israel Aircraft Industries **F-21A Kfirs** to Israel by mid-summer. The F-21As, assigned to VF-43 at NAS Oceana, Va., were used to provide adversary training to Naval aviators. The Marines will continue to train for the time being with their Kfirs at MCAS Yuma, Ariz., however. The Navy is converting to F-16Ns (an F-16C without some of that aircraft's avionics and the 20-mm cannon), and F-16 conversion training is being provided by the Air Force's 58th Tactical Training Wing at Luke AFB, Ariz. Fourteen F-16Ns will be assigned to NAS Miramar, Calif., and twelve other aircraft will be stationed at NAS Key West, Fla.

With 222,338 female officers and enlisted personnel and another 1,467 women in the military academies, **women now make up 10.3 percent of the US's military forces,** according to Pentagon figures for FY '87. This represents the highest total of women in the military since 1945. When World War II ended, 266,256 women were in the armed services.

In a related note, the **Danish** government announced that effective July 1, **women will be allowed to serve in all front-line combat positions,** including infantry, paratroop, and commando units. Denmark is the first NATO nation to allow women in combat units. Danish women pilots, however, will not be allowed to fly the country's F-16s until further tests are completed.

Senior Staff Changes

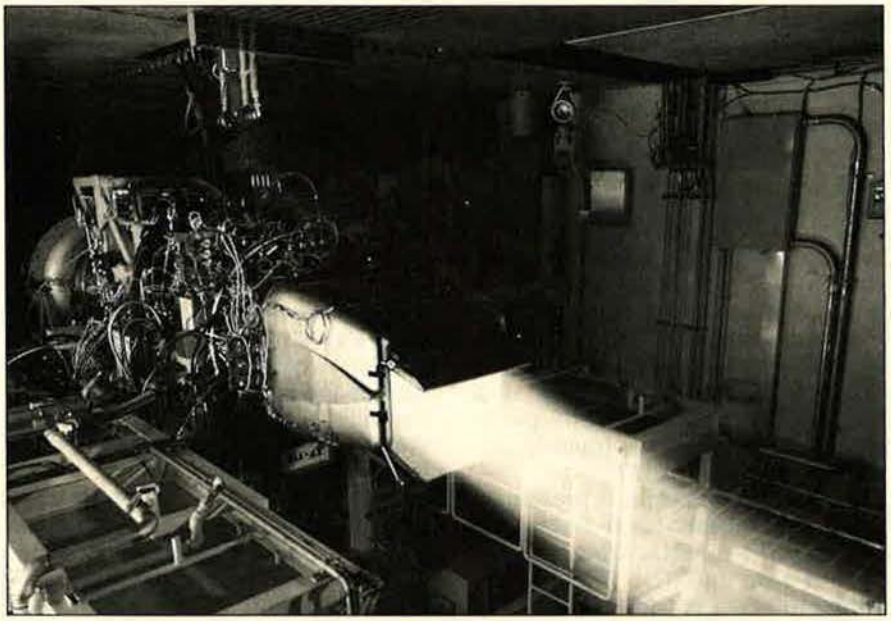
RETIREMENTS: L/G Aloysius G. **Casey;** B/G George E. **Chapman;** M/G Joe P. **Morgan;** L/G David L. **Nichols;** M/G Robert W. **Norris.**

Also, Gen. Robert H. **Reed;** B/G Horace L. **Russell;** M/G Jack W. **Sheppard;** B/G Earl S. **Van Inwegen;** B/G Charles P. **Winters;** B/G Mark J. **Worrick.**

CHANGES: B/G (M/G selectee) Robert M. Alexander, from Cmdr., 19th AD, SAC, Carswell AFB, Tex., to ACS/Studies & Analyses, and Cmdr., AFCSA, Hq. USAF, Washington, D. C., replacing B/G (M/G selectee) Richard E. Carr . . . **B/G (M/G selectee) Lester P. Brown, Jr.,** from Vice Cmdr., 12th AF, TAC, and Vice Cmdr., USSAF, USSOUTHCOM, Bergstrom AFB, Tex., to Cmdr., 24th AD, TAC, Griffiss AFB, N. Y., replacing M/G David M. Goodrich . . . **Col. (B/G selectee) Ralph T. Browning,** from DCS/Ops., 12th AF, TAC, Bergstrom AFB, Tex., to Vice Cmdr., 12th AF, TAC, and Vice Cmdr., USSAF, USSOUTHCOM, Bergstrom AFB, Tex., replacing B/G (M/G selectee) Lester P. Brown, Jr. . . . **M/G James T. Callaghan,** from C/S, ROK/US Combined Forces Command, Yongsan, Korea, to Dir., P&P, J-5, Hq. USEUCOM, Vaihingen, Germany, replacing retiring M/G Gordon E. Williams . . . **B/G (M/G selectee) Richard E. Carr,** from ACS/Studies & Analyses, and Cmdr., AFCSA, Hq. USAF, Washington, D. C., to C/S, ROK/US Combined Forces Command, Yongsan, Korea, replacing M/G James T. Callaghan . . . **AFRES B/G John J. Closner III,** from Cmdr., 10th AF, AFRES, Bergstrom AFB, Tex., to Cmdr., 10th AF, AFRES, and Member, Reserve Forces Policy Board, Bergstrom AFB, Tex.

M/G Archer L. Durham, from Dir. of Deployment, USTRANSCOM, MacDill AFB, Fla., to Dir., Washington Office, USTRANSCOM, Washington, D. C. . . . **B/G Frederick A. Fiedler,** from Director, C^2, Hq. SAC, and Ass't Dep. Dir., C^2, STRACOS, Offutt AFB, Neb., to DCS/Test & Resources, Hq. AFSC, Andrews AFB, Md., replacing retired B/G Charles P. Winters . . . **Col. (B/G selectee) Benard W. Gann,** from Cmdr., 5th Bomb Wg., SAC, Minot AFB, N. D., to Cmdr., 43d Bomb Wg., SAC, Andersen AFB, Guam, replacing Col. Grover R. Southerland . . . **M/G David M. Goodrich,** from Cmdr., 24th AD, TAC, Griffiss AFB, N. Y., to Ass't DCS/P&R, Hq. USAF, Washington, D. C., replacing retired M/G Jack W. Sheppard . . . **Col. (B/G selectee) Arthur E. Johnson,** from Dep. Dir., Resources, DCS/P&R, Hq. USAF, Washington, D. C., to JCS Rep. to Defense and Space Talks, OJCS, Washington, D. C., replacing retiring B/G Roger C. Smith . . . **Col. (B/G selectee) Owen W. Lentz,** from Dep. ACS/Intel., Hq. SHAPE, Mons, Belgium, to Dir., Intel., Hq. USSPACECOM, Peterson AFB, Colo., replacing B/G Richard J. O'Lear . . . **B/G Charles D. Link,** from Ass't Dep. Dir., Politico-Military Affairs, J-5, OJCS, Washington, D. C., to Dep. Dir., Politico-Military Affairs, J-5, OJCS, Washington, D. C.

Col. (B/G selectee) James W. McIntyre, from Dep. Dir., Bases and Units, DCS/P&R, Hq. USAF, Washington, D. C., to Command Dir., NORAD Combat Ops. Staff, J-31, Cheyenne Mt. Complex, Colo., replacing B/G Jimmy L. Cash . . . **Col. (B/G selectee) Philip W. Nuber,** from Cmdr., 343d TFW, AAC, Eielson AFB, Alaska, to Dep. Dir., AFCOS; Dep. Dir. of Ops, DCS/P&O, Hq. USAF; and Dep. Dir., Office of Mil. Support, Hq. DAMO/ODZ (Army), Washington, D. C., replacing retiring B/G Richard L. Craft . . . **B/G Richard J. O'Lear,** from Dir. of Intel., Hq. USSPACECOM, Peterson AFB, Colo., to DCS/Intel., and Cmdr., 7455th TIW, Hq. USAFE, Ramstein AB, Germany, replacing B/G Gary W. O'Shaughnessy . . . **Col. (B/G selectee) Graham E. Shirley,** from Cmdr., 20th TFW, USAFE, RAF Upper Heyford, UK, to Dep. Dir., Regional P&P, DCS/P&O, Hq. USAF, Washington, D. C., replacing retiring B/G William L. Hiner . . . **Col. (B/G selectee) Thad A. Wolfe,** from Spec. Ass't to CINC, Hq. SAC, Offutt AFB, Neb., to Dep. Dir., NSTL Div., JSTPS, Offutt AFB, Neb., replacing retired B/G Horace L. Russell. ■



Initial demonstration tests at sea level are under way at United Technologies' Pratt & Whitney facility in West Palm Beach, Fla., to show the vectoring capabilities of a two-dimensional, multifunction exhaust nozzle incorporated into the XF119 engine. The nozzle could be used to increase aircraft maneuverability and responsiveness. Tests at altitude will be conducted later this year at USAF's Arnold Engineering Development Center in Tennessee.

★ **DIED—Soviet Admiral of the Fleet Sergei G. Gorshkov,** "the father of the modern Soviet navy," on May 13. He was seventy-eight. As Commander in Chief of the Soviet fleet from 1956 to 1985, he oversaw the development of the navy from a collection of coastal vessels and rivercraft to one of the two most potent maritime forces in the world today.

Also: retired **Col. Bruce D. Witwer,** who was in charge of the joint Air Force/Atomic Energy Commission (now the Nuclear Regulatory Commission) attempt to develop a nuclear-powered airplane, of a pulmonary embolism on May 12. He was seventy.

From 1955 to 1961, Colonel Witwer headed the project to build the nuclear-powered X-6. Although the project was canceled in 1961, a P-1 nuclear reactor was installed in the NB-36H Crusader aircraft and was successfully operated in flight (although not to power the plane) as part of the X-6 effort. Colonel Witwer was later in charge of the Air Force's nuclear power division. ■

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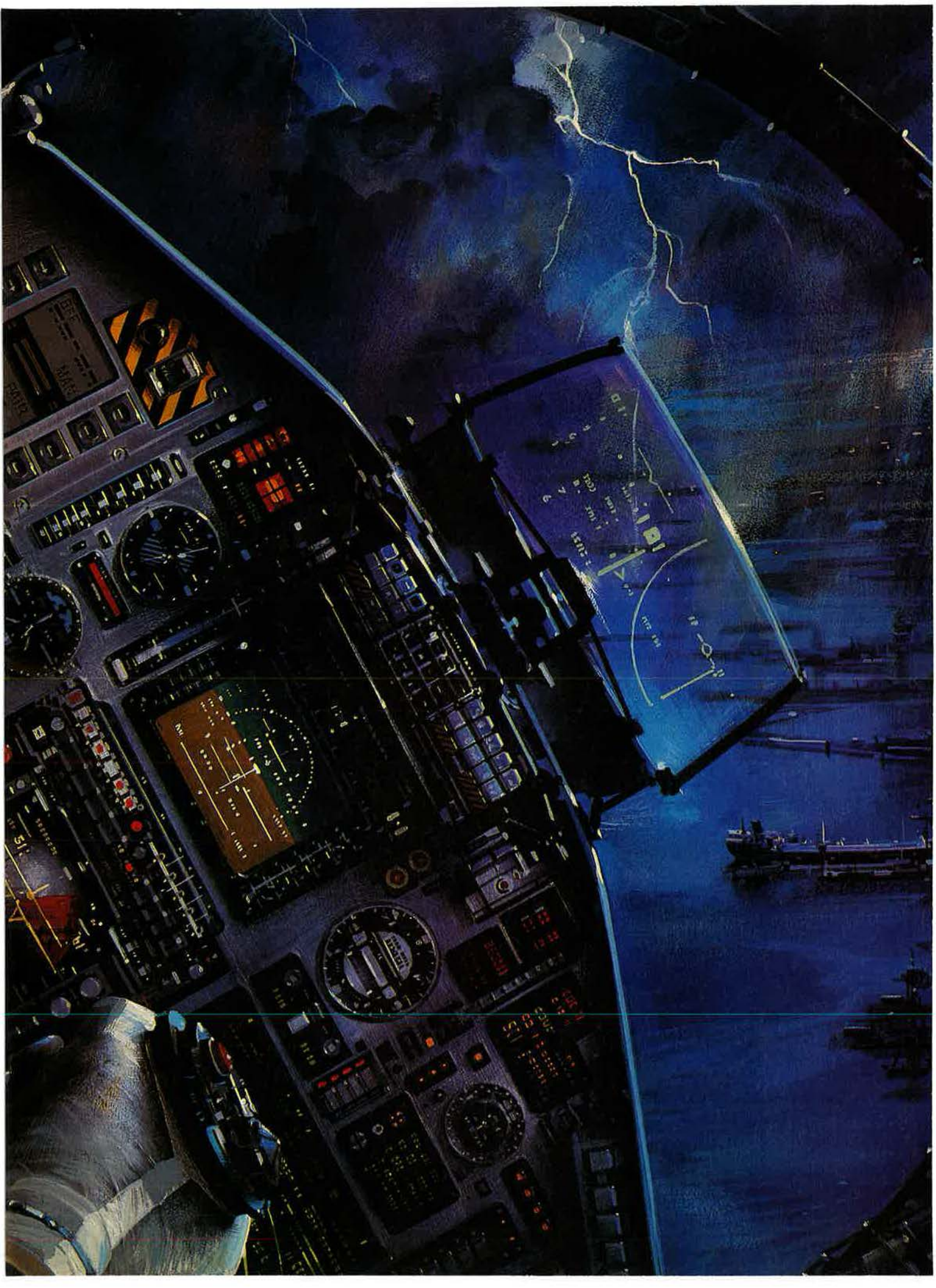

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Emphasis has shifted in military electronics. The big effort now is systems for the AirLand Battle, and the flagship program is Joint-STARS.

ESD Tunes Up For a Tactical Push

BY ROBERT S. DUDNEY
SENIOR EDITOR

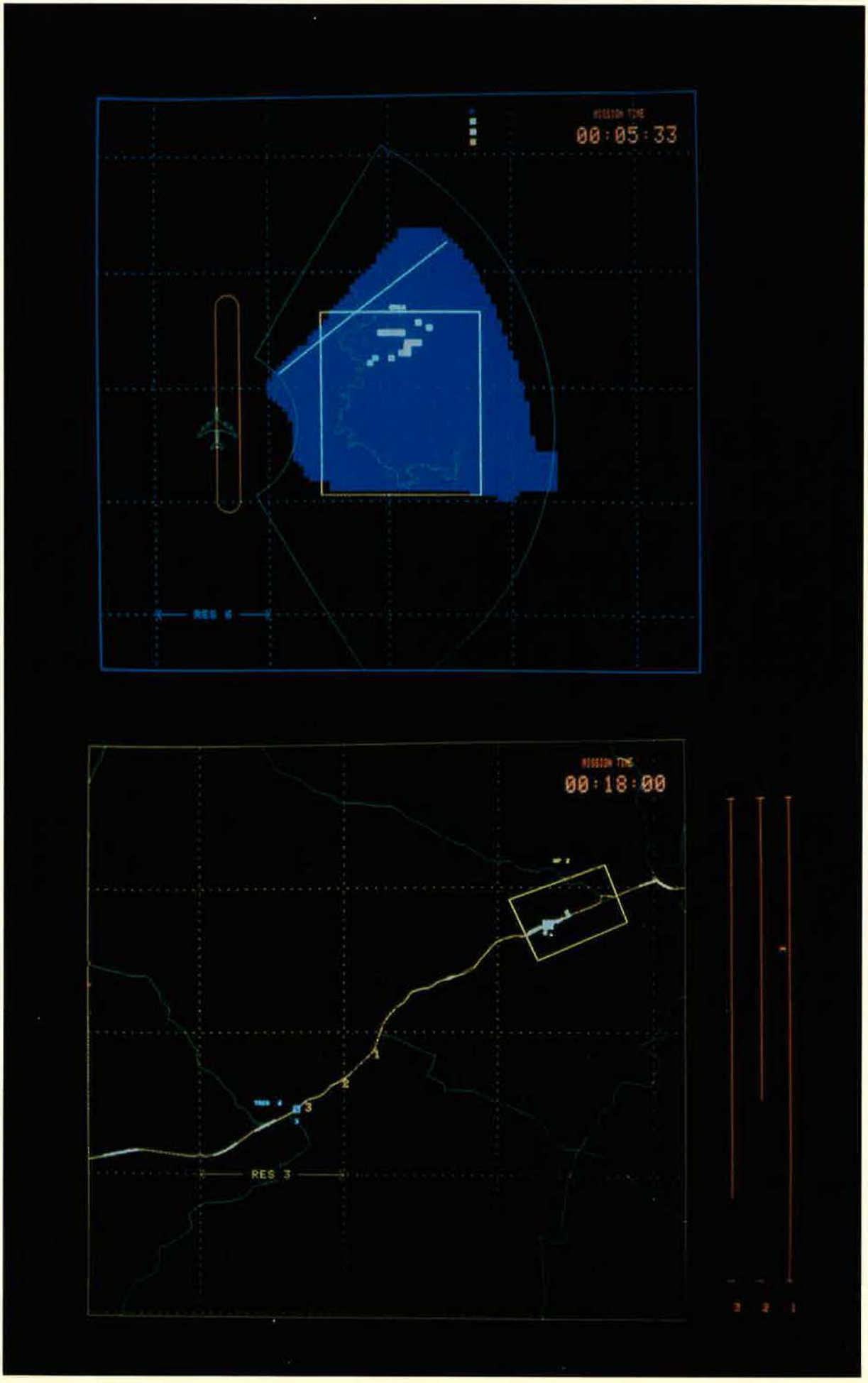
THIS November, an E-8A aircraft prowling off the Florida coast will flash a powerful radar beam at Cape Canaveral. Air Force officers will hold their breath, waiting to see how well the Joint Surveillance Target Attack Radar System detects "movers" on the ground.

Thus will begin many months of key tests and fixes that will pit the first Joint-STARS airplane against targets ranging from a few trucks moving at medium speeds all the way up to large numbers of slow-moving tanks and other vehicles dispersed over vast stretches of US terrain.

The Air Force hopes that the end result will be an electronic marvel of an aircraft—able to peer deep into enemy territory to locate and target tanks. The reason is simple: This capability holds a key to NATO's "Follow-On Forces Attack" plan to counter Soviet landpower.

The ramrod of the Joint-STARS program, Air Force Systems Command's Electronic Systems Division at Hanscom AFB, Mass., has its work cut out for it. ESD is

With a fleet of twenty-two USAF/ Grumman E-8 Joint-STARS aircraft aloft over Europe, Western forces could seize the electronic "high ground" critical to prosecuting the battle on land. The Boeing airframe (above) will carry a Norden radar that will display levels of enemy activity and plot directions, speeds, and possible engagement points (photo at right).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—Photo by Paul Kennedy

the nation's fleet of thirty-four E-3 AWACS sky-sweeping sentry planes. It would be a key element of ESD's major program to upgrade these aircraft and keep them useful into the next century.

ESD currently is well along in full-scale development of articles and software for its so-called "Block 30/35" upgrade to the AWACS, a four-part, $650 million program spanning nearly a decade.

The upgrade, managed by Boeing, would integrate the JTIDS Class II terminals into the AWACS system, integrate Global Positioning System terminals, and upgrade the main IBM CC-2 computer to the CC2-3 configuration through installation of an advanced bubble memory that will increase its speed by a factor of four.

"Ears" for the AWACS

The fourth element, the so-called Electronic Support Measures program, is a cooperative US/NATO effort that will give the thirty-four US and eighteen NATO AWACS a highly sophisticated passive detection system to go with their active radar equipment. It is being performed by UTL Corp. of Dallas.

"This system," says Col. Jim Bash, program manager for the AWACS upgrade, "will be able to identify emitters out there using a huge data base that is being developed." This classified data base will compile information from US and allied intelligence sources.

ESD expects no problems with critical design review of the Block 30/35 upgrade, scheduled to take place in October. TAC aircraft will begin receiving the equipment in 1992.

Also in the works are two other major AWACS programs, the most important of which is the Radar Sensitivity Improvement Program now in the early development stage.

ESD has the job of making AWACS radars more capable of spotting and tracking airborne targets. It is not the radar itself that will be altered. Rather, the radar's computers will be given extra power. That will permit AWACS to see standard aircraft at greater distances as well as to spot smaller targets, such as cruise missiles.

The radar program has the potential for significantly extending current detection ranges against unstealthy targets.

The other program, just completing development, would integrate the new Have Quick II ultrahigh-frequency radios into the vast AWACS electronic architectures. Tested this past spring, the integrating system came through without a hitch.

Similar results can be found in ESD's portion of systems in the joint-service TRI-TAC communications program, set up to bring all the US military ground networks into the digital world for the first time.

The new systems, replacing similar items from the outdated analog world, are bringing about a quantum leap forward in communications capability as well as major gains in reliability and maintainability of the equipment.

The prime case in point is the Air Force's new troposcatter radio, the TRC-170, which is part of the TRI-TAC system.

Built by Raytheon, the tropo radios relay messages over distances up to 200 miles—far beyond the capabilities of earlier radios—simply by bouncing radio signals off the troposphere for receipt on earth. Not only do the tropo radios send messages farther, they also break less often and provide a higher degree of security.

Last October, US troops in West Germany took the radio out for a demonstration shot. Having always used the old TRC-97 radio, they

USAF's E-3 AWACS sentry plane (left) will retain its distinctive skunk-stripe radome on top, but elsewhere there will be big changes. E-3s such as the one being tended here by A1C Rod McFadden and TSgt. Ricky Maddox will get JTIDS Class II terminals, Global Positioning System terminals, extra shots of speed and power in its CC-2 computer, and a new passive detection system to complement its active radar. The hope is that E-3 battle managers (right) will get a sharper, fuller picture of the air battle than ever.

never could transmit more than about sixty miles. "We put in a shot from about 115 miles," says an ESD program officer. "They didn't have to adjust anything. They set the antennas up. As soon as they turned it on, they were locked in."

More than 200 tropo radios have been delivered, with another 600 yet to be built at a cost of about $1 million each. Unisys of Salt Lake City has won the right to compete against Raytheon. It should have achieved qualification by 1989.

"Seeing" Cruise Missiles

On the strategic side of the ESD house, the going has been difficult in many programs—mainly as a result of up-and-down funding over the years. Still, program officials can point to steady progress in recent months in developing new surveillance and C^3 systems.

ESD's Over-the-Horizon Backscatter (OTH-B) radar system is a case in point.

OTH-B transmitter antennas bounce high-frequency signals off the ionosphere to the earth's surface. The signal is then reflected toward a receiving antenna. When the signals strike airborne targets at any altitude, they bounce back with data on their precise location.

After long delays, the first two sectors of the three-part East Coast OTH-B system, based in Maine, went into limited operation and are now into their eighth month of use. The central sector is scheduled to begin limited operations this month. And a West Coast system is well into construction.

Even more significant, however, was the outcome of ESD's so-called Small Target Test Program (STTP) conducted in recent months. ESD picked up valuable data about how to detect and track cruise missiles with OTH-B, though the radar system was not originally designed to do so.

ESD began testing last January by sending remotely piloted vehicles (RPVs) that resemble cruise missiles against the East Coast facility, launching a total of twenty-nine RPV missions over a range of altitudes, at different times of day and night, and at various aspect angles, including head-on.

One result of this sequence, according to Col. James Lee, the OTH-B program manager: "We can say is that we do have a capability against the cruise-missile threat with the East Coast system."

A more important result, however, is that the testing provides hard information about the proper kinds of improvements to make to the remaining West Coast, Alaska, and Central OTH-B radar segments as they are developed and deployed.

The RPV testing is complete, but the STTP will continue through the summer. ESD will conclude an official report on the tests sometime early in the fall.

In another aspect of strategic air defense, the US/Canada North Warning System is heading for operational status in 1992, apparently on schedule. The NWS, composed of fifty-two new radar stations facing the Arctic, will replace the aging Distant Early Warning Line. OTH-B and NWS, taken together, are expected to give Washington a superior new early warning system against Soviet air attack.

What's more, ESD appears to be pressing forward with its portion of the Air Defense Initiative (ADI), a research program set up in 1985 to develop the kinds of advanced surveillance and battle management technologies, and ways of integrating them, that might help yield an in-depth defense against bombers and low-flying cruise missiles.

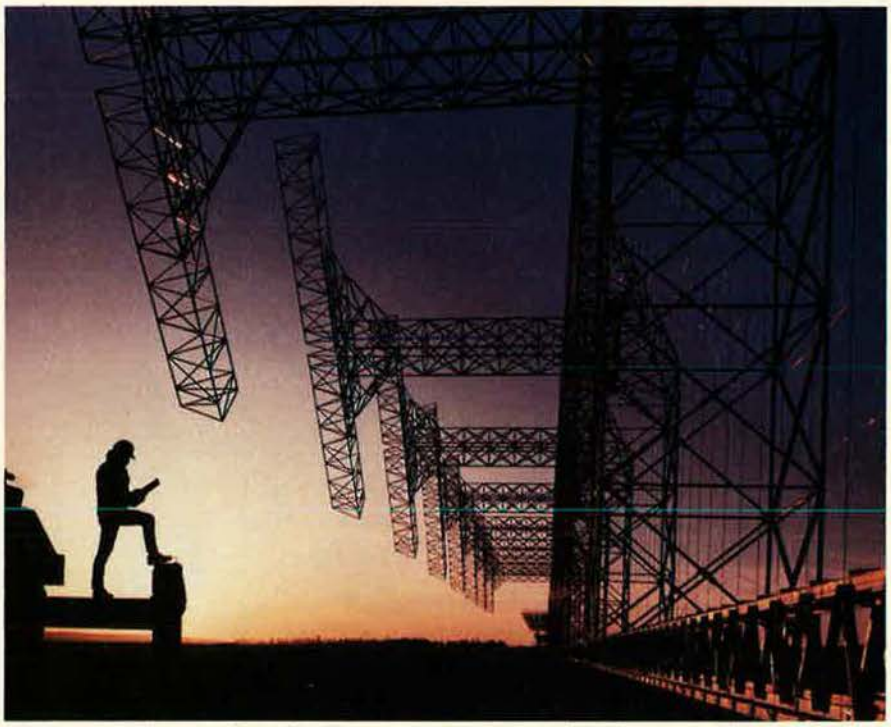
ESD's portion of ADI is currently in the concept-definition phase only, with no new starts on the horizon. But there is plenty of action.

ESD's Advanced Surveillance and Tracking Technology (ASTT) program seeks to develop new sensors that can be teamed up with the OTH-B and others in providing "wide-area surveillance" of all air approaches.

What's more, the year 1989 will see acceleration of technology work—ranging from work in infrared spectrum technology to work in various L-band surveillance radars.

Other ADI engineers are studying such new ideas as picket-ship RPVs over Canada and neural networks to help air defenders sort out targets. These ideas are being pulled together by four contractor teams given a mission to think up different kinds of ADI "architectures." The contractor team-leaders are General Dynamics, Hughes, SAIC, and Raytheon.

The situation in ADI is summarized in this fashion by one ESD worker: "The good news—and bad news—is that there are more tech-



With the advent of the Over-the-Horizon Backscatter (OTH-B) radar system, a new day is dawning in long-range airspace surveillance. The transmitter subsection of the East Coast segment, shown here, contains twelve elemental 100-kilowatt transformers. The system can "see" airborne targets out to a distance of 2,000 miles.

nical opportunities than we can afford. The real challenge is to figure out how to keep the technology fires burning while responsibly beginning to select and invest increasingly larger amounts in the things that have the highest payoffs and the most relevance to the user."

Steady Milstar Steps

In the C^3 segment of the strategic modernization program, the highest priority is the classified Lockheed EHF Milstar communications satellite and its associated terminals. The latter are being built by Raytheon, teamed with Bell Aerospace and Rockwell Collins.

At the heart of the Milstar program is its ability to provide global two-way communications to the strategic and tactical forces that will be less susceptible to the effects of nuclear detonations and jamming. Critical as this is to US nuclear strategy, both the Milstar satellite program and the terminals program have lagged.

Col. Richard Bush, ESD's head of the terminals program, estimates that the overall Air Force Milstar effort remains eighteen to twenty-four months behind schedule. ESD's terminals portion is about halfway through development.

Even so, ESD officials believe they have turned the corner on this critical program. There is evidence to support their case.

First, engineers predict that the Air Force will complete its total, formal qualification for all the black boxes for the Milstar terminals by the end of the year. This is expected to apply to both hardware and software elements.

What's more, says Colonel Bush, there have been two successful tests at the system level in recent months—one where a Milstar terminal and a prototype Milstar satellite communicated together, the other being a successful communication between an Air Force and Navy terminal.

"What I will assert to you is that our technical problems are now largely behind us," says Colonel Bush. "I would not have made this same statement to you a year ago." Funding, however, remains problematic.

ESD reached another milestone of sorts earlier this year with establishment of full operational capability of its long-awaited SAC Digital Information Network (SACDIN). ESD's work on the 135 functional areas of the SACDIN system has been completed and is undergoing final evaluation. Operational control is scheduled to be formally passed to SAC operators this month.

Riding "the wave" of tactical development efforts will be such USAF fighters as this F-15 Eagle from the 18th Tactical Fighter Wing at Kadena AB, Okinawa, Japan. Air-to-air and air-to-ground warplanes, it is hoped, will piggyback on new electronic systems, such as AWACS and Joint-STARS planes, to reach maximum combat power.

It has been a long wait for the SACDIN system, which provides high-speed transmission of data from US command centers to SAC bomber and missile centers. First proposed in different form in 1969, the development program has had a bumpy road, with many changes to system schedules and direction.

Now that it's completed, however, ESD officials and SAC appear to be pleased with the results. Maj. Wayne Balcom, SACDIN's program manager, says the system would permit the President to flash a vital emergency action message to all bomber and missile locations in a mere fifteen seconds or less—all of it encrypted and secure.

Beyond the "Thin Line"

Similar results can be seen in the development of the nation's Ground Wave Emergency Network, a multistation linkup of low-frequency radio towers and receiving terminals that would be resistant to the effects of nuclear electromagnetic pulse that could knock out other systems during the first stage of a nuclear exchange.

ESD has completed the development tests portion of the program, which in its initial "thin-line" configuration will consist of fifty-six relay nodes. Now under way is the initial operational test and evaluation phase, intended to confirm to SAC that the system will meet its needs.

Construction of the relays in this initial phase is nearly completed. Fifty-one of the fifty-six nodes have been erected. Site selection, evaluation, or construction is under way on the final five, located in Colorado, southern New Jersey, and three sites in the New England region.

Between now and 1996, according to current Air Force plans, the initial system will be expanded to approximately ninety-six relay towers, the better to provide redundancy for the critical communications system. Even this, however, would mark a sharp reduction of the program, which originally envisioned building as many as 240 towers.

"Obviously, you can't reach as many places as many ways with fewer towers," explains Lt. Col. William Colmer, ESD's GWEN program manager. "But we have found that ninety-six relay nodes will do an excellent job of performing the system task." ■

A Checklist of Major ESD Systems

Work in progress at the Electronic Systems Division.

Advanced HF Concepts
Development and acquisition of new technologies for existing high-frequency radios; narrowband and wideband items for uses after 1995. **Contractor:** None. **Status:** Concept definition.

Advanced Tactical Battle Management System
Program to identify alternatives to satisfy future tactical C^3 needs. **Contractor:** None. **Status:** Research.

AF JINTACCS
USAF input to a program for joint interoperability of tactical command and control systems, designed to ensure that Air Force standards are included in the program. **Contractor:** JTC^3A. **Status:** Full-scale development.

AF SAFE Program
Procurement of physical security equipment for deployment to seventy USAF bases and 210 sites overseas. **Contractor:** None. **Status:** Deployment.

AF Tactical Shelter Systems Development
This Air Force focal point for all mission systems requirements for mobility and transport gives early engineering support to all program offices that use mobile tactical shelters and is overall manager of R&D on shelters. **Contractor:** Multiple. **Status:** Full-scale development.

AF Worldwide Military Command and Control Information System
The C^3 systems planning and engineering center for USAF elements of the defense-wide system. **Contractor:** GTE, IBM. **Status:** Full-scale development.

Airborne Battlefield Command and Control Center III
A C-130-based, automated airborne command and control system for TAC use in forward battle areas and with special operations forces. **Contractor:** Unisys. **Status:** Production.

Airborne Warning and Control System (E-3)
A major upgrade program for the AWACS surveillance and battle management aircraft. It includes additional sensors, anti-jam communications, and radar systems upgrades to keep the plane in service into the next century. **Contractor:** Boeing. **Status:** Full-scale engineering development.

Aircraft Alerting Communications Upgrade
An upgrade program designed to provide assured communication from CINCSAC to alert aircraft, secure from effects of electromagnetic pulse (EMP). **Contractor:** BDM Corp. **Status:** Full-scale development.

Air Defense Initiative
Definition, development, and demonstration of new technologies required for future construction of a comprehensive active air defense system for the continental United States. Emphasis is on technologies for surveillance, battle management, and C^3I against advanced air vehicles. **Contractor:** Multiple. **Status:** Concept definition.

Air Logistics Centers/Local Area Network
Provides for development, installation, testing, and integration of a local communications system connecting the five Air Logistics Centers. **Contractor:** TRW. **Status:** Deployment.

Air Traffic Control and Landing System
Development of an AN/GPN-20 electronic countermeasures program to protect approach-control radar performance against countermeasures. **Contractor:** None. **Status:** Concept definition.

Alaskan HF Networking Demonstration
An eleven-node, high-frequency networking demonstration, conducted with the Alaskan Air Command, using ESD software. **Contractor:** MITRE. **Status:** Advanced development.

Alternate Command Operations Center/ Royal Saudi Air Force
Acquisition of an alternate operations center composed of commercially available hardware and software. **Contractor:** Hughes. **Status:** Preoperational.

Automated Tactical Aircraft Launch and Recovery System
Development of a system to automate air

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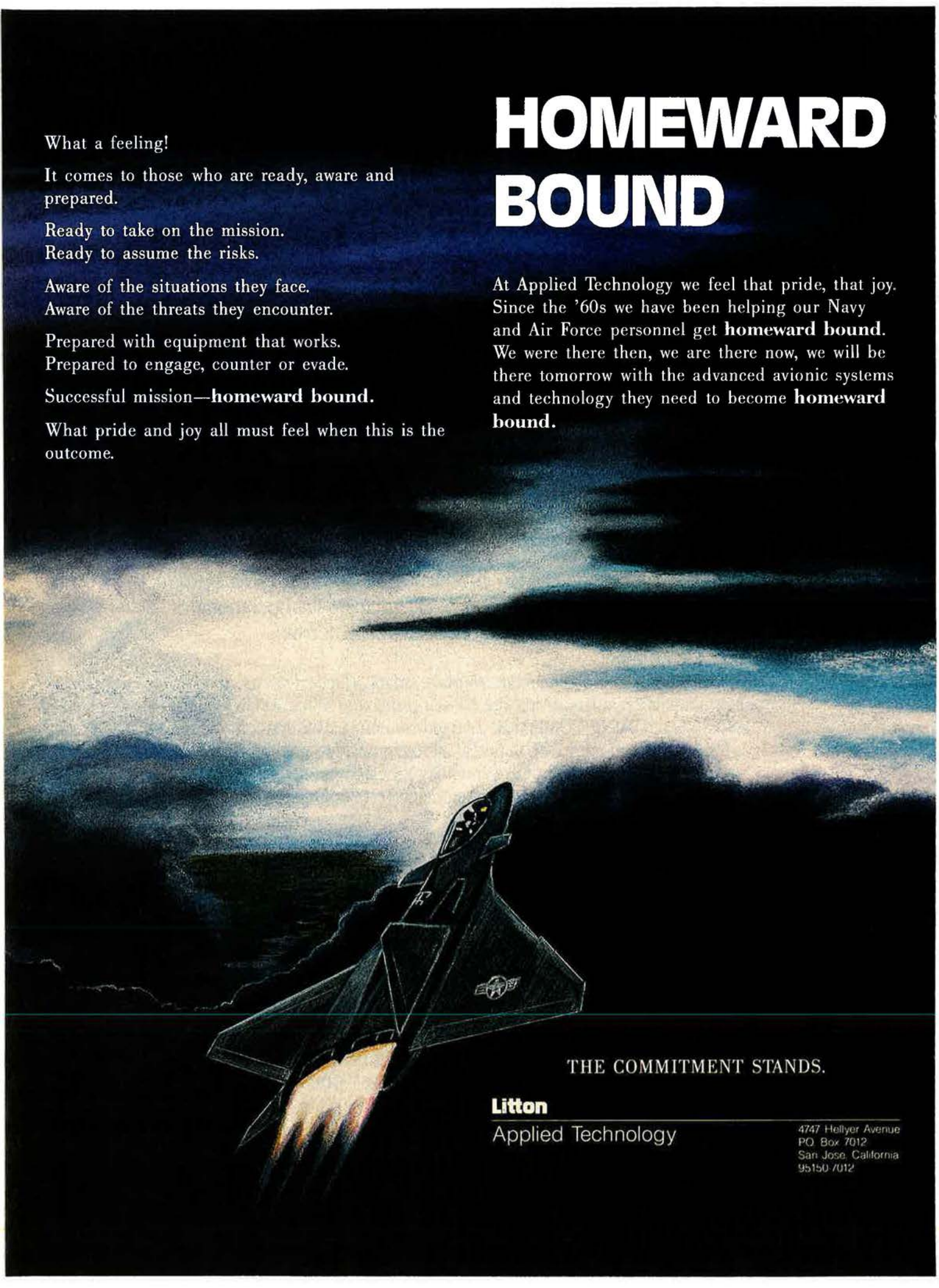

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traffic control and to integrate aircraft systems. This system would control independent landing locations and integrate battle management systems. **Contractor:** Transportation Systems. **Status:** Concept definition.

Automated Weather Distribution System
Program to enhance the Air Weather Service's meteorological support for the Army and Air Force by using advanced computer technology and graphic presentation software. **Contractor:** Canadian Commercial Corp. **Status:** Development.

Avionics Intermediate Shop Mobile Facility
Program provides for developing shelter systems for F-15, F-16, A-10, and F/EF-111 avionics maintenance. **Contractor:** Medley Tool & Model Co. **Status:** Production.

Battlefield Weather Observation Forecast Systems/Decision Aids
Program to provide decision aids that will assess weather effects on various weapon systems in specific battle situations. **Contractor:** None. **Status:** Research.

Battlefield Weather Observation and Forecast System/Surveillance
A tactical decision aids system for providing weather observation from enemy and other hostile areas. **Contractor:** None. **Status:** Advanced development.

BMEWS Modernization Program
Program to upgrade the Ballistic Missile Early Warning System radars in Greenland and the UK, plus modernization of BMEWS radars in Alaska. **Contractor:** Raytheon. **Status:** Production.

Caribbean Basin Radar Network
Program to upgrade US air surveillance in the Caribbean by means of transmission of radar data via satellite and land links to US C^3 centers. **Contractor:** Westinghouse. **Status:** Production.

Cobra Dane Modernization
Upgrade to replace aging computers and software and improve processing of data from the land-based phased-array radar at Shemya AFB, Alaska. **Contractor:** None. **Status:** Planning.

Combat Communications Access for Support Elements
Program to develop system for transfer of logistic information within battle areas and between battle areas. **Contractor:** None. **Status:** Development.

Combat Grande
Joint USAF and Spanish Air Force program to modernize Spain's air defense system. **Contractor:** None. **Status:** Development.

Comfy Crane
Special signal-acquisition radar that processes and records the capability for intelligence collection in the southeast United States. **Contractor:** Not available. **Status:** Operational.

Comfy Sword
Program to develop a jamming and deception system for training aircrews to operate in an electromagnetic environment. **Contractor:** Tracor Flight Systems. **Status:** Production.

Command Center Processing and Display System
A replacement system, part of the ballistic missile warning network, to receive warning information from sensors and produce integrated warning and attack assessment displays for Cheyenne Mountain and SAC headquarters. **Contractor:** TRW. **Status:** Full-scale development.

Communications System Segment Replacement
A replacement system to improve the reliability, capacity, and flexibility of Cheyenne Mountain communications processing. **Contractor:** GTE. **Status:** Full-scale development.

Computer Resource Management Technology
Engineering development program to transform the software advances of industry, universities, and laboratories into use in USAF weapon systems dependent on computer resources. **Contractor:** HH Aerospace. **Status:** Engineering development.

Deep Space Surveillance Radar
Program to develop radars that will gather surveillance and warning information on critical synchronous-altitude space assets. These radars are expected to be an integral part of the US Deep Space Surveillance Network. **Contractor:** None. **Status:** Concept definition.

Digital Brite
System that will replace the existing Brite display system with more reliable equipment displaying alphanumeric beacon data. **Contractor:** SDC, Unisys. **Status:** Preproduction.

Digital European Backbone
Incremental upgrade to portions of the European Defense Communications system from insecure analog systems to secure digital systems. **Contractor:** GTE. **Status:** Production.

Diversity Reception Equipment
System to improve low-frequency communications for the Worldwide Airborne Command Post fleet. **Contractor:** Sonicraft Corp. **Status:** Full-scale development.

DoD Base and Installation Security System
RDT&E program to develop physical security equipment for DoD sites worldwide. **Contractor:** None. **Status:** IOT&E.

Egyptian Encryption Acquisition
Acquisition of commercial digital encryption devices to link Egyptian E-2C aircraft and the ground-based air defense system. **Contractor:** Rockwell. **Status:** Development.

Egyptian E-2C/776 Interoperability
Technical assistance to Egypt on how to coordinate the E-2C Hawkeye aircraft and the 776 Ground System. **Contractor:** Hughes. **Status:** Deployment.

Eifel
US/German program to improve telecommunications and automated data processing at the Air Tactical Operations Center at Sembach AB, West Germany, and associated bases. **Contractor:** Dornier GmbH. **Status:** Ongoing.

GEODSS
A ground-based, electro-optical deep space surveillance system that will extend Air Force Space Command's spacetrack capabilities out to 20,000 miles in space. **Contractor:** TRW. **Status:** Production.

Granite Sentry
Program that will replace the current NORAD computer system and modular display system and upgrade the command post, air defense operations center, battle staff support center, and weather support unit in Cheyenne Mountain. **Contractor:** Digital Equipment Corp. **Status:** Full-scale development.

Ground Attack Control Capability
System to give the Tactical Air Control System the ability to coordinate air interdiction attacks rapidly against timely ground targets, moving and stationary. **Contractor:** Litton Data Systems. **Status:** Full-scale development.

Ground Mobile Forces SATCOM Terminals
Program to produce highly mobile satellite communications terminals for the tactical air forces and others. **Contractor:** RCA/Harris. **Status:** Production.

Ground Wave Emergency Network
Strategic C^3 program to provide US strategic forces with long-range communications that can continue to function even in the presence of electromagnetic pulse. **Contractor:** RCA. **Status:** Full-scale development.

Have Quick II/IIA
An upgrade improvement to the Have Quick antijam UHF voice communications radio. **Contractor:** Multiple. **Status:** Production.

Have Sync
Development of a single-channel ground and airborne radio system for antijam, secure-voice VHF/FM/AM communications to replace the AN/ARC-186 radio. **Contractor:** Cincinnati Electronics. **Status:** Full-scale development.

Information Processing System
Provides automated support for command and control functions for MAC. **Contractor:** Multiple. **Status:** Research.

Integrated Tactical Warning and Assessment System
Acquisition of new systems and upgrade

of existing systems of the Integrated Tactical Warning and Assessment System. **Contractor:** None. **Status:** Research.

Intelligence Work Station
Joint ESD/Rome Air Development Center project to replace standard intelligence terminals with modular, standalone stations. **Contractor:** Eaton. **Status:** Production.

Intratheater Imagery Transmission System
Program to develop a hard-copy image dissemination system to allow the tactical air forces to transmit photographs and other intelligence information swiftly by electronic means. **Contractor:** GE, Litton. **Status:** Full-scale development.

Joint Services Imagery Processing System
Development of a ground station to receive, process, and disseminate national, strategic, or tactical imagery to combat commanders. **Contractor:** E-Systems. **Status:** Full-scale development.

Joint Surveillance Target Attack Radar System
A joint Air Force/Army program to develop the primary sensor needed to carry out the AirLand Battle doctrine. A sensitive, side-looking multimode radar will be integrated with an E-8A platform to create a targeting system able to detect stationary and moving targets on the ground. **Contractor:** Grumman/Boeing/Norden. **Status:** Full-scale development.

Joint Tactical Fusion Program
An evolutionary program to develop the Air Force's Enemy Situation Correlation Element and the Army's All-Source Analysis System, two programs that use data from numerous sources to create a picture of the battlefield. **Contractor:** NASA/JPL. **Status:** Development.

Joint Tactical Information Distribution System
A program to develop a high-capacity, jam-resistant, secure digital information system that will permit the distribution of intelligence data among fighter aircraft, surveillance aircraft, ground air defense units, and naval vessels. Class II terminals are under development. **Contractor:** Singer Electronics. **Status:** Demonstration.

Knowledge-Based Systems Application
Development of a computer expert system, using artificial intelligence techniques, to augment MAC airlift planning. This system will permit planners to perform certain tasks 10,000 times faster than is the case today. A second program will apply to Air Force Space Command for decision-making. **Contractor:** MITRE. **Status:** Demonstration.

Logistics Information Management System
A program to produce logistics information architectures and recommendations for helping to keep USAF weapons in a high state of readiness. **Contractor:** None. **Status:** Concept definition.

MAC Global Decision Support System
Program to upgrade MAC's six principal command centers. **Contractor:** NASA. **Status:** Deployment.

Microwave Landing System
A four-part DoD program to develop and produce landing systems to replace existing instrument landing system and precision approach radars. **Contractor:** Multiple. **Status:** Engineering development.

Milstar Satellite Terminals
Development of reliable, antijam, and survivable extremely-high-frequency satellite communications terminals for strategic and tactical use among all services. **Contractor:** Raytheon. **Status:** Full-scale development.

Miniature Receive Terminal
A program to develop survivable, low-frequency terminals to upgrade communications among the NCA, SAC, and SAC bombers and that will work even in a nuclear environment. **Contractor:** Rockwell. **Status:** Full-scale development.

Modular Control Equipment
Development of a transportable, modular automated air command and control system. **Contractor:** Litton Data Systems. **Status:** Production.

NATO Air Base SATCOM Terminal Program
Development of survivable terminals for wartime communications between NATO Air Operations Centers and allied airfields. **Contractor:** Harris/Ford. **Status:** Production.

NATO AWACS Program
Development, production, and enhancement of NATO's eighteen AWACS sentry planes. The program includes installation of a major upgrade known as Electronic Support Measures to provide a passive sensor system as a complement to active radar sensors. **Contractor:** Boeing. **Status:** Deployment.

North Warning System
A program to develop new long- and short-range radars that will replace the aging Distant Early Warning (DEW) Line and provide continuous coverage from the northern slopes of Alaska across Canada and down the east coast of Labrador. **Contractor:** Unisys/GE. **Status:** Full-scale development.

Over-the-Horizon Backscatter Radar
Program to develop and deploy a series of four radar systems for long-range detection, early warning, and attack assessment of bomber and cruise-missile threats. **Contractor:** GE. **Status:** Full-scale development.

Pakistan Aircraft Early Warning Study
A joint survey of Pakistan's requirements for aircraft early warning systems and a detailed comparison of candidate systems to meet these needs. **Contractor:** None. **Status:** Feasibility studies.

Pave Paws
A program to develop and deploy advanced, large-scale, phased-array radar systems to provide precise early warning and attack characterization of enemy sea-launched ballistic missiles from all directions. **Contractor:** Raytheon. **Status:** Deployment.

Peace Cube
Development of command control communications for Somalia's Ministry of Defense. Construction and installation of displays, local area communications, and long-haul communications subsystems are included in this effort. **Contractor:** Contel. **Status:** Preoperational.

Peace Quiet
Development, procurement, and installation of secure voice devices for telephone communications of senior Air Force officials. **Contractor:** Boeing. **Status:** Deployment.

Peace Shield
Development and acquisition of a ground-based command control communications system for the Royal Saudi Air Force. The system includes equipment, facilities, and support units that will link up with existing Saudi tactical radars, the Saudi AWACS planes, and elements of other Saudi military forces. **Contractor:** Boeing. **Status:** Development.

Royal Thai Air Defense Systems
Program aimed at upgrading and automating the existing Royal Thai Air Defense System and expanding its long-haul communications network. **Contractor:** SDG. **Status:** Development.

SAC Digital Network
Modernization of Strategic Air Command's existing control and communications system to provide better performance and higher reliability. **Contractor:** ITT. **Status:** Production.

Saudi Arabian AWACS
Program to acquire and outfit five US-built AWACS E-3 aircraft for the Royal Saudi Air Force. **Contractor:** Boeing. **Status:** Deployment.

Scope Shield
Program to create a security police communications system that will replace radios currently used by USAF security police for air base defense, weapon system security, and law enforcement. **Contractor:** Magnavox. **Status:** Production.

Security Pro
A security products program to design and develop secure computing systems able to meet war-planning, intelligence, and force-management requirements generated by Strategic Air Command. **Contractor:** None. **Status:** Source selection.

Seek Score
Development of a radar bomb-scoring system made up of a ground radar that tracks aircraft and a computer that determines

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For more information, please contact Roger Neighborgall or Marshall Fram, DRS Business Development Group, Dept. AFM, 16 Thornton Road, Oakland, NJ 07436 (201) 337-3800. Telex: 710-988-4191

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the bomb impact point after a simulated bomb release. **Contractor:** LTV. **Status:** Development.

Seek Screen ARM Decoy
Program to build a decoy that would protect the AN/TPS-43 radar from destruction by incoming antiradiation missiles. **Contractor:** Multiple. **Status:** Production.

Seek Screen Ultra-Low Sidelobe Antenna
Development of a modification kit to provide enhanced electronic counter-countermeasures and performance for the AN/TPS-43E tactical radar. This modification will make this radar more resistant to enemy aircraft jamming, increase the radar's range and sensitivity, and make it more survivable. **Contractor:** Westinghouse. **Status:** Production.

Sentinel Aspen Phase I
Fabrication of a general-imagery intelligence training system for Air Training Command. This training system uses computer-aided instruction in preparing imagery analysts for operational systems. **Contractor:** Loral. **Status:** Full-scale development.

Sentinel Aspen Phase II
Program to modernize the air intelligence, targeting indications, and warning and fusion training conducted by Goodfellow Technical Training Center. **Contractor:** None. **Status:** Requirement definition.

Sentinel Bright I
Development and acquisition of a voice-processing training system with 460 workstations for the training of cryptologic linguists. **Contractor:** Engineering Research Co. **Status:** Postproduction.

Sentinel Bright II
Design, development, and acquisition of a classified training system with 275 workstations and an unclassified training system with 113 workstations. These systems will be used to train operators, analysts, and maintenance technicians for modern crypto systems. **Contractor:** American Systems Corp. **Status:** Production.

Soft-Copy Exploitation System
Development of a common family of workstations for exploitation of digital imagery. This is a DoD program managed by ESD. **Contractor:** Classified. **Status:** Production.

Somali Radar Repair
Program to reengineer, repair, refurbish, and redeploy existing Somali air defense radars. **Contractor:** EG&G. **Status:** Preoperational.

Space Defense Operations Center
Program to develop new SPADOC at Cheyenne Mountain AFB. This will be the central command control communications and intelligence element of the Space Defense Command and Control System and will be used to collect and distribute information on space status and warning. **Contractor:** Ford. **Status:** Full-scale development.

STARS
Program known as Software Technology for Adaptable, Reliable Systems. STARS pursues the DoD goal of dramatic improvements in weapon software quality while reducing costs. **Contractor:** None. **Status:** Full-scale development.

Strategic Defense Initiative Battle Management
Analysis of and experimentation with promising concepts and technologies for C^3 and battle management of a future strategic defense system. An experimental version of a strategic battle manager will be used. **Contractor:** Sparta, Inc. **Status:** Concept definition.

Strategic Defense Initiative Planning/Test-Bed
Design and development of the National Test-Bed for SDI. This is an environment for evaluation and validation of possible SDI systems. **Contractor:** Martin Marietta. **Status:** Concept definition.

Sudan Air Defense System
Program for the reengineering, repair, refurbishment, and redeployment of Sudanese air defense radars; local maintenance of air defense radars; and acquisition of communications equipment. **Contractor:** EG&G. **Status:** Operational.

Survivable Base Communications System
Program aimed at dramatically reducing the time required to assess damage and direct efforts of air base recovery teams. The system combines communications equipment and computers for effective command of recovery personnel. **Contractor:** None. **Status:** Full-scale development.

Survivable Communications Integration System
Development of a multimedia management and control system for sending missile warning data between sensor sites and command authorities. **Contractor:** E-Systems. **Status:** Full-scale development.

System Trainer and Exercise Module
Development of trainer for personnel operating CRC/CRP AN/TSP-91 radars. The trainer will provide the capability to prepare exercise scenarios simulating flights of tactical aircraft. **Contractor:** GTE Government Systems. **Status:** Production.

Tactical Digital Facsimile
System to receive transmission of and to reproduce photographs, maps, fingerprint replicas, and other forms of hard-copy images; compatible with standard modems. **Contractor:** Litton/Amecon. **Status:** Production.

Technical On-Site Inspection
Program to investigate technologies and concepts for on-site inspections of international arms-control agreements. Procurement of a prototype of a continuous monitoring system supports this goal. **Contractor:** Sandia Laboratory. **Status:** Engineering development.

TRI-TAC AN/TRC-170
Development and production of digital troposcatter radio terminals for use by tactical forces. These terminals provide secure transmission of messages and perform analog and digital voice transmission and transmission of digital data over a range of up to 200 miles. **Contractor:** Raytheon/Unisys. **Status:** Production.

TRI-TAC Communications Nodal Control Element
CNCE program to enhance technical assessment and control of tactical communications. CNCE will provide the capability to monitor performance and restore essential communications rapidly after failures and rapidly to reconfigure communications to meet changing circumstances. **Contractor:** Martin Marietta. **Status:** Production.

TRI-TAC Joint Tactical Communications
Program to investigate and acquire new ground-based tactical digital communications equipment for multiservice use. **Contractor:** Multiple. **Status:** Production.

TRI-TAC United Arab Emirates
Program to modify and develop an AN/TRC-170 troposcatter radio set, with support equipment, for the UAE HAWK missile program. **Contractor:** Raytheon. **Status:** Production.

Turkish Air Defense System
Evaluation of requirements and resources to prepare a modernization plan for the air defense system of Turkey. **Contractor:** None. **Status:** Concept definition.

UHF Satellite Terminal System
Development of a deployable, multiple-access communications system based on a single UHF satellite channel for Military Airlift Command and DoD users. **Contractor:** MA/COM. **Status:** Full-scale development.

Universal Modem
Program to develop an antijam, nuclear-hardened modem for use in all superhigh-frequency SATCOM terminals that use the Defense Satellite Communications System. **Contractor:** Raytheon, MA/COM. **Status:** Full-scale development.

USTRANSCOM C^2 Study
Development support for US Transportation Command's effort to deploy new command and control systems linking various parts of its structure. **Contractor:** None. **Status:** Research.

Warrior Preparation Center
Program to provide better training of ground battle commanders and thereby strengthen tactical power in the European theater. **Contractor:** MITRE. **Status:** Research.

Weapons Storage and Security System
Research effort to determine new ways to provide dispersed, unattended tactical weapons storage using hardened vaults beneath the floors of aircraft shelters. **Contractor:** None. **Status:** Source selection. ■

It would be easy to solve the interoperability problem in base-level communications if USAF could start anew. That isn't possible, though. The job must be done by integration.

Harmonizing the Networks

BY MAJ. GEN. JAMES S. CASSITY, JR., USAF
COMMANDER, AIR FORCE COMMUNICATIONS COMMAND

INTEGRATING standard Air Force communications-computer systems worldwide presents a formidable challenge. All too often in the past, functional organizations bought new systems independently and without giving much thought to whether another system—such as one to track the movement of base-level supplies or household goods—already offered the same capabilities. They also acquired new systems that might interface with others on the base—and then again, might not.

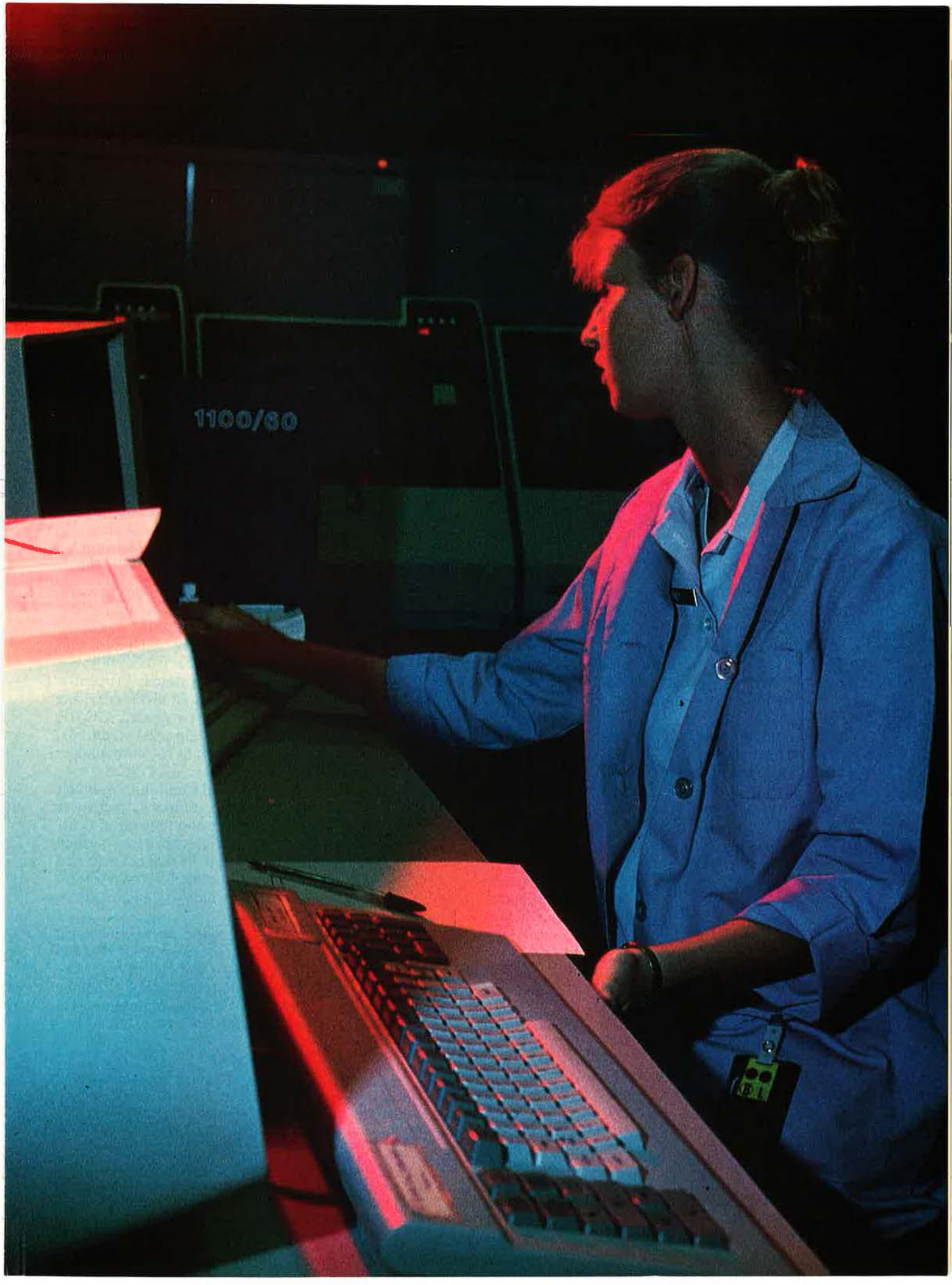
It would be easy if Air Force Communications Command could start with a clean slate by building integrated base-level communications and computer systems from the ground up. However, that would be prohibitively expensive, and the Air Force can't afford it. Instead, we find ourselves entering the game with some of the cards already dealt.

For example, the average Air Force base has some ninety different computer-based systems on it. AFCC must work with these systems and make them selectively talk to each other and work together as we add still more capability.

The Air Force Communications-Computer Systems Integration Office (AF CSIO), established in October 1987, is working to ensure that new base-level communications-computer systems in the Air Force will indeed work within the existing communications infrastructure.

In addition to integrating existing base-level systems, AF CSIO provides a clearinghouse service for reviewing proposed Air Force-wide communications and comput-

Air Force Communications Command has a responsibility that is unsurpassed in importance, that of providing computer services throughout the Air Force. Here, A1C Kay Brady runs a Sperry 1100/60 mainframe computer at Langley AFB, Va., home of Hq. Tactical Air Command. The average base has about ninety different computer-based systems, and AFCC sees to it that they work together while being improved.

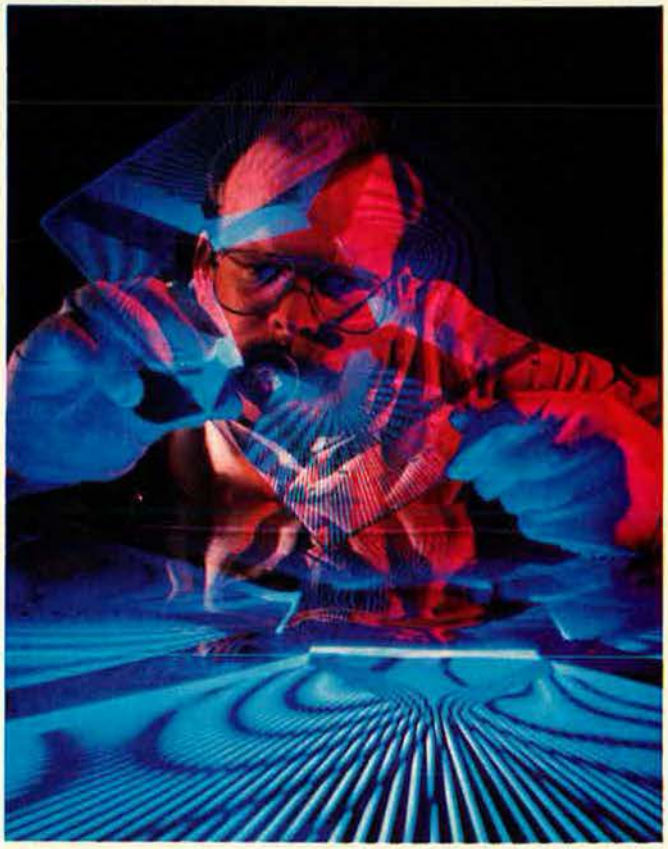

1100/60

sponsorship of the Defense Advanced Research Projects Agency (DARPA) and moved into high gear with President Reagan's call for an "Orient Express" in his 1986 State of the Union address. The program envisions an entirely new family of hypersonic vehicles capable of operating within the atmosphere and providing low-cost access to space through the use of a single-stage-to-orbit craft.

NASP and its derivatives are intended to operate from conventional runways, taking off and landing horizontally, and will push state-of-the-art aerospace technologies across the board. This means advanced hydrogen propulsion systems, structures made of new materials capable of withstanding high temperatures, optimal aerodynamic configurations, and leading-edge avionics employing fiber optics and components from the very-high-speed integrated circuit (VHSIC) and microwave and millimeter wave monolithic integrated circuit (MIMIC) programs.

With last fall's selection of the major X-30 contractors (General Dynamics, McDonnell Douglas, and Rockwell International on the airframe, Rockwell/Rocketdyne and United Technologies/Pratt & Whitney on the propulsion system), the program has entered Phase II, in which the contractor teams will build actual engine modules and design vehicles. A technology readiness review is planned for 1990, which could lead to flight tests of prototype vehicles by early 1993.

All five of the technologies on the Air Force's short list could contribute to NASP and to such Air Force programs as the Advanced Tactical Fighter (ATF). Two companies are now developing flying ATF prototypes: Lockheed with its YF-22A and Northrop with its YF-23A. First ATF flights are scheduled for early 1991. This program provides even greater impetus to push the enabling technologies.



Microelectronics is one of the cornerstones many new technologies are built on. Here, Tim Hopkins, a General Dynamics technician, checks circuit paths printed on a glass plate. The plate, used to test missile electronics, must be accurate to twenty millionths of an inch.

Integrated photonics, for example, is aimed at eventually replacing today's electronic information-processing systems with a new generation of powerful, lightweight optical computers. These computers possess the additional benefits of immunity to electromagnetic interference (EMI) and electromagnetic pulse (EMP), which threaten to negate today's electronic warfare systems. The research is centered at Rome Air Development Center (RADC) and is proceeding from a technology base built on advances in materials research, wafer level integration, laser diodes, and optical fibers.

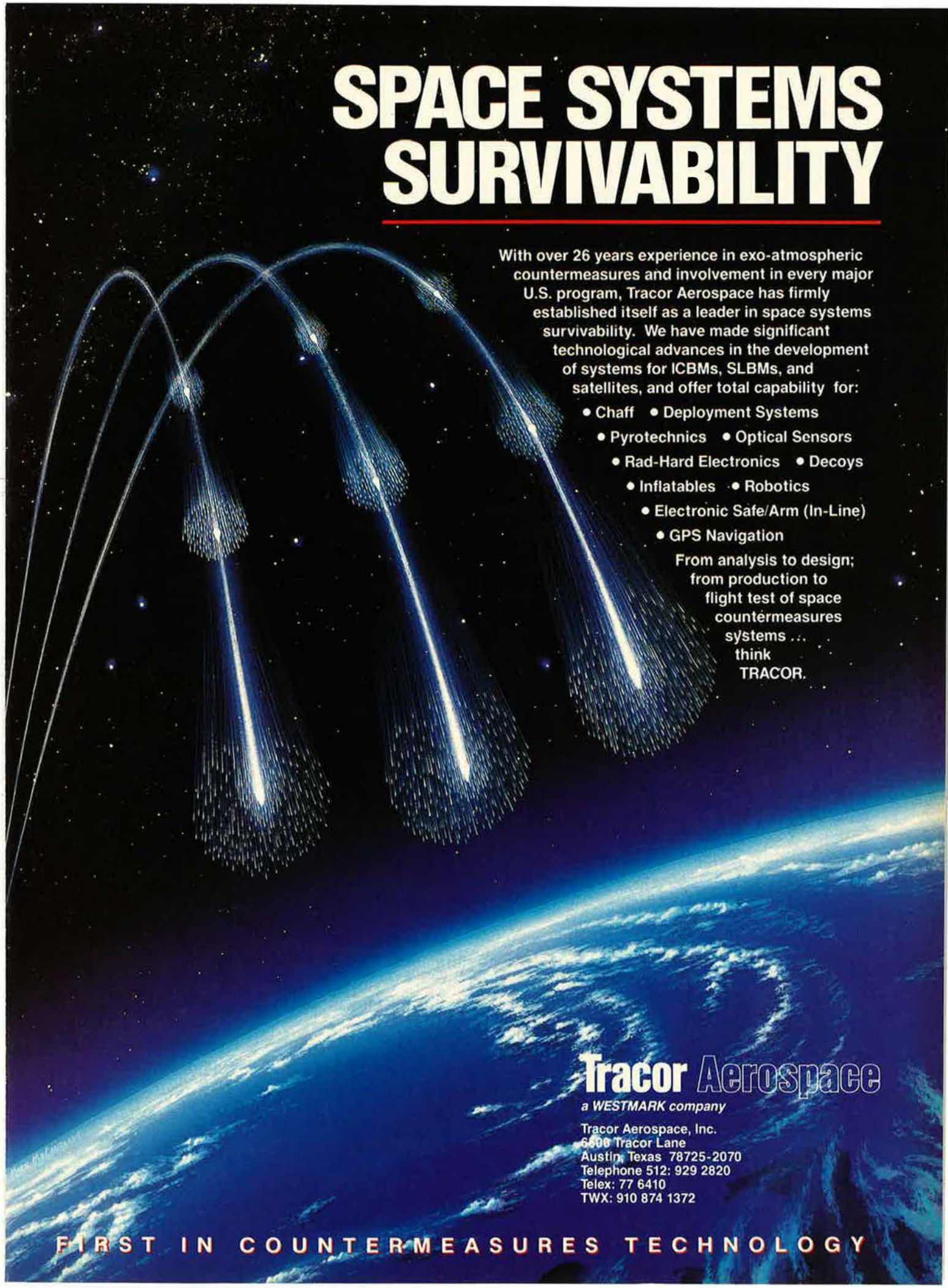
A Trillion Bits in a Cubic Meter

Reporting on results to date, Mr. Welch and General Monahan in their acquisition statement singled out the development of an optical read/write/erase memory that will soon demonstrate trillion-bit capacity in military computers less than a cubic meter in size. Mr. Goldstayn added that he expected to see optical computers and optical radio systems within the next ten years. The combination of high bandwidth and invisibility to electronic detection (because optical systems don't radiate electromagnetic energy) makes this technology ideal for the Strategic Defense Initiative (SDI).

Basic research in another optical technology—nonlinear optics—is aimed at creating new airborne arrays for automatic pointing and tracking and secure communications. Nonlinear optical phenomena can automatically correct for atmospheric effects so that a laser can transmit maximum energy through the atmosphere. An optical Doppler radar, according to the acquisition statement, could provide long-range automatic tracking, identify all objects in a given airspace, and recognize the most significant threats. The section of Forecast II devoted to nonlinear optics stresses, however, that the program "will be application-driven, not material/physics-driven."

Knowledge-based systems loom as the tangible embodiment of research under way for decades in the field of artificial intelligence. Enhancements of performance are anticipated across the board in future weapon systems, but the acquisition statement cited three emerging systems that could soon benefit from the ability of such systems to provide real-time assistance to decision-making: battlefield information management, the super-cockpit, and smart skins. Knowledge-based systems can also make an immediate contribution toward enabling lower-skilled flight-line maintenance personnel to support advanced weapon systems under combat conditions.

The aerospace vehicles of the future will need new propellants. The S&T program includes an effort in atomic and molecular chemistry aimed at creating stable excited-state materials up to sixteen times more efficient than the most efficient propellant combination used today—liquid oxygen and liquid hydrogen. The research team at the Air Force Astronautics Laboratory stresses that this is a "revolution in operational rocket propul-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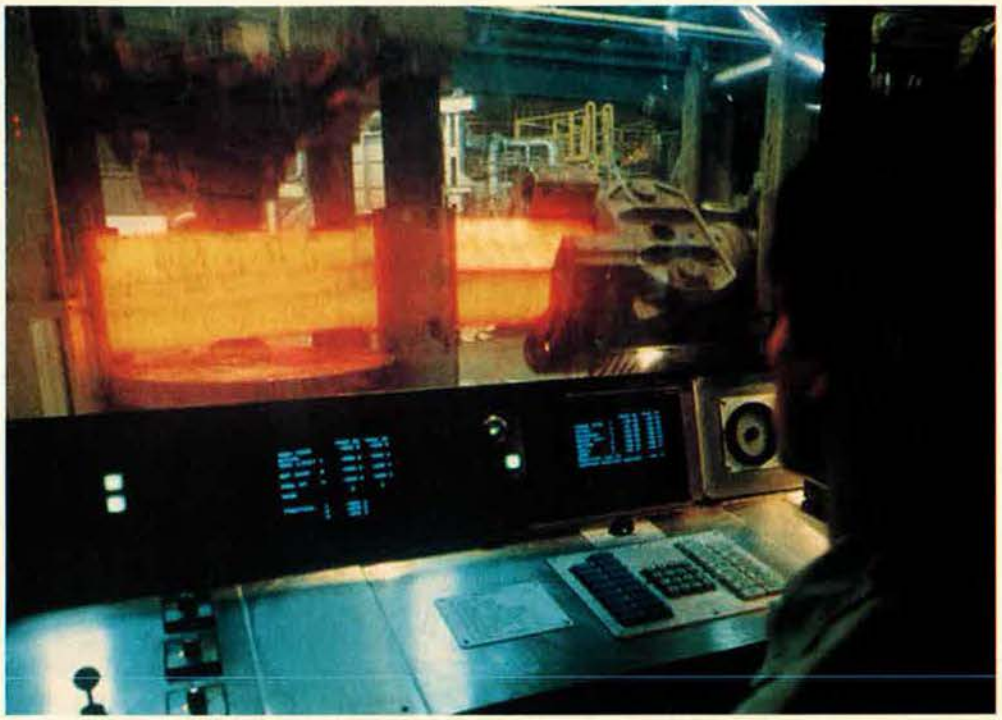


Manufacturing will also benefit from new technologies. This "smart" work station features computer-aided engineering (CAE), artificial intelligence, and parallel processing. Equipment for this work station is two orders of magnitude less expensive than the supercomputers usually required for sophisticated CAE tasks.

engines that would enable patrol aircraft to achieve long endurance. In addition to AFWAL, NASA is participating in joint studies under Air Force management.

Smart skins, an idea that has been around for years, would make the aircraft surface an active part of the overall weapon system. The idea is to integrate the antennas, sensors, processors, and cable into the skin as part of aerodynamically efficient conformal arrays rather than "cutting holes in the skin" to insert the necessary avionics. Key supporting technologies include fiber optics and the new class of gallium arsenide integrated circuits for use as sensors being developed under the MIMIC program. Load-bearing structures (perhaps composites) would carry signals from the sensors to communications systems, according to Mr. Goldstayn, who sees integration of these concepts into systems to be about fifteen years away. The applications in stealth and other "black" programs are obvious.

Sparse arrays in space, which Mr. Goldstayn calls "a concept, not a program," could lead to an economical, flexible space-based radar (SBR) that would compare in importance to SDI with advanced battle management systems. In this concept, each of many small spacecraft would serve as an autonomous phased-array radar with its own power, thrusters for attitude control, and onboard communications. Flexibility is achieved by adding spacecraft incrementally as the SBR grows to meet future requirements. Economies of scale are possible by producing large quantities of similar spacecraft.

The Supercockpit—High on the List

The supercockpit, which has long been high on the Air Force's wish list, involves the development and testing of a family of virtual cockpit subsystems. Information from the advanced sensors being developed under other research programs is fused, organized, and presented to the crew within a panoramic visual and auditory display. "The near-term objective is to demonstrate a full head-up display and head-aimed fire control with night vision for the ATF," the acquisition statement notes.

The one nominally nontechnological item on the list of twelve may actually prove to be the most important—and the one that makes all the others possible—Mr. Goldstayn predicts. This is called unified life-cycle engineering (ULCE), and it involves the integration of computer-aided design, computer-aided manufacturing, and computer-aided supportability (CAD, CAM, and CAS) with knowledge-based systems.

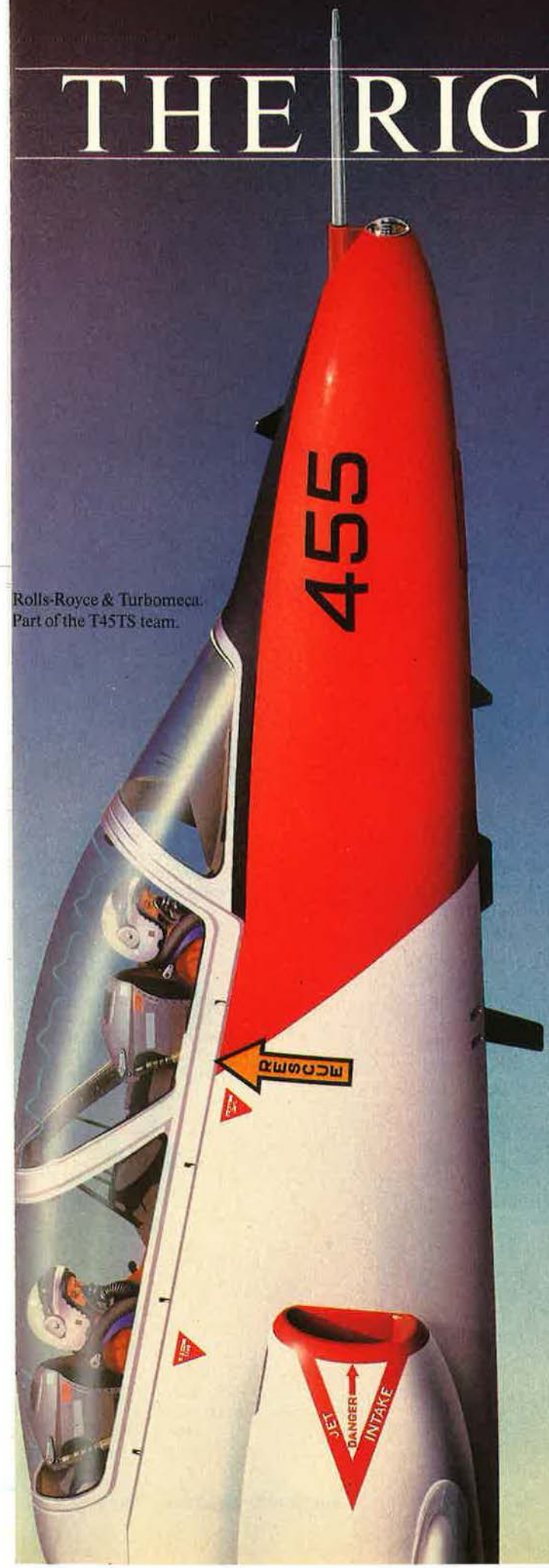
The advantage to the system designer, he explains, is that this approach enables him at the beginning of a program to trade off the last five percent of performance to achieve 100 percent maintainability. In any complex program, many small decisions made over a period of time have a cumulative effect on overall reliability and maintainability that cannot be anticipated by the people working day-to-day on the project. "The bottom line is [that] ULCE can answer these questions [in a] timely [manner] so that a better system can be fielded at a lower cost," the acquisition statement concludes.

These twelve high-visibility S&T programs have been targeted for what the Air Force believes is the "right" investment strategy of balancing current user needs against opportunities to apply fundamental advances to future systems. "It is a balance between the evolutionary and the revolutionary," the acquisition statement notes, "[between] the lower-risk, near-term return on investment and the high risk [and] high potential for technological breakthrough."

In striking that balance, the Air Force of today is creating the Air Force of the future. ■

John Rhea is a free-lance writer based in Woodstock, Va., who specializes in military technology topics. He is the author of SDI—What Could Happen, *published in May by Stackpole Books, Harrisburg, Pa. His most recent article for this magazine, "Fly by Light," appeared in our March '88 issue.*

THE RIGHT STUFF



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Birds change the shape of their wings in flight. Now, aircraft designers have come up with the Mission Adaptive Wing to give aircraft some of the same advantages.

Pilot Report: AFTI F-111

BY MAJ. SCOTT E. PARKS, USAF

BIRDS are beautiful and efficient flying machines. I have often observed hawks flying high above the desert at Edwards AFB, Calif., effortlessly positioning their wings to the optimum shape dictated by instinct and learned through experience. They soar smoothly in the summer afternoon thermals with wings comfortably forward, only to dive suddenly for an unsuspecting target at high speed with wings swept back. Landings, on the other hand, require the hawk's wing to be forward and highly curved, or cambered, as they turn into the wind to achieve the slowest possible approach speed. Precise control is achieved by small changes in the position of the feathers located on the wingtips.

Aircraft designers, having less experience with flight than the Almighty does, have been constrained to a fixed-wing shape that is optimum for only one flight condition. This means that in other flight conditions, the wing is a compromise that results in reduced range and/or payload.

Prior to the jet age, optimizing wing shape was not a concern because of limitations in aircraft altitudes and airspeeds. Later expansion of the flight envelope, with the advent of jet-powered supersonic fighters and bombers, forced designers to recognize the critical need for a variable shape wing. High-performance aircraft need a wing that is efficient at high subsonic and supersonic speeds and that at the same time can minimize approach speeds for landing. Flaps are one answer to this dilemma.

Flaps have been used for many years to allow aircraft to fly at lower approach speeds on landing. As aircraft materials and control systems have been improved, flaps have been automated and their use extended to flight at high speeds and elevated load factor. Flaps used for this purpose are often called maneuvering flaps. A number of current aircraft, including the F-16 and F/A-18, employ maneuvering flaps. These give designers some ability to improve wing performance throughout the flight envelope.

The Mission Adaptive Wing, a radically new concept, enables an aircraft to change wing shape continuously and smoothly while in flight for greatly improved agility and performance. Shown at right is the Advanced Fighter Technology Integration (AFTI) test craft, a special F-111 fitted with the developmental wing.

The Advanced Fighter Technology Integration (AFTI) F-111 research program is designed to flight-test a totally new concept called the Mission Adaptive Wing (MAW). This wing, just like the hawk's, optimizes its performance by continuously and smoothly changing shape in flight. The AFTI F-111 is sponsored by the Air Force Flight Dynamics Laboratory (AFFDL) and NASA.

I had the opportunity to be one of the first two Air Force test pilots to fly the AFTI F-111 and was active in the program from March 1984 through my departure from Edwards AFB in July 1987. We began a two-phase flight-test program evaluating the MAW concept in 1985. Phase I, completed in November 1986, met its objectives by determining the feasibility of a MAW on high-performance aircraft. The second phase, currently in flight test at Edwards AFB, is demonstrating potential uses for this unique wing design.

The F-111 aircraft we used for AFTI was flown from 1973 to 1979 in a program called Transonic Aircraft Technology (TACT). TACT tested a unique wing shape called the supercritical airfoil that improved cruise performance in high subsonic flight and verified the performance advantage of this type of wing in cruise flight. An advanced version of this type airfoil became one of the many shapes of the Mission Adaptive Wing.

With the Mission Adaptive Wing in the fully cambered position, as in this photo, both the leading and trailing edges move approximately twenty degrees downward. The upper surfaces of both edges are made of high-strength, lightweight composite material that bends when actuated by internal hydraulic systems.

Testing a New Aircraft

Simulation played an important role in the engineering development of the MAW. Flying simulators is definitely not the most popular part of a program for the pilots, but for every hour in flight, we spent many times that in the simulator.

Prior to first flight, our knowledge of how the aircraft would fly was very limited, thus requiring many hours "in the box" evaluating controllability. In addition, the simulator was extremely useful in developing emergency procedures. For example, we found that under certain flight conditions, the aircraft would be uncontrollable if there were an uncommanded asymmetry between the left and right wings. This knowledge changed our operating procedures to avoid this condition. The flight profile for every test flight is flown first on the simulator, which allows the pilots to make maximum use of available flight time.

We treated the first flight of the AFTI F-111 as if we were flying a new aircraft. Externally, the aircraft looks somewhat like an F-111, but the unique wing and internal changes created many unknowns that required a cautious approach. The flight profile consisted of little more than takeoff, systems checks, controllability evaluation, and landing. It had been flown in the simulator many times prior to flight.

The day before the first flight, a dress rehearsal was conducted with the control room operational and a high-speed taxi down the runway. Control room operation is similar to Houston control for spacelaunches and depends on experts in every facet of the aircraft. One individual is designated NASA 1 and is the only person allowed to communicate with the aircraft.

Lt. Col. Frank Birk (USAF) and Rogers Smith (NASA) manned the aircraft on the first flight, while I flew chase in a T-38. Einar Enevoldson (NASA) was NASA 1. The initial takeoff was made toward the dry lake bed at Edwards in case of an abort. To the satisfaction of all involved, the flight went flawlessly and inaugurated Phase I of testing.

That first flight also established a new flying specialty. The project test pilots who flew in the right seat did not appreciate being referred to as copilot or navigator. Wishing to alleviate the problem, Steve Smith of the Air Force Flight Test Center—joint manager (with NASA's Louis Steers) of flight test—created a new specialty, the Mission Adaptive Wing Systems Operator, or MAWSO. MAWSO became the standard reference for the pilot flying in the right seat.

The objective of the first flight-test phase was to determine the operation and basic aerodynamics of the Mission Adaptive Wing. This included verification of structural integrity and controllability. We accomplished this by cautiously expanding the flight envelope of the aircraft in altitude, airspeed, and load factor, which is measured in G forces. Within that envelope, actual performance data could then be collected.

Results indicate that the potential exists to meet or exceed the performance goals established from wind-tunnel data. Comparing TACT and MAW, the goals include a thirty percent increase in range, a twenty percent increase in sustained turn radius, and a thirty percent increase in usable buffet-free lift.

Systems evaluations are also con-

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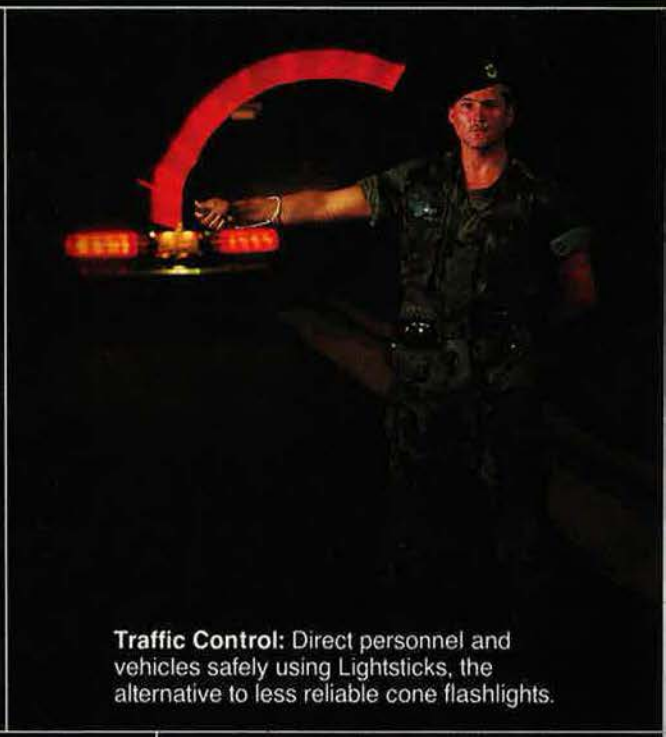

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TEXAS INSTRUMENTS

ducted to verify proper operation of the MAW and its interface with the aircraft. Operation with one hydraulic system or one engine out was of particular concern, and a significant amount of ground testing was required to determine if the wing could operate under these adverse conditions. An unplanned test of this was almost conducted on the aircraft's third flight and my first flight when the chase plane noted a massive hydraulic leak from the bottom of the aircraft. Recovery was made without any problem, and the leak was found to be unrelated to the MAW.

Results of the first phase were very encouraging. The wing's performance had lived up to expectations. The drag reduction benefits of the wing were very close to those predicted during wind-tunnel testing. Aircraft handling was excellent (similar to that of the production F-111), with the exception that approach speeds for landing were twenty-five to thirty knots above that of the standard F-111. Normal approach speeds could be achieved with the MAW, but were not required to meet the objectives of the research program.

In Phase II, four different modes are being evaluated to demonstrate potential uses for the Mission Adaptive Wing. Two of these modes have already been flown: cruise camber control (CCC) and maneuver camber control (MCC).

CCC operates by deflecting the trailing edge of the wing and sensing speed change. The mode will continue deflecting the wing until maximum speed for a given power setting is achieved. MCC operates by continuously positioning the wing to its optimum shape as a function of G and Mach number. Test results for MCC have been excellent. Pilots indicate that they are unaware that the mode is operating, with the exception that handling is improved in pitch. Testing of CCC has been less successful. Further refinement of the mode will be required.

Two modes are yet to be tested: maneuver load control (MLC) and maneuver enhancement/gust alleviation (MEGA). MLC will operate by computing bending loads at the wing root and changing the wing shape to prevent exceeding predetermined limits. MEGA actually has two functions. First, during cruise flight, it will act to reduce the aircraft's susceptibility to gusts and provide a smoother ride. Secondly, during maneuvering flight, this mode will deflect the wing and horizontal stabilizer to make the aircraft more responsive in pitch.

How the Wing Works

The F-111 used in the research program is a preproduction A model that was used in the original F-111 flight-test program and has never been brought up to the production standard. This poses some interesting problems for the maintenance team. Replacement parts have sometimes been difficult to come by, and unique "work-around" procedures have had to be devised.

While the aircraft is already nonstandard, modifications made for the MAW test program make it truly unique. The existing wings are replaced with Mission Adaptive Wings, and the fuselage is modified to allow the new wings to sweep aft without interference. Extensive instrumentation is added to the weapons bay to monitor every facet of the wing's operation. Computers for controlling the wing are housed in the nose.

Clearly, the most significant modification to the aircraft is the wing itself. It is designed with a completely smooth upper surface and actuation mechanism housed totally within the wing. The center portion of the wing (wing box) is fixed in shape, with only the leading and trailing edges capable of deflection. The wing box was also used in the TACT program. The leading edge of the wing is a single-span surface, while the trailing edge consists of three panels capable of independent motion.

Both the leading edge and trailing edge move approximately twenty degrees in their fully deflected positions. The upper surface of the leading and trailing edges is made of a composite material that actually bends to change the wing shape.

Power for actuation of the wing comes from the dual hydraulic systems found on the standard F-111. Each system is upgraded to increase its capacity and is capable of independently operating the wing. The eight hydraulic drive units, two for the leading edge and six for the trailing edge, are capable of very fast response and require no mechanism external to the wing. Designing an entirely internal mechanism was a difficult but not insurmountable task.

Advanced computers for controlling the Mission Adaptive Wing are contained in the F-111's nose. The upper surface of the wing is completely smooth, with the mechanism for controlling it buried inside. The wing's leading edge is a single span surface; the trailing edge consists of three panels capable of independent motion.

Control of the wing is via dual digital computers with two analog computers used for backup. Each digital computer commands one of the two drive units for each surface. The analog computers take over if the commands from the digital computers do not agree or if any errors are detected. Without these high-capacity digital computation devices, control of the Mission Adaptive Wing would be nearly impossible.

Selection of manual and automatic modes is accomplished via a control panel located between the pilot and the MAWSO. With the wing operating in manual mode, the single leading edge and three trailing edge sections on each wing can be independently positioned symmetrically to any desired position. In addition, through the pilot's control-stick inputs, the midspan and outboard trailing edge panels can move asymmetrically to assist in roll control.

The fleet F-111 uses spoilers to accomplish the same function. All automatic modes can be engaged independently, and some modes can be engaged jointly via the control panel. For example, maneuver camber control and maneuver load control could be selected in order to complement each other.

The control panel also provides cockpit warning of any MAW-related malfunctions and the ability to lock in place symmetrically each set of movable panels. The gun trigger on the control stick is modified, in the event of a malfunction, to position the wing immediately to the wing shape tested during TACT. This gave us a very quick way of shaping the wing to a known configuration should something unexpected occur.

What Can the Wing Do?

Current wing designs are a compromise involving many factors. Some of these include maneuverability, cruise performance, and strength. Wings are optimized for one flight condition and then modified to obtain satisfactory characteristics throughout the flight envelope.

These compromises create a particular problem with fighter aircraft that have a large altitude and airspeed range and are required to possess maneuver capability up to high G levels. As G is increased, a wing designed for level flight cruise becomes less efficient, which limits the sustained G capability of the aircraft. The farther from design condition the aircraft is maneuvered, the greater the loss in efficiency.

Flaps have been used for many years to allow a wing optimized for cruise flight to also provide reasonable approach speeds for landing. The increased drag associated with these surfaces and their structural design limits minimized their usefulness for cruise and maneuvering flight.

As strong, lightweight materials became available, maneuvering flaps were designed that could be operated throughout most of an aircraft's flight envelope. Improvements in flight-control systems allowed operation of maneuvering flaps to be automated. Current-generation fighter aircraft use maneuvering flaps to improve performance during such maneuvering flight as air combat. For example, the F/A-18 automatically deflects both its leading and trailing edge flaps when the wing reaches high angles of attack. The great disadvantage of these surfaces is relatively high drag (compared to that of a smooth surface) when they are in operation.

The Mission Adaptive Wing solves this problem. An F/A-18 operating with the maneuver camber control described previously would have its wing continuously changing shape as a function of flight condition. This would provide the pilot higher sustained G capability and higher overall energy level. Both of these are important to aerial combat.

Another example of improved maneuverability that could be provided by the Mission Adaptive Wing is a concept called "direct lift." When a pilot commands a change in pitch, the wing deflects in combination with other control surfaces to produce a change in flight path. This mode allows the aircraft to be more responsive to pilot inputs and can increase a fighter's ability to generate instantaneous G.

Other features inherent in the design of the Mission Adaptive Wing have the potential to improve fighter, bomber, and transport performance. One of these is the ability to change the distribution of air loads along a wing while in flight.

For long-range missions, it is desirable to increase the ratio of a wing's length to its width (chord), thus increasing its aspect ratio. The ability to do this is limited by structural loads at the wing root, which increase as a function of wing length. The stiff, low-aspect-ratio wings of most fighter aircraft result from their need to achieve high G and the resulting high wing loads. Even in cruise flight, the aspect ratio of a wing is limited by the need to provide a safety factor for protection from gusts. A limited solution to this problem is employed by such aircraft as the U-2, in which the pilot can manually reposition the outboard aileron to reduce the loads at the wing root. A Mission Adaptive Wing can carry this concept much further.

The MAW, with its digital control system and fast response time, can continuously compute the loads at the wing root and change the camber of the outboard section of the wing as required to control those loads. For fighters, this means wings that have lower structural weight or can achieve higher maximum G. In transport and bomber designs, the higher-aspect-ratio wings allowed by the concept of load control can produce improved fuel consumption and longer range and endurance.

All aircraft, regardless of mission, cruise during some portion of their flight profile. The traditional fixed-wing shape is suitable for aircraft, such as transports, that cruise at a fixed speed and altitude. Other aircraft, such as strategic bombers and fighters, which must cruise at high altitude and must ingress to a target area at low altitude and high speed, would benefit from the Mission Adaptive Wing concept.

The MAW with cruise camber control deflects the trailing edge of the wing until maximum forward velocity is obtained regardless of flight condition. This is especially effective for an aircraft, such as the Advanced Tactical Fighter, that must cruise in both the subsonic and supersonic flight regimes. This concept may also allow aircraft to achieve higher maximum altitudes, which may be important for recon-

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With the Mission Adaptive Wing, the "catch" is that airplane designers must be prepared to develop new airfoil shapes for each of the flight conditions that future aircraft will encounter. Result: a more complex design process, with a need for structures, flight controls, and other elements to work closely together.

naissance applications. Another benefit is the MAW's capability to provide maximum performance even when carrying external stores.

The gust-alleviation mode is especially important for aircraft that must cruise at low altitude and high speed. Good low-level ride quality is generally associated with aircraft that have high wing loading (force per unit area) on the wing—for example, the production F-111. The disadvantage of high wing loading is a large rate of energy loss when the wing is subject to G. The Mission Adaptive Wing can achieve the same ride quality with lower wing loading.

What's the Catch?

The first thought most everyone has is that the MAW must be heavier, more complex, and more costly to maintain than existing wing-flap designs. This is not true. Ron DeCamp, AFFDL program manager for the AFTI F-111, provides excellent answers to these common misconceptions. Using the F-111 as an example, Mr. DeCamp states that replacing the existing complex arrangement of slats and flaps with a production version of the MAW would actually save approximately 600 pounds. Also, maintenance costs may actually be reduced for an MAW aircraft.

Current aircraft with slots, slats, and flaps have crevices that collect dirt, ice, snow, etc., that can jam the sliding tracks and hinges. The MAW mechanisms, on the other hand, are completely sealed, which Boeing estimates may reduce maintenance requirements by as much as thirty-five percent. As to complexity, the MAW is no more complex than the maneuvering flap designs found on current generation fighters. Another misconception is that the MAW mechanisms extend into the wing fuel cavity and thus reduce aircraft fuel capacity. Not true! All mechanisms of the MAW leading and trailing edges are confined to areas formerly occupied by high lift devices.

The higher approach speeds used on the AFTI F-111 research vehicle were dictated by the production F-111 design, which limits the landing angle of attack to prevent the tail from making contact with the runway. Designers could use one of two approaches on future aircraft to provide satisfactory speeds for landing.

The most desirable approach is to design the aircraft to land at a higher angle of attack, taking advantage of the higher stall angle of attack available with the Mission Adaptive Wing. The second approach is to add existing high-lift devices to the MAW. This alternative is less desirable because of the added weight and complexity.

In short, the "catch" is that designers must be ready to develop a new airfoil shape for each of the many flight conditions that future aircraft will encounter. This will make for a more complex design process, one in which all disciplines (structures, flight controls, aerodynamics, etc.) must work more closely together.

The first phase of testing, completed in November 1986, proved the functional capability and aerodynamic potential of the Mission Adaptive Wing. The current phase of testing, slated for completion in 1988, is evaluating the automatic modes and the ability to maintain aerodynamic efficiency and operational flexibility without adding to pilot work load or interfering with other pilot tasks.

Future applications of the MAW include improved aircraft maneuverability, control of load distribution on the wing, better ride qualities, and improved cruise performance. This equates to enhanced range and payload for bombers and increased G capability and reduced energy loss during maneuvering for fighters.

The AFTI F-111 test program is just the first step in proving the concept of the Mission Adaptive Wing. While there are unquestioned performance benefits, they will have to be weighed against the wing's added design complexity. As with any new idea, it must be integrated in light of real-world constraints. There is much work yet to be done, but the AFTI F-111 is a giant first step. ■

Maj. Scott E. Parks, presently assigned to the National Aerospace Plane Joint Program Office at Wright-Patterson AFB, Ohio, served for several years with the 6510th Test Wing at Edwards AFB, Calif., where he held a number of positions, including that of Project Pilot for the Advanced Fighter Technology Integration (AFTI) F-111 Test Team. A graduate of the USAF Test Pilot School, he holds a master's degree in aeronautical engineering from the Air Force Institute of Technology and a bachelor's in mechanical engineering from Georgia Tech. He has just completed an assignment at the Air Command and Staff College.

Survivability in the 1990s will boil down to five factors—but the main one is speed. Slow ducks will be dead ducks.

No Sitting Ducks

BY GEN. ROBERT D. RUSS, USAF
COMMANDER, TACTICAL AIR COMMAND

CLOSE air support aircraft must be survivable if they are to contribute to the AirLand Battle. Today's Army theater commander plans to use CAS aircraft against a broad spectrum of targets, both along and behind enemy lines.

Under this employment concept, CAS aircraft must attack and survive an enemy who's ready to use a sophisticated array of weapons. Near the front lines, CAS aircraft will encounter improved surface-to-air missiles, antiaircraft artillery, and small-arms fire as the primary threat. For targets deeper into the battlefield, they'll face higher concentrations of SAMs and AAA, along with the added threat of enemy interceptor aircraft.

On top of that, the Soviets' newer air defense systems have longer ranges and lower altitude engagement capability than those of the past.

Air Force experience and studies show that survivability in that environment boils down to five factors: speed, maneuverability, electronic countermeasures, force packaging, and hit tolerance.

The Air Force claims that its next close air support (CAS) aircraft will have to be faster and more maneuverable than the A-10 it will replace. USAF has in mind for CAS a variant of the F-16. Here, a two-seat F-16B bristles with weaponry for a low-level ground attack mission at night—LANTIRN pods and Maverick missiles, with air-to-air Sidewinders at its wingtips.

Detecting, tracking, and destroying ground-attack aircraft has become a fine art as practiced by ground troops in modern air defense warfare. These soldiers show just a couple of ways of spotting such aircraft over the fluid, extremely lethal battlefields of today and tomorrow. Thus, says the author, "the faster an aircraft can fly, the less time it spends in enemy detection and acquisition zones."

—USAF photo by Steven M. Zapka

All five are important, but speed is the most critical factor. The faster an aircraft can fly, the less time it spends in enemy detection and acquisition zones. Even if the aircraft is detected and acquired, speed greatly complicates the enemy's tracking problem. Just as it's easier to shoot a slow-moving duck than a fast-moving one, the angular tracking solution of an enemy missile, gun, or aircraft is significantly complicated by a faster target.

If shot at, a fast-moving aircraft has the best chance of defeating the threat when the advantage of maneuverability is added.

Maneuverability, the second survival factor, is defined in simple terms as an aircraft's ability to generate high turn rates. A pilot uses the combination of speed and maneuverability to create as much "miss distance" as possible and defeat the effects of missiles or bullets.

Turning Isn't Enough

Continuing the duck analogy, a "sitting duck" is very maneuverable—it can turn instantly—but it isn't moving and therefore is easily tracked. As a result, it's not very survivable. Only when the duck combines speed with maneuverability does it become more difficult to shoot.

Figure I

Sustained Turn Comparison

(sea level)

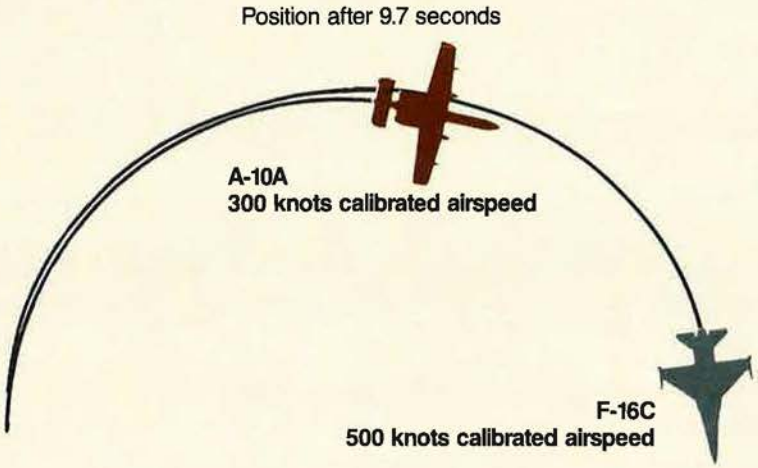
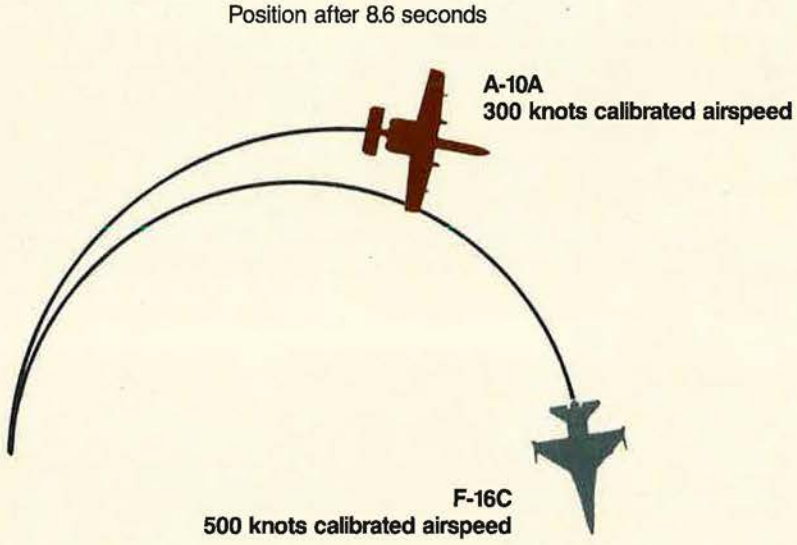


Figure II

Maximum Turn Comparison

(sea level)



This is true of our modern fighters as well. As shown in Figure I, the faster F-16 greatly outturns and travels much farther than the A-10. The F-16 makes a 180-degree turn in just under ten seconds; the slower A-10 turns only slightly more than half that amount in the same period.

Fighter pilots often use maximum turn rates to put the threat at the best relative position or to cause a miss by a heat-seeking missile homing on the aircraft's tail pipe. Figure II compares the F-16 and the A-10 and demonstrates a significant F-16 advantage: the ability to turn engine exhaust completely away from a threat in less than ten seconds. This maneuverability translates into hit avoidance capability.

The CAS fighter must be able to use the third factor—on-board electronic countermeasures, or ECM—to survive in a high-threat arena. Current ECM equipment can locate, identify, and jam or deceive a wide variety of Soviet systems.

"Expendables," such as chaff and flares, act as decoys against enemy missiles and guns, further complicating enemy efforts to shoot down aircraft. Imagine our duck with a "hunter detector" and releasable decoys. This would certainly increase its survivability.

Working Together

Force packaging is another critical factor in survivability, especially when the Army theater commander uses CAS aircraft against time-sensitive targets in the enemy's follow-on echelons. This translates to CAS aircraft flying with F-15s that will defend against enemy fighters, F-4G "Wild Weasels" to suppress or destroy enemy SAM and AAA sites, and EF-111s for jamming enemy threat radars.

All these aircraft team up to penetrate high-threat areas en route to the target, sharing information about the battlefield situation and providing mutual support to fight back if the enemy tries to stop them.

For the force package to be effective, all the aircraft must be compatible in speed and maneuverability. Similarly, a flock of ducks must be able to fly together at the same speed. If not compatible, slow ones would be left behind to fend for themselves. The faster ducks could

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FIGURE III. The keys to aircraft survivability in today's dense air defense environments are speed, maneuverability, electronic countermeasures, force packaging, and hit tolerance. As an example of the last of these, this F-16 remained flyable and came home handily after a midair collision inflicted major damage to its tail and one of its wings. The fighter's built-in durability saved it.

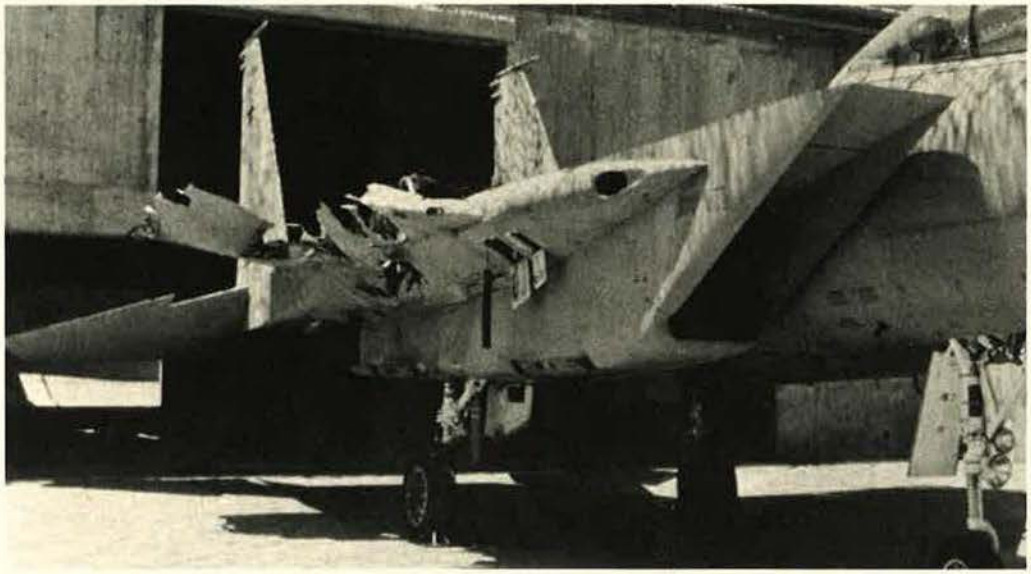


FIGURE IV. The nonpareil example of an aircraft taking a structural beating and remaining airworthy is this F-15, which recovered safely after losing an entire wing in a midair collision. USAF's new fighters owe their capacity for such survivability to stronger materials, ingenuity of design, and "smart" flight controls that compensate for structural damage by getting the most out of the aerodynamic capability that remains.

reduce their speed, but this would sacrifice their most important survivability factors, speed and maneuverability, putting the whole flock in jeopardy.

The fifth and final aspect of survivability that bears examination is hit tolerance—the ability to take hits and still fly home. Today, more than ever before, aircraft are built with this in mind.

For example, modern aircraft have what are called "redundant structural load paths" to allow for major battle damage without catastrophic failures of key parts needed to keep the aircraft airworthy. Today's aircraft have several different structural paths, each independently capable of keeping the aircraft in one piece.

Built-in Durability

We also have "smart" flight control systems. These systems are computer-controlled and allow the pilot to keep flying the aircraft even when major portions of the flight control surfaces are damaged or missing.

Figures III and IV are just two examples of situations in which pilots have flown severely damaged aircraft home safely thanks to this built-in durability.

The F-16 in Figure III lost large portions of its wing and tail in a midair collision, but recovered enough to perform an uneventful landing. Even more impressive is the F-15 in Figure IV, which lost an entire wing and still recovered safely. Stronger materials, foresight in design, and smart flight controls built into our new fighters give them the ability to take hits and continue flying. If our duck could fly home on one wing, then it would indeed become a very survivable flying machine.

The AirLand Battle doctrine depends on a survivable attack force from the Air Force. A fast, maneuverable aircraft, capable of using ECM and compatible with force packaging, will give us the greatest chance of destroying any target that the Army identifies—on the front line or deeper within enemy territory. ■

Gen. Robert D. Russ is the Commander of Tactical Air Command. A command pilot with more than 5,000 flying hours, he is a distinguished graduate of the Air Command and Staff College. General Russ previously served as the Special Assistant to the Vice Chief of Staff of the Air Force and as the Deputy Chief of Staff for Research, Development, and Acquisition.

The Morale, Welfare, and Recreation program isn't what it used to be. The next round of cuts could force the closure of many military open messes and leave the others operating in the red.

The Assault on MWR

AN AIR FORCE MAGAZINE STAFF REPORT

ANOTHER chunk of the military lifestyle has now come under assault in the extraordinary budget-cutting campaign that began last December. If a plan under consideration by Congress carries through, military open messes—popularly known as officers', NCO, and airmen's clubs—will be in deep trouble.

The House Armed Services Committee proposes to abolish all appropriated funding for these clubs by 1990. Open messes currently generate eighty-two percent of their own operating revenues, but need a supplement from Congress to cover the remaining eighteen percent.

Service officials contend that this level of support is reasonable. In addition to their morale value, the clubs provide meals to the troops while they are on duty. They perform an "essential feeding" role in wartime plans, partly making up for a significant shortage that still exists in regular food-service capability. The government also uses the clubs extensively for official functions, and numerous organizations hold their meetings in these facilities.

As funding tightened in recent years, clubs have raised their menu prices by about fifteen percent and have reduced their hours of operation. Member dues are up, from $13 a month to $18 in the typical officers' club and from $4.50 a month to $8 in the enlisted clubs.

The Air Force says the impending cuts would drive the vast majority of its clubs into deficit. Nearly 200 open messes—ninety-six of them officers' clubs and 102 enlisted clubs—would be left in the red. Fifty-eight clubs, mostly at smaller bases in rural locations, would face closure.

Concern about open messes is part of a much broader issue about the funding and operation of military morale, welfare, and recreation (MWR) programs. These activities range from marinas and softball fields to child-care centers and craft shops. By a complicated management process, the Air Force uses profits from some programs (bowling and golf, for example, earned $38 million in FY '87) to support other activities, such as libraries and gymnasiums.

Despite increased membership dues and menu prices, open messes, such as this NCO Club at Bolling AFB, remain popular. In addition to benefiting morale, these open messes perform an "essential feeding" role in wartime plans.

Overall, sixty-four percent of the money to operate the MWR program is generated by the troops themselves, mostly by dues or fees in MWR facilities or profits from exchanges. The program also gets a share of the income from slot machines, Class VI (package liquor) sales, pay telephones on base, and other sources.

Wrangling Over Policy

For several years now, the Pentagon and Congress have been wrangling about MWR policy. The controversy comes in several parts.

The first, of course, is money. Congress wants to reduce the thirty-six percent portion of MWR support that comes from appropriated funds. The Defense Department points to a survey conducted by the University of North Carolina that found that, nationwide, seventy-one percent of the recreation programs in civilian communities are paid for by tax dollars. MWR includes some activities not found in civilian recreation programs, but on the other hand, the big difference in funding percentages more than makes up for the disparity.

Military people, seldom in the same location long enough to sink roots, tend to regard the service and the base of current assignment as their community. They're taxpayers, too—and they notice that tax revenues underwrite civilian community recreation at twice the percentage that military MWR is supported. The decline of the on-base community recreation program has increasingly become a source of discontent. In 1987, Congress directed that MWR user fees should be within twenty-five percent of the prevailing rate charged in civilian facilities. Out-of-pocket costs for the troops have risen, a ten to thirty percent jump in bowling fees being one example.

A second aspect of the controversy is that Congress believes MWR is poorly managed. It has had three civilian consulting firms study the situation. One report, typical of the others, claims that millions of dollars are wasted by a management structure "suffocating under the military umbrella." In a recent analysis, the House Armed Services Committee said that "these business activities will continue to function inefficiently so long as they use rules, regulations, and procedures similar to those applied to other traditional military base operations."

Military managers seethe at this blanket indictment of their effectiveness, regarding it as both incorrect and unfair. Also, perhaps remembering other miracle cures touted by outsiders with a limited understanding of the military world, they put less stock than Congress apparently does in what the consultants say.

A specific point of aggravation for the Air Force is congressional criticism that USAF's ratio of base-level MWR profits to appropriated fund costs is worse than that of the other services. It says Congress overlooks a critical difference in bookkeeping—failing to consider that assessments to USAF's central MWR investment fund are recorded as expenses at base level, although the "expense" is later redistributed along with investment revenue.

The third sticking point is that Congress disapproves of using profits from MWR money-makers to support money-losers, with Congress accusing the services of "laundering" funds by this practice. The House Armed Services Committee further says that "in recent years, increasing amounts of nonappropriated funds have been used to pay for programs for which appropriations

Impending cuts in MWR funds by Congress could spell doom for some fifty-eight of USAF's open messes, mostly at smaller bases in rural locations, arguably where they are most needed and appreciated.

are authorized. In addition, facilities eligible for appropriated funding have been constructed using nonappropriated funds. For example, in Fiscal Year 1988, more than $100 million in nonappropriated funds are programmed for construction that, under DoD policy, is considered an appropriated fund obligation."

(The eligibility of a project for appropriated funds does not guarantee, of course, that Congress will actually vote the funds for it. The real issue here is that the agency that allocates the funds also controls the priorities.)

Dirty Pool?

It is this money-reshuffling issue more than anything else that sets up the turmoil of the open messes. Six months ago, MWR activities were grouped into four categories, supposedly reflecting the degree to which they deserve appropriated fund support.

Category A is as unassailable as motherhood: libraries, gyms, recreation centers, and movies for troops in isolated locations. Congress wants to fund these programs completely, eliminating the need for "laundered" money. At the other extreme, in Category D, were the money-makers: golf courses, bowling alleys, marinas, and such. They would get no direct appropriated funding. Also noncontroversial is Category B, which includes child-care centers, swimming pools, craft centers, and the like. It is down for "substantial" appropriated funding.

In the original rackup, Category C—the main program being the open messes—was to have "limited" appropriated fund support. The FY '89 legislation now pending would eliminate this category and move clubs, recreation equipment checkout centers, and transient lodging facilities to Category D, which gets zero direct support.

The lost revenue threatens the financial basis of the open messes, but that is not the entire problem. The 439 military managers now in USAF's club system would be assigned to other duties. The force is already short 3,300 active-duty personnel for "essential feeding" under wartime operations plans, and that shortfall would worsen. The clubs would also lose 294 civilian managers, now paid from appropriated funds. They cannot simply switch over to nonappropriated fund status, since the two personnel systems are separate and there is no "portability" of benefits. As the Air Force knows from previous attempts to hire people for its clubs, the skills being lost cannot be readily replaced from the labor market.

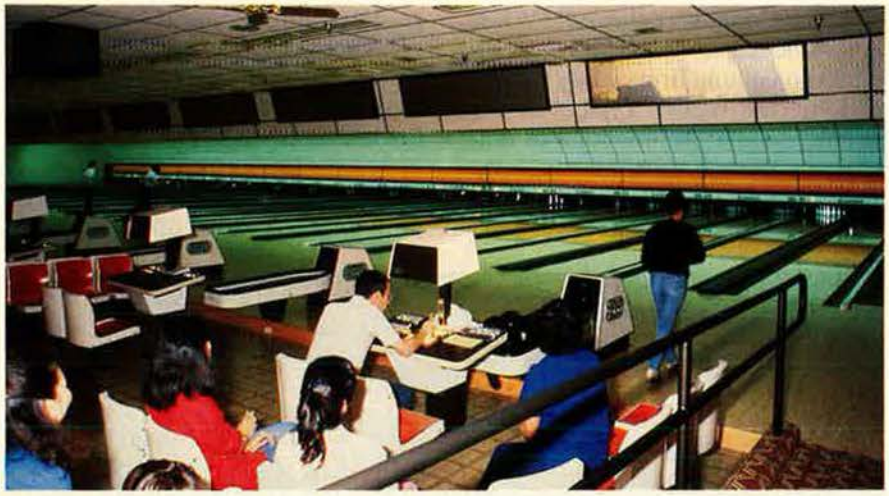
Congress wants the Class VI package liquor stores turned over to the Army-Air Force Exchange Service by October. The Air Force concurs with the move, but is asking for enough time to ensure an orderly transfer. Congress has also placed a dollar ceiling on MWR activities. As budget reduction options become fewer in the years ahead, the full funding foreseen today for bedrock MWR programs will become less and less certain.

The outlook for MWR in general—and open messes in particular—is not good. Even if the Pentagon can strike a compromise on some of the more damaging actions, the program will still have declined considerably. The troops, mindful of the losses in their community recreation programs and having heard many a pitch from recruiters and retention counselors about their MWR benefits, may understandably perceive this as dirty pool. ■

MWR Facilities and Programs

Arts and Crafts	450	Class VI (Package Liquor) Stores	156
Outdoor Recreation	356	MWR Supply	144
Libraries	352	Youth Facilities	131
Swimming Pools	285	Child-Care Centers	126
Open Messes	260	Preschool Facilities	112
Bowling Centers	217	Golf Courses	98
Sports/Gym	214	Aero Clubs	48
Recreation Centers	183		

This chart tallies some of the major kinds of morale, welfare, and recreation programs the Air Force operates. In all, there are 7,100 facilities, not counting ball fields and tennis courts. The program employs 49,418 people, of whom fifty-eight percent are part-timers.



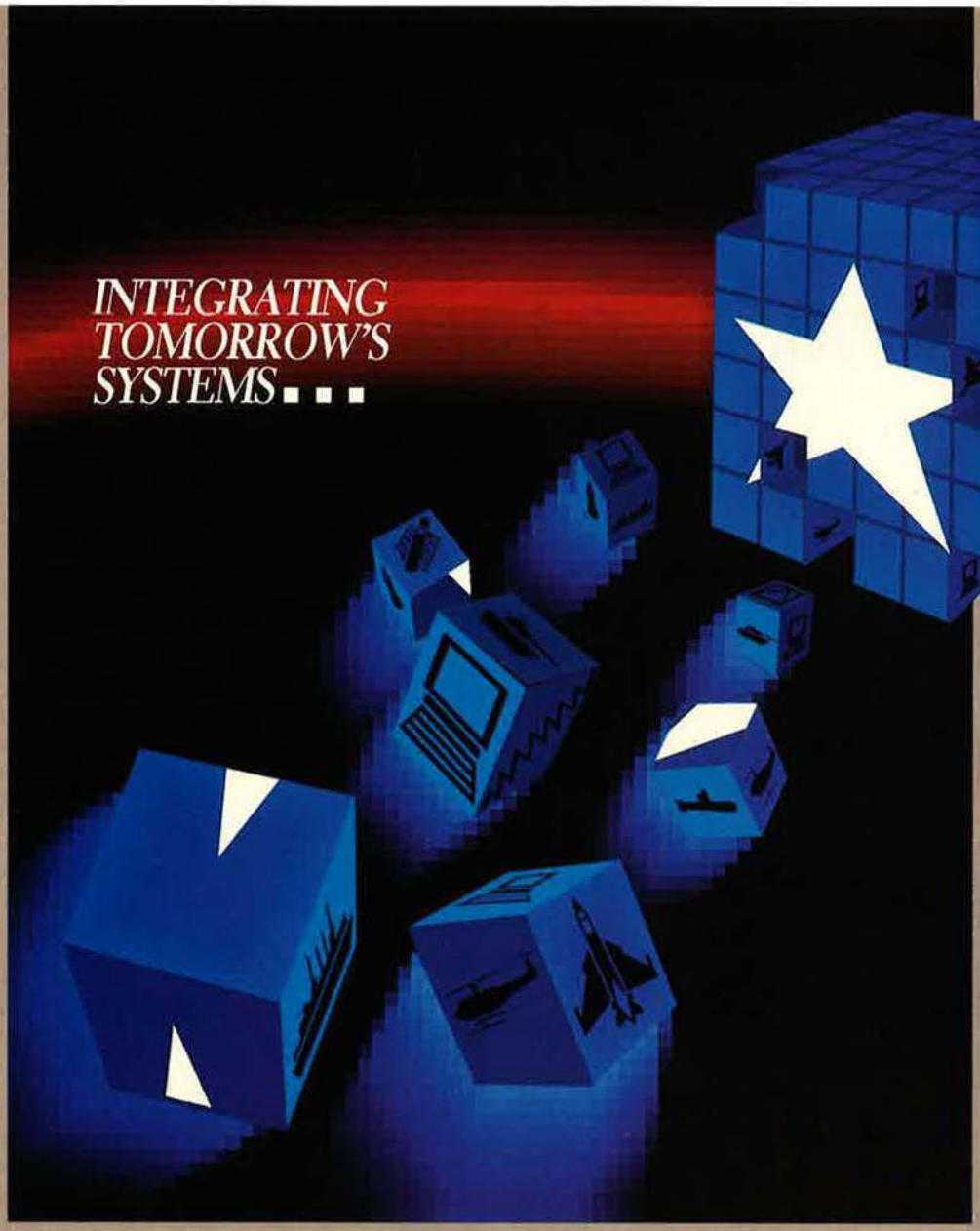
To many military people, their base is their community, and they, as taxpayers, justifiably view as unfair Congress's reluctance to fund their recreation programs at the same level as those in civilian communities.

Sources of Funding

(Outlays in $ millions)

	FY '83	FY '84	FY '85	FY '86	FY '87
Appropriated Funds	297.0	320.8	352.3	359.0	373.7
Nonappropriated Funds	540.9	573.2	619.2	646.9	666.7
Total	**837.0**	**894.0**	**971.5**	**1,005.9**	**1,040.4**

In recent years, the Air Force has depended on appropriated funding for only about thirty-six percent of its morale, welfare, and recreation support. The remainder is money generated by the troops themselves.



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The War That's Fizzling

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

The voters demand a solution to the drug problem. Noting that a variety of other measures have failed, Congress now says that the armed forces should seal our borders. This is a grandstand play that won't work.

A few nations in this troubled world handle drug smugglers the old-fashioned way: They kill them. Not surprisingly, those nations are without any serious drug problems. Summary execution can have a powerfully inhibiting effect, whether on drug peddling, desertion in the face of the enemy, or horse thievery in the old Wild West. It is also out of the question in an enlightened society like ours where mass murderers can rely on years of appeals before, if ever, they face the final solution.

Thus far, the war on drugs has fizzled, as evidenced by the widespread availability of the entire dope cornucopia. We read of teenage guttersnipes replete with gold chains and Mercedes cars before they are old enough to drive. Drugs are at the root of most violent crime. In the face of all this, there is an urgent need to do something.

If a real solution, like Malaysia's application of the capital penalty, is not to be considered, then we must consider the limited number of other options. Some respected citizens think legalization is the answer; that, so goes the argument, would take the profit out of the drug trade. It would also, almost certainly, create a few new problems.

Then there are the arguments for random testing across a broad spectrum of occupations. The armed forces have already proven the efficacy of this disincentive to drug use, but they are a special case. Civil-liberties activists will fight any testing of the populace at large.

The polls, nevertheless, show that drugs have become the chief concern of American voters, and politicians do pay attention to polls. As a result, Congress has come up with a hasty and poorly conceived solution: charge the armed forces with stopping the flow of narcotics. As one Senator observed, it is reminiscent of Canute the Dane, King of England from 1016–35, whose failed attempt to command the tides demonstrated to his court the limits of power, even for a king.

Superficially, the scheme seems to make sense—admittedly, not much sense, but a little. After all, the AWACS can track anything that moves, fighter aircraft can do lazy eights around any airplane the drug trade flies, and the Navy can blow smugglers' boats out of the water as easily as it destroys Iranian oil platforms. Add armed helicopters, soldiers at key points, surveillance radar along the coast, and you have, in theory, a formidable barrier to drug criminals. Only in theory, however. A more likely result would be an almost undetectable reduction in the available amount of brain-destroying chemicals and the occasional shootdown of some blundering, off-course, unidentified but innocent airplane.

In addition, there is the matter of military readiness, which is, after all, the principal reason we will spend nearly $300 billion this year on national defense. Chasing around the Caribbean after small boats and light aircraft is no way to prepare for serious military opponents. Besides, there are ever so many means by which drugs can enter the country, a principal one being container ships that offer a convenient way to smuggle in job lots worth millions.

Some years ago, the French Connection concealed heroin consignments in shipments of military household belongings; they planted the stuff in upholstery and retrieved it in the warehouse at the other end. A sergeant in my NATO office was once offered a substantial bribe to bring in a few pounds hidden in a document box aboard a military aircraft. He reported the offer, and it helped to break the French Connection, but the incident served to illustrate another of the myriad ways that drugs can be slipped through.

From what has happened so far, it is apparent that this country is not ready to meet the drug problem head on. The congressional grandstand play of passing the job to the military is an elaborate evasion, and the armed forces almost certainly will suffer both in capability and reputation if they have to carry out the charade. Ironically, the Coast Guard—the service responsible for and most knowledgeable about the problem—has had its budget axed to a level that may force it to tie up some of its ships.

This diversion of the military to the drug war stirs up uneasy memories of the early days in Vietnam and the fascination with counterinsurgency. Old airplanes came out of mothballs, and newer ones, like F-102s, began to stagger around at low level in the futile pursuit of slow and primitive intruders. In time, we might even have worked our way back to observation balloons. It was all great fun, but it didn't have much to do with the primary mission of national defense. The Air Force, at least, could have bypassed most of the counterinsurgency game in favor of direct action, a lesson we learned too late.

It took a while after Vietnam for the armed forces to get back on course. This new scheme to mount a massive military effort against the drug network bears a disturbing similarity to that last diversion, and it could have the same degrading effect.

The drug war is one this country must win, but are the armed forces the best instrument for this job? ■

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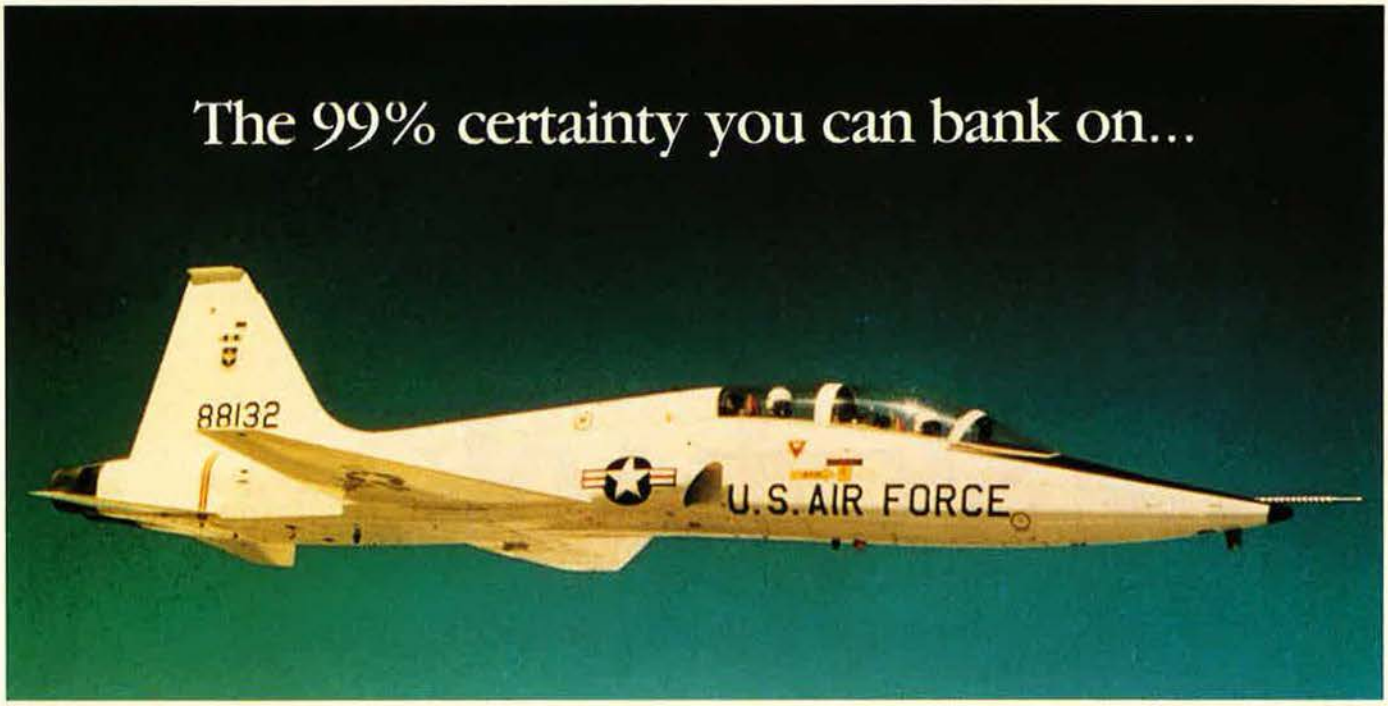

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In 1945, the military helicopter was still a novelty, and rescue methods were primitive by today's standards. Still, supported by engineers, tree-cutters, and earth-movers, the YR-4 got its man out of the Burmese jungle.

The Skyhook

BY C. V. GLINES

THE helicopter is now a familiar sight in the world's skies, but there was a time when it was a rare bird and its future was in great doubt. After many false starts dating back to World War I by American and foreign inventors, it was Igor Sikorsky who finally solved the riddle of vertical lift and proved that helicopters had a place in aviation's future. His first successful helicopter, the VS-300, was improved and became the XR-4, which was delivered to the Army Air Corps in May 1942. An order for fifteen YR-4As for service test followed in December, and the saga of the practical helicopter began.

Lt. Raymond F. Murdock was one of the early Air Force pilots who helped prove how valuable the "flying eggbeaters" could be. Now retired from his job as a high school guidance counselor in Waynesburg, Pa., he has tucked away in a footlocker a Distinguished Flying Cross and the Air Medal with three Oak Leaf Clusters earned for air search-and-rescue missions while serving in the CBI during World War II. The citation for the DFC explained that the award was "for extraordinary achievement by participation in operational flights as pilot from 4 October 1944 to 29 March 1945, totaling more than 300 hours, during which exposure to enemy fire was probable and expected. These flights, performed for the purpose of search, supply, and rescue of aircrew members downed in the jungles and mountains of Burma, were accomplished with untiring energy and a devotion to duty above and beyond that normally expected."

Just like a big Revell model! Here Sgt. Don Nigro (on top, working on the main rotor assembly) and his colleague at Myitkyina, Burma, reassemble the first YR-4 helicopter shipped to the Burma-India theater for rescue work during World War II. The Sikorsky was flown from Wright Field in a C-54.

But it was the single mission for which Ray Murdock received the second Oak Leaf Cluster to the Air Medal that earned him a permanent niche in Air Force history. The story of that mission begins on March 19, 1945, when an Air Transport Command C-46, flying the Hump to Kunming, iced up and crashed in the Burmese mountains. The crew bailed out near the Shingbwiyang Air Field, and an air search was begun. The next day, a Naga native arrived with a note from the C-46 radio operator saying he was badly hurt. A search party followed the native into the jungle and located him. Meanwhile, a Naga chieftain arrived and, with gestures and grunts, managed to convey the message that he knew where the C-46 had gone down and exactly where the other crew members were located.

When asked by sign language if he would be willing to go aloft and point out where the crew might be found, he agreed and was promised a reward of money and gifts for his wives if the men were located.

The plane chosen for the search was a Fairchild PT-19 trainer assigned for proficiency flying. Capt. James L. Green strapped the Naga chief in the front seat and took off. After two hours of fruitless searching, Green concluded that the chief was completely disoriented and headed back toward the Shingbwiyang Air Field. He had only one more ridge to cross when the plane's engine coughed and died. Too close to the ground, there was nothing Green could do but ride the plane down and hope for a soft landing in the jungle treetops.

Crash Landing in the Jungle

The PT-19 smashed through the tall trees on the side of the mountain and dropped into the jungle below, five miles short of the field. It might as well have been a thousand.

Search efforts intensified when Green was overdue. Without a radio, he had been unable to report his position periodically, so no one knew where to look for him. Just at sundown, the C-46 crew members were sighted and led to safety by a ground party. This left Green and his Naga passenger as the focus of the search effort.

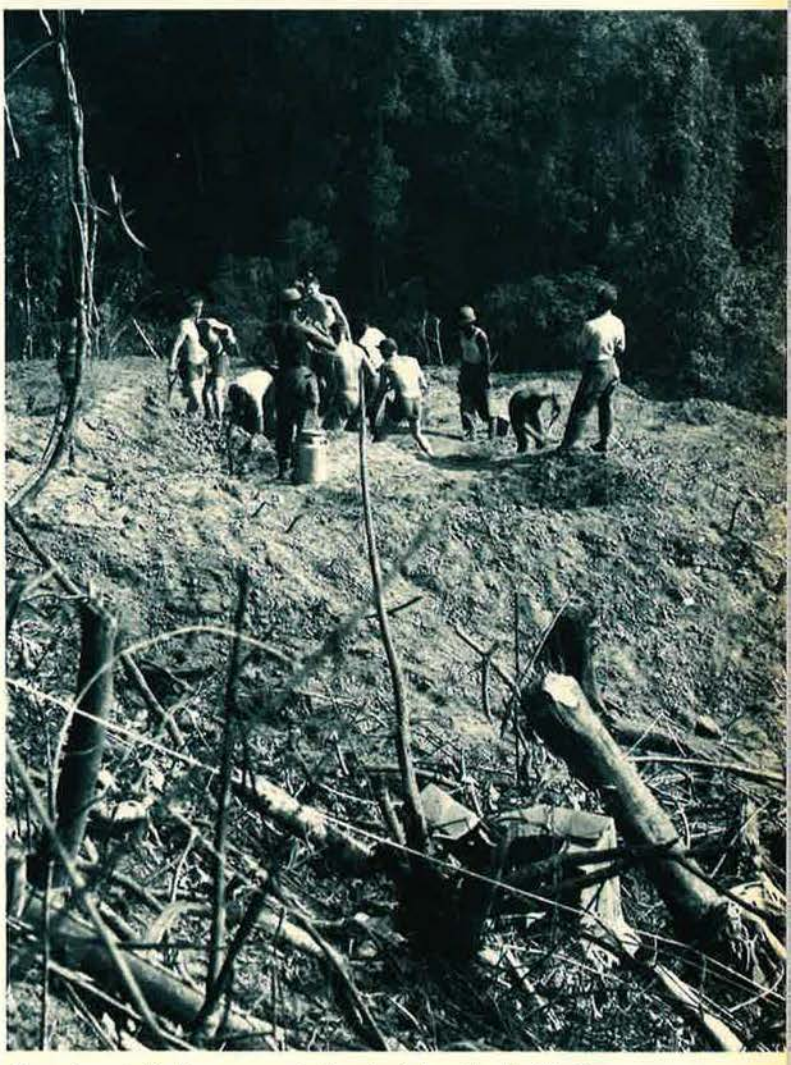
When Green's PT-19 had gone down, his unit at Shingbwiyang dispatched a C-47 to assist in the search. At dusk, as the Gooney Bird was preparing to land, one of its crew members sighted the twisted wreckage of the PT-19. There were no signs of life.

Although Green's plane was down only a short distance from the field and could be seen from the air, nothing could be done until the next morning. At dawn, a team of rescuers, led by Lt. William Diebold and guided by a pilot in an L-5 radioing directional instructions, slashed up the mountainside through dense jungle toward the crash site. They arrived after a day and a half of backbreaking effort. Tearing at the wreckage, the team found Green underneath, barely alive. Capt. (Dr.) Jim Lamberts, the base flight surgeon who had volunteered to go along, pronounced Green's condition critical. The luckless pilot had suffered a concussion, a broken pelvis, internal injuries, a broken jaw, and serious cuts about his face. He was delirious, his eyes were swollen shut, and he could not communicate with his rescuers.

While Dr. Lamberts worked on Green, the rest of the team searched for the Naga chieftain. Tracing bent branches and trampled undergrowth, they discovered the Naga chief's body in a shallow grave nearby. Apparently, his tribesmen had found the wreckage, buried their leader, stolen Green's pants, watch, and wallet, and left Green to die, possibly as punishment for causing the death of their chief. Green may have been luckier to be alive than he realized. Many of the Naga tribes in that area still practiced headhunting. However, so far as was known, they practiced decapitation only against enemy tribes and, possibly, the Japanese.

The more Dr. Lamberts checked his patient, the more convinced he was that Green could never survive being carried down the steep slope and through the jungle back to the base. His internal injuries were uncertain, and the extent of his fractures would not be known until he could be X-rayed at the base hospital. Splinters from Green's broken pelvis could puncture his internal organs if he were jostled on a stretcher. But if he were not evacuated, he would surely die from infection and internal bleeding.

Dr. Lamberts conferred with Lieutenant Diebold, the rescue party leader, and asked if it would be possible to carve a landing site out of the jungle so that an L-5 could land and evacuate Green. Diebold shook his head. "Doc,



Almost ready for the rescue helicopter's landing is this tiny patch carved out of the dense jungle on a narrow hilltop in Burma. Combat engineers and rescue personnel had to be resupplied by air for two weeks as they struggled to keep downed pilot Capt. James L. Green alive and to make his rescue possible.

Payoff for the rescue effort finally came on April 4, 1945, when the injured pilot of the downed PT-19 was carried by rescue personnel on a makeshift litter to the YR-4 helicopter sent from Myitkyina, Burma. The rescue mission took two weeks, though the injured pilot, Capt. James L. Green, went down only three minutes' flying time from his base, Shingbwiyang Air Field, in Burma. Here, members of the rescue team make their slow way from the jungle to "Pecorare the Greek's Airstrip" and the waiting chopper.

it would take a strip at least 1,500 feet long and maybe longer because of those 150-foot trees. It would take weeks to get a strip built on the side of this mountain and [would] require a couple hundred men."

"What We Need Is a Skyhook"

Lamberts had never been faced with such a complete lack of alternatives before. The patient had to get to hospital care, but if he were carried out, the trip would kill him. "What we need is a skyhook," he said to no one in particular.

Diebold nodded, but did not reply as he knelt down beside Green, who lay moaning on the ground. The word "skyhook" lingered in his mind, and he recalled how as a Boy Scout he had wished several times for a mythical skyhook on some of his mountain-climbing trips. Suddenly, he stood up and said, "Doc, they've got a skyhook! That air rescue outfit at Myitkyina has a helicopter—one of those 'flying eggbeaters.' Maybe this is a chance for those pilots to show what they can do!"

The Tenth Air Force's Air Jungle Rescue Detachment at Myitkyina was immediately contacted by radio. Their Sikorsky YR-4 helicopter would be dispatched promptly to Shingbwiyang. Lt. Raymond F. Murdock would be the pilot.

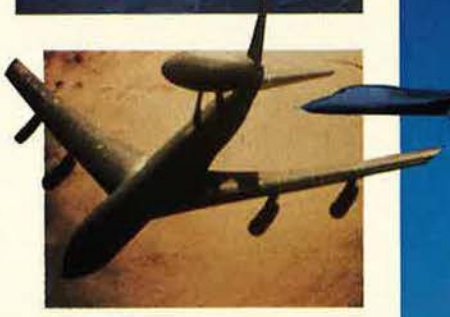
The YR-4 was still relatively new to the Army Air Forces in 1945. Although 128 R-4s, followed by about 300 R-5s and R-6s, were delivered by Sikorsky to the AAF before the war was over, all were very limited in their load-carrying and altitude capabilities.

However, in April 1944, Lt. Carter Harman showed that the noisy, ungainly YR-4 could play a role in saving lives in the CBI. He rescued a trio of injured British soldiers and their American pilot, T/Sgt. Edward Hladovcak, whose L-1 liaison plane had been shot down behind enemy lines. Despite the high altitude, humidity, and tropical temperatures that strained the YR-4 to its limits, especially in its ability to hover, he was able to pluck the four, one by one, out of a rice paddy almost under the noses of the Japanese. Harman made several more jungle evacuations before returning to the States. The YR-4 was put in temporary storage afterward because no one was checked out in it.

In January 1945, a B-25 crashed in a remote jungle area in Burma, and Gen. H. H. Arnold personally ordered another YR-4, along with two pilots and maintenance personnel, flown from the States to assist in the rescue of the downed crew. Seventy-four hours after receiving the order, the YR-4 was offloaded at Myitkyina. Within the next twenty-four hours, it was assembled and ready for flight. Lt. Irwin C. Steiner, test pilot from Wright Field, volunteered to attempt the rescue; however, before takeoff, the B-25 was located, and the crew walked out of the jungle by themselves.

Capt. Frank W. Peterson, officer-in-charge of the helicopter crew, had orders to keep his men in the CBI for thirty days, participate in any rescues in which the "flying eggbeater" was needed, and train two or three pilots in its operation before returning to the States. Peterson and his crew didn't have long to wait for a

The Threats Are There



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rescue mission. At midnight on January 23, 1945, a call was received that an enlisted man at a weather station located high in the Naga hills in northern Burma had accidentally shot himself through the hand. His wound had become infected, and he needed prompt medical attention. Could Captain Peterson land the eggbeater at this high altitude and get the man out? He did by making a running takeoff.

The Lightest Pilot Available

In the weeks following, the underpowered machine was a familiar sight to the crews flying in and out of Myitkyina. Instead of two or three pilots being checked out, however, only Lieutenant Murdock qualified because he was the lightest pilot available. With an instructor pilot and a heavy student pilot, the struggling YR-4 with its 185-hp engine could hardly make it off the ground under the best of conditions. Murdock soloed in six and a half hours and built up flying time on short flights, identifying for record purposes the known sites of crashed planes. After Peterson and Steiner returned to the States, Murdock used the craft on several local searches, but had not been called on to perform any life-saving missions until the request came from Shingbwiyang.

After arrival there, Murdock flew over the crash site in an L-5 and advised the ground crew where to build a landing spot. If he were to get the YR-4 down nearby, Diebold and his men would literally have to carve a landing pad out of the jungle. It would take time, equipment, manpower, ingenuity, and a lot of luck. How long could Green last without hospital care?

Dr. Lamberts answered the question quickly. "If I can keep the infection down and keep him fairly immobile, I think he can stand it for about a week. Any more time than that and it will be touch-and-go because I really can't tell the extent of his internal injuries."

A group of combat engineers and base personnel, led by Lt. Michael Pecorare, volunteered for a work detail and pushed their way to the crash scene. Pecorare estimated that it would take about ten days to construct a landing pad with enough clearance all around so that Murdock could get the Sikorsky in safely. Instead of constructing the pad on a ridge of a half-bowl-shaped area where Murdock recommended, however, the team decided to construct a landing pad on a ledge on the side of the mountain inside the half bowl. Trees would have to be cut first, then the stumps blasted out. Dirt would have to be dug out of the cleared area and bulwarked to make the pad. Supplies would be airdropped until the evacuation was completed.

Dr. Lamberts was replaced by Capt. (Dr.) H. D. Underwood, who sat with the injured pilot around the clock. Green's condition improved when penicillin arrived, the new antibiotic "miracle" drug just being made available.

The work went slowly. The crews radioed for a power saw, which was airdropped on March 28, and the tree-cutting speeded up. Tons of dirt were dynamited so that the eighteen-degree slope could be leveled to about five degrees for drainage.

While the engineers worked from dawn to dusk, Dr. Underwood grew concerned about his patient. He radioed for Maj. (Dr.) Arthur R. Dewey, a maxillofacial specialist, to help him. Dewey took one look at Green's swollen face, promptly pulled three of Green's front teeth, and wired his fractured jaw so that it would heal properly. It was the consensus that Green's condition was still critical; moving him down the mountain on a stretcher was out of the question.

"Pecorare the Greek's Airstrip"

The diary kept by the ground party noted for March 29: "Work on the strip progressed with everyone taking a turn with pick, shovel, and axe. Dirt that wasn't blasted away was shoveled into empty TNT cases and towed away with [parachute] shroud lines tied to them. . . . Many tons of dirt were hauled away in this manner by the 'truck drivers' union,' dumping it in the right places."

By March 31, the story of the attempt to rescue Capt. Jim Green had spread throughout the China-Burma-India theater. More volunteers arrived to relieve the exhausted men who had been there since the first day. Supplies were airdropped regularly; a full-sized camp was established to take care of the growing numbers of men who insisted on helping. The combat engineers, augmented by mechanics, clerks, MPs, and truck drivers, kept plugging away as long as they could see to work.

By April 3, enough dirt had been piled up, bulwarked, and packed down so that the surface seemed hard enough to take the weight of the YR-4. Murdock, who had been watching the progress from the air, radioed that he would try to get the chopper in the next day. That night it rained heavily, and the engineers worried that the landing pad would be washed down the mountainside. However, the first light of dawn proved that their foresight in making an extra strong bamboo bulwark had paid off. The pad was intact, although the steps they had carved for themselves from the campsite to the pad had disappeared.

The morning light brought other good news. Green's promotion to major was radioed to the site, and his squadron commander promised him a promotion party when he returned. Green, no longer delirious, could only grin around his wired jaws.

But there was bad news, too. Perched 1,500 feet above the valley, the men on "Pecorare the Greek's Airstrip" looked down on a solid blanket of fog. Shingbwiyang was socked in while they sat above the clouds, ready but helpless.

On the ground, hoping to get airborne before the temperature increased and raised the air density, Murdock preflighted the YR-4 and waited for the fog to lift. At 9:30, the weatherman told him to stand by. At 10:00, Murdock cranked up, blasted off, and headed for the bare spot on the side of the mountain.

Murdock was worried about this mission, although he did not mention it to anyone. He had only thirty-six hours in the chopper and no experience landing in such a limited space under such dangerous conditions. The helicopter's engine was overdue for replacement and was not pulling full power. With the extra load of a passenger at a higher altitude, he knew he would be riding on the ragged edge of the craft's absolute maximum performance capability, even though he had stripped it of all nonessential equipment.

When he arrived over the landing site, a stiff breeze

Airman's Bookshelf

Lifting the Iron Curtain?

Uncovering Soviet Disasters, by James E. Oberg. Random House, New York, N. Y., 1988. 317 pages with photos, notes, appendices, and index. $19.95.

On May 4, the Pacific Engineering & Production Co. plant in Henderson, Nev., was flattened by a massive explosion. The plant, which produced a critical ingredient of the solid-rocket fuel that powers US civil and military rockets, was crucial to the US space and defense program.

Within hours of the disaster, news crews had descended on Henderson, and soon the nation and the entire world had learned of the catastrophe. Survivors were interviewed on the evening news, damage estimates and casualties were announced, and government officials began investigations to discover the cause of the explosion and to assess the impact on current spacelaunch programs.

The explosion made the front page of most major newspapers, and evening television news programs broadcast reports from Henderson.

On May 17, the Department of Defense announced that US reconnaissance satellites had detected a major explosion at Pavlograd, 500 miles southwest of Moscow. US spokesmen said that the explosion had occurred at a Soviet facility that makes rocket propellant for the mobile SS-24 ICBM.

On May 19, the Washington *Post* reported that the Soviets had acknowledged a blast in Pavlograd. But the Soviets denied that the rocket propellant plant was involved. In what the *Post* characterized as "a carefully worded statement," the Soviets refused to confirm or deny directly Western press reports about the blast. The delay in reporting on the explosion, the article continued, "appeared to reflect extreme sensitivity about information relating to [the Soviet Union's] nuclear missile program."

The article went on to quote Mark Kramer, a Harvard military affairs specialist. Mr. Kramer observed: "I think we are witnessing the limits of *glasnost.*"

James Oberg is unlikely to be surprised by the contrasting Soviet and American reactions to disaster.

Mr. Oberg, a NASA engineer and noted space writer, has canvassed numerous sources and probed many records to produce this catalog of confirmed and suspected Soviet disasters. Subtitled *Exploring the Limits of Glasnost,* this book lays out the Soviet attitude toward mishaps and analyzes how Mikhail Gorbachev's vaunted policy of openness will affect the reporting of future accidents.

"The limits of *glasnost,*" Mr. Oberg writes, "have been sharply demarcated by the official handling of news of disasters; 'openness' is broad, indeed, but not universal by any means, and it is shallow, very shallow."

How will *glasnost* fare in a country notorious for its secrecy and sanitized press? Oberg offers this example of the ingrained Soviet penchant for "official" versions of events:

In September 1976, a fire raced through an apartment block in Moscow fewer than twenty-five yards from the Foreign Ministry. Incredibly, rush-hour crowds of commuting Muscovites hurried past the fire, taking no notice of it. Passers-by were oblivious to the conflagration. When a foreigner raised a camera to photograph the blaze, he was accosted by a bystander. "Why would you want to take a picture of that?" the photographer was asked. Officially, the fire didn't exist.

Oberg warns that such secrecy has its price for Westerners and Soviets alike. One Soviet cosmonaut, Oberg reports, died in 1961 in a tragic oxygen-rich fire. That fire was not unlike the one that killed three American astronauts in 1967 during the Apollo program. Would events have turned out differently for the American astronauts had NASA known of the existence and cause of the Soviet tragedy?

More than valuable lessons can accrue to the West from a study of Soviet accidents, Mr. Oberg writes. Crucial information on Soviet science and technology, for instance, can be gleaned from such reports.

But perhaps the greatest justification for ferreting out information on Soviet mishaps is that, under the Gorbachev policy of *glasnost,* such investigations have tended to beget more openness. The author points to the Chernobyl nuclear plant accident as a watershed in this respect. Whereas the initial Soviet reaction ran true to form (deny, minimize, blame others), Western persistence finally resulted in an unprecedented Soviet accounting of what happened.

Such instances engender a cautious optimism in Mr. Oberg. *Glasnost,* he writes, "seems more than a veneer or chrome trim." But it clearly has its limits.

Nowhere are those limits more striking than when they concern such military accidents as the one at Pavlograd mentioned earlier. Enthusiastic Westerners should take note of Mr. Oberg's ominous caution on this score:

"*Glasnost* has cast no light at all into this corner [military accidents] of Soviet reality, and the Soviet military establishment clearly intends to keep it that way."

—Reviewed by Hugh Winkler, Assistant Managing Editor.

Leonardo's Toy

Attack Helicopters: A History of Rotary-Wing Combat Aircraft, by Howard A. Wheeler. The Nautical & Aviation Publishing Co., Baltimore, Md., 1988. 117 pages with notes, photos, and index. $22.95.

The helicopter began as a toy. For centuries, it was nothing more than that. But from this simple toy came the most wondrous of flying machines—an aircraft rivaling the flying carpet in its ability to go straight up or straight down, fly forward, backward, or sideways, turn completely around, or hover motionless in one spot.

Leonardo da Vinci put his superlatively inventive mind to helicopter

design—and so, more than three centuries later, did Thomas Edison. But large, multiengine airplanes would be spanning the globe before the first rickety helicopter would fly successfully, and years would pass before the helicopter would be a versatile machine suited to war or peace and capable of performing tasks over land, at sea, and in the air beyond the reach of other vehicles.

The helicopter is one of man's most useful and least understood flying machines, asserts Howard A. Wheeler, author of this narrative history of combat helicopters.

Because of their mobility, speed, and the ease with which they take off and land, helicopters are well suited to modern combat conditions. Proponents of rotary-wing aircraft argue persuasively that this unique design has changed the nature of modern warfare. Such national and international events as the Malayan Emergency, the French-Algerian War, Vietnam, the Falkland Islands conflict, and Grenada attest to the helicopter's flexibility and adaptability.

War has inspired many impressive inventions. Unlike most military inventions, which were designed either for projecting firepower or defending against the enemy, the helicopter began its military career as a lifesaver—for the purpose of medical evacuation (medevac). *(See p. 104 of this issue for a graphic account of a World War II medevac.)*

Wheeler argues that the single most important catalyst that contributed to the long-awaited development of the practical helicopter was the internal combustion engine—first the gasoline piston engine, then the gas turbine engine. The gasoline engine's favorable power-to-weight ratio enabled the early gyrating rotary-wing flying machines to get airborne vertically and to sustain controlled hover and forward flight.

The history of attack helicopters is as much about the pilots, flight crews, inventors, and engineers as it is about the incredible vertical flying machines themselves. The author credits the growth of rotary-wing technology to scientists and engineers from many nations, most notably Germany, France, England, the US, and the Soviet Union.

The attack helicopter, Wheeler writes, is a superb force-multiplier, because it allows the field commander to employ his forces with greater efficiency. Moreover, he argues, the combination of modern missile technology and combat helicopters may soon threaten the main battle tank with obsolescence.

For years, the helicopter's capabilities were greatly underestimated by military tacticians and planners. Its potential was not aggressively explored, and it was not properly designed and built to face the rigors of battle. This skepticism is fast disappearing, Wheeler says.

The helicopters of the 1980s and 1990s, the author points out, are being designed with particular combat scenarios in mind. In both conventional and guerrilla warfare, the helicopter has become essential, because it can provide lifesaving, logistics, reconnaissance, close air support, and fire-suppression services. It is unlikely that any military operations would be carried out today without them, he concludes.

The author looks ahead to the technological advances that will expand the capabilities of helicopters in the future. To the list of missions traditionally associated with the helicopter—combat logistics, battlefield reconnaissance, medical evacuation, and search and rescue—he adds others for the 1990s and beyond. For example, antisubmarine, light attack, antiship, antiarmor, and antiaircraft (air-to-air) missions will all be carried out from rotary-wing platforms.

In his crystal ball, Wheeler sees future helicopters built from nonmetallic materials, use of sophisticated aerodynamic designs in order to achieve higher speeds, and helicopters equipped with infrared and low-light sensors and carrying more types of weapons than any other flying machine. Digital flight controls and fly-by-wire systems will make helicopters easier to fly.

Wheeler, a retired US Navy commander, has more than twenty years of military experience. He served as a helicopter pilot and aircraft commander and was managing editor of *Naval Aviation News* magazine for two years.

Because it offers an inspiring look at the least understood of our combat aircraft, this book will appeal to the serious student of military aviation. Readers searching for ways to expand the capabilities of helicopters will be especially interested in the last chapter of the book.

It remains to be seen, however, if the funding will be made available to mold rotary-wing design ideas into physical form for use in combat.

—Reviewed by Maj. Michael B. Perini, USAF. Major Perini is Deputy Director of Public Affairs for Pacific Air Forces at Hickam AFB, Hawaii.

Triumph at Thai Nguyen

Jim Brickel's RF-101 was shredded by flak, but there could be no turning back on this mission.

BY JOHN L. FRISBEE
CONTRIBUTING EDITOR

RECONNAISSANCE has been a key element in warfare since men began fighting with clubs and stones. During the long years of the Vietnam War, special requirements were laid on the pilots who flew photo recce missions in the heavily defended areas of North Vietnam. The decision-makers in Washington wanted volumes of target and poststrike photos almost before the smoke of battle had settled.

Until late 1967, most of the photo recce work in the North was done by venerable RF-101 Voodoos, flying alone, in pairs, or leading a formation that included F-4 MiG CAP fighters. Enemy defenses and recce tactics—photo runs were flown at low to medium altitude—took a heavier toll of the unarmed RF-101s than of strike fighters. Photo recce pilots were in a technically sophisticated, extremely dangerous, and rarely lauded business.

Into this sweaty and demanding environment came Lt. Col. James R. Brickel on November 30, 1966, assigned to the 20th Tactical Reconnaissance Squadron at Udorn Royal Thai AFB. A 1952 graduate of the Naval Academy, Jim Brickel transferred to the Air Force and cut his teeth as an F-86 pilot. Later earning two advanced degrees in engineering, he spent seven years in nuclear weapons R&D and with the Apollo lunar landing program before volunteering for RF-101 combat crew training.

Three months after reporting at Udorn, he was named squadron operations officer. By that time, it was apparent that RF-101s could not continue flying over the North much longer. Losses to ground fire and to MiGs had run as high as seven in one month. Plans were afoot to replace them with newer and higher-performance RF-4s, but never mind that. The insatiable demand for photo coverage had to be satisfied, regardless of risk.

March 10, 1967, was a landmark day in the SEA war, as it was for Jim Brickel. After months of hesitation, Washington had released the iron and steel plant at Thai Nguyen, some thirty miles from Hanoi, for attack. *(See "Valor," August '86 issue.)* Seventh Air Force Commander Gen. William Momyer called it "the most important target of the war." It was also one of the most heavily defended. Colonel Brickel, now a veteran of fifty sorties in the North, volunteered for this hazardous photo mission, which meant flying through a sixty-mile circle of thoroughly alerted SAMs and guns, with MiG-21s lurking in the wings.

As Colonel Brickel and his escort of four F-4s from the 8th Tac Fighter Wing under Lt. Col. Thomas McGuire swung south over Thud Ridge toward the smoke and flame rising from Thai Nguyen, the defenses opened up, first with 37-mm and 57-mm guns, then with an estimated ninety radar-controlled 85s. According to Colonel McGuire, flak was the heaviest he had seen, "except in World War II movies." As Colonel Brickel rolled into his photo run, there may never have been so much flak thrown at a single flight of aircraft.

Then, about ten miles short of the target, an 85-mm shell exploded directly under the RF-101's left engine. Oil pressure on that engine dropped to zero, the left aileron was torn up, a hydraulic pump that provided power for the flight controls failed, and the cockpit filled with smoke. With the damaged engine retarded, airspeed dropped off by fifty knots, making the Voodoo even more vulnerable. Fire and an explosion seemed imminent, but Colonel Brickel regained control of the aircraft and resumed his run just as the cameras began to roll. He knew there could be no abort on this mission so long as he could keep his crippled bird in the air.

Fighting on through barrage after barrage of flak, Jim Brickel came through with complete photo coverage and nursed his stricken Voodoo back to Udorn. General Momyer, who presented the Air Force Cross to Colonel Brickel, termed his performance over Thai Nguyen "a superb display of guts." General Momyer never was one to bestow compliments lightly.

The heaviest flak he had seen "except in World War II movies."

Jim Brickel flew another fifty-six missions over North Vietnam as squadron commander and was awarded a Silver Star and the Vietnamese Cross for Gallantry before returning to the States and a distinguished career in command and research assignments. He retired as a lieutenant general in September 1984 and now is a vice president of United Technologies Corp.'s Defense and Space Systems Group in Washington.

Today General Brickel has the highest praise for "the career tac recce pilots who flew those demanding missions throughout the war. They set an exceptional standard of courage, dedication, and professionalism," he says. "Flying with them was one of the most rewarding experiences of my Air Force years." ■

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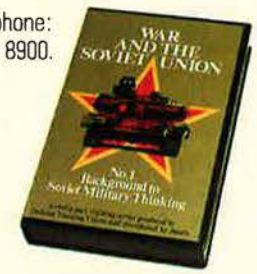

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Intercom

By Robin L. Whittle, AFA DIRECTOR OF COMMUNICATIONS

General Randolph Addresses Lindbergh Chapter

Air Force Systems Command Commander Gen. Bernard P. Randolph was the man of the hour at the Charles A. Lindbergh Chapter's March 18 formal dinner dance. The event, which honors the recipient of the Chapter's coveted "Lone Eagle Award," was held at the Italian Center in Stamford, Conn.

"Some 300 guests from as far away as Seattle, Wash., turned out to see General Randolph receive our Lone Eagle Award and to hear him outline how AFSC is helping to shape an improved and streamlined acquisition process," said Chapter President Dick Anderson, who served as the evening's master of ceremonies.

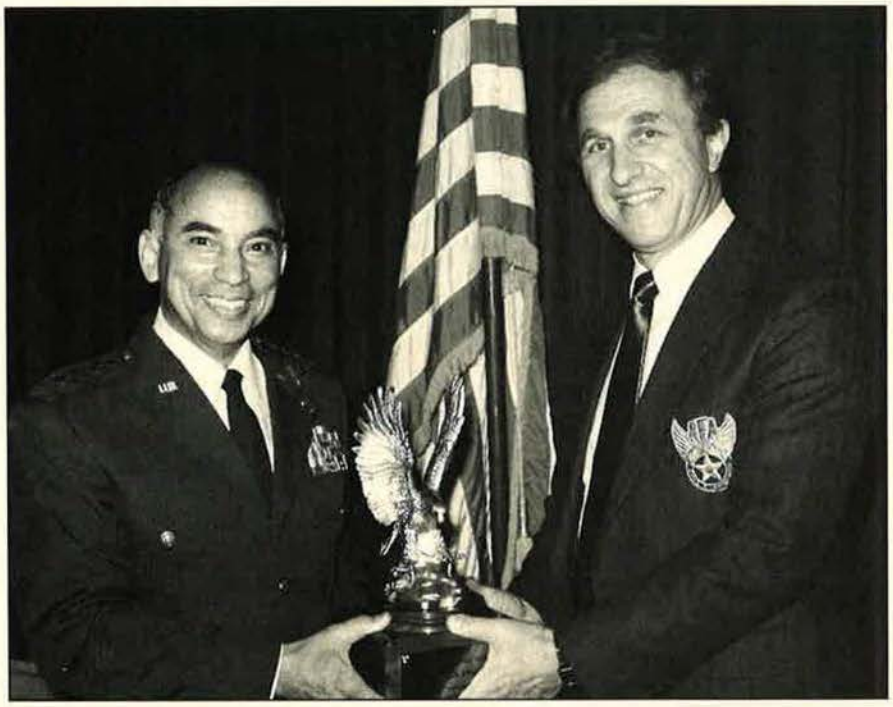
In his remarks, General Randolph said that reporting requirements for program directors have been reduced and that improvements have given them a shorter route to the top.

"Of our 364 programs, forty are major executive programs whose directors report only to their program executive officer, who in turn is wired straight to Jack Welch, the Air Force acquisition executive," he said. The other 320 or so programs will be delegated to AFSC.

He told the AFA crowd that he was a big believer in the eighth of Augustine's Laws, which are a set of often pithy principles of acquisition and program management coined by Norm Augustine, Chairman and CEO of the Martin Marietta Corp. That eighth law, said General Randolph, holds that "if a sufficient number of management layers are superimposed on top of each other, it can be assured that disaster is not left to chance."

General Randolph said that any program deemed less than satisfactory by the program director in his monthly report "will be sent up to me for resolution of whatever it takes to get the program back on track."

AFSC itself looks very different from the way it looked at this time last year. "We've reduced the staff by taking an additional seven percent reduction over the ten percent directed



Charles A. Lindbergh Chapter President Dick Anderson presents the Chapter's coveted Lone Eagle Award to Gen. Bernard Randolph, Commander of Air Force Systems Command, in recognition of his distinguished military career. General Randolph was also invested as a Gen. Ira Eaker Fellow at the March 18 dinner dance in Stamford, Conn.

In Maryland, AFA President Sam E. Keith, Jr., congratulates the winners of the Thomas W. Anthony Chapter's "Women of Distinction in Aerospace" awards. The honorees are, from left to right, Capt. Teresa Vandendolder, a C-21 pilot at Andrews AFB; Ruth Bates Harris, a pioneer in obtaining equal employment opportunities for blacks and women at NASA; and Florence Marston, a World War II ferry pilot.

The youngest pilot to complete a transcontinental (Fort Lewis, Wash., to Miami, Fla.) flight, ten-year-old Erik Fiederer, holds a Scott Associate plaque that he received from Robert H. Goddard Chapter President Carrol Buford, right, at a recent Chapter luncheon in California, as Erik's parents, retired Col. Joe Fiederer and Col. Nancy Fiederer, USAF, show their proud approval.

last year." Further, the plans and technology shops have been combined, and all support elements have been merged. While this reflects budget realities, "we've also reorganized for greater effectiveness in responding to users' needs. For us, that's job number one: supporting the operational users, whose lives are on the line to deter war and, if need be, to fight and win," he said.

At the conclusion of his remarks, General Randolph was presented the Lone Eagle Award by Lindbergh Chapter President Dick Anderson in recognition of his distinguished military career and in appreciation for his second speaking appearance at a Lindbergh Chapter function.

"Our Lone Eagle Award is symbolic of the courageous, nonstop, transatlantic flight by young Lindbergh in May 1927," Mr. Anderson said. General Randolph was also inducted as a Gen. Ira C. Eaker Fellow of AFA's Aerospace Education Foundation, while Mrs. Randolph received a crystal bowl from the Chapter.

"We had an all-female AFJROTC drill team from Norwalk High School demonstrate their technique as first-place winners in a recent regional drill competition," Mr. Anderson said. That was capped by an evening of dancing and camaraderie.

General Randolph is the fifth recipient of the Lindbergh Lone Eagle Award. Past honorees include Anne Morrow Lindbergh, now retired Gen. Leo Marquez, then Transportation Secretary Elizabeth Dole, and now retired Gen. Lawrence A. Skantze, the former AFSC Commander.

Vinson Chapter Honors Retiring Commander

AFA's Carl Vinson Memorial Chapter in Warner Robins, Ga., honored as the Association's outstanding chapter in the nation at last year's AFA Convention, paid tribute to longtime Chapter supporter and now retired Maj. Gen. Cornelius Nugteren, who served as Warner Robins Air Logistics Center Commander from 1982 through May 1 of this year.

At a farewell dinner at the Robins AFB Officers' Club in April, Vinson Chapter President Jim Milton presented General Nugteren with a Jimmy Doolittle Fellowship plaque. The General was cited "for outstanding achievement and in recognition of his tremendous support," Mr. Milton told the crowd. The honor represents a $1,000 contribution to AFA's Aerospace Education Foundation. It marked the first time in Chapter history that an individual was honored with two fellowships. General Nugteren had already been named by the Chapter as a Gen. Ira C. Eaker Fellow of the Foundation.

In his address, General Nugteren told the audience that as members of the best chapter in the country, "you are in a good position to influence national matters. We need to keep focused on what AFA is all about," he said. The General also discussed the challenges ahead posed by stringent budgets as well as what has been accomplished during his tenure to improve quality-of-life programs.

"If you ever stop putting people number one, you might just as well hang it up because you will have a second-rate outfit. Quality people—properly educated, trained, and treated fairly—are going to be motivated, and they clearly will be the key to anyone's success. If I have had any successes in this position, it's not because of what I did, it's because of what the people did," he said.

Three Robins AFB civilian employees were honored with AFA Medals of Merit during the evening. Lynn Dalrymple, a secretary in distribution, Chris Zdrakas, a public affairs specialist, and Jack Steed, a retired chief

Jim Milton, President of last year's top chapter nationwide—the Carl Vinson Chapter in Georgia—presents a Gen. Jimmy Doolittle Fellowship plaque to the retiring Commander of the Warner Robins Air Logistics Center, Maj. Gen. Cornelius Nugteren, in honor of his outstanding support of the Chapter.

master sergeant and now vice president of marketing for BankSouth in Warner Robins, received the medals.

"We were proud that this event was front-page news in the daily Warner Robins *Sun* and the *Robins AFB Rev-Up* base newspaper," said Maj. "P. J." Johnson, who edits the Vinson Chapter's attractive and informative newsletter.

Doolittle Raiders Rendezvous In Monterey

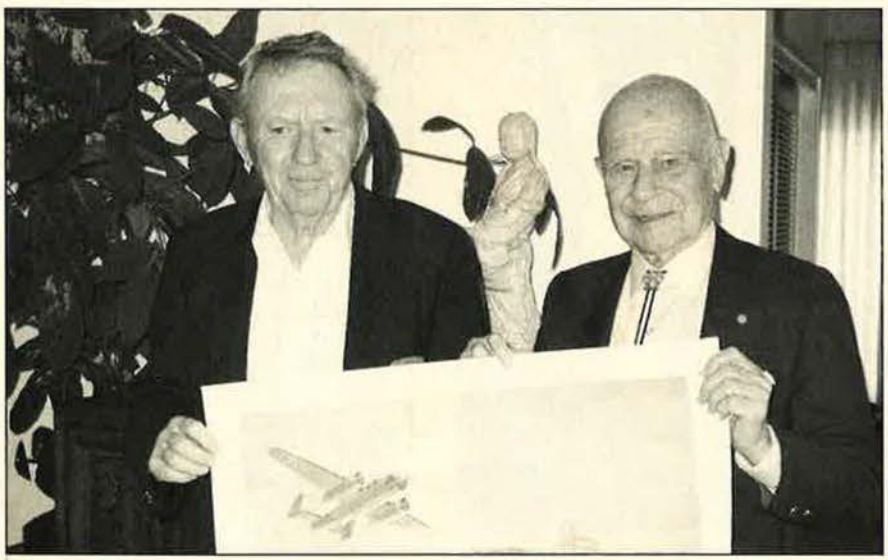
AFA's first National President Gen. Jimmy Doolittle and twenty-four survivors of his famous Tokyo Raid in the spring of 1942 met in Monterey, Calif., for their annual reunion.

"Like the Raid itself, this year's meeting featured close interservice cooperation," said Sacramento Chapter Communications Vice President Doug Baldwin. The Navy's Postgraduate School and the Army's Fort Ord supported the main reunion events, which included flyovers by B-25 Mitchells and B-17 Flying Fortresses during the main outdoor ceremony at Monterey's Presidio. California AFA President and National AFA Communications Committee member Hal Strack and Monterey Chapter leader Jim Crispelle coordinated the flyovers.

General Doolittle helped present the newly issued Prisoner of War Medal to four Raiders: Robert Hite and Jacob DeShazer, both captured after the raid and held prisoner for forty months, and David Jones and Thomas Griffin, who survived the raid only to be shot down and captured in later action against the Germans.

Retired Brig. Gen. E. W. "Brick" Holstrom, who destroyed a Japanese sub at the mouth of the Columbia River—the first enemy sub sunk off the West Coast during World War II—served as the reunion coordinator. Raiders attending the reunion in addition to Generals Doolittle and Holstrom and the four former POWs were Robert Bourgeois, Metairie, La.; William Bower, Boulder, Colo.; Richard Cole, San Antonio, Tex.; Jacob Eirman, Fort Walton Beach, Fla.; Robert Emmens, Medford, Ore.; Ed Horton, Fort Walton Beach, Fla.; Frank Kappeler, Santa Rosa, Calif.; Richard Knobloch, San Antonio, Tex.; Herb Macia, San Antonio, Tex.; Joseph Manske, San Antonio, Tex.; Charles McClure, Tucson, Ariz.; Jim Parker, Houston, Tex.; David Pohl, Manhattan Beach, Calif.; Henry Potter, Austin, Tex.; Doug Radney, Flagstaff, Ariz.; Jack Sims, Naples, Fla.; Roy Stork, Los Angeles, Calif.; Dr. Robert White, Palm Springs, Calif.; and Carl Wildner, Benton, Pa.

In an attempt to capture the flavor of a bygone era, the crew of the B-25* Pacific Princess, *from left, John Benton, Tony Ritzman, Carl Scholl, and Mike Matthews, dressed the part at this year's reunion of the Doolittle Raiders, which featured a flyover by B-25s and B-17s.



Doolittle Reunion Coordinator Brig. Gen. E. W. "Brick" Holstrom, who sank the first enemy sub off the West Coast during WW II, joins his former boss Gen. Jimmy Doolittle to display a painting of a B-25 leaving the USS* Hornet *on the famous raid. Twenty-four Doolittle Raiders gathered in Monterey, Calif., to celebrate their forty-sixth anniversary.

On the Scene

More than 300 industry executives and government representatives attended the classified and jointly sponsored AFA Paul Revere Chapter/Electronic Systems Division, AFSC, symposium on Strategic Defense Initiative/Air Defense Initiative (SDI/ADI) Simulation and Modeling, held March 23–24 in Bedford, Mass. **Maj. Gen. Eric Nelson,** ESD Vice Commander, welcomed the crowd and discussed key defensive counterair issues. Retired **Maj. Gen. Jasper Welch** provided a keynote address on analysis and strategic defense. Other participants included **Maj. Gen. Tom Moorman,** Director, Space and SDI Programs (SAF/ADS); **Frank Kendall,** Under Secretary of Defense; and **Col. Dick Paul,** ESD Deputy for Advanced Technology and Honorary Chairman of the Symposium. Technical Cochairmen for the event were **Gary Grann** and **Ken Madsen.** General Chairman was **Bill Rice.**

AFA's Charleston Chapter in South Carolina presented awards to five outstanding junior and senior AFROTC cadets at a luncheon banquet featuring **Col. David R. Marcrander,** Vice Commander, 437th MAW, as speaker. Held at Charleston AFB, the event honored AFJROTC cadets **Meredith McCrea, Jerry Henning,** and **Brian Bowick** and senior ROTC cadets **Douglas Hooks** from The Citadel and **Douglas Gracy** from Baptist College, who also received AFA watches. Doing the honors at the event was Charleston Chapter Vice President **Jim Friar.**

AFA Board Chairman **Marty Harris** recently presented awards to three NCOs assigned to Detachment 159 at the University of Central Florida. Honored were **TSgt. Tim Beavers,** AFROTC NCO of the Year; **TSgt. Vicki Murphy,** AFROTC Outstanding Personnel Manager of the Year; and **SSgt. Bill Dennehy,** AFROTC Outstanding Administrator of the Year.

Colorado AFA President **Jack Powell** presented AFA's AFJROTC medal to outstanding **Cadet Lt. Col. Sean O'Brien** and a $200 check to **Cadet Capt. Mike Erickson** on behalf of the Denver AFA school-assistance

Bob Hope Village Apartments

Widows of Air Force enlisted persons who qualify and who desire to live in the Teresa Village or Bob Hope Village may apply now for existing or future vacancies at either facility. Both Villages are located in the Fort Walton Beach and Eglin AFB area in northwest Florida.

The Air Force Enlisted Men's Widows and Dependents Home Foundation, Inc., plans to construct sixty-four additional garden-style apartments at Bob Hope Village, with an opening date set for May 1989. Officials say some apartments could become available during the year. The Foundation is interested in making these units available to all widows who qualify and especially those in a "dire need" category.

To qualify, an applicant must be the widow of a retired enlisted person from the active Air Force, Air Force Reserve, or Air National Guard who received full retirement benefits or the widow of a career enlisted person who died while on active duty with the active Air Force, Reserve, or Guard. The applicant must also be age fifty-five or older.

For more information, contact the Admissions Committee, Air Force Enlisted Men's Widows and Dependents Home Foundation, Inc., 571 Mooney Road, Fort Walton Beach, Fla. 32548-1859, or call (904) 863-4113.

program during the annual AFJROTC Military Ball/Awards Banquet held at the NCO Club at Lowry AFB on March 18.

CINCMAC **Gen. Duane Cassidy** was the featured speaker at a joint meeting of AFA's Greater Seattle Chapter and the local American Defense Preparedness Association dinner meeting held April 18 at the Bellevue Red Lion Inn. During his address and at a press conference held earlier, General Cassidy said that defense budget cuts and the decline in American merchant shipping will mean fewer ships and Air Force transport planes available for emergency deployments to trouble spots in Southwest Asia, South Korea, or Western Europe, according to Washington AFA President **Al Lloyd.** General Cassidy told the gathering that budget cuts have forced MAC to implement emergency measures, including reduced flying training hours and cancellation of training exercises.

During the meeting, Chapter officials distributed to guests AFA's white paper, "A Resource in Danger," which expressed AFA concern about the dire effects of defense budget cuts on Air Force people and morale. "It was well-received," Mr. Lloyd said.

AFA's High Point Chapter in New Jersey, under the leadership of President **Delores Vallone,** sponsored a meeting with retired **Col. Charles D. Wydner.** The Colonel's discussion of his Air Force experiences was enjoyed by members and guests, President Vallone said.

Former Vice CINCSAC **Lt. Gen. Jim Keck,** USAF (Ret.), President of AFA's Aerospace Education Foundation, addressed an AFA membership drive kickoff dinner sponsored by the Central Missouri Chapter at Whiteman AFB, Mo., on April 15, reports longtime AFA leader **Orville Blair.** The former Vice CINCSAC outlined the critical issues facing AFA and the Foundation and encouraged attendees to get involved in order to support AFA/AEF objectives. Some 118 people turned out to hear the former Vice CINCSAC, including National Director **Earl Clark, Jr.,** and his wife **Jean;** National Director **Charles Church** and his wife **Judy;** Missouri AFA President **Raymond W. Peterman** and his wife **Louise;** and Missouri AFA Vice President **Judge Garrett R. Crouch** and his wife **Sue.**

AFA Roanoke Chapter President **George McKay** presented awards at the Chapter's third annual awards banquet in early March.

Following a speech to the Chiefs and First Sergeants at a breakfast meeting during a tour of facilities at Hill AFB, Utah, AFA National President Sam E. Keith, Jr., center, was installed as an honorary member of the Hill AFB Chief's Group. Presenting the award are, from left, CMSgt. Jerry F. Derrick, 419th TFW SEA; CMSgt. David Hall, 388th TFW SEA; CMSgt. Joe Jones, Ogden ALC SEA; and CMSgt. Lewis Glover, 2849th Security Police Superintendent.

Coming Events

July 8–9, **Missouri State Convention,** Springfield . . . July 15–16, **Mississippi State Convention,** Columbus . . . July 15–17, **Pennsylvania State Convention,** Pittsburgh . . . July 22–24, **Texas State Convention,** Kerrville . . . July 23–24, **North Carolina State Convention,** Raleigh . . . July 29–30, **Colorado State Convention,** Lowry AFB . . . July 29–31, **Florida State Convention,** Fort Lauderdale . . . August 4–6, **California State Convention,** San Diego . . . August 5–7, **New York State Convention,** Long Island . . . August 9–11, **Arizona State Convention,** Casa Grande . . . August 12–13, **Illinois State Convention,** Chicago . . . August 18–19, **Delaware State Convention,** Dover AFB . . . August 19–20, **Oregon State Convention,** Portland . . . August 20, **Indiana State Convention,** Grissom AFB . . . August 26, **Arkansas State Convention,** Little Rock . . . September 19–22, **AFA National Convention and Aerospace Development Briefings and Displays,** Washington, D. C.

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Paint ☐ two-tone ☐ stripe
Power Equipment ☐ Brakes ☐ Steering
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☐ Mirrors ☐ Windows ☐ Tailgate/trunk release
☐ Seats _____ driver _____ passenger _____ bench
Radio ☐ AM ☐ AM/FM Stereo
☐ AM/FM Stereo with cassette player
☐ AM/FM Stereo w/cassette & premium sound
Roof ☐ Full vinyl ☐ Other _____
Seats ☐ Bench ☐ Notchback 55/45 ☐ 45/45
☐ Bucket ☐ Other _____
Seat Trim ☐ Cloth ☐ Vinyl ☐ Leather
Steering Wheel ☐ Tilt ☐ Telescopic
Tires ☐ White SW ☐ Black SW ☐ Other _____
Wheel Covers ☐ Standard ☐ Wire
Wheels ☐ Aluminum ☐ Other _____
W/S Wipers ☐ Intermittent ☐ Rear Window
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For more information call (800) 227-7811, or in Ohio, (419) 335-2801.

Program not available in the state of Louisiana.

This Is AFA

The Air Force Association is an independent, nonprofit, aerospace organization serving no personal, political, or commercial interests; established January 26, 1946; incorporated February 4, 1946.

OBJECTIVES: The Association provides an organization through which we as a free people may unite to address the defense responsibilities of our nation imposed by the dramatic advance of aerospace technology; to educate the members and the public at large in what that technology can contribute to the security of free people and the betterment of mankind; and to advocate military preparedness of the United States and its allies adequate to maintain the security of the United States and the free world.

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(703) 892-0331

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(203) 875-1068

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Lemont, Pa. 16851
(814) 238-4212

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(801) 479-4885

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"A capacity crowd filled the Silver Spoon Restaurant," Mr. McKay said. Honored at the event were **Capt. David A. Biggs,** Junior Officer of the Year; **SMSgt. Ralph B. Sturms,** Senior NCO of the Year; and **MSgt. Dan K. Moyee,** NCO of the Year. All are members of the 3534th USAF Recruiting Squadron. Also honored were outstanding cadets from two area high schools—**Cadet Lt. Christopher Azar,** William Flemming High, and **Cadet Maj. Michael Brown,** Patrick Henry High. Chapter Certificates of Merit went to **Rodney A. Franklin,** past Roanoke Chapter president, and **David Spangler,** Roanoke Chapter Vice President for Aerospace Education. ■

In Virginia, MSgt. Dan K. Moyee of the 3534th USAF Recruiting Squadron receives his award as NCO of the Year from Roanoke Chapter President George McKay at the Chapter's third annual awards banquet. Fellow members of the 3534th, Capt. David A. Biggs and SMSgt. Ralph B. Sturms, were also honored at the banquet.

Unit Reunions

Air Commando Ass'n
The Air Commandos of World War II (2d and 3d Air Commando Groups) will hold a reunion on October 21–24, 1988, in Los Angeles, Calif. **Contact:** W. Robert Eason, Rte. 1, Box 28, Orange, Va. 22960. Phone: (703) 672-4074.

Air Rescue Ass'n
Air Rescue personnel will hold a reunion on September 21–24, 1988, at the Embassy Suites in Irving, Tex. **Contact:** Lt. Col. Leon M. Shaddox, USAF (Ret.), 222 Greycliff, San Antonio, Tex. 78233. Phone: (512) 656-0306.

Air Resupply and Communications Ass'n
Members of the Air Resupply and Communications Association will hold a reunion on September 28–October 1, 1988, at the Sahara Hotel and Casino in Las Vegas, Nev. **Contact:** Jim Bassett, P. O. Box 3475, San Pedro, Calif. 90731-0450. Phone: (213) 835-9047.

Crash Rescue Boat Ass'n
AAF/USAF crash rescue boat personnel will hold a reunion on September 30–October 2, 1988, in Orlando, Fla. **Contact:** John E. Hagan, 6749 Sandwater Trail, Pinellas Park, Fla. 34665.

Deming Army Airfield
Personnel who were stationed at what was then called Deming Army Airfield, N. M., will hold a reunion on September 9–11, 1988. Please send a legal-size, self-addressed, stamped envelope for additional information. **Contact:** Col. Robert V. Green, USAF (Ret.), 423 DeSoto Dr., Universal City, Tex. 78148.

Glider Pilots
World War II glider pilots will hold a reunion on September 7–11, 1988, in Norfolk, Va. **Contact:** Virginia Randolph, 136 W. Main St., Freehold, N. J. 00728.

Northcoast Vietnam Vets Coalition
Vietnam veterans will hold a reunion on August 18–20, 1988, in Cleveland, Ohio. **Contact:** Northcoast Vietnam Veterans Coalition, 400 Terminal Tower, Cleveland, Ohio 44113.

Return of the Eagles
The Royal Australian Air Force Association and the Prime Minister of Australia have invited veterans of the Fifth Air Force who served in the Southwest Pacific during World War II to return to Australia in October 1988 for the Australian Bicentennial celebration. **Contact:** Lt. Col. B. A. "Barney" Dobbs, USAF (Ret.), The Return of the Eagles Organizing Committee, 150 Powell St., #307, San Francisco, Calif. 94102. Phone: (415) 433-1614, (800) 792-0747 (California), or (800) 227-5464 (out of state).

Reunion Notices

Readers wishing to submit reunion notices to "Unit Reunions" should mail their notices well in advance of the event to "Unit Reunions," Air Force Magazine, 1501 Lee Highway, Arlington, Va. 22209-1198. Please designate the unit holding the reunion, a time and location, and a contact for more information.

Thud-In
Lovers of the F-105 Thunderchief will hold a reunion on September 16–18, 1988, at the Reno, Nev., Air Races. **Contact:** Lt. Col. Thomas L. "Waldo" King, USAFR, 5432 N. Old Ranch Rd., Park City, Utah 84056. Phone: (801) 649-5097. 466th Tactical Fighter Squadron (AFRES), Hill AFB, Utah 84056. Phone: (801) 777-3505. AUTOVON: 458-3505.

4th Emergency Rescue Squadron Ass'n
The 4th Emergency Rescue Squadron will hold a reunion on October 4–7, 1988, in Charleston, S. C. **Contact:** William "Mac" McGregor, P. O. Box 98, St. Germain, Wis. 54558. Phone: (715) 479-8801.

7th Photo Reconnaissance Group Ass'n
Members of the 7th Photo Reconnaissance Group will hold a reunion on October 12–16, 1988, at the Marriott Hotel in Des Moines, Iowa. **Contact:** George Lawson, 4390 14th St., N. E., St. Petersburg, Fla. 33703. Phone: (813) 526-8480.

8th Air Force Historical Society
The 8th Air Force Historical Society will hold its fourteenth annual reunion on October 12–15, 1988, in Des Moines, Iowa. **Contact:** 8th Air Force Historical Society, P. O. Box 3556, Hollywood, Fla. 33083.

9th Bomb Group Ass'n
Members of the 9th Bomb Group who served on Tinian during 1945 will hold a reunion on October 13–16, 1988, in Dayton, Ohio. **Contact:** Herbert W. Hobler, 295 Mercer Rd., Princeton, N. J. 08540.

21st Air Depot Group
The 21st Air Depot Group will hold a re-

Unit Reunions

union on September 3, 1988, at the Radisson Inn in Dayton, Ohio. **Contact:** James Campbell, 20 Chelsea St., Staten Island, N. Y. 10307.

22d Bomb Group
Members of the 22d Bomb Group, Fifth Air Force (WW II), will hold a reunion on September 15–18, 1988, in Wilmington, N. C. **Contact:** John E. Clark, P. O. Box 0967, Rockledge, Fla. 32955.

27th Troop Carrier Squadron
World War II veterans of the 27th Troop Carrier Squadron will hold a reunion on August 26–28, 1988, at the Sheraton Hotel in Springfield, Ill. **Contact:** Lester J. "Rip" Van Winkle, 126 Riojas Dr., Kerrville, Tex. 78028. Phone: (512) 995-2558.

31st Fighter Officers Ass'n
The 31st Fighter Officers Association (an association of former officers of the 31st Fighter Group and Wing) will hold a reunion on October 13–16, 1988, at the Marriott Riverwalk Hotel in San Antonio, Tex. **Contact:** Edwin Dalrymple, 4211 Prickly Pear Dr., Austin, Tex. 78731. Phone: (512) 345-1479.

Class 42-A
Pilot Class 42-A of Central Training Command (Ellington, Foster, and Kelly Fields) will hold a reunion on October 13–16, 1988, at the Marriott Rivercenter Hotel in San Antonio, Tex. **Contact:** Col. Arnold R. Bredewater, USAF (Ret.), 2 Royal Crest, New Braunfels, Tex. 78130. Phone: (512) 629-2697 or (512) 658-1012.

Class 43-B
Members of Class 43-B (Pampa AAF, Tex.) will hold a reunion on August 18–20, 1988, in Pampa, Tex. **Contact:** Cliff Conrad, 3770 S. Loop East, Houston, Tex. 77021-6197. Phone: (713) 747-0683.

Class 64-E
Members of Class 64-E (Williams AFB, Ariz.) will hold their twenty-fifth-year reunion in February 1989 in the Phoenix, Ariz., area. **Contact:** Lt. Col. William Cummings, USAF (Ret.), 12031 Mahogany Dr., Fort Wayne, Ind. 46804. Phone: (219) 672-2728.

66th Airdrome Squadron
Members of the 66th Airdrome Squadron, Ninth Air Force, will hold a reunion on October 14–16, 1988, at the Sheraton LBJ Hotel in Dallas, Tex. **Contact:** C. E. Juday, 1616 Lakeside Dr., Garland, Tex. 75042-5813. Phone: (214) 276-6790.

70th Fighter Squadron
The 70th Fighter Squadron, 347th Fighter Group, will hold a reunion on October 13–16, 1988, at Moody AFB, Ga. **Contact:** Elbert Major, Rte. 4, Box 573, Lindale, Tex. 75771. Phone: (214) 882-5864.

AFA's 1988 NATIONAL CONVENTION and AEROSPACE DEVELOPMENT BRIEFINGS AND DISPLAYS

"A CREED TO BELIEVE IN—FREEDOM"

AFA Convention delegates from around the world will gather together to affirm the Convention theme "A Creed to Believe In—Freedom."

Convention activities include a Membership Awards Reception, 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, a Roundtable on "The Defense Industrial Base," and a black-tie Reception and Dinner Dance salute to the Air Force's forty-first birthday, featuring the incomparable Mitch Miller and the United States Air Force Band.

SHERATON WASHINGTON HOTEL SEPTEMBER 18–22

AFA Delegates, Industrial Associate Members: *Watch your mail for additional information and Sheraton Washington Hotel reservation forms.*

Hotels available other than the Sheraton Washington are: Washington Hilton, Connecticut Ave. (at Columbia Rd.), Washington, D.C. 20009. Phone: 202/483-3000. Cutoff date—August 28. Normandy Inn, 2118 Wyoming Ave., N.W., Washington, D.C. 20008. Phone: 202/483-1350. Cutoff date—August 17. Connecticut Avenue Days Inn, 4400 Connecticut Ave., N.W., Washington, D.C. 20008. Phone: 202/244-5600. Cutoff date—August 5.

To assure acceptance when making your reservation requests, please refer to the AFA National Convention. All reservation requests for the above hotels must be accompanied by one night's deposit or a major credit card number.

315th Bomb Wing Ass'n
The 315th Bomb Wing will hold its reunion on October 6–8, 1988, at the Marriott Hotel in Dayton, Ohio. **Contact:** Col. George E. Harrington, USAF (Ret.), 4600 Ocean Beach Blvd., Apt. 505, Cocoa Beach, Fla. 32931. Phone: (407) 784-0342.

320th Bomb Group
Members of the 320th Bomb Group will hold a reunion on September 8–10, 1988, in Seattle, Wash. **Contact:** Ben A. West, 50 Navigator Lane, Port Ludlow, Wash. 98365.

352d Fighter Group Ass'n
The 352d Fighter Group (Bodney, England) will hold a reunion on October 6–9, 1988, at the Hilton Airport Hotel in Norfolk, Va. **Contact:** Richard J. DeBruin, 234 N. 74th St., Milwaukee, Wis. 53213. Phone: (414) 771-0744.

364th Fighter Group
Members of the 364th Fighter Group will hold a reunion on September 28–October 1, 1988, in Colorado Springs, Colo. **Contact:** Jack Callahan, 1545-B Franklin Ave., River Forest, Ill. 60305. Phone: (312) 771-9293.

368th Fighter Group Ass'n
The 368th Fighter Group (Ninth Air Force) will celebrate its forty-fifth anniversary with a trip to Europe from September 22–October 3, 1988. **Contact:** Marvin J. Rosvold, 600 S. 13, Norfolk, Neb. 68701. Phone: (402) 371-6633.

390th Bomb Group Veterans Ass'n
The 390th Bomb Group (Framlingham/Parham, England) will hold a reunion on August 31–September 4, 1988, in Nashville, Tenn. **Contact:** Jim Warren, P. O. Box 18, Nashville, Tenn. 37202. Phone: (615) 385-1484.

452d Bomb Group Ass'n
The 452d Bomb Group, which served at Deopham Green, England, during World War II, will hold a reunion on October 27–30, 1988, in Tampa, Fla. **Contact:** Rom Blaylock, P. O. Box 2526, New Bern, N. C. 28561.

456th Bomb Group
Members of the the 456th Bomb Group, Fifteenth Air Force (WW II), will hold a reunion on September 14–21, 1988, at the Reef Hotel in Honolulu, Hawaii. **Contact:** James F. Watkins, 11415 Minor Dr., Kansas City, Mo. 64114-5436.

465th Troop Carrier Wing
The 465th Troop Carrier Wing will hold a reunion on October 14–16, 1988, in San Diego, Calif. **Contact:** A. J. Ruta, 6124 Calle Empinada, San Diego, Calif. 92120. Phone: (619) 287-1000 (home) or (619) 280-0440 (office).

492d Bomb Group
Members of the 492d Bomb Group (North Pickenham, England) will hold a reunion along with the 8th Air Force Historical Society on October 14–16, 1988, in Des Moines, Iowa. **Contact:** Elmer W. Clarey, 2015 Victoria Ct., Los Altos, Calif. 94022. Phone: (415) 961-0231.

754th Radar Squadron
Personnel assigned to the 754th Radar Squadron (military and civilian) will hold a reunion on August 18–21, 1988, at Port Austin AFS, Mich. **Contact:** Capt. Antonio M. Reyes, USAF, P. O. Box 526, Port Austin, Mich. 48467-8195. Phone: (517) 738-8238.

USAF Test Pilot School
The US Air Force Test Pilot School at Edwards AFB, Calif., will be celebrating its forty-fifth anniversary in 1989. The school would like to update the addresses of all its graduates to keep them abreast of the scheduled events.

Graduates who would like to participate in this celebration should contact the address below.

Executive Officer
USAF Test Pilot School/TENE
Edwards AFB, Calif. 93523

2d Air Depot Group
I would like to hear from members of the 2d Air Depot Group, Eighth Air Force, who served in Burtonwood, England (1942 and later). I am trying to organize a reunion.

Please contact the address below.

Lt. Col. Jack Holt, USAF (Ret.)
1503 Wavecrest Lane
Houston, Tex. 77062

25th Bomb Group Ass'n
I am trying to locate former members of the 25th Bomb Group who served in Watton, England, during 1944–45. I would like to organize a reunion.

Please contact the address below.

Robert Herzog
4 Colonial Lane
Larchmont, N. Y. 10538

Class 44-D
I would like to hear from members of Class 44-D (Blytheville AFB, Ark.) for the purpose of organizing a reunion.

Please contact the address below.

Maj. William Pacitti, USAF (Ret.)
1015 LaPlaisance Rd.
Monroe, Mich. 48161

46th/72d Reconnaissance
A reunion is in the planning stages for the 46th and 72d Reconnaissance "Project NANOOK" personnel. For additional information, please send a self-addressed, stamped envelope to the address below.

Allan K. Chapman
P. O. Box 2653
Santa Rosa, Calif. 95405

Class 49-B
Members of Class 49-B who trained at Perrin AFB, Tex., and Enid AFB, Okla., are planning a fortieth-anniversary class reunion for 1989.

Interested graduates should contact one of the addresses below.

Robert E. Skoog
210 Wilson Circle
Hillsboro, Ohio 45133
or
John A. Stolly
11323 Cotillion Dr.
Dallas, Tex. 75228
Phone: (513) 393-4792 (Skoog)
(214) 681-8290 (Stolly)

AFA's CHAMPLUS® . . . With the

Exceptional Basic Benefits

1. Four year basic benefit. Benefits for most injuries or illnesses are paid for up to a four-year period.

2. Up to 45 consecutive days of in-hospital care for mental, nervous or emotional disorders. Outpatient care for these disorders may include up to 20 visits by a physician or $500.00 per insured person each year.

3. Up to 30 days per year for each insured person confined in a Skilled Nursing Facility.

4. Up to 30 days per year (to a 60-day life-time maximum) for each insured person receiving care through a CHAMPUS-approved Residential Treatment Center.

5. Up to 30 days per year (to a 60-day life-time maximum) for each insured person receiving care through a CHAMPUS-approved Special Treatment Facility.

6. Up to five visits per year for each insured person to Marriage and Family Counselors under conditions defined by CHAMPUS.

And the New 'Expense Protector' Benefit

While CHAMPUS Supplement coverage was originally intended to cover the cost of medical services not provided by CHAMPUS, practitioners and service institutions may charge fees that are considerably greater than those approved for payment by CHAMPUS. And, because Supplement policies traditionally base their payments on the amount paid by CHAMPUS, the insured can be left with sizable out-of-pocket expenses. AFA's ChamPLUS® coverage includes a special feature which places a limit on these out-of-pocket expenses.

Called the 'Expense Protector' Benefit, this program limits out-of-pocket expenses for CHAMPUS covered charges in any single calendar year to $1,000 for any one insured person (or $2,000 for all insured family members combined). Once those out-of-pocket expense maximums are reached, ChamPLUS® will pay 100% of CHAMPUS covered charges for the remainder of that year.

An example of the way the 'Expense Protector' works follows. Assume you are hospitalized for 35 days, that the hospital charges you $330 per day and that this is $75 per day *more* than allowed by CHAMPUS. This would mean that you have an out-of-pocket expense of $2,625. With AFA's 'Expense Protector' benefit, your cost would be limited to $1,000. All covered costs over this amount—for the whole calendar year—would be paid by ChamPLUS®!

It's an important benefit that can mean significant savings to you and your family.

Who Is Eligible?

1. All AFA members under 65 years of age who are currently receiving retired pay based upon their military service and who are eligible for benefits under Public Law 89-614 (CHAMPUS), their spouses under age 65 and their unmarried dependent children under age 21, or age 23 if in college.

2. All eligible dependents of AFA members on active duty. Eligible dependents are spouses under age 65 and unmarried dependent children under age 21 (or age 23 if in college). (There are some exceptions for older age children. See "Exceptions and Limitations.")

Renewal Provision

As long as you remain eligible for CHAMPUS benefits and the Master Policy with AFA remains

AFA ChamPLUS® Benefit Schedule

Care	CHAMPUS Pays	AFA CHAMPLUS® PAYS
For Military Retirees Under Age 65 and Their Dependents		
Inpatient civilian hospital care	CHAMPUS pays 75% of allowable charges	CHAMPLUS® pays the 25% of allowable charges not paid by CHAMPUS . . . plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year.
Inpatient military hospital care	The only charge normally made is a $7.55 per day subsistence fee, not paid by CHAMPUS.	CHAMPLUS® pays the $7.55 per day subsistence fee.
Outpatient care	CHAMPUS covers 75% of outpatient care fees after an annual deductible of $50 per person ($100 maximum per family) is satisfied.	CHAMPLUS® pays the 25% of allowable charges not paid by CHAMPUS after the deductible has been satisfied . . . plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year.
For dependents of Active Duty Military Personnel		
Inpatient civilian hospital care	CHAMPUS pays all covered services and supplies furnished by a hospital less $25 or $7.55 per day, whichever is greater.	CHAMPLUS® pays the greater of $7.55 per day or the $25 hospital charge not paid by CHAMPUS.
Inpatient military hospital care	The only charge normally made is a $7.55 per day subsistence fee, not paid by CHAMPUS.	CHAMPLUS® pays the $7.55 per day subsistence fee.
Outpatient care	CHAMPUS covers 80% of outpatient care fees after an annual deductible of $50 per person ($100 maximum per family) is satisfied.	CHAMPLUS® pays the 20% of allowable charges not paid by CHAMPUS after the deductible has been satisfied . . . plus 100% of covered charges after out-of-pocket expenses exceed $1,000 per person (or $2,000 per family) during any single calendar year.

NOTE: Outpatient benefits cover emergency room treatment, doctor bills, pharmaceuticals, and other professional services. There are some reasonable limitations and exclusions for both inpatient and outpatient coverage. Please note these elsewhere in the plan description.

New 'Expense Protector' Benefit!

in force, termination of your coverage can occur only if premiums for coverage are due and unpaid, or if you are no longer an AFA member. Your certificate cannot be terminated because of the number of times you receive benefits.

Exceptions and Limitations

Coverage will not be provided for conditions for which treatment has been received during the 12-month period prior to the effective date of insurance until the expiration of 12 consecutive months of insurance coverage without further treatment. After coverage has been in force for 24 consecutive months, pre-existing conditions will be covered regardless of prior treatment. Children of active duty members over age 21 (age 23 if in college) will continue to be eligible if they have been declared incapacitated and if they are insured under CHAMPLUS® on the date so declared. Coverage for these older age children will only be provided upon a) notification to AFA and b) payment of a special premium amount.

Plan 1
For Military Retirees and Dependents

QUARTERLY PREMIUM SCHEDULE

In-Patient Benefits Only

Member's Attained Age*	Member	Spouse	Each Child
Under 50	$22.97	$ 45.12	$16.34
50-54	$34.33	$ 56.21	$16.34
55-59	$50.32	$ 60.17	$16.34
60-64	$62.98	$ 69.27	$16.34

In-Patient and Out-Patient Benefits

Under 50	$33.90	$ 61.02	$40.84
50-54	$46.59	$ 69.87	$40.84
55-59	$64.41	$ 96.11	$40.84
60-64	$77.38	$102.15	$40.84

*Note: Premium amounts increase with the member's attained age

Plan 2
For Dependents of Active Duty Personnel

ANNUAL PREMIUM SCHEDULE

In-Patient Benefits Only

	Member	Spouse	Each Child
All Ages	None	$ 9.68	$ 5.94

In-Patient and Out-Patient Benefits

All Ages	None	$38.72	$29.70

CHAMPLUS®

Coverage After Age 65

Upon attainment of age 65, the coverage of members insured under CHAMPLUS® will automatically be converted to AFA's Medicare Supplement program so that there will be no lapse in coverage. Members not wishing this automatic coverage should notify AFA prior to their attainment of age 65.

Exclusions

This plan does not cover and no payment shall be made for:

- routine physical examinations or immunizations
- domiciliary or custodial care
- dental care (except as required as a necessary adjunct to medical or surgical treatment)
- routine care of the newborn or well-baby care
- injuries or sickness resulting from declared or undeclared war or any act thereof
- injuries or sickness due to acts of intentional self-destruction or attempted suicide, while sane or insane
- treatment for prevention or cure of alcoholism or drug addiction
- eye refraction examinations
- prosthetic devices (other than artificial limbs and artificial eyes), hearing aids, orthopedic footwear, eyeglasses and contact lenses
- expenses for which benefits are or may be payable under Public Law 89-614 (CHAMPUS)

APPLICATION FOR AFA CHAMPLUS®

Group Policy GMG-FC70
Mutual of Omaha Insurance Company
Home Office: Omaha, Nebraska

Full name of Member _____
Rank Last First Middle

Address _____
Number and Street City State ZIP Code

Date of Birth _____ Current Age ____ Height ____ Weight ____ Soc. Sec. No. _____
Month/Day/Year

This insurance coverage may only be issued to AFA members. Please check the appropriate box below:

☐ I am currently an AFA Member.

☐ I enclose $21 for annual AFA membership dues (includes subscription ($18) to AIR FORCE Magazine).

PLAN & TYPE OF COVERAGE REQUESTED

Plan Requested (Check One)
☐ AFA CHAMPLUS® PLAN I (for military retirees & dependents)
☐ AFA CHAMPLUS® PLAN II (for dependents of active-duty personnel)

Coverage Requested (Check One)
☐ Inpatient Benefits Only
☐ Inpatient and Outpatient Benefits

Person(s) to be insured (Check One)
☐ Member Only
☐ Spouse Only
☐ Member & Spouse
☐ Member & Children
☐ Spouse & Children
☐ Member, Spouse & Children

PREMIUM CALCULATION

All premiums are based on the attained age of the AFA member applying for this coverage. Plan I premium payments are normally paid on a quarterly basis but, if desired, they may be made on either a semi-annual (multiply by 2), or annual (multiply by 4) basis.

Quarterly (annual) premium for member (age ____) $_____

Quarterly (annual) premium for spouse (based on member's age) $_____

Quarterly (annual) premium for ____ children @ $ $_____

Total premium enclosed $_____

If this application requests coverage for your spouse and/or eligible children, please complete the following information for each person for whom you are requesting coverage.

Names of Dependents to be Insured	Relationship to Member	Date of Birth (Month/Day/Year)

(To list additional dependents, please use a separate sheet.)

In applying for this coverage, I understand and agree that (a) coverage shall become effective on the last day of the calendar month during which my application together with the proper amount is mailed to AFA, (b) only hospital confinements (both inpatient and outpatient) or other CHAMPUS-approved services commencing after the effective date of insurance are covered and (c) any conditions for which I or my eligible dependents received medical treatment or advice or have taken prescribed drugs or medicine within 12 months prior to the effective date of this insurance coverage will not be covered until the expiration of 12 consecutive months of insurance coverage without medical treatment or advice or having taken prescribed drugs or medicine for such conditions. I also understand and agree that all such pre-existing conditions will be covered after this insurance has been in effect for 24 consecutive months.

Date _____, 19 ____ _____
Member's Signature

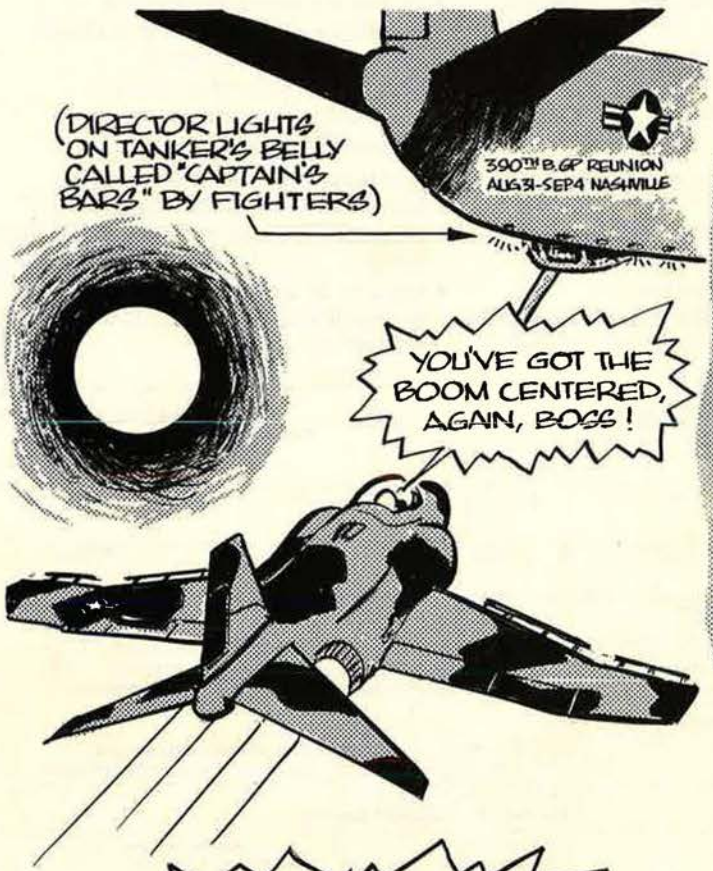
Form 6173GH App.
7-88

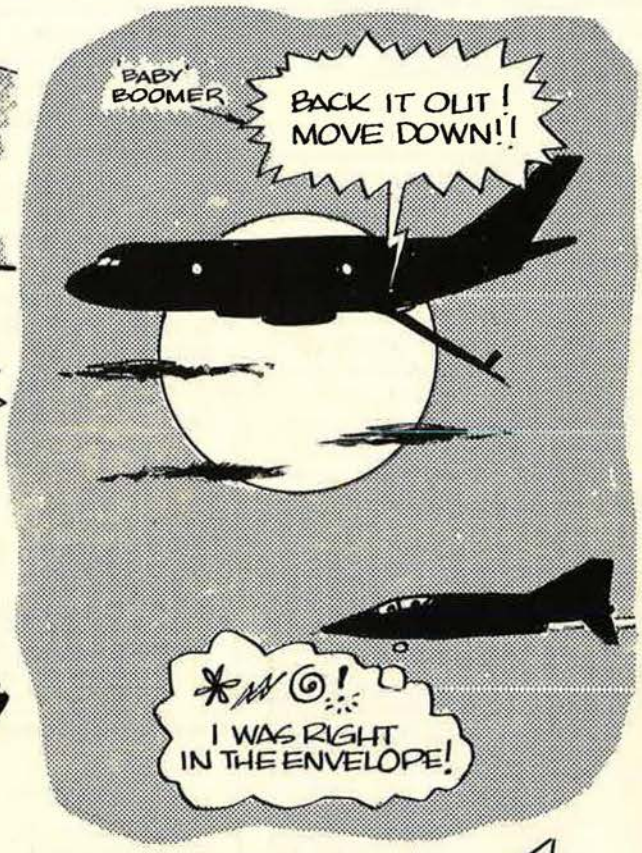
Application must be accompanied by a check or money order. Send remittance to: Air Force Association, Insurance Division, 1501 Lee Highway, Arlington, VA 22209-1198

Bob Stevens'

"There I was..."

AERIAL REFUELING IS NOT A STROLL IN THE PARK! ADD NIGHT, A COMBAT ZONE and A RATHER GREEN, NEW-IN-S.E.ASIA BOOMER and THE PROCEDURE CAN BECOME A FRUSTRATING ONE FOR A WELL-SEASONED RECEIVER...





781ST B.SQ & 465TH B.GP REUNION SEP 14-18 SAN ANTONIO, TEXAS

THANKS TO L/C KENT EDIE & MAJ BOB TARASZI, HQ USAF

Bob Stevens

Collins Defense Communications experience in information transfer can help make C³I a reality. As specialists in communications and ECM/ECCM systems for air, sea and land battle scenarios, we know the intricacies of interconnectivity. ■ We are currently applying that expertise to our involvement in VLF/LF communications for the Navy's TACAMO relay link aboard the Navy's E-6, and for the Air Force's Airborne Command Post. ■ We are also participating in SAC's Scope Signal, MILSTAR, Project Overtake, the USN High Frequency Anti-Jam Programs, the SDI Integrated Defense Simulator, information switching systems and other major C³I programs. ■ We have the facilities in place to provide the products, systems analysis and integration, functional architecture, system partitioning, training and logistics support to meet your multi-platform/multi-service C³I needs. ■ Collins Defense Communications, Rockwell International, 350 Collins Road, N.E., MS 120-145, Cedar Rapids, Iowa 52498, U.S.A. Phone (319) 395-1600. Telex 464-435. **We Know C³I.**

FROM AIRPOWER TO SEAPOWER, WE KNOW C³I

Rockwell International

...where science gets down to business

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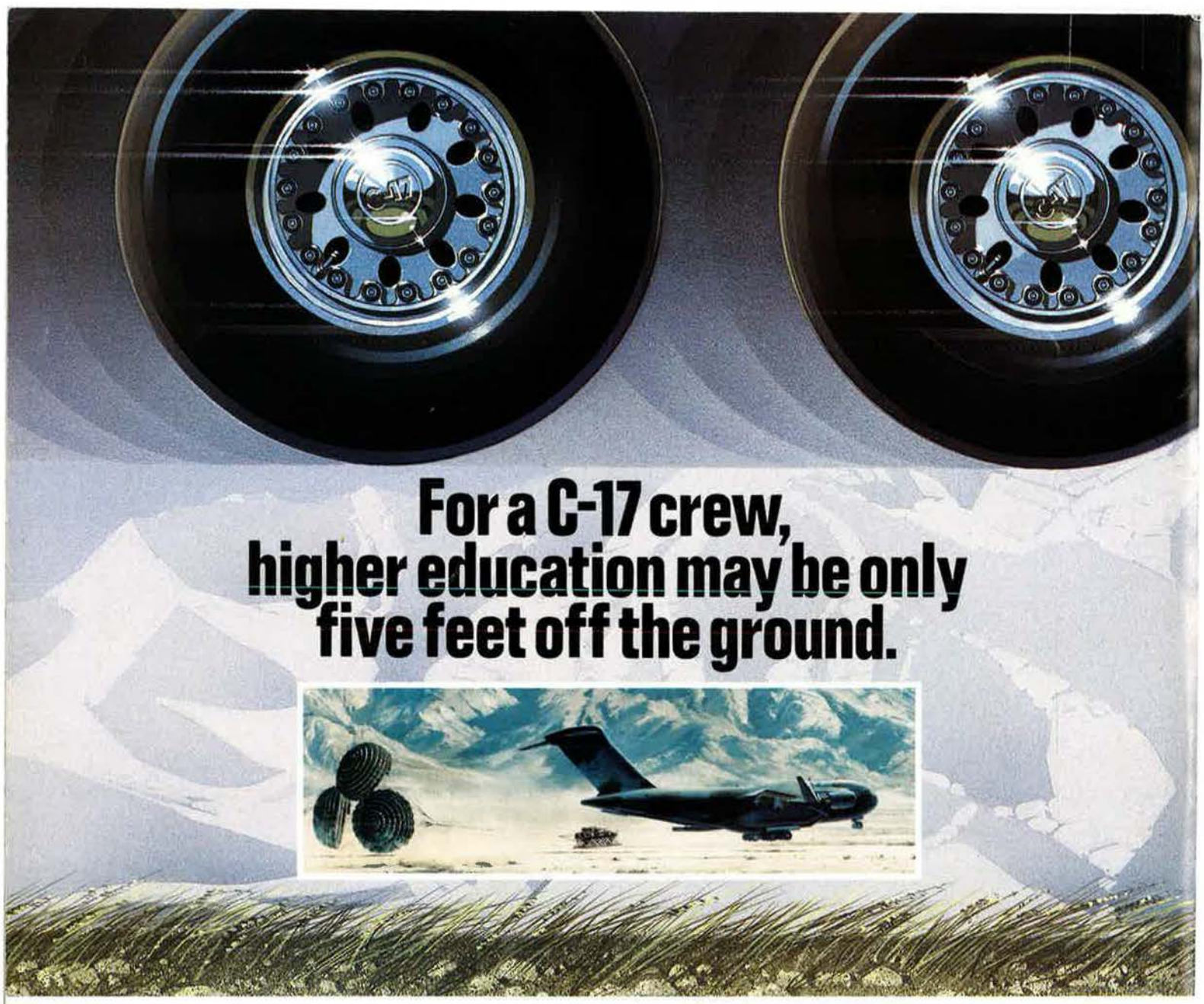
General Industries / A-B Industrial Automation



For a C-17 crew, higher education may be only five feet off the ground.

Our C-17 aircrew instruction will be as advanced as the airlifter itself. At 140 knots, wheels barely above the meadow's surface, chutes pop and a 30-ton pallet of military hardware surges off the cargo ramp and skids to a halt near waiting troops. Mission accomplished.

Low-altitude parachute extraction is one of the advanced capabilities being built into the C-17. And one of the skills its aircrews must master.

That's the work of McDonnell Douglas Training Systems and Services. Here, advanced, computer-based academics and state-of-the-art flight simulation will instruct aircrews for the C-17's short field and air drop operations, ground maneuvering and cargo handling. A training management system will keep the operation running as a single, integrated program.

With flight training experience no one else can match, we're ready now to help the Air Force gain every bit of performance being built into this airlifter. For more information, write: McDonnell Douglas, Dept. C1-G10, Mail Station 76-60, Long Beach, CA 90846. Or call Richard Fry, (213) 593-3354.

MCDONNELL DOUGLAS