JULY 1976/$1

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

THE ELECTRONIC AIR FORCE

SAF's PHASED-ARRAY RADAR AT EGLIN AFB, FLA.

The TACAN that's small enough to fit in a magazine

Micro II combines in one compact, low cost package advantages and capabilities that are unmatched by any competitive airborne TACAN available today.

It sets a new standard for reliability.

Most solid-state TACAN systems specify a reliability of 500 hours—or even 1,000. But MICRO II, because of technological improvements, offers 1,500 hours MTBF—or three times previously acceptable performance.

One tube does it all.

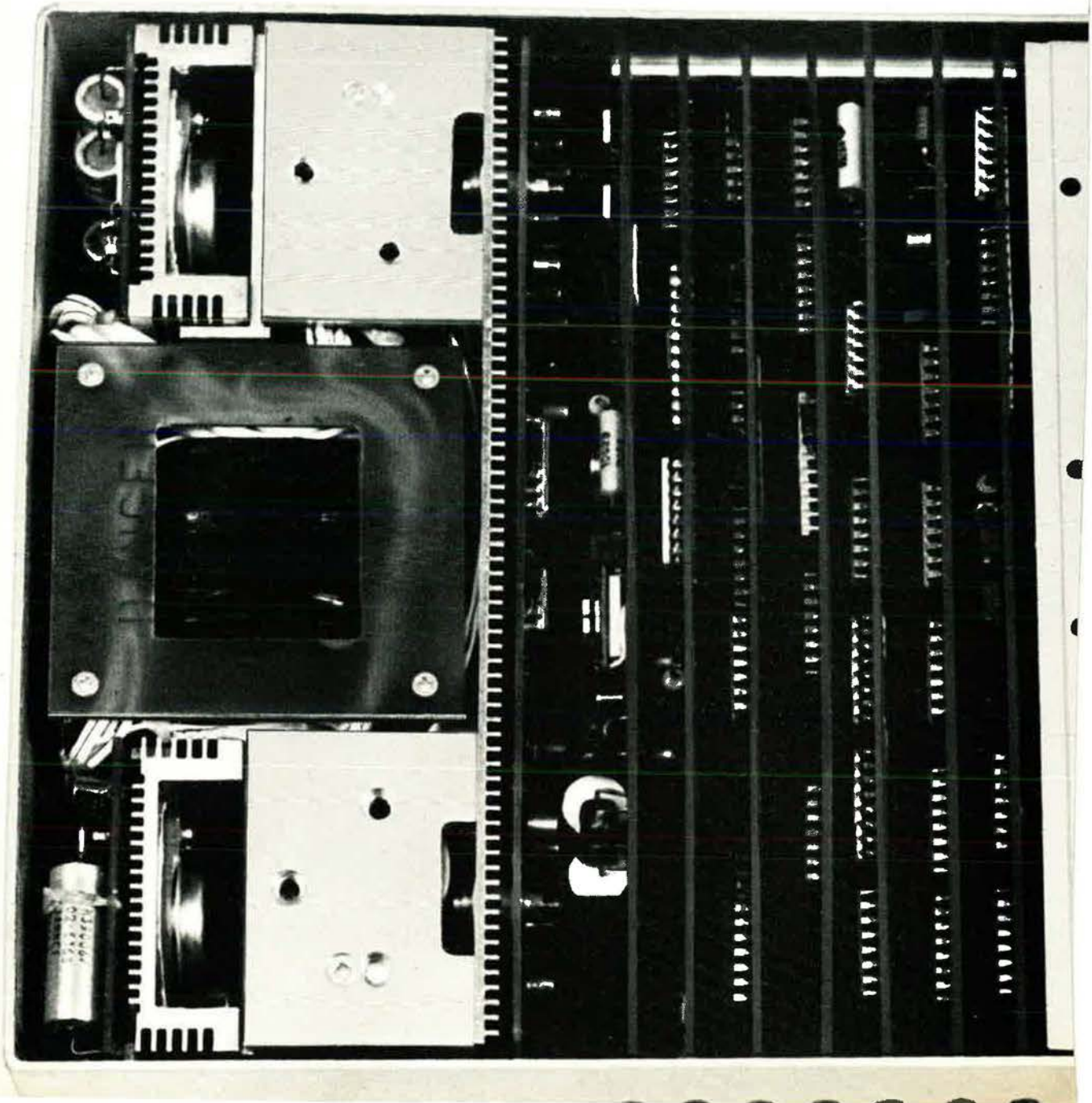
Instead of the 2 or 4 vacuum tubes previously required for the TACAN power amplifier, MICRO II uses only one. That means less life-limited components to wear out, less maintenance, greater overall reliability.

Two major pilot advantages.

Along with complete Air-to-Air Bearing Transmit and Receive capabilities, MICRO II includes Inverse Mode operation. Never before obtainable in a TACAN of such low cost and size, these features provide new operational capabilities—for such critical assignments as in-flight rendezvous and refueling.

Plenty of RF power output.

MICRO II has a 1 kilowatt peak RF power output. Under



yet advanced enough to take you anywhere.

normal conditions, a lower power rating would be sufficient. However, MICRO II is designed to cope with transmission conditions that are not normal. So when the need arises, you'll have the extra power to meet it.

Advanced technology couplers.

The instrument couplers in MICRO II are solid-state, not electro-mechanical. Consequently, you don't have to worry about moving parts that can wear and fail. As for configuration, it adds up to a single R/T package that will provide simultaneous digital and analog outputs of range and bearing for three instrument loads.

Other things to consider.

MICRO II is available in two lightweight, compact configurations. A 26 lb. R/T for digital installations, or a 29 lb. R/T for applications requiring analog instruments. Both are qualified to Mil-E-5400 Class II.

What will you put in all that extra space the MICRO II will save you? You name it. Because now you may have room for it.

Hoffman

NavCom Systems

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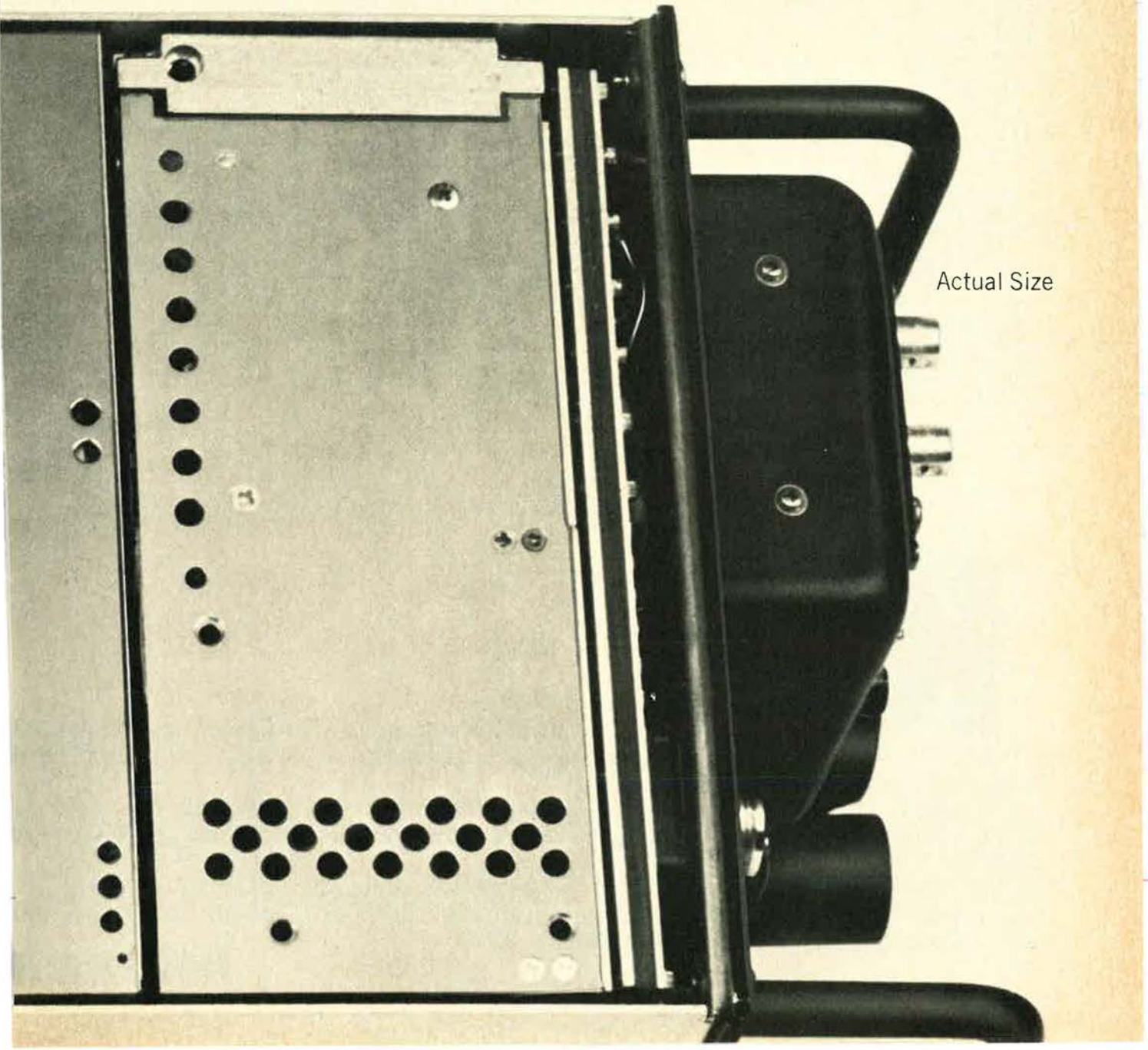

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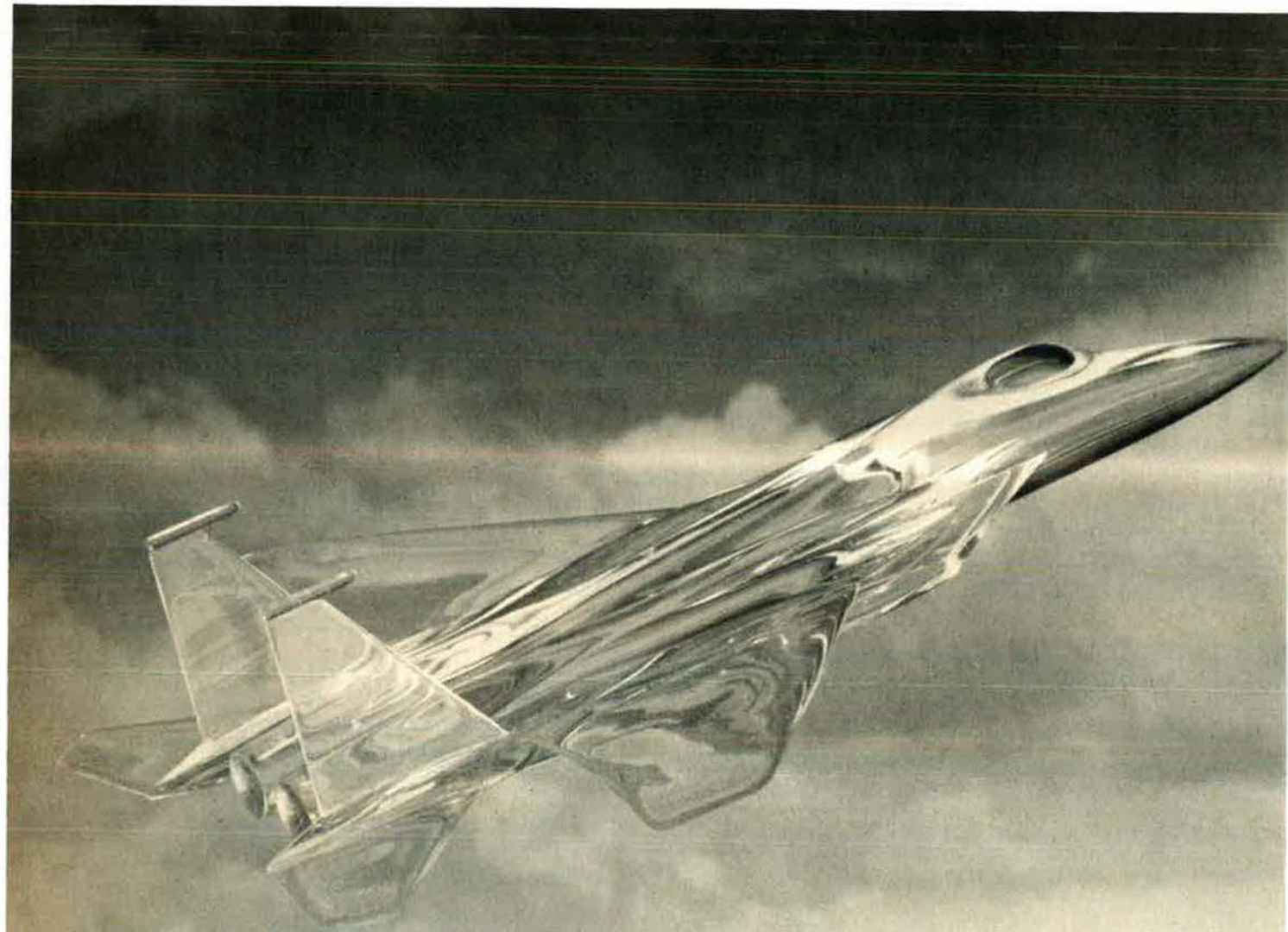

ICS

Internal Countermeasures Set. Designation: AN/ALQ-13
Makes USAF F-15 practically invisible to hostile forces by automatically jamming their radar signal
Enhances F-15's survivability.

Packaged internally so as not to affect F-15's performance or maneuverability. Most advance
electronic countermeasures system yet developed for tactical aircraft. Dual Mode: continuous wav
energy and time pulse energy.

More than 14,000 jamming transmitters produced by Northrop since 1952.

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NORTHRO

AIR FORCE MAGAZINE
PUBLISHED BY THE AIR FORCE ASSOCIATION

This Month

BOUT THE COVER

Electronics technology has become an integral part of USAF's combat capability. Reflecting this fact, AIR FORCE Magazine presents a special section that examines the Air Force's expanding dependence on the force "multiplier effect" of electronics. Here, a phased-array radar at Eglin AFB, Fla. Photo by Kenneth Hackman, AAVS.

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BPA Circulation audited by Business Publication Audit

The Air Force sel

The Air Force recently completed a major selection program for an ARINC-561 system to update the navigation equipment on C-141 and C-135 aircraft.

Delco's Carousel system was compared with competing ARINC-561 systems for operational suitability, accuracy, reliability, logistics supportability, technical features, and a detailed projection of ten-year life cycle costs.

Using these criteria, the Air Force awarded the contract to Delco Electronics.

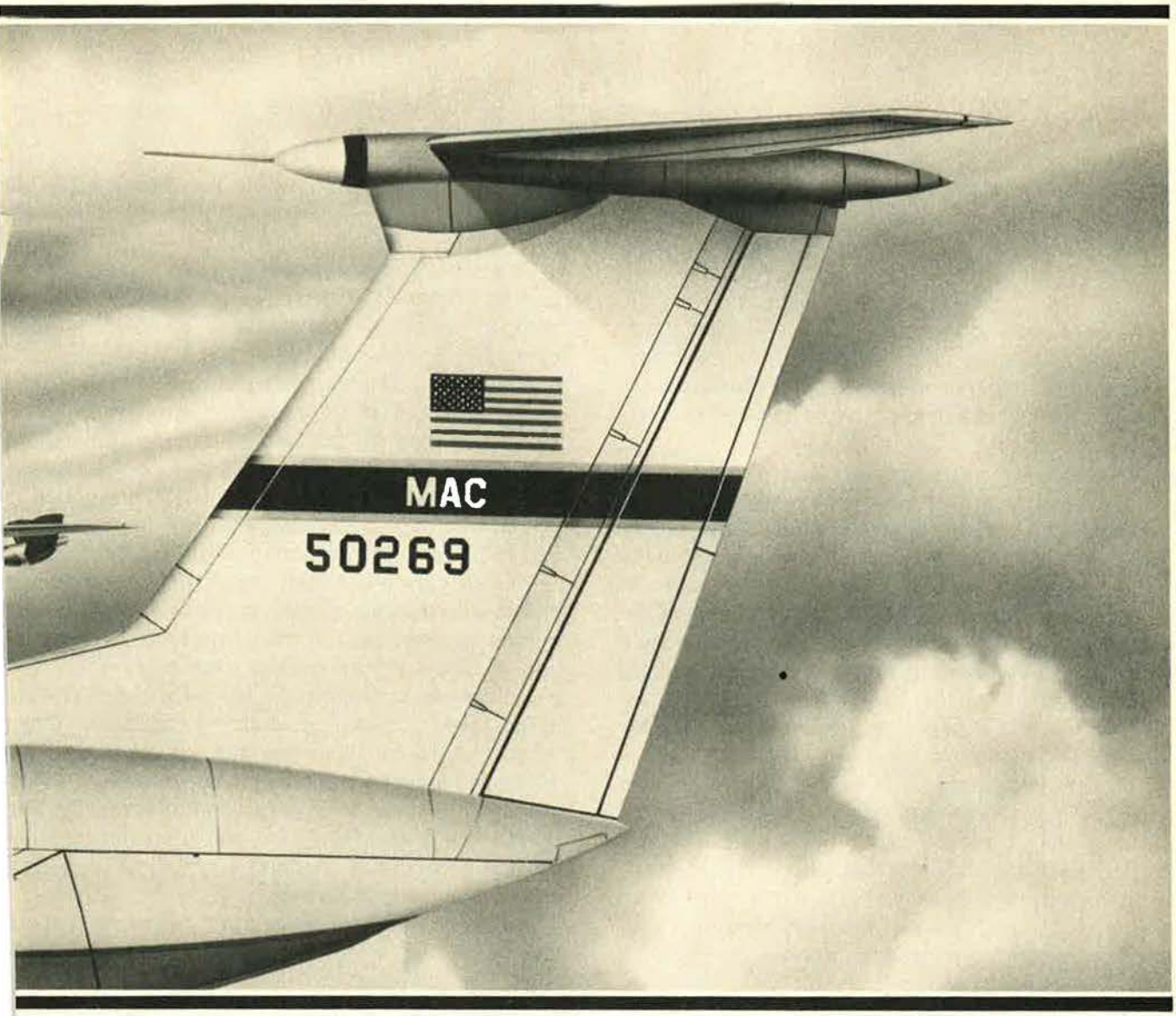
The C-141 flight test program is now in progress and the contract contains options to retrofit the entire MAC force of 275 C-141's with dual systems. It also includes options to provide single Carousel IV systems for the Strategic Air Command's KC-135 and other C-135's, totaling 739 aircraft.

The world's most accepted INS.

Delco Electronics is proud to have had Carousel INS earn this major Air Force contract. And we are equally proud to have been selected by 47 of the world's major commercial airlines as well as for 18 previous military programs and a number of executive jet applications. Carousel systems have accumulated over 17 million operating hours; some 1,700 Carousel systems are currently operational in the field.

Let us tell you more about Delco Carousel systems and how their reliability, accuracy, proven performance, and worldwide acceptance can work for you.

ted Carousel INS



Delco Electronics
Division of General Motors Corporation
Milwaukee, Wisconsin 53201
Phone: (414) 762-7000

AN EDITORIAL

BICENTENNIAL PRIORITY

By John F. Loosbrock, EDITOR

THE fact that the United States, on July 4, 1976, is celebrating its two-hundredth birthday scarcely qualifies as spot news. The Bicentennial observance has been with us now for months, complete with special events, souvenirs, and millions of words, written and spoken—and too often stretched, compressed, or twisted in a kind of patriotic procrusteanism to fit the Bicentennial theme, however awkwardly. One hesitates to add one's own few droplets of ink to the flood.

At the same time, one's sense of history cannot remain unstimulated by the Bicentennial mood even within the somewhat constrained limits of this magazine's sphere of interest. Powered flight has been with us for only seventy-three of the two hundred years, and the Air Force itself has yet to reach the magic age of thirty. Yet the phenomenon of flight and the military manifestations thereof are essential threads in the rich tapestry of America, having perhaps as much to do with the present shape and texture of our national life as any other single factor.

All well and good. To wax introspective over where we have been and how we got to where we are is a healthy enough moral and mental exercise so long as it does not dissolve into a self-congratulatory fog of complacency. But where we are going and in what condition we are likely to arrive is of infinitely greater significance. We are products of our past, shaped and molded by what has gone before. The future is the product of our own efforts in the here and the now. In that sense, all of us are Founding Fathers.

Let us now narrow the focus, looking for clues as to how best we can discharge our obligation to oncoming generations of Americans.

The first and foremost priority, we submit, must be given to ensuring the continued existence of a free and democratic society in the United States as the best guarantor of peace with justice for all men, everywhere.

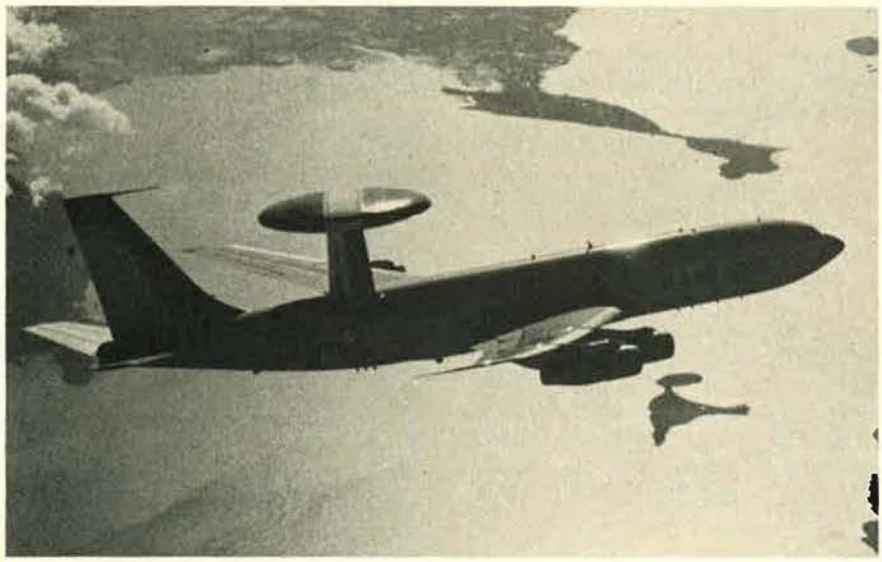
This is no simple task, and simplistic approaches to it will not work. Our society operates in a highly competitive world marketplace—competitive economically, socially, politically, ideologically, technologically, and militarily. We must be strong. We must be tough. We must be productive. We must be intelligent. We must be fair. We must have the will and the desire to be competitive which, in the last analysis, means we must believe so deeply in ourselves and in our system that we will be willing to do what has to be done to preserve it and to improve it.

To this task the United States brings formidable assets—its people, its resources, its technology, its competitive tradition. At the same time, the opposition is tough. It has a clear idea of its goals and a willingness to marshal its resources, concentrate its energies, and sacrifice material comforts to attain them. The United States has deficiencies in all these areas, but they are institutional, not pervasive, which means they can be solved, and quickly, by firm leadership. Unfortunately, an election year does not provide a congenial seedbed for the kind of realism that the deep issues require.

In that context, it is easy to be pessimistic about the future, and it must be admitted that pessimism is not unjustified. On the other side of the balance however, one must place the mounting evidence that the American people are more responsive to the challenge than its leaders and would-be leaders are willing to admit. It is in this basic good sense that one must place one's confidence that there will be a tricentennial to look forward to.

As for ourselves, we'll settle for a good next ten years.

Electronics News



A new E-3A radar system with fewer parts, less weight, and better performance

In repackaging the radar from its prototype to DT&E configuration, our engineers were able to eliminate 35,000 parts and cut unit weight nearly in half, while increasing the radar's range and target capacity.

During recent flight tests, this extraordinary system gave commanders a clear "instant overview" of both friendly and hostile forces over thousands of square miles. Acknowledged as "the greatest single quantum jump in command and control capability since the development of radar," the E-3A is the only system being built today that can effectively gather surveillance information on all airborne targets for an extended period of time. Highly cost effective in its own right, the E-3A also multiplies the effectiveness of the myriad combat assets it can control.

350-hour MTBF for B-52 night-vision system

Flying a B-52 just above ground at night or under "closed curtain" conditions takes a lot of skill, and reliable equipment. With a field MTBF of 350 hours (and rising), our steerable television subsystem helps make such flights possible.

During the past 4½ years, Westinghouse has produced over 300 camera assemblies, camera electronics, and control panels for installation in B-52 G and H aircraft.

Combined with an accompanying FLIR subsystem, these equipments give pilot, copilot, and crew a blind-flying capability equal to daylight flight. Pilots who have flown the system have equated it to "just like looking out a window."

500% more data from new meteorological sensor

A new meteorological sensor for the Air Force Defense Meteorological Satellite Program is being introduced into operational use. The new sensor/data management system will provide improved views of the world's weather and more precise location of severe storm conditions. A unique mechanically resonant sinusoidal scanning technique produces near-constant resolution with about one-tenth the drive power of a conventional system. A Westinghouse on-board digital data processor and high-density digital tape recorders provide the U.S. Military Services with five times the data of previous sensors.

This improved data permits computer preparation of more accurate weather forecasts, allowing Air Force pilots access to worldwide flight conditions with the ease of merely dialing the telephone.

On-time delivery record continues for ALQ-119 ECM pod

We've just completed 31 consecutive months of on-time delivery of the sophisticated ALQ-119 pod-mounted ECM system. Westinghouse has delivered over 1300 of these tactical jamming pods, and we're still counting.

Pave Spike exceeds reliability requirements

The Westinghouse Pave Spike, the first airborne TV target acquisition/laser designator to meet both military reliability and environmental specifications, exceeded its 125-MTBF requirements during reliability tests.

Recent flight tests prove reliability of new F-16 radar

In 43 flights during the fly-off competition, with over 142 hours on the aircraft system, only two failures occurred. The supporting bench system had over 400 hours and no failures. System availability on a two-mission-per-day schedule —100%.

At half the size and weight of previous fighter radars—and lower cost—this highly versatile new-generation radar gives the best in single-seater air combat capability plus enhanced air-to-ground and ground mapping.

Westinghouse Defense

Airmail

Strategic Misnomer
In the April AIR FORCE Magazine (page 61), an insert article, titled "Antilaser Protection of Satellites," stated that the US Early Warning Satellite System was: ". . . the nation's pivot in terms of *strategic* warning." This is a misnomer as can be verified by the following definitions from JCS Pub 1:

Strategic Warning: Notification that enemy-initiated hostilities may be imminent.

Tactical Warning: Notification that the enemy has initiated hostilities. A notification to operational command centers that a specific threat is occurring.

Clearly, the early warning satellite provides *tactical,* not *strategic,* warning. The interchange of these two terms is a fairly frequent occurrence, and I hope this clarification will be helpful to you and your readers.

Lt. Col. E. S. Van Inwegen
Ent AFB, Colo.

• *We enter a plea of* nolo contendere. *The intent of the sentence in question was to identify the US Early Warning Satellite system as ". . . the nation's pivot in terms of* warning of strategic attack," *and should have been so stated.*—THE EDITORS

Total Force *Policy*
Congratulations on the May 1976 AIR FORCE Almanac issue. This is yet another glowing example of the long history of great publication successes enjoyed by our Association.

I have, however, one exception that is included in Gen. David C. Jones's article, "The Cutting Edge: Combat Capability," that being his reference to "Total Force Concept." We have long been led to believe that Total Force long ago escalated from "Concept" to "Policy" by direction of the Secretary of Defense.

Is this an editorial slip, or does this really reflect the feeling of our leaders as some in the field are inclined to believe? Whichever, the effect undoubtedly desired from this otherwise well-written article was dulled considerably by these unfortunate references.

Maj. Gen. Edward R. Fry,
KanANG
The Adjutant General
State of Kansas Military Department
Topeka, Kan.

• *A slip indeed occurred in the use of the term "Total Force Concept," rather than "Policy." Ordinarily we are on the alert for this same slip, since ingrained habits are hard to erase, and we should have caught and corrected it.*—THE EDITORS

Wrong Missile
On page 127 of the May issue you show a picture titled "AGM-78 Standard ARM." The missile in your picture is not a Standard ARM but a version of the Navy Standard Missile, RIM-66. The Standard ARM is designed to go to war carried on aircraft such as the Air Force F-105C and F-4C Wild Weasels. It is not launched, as shown, from shipboard launchers.


Here's what the Standard ARM really looks like (on an F-105).

Unclassified information published about the missile reveals a velocity capability in excess of Mach 2.5 and a range considerably in excess of 15.5 miles.

R. K. Markel
Corona, Calif.

Staff College Approval
My sincere thanks for your continued support of the Staff College and its Air Force orientation program. The AIR FORCE Magazine with the personalized letter for each of the students greatly enhanced the curriculum and made teaching aerospace operations a relatively easy task. The wealth of information contained in the Almanac Issue complemented perfectly the instruction given during the lecture and seminar periods. AIR FORCE Magazine is thought by the students and faculty to be definitely one of the most educational and valued publications issued during service weeks.

Col. Richard A. Vogel
Chief of Staff
Armed Forces Staff College
Norfolk, Va.

Officers' Club It Isn't
Whoever said the Air Force Association was an "officers' club"? The May issue is proof of the Association's concern and interest in enlisted people. The report on the major commands and separate operating agencies was, as usual, very meaningful and informative. The picture of the Senior Enlisted Advisor for each of these commands along with the Commander was another step in the right direction to make AIR FORCE Magazine the best publication around today.

Thanks for showing that these NCOs are really occupying key positions within the Air Force.

CMSgt. John E. Schmidt
Tyndall AFB, Fla.

• *CMSgt. Schmidt is a member of the Air Force Association's Enlisted Council.—THE EDITORS*

ANG Omissions
In reference to the May issue article, "Air National Guard, Vital Adjunct to the Active Air Force," I find it very hard to believe that there was absolutely no mention of nineteen Air National Guard Electronic Installations Squadrons who have contributed approximately 18,000 man-hours per squadron to the Air Force Communications Service's worldwide workload in the Electronic Installations Management System.

In addition, the members of these EI Squadrons perform vital services to the nation by volunteering for thirty-one, sixty, ninety, and 180 day active-duty tours in Europe, Korea, Japan, etc., during the year, thus saving the Air Force and the federal government large sums of money, since this work does not have to be accomplished by civilian contractors. These men and women

SCIENCE/SCOPE

Sweden has ordered the U.S. Air Force TV-guided Maverick missile for use with the Swedish Air Force's AJ-37 Viggen aircraft. The Viggen will carry the missile on a specially designed single-rail launcher. Carried on U.S. Air Force Phantom fighters, the air-to-ground Maverick has shown high accuracy against tanks, bunkers, radar sites, and field fortifications. Its versatility makes it adaptable to a wide range of foreign attack aircraft.

The location of enemy artillery can be pinpointed in seconds with the U.S. Army's new AN/TPQ-37 artillery locating radar. Its three-dimensional antenna scans the horizons with a pencil-shaped beam which moves so fast it forms an electronic barrier that can detect incoming projectiles as they rise above the horizon. These are tracked and their trajectories are back-plotted to locate the firing weapons, often before the first shell hits the ground. A contract for further development and for limited production of 10 ALRs has been awarded to Hughes.

The ALR can be deployed quickly and set up in 30 minutes. It has two main units: an antenna trailer towed by a 5-ton truck which carriers the transmitter, receiver, and generator, and an operations unit housed in a standard S-280 shelter mounted on a 2½-ton truck. The shelter has room for two operators and a supervisor, although one man can do the job if necessary.

Pictures from NASA's Landsat-1 satellite are helping Alaska's natives -- some 100,000 Indians, Eskimos, and Aleuts -- select the best agricultural, forest, and mining lands from the 99 million acres set aside for them from the federal public domain. Doyon, Ltd., one of 12 regional native corporations, asked the University of Alaska to survey a vast, roadless tract in central Alaska.

Using the Landsat pictures and the limited ground and aerial data available, university scientists mapped seven million acres in the most promising areas. The maps show potential farm land, marketable timber, and hard-rock mineral deposits. The Landsat pictures were taken by the Hughes-built multispectral scanner.

Some 2,000 standard metric items will enter the U.S. Army's logistics system as Hughes begins production of the Franco-German-designed Roland short-range air defense missile in its Arizona and California plants. Subcontractors in 25 other states will share in this major metric production program for the Army. Hughes and its principal subcontractor, Boeing Aerospace Company, are co-licensees from Euromissile for the U.S. Roland weapon system.

More than 20 countries have selected the U.S. Army's TOW (tube-launched, optically-tracked, wire-guided) missile as their infantry heavy assault antitank weapon. Hughes/Tuscon has produced more than 120,000 TOWs to date. Test firings from 150 lots -- governed by the Army's rigid "fly before buy" program -- have resulted in 100 percent acceptance. Missile reliability in all firings, foreign and domestic, is 97.6 percent. TOWs fired from U.S. Army AH1Q Cobra helicopters have been equally reliable. TOW can also be installed in several other helicopters, foreign and domestic.

Airmail

also perform the same tasks in the CONUS.

Another factor not mentioned was the humanitarian efforts during floods, hurricanes, etc., and the emergency repairs made to communications systems during these natural disasters.

I am speaking in general terms, as I only want to bring to light the fact that there are many personnel supporting the USAF that are not mentioned, nor given any credit. This has happened in the past in many other Air Force and civilian-related publications, and I think it is time to place some plaudits to the people who do the behind-the-scenes work to keep all those flying units in the air. You realize as well as I do that these people do exist, and we know we do, too. Now why can't the leadership of the Air Force, the Air National Guard, and the military and civilian publications make it well known? I do believe that the ANG Electronic Installations Squadrons are long overdue for some plaudits and recognition—all nineteen ANG squadrons.

I realize that you can only print what is submitted by your staff, and they what they themselves receive. However, by looking at past publications of your magazine, I am sure that you will agree the same eyewash has been printed for the ANG every year for quite some time. It is time for new material and stories about our support personnel in the Air Reserve Forces.

The Air Force Association is a great organization, and we have a fine, informative, and highly professional magazine in AIR FORCE Magazine. The information contained in every issue is read by me from front to back cover every month. The magazine fills in for me what the usual wayward civilian press fails to tell the American people, and arms me with facts and figures to successfully debate our defense posture with people in respected positions who should know more than myself, but are not able to launch a verbal assault on me due to the knowledge I have received every month from this fine publication. I offer my sincere congratulations and all due respect to you for publishing this outstanding publication.

Now, just that one area for those who support those who fly.

SMSgt. Robert B. Pomeroy,
PaANG
Annville, Pa.

An NCO Looks at AFA

I want to address a few words to a "sore spot" among enlisted people about the Air Force Association, and that is the feeling held by so many that the Association is strictly "of the officers, by the officers, and for the officers."

AFA was formed by a cadre of concerned airmen—mostly officers—in 1946. They saw the need for a professional association to represent the military establishment with specific goals in mind. AFA proposals have been seen and heard in virtually every circle of American public and political life that impacts on the military.

There are approximately 15,000 active-duty enlisted people holding AFA membership. This is about eleven percent of the total membership and partly explains why many feel AFA is an officers' organization. One of the most-often stated reasons for the "AFA-is-for-officers" argument is that the majority of AIR FORCE Magazine articles are written by or targeted toward the officer audience. This is partly true; but in all fairness, isn't it logical to favor the largest segment of membership in any official organizational publication? If the balance is to begin to shift toward items of more interest to enlisted personnel, we must likewise shift the balance of membership. As well as gaining more enlisted readers, we need well-spoken enlisted folk offering to contribute meaningful articles. As in so many areas of life, involvement seems to be the key. Let's not criticize others unless we are willing to help.

AIR FORCE Magazine is an outstanding publication that helps resolve tunnel-vision problems at all levels, and the Air Force Association is an outstanding organization dedicated to promoting a better Air Force and helping to prevent further erosion of benefits for all military services. To do that effectively, it needs a large membership, for it is a fact of life that an organization purporting to represent any segment of society is not taken very seriously when only a small percentage of society associates itself with that organization.

How does AFA help enlisted personnel? The Air Force Association was the driving force behind establishment of the Community College of the Air Force (CCAF); it initiated the Outstanding Airman (of the year) Program in 1956; and it supports the Air Force Enlisted Widows' Home Foundation through the AFA Enlisted Council and by gifts to the Home from AFA Chapters around the world. These are but a few of the more visible ways the AFA works for the enlisted force.

Though I am a fairly new member of AFA, I support it fully and only regret that I didn't join years ago. If you, as I did for so long, are thinking of joining but would like to "wait and see," I urge you to join now. We are faced with the stark reality of an attempt at unionization of the military services. Professional organizations such as the AFA can negate the need for unionization. They can serve the same beneficial purposes more effectively than a union ever could and yet not encumber us with the disadvantages—even dangers—that unions present.

I invite each E-1 through E-9 to review all available literature about AFA, browse through a few copies of AIR FORCE Magazine, and then base your decision to join or not to join on fact—not myth, such as has been propagated in the past. Believe me, AFA is *not* "for officers only."

CMSgt. Patrick E. Pasley
Wing Senior Enlisted Advisor
6920th Security Wing
APO San Francisco

In your May "Air Force Almanac," you listed the various separate operating agencies within the Air Force. The article concerned with the Air National Guard was both informative and interesting.

I did notice an oversight in the listing of the various ANG units by major command assignment. The 183d Tactical Fighter Group at Springfield, Ill., was excluded. This organization was the first ANG unit to fly the F-4 Phantom and should be listed appropriately under the Tactical Air Command.

As a former ANG recruiter for the 183d, I take great personal pride in being affiliated with this unit. Its past performance and accomplishments would be the envy of any Air Force organization, whether active duty or Reserve. The recent evaluation by Twelfth Air Force confirms the 183d Tactical Fighter Group's vital and important role with TAC and the entire Air Force inventory.

MSgt. John G. Sheedy, IIIANG
Pawnee, Ill.

• *The list of Air National Guard units that appeared in the May Almanac issue was provided by the National Guard Bureau. Omission of the 183d Tactical Fighter Group was an error, which we regret. Our apologies to the people of the 183d.*—THE EDITORS

Kudos From Academy Captain

Congratulations to AIR FORCE Magazine for writing a straightforward, no nonsense article about the coming of women to the Air Force Academy—"USAFA Prepares For First Women Cadets," April '76. Also, give yourselves at least ten "atta persons" for voluntarily doing away with the "Gentlemen" salutation on each letter in your "Airmail" section. That one word must have stuck in the craw of every member of your staff who ever had occasion to use a ladies' room.

It's nice to see your group being so progressive. Keep up the good work.

Capt. Kitty Taylor
USAF Academy, Colo.

Vietnam Aces

I found your May '76 edition of AIR FORCE Magazine very interesting. However, I would like to make one comment about the "Guide to Aces" on page 143. Reference "American Aces of the Vietnam War," you show five men, three Air Force and two Navy. I feel that you should make a distinction in the Air Force aces in view of the fact that two of the Air Force aces were GIBs (Guys in Back), meaning they were riding the back seat of two-seater fighters when they became aces.

I believe the record should be set straight that only my good friend Richard (Steve) Ritchie, of Reidsville, N. C., was a pilot ace. I am not aware of the two Navy pilots as to whether they were pilots or GIBs.

Lt. Col. William B. Mills, USAFR
Thomasville, N. C.

• *A point well taken. Of the Navy aces, Lt. Randy Cunningham was a pilot, Lt. William Driscoll an RIO (Radar Intercept Officer—translate: GIB).*—THE EDITORS

New Spectre Chapter

Announcing the formation of the Wright-Patterson Chapter of the Spectre Association *(see Unit Reunions, below).*

Membership is open to those who have contributed to the development/production or participated in operational flight/support of the Spectre and other side-firing aircraft.

The purpose of the organization is to foster, promote, and encourage a sense of appreciation for side-firing weapon systems.

Interested individuals may obtain information by contacting

Lt. Col. W. E. Craven
7185 Kylemore Dr.
Dayton, Ohio 45424
Phone: (513) 233-2077, 255-4825, or 255-3407

25th and 447th BG Members

I would like to appeal to readers for the loan of any photographs depicting B-17s of the 447th Bomb Group, which flew from Rattlesden, England, during WW II. The photos are needed to illustrate a magazine article now awaiting publication. Any material would be most carefully treated and returned as soon as possible.

Also, I am trying to trace former members of the 25th Bomb Group (R), Eighth Air Force, which flew the British Mosquitoes from Watton Air Base, England, during WW II. In particular I would like to contact Col. Leon W. Gray, the Group's CO; Maj. A. E. Podwojski, Deputy CO; and Maj. Roy Ellis-Brown, Group Operations Officer. I also appeal to any readers with information on Eighth Air Force Mosquitoes to get in touch with me.

Flt. Lt. Tony Fairbairn, RAF
85 Honington Rise
RAF Honington
Bury St. Edmunds
Suffolk, England

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

UNIT REUNIONS

Air Weather Service

Northern California AWS officers will meet October 1–3 in Sacramento. All ex/retired AWS officers welcome. Contact

Milt Sipple
2589 Dumbarton Ave.
San Jose, Calif. 95124

Commonwealth Aircrews

The Wartime Pilots' and Observers' Association of Winnipeg, Manitoba, Canada, will hold their second (and perhaps the last) Commonwealth aircrew reunion in the giant, new Winnipeg Convention Center, September 9–11. This invitation extends to everyone who flew with the Commonwealth Air Forces or trained with the British Commonwealth Air Training Plan as aircrew—flyers of the present and former Commonwealth nations, present and former British colonies, Yanks, Dutchmen, French, Norwegians, Czechs, Poles, and those of other nations who volunteered to fly and fight with the air forces of the Commonwealth. Send name and address, and those of your aircrew buddies, to

Aircrew Reunion
P. O. Box 1702
Winnipeg, Manitoba
Canada R3C 2Z6

NORAD Band

The North American Air Defense Command (NORAD) Band is planning its first reunion September 11–13, in Colorado Springs, Colo. Former members interested in attending should write or call

MSgt. John N. Rubba
NORAD Command Band
Stop 31
Peterson AFB, Colo. 80914
Phone: (303) 591-4701

Spectre Association, Inc.

The Spectre Association, Inc., will hold its annual reunion in Fort Walton Beach, Fla., October 22–24. Anyone interested

Airmail

in side-firing gunships is invited. Further details from

Spectre Association, Inc.
P. O. Box 707
Mary Esther, Fla. 32569

Tuskegee Airmen
The 99th and 553d Fighter Sqdns., 332d Fighter Group, 477th Bomb Group (M), and 118th and 126th ABUs (Sq-F) and supporting units of WW II at Tuskegee Institute; Tuskegee, Walterboro, Attabury, and Freeman AFBs; and Selfridge, Godman, and Lockbourne AFBs, and overseas, are holding a reunion at the Marriott Motel, Philadelphia, Pa., August 19-22. All personnel of these units—military, civilian, ex-cadets, instructors, dependents and dependents of deceased personnel, and AF active-duty personnel—are invited. Contact

William M. Cousins
P. O. Box 18966
Philadelphia, Pa. 19119

Victorville Flying School
Members of the Victorville Flying School will hold a reunion September 24–26. For details please write

1976 Reunion
P. O. Box 1464
Apple Valley, Calif. 92307

1st Tac Fighter Wing
A reunion of the 1st Tactical Fighter Wing (formerly the 1st Pursuit Group) will be held September 24–25, at Langley AFB, Va. Former and present members invited. For information and reservations contact

Capt. Donald E. Waddell III
27th TFS
Langley AFB, Va. 23665

2d Aircraft Delivery Group
The 35th reunion of the 2d Aircraft Delivery Group (TAC) will be held August 13–14 at Langley AFB, Va. Former members of the 2d ADG, 4440th ADG, 1708th Ferry Wing, etc., are invited. For details contact

Lt. Col. Bill Watson
or
Lt. Col. Hank Zimmerman
2d ADG
Langley AFB, Va. 23665
Phone: (804) 764-7947
Autovon 432-7947

37th Fighter Sqdn.
On September 17–19, the 37th Fighter Sqdn., 14th Fighter Group, 15th AF, of WW II, will hold a reunion in Tulsa, Okla. Please contact

Walt Goodman
Box 549
Gramercy, La. 70052

Flying Class 41-G
The 35th year annual reunion for the AAC Flying Class 41-G will be held September 23–26, at the Sheraton-San Antonio Motor Inn. Contact

Bob Ficke
401 Spaceway Dr.
San Antonio, Tex. 78239

Class 44-K
Members of Pilot Class 44-K, graduated February 1, 1945, from Turner Field, Albany, Ga.—a roster is being organized and a possible reunion. Contact

Eugene R. Kaczmarek
617 Dodge Ave.
Evanston, Ill. 60202

48th Fighter Sqdn.
The 48th Fighter Sqdn., 14th Fighter Group (P-38s) is having a reunion of all WW II members at South Padre Island, Tex., September 24–26. Contact

George "Pinky" Schulgen
P. O. Box 269
Port Isabel, Tex. 78578

92d Bomb Group
A reunion of the 92d Bomb Group, 8th AF, WW II, will be held in St. Louis, Mo., September 30–October 3. All former members of the 92d and supporting units stationed at Bovingdon, Alconbury, and Poddington, England, during WW II are invited. For details contact

Sheldon W. Kirsner
2603 Cathedral Dr.
St. Louis, Mo. 63129

94th Fighter Sqdn.
A fall reunion is being planned by the 94th Fighter Squadron, WW II. Further information from

George T. Burks
Rt. 1, Box 300
Carriere, Miss. 39426

374th Tac Airlift Wing
Former members of the 374th Tactical Airlift Wing and its support units at Ching Chuan Kang ROCAFB will have a reunion in San Antonio, Tex., August 5–8. Contact

Capt. Robert L. MacNaughton
374/CCK Reunion
P. O. Box 787
Randolph AFB, Tex. 78148
Phone: (512) 652-5745

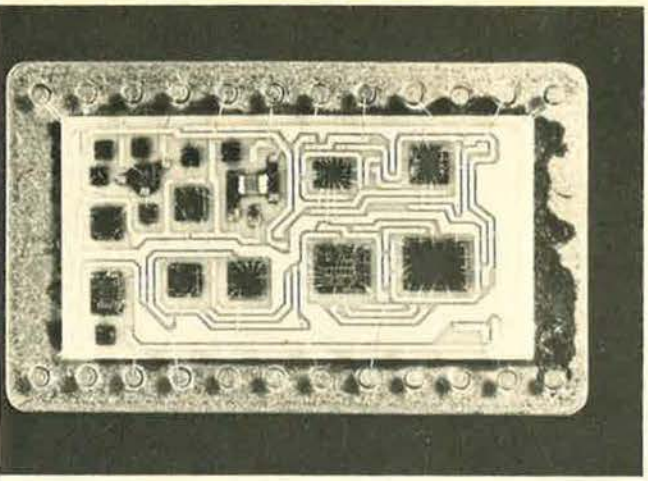
402d Fighter Sqdn.
The 402d Fighter Sqdn., 370th Fighter Group, 9th AF, WW II, is having its first reunion in New Orleans, La., August 5–7. For details contact

Edward J. Meyer, Jr.
4829 Dreux Ave.
New Orleans, La. 70126
Phone: (504) 282-3450

509th Bomb Wing
The 509th Bomb Wing is preparing a mailing list for a reunion in Las Vegas, Nev., Sept. 10–12. Send name and address, and names and addresses of 509ers you know, for reunion letter.

Clifford B. Kiah
Box 67
Avery, Calif. 95224
Phone: (209) 795-1838

hange by Managing Technology



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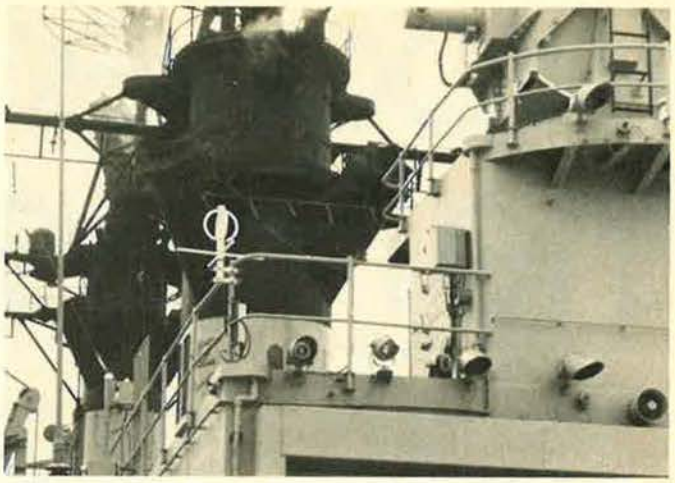

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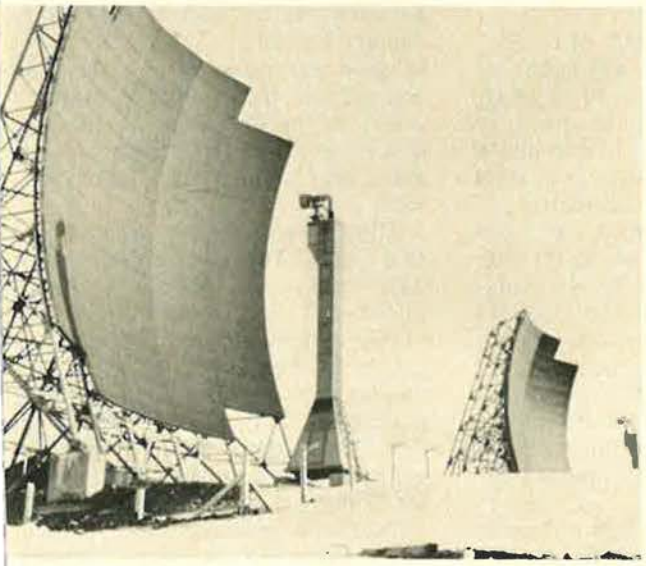

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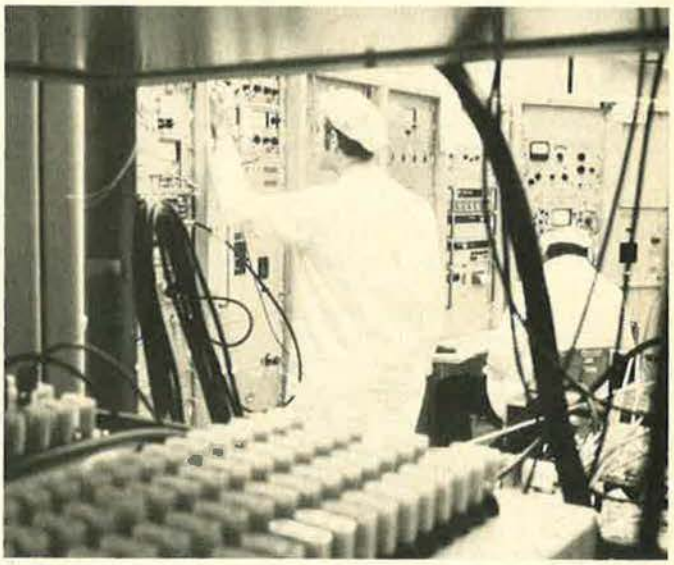

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Airpower in the News

By Claude Witze, SENIOR EDITOR

A Birthday of Turmoil

Washington, D. C., June 7

It would be nice to just wish everyone a Happy 200th Birthday this July of 1976, but the news will not permit it. The Armed Services Committees of the House and Senate are heading into a conference, as we go to press, to resolve differences with regard to the military procurement authorization bill for Fiscal 1977. We suspect there is a heated row ahead, fueled to no small degree by the fact that there will be a Presidential election in November.

For the US Air Force, the key item under discussion is the proposed B-1 bomber. It was on May 20 that the Senate adopted, 44 to 37, an amendment that, if it prevails, will seriously impede the new aircraft program. It was best explained on the floor of the Senate by its sponsor, John C. Culver, an Iowa Democrat. Here is the way he is quoted in the *Congressional Record:*

"This amendment would provide that procurement funds for the B-1 bomber not be obligated prior to February 1, 1977, and that they may be spent after that time only if the President certifies to the Congress after January 31 that he has reviewed the test and evaluation data on the B-1 and that he regards procurement to be in the national interest." Mr. Culver added his opinion that it is not "in the national interest for a decision to be made in the heat of an election year when calm and sober reassessment might be better made when all the facts are in and when the world situation next January is known."

As an argument for delay, there was not much merit to the Culver case. Sen. Barry Goldwater said so on the floor, in a prompt response. He said the amendment offered nothing new and already had been rejected by the House of Representatives and the Senate Armed Services Committee. The fact seemed to be that the fast-boiling political campaign had burst into the legislative tent.

Democratic opponents of the B-1 —and other systems—are accusing the Ford Administration of accelerating weapon programs more to scare Ronald Reagan than to scare the Russians. The Californian now challenging the White House recognizes the deterioration of our military capabilities, but, so far, has failed to trace it back to Kennedy-McNamara years and the debilitations of the war in Vietnam, where it started. With the possibility of victory in November, the opposition party, or much of it, sees the possibility of reverting to the policies that led to our pending military deficiencies.

The political angle has not been ignored at the Pentagon. The Culver amendment was accepted in the Senate on May 20. The next day, Defense Secretary Donald H. Rumsfeld pointed to what the amendment says: "None of the funds authorized to be appropriated in this act may be used prior to February 1." Then, the Secretary commented: "That means there would be a gap of some months during which time no additional information would be forthcoming. The only conceivable reason for doing it would be political. Not only does it not do what apparently the authors intended, but it would in addition cost additional funds."

This is a reference to the simple fact that stopping and starting an airplane program is expensive. Bastian Hello, who is the boss of the B-1 project for Rockwell International, says he can understand why there has been so much debate, but also maintains that the stop-and-go history of the bomber continues to add to its cost, and cost may be the most vulnerable point on the airplane.

"It turns out like almost every other major undertaking; you can't do it in pieces; once you start it, you'd better continue, or quit," Mr. Hello told a New York *Times* interviewer. "If I have to lay off all my people and wait two years to go into production, you know and I know that those people are going to be used for other things."

This is what Mr. Rumsfeld was talking about. The idea of quitting also was put before the Senate, in an amendment from Sen. George McGovern, who wanted to eliminate all B-1 procurement funding. He lost. The vote was 33 to 48. If you examine the tallies in the *Congressional Record* you will find that thirteen senators who had voted against the McGovern amendment voted for the Culver proposal. Only one voted for the McGovern amendment and against the Culver version.

The Rumsfeld effort to clarify the real issue was augmented a few days later by Air Force Secretary Thomas C. Reed, who met with a highly skeptical and contentious group of Pentagon reporters. He handed out a graph showing what a program halt and recovery next February would mean in terms of workers on the project (*see chart*). Mr. Reed explained that the Culver amendment proposes a total shutdown of the B-1 program in November, when the current contract runs out at the end of that month. There is $87 million in funding for that contract. Then, also under the Culver amendment, the contract would be continued—providing the Pentagon and the new President turned all lights green—starting next February 1. How much would this delay —Mr. Hello's "stop-and-start"— cost the taxpayers? The estimate is $492 million. Mr. Reed made it clear he was talking here about procurement program funding, not about research and development, the testing exercises, and other necessary activity.

The press corps found these explanations of a highly complex and massive disruption impalpable, both at the meeting with Secretary Reed and when they got to their typewriters. The news about the real cost of the Culver approach

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Airpower in the News

received cursory treatment. A simple example of obtuseness came out of Mr. Reed's declaration that a two-month shutdown, from November 30 to February 1, would push the program out of kilter about five months. How can that be? The Secretary said it was a good deal like being forced to pull up at the side of a freeway in your automobile. When you try to reenter the stream of traffic, you face a delay. In addition to the labor problem, as illustrated, there is plant overhead and the interruption of long lead-time activities. The total stretchout of the program, running into future years, will add an astounding $305 million simply as a tax inflicted by the expected normal inflation over those years.

Mr. Reed made it clear that the suggested $492 million total is not money that has to be provided at once. Said he: "You don't really have to come up with that money until the early '80s. And I would not for the moment say that $492 [million] was the right number, or $491. The point is that there appears to be [an increased cost of] hundreds of millions of dollars for a significant slowdown and a significant startup."

He was pursued further. Suppose you are wrong? Suppose the new President says so and kills the B-1? Don't you then save money?

"Then you save money. It costs about $110 million if he decides on February 1 to cancel it."

Meanwhile, back on Capitol Hill, the Senate wrapped up action on the proposed authorization measure. A half-dozen noncontroversial amendments were approved. On May 26, the chamber stayed in session until almost 9:30 p.m. in order to approve the measure. The vote was 76 to 2. There was a serious effort, led by Sen. Edward M. Kennedy, to delete the Administration's supplemental request for $317 million to buy sixty Minuteman III ICBMs with an improved warhead. Production had been scheduled to end in September, but the money will keep the line open.

Kennedy lost, 35 to 49, but not without a heated argument. Senator Kennedy maintained the money would be better spent on newer land- and sea-based missile systems. He also contended that the Mark 12A warhead in question, with increased power and accuracy, might change Soviet strategy, leading them to "launch on warning," a "strategy that brings the world far closer to nuclear destruction."

The opponents, who prevailed, argued that this is not the time to close down the only ICBM production line and that any new missile, land-based or sea-based, is five or more years away. More telling was Soviet intransigence in the SALT negotiations.

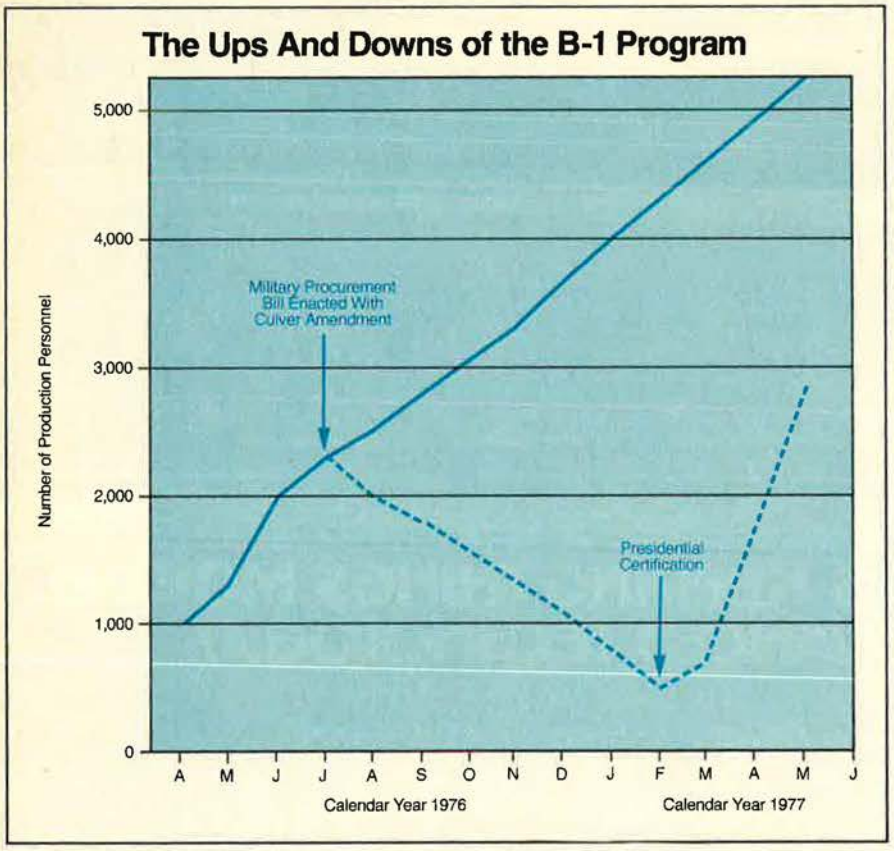
The Senate did approve an amendment by Sen. Gary Hart of Colorado that struck from the bill $120 million added by the Armed Services Committee to provide the Air National Guard with twenty-four A-7D attack planes. The vote was narrow, 38 to 37.

Sen. Robert Taft, Jr., of Ohio, made a last-minute effort to revise the Culver amendment decision. He proposed that President Ford be allowed to order the B-1 into production if he thought it would enhance arms negotiations with Russia. He was turned down, 47 to 30.

All in all, the Senate voted to authorize $31.8 billion for procurement and research, development and evaluation. This is about $2.4 billion less than the Administration's revised requests. It compares with $33.3 billion authorized by the House.

The Senate/House conference to decide on a final figure may run close to the end of June. The reasons: a wide difference of opinion on the Navy's shipbuilding program and another impending row in the Senate over adherence to the budget targets already established by Congress and jealously guarded by the Senate Budget Committee.

The warship matter, delineated by the Armed Services Committee in its report, comes from a call for repeal of a 1974 law requiring that all major combat ships be nuclear-powered. Chairman John C. Stennis of Mississippi, declared his committee is not antinuclear, but that



The chart shows the programmed number of production personnel for the B-1 under (solid line) the current plan and (broken line) the Culver Amendment. The graph covers the period from April 1976 through May 1977. Companies include Rockwell International, Boeing, General Electric, and AIL Cutler-Hammer.

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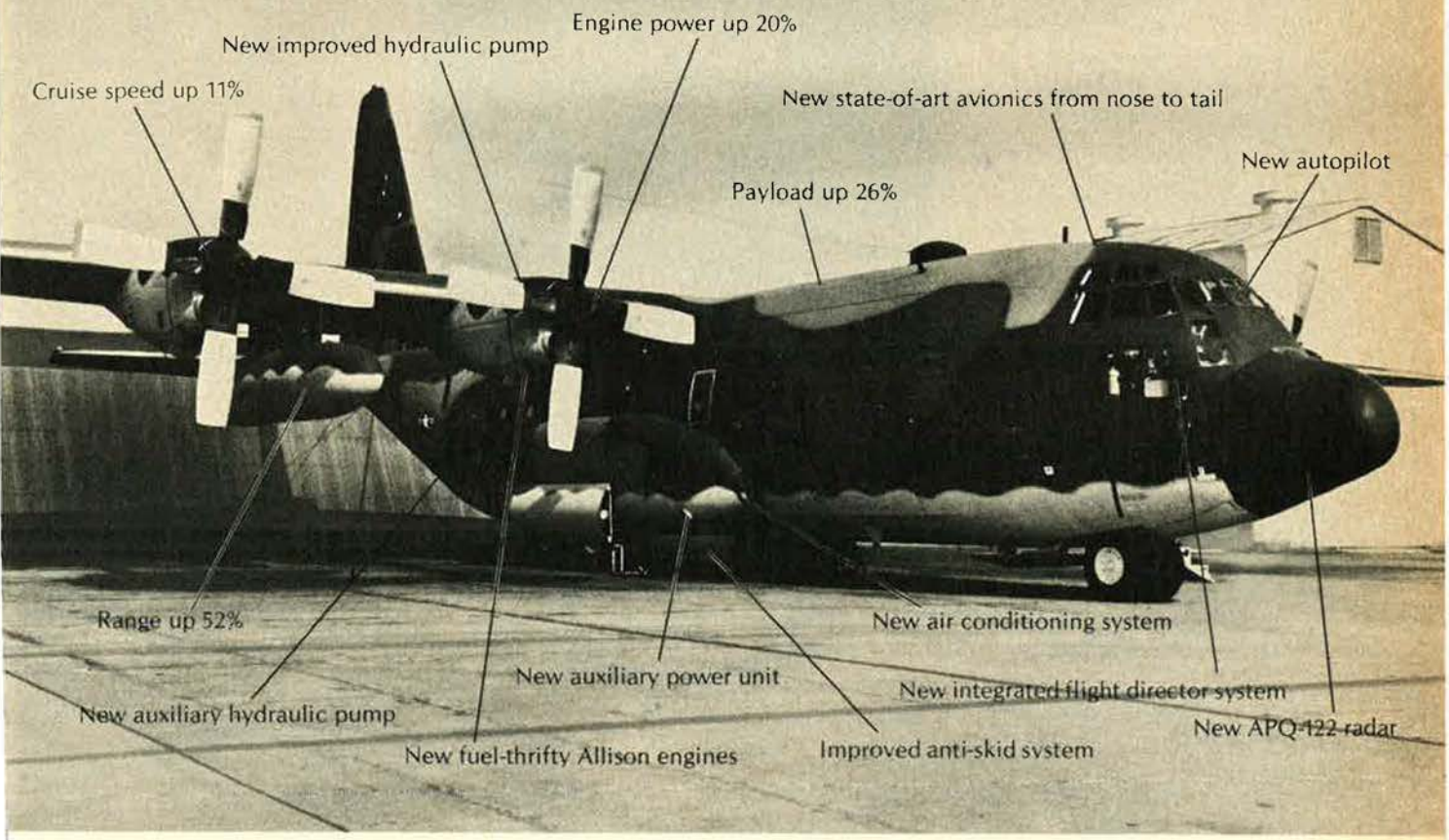

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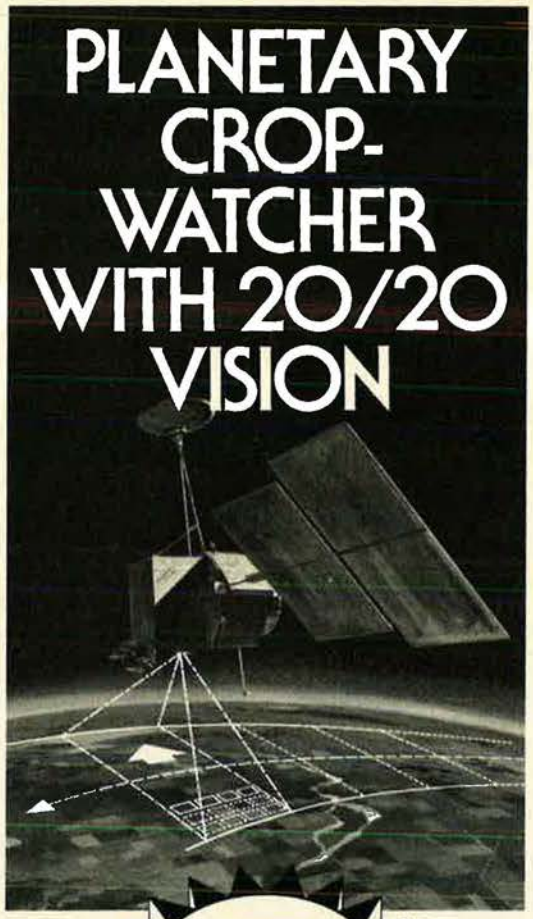

Thematic Mapper scheduled to fly in 1980 aboard Landsat-D spacecraft will be in sun-synchronous orbit at 705 km altitude, scanning a swath 100 nm wide and covering all inhabited areas of the earth.

Forecasting crop yields is still more of an art than a science. No electronic system, however sophisticated, can yet match a farmer's feel for how his crops are doing. But individual assessments like "pretty good" or "we'll have a bumper crop if the weather holds" can't be used effectively for worldwide or even regional forecasts. They don't fit into a computer, and they take too long to compile and analyze.

What's needed is millions of precise, numerical estimates of crop status flowing steadily into the computer on an acre-by-acre basis. This calls for a satellite-borne system which provides a truly synoptic view of the earth's arable areas. NASA's Landsat, in orbit since 1972, provides this kind of general data. But the data requires a lot of correction to compensate for satellite motion and the optical and electro-mechanical limitations of the sensors.

The next generation Landsat sensor system, called Thematic Mapper, is now in the study phase. This new system will provide improved spatial and spectral resolution over the present system. It will be able to discriminate more effectively between different crops, stages of growth, and sick and healthy vegetation. Besides crop watching, it will be able to survey forest resources, detect changes in land use, monitor rangelands for better livestock management, and help in watershed and water use management.

Some additional advantages will be built into the Thematic Mapper design under study by TRW Systems and Perkin-Elmer. Because of its unique rotary scanning system, the scan is unidirectional and the sensor output is inherently linear. Little or no special processing will be needed to compensate for optical and electro-mechanical distortions. This means less complex spaceborne equipment, simplified data processing on the ground, faster status reporting, and thus an overall reduction in system operating costs.

Simplified ground data processing is particularly important. It means that low-cost ground stations can be set up around the world. They'll be able to take data on local crop conditions directly from the satellite as it passes overhead; no need to go through a central receiving station. Such reports will become even more valuable when they can be coordinated with long-range weather forecasts.

The Thematic Mapper is one of many ways that TRW is working to improve space technology as a tool to give us a better understanding of our earth and man's impact on it. If you are interested in using our skills in this area, we invite you to write and tell us about your specific needs.

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it believes there should be a mix including conventional vessels. The reason: The committee says it is necessary to keep the budget within reasonable limits. The bill, as approved by the Senate, strikes out funding for three vessels already approved by the House. It is a testy issue.

Much of the floor debate on May 26 centered on concerns expressed by Sen. Edmund S. Muskie, of Maine, who chairs the Budget Committee. He was supported by Sen. Sam Nunn, of Georgia, who happens to be a member of both the Armed Services and Budget Committees. They pointed out that the existing concurrent budget resolution provides a total defense budget authority of $112.5 billion and outlays of $100.8 billion. The procurement and R&D authorization bill will cover a substantial part of this total.

Highly critical, according to Mr. Muskie, is the Budget Committee's assumption that the President was serious when he proposed economy steps that will save $5.4 billion in budget authority and $4.5 billion in outlays. The items in mind include stockpile sales, elimination of the one percent add-on for retired pay, the end of dual compensation for federal workers on Reserve duty, the phaseout of commissary subsidies, and others. Some of these savings will require legislation. Will it be passed? That is the Muskie question.

Senator Nunn was even stronger in his floor statements. He was highly critical of the House, accusing it of not abiding by the budget pledges. He said the House is $1.7 billion above the budget target and the Senate $565 million below.

"I do not believe it is going to be possible to reconcile these differences. . . . A budget resolution, per se, means nothing unless the House is willing to have some discipline. . . ."

At this point it must be recalled that a year ago—on August 1, 1975—the Senate, for the first time, turned down a House/Senate conference report on military procurement. The action was an exercise, more or less, because the new law creating budget targets and ceilings was not fully in operation. This year it is in full effect. The vote in 1975 was a humiliating defeat for the venerable John Stennis, and he is unlikely to put himself in the position of inviting it to happen again. ■

The Wayward Press

The press, at the moment, is agog over the love life of Rep. Wayne Hays and the suspicion that he bought his boudoir bouncing with public money. It is not considered nice to Kiss and Tell, but indiscreet politicians are learning that social customs, like laws, are broken. Frank Sinatra tried to tell them, too late, that hell hath no wrath like a hooker with a literary agent. Elizabeth Ray has one, along with a ghost writer and a tape recorder.

It was a Sunday morning when the story broke, with a big front-page play in the Washington *Post*. Later, the newspaper's ombudsman gleefully pointed out that the story was unsavory to the rival New York *Times*. On Monday morning, the *Times* could not ignore it, but played the nasty item in a perfunctory way on page 53, the next to last page of the paper.

None of this has a bearing on national security, but is a zestful illustration of our long-standing precept that one man's news is another's anathema. Newspapers are edited by people, and people disagree.

A germane example was in the papers of May 22. Back on page 11 of the Washington *Post* the editors reported the conclusion of a two-day meeting of NATO foreign ministers. The dispatch was from their foreign correspondent, Michael Getler, and filed from the meeting site in Oslo. Said the headline: "NATO Resolve Intact; 3 Problems Unsolved."

Reporter Getler found "renewed confidence in a firm American policy toward the Communist bloc," but he put the real emphasis on the unresolved "serious problems." These, he wrote, involved (a) the Greek-Turkish row over Cyprus, (b) Britain's disagreement with Iceland about cod fishing, and (c) what do we do if Italy admits Communists to its government? The dispatch used about a column of space to discuss these items and report on the conduct of Henry Kissinger. It devoted barely more than a couple of sentences to the final communiqué issued in Oslo by the ministers, saying only that it called for restraint in the interests of détente and a "relaxation of tensions."

If we turn to the New York *Times* of the same date, it is difficult to understand that the two newspapers were reporting the same story. In the *Times*, the dispatch from Oslo was the lead story in column eight, page one. Proclaimed the heading: "NATO Conference Asserts Moscow Imperils Détente." This was news, particularly to readers of the Washington *Post*, who simply were not told about it. Said *Times* correspondent Craig R. Whitney in his lead:

"A strong warning that the Soviet Union is endangering détente by continuing a military buildup in Central Europe and by lack of restraint elsewhere concluded the two-day meeting of 15 foreign ministers of the North Atlantic Treaty Organization here today."

Whitney went directly to the communiqué, detecting concern and worry. He found many of our allies, particularly the West Germans, "frightened by the Soviet Union's heavy involvement and support of 12,000 Cuban troops in Angola last winter." He said the communiqué displayed alarm over the "sustained growth of the Warsaw Pact countries' military power, on land, at sea, and in the air, beyond levels apparently justified for defensive purposes."

In all, the *Times* gave well over a column to Whitney's dispatch. Another forty-five inches of type on an inside page were taken up with the text of the Oslo communiqué. There was a short sidebar on the fretting of NATO ministers about possible Communist inroads in Italy. The *Times* was silent on the two unresolved issues—Cyprus and cod fishing—that the *Post* found so newsworthy.

We will not make any judgment. The reporters and editors are not required to meet any professional standards. They are mere men who happened to get jobs on newspapers. In support of the *Times*, it must be added that the Los Angeles *Times* also had a man in Oslo—one Don Cook. He read the Oslo communiqué and told his readers the onus was placed on Russia, which was warned to stop the buildup of Warsaw Pact forces in Europe. The Cook report was, if anything, stronger than that of the New York *Times*, and even more remote from the version that had been offered by the Washington *Post*.

It is worth noting that the NATO communiqué was released on May 21, the day after our Senate voted to defer procurement of the B-1 bomber. It was five days later that the chamber completed action on the Pentagon's procurement authorization bill, and sent it to conference. If there is any senator, or citizen, who relied only on the *Post* for information on the NATO ministers' conference in Oslo, at the height of the weapons debate, he did not get all the facts.

QUESTION MARK 'REFUELERS' HONORED

Two Air Force pioneers have been awarded DFCs nearly half a century after their key role in a world record endurance flight.

THREE centuries ago, the French philosopher François de La Rochefoucauld wrote, "History never embraces more than a small part of reality."

All who have an interest in aviation know about the flight of the *Question Mark*, a trimotor Fokker C-2 which, in January 1929, stayed aloft over southern California for more than six days to set a world endurance record. A reality of the feat that has been virtually ignored by history is the work of the two refueling crews who kept *Question Mark* in the air.

On May 26, more than forty-seven years after the event, the two surviving members of the refueling crews, retired Brig. Gens. Ross G. Hoyt and Joseph G. Hopkins, were awarded the Distinguished Flying Cross by Air Force Chief of Staff Gen. David Jones. The Pentagon ceremony took place before a distinguished audience of retired Air Force three- and four-star generals. The entire *Question Mark* mission was commanded by then Maj. Carl Spaatz, who was to become the first Chief of Staff of the Air Force in 1947.

Generals Hoyt and Hopkins were cited for their contribution to the development of air-to-air refueling, which has made possible the present Air Force global deterrence capability. General Hoyt, pilot of Refueling Plane # 1, flew forty sorties in preparation for and during the record flight. General Hopkins participated in sixteen refueling contacts.

USAF Chief of Staff, Gen. David C. Jones, is flanked by (from left) Lt. Gen. Ira Eaker, a pilot of the Question Mark, *and Generals Hoyt and Hopkins.*

A more graphic portrayal of the refueling crews' exceptional airmanship is this description of one night sortie, taken from the first published account of *Question Mark* refueling operations, General Hoyt's article, "Reflections of an Early Refueler," which appeared in our January 1974 issue:

"Our operations at Rockwell Field were not conducive to longevity! Once we had to take off in the dark into fog . . . climb through the fog to the *Question Mark* cruising in the clear, deliver a load of fuel . . . and return to find Rockwell Field completely obscured by a thick layer of fog. [The refueling planes had only rudimentary instruments, no radio, and there were no landing systems.]

"Fortunately, the Douglas C-1 was a very stable airplane. With proper setting of control tabs . . . adjustment of the horizontal stabilizer and throttle for minimum speed in the landing glide, and the use of the lights of San Diego and the floodlights at Rockwell Field glowing dully up through the fog as reference points, it was possible to glide down into the soup 'hands off.' After what seemed an interminable wait, the wheels touched. . . . A truck had to come out and lead us to the flight line."

General Hoyt's career subsequent to the *Question Mark* project was largely in fighter aviation. He was involved in many tactical innovations, pioneering flights, and the selection of new fighters, including the P-47 of World War II fame. His last assignment before retirement for physical disability in 1944 was Commander of the Eighth Air Force Fighter Command's Air Defense Wing in England.

General Hopkins, also a fighter pilot in his early years, served in the China-Burma-India theater during World War II. After the war, he had several assignments with the Military Air Transport Service, including Commander and Deputy Commander of the Atlantic Division just prior to his retirement in 1955.

In honoring these two pioneer "refuelers," the Air Force has added another element of reality, hitherto obscured by the passage of time, to the record of the *Question Mark* flight. It was history's first sustained air refueling operation. The courage, skill, and ingenuity of Generals Hoyt and Hopkins, the other refueling crew members, and the crew of *Question Mark* demonstrated the feasibility of a technique that, two decades later, was to become the foundation on which USAF's global airpower now stands. That is something one can look back to with satisfaction, and with pride. —J.I

What's our mild-mannered civilian turbofan engine doing in a tough bird like this?

Just proving a point, just proving a point.

The bird is the new CASA C-101 trainer/light attack aircraft.

The engine, Garrett's TFE 731 turbofan.

And the point is this:

Our TFE 731 has what it takes to perform as efficiently and reliably in the combat environment as it does in the world of the business jet.

The C-101, being developed by CASA (Construcciones Aeronauticas S.A.) for the Spanish Air Force, is a basic and advanced trainer, with an air-to-air and air-to-ground weapons delivery capability. Armed recon, ECM and photo recon missions are also planned because of the CASA's maneuverability and long endurance at low level.

Its Garrett engine will be essentially the same fuel-saving, low-pollution turbofan now used by four leading business jet builders—Dassault, Israel Aircraft Industries, Learjet and Lockheed. The TFE 731 is also the conversion engine for AiResearch Aviation's 731 JetStar.

The CASA 101. As the forerunner of a new breed of economical, virtually smokeless combat aircraft, it makes sense to power it with the turbofan that powers the economical clean-flying business jets.

GARRETT

The Garrett Corporation One of The Signal Companies

GARRETT'S TFE 731 TURBOFAN

The only one in its class

Northrop Corp. and Messerschmitt-Boelkow-Blohm (MBB) are partners in the development of the C-101.

THIS POPULAR CORPORATE JETPROP IS AT HOME IN THE AIR FORCE.

The Air Force C-12A utility transport first gained its world-wide reputation for capability as a corporate jetprop, the Beechcraft Super King Air.

A reputation gained for a number of solid reasons that make it particularly well-suited for its new role in the Air Force.

Because the Air Force, like industry, needs to move people and cargo swiftly, economically and dependably. And more often than not, the service needs on-demand transportation that commercial carriers do not deliver, plus small-field capabilities that many other aircraft cannot provide.

This fine transport comfortably accommodates eight passengers and two pilots. And it provides a lavatory plus adequate space for baggage. It has a useful load of 4,425 lbs. Cruise speed is more than 228 knots and maximum range with full load is more than 1,200 miles. Cabin pressurization allows over-the-weather operation to 30,000 ft. without oxygen.

With these performance capabilities, the C-12A gives the Air Force an economical alternative to other aircraft in its utility fleet. Because operating and maintenance costs are significantly lower than most other available personnel and cargo carriers.

Even though the C-12A begins its Air Force service as an air attache transport, its versatility, performance and economy suggest several other mission possibilities: aerial surveillance, photography, tactical field support, proficiency flying for desk-bound pilots, courier service, shuttle air-service over heavy traffic routes, to name a few. There are many more.

In addition, Beech's new C-12A program introduces a first for the Air Force. All C-12As under current order have full contractor support on a world-wide arrangement, wherever these airplanes are stationed. Through full Beech logistic support, these airplanes are exceeding the contractual requirement for 80% operational readiness.

The versatile, economical Beechcraft C-12A. It's right at home in the Air Force.

ASK FOR OUR C-12A INFORMATION KIT.

Perhaps your organization has a mission requirement that this hustling jetprop can fulfill. We'd like to show you how it can.

For your information kit, write or call E.C. Nikkel, Vice President-Aerospace Program, Beech Aircraft Corporation, Wichita, Kansas 67201. Phone (316) 689-8175.

Beechcraft

Aerospace World News, Views & Comments

By William P. Schlitz, ASSISTANT MANAGING EDITOR

Washington, D. C., June 4

★ What has been termed "a new era" began late in May with the inauguration of scheduled transatlantic service by Concorde SST commercial airliners between Dulles International Airport near Washington, D. C., and London/Paris.

Thus began a sixteen-month test program to determine whether the British/French-developed SST can achieve acceptable noise levels for continued service to the US, a potentially lucrative market upon which many observers say hinges the economic fate of the SST. Noise on takeoff has created the major controversy surrounding initial SST operations. Air France and British Airways hopes rest on the SST's claim to fame—that it can cross the Atlantic in less than four hours, or less than half the time of its speediest subsonic competitors.

The SST's biggest drawback is its seating capacity: a maximum of 100 passengers. Fares are expensive, in relative terms. For example, one-way passage from Washington to London is $801, compared to about $660 first class and $338 economy fare for subsonic liners.

Current schedules call for both British and French round-trip flights thrice weekly.

★ USAF's A-10 close support aircraft has completed a second lifetime of fatigue testing at Fairchild Republic's facility in Farmingdale, N. Y. (*For a pilot report on the A-10's performance, see p. 75.*)

Equivalent to 12,000 hours of operational flight, the fatigue tests confirm the aircraft's design lifespan of 6,000 hours—or about twenty years of operational flying.

Fatigue testing of the basic A-10 airframe began in July 1975, mostly on a twenty-four-hour-a-day schedule with stops at set intervals for visual inspection.

Seven fatigue cracks appeared during the double lifespan test, but none that could not be corrected with minor modifications, officials said. These will be incorporated in production aircraft and in the A-10s already delivered to the Air Force.

One 6,000-hour test life equates to nearly 3,000 missions, including takeoff and landing, diving and rolling, and other maneuvers.

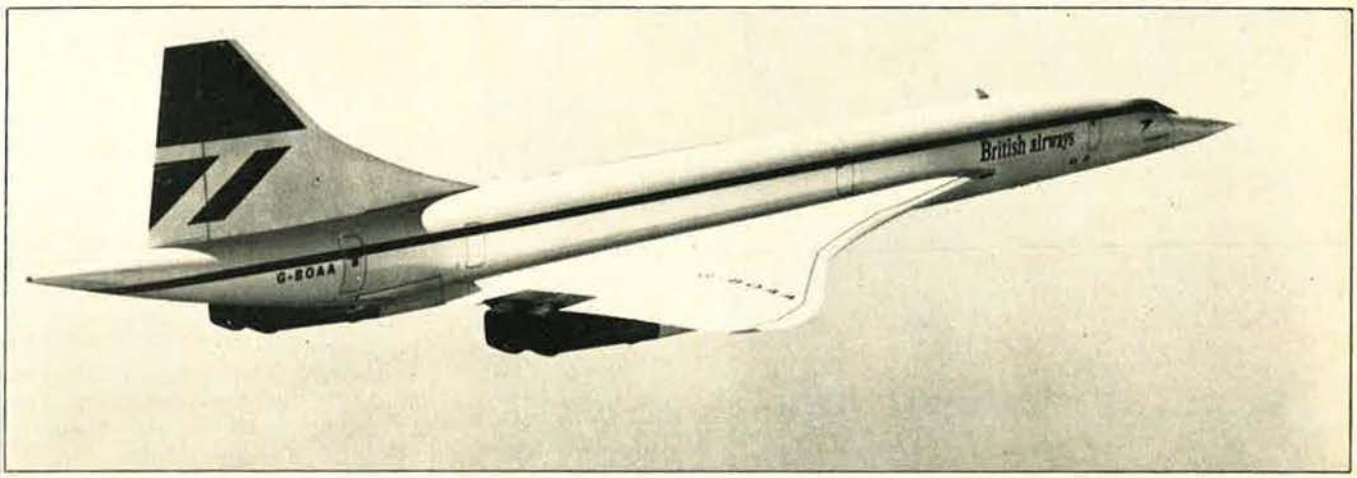
USAF plans to buy 733 of the single-seat attack aircraft to equip five TAC wings and units of the ANG and AFRES.

Presenting AFA's trophy for best Minuteman operations following the recent SAC missile competition at Vandenberg AFB, Calif., is AFA President George M. Douglas, right. Left, Col. W. R. Brooksher, 341st SMW Commander, and 1st Lt. Jack Smith, crew commander. See item.

★ The 341st Strategic Missile Wing, Malmstrom AFB, Mont., achieved a decisive victory during this spring's SAC Missile Combat Competition at Vandenberg AFB, Calif.

The 341st went home with sixteen of the twenty-three awards in contention, including the top honor—the Blanchard Trophy.

In overall scoring, the meet was close. The Montana Minuteman unit



May saw the inauguration of Concorde supersonic commercial airline service between Washington, D. C.'s, Dulles International Airport and London and Paris. A sixteen-month trial will determine the environmental and noise impact of the SSTs.

Aerospace World

scored 5,209 points, 93.7 percent of a possible total, while the 351st SMW, Whiteman AFB, Mo., followed by just 1.1 percentage point.

Best of the Titan II wings was the 381st of McConnell AFB, Kan. It took fourth place with an 89.4 percent tally.

Besides the three Olympic Arena awards taken by the 308th SMW, Little Rock, Ark., the unit also garnered an AFA award for best Titan operations. The AFA award for best Minuteman operations went to the Montana missileers.

For the 341st the taste was sweet—it was the unit's first win in the history of the competition.

★ In mid-May, the second Air-Launched Cruise Missile prototype was successfully launched from a B-52 over the White Sands Missile Range in New Mexico.

During a flight of some thirty minutes' duration, all test objectives were met, officials said.

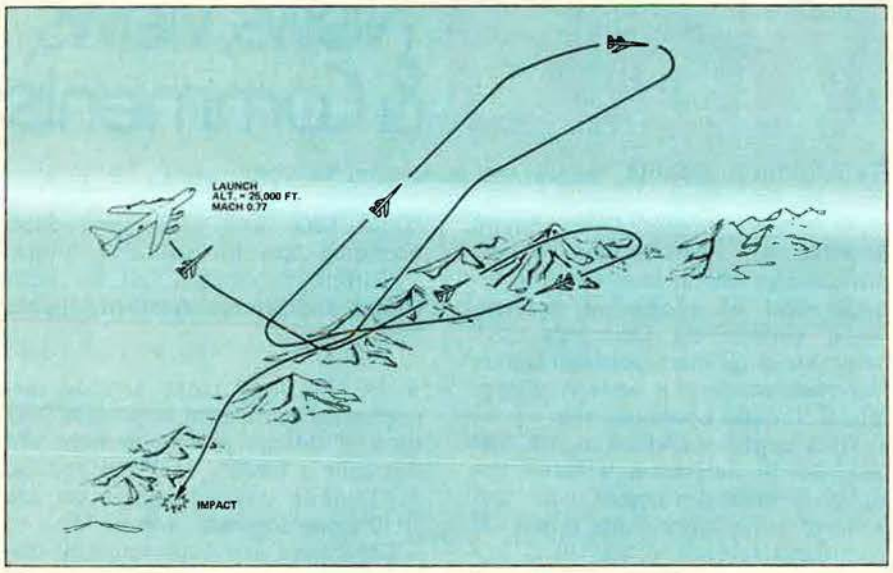
Launched at 25,000 feet, the ALCM demonstrated maneuverability through an altitude pattern from 9,000 to 17,000 feet, during which the missile's turbofan engine performed at speeds from 415 mph to 540 mph. The ALCM's radar altimeter was also checked out during the 200-mile flight.

The seven-missile flight test program of ALCM, for which Boeing is prime airframe and systems integration contractor, is to be concluded by next December.

★ A new Visitors Center is now open to the public at NASA's Goddard Space Flight Center, Greenbelt, Md.

The new facility at Goddard, which is near Washington, D. C., offers a self-guided tour of a number of the US space program's most important ongoing activities.

Visitors will be permitted to observe operation of the control hubs of the space agency's global tracking and communications networks. Open also for viewing will be the huge computer complexes that process masses of data flowing into Goddard from dozens of earth satellites, space probes, and lunar-based instruments.



Flight path of the second ALCM prototype to be air-launched from a B-52 bomber over the White Sands, N. M., Missile Range. Test objectives were met, officials said.

Inside the Visitors Center itself will be an operating weather station displaying satellite photos of current weather systems over the US and South America. Among other "live" exhibits will be the solar-cell conversion—as on satellites in space—of sunlight directly into electricity. A laser system that carries communications signals also will be on hand, as well as many examples of other space-age technology.

The Visitors Center will be open from 10:00 a.m. to 3:00 p.m. Tuesday through Saturday. Parking and picnic facilities are available.

★ In early May, NASA launched an unusual satellite that is expected to have a rather long orbital life—8,000,000 years, in fact.

LAGEOS, for Laser Geodynamic Satellite, weighs 903 pounds (409.5 kg.), but having a core of solid brass is only two feet in diameter.

LAGEOS has been designed with an outer shell of 426 laser reflectors and, being very precisely situated in orbit, has the primary mission of aiding scientists in detecting changes in geography through movements of the earth's crust.

LAGEOS will make possible ex-

Col. R. L. Miller III, right, 40th Tac Air Control Group CO, and Aviano AB Commander Col. L. D. Covington inspect damage to Forgaria, Italy, following quake.

U. S. Air Force

Task Masters.

For the jobs that need to be done, the engines to do the job.

The F101-powered B-1 strategic aircraft.

The TF34-powered A-10 close support aircraft.

The F103-powered YC-14
Advanced Medium STOL Transport.

The F103-powered E-4A Advanced Airborne Command Post.

General Electric engines continue to prove they can handle the toughest Air Force assignment.

The B-1, for example, is now successfully airborne. Powered by four advanced-technology F101 augmented turbofans, the B-1 will fly from low-level penetration speeds just under Mach 1 to supersonic speeds at high altitudes. And it will cover a longer mission range with greater survivability and nearly twice the payload of America's current intercontinental bomber.

The A-10, powered by twin GE TF34 high bypass turbofans, is poised to meet its mission requirements, too. The TF34's high thrust-to-weight ratio and low fuel consumption provide the A-10 with unmatched performance capability for its close air support mission. Plus improved short-field takeoffs and landings, exceptional maneuverability and the capability for increased loiter time in the mission area.

Two advanced aircraft are powered by GE's F103 engine. Powering the YC-14 Advanced Medium STOL Transport (AMST), twin F103s will provide that aircraft with outstanding and reliable short-field capabilities plus excellent mission range and payload. Powering the E-4A Advanced Airborne Command Post, four F103 high bypass turbofans give that aircraft the power, reliability and low fuel consumption needed to meet its varied and complex mission objectives.

General Electric engines. Once again, the Task Masters for critical Air Force missions. 205-115

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electric company!

The U. S. Air Force EF-111A Tactical Jamming System (TJS) will be welcome company indeed, for tactical aircraft operations in tomorrow's ominous electronic warfare environment.

Vastly more powerful electronically than any previous tactical jammer, the combat-proven ALQ-99 system will provide a safe "highway in the sky" by denying an enemy effective use of his surveillance "eyes" and weapons guidance radar.

Now under prototype development at Grumman, the EF-111A will move U. S. tactical jamming into the supersonic era.

EF-111A TJS . . . will be known (and appreciated) by the company it keeps!

GRUMMAN AEROSPACE CORPORATION

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tremely accurate measurements, to within inches of distances in the thousands of miles. The satellite will also be of use in recording with great precision wobbles in the earth's spin axis and any changes that might occur in the planet's rotation rate.

The satellite also has potential for helping to predict earthquakes.

LAGEOS has on board three maps of the world that show the earth's topography in the distant past, how the continents are positioned currently, and a future prediction of further movement. Among other information, these will assist anyone intercepting long-lived LAGEOS in the far future to interpret its purpose.

★ While a full-scale development flight test program of the prototype is currently under way, a decision on whether to begin production of the Air Force's new Pave Low III night/adverse weather search and rescue helicopter is expected this summer.

The highly modified Sikorsky HH-53B completed an initial phase of flight tests at Wright-Patterson AFB, Ohio, and is now being evaluated in the mountainous regions around Kirtland AFB, N. M.

The core of the Pave Low III system is a terrain following/avoidance radar, augmented by a forward-looking infrared set, that provides safe flying at very low altitudes. In combat search operations, this would help in evading enemy ground-based radar.

Adjuncts to the ground-avoidance systems are a Doppler, inertial systems, and projected map display that make possible precision navigation. (All subsystems are integrated through a central avionics computer.)

Design, engineering, and actual modification of the Pave Low III prototype were undertaken in Aeronautical Systems Division shops, using technology and techniques that produced the highly successful nighttime AC-130 gunship of Vietnam fame.

Gen. R. H. Ellis, CINC USAFE, with German engineer Walter Will, the first foreigner to win USAF Civilian Award for Meritorious Achievement.

In piloting the helicopter, the crew views the scene ahead and below on a TV-like screen.

★ The US Navy has initiated concept formulation studies "leading to definition of a combat system planned to provide both surface warfare offensive capability and self-protection against antiship missiles" for naval vessels in the post-1985 period.

Shipboard Intermediate Range Combat System, or SIRCS, is conceived as an "integrated, detection-to-kill, modular combat system that may incorporate sensors, weapons control, guns, missiles, electronic warfare, and other functional modules."

SIRCS would be tailored to the various missions of the Navy's fleet of combat, amphibious, and auxiliary ships, ranging in size from patrol combatants to aircraft carriers, Navy said.

Conducting independent, nine-month studies will be McDonnell Douglas Corp., Raytheon Co., and RCA Corp.

★ Aerospace technology has lent itself to a number of significant applications in the field of medicine.

A new twist has been the use of satellites to transmit medical data from remote areas—even moving ambulances—to hospitals and medical centers.

These communications linkups are billed as a potentially "important breakthrough in emergency medical care," according to NASA officials. Ultimately, they say, a special medical satellite may be developed that could relay health information (the transmission of electrocardiograms has already been demonstrated) from such places as rural hospitals, ships at sea, and offshore drilling platforms to major medical centers for consultation.

A portable transmitter and antenna developed by NASA's National Space Technology Laboratories, Bay St. Louis, Miss., and GE's Science Services Lab recently proved the economic and technical feasibility of sending voice and medical data from moving vehicles. Medical stations can also be equipped with inexpensive receivers.

★ Eight aviation pioneers are to be enshrined in the Aviation Hall of Fame during special ceremonies at Dayton, Ohio, Convention Center July 24. (*See drawings, p. 30.*)

Joining the illustrious of the aerospace world will be:

• **Clarence D. Chamberlin,** eighty-three, a pioneer test and racing pilot noted for his endurance and long-distance flights, including a nonstop flight from New York to Germany in 1927.

• **John H. Glenn,** fifty-five, currently a US Senator from Ohio. Following a distinguished military career during World War II and Korea, Glenn made an epic contribution as an astronaut. He is retired from the Marine Corps in the grade of colonel.

• **George W. Goddard,** eighty-seven, while a member of the Air Force contributed greatly to aerial photography as a means of improving reconnaissance and mapping and as the prime developer of the Air Force aerial strip camera used in nuclear tests and overflights. He is a retired brigadier general.

• **Albert F. Hegenberger,** eighty-one, a retired Air Force major general, pioneered early flight instruments and navigation equipment, which, among other things, enabled him to make the first official blind solo flight and first flight from California to Hawaii. During his career, he earned the Mackay Trophy and two Collier Trophies.

• **Edwin A. Link,** seventy-two, invented the famous flight simulators that have been used for decades to train pilots in solo flights, instrument flying, and aerial navigation, and in the space program to train astronauts.

• **Sanford A. Moss,** 1872–1946, was a scientist/engineer whose research in thermodynamics helped produce the aircraft engine turbo-

Aerospace World

supercharger, enabling aircraft to maintain high-speed flight at altitude.

• **William A. Patterson,** seventy-seven, retired former head of United Airlines, was a central figure in the US commercial airlines industry for four decades, helping to merge elements into a major transcontinental airline system.

• **Nathan F. Twining,** seventy-nine, is a retired USAF general who played a major leadership role in World War II, helped shape the modern Air Force, and went on to serve as Chief of Staff and as Chairman of the Joint Chiefs of Staff.

Serving as Honorary Chairman at the enshrinement ceremonies will be author and explorer Lowell Thomas, who recently retired from a long career as news commentator.

★ The highest proton energy ever produced in a man-made machine was attained in mid-May at the Energy Research and Development Administration's Fermi National Accelerator Laboratory, Batavia, Ill.

The lab accelerated a beam of protons to an energy level of 500 billion electron volts, besting the mark of 450 billion electron volts set in August 1975. (High energy physics, in the view of many military experts, represents an important field for achieving decisive breakthroughs in weapons technology.)

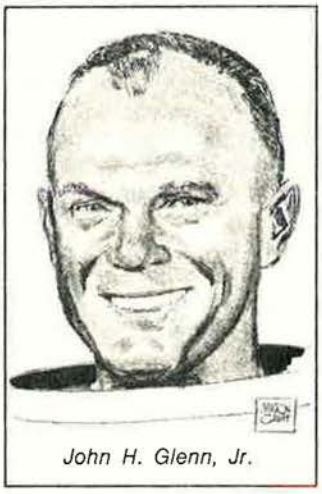
The increase in energy output—two and a half times what the facility was originally designed for—was made possible by upgraded equipment, including the installation of a new primary power transformer, according to ERDA Administrator Dr. Robert C. Seamans, Jr. The former Air Force Secretary said that the lab's achievement "maintains the position of the FERMILAB accelerator as the highest energy machine in the world."

The primary undertaking at the lab is the conduct of experiments aimed at understanding the laws governing the fundamental structure of matter. The creation of high energy allows scientists to study smaller and smaller details of subnuclear particles, officials said.

Canards on underfuselage of YF-16 test-bed aircraft improve maneuvering capability. See below.

★ A test-bed aircraft modified for unique maneuver capabilities is in the midst of a seven-month flight-

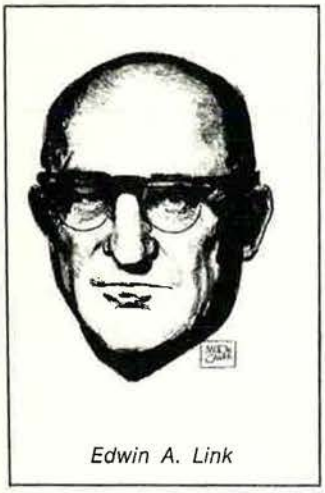
Clarence D. Chamberlin



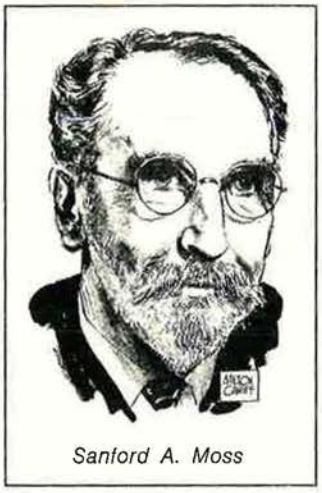
John H. Glenn, Jr.

George W. Goddard

Albert F. Hegenberger

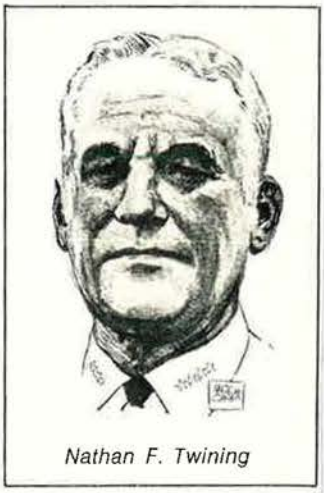


Edwin A. Link



Sanford A. Moss

William A. Patterson



Nathan F. Twining

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Ordinary digital computers process only one or a few discrete points of data at a time. But the STARAN system combines content addressability with parallel array arithmetic to process hundreds, or even thousands, of data points at once.

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For complete information, just write to Wayne Brubaker, Goodyear Aerospace Corporation, Akron, Ohio 44315. Or call him at (216) 794-3631.

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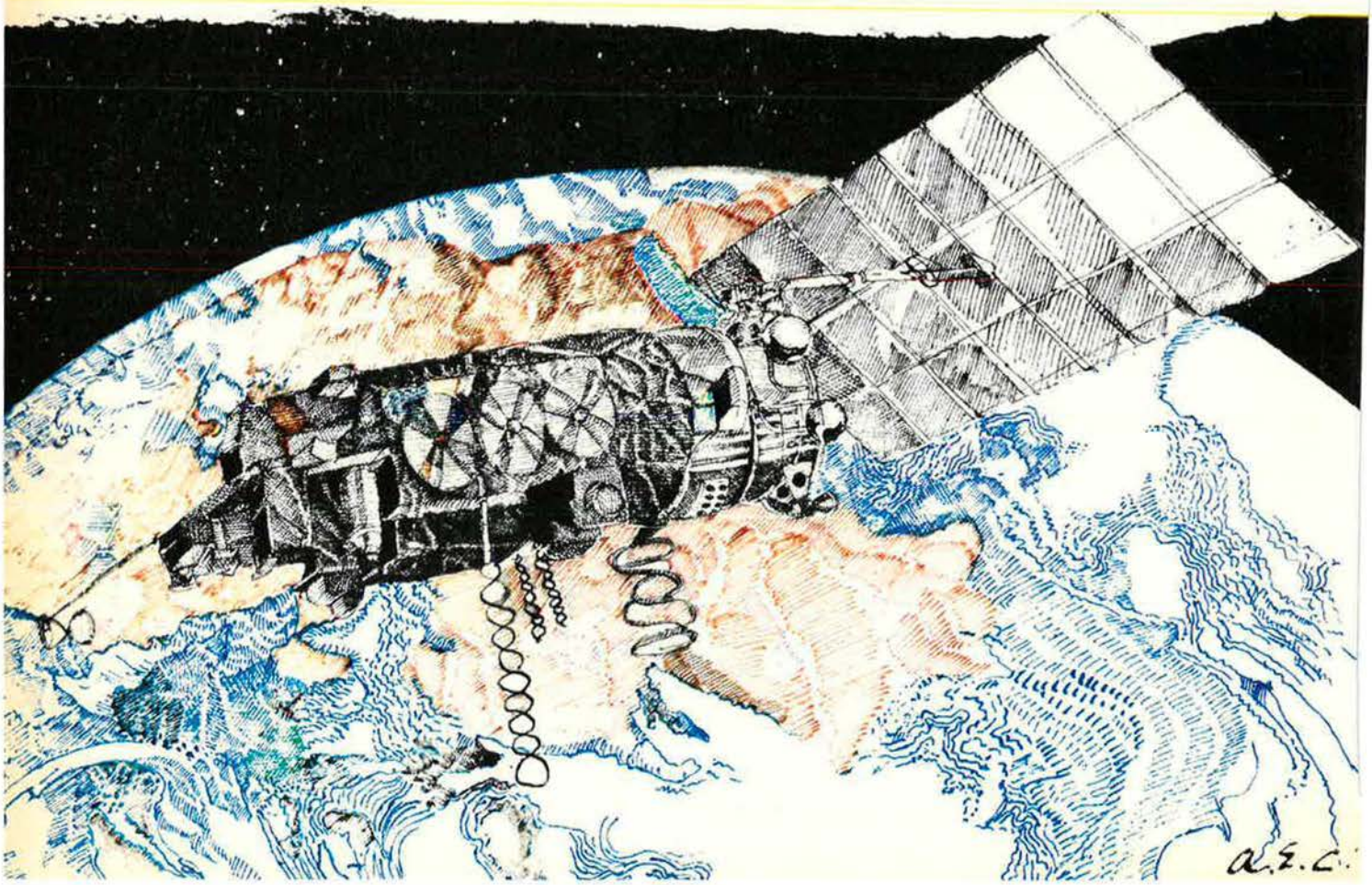

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test program at Edwards AFB, Calif.

Known as the Control Configured Vehicle (CCV), the aircraft is a General Dynamics prototype YF-16 equipped with two canards mounted below its air inlet. These, in conjunction with the plane's other control surfaces, provide direct lift and sideforce control, allowing ascent, descent, and sideway motion without pitch or roll changes.

The YF-16 is regarded as an ideal test bed because it is a high-performance aircraft with a fly-by-wire, computer-directed flight control system compatible with CCV technology.

Aim of the CCV program is to study use of aircraft control surfaces for better performance and less-demanding work load on the pilot, including combat maneuvers not previously possible, USAF said.

End product may be smaller, lighter, less-expensive aircraft with greater combat maneuvering advantages.

Beside the addition of the canards, the CCV's fuel system has also been modified to provide increased in-flight control of the aircraft's center of gravity.

★ In the interests of economy, efficiency, and standardization, four NATO nations—Germany, Denmark, Norway, and the US—have agreed in principle to conduct a joint basic helicopter pilot training project at the US Army's Aviation School, Ft. Rucker, Ala.

The project is the result of a NATO study which concluded that significant savings could be achieved by combining several nations' helicopter training. An additional benefit is the efficiency of the joint use of such modern and

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expensive training devices as flight simulators, officials said.

The course's first students arrived in May.

★ Air Force Logistics Command has set up an Acquisition Logistics Division at Wright-Patterson AFB, Ohio.

Formed from existing AFLC resources, the new organization will aim to expand and strengthen the interfaces between AFLC and Air Force Systems Command "to improve the operational utility, field availability, and supportability of new systems while reducing their operating and support costs," officials said.

The action is seen as underlining USAF's new management policy of considering the total cost of a major system—not only acquisition cost but also all associated O&M (operations and maintenance) costs over the life of the system, known as life-cycle cost.

The Acquisition Logistics Division is staffed by personnel reassigned from within AFLC elements, with no increase in manning spaces. The ALD is headed by Lt. Gen. Bryce Poe II, formerly Vice Commander in Chief, USAFE.

Gen. John D. Ryan, USAF (Ret.), accepts award from Air Academy Superintendent Lt. Gen. James R. Allen at recent ceremonies at the Academy. See news note.

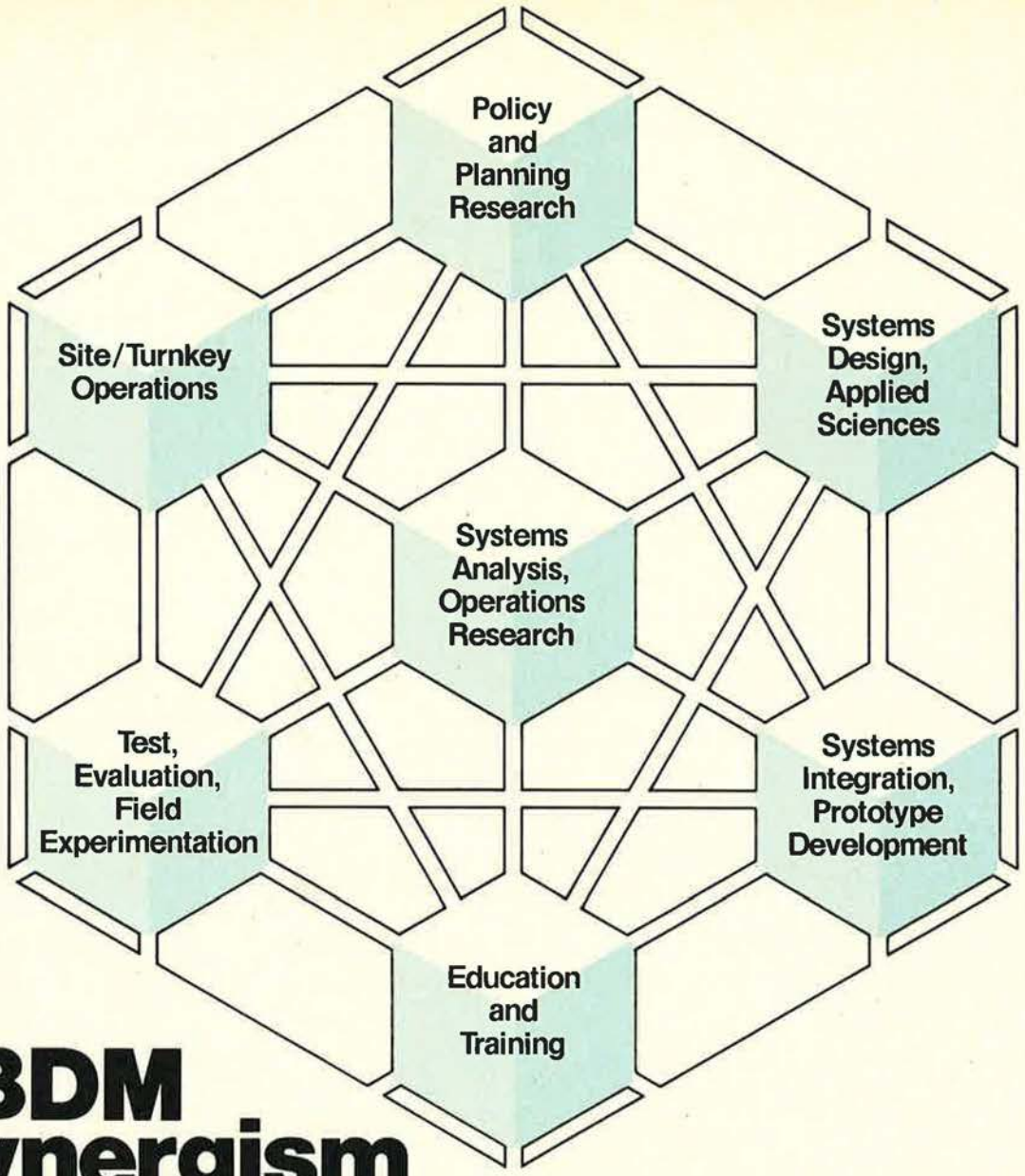
★ **NEWS NOTES**—Former Air Force Chief of Staff **Gen. John D. Ryan** has been awarded the Air Force Academy's 1976 **Thomas D. White National Defense Award.**

Capt. Michael B. Lackey has been presented the **1975 Aviator's Valor Award** for his actions as commander of a CH-53 helicopter during the Mayaguez incident. He performed his mission under intense enemy fire, was able to rescue three downed helicopter crewmen, and flew his crippled aircraft, with wounded aboard, 200 miles to safety. He's currently assigned to TAC's 1st Special Operations Wing, Hurlburt Field, Fla.

The **10th TFS** has been awarded USAFE's **Commander's Trophy** as the outstanding tactical fighter squadron in Europe for 1975.

Late in May, **Marisat-B,** the second maritime communications satellite, was put in equatorial orbit over the Pacific. Full-time commercial voice and data communications via both Marisat satellites is to commence July 1.

A bill has been signed into law creating the post of **science adviser to the President** and creating a presidential committee to undertake a two-year study of the entire federal science, technology, and engineering effort. The committee will be seeking data inputs from the community at large, a White House source said. ■



BDM Synergism

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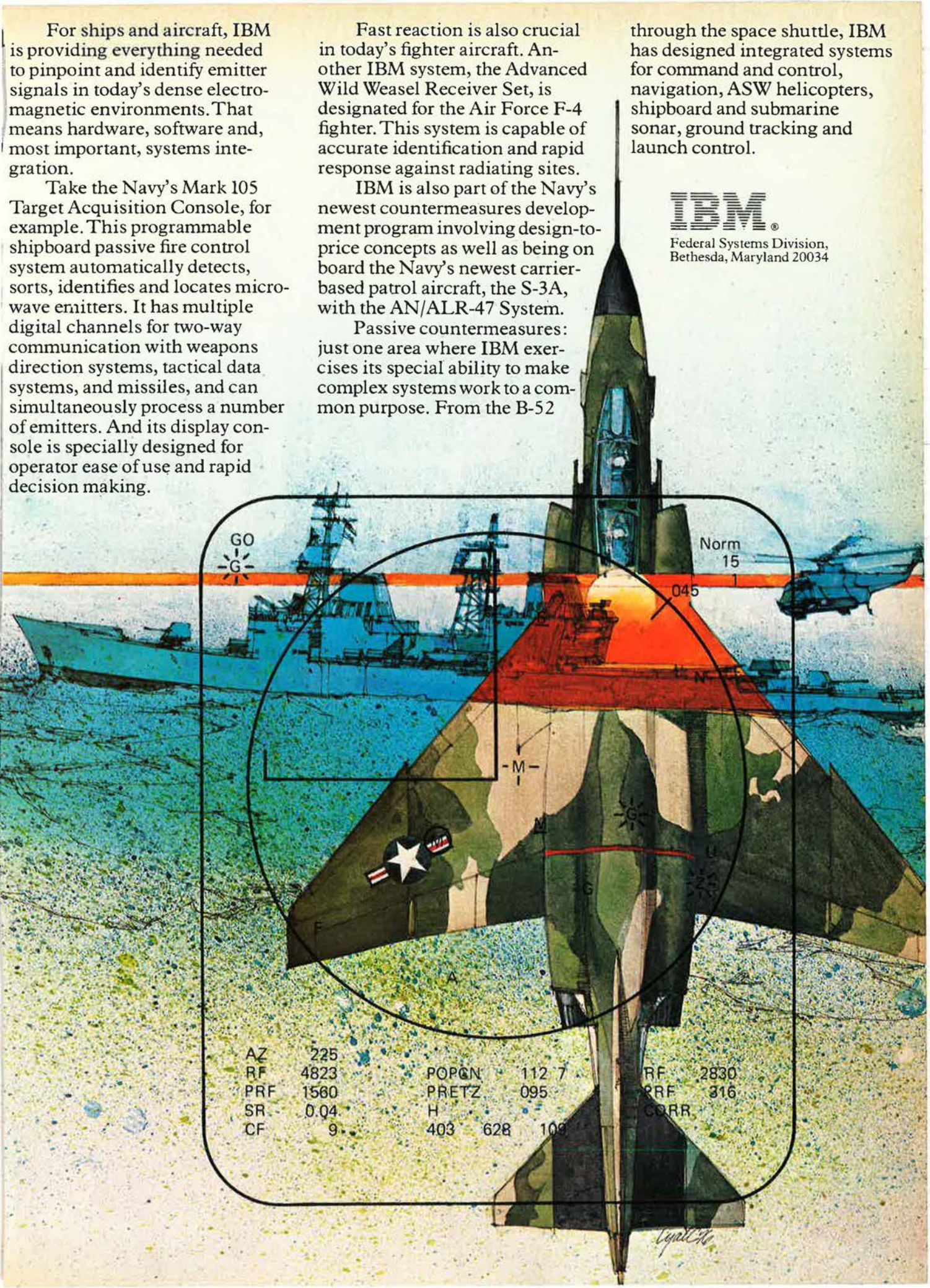


Electronics, having opened the era of "smart weapons" and man's mind with "artificial intelligence," now must measure up to the unforgiving yardsticks of affordability, reliability, and maintainability as applied by the Department of Defense and the US Air Force to all new electronic systems and components.

In the lead article of this special electronics issue of AIR FORCE Magazine, the Pentagon's research chief scans the technological horizon and sees new electronic systems that can

. . . negate optical countermeasures directed against US electro-optical sensors and target designators through multicolor lasers.

. . . implant in optical search and track systems the ability to operate at night through infrared imaging devices of lower cost, weight, and size, but higher performance, thereby making infrared technologies affordable across the spectrum of military tasks.

. . . spot moving ground targets with new pyroelectric imagers that filter out the ground's natural infrared signature and lock onto moving targets.

. . . dramatically reduce the cost, weight, size, and vulnerability of conventional wire cables aboard aircraft through fiber optics—a marriage of laser technology with glass rods that can "bend" light rays.

. . . revolutionize inertial navigation through new laser gyros, having no moving parts, that promise to increase reliability and decrease cost of aircraft and missile guidance.

. . . make possible missiles and RPVs that can "ride the beam" of new millimeter radars to targets concealed by fog, dust, haze, or snow.

. . . economically equip missiles with microcomputer brains, no larger than a paper clip but that can deliver a weapon to its target through terrain-contour matching and permit banking maneuvers previously achievable only in manned aircraft.

THE ELECTRONIC AIR FORCE

AIR FORCE
JULY 1976

ELECTRONICS
KEY MILITARY 'FORCE MULTIPLIER'

BY DR. MALCOLM R. CURRIE
DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

I BELIEVE we are now witnessing still another electronics revolution. Just as the vacuum tube made some electronic operations possible and the transistor really made them practical, I believe the current generation of devices and techniques will make them affordable and reliable. The evidence strongly suggests that we have "turned the corner" on price, reliability, and maintainability and that we stand at the threshold of an era in which the enormous potential of electronics can be realized.

We are already surrounded by a host of new devices and systems that are transitioning from the development stage into common items in the inventory: myriad smart weapons that can find and precisely destroy targets, surveillance systems with a capability to detect and discriminate targets of interest from a world of clutter, aircraft with new aerodynamic capabilities achieved by replacing mechanical controls with digital computer interfaces, and navigation systems capable of giving location with pinpoint accuracy at costs that are impressively low. More will be said about these.

No single idea or development made this possible; rather, many melded technologies contributed. We are proud that the Department of Defense played a key role in the invention and development of almost all of them. Among those disciplines that have made it possible, a few stand out. Certainly, the science of solid-state physics has become a cornerstone of modern electronics. Perhaps another cornerstone is the design computational capability, made possible by modern computers, which allows us to solve extremely complex design problems. Other technologies that are contributing to this revolution include the integrated-circuit realization of solid-state devices, which, via large-scale integration, is making possible microprocessors of extremely small size and extremely large capability, and the capability to efficiently use such microprocessors as a result of advances in the science of digital signal and data processing. Finally, we have combined a number of these building blocks into a new type of system architecture that makes possible built-in test facilities and self-diagnosis, so that our maintenance people not only can cope with such complex systems, but can do so with less training and much greater effectiveness than ever before possible.

"I want to encourage Air Force managers involved in software to apply stronger top-down direction to ensure that software is not developed in a piece-by-piece fashion. We must use the same approach that is used for conventional hardware weapons in establishing appropriate guidelines to incorporate structured programming and tools for each weapon system, in addition to clear cost/schedule estimates and documentation of delivery requirements."

We in the Department of Defense who are responsible for making decisions that will shape our military forces in the 1980s and '90s must come to grips with the challenges and opportunities of many dynamic technologies, of which electronics is only one. We must not only keep abreast of what is going on in these fields, but also assess and project the trends as they may apply to our future national security requirements. This article will present some views on how we are doing and where we are going in the field of aerospace electronics.

It is clear that electronics is already pervasive throughout the spectrum of warfare. Develop-

ments in strategic forces, in command control and communications, and in the revolution of conventional warfare that is occurring during this decade can all be traced in large measure to the impact of electronics. I can see nothing on the horizon that will diminish the future importance of electronics to any element of our deterrent posture. Quite the contrary, we can be confident that electronics will play an increasingly important role in future weaponry, strategy, and tactics.

We must also recognize that electronics is at the heart of whatever technological advantage we now maintain over the Soviet Union. We have no choice but to build on our advantage in electronics and to exploit it to the maximum.

How we exploit it is crucial. The mere possession of advanced technology is not enough. We must do a better job of applying new technology not only to solve near-term problems and to exploit weaknesses in our adversary's forces, but also to force him into competition in areas of our advantage, such as electronics. And once the competition is joined, we must make up our mind to prevail. There is no doubt in my mind that we can prevail.

Keys to Success

There are several keys to success in this kind of competition. First, we must make the necessary investment over the long term. Since continuity is crucial to the development of new technology, our investment must show steady real growth over several years. The FY '77 Defense RDT&E budget and Five-Year Defense Plan are based on providing the necessary real growth in our investment.

Second, we must also be alert—more so than in the past—to the importance of devising innovative uses of our technology in the overall military context. I believe that we must integrate tactical concepts into the earliest stages of the design and development process. We must also pay more attention to how new systems can and will relate to other systems in the context of a particular mission, and to command control and communications in general. This will require a willingness to transcend the current barriers to innovation—tradition, bureaucratic inertia, established roles and missions, and the tendency to project past experiences into a rapidly changing future. I believe that our success in this effort will be as important, perhaps even more important, to the outcome of the future competition with the Soviet Union than the possession of better technology, *per se*.

Third, we must also be alert to opportunities for aggregating existing systems to achieve large, near-term payoffs in a particular mission area. An example is the current work of the Defense Advanced Research Projects Agency (DARPA) and the Navy in the ASW area, which integrates current electronics devices in imaginative ways to seek significant improvements in our capabilities.

"We must also recognize that electronics is at the heart of whatever technological advantage we now maintain over the Soviet Union."

Fourth, we must give greater attention to the use of our advanced technology to multiply the combat effectiveness of our forces. Electronics can make a particularly important contribution in this regard. AWACS, for example, will permit us to employ effectively less sophisticated and less costly systems against the projected threat in Europe. The NAVSTAR Global Positioning System will provide payoffs in navigation and guidance to a wide range of systems. These are but two examples of how we can employ electronics as a "force multiplier" and thereby counter Soviet quantitative advantages in weaponry. The challenge for the future is to multiply this kind of "force multiplier." New electronic systems alone won't do it; we also need good ideas about how to apply electronics.

Finally, we need to concentrate our effort on exploiting our existing technological lead in certain key areas that have enormous future military potential. Space is such an area, and our current lead in space technology is the result of our lead in electronics. I believe we will become even more dependent in the future on our capabilities for surveillance, warning, and command control and communications from space-based systems. Again, how well we exploit the potential of space will depend on our ability to use advanced electronics imaginatively to meet real requirements. And we cannot be comforted by our current lead in space technology. The Soviets understand the future role of space, and have already deployed an impressive global command and control system based on inferior but imaginatively employed technology. The competition is real, in space as in other military environments. We must make up our minds to win that competition.

MAJOR TECHNOLOGY THRUSTS

The pervasive role of electronics in current aerospace systems and the direction toward which we are moving to exploit advanced electronics can best be shown by examining three distinct electronic technologies—electro-optics, radio frequency (RF) and microwaves, and computers—and how each affects a variety of systems.

Electro-Optics Technology

Electro-optics is still an emergent and rapidly growing technology. The revolutionary development of the laser and the evolutionary development of low-cost, compact television cameras have led to the smart bomb and laser-designated precision weapons, which are now familiar. However, electro-optics also includes many other devices, such as infrared imaging devices, charge coupled imagers and signal processors, ring laser gyros, fiber optics, and displays, to name a few. Laser investigations range from very high energy gaseous lasers for fusion to milliwatt semiconductor lasers as optical sources for communication systems.

With respect to **laser designators,** the medium power crystal lasers represented by neodymium-doped YAG have progressed furthest toward operational systems in the form of lightweight target designators and range finders. The Tactical Air Command has three advanced electro-optical target acquisition, tracking, and designation systems under development. The PAVE SPIKE system, when integrated with the F-4's avionics, permits daytime laser designated ordnance delivery by either the designating or other aircraft. The designator pod displays a TV picture in the aircraft's front and rear videoscopes. The TV and laser optics are on a common gimballed mount controlled by the weapons operator. The PAVE TACK infrared imaging system will provide F-4Es and F-111Fs with a day/night, all-weather capability to acquire, track, and designate ground targets with a laser range designator. The system permits the designating aircraft to deliver guided or unguided ordnance, or it can designate targets for other aircraft carrying laser-guided weapons. The PAVE PENNY miniaturized laser search-and-track system will pick up targets illuminated by either an airborne or ground-based forward air controller. The compact system can be used by various combat aircraft, including the A-10 close air-support system.

The designator-ranger technology has matured sufficiently that current efforts are directed at refinements to allow several designators to operate without mutual interference and also to avert simple countermeasures. Frequency diversity in the optical sense of multicolor lasers is also being pursued to optimize performance in certain spectral windows and as a counter-countermeasure against sophisticated optical countermeasures.

Infrared imaging devices, as already mentioned, offer a night-operation capability to optical search and track systems, in addition to improved vision in inclement weather. The technology breakthrough that spawned the current infrared imaging systems was the development and optimization of compound semiconductors having enhanced photoresponse at wavelengths where ground targets radiate thermal energy. These detector materials require cooling, but not nearly as much as the previously available elemental semiconductors. One major thrust has been the application of technology for **cost reduction,** so that we can now afford widespread deployment of infrared imaging devices. In the Modular FLIR (forward-looking infrared) program, considerable advances were made in reducing the cost of the detector arrays, optical system, cooling system, viewers, and power supply. A side benefit has been reduced size and weight. The Modular FLIR is expected to be used, for example, in the above-mentioned PAVE TACK system.

"One major thrust has been the application of technology for cost reduction, so that we can now afford widespread deployment of infrared imaging devices. . . ."

Two other applications of infrared imaging devices are evident in alternative capabilities to the night attack version of the USAF Maverick missile. In the first, a miniature FLIR is used in replacement of the visible imaging devices on the missile. In night tests at Eglin AFB, Fla., three of four infrared imaging Mavericks had successful flights against tank-like targets. The advantage of having a miniature infrared imager in the missile is that any aircraft outfitted to fire the standard daylight TV Maverick can use the IR version without modification or addition of a cockpit-mounted FLIR. In a second version, a FLIR is placed in the aircraft, and a simpler IR seeker is used, together with boresight correlation between the FLIR and seeker. The advantage of this system is lower cost, broader field of view, and higher resolution, the latter two providing improved target acquisition.

One major future thrust for infrared imagers is the development of two-dimensional arrays of infrared detectors, which promise to provide increased sensitivity, reso-

lution, compactness, and reliability. This "focal plane array" is in contrast to the present one-dimensional or linear array of infrared sensors presently used in FLIR systems. A side benefit of an array is the elimination of the rotating mirror that is presently required for image scanning. This is difficult technology since large numbers of detectors are required (more than 100,000), but the use of integrated electronic techniques is expected to provide the needed advances. One direction is to use charge-coupled devices (CCDs) (*see below*), with impurities added to absorb far infrared wavelengths.

A second approach is the use of a pyroelectric detector as a vidicon target, since this eliminates the need for cooling, as compared to long wavelength FLIR imaging. Pyroelectric materials are sensitive only to changes in energy, thereby ignoring the large steady-state background of thermal flux from a scene, and responding only to movement in the scene. Pyroelectric imagers do not yet have the resolution and sensitivity necessary for many military imaging systems, and further improvements are needed, but could provide a low cost option.

With respect to visible sensors, a major advance has been achieved in the development of a miniature solid-state TV camera by using CCDs. This is unique in providing self-scanning of the scene, thereby eliminating the vacuum tube, electron beams, and filament. It contains more than 200,000 detectors in an area the size of one's thumbnail. Apart from its size and reliability advantage, it has exceptional dynamic range (500 to one), greater sensitivity than vidicon tubes for low-light-level viewing, 10 MHz data rates, and digital system compatibility with sampled data outputs. Current technology efforts are directed toward larger arrays to improve resolution, and techniques to extend the long wavelength response. Arrays of 244 x 190 are obtainable today, and progress is rapid toward broadcast-quality TV imaging.

Fiber optics transmission research has accelerated rapidly in the last five years as a result of two significant technological demonstrations in 1970, namely, a room temperature continuous wave (cw) solid-state laser and a fiber wave-guide of less than 20 dB/km attenuation. The laser provides a nearly ideal source for using the fiber as a transmission medium. Since then, fibers with less than 2 dB/km have been made and unique fiber cabling and splicing techniques have been developed to make the fibers a rugged medium for field use. During this time there has been steady progress at improving the reliability of the lasers, and 100,000-hour life has been demonstrated on a laboratory basis. Other laser work has been directed toward varying the alloy composition of the laser material to shift the operating frequency into a wavelength region where the better fibers have minimum loss. By varying the composition of aluminum-gallium-arsenide-antimonide lasers, room temperature cw operation can be adjusted between 1.0 and 1.2 microns wavelengths. Fiber optic "wiring," which will replace conventional wire cables in the A-7 aircraft fire-control demonstration system, will be flight-tested in 1977. These are the first fiber optic hardware items to be MIL qualified. Pressure bulkhead connectors and standard transmitter and receiver modules will be packaged for equipment bulkhead mounting and will use electrical interfaces compatible with standard digital formats at rates to twenty megabits. Fiber optics on the A-7 will potentially lower weight and volume from 200 to 1,000 times, increase reliability, lower initial and life-cycle costs, eliminate radio frequency interference problems, and be less susceptible to battle damage.

"With respect to visible sensors, a major advance has been achieved in the development of a miniature solid-state TV camera by using CCDs."

Ring laser gyros have been and continue to be the subject of intensive research and development efforts. The ring laser gyro has no moving parts in the conventional sense; instead, the measurement of frequency change of the laser beams is used to detect attitude changes. The laser gyro allows fast start-up time and has a great potential for higher reliability due to the lack of conventional moving parts. This will result in reduced support costs with no loss of performance accuracy. The laser gyro will be more resistant to shock, vibration, acceleration, and other demanding requirements of an aircraft or missile environment. Laser gyros will be capable of integration through microprocessor technology into aircraft navigation and control systems. A coordinated Air Force, Navy, and Army program from exploratory through advanced development is in progress. An experimental laser inertial navigator has demonstrated an accuracy of better than one nautical mile per hour of flight time in actual flight tests. This accuracy is equivalent to that achieved with comparable current navigators using more complicated mechanical gyros, and is about ten times better than achieved with previous laser gyro systems. Plans call for flight tests of a completed navigation system in 1978, with production units by 1980.

RF and Microwave Technology

Microwave technology for radar and communications is considerably more mature than electro-optics, but continues to show surprisingly vigorous evolution. First,

the signal-generation function has seen solid-state devices satisfying the low power requirements at frequencies from UHF to millimeter waves through a decade of device discovery and development. Second, there have been major advances in our ability to carry out sophisticated signal processing.

With respect to **solid-state sources,** the discovery of the Gunn and Read effects led to the displacement of low power klystrons entirely within seven years. Presently, Gunn diodes are the preferred choice for local oscillator applications from 5 GHz to 35 GHz because of their low AM and FM noise and convenient operating voltages, typically 12 volts and less. Their efficiency is low, however, being about three percent. IMPATTS at about ten percent efficiency are the choice for most medium power transmitter functions, with Schottky-barrier Read IMPATTS capable of 10 watts of power at 10 GHz with twenty percent efficiency. This performance has made them the leading candidate for the transmitters in solid-state microwave communications links, where sixteen-mile separation between terminals is desired. Present R&D efforts are concerned with gallium arsenide (GaAs) material technology to achieve this performance consistently and reliably.

Gallium arsenide is the material of importance for the latest solid-state power source, the Field Effect Transistor (FET). This device has recently demonstrated an output of more than one watt at 10 GHz, complementing its previously demonstrated low noise characteristics for signal detection. The FET offers the advantage of three terminal amplifier operation, eliminating the circulators needed for two terminal devices such as Gunn and IMPATTS diodes. This saves size, weight, and cost. The other potential advantages are high efficiency (more than thirty percent) and extremely wide bandwidth. For example, amplifiers covering 8 to 18 GHz have recently been demonstrated. This has considerable significance for electronic countermeasures systems where wide bandwidths allow a single jammer hardware configuration to handle many frequency diverse threats through reprogramming of the software. Current research efforts are directed toward GaAs processing to achieve the ability to fabricate integrated circuits. High-yield processes are being pursued so that large-scale integration of FET logic will be practical. The payoff will be in digital circuits capable of extremely fast signal processing.

For fundamental physical reasons, **tubes** continue to supply the high power transmitter sources needed for search, acquisition, and tracking radars. The emphasis has been on increased reliability and lower life-cycle costs.

"An experimental laser inertial navigator has demonstrated an accuracy of better than one nautical mile per hour of flight time in actual flight tests."

Cathode development has reached the point where 30,000-hour life is no longer remarkable. Tube failures now are generally due to reasons other than wear-out mechanisms, particularly for high-power, high-efficiency tubes where a fault in the antenna and other circuitry at the output end of the tube can reflect enough power back into the tube to damage it. Fail-safe circuitry using solid-state microsensors and more rugged thermal designs of the tube structure are being pursued.

A major technology thrust is in **signal processing for ECCM** in both radar and communications. A minirevolution here has been the emergence of surface-wave-acoustic filters and CCD delay lines, allowing sophisticated signal processing to be accomplished in a simple manner, such as bandwidth conversion and signal coding. Computers and microprocessors are also playing an important role in signal processing as the hardware becomes smaller and more cost-effective. The microcomputer technology and CCD technology are being pursued for commercial applications and a large base of development is available from which to branch out into military applications.

The surface wave technology does not enjoy such a commercial following, but fortunately is very similar to large-scale integration (LSI) technology in requiring fine line photolithography and thin film metallization. The military support has been for better acoustic materials, transducer development, and novel circuitry and packaging. An example of the utility of these devices is the use of a CCD as an analog sampled-data processor in a moving target indicator (MTI) radar. In high-performance radars, the MTI function has been performed by converting the analog signals to digital samples that are sent to a shift-register storage to subtract the stationary target data before converting back to analog for display. This process removes the ground clutter, which has a narrow Doppler spectrum, permitting the high-speed targets to be more visible

on the display. The CCD filter can eliminate the complex and expensive analog/digital (A/D) converters entirely, or can reduce their cost by preprocessing the signal so that low bit rate, high-speed A/D converters can be used. The CCD filter samples the analog signal, but does not digitize it. Instead, the samples are stored and processed as discrete analog packets of charge. An advantage—apart from cost—is that a continuous range of amplitudes and large dynamic range are possible. The same function can be performed by acoustic delay lines, but oven control of the delay line temperature is usually required, whereas the CCD filter stability is a function only of the clock rate, which can be made very stable.

An emerging thrust is that of **millimeter (mm) waves,** which refer to wavelengths of one to ten millimeters, or corresponding frequencies of 30 to 300 GHz. Work on mm wave radars for tactical warfare applications is just beginning, although a limited number of space applications and experimental commercial communication links have been used in prior years. The mm wave advantages for tactical applications are that they can provide better focused beams (making them very difficult to jam); provide good resolution; and perform better than lasers in smoke, fog, or clouds. Rain backscatter can obscure targets, but for properly designed systems, rain backscatter is less limiting than attenuation. Fog, dust, haze, or snow have no significant effect on performance. In addition, the small size of mm systems may have lower cost implications, although this is unproven today. The applications for mm radars are target designation, air-to-ground imaging, guidance for beam-riding missiles, and low-angle tracking of surface-hugging missiles and aircraft.

One example of the type of system in exploratory development is the radiometric area correlator (RAC), which is an airborne passive mm wave receiver that exploits the natural mm wave radiation from surface features on the ground to obtain precise position fixes and improve guidance of advanced standoff weapons to their targets. Nonuniform emission from the earth's terrain can be mapped in advance and the data correlated to that observed by the scanning radiometer to update position and velocity data for a low-cost inertial-guidance system.

The Air Force Armaments Laboratory will conduct flight tests of the RAC this year over different regions of the country to accumulate terrain data in a variety of environments. If successful, the system will be very difficult to countermeasure and will operate day and night, in light to moderate rain and cloudy weather—the last being a problem for current infrared radiometric systems. Present technology efforts are directed at improving the noise figure of receivers while condensing their size through the use of microwave integrated circuits. For active radiometers and radars, the IMPATT diode transmitter and Gunn diode local oscillator research is being pushed to even higher powers and frequencies.

"The applications for [millimeter] radars are target designation, air-to-ground imaging, guidance for beam-riding missiles, and low-angle tracking of surface-hugging missiles and aircraft."

Computer Technology

Exploitation of the phenomenal growth of computer science is a major area of technological emphasis within DoD. Given the rapidly decreasing cost of hardware, a number of computer-based research areas offer the potential of providing a major impact on the military systems of the 1980s and 1990s. Major advances in both hardware and software are occurring.

With respect to **hardware,** the major thrust is the development and utilization of microprocessors, which in turn is a result of advances in semiconductor large-scale integration (LSI) technology. These "computers on a chip" are now well known through the popularization of hand-held calculators, which have dropped in price at least by an order of magnitude in the last decade. Here we see an important example of an advance in technology that not only provides improved performance, but increased cost-effectiveness. A single microprocessor, barely larger than a paper clip, can contain several thousand transistors, equivalent to a large rack of instruments just a decade ago. It acts as the central processing (arithmetic) unit, and put together with a solid-state memory and input/output peripherals, one has a microcomputer.

Because of their low cost, compactness, and reliability, microcomputers will revolutionize a variety of functions in missiles and aircraft. For the first time, we are able to develop guidance capabilities in a missile in which mapping information is stored in the computer memory, and sensor information is used through computer correlation to update the gyro controls. This includes radar mapping, passive millimeter wave

information (discussed previously), and terrain contour information. In the previously mentioned non-imaging Maverick system, a microcomputer serves as the brains to provide the bore-sight correlation. One can consider improved missile flight control and agility through banking maneuvers previously achievable only in manned aircraft.

Another important application is in air-to-ground missile target acquisition. For example, in passive IR homing missiles such as in Terminally Guided Sub Missiles (TGSM), one can perform adaptive threshold and adaptive gating processing that enable the missile to distinguish a target from the ground clutter and noise. This could provide the breakthrough required for an effective IR homing air-to-ground missile.

Yet another application of the advances in computer techniques is in digital avionics. Present aircraft can contain as many as a dozen **minicomputers,** handling functions such as navigation, altimetry, fire control, weapon delivery, search, and flight control. The Air Force's Digital Avionics Information System (DAIS) is a test bed to evaluate new systems architecture, in which information is transferred rapidly between the various parts. It includes standardized interfaces, an expandable instruction set, and a common computer language. The results from this program should provide improved system effectiveness, greater reliability, and, perhaps most important, the ability to perform simple "executive" functions with respect to information display. The thrust is to move away from single function displays to multifunction displays in which specialized information, including alphanumeric information, is presented on cue from the pilot or the minicomputer.

The role of microcomputers in avionics will be to provide lower cost, increased flexibility (in terms of modularity), and the addition of new functions such as failure diagnostics and prediction. Microprocessors will reverse the past trend from a large dedicated system to a distributed processing system. Microcomputers would be linked directly to many instruments, and the resultant signals then sent to a central unit that would provide the "management" function. They will also hasten the trend to multifunction computer control and displays, and are expected to impact programs such as DAIS.

In addition to research aimed at **developing** better computer hardware, DoD is also placing increasing emphasis on **using** our hardware capabilities more effectively, primarily through software improvements. In fact, DoD spends an estimated $3 billion annually on software-related problems. Accordingly, a major object is to reduce these costs, and there are three major thrusts here.

The first is the development of a minimum number of higher order computer languages (HOLs) that will fit the broad requirements of the three services. At present, each new weapon system tends to be accompanied by a new language, or new dialect to an existing language, and this proliferation causes considerable duplication in software efforts. Instead, a tri-service program has been initiated to develop a standard HOL with the requisite flexibility, transferability, and consistency from system to system.

Dr. Malcolm R. Currie assumed the office of Director of Defense Research and Engineering in June 1973, following a brilliant career in electronics research and development. A Ph.D. (EE) (University of California, Berkeley), Dr. Currie, who is the holder of many patents, served as Corporate Vice President and General Manager of the Hughes Aircraft Company's Research and Development Division and as Vice President of Research and Development of Beckman Instruments, Inc.

The second concerns the use of HOLs, in particular the achievement of a useful structure. Here the concept of modularity enters, to allow parts of a program to be interdependent and autonomous.

The third is to provide tools for the software engineer to increase his productivity. Much of the software costs come after the program is structured, in making subroutines fit together and work in an optimal fashion. This would include incorporating both hardware and software to provide the needed diagnostics, verification, and validation.

I want to encourage Air Force managers involved in software to apply stronger top-down direction to ensure that software is not developed in a piece-by-piece fashion. We must use the same approach that is used for conventional hardware weapons in establishing appropriate guidelines to incorporate structured programming and tools for each weapon system, in addition to clear cost/schedule estimates and documentation of delivery requirements.

Conclusion

Electronics will continue to play a crucial role in the evolution of our future military capabilities. It has already given us spectacular advancement in performance at a continually decreasing cost. It has also provided astonishing improvements in reliability. The accomplishments have been revolutionary and the promise of electronics in the future is still enormous.

It is one of our great strengths. Whether we exploit its potential properly depends upon maintaining the momentum we have built and developing innovative uses of the opportunities this momentum will provide. There is no greater challenge in technology today, and our success in meeting this challenge will affect our security into the twenty-first century. ■

THE ELECTRONIC AIR FORCE

ELECTRONICS, PIVOT OF USAF'S TECHNOLOGICAL STRENGTH

BY EDGAR ULSAMER, SENIOR EDITOR

Avionics, electronic warfare, and command control and communications systems are the Air Force's principal users of electronics. The following article deals with new electronic technology under development by AFSC's Aeronautical Systems Division, and with the RDT&E and acquisition programs of AFSC's Electronic Systems Division.

In a purely statistical context, the importance of electronics to the Air Force is electrifying: USAF's $14 billion worth of electronics represents about one-third the total value of its weapons and equipment inventory. In the last analysis, of course, without electronics the Air Force could neither fly nor fight. In order to see, to command, to communicate, to compute, to guide, to detect, and to do all the other jobs that combine to make up the Air Force mission, electronic capability is quintessential.

USAF's reliance on electronics —like that of the other services and of its potential adversaries— is nearly total; the consensus among Air Force planners and managers is that this dependence will intensify sharply. The increasing external threat and internal economic pressures resulting from rising personnel costs require weapon systems and equipment that are more efficient and can function more automatically, with less manpower and maintenance than past designs.

A NEW ERA IN ELECTRONIC WARFARE

USAF's dependence on electronics is epitomized by the interrelated and, in terms of both operations and design, usually integrated areas of offensive avionics, defensive avionics, and electronic warfare. Combined, these functions absorb about two-thirds of USAF's investment in electronics. The purpose of offensive avionics, in simplified terms, is to guide an aircraft or missile to its destination and to deliver its weapons (or warhead) with maximum accuracy on targets that may be known in advance or that have to be detected, tracked, designated, and homed in on. Conversely, defensive avionics are designed to reduce or nullify counteraction by the enemy.

Sitting astride both functions is electronic warfare (EW), an omnibus term encompassing tactics and hardware to safeguard the user's activities in the electromagnetic spectrum while impeding those of the enemy. EW's three principal components are electronic warfare support measures, electronic countermeasures (ECM), and electronic counter countermeasures (ECCM). The support measures consist mainly of electronic intelligence (ELINT) and communications intelligence (COMINT). ECM seeks to blind, deceive, or overload the enemy's electromagnetic activities, while ECCM, in turn, combats the enemy's ECM.

Much, but by no means all, of the Air Force's EW research and development and acquisition are carried out under the aegis of the Deputy for Aeronautical Equipment at AFSC's Aeronautical Systems Division. Air Force funding for EW systems in FY '77, not counting the substantial EW investments in the B-1 and F-15 programs, is expected to be close to $400 million.

Major Program Milestones

Several major EW milestones should be reached this year, according to Col. Francis P. Dube, who directs the Deputy's EW programs. The decision to enter the F-4G Advanced Wild Weasel into production is expected to take place in the near future, perhaps as early as this summer. This program consists of adding sophisticated electronic warfare capabilities to 116 F-4E aircraft at an estimated cost of about $250 million. (*See February '76 issue, p. 27.*) A follow-on to the F-105 Wild Weasel, the F-4G will detect ground-based threats to a pene-

trating strike force, sort out the most acute dangers, and destroy or suppress them with ordnance ranging from the CBU Rockeye area weapon to various antiradiation missiles.

The F-4G's effectiveness would gain from, but is not dependent on, AGM-88 HARM, the high-speed antiradiation missile under development by the US Navy for joint service use. This system probably will enter preproduction this year. Establishing compatibility, especially in the system's software, between the differing requirements of the two services is progressing well, according to Air Force sources.

Closely linked to the F-4G in an operational sense is the Tactical Electronic Reconnaissance (TEREC) system, which is expected to enter production this year. Basically a modification of the RF-4C, TEREC locates and "fingerprints" threat radars for both peacetime and wartime ELINT. The system can be data-linked to ground stations to provide tactical air commanders real-time information about hostile radar systems, either from a standoff position or while penetrating with a strike force. TEREC is scheduled to complete flight testing this fall and, if subsequently put into production, is to be deployed on eighteen RF-4Cs.

"Smart" ECM Systems

Possibly one of the most significant EW advances this year could be a production decision on the new generation ALQ-131 ECM system, the first operational ECM pod representative of what USAF planners predict will grow into a wave of power-managed, "smart" electronic systems. The advantages to the aircrew of the new ECM system, developed by Westinghouse, are major and broad. Once the system has been turned on, the pilot doesn't have to make adjustments or worry about responding to threat radars; the ALQ-131 will be developed to do the countermeasures job without operator assistance. At the same time, the ALQ-131 indicates to the pilot its operating status, including malfunctions, in various frequency bands. A go/no-go indicator controlled by the system's self-test circuitry gives the pilot confidence that his ECM protection is working, autonomously and continuously.

The concept of power management in EW systems is of pervasive impact to both strategic and tactical weapon systems. (The B-1 is to be equipped with a sophisticated power-managed frequency surveillance/ECM system currently under development by the AIL Division of Cutler-Hammer in conjunction with Northrop, Sedco, and Litton. A similar capability is being developed and produced for the F-15.) The need for such systems stems from the fact that aircraft penetrating the airspace of a technologically sophisticated enemy invariably are "outnumbered" in terms of ECM; they will be confronted by more air defense radars and SAMs than they have jammers, and the power driving the defender's sensors will far exceed the jamming power available to the penetrators. Power-managed or "smart" ECM systems, according to Brig. Gen. G. K. Patterson, ASD's Deputy for Aeronautical Equipment, compensate for the brute-force advantage of the ground-based threats by focusing all available energy "against the most immediate threat rather than dissipating it all across the electromagnetic landscape."

Smart ECM systems diagnose threats as they are encountered, establish priorities for dealing with the most acute ones, adapt the jammers to the characteristics of the threat through an intricate sequence of actions controlled by an onboard computer system, and determine and start whatever specific jamming action—spot noise, cover pulse, inverse gain, etc.—is most effective. The system operates in a digital mode and—in the case of the B-1—uses "agile," or steerable, antennas to pump out jamming energy in a specific narrow bandwidth focused against a specific threat.

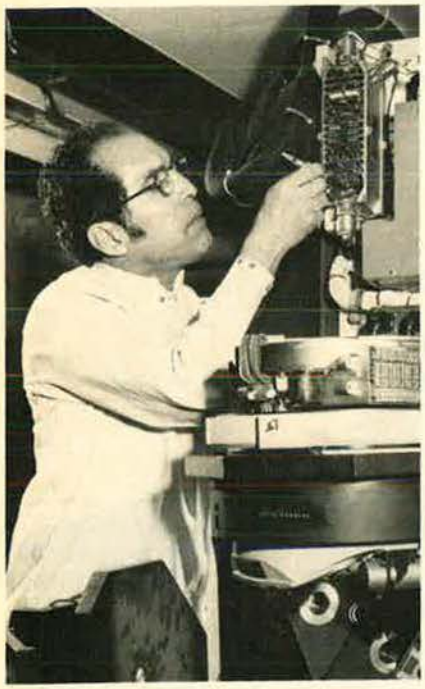
The principle of smart ECM systems is simpler than its technical execution, which requires extensive real-time data processing, considerable memory capacity to store information about various threat features, and a meticulous

ASD's System Program Director for the EF-111A, Col. Larry McKenna (left), and Grumman test pilot Chuck Sewell prior to test flight in aircraft with radome mounted underneath.

software structure. General Patterson described how a power management system might function against a SAM threat. After detecting tracking energy emitted by a hostile radar, the ECM system either remains in a "wait-and-see" condition until it detects a command guidance signal steering the SAM in its direction or immediately starts jamming the tracking radar. The choice is mission programmable. "Throughout the process, the system spares the pilot all information he doesn't need, so he can concentrate on doing his primary job."

Operational Flexibility

The ALQ-131 pod system, according to Colonel Dube, offers "unprecedented flexibility" because its software is reprogrammable and its design modular.



B-1's FLIR, built by Hughes, provides TV-like image of terrain day or night, in almost any weather condition.

Tactical air commanders will have the option to tailor its capability against known threats in the target area on a selective basis or provide it with enough flexibility to handle new threats as they are encountered. The addition of a ram air turbine generator makes it possible to operate the pod independent of aircraft power.

With the ALQ-131 installed on the aircraft, "we have demonstrated that we can put in a completely new software program in fifteen minutes," Colonel Dube told AIR FORCE Magazine. Assuming that a production decision is made on schedule, present plans call for the acquisition of about 150 ALQ-131 systems within two years thereafter. The first using aircraft is to be the F-4, but the F-16, A-7, A-10, and possibly the F-15 and F-111 are also candidates. Also, where the F-15 is concerned, the ALQ-131 could complement the ALQ-135, an internally carried fully automatic and reprogrammable system that covers a different frequency range. Under certain circumstances, it would be beneficial to have the option of using one or the other system, he explained.

Two areas of pervasive importance to all Air Force EW work, according to General Patterson, are simplification and standardization of system software and allowance for ECCM concurrent with the design of ECM systems. With the US selling a range of offensive systems, such as radars and missiles, to many countries, it is only prudent to assume that some of these systems might be used against the US forces. For that reason, system designers need to worry about effective ECM at the "same time that we develop the ECCM capabilities of these weapons," he said.

Software continues to be the Air Force's largest single investment for all systems controlled by computers and processors. A major advance in controlling the software problem is creation of an EW Software Center at the Warner Robins Air Logistics Center in Georgia to exercise Air Force-wide configuration control. Now in early development, the Center eventually will be staffed by some 130 experts working closely with all user commands.

Tactical Warning Systems

Another area of the EW field marked by advance and innovation this fiscal year involves a variety of warning systems, including both infrared (IR) and radar designs. The Air Force plans to make source selections during FY '77 for a lightweight, low-cost IR warning system and a pulse Doppler tail warning system for the B-52 that may also be used on the F-15. The Doppler tail warning system is in prototype state, with AIL and Westinghouse entries in competition. The IR system is to be used by helicopters and the C-130s. Also, the first ALE-40 chaff/flare-dispensing system, an important new countermeasure to thwart IR and radar seekers, will come off the production line this summer and is to be used on F-4 aircraft. For the time being, it will be operated manually by the pilot. Eventually, this equipment may also be installed on such aircraft as the A-10 and F-16 to supplement the self-protection provided by ECM pods.

The ALE-40 system, especially its flare-dispensing component, is also under consideration for a direct tie-in with Doppler tail warning systems. "We plan on linking the radar tail warning system to an automatic flare dispenser on both the B-52 and F-15," according to General Patterson. "Tripping flares automatically in the case of a tail chase when the pilot's hands are full and his reaction time is limited can be invaluable. In the past, we have had problems with false alarms, but the new design includes a time delay and an arrangement whereby the warning system 'votes' on whether there is an actual threat before IR countermeasures are activated."

"Pyrophorics" is a project to improve current flare technology, which now is handicapped by the inadequacies of standard pyrotechnic devices. High-intensity, rapidly igniting flares that more closely match the IR spectrum of aircraft engine exhausts are un-

Mockup of B-1's offensive avionics station shows multifunction displays for FLIR as well as alphanumeric data, with round screen below the display for forward-looking radar.

dergoing tests at Eglin AFB, Fla.

Another warning system slated for production this year is the ALR-62 radar warning receiver that, along with the internally installed ALQ-137 ECM repeater system, modernizes the F/FB-111s' EW capabilities. The ALQ-137 provides threat warning, identification, and azimuth information, and permits frequency extension, digital processing, and software reprogramming. The ALQ-137 will provide full hemispheric coverage and power distribution.

Other EW Systems

One of USAF's potentially most important EW systems is the EF-111A Tactical Jamming Aircraft, a high-performance replacement for the EB-66 that provided jamming support during the Southeast Asian war. Now about halfway through its thirty-eight-month prototype development phase, this program entails the modification of F-111A aircraft in USAF's inventory to perform penetration, close support, and standoff jamming with an improved version of the ALQ-99 jamming subsystem designed for the US Navy's EA-6B. Two prototypes are being developed by Grumman Aerospace Corp. as part of this $117 million RDT&E program. The updated jamming subsystem is carried internally and was modified to provide "frequency agility" to cope with a broad range of existing and projected EW threats.

An important ancillary role of the EF-111A is training tactical aircrews in ECCM operations, where effectiveness is largely dependent on the skills and expertise of the user. By replicating the effects of hostile ECM, the EF-111A will serve as a unique training tool for aircrews without combat experience in jammed airspace.

Under the heading of *improved tactical bombing,* the Air Force is pursuing several projects to achieve an around-the-clock adverse weather attack capability and to extend the so-called smart weapons technology into new fields. A pivotal effort is PAVE TACK, a podded FLIR (forward-looking IR) sensor and laser designator for use on the F-4E and RF-4C, with an internally carried version for the F-111. The system's distinguishing feature is that targets can be viewed on the FLIR display in fine detail to make possible accurate designation by laser. Flyoff of competitive FLIR systems began in May of this year. Completion of the F-4E/RF-4C flight test is expected by November 1976, to be followed by a production decision a month later. PAVE TACK/F-111F testing will continue through December 1977. The use of the system on board the A-10 is under study and may lead to flight test toward the end of 1977, according to General Patterson.

PAVE SPIKE, an Air Force program of high potential payoff in battlefield interdiction, involves developing a laser-guided attack capability for the F-4 and such single-seat aircraft as the A-10, F-15, and F-16. When integrated with the F-4's avionics, PAVE SPIKE, using common optics for both its TV and laser components, permits laser designated ordnance delivery by either the designating or other aircraft. The weapon system operator acquires and tracks targets on his videoscope and designates them with a modified

F-4G Wild Weasel, shown here at McDonnell Douglas facility, is currently in flight test. Pod under the nose and pod on the top of tail are added to standard F-4E.

radar hand control. The Air Force is buying 156 systems, with delivery to be completed by the end of this year.

A third system to improve USAF's tactical bombing capability is PAVE PENNY, a miniaturized laser search-and-track system that can be used by day or night to pick up targets illuminated by either an airborne or ground-based forward air controller. The A-10 close air support aircraft is the principal candidate for this system. The system's designator gives the pilot a headup display and can be integrated with the aircraft's weapons release system or used to cue other types of guided weapons.

An area of EW still in a formative state is the development of countermeasures other than camouflage against electro-optical weapons. The basic objective is to deny the enemy use of his TV and other electro-optical trackers by saturating his sensors, possibly with laser energy. Even less fully defined are means of combating future laser weapons except for the obvious initial requirement for detectors that warn USAF aircraft before they come within the effective range of such weapons.

Another electronics effort in an early exploratory state is the RF-X project, centered on the development of a sophisticated avionics package for an advanced recce/strike fighter that might be required a decade hence, General Patterson told AIR FORCE Magazine. Known as the all-weather tactical strike system (AWTSS), this research project is keyed toward comprehensive advances in radar technology such as synthetic aperture systems to achieve a multimode capability, and "to tie the entire battlefield together in terms of C^3," he said. The F-15 is among the leading candidates for the RF-X mission, he added. AWTSS also might be used in such single-seat aircraft as the F-16 and A-10, to give them comprehensive day/night/weather capabilities, according to General Patterson.

New Avionics Programs

Boeing-Wichita, under Air Force contract, is studying possible systems architectures of new low-cost, highly reliable avionics for large aircraft, especially the B-52 and KC-135 fleets, according to General Patterson. While there now is no stated requirement for such a system aboard the B-1, it could be incorporated into the proposed new bomber's offensive avionics package later on. Upon completion of this study, the Air Force plans to formulate the specifications for a prototype system tailored principally to the B-52G/H bomber fleet. Prototype flight testing might begin within about two years.

There are several reasons for this avionics improvement program that is to be retrofitted to all B-52Gs and Hs by the mid-1980s, according to General Patterson. The offensive avionics and navigation systems of the B-52 were designed in the early 1950s and, with the exception of minor changes, have been in operation ever since. The absence of modern avionics systems limits the potential of the B-52, which remains structurally sound and will be in USAF's inventory into the 1990s. The update program will yield greater navigational accuracy, more effective use of the nuclear-armed SRAM missile (whose inherent high accuracy is reduced because B-52 systems can't provide enough precise position information at the time of launch), and lower operating costs through increased maintainability and reliability. If, as the Air Force plans, the new avionics are used also by the KC-135 tankers, aerial refueling rendezvousing will be facilitated. Crew work load aboard all using aircraft could be reduced, with a cut in crew size possible. USAF's proposed Advanced Tanker/Cargo Aircraft (ATCA) is another candidate for this system.

Potentially the most innovative avionics program of the Air Force is DAIS, the Digital Avionics Information System under development by Hughes Aircraft Co., Westinghouse Electric Corp., IBM Corp., and Intermetrics, Inc., of Cambridge, Mass. DAIS organizes all aircraft avionics functions, from navigation to stores management and weapons delivery, around common computer modules that handle information from the various sensors, make computations, and display necessary information to the pilot at one central location. All information is handled in digital form and transferred within the aircraft over a common multiplex "bus." Managed by the Air Force Avionics Laboratory, DAIS is to enter limited hardware demonstration by the end of 1977. The system's revolutionary aspects are reduced crew work load, high-performance avionics at much lower cost, and easy linkup with other digital systems to share vital combat information, from ground threats to target designation.

USAF's surging concern with avionics capability, according to Colonel Dube, creates new challenges for electronic systems designers: "The Southeast Asian and Yom Kippur wars brought EW into its own. We must sustain this momentum toward EW credibility by turning over to the operating commands not only systems that do the job but that are also reliable and maintainable, even though the requirement for ever-increasing sophistication makes that difficult. The first order of business is to get away from the Southeast Asian war syndrome of building EW systems in a hurry. Our emphasis now must be on reliability, maintainability, lower life-cycle costs, and standardization."

AFSC'S ELECTRONIC SYSTEMS DIVISION (ESD)

ESD, the Air Force Systems Command's Electronic Systems Division at Hanscom AFB, Mass., is a thriving, booming business, with an annual budget of about $2 billion. Its charter extends from planning, developing, and acquiring USAF's command control and communications (C^3) systems to pioneering research in electronics technology that can boost the cost-effectiveness of future weapon systems.

There is palpable evidence of ESD's growing importance as USAF's focal point for the development and acquisition of command control and communications systems. Its commander and vice commander have been elevated to three-star and two-star rank respectively. The Rome, N. Y., Air Development Center, which absorbed a portion of the defunct Cambridge Research Laboratory—renamed Deputate for Electronics Technology—now reports to the ESD commander. The result, Lt. Gen. W. L. Creech, ESD Commander, told AIR FORCE Magazine, is "that we became a product division with our own research organization, giving us the advantage of moving programs from initial R&D through to operational systems in the field."

ESD Commander Lt. Gen. W. L. Creech strives for affordability, reliability, and survivability in USAF's electronic systems.

ESD's prime focus is on developing and providing the Air Force and other DoD users with electronic systems that are affordable and reliable, traits that, taken separately, modern technology can furnish readily but are hard to come by in combination, according to General Creech. The electronics in USAF's space systems have proved their broad reliability, including the ability to function unattended for years, to incorporate survivability and jam resistance, and, in some cases, even to be "self-healing." This kind of reliability, however, is expensive, often prohibitively so.

Affordability, in ESD's lexicon, means maximum reliability at minimum life-cycle cost, a goal attainable only through concerted efforts by USAF and industry, including providing incentives to industry through such devices as RIW (reliability improvement warranties, developed by the commercial aviation community). Industry, General Creech conceded, is guarded in its reaction to RIWs for government contracts "because they haven't yet worked out the ramifications of applying this new approach to military systems, where both the market dynamics and the numbers are far more limited than in the commercial field." ESD, through a special, dedicated branch of Rome Air Development Center, is pursuing the development of reliable, low-cost electronics, and "cataloging potentially promising technologies to foster and encourage emphasis by industry on this vital area," the ESD Commander told AIR FORCE Magazine.

Among promising techniques to provide highly reliable, economical electronics are fiber optics, in General Creech's view. This technique exploits the inherent advantages of laser communications—the ability to transmit information at a thousand times the rate of conventional means without the normally associated penalties of only line-of-sight transmission and atmospheric or other interference. Compared to transmitting information by wire, fiber optics offer sharp weight reduction, much lower cost, the option of high invulnerability through redundancy, and markedly improved reliability. The underlying principle is that light waves, which normally travel in straight lines, may be transmitted through glass rods (called fiber optics), even though the rods are curved or twisted. Widespread use of fiber optics may be several years away because of the difficulty of mass producing "pure" glass fibers. Even minute impurities can cause severe energy loss.

A second key area of concern to USAF's electronic systems designers centers on reducing the number of people required to perform USAF's mission, General Creech said. Involved is the two-fold task of designing new systems that require few if any operators (such as closed-loop or unattended systems) and of performing routine jobs electronically. Again, reliability and affordability are of overriding importance.

An important ESD program typifies the command's "labor-saving" efforts. The 485L Tactical Air Control Centers (TACC) automation program, under test at Langley AFB, Va., replaces batteries of human plotters operating with earphones, manual files, and displays, and requiring up to thirty minutes to prepare mission reports and reaction orders. The TACC computer-controlled group display

operated by one person can do the same job in less than a minute. Mission reports can now be transmitted rapidly to other tactical air control elements via digital data links.

The increasing trend toward computer networks and time-sharing on large general-purpose computers is posing a security problem of major concern to the Defense Department and the Air Force. Means to secure information available in such networks are being developed by ESD and its contractors, General Creech told AIR FORCE Magazine. The magnitude of the problem is being demonstrated graphically by ESD's "tiger team," officers from the Command and Management Systems Deputate and MITRE computer experts, who have broken several allegedly secure computer programs. Computer security is not confined to the military; it also involves unauthorized access to commercial computer systems leading to losses by financial institutions that amount to many millions of dollars.

Far more consequential would be unauthorized, hostile access to such national C^3 systems as the Strategic Air Command Total Information Network, Air Force Satellite Communications (AFSATCOM II), and the E-4 airborne command post, under development by ESD. In 1971, the command started work on a multilevel security system that eventually will process simultaneously several levels of information—from unclassified to top secret—and regulate access correspondingly and in consonance with Air Force security standards. An important first step toward this goal is the development of secure military minicomputers by Honeywell, under ESD contract, for potential use in C^3 systems, as well as a device called "security kernel," a combination of hardware and software to control access to information within a computer system. The latter was developed by ESD in conjunction with the MITRE Corporation and is expected to complete its test and verification cycle late this year.

The E-4 Airborne Command Post

One of ESD's most important C^3 programs is the E-4 airborne command post fleet of modified Boeing 747 aircraft that provide the National Command Authorities (NCA) and Strategic Air Command with a highly survivable command and control system. Restructured last year because of rising costs, the R&D phase of the program was slowed down, programmed size of the E-4 fleet reduced from seven to six aircraft, and operational responsibility for all aircraft assigned to SAC. Andrews AFB, Md., serves as the forward operating base of those E-4s assigned to the NCA as National Emergency Airborne Command Posts (NEACPs), with Hq. SAC acting as the single manager for these as well as its own E-4 aircraft.

The E-4 is being developed in stages, beginning with three "A" models that are in the operational inventory and serve as interim NEACPs. These aircraft incorporate the C^3 packages removed from phased-out EC-135s. E-Systems was the prime contractor for this part of the E-4 program. Compared to EC-135s, the E-4s have substantially increased communications capability, enhanced hardness, increased endurance, and have a much larger battle staff area. The final E-4s, designated as E-4Bs, will be equipped with both SHF (super high frequency) and UHF (ultra high frequency) communications equipment to provide secure voice and data communications via the satellites of the Defense Communications System, and to maintain survivable communications with the nation's nuclear forces. The aircraft should have a useful life of about twenty-five years, according to DoD, and during that period "we anticipate modification and modernization as new technology needed to support our national policy becomes available."

Experience gained from the operation of the three interim NEACP E-4s is reflected in the design of an advanced C^3 package that is being developed and installed on a fourth test-bed aircraft. The first fully equipped E-4B is expected to become operational late in 1979. In the following year, two additional 747s are to be purchased. These aircraft and the three that now serve as interim NEACPs will then be equipped with the advanced C^3 package, which should be completed by 1983. All aircraft are being modified for air-to-air refueling. Total cost of the program up to 1983 is expected to be about $880 million. Boeing is the prime contractor for the E-4B. A follow-on phase of the E-4 program that includes even more sophisticated equipment emphasizing automatic data processing has been "reassessed and slowed in keeping with congressional guidance," according to DoD's congressional testimony.

Composition and scope of the E-4's automatic data processing equipment (ADP)—essentially determined by the nature of onboard computer systems and the associated data storage, and its link to WWMCCS, the World Wide Military Command and Control System—have been under study by the Defense Department and the NCA for several years. Among the questions that remain unanswered, General Creech said, is the primal issue of "What do we want from the machine on the airplane? The automatic data-processing alternatives being studied range from basic to complex approaches. The simplest and least costly approach would allow individual E-4B battle staff members to receive data through communications and to view them on remote display devices mounted on their work consoles. This data could then be stored in the E-4B onboard computer for retrieval and use, as needed. This boils down to an automated way of keeping your onboard file."

The more complex approach involves integrating the communications processor with a separate data processor. This arrangement, in addition to performing the func-

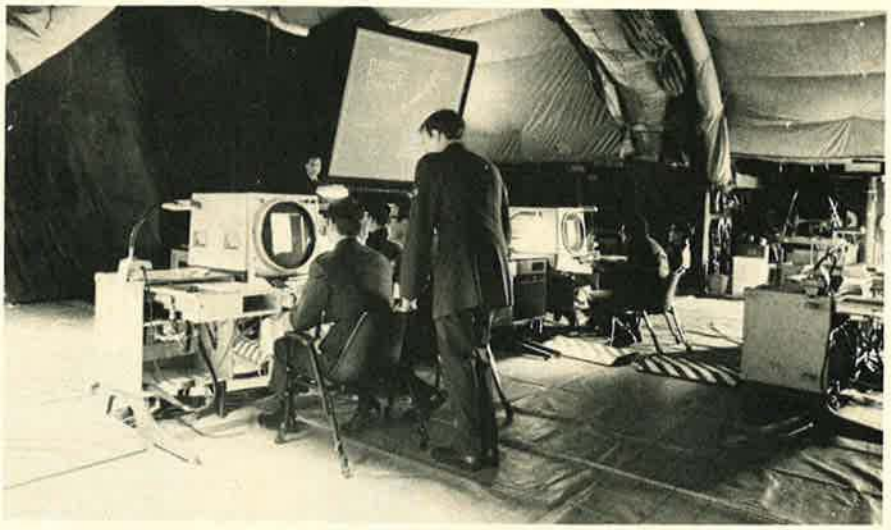
tions of the simpler system, would allow direct update of the onboard ADP data base through computer netting and have sufficient capacity and capability to permit successful independent accomplishment of critical operations if access were lost to data in the ground computers, he said.

"Our key concern in shaping the E-4's ADP system, just as in the case of all C^3 systems," is to achieve a degree of survivability that will prevent command control from becoming the Achilles' heel of national deterrence, the ESD Commander said.

SAC's New Survivable C^3 System

Tied to the E-4's other role as SAC's new "Looking Glass" flying command post is another major ESD development, the $270 million Strategic Air Command Automated Total Information Network (SATIN IV). By the early 1980s, it will replace the communications portion of the 465L C^3 system, which is based on technology of the 1950s, according to General Creech. In a planning state since 1968, SATIN IV now is in source selection, with the winning contractor to be named within two months. (The Air Force will neither confirm nor deny unofficial reports that the competitors who answered USAF's requests for proposals are Boeing, ITT, GTE Sylvania, and Computer Sciences.)

The purpose of SATIN IV, according to Col. Wesley D. Woodruff, Program Director, is to furnish, under transattack and postattack conditions, "highly responsive, functionally survivable, and secure communications" between CINCSAC, the NCA, and SAC missile and bomber/tanker command posts. In effect, SATIN IV functions as a vital subsystem of WWMCCS, with near real-time access to the latter's computers.



ESD's transportable, computer-controlled display consoles and area viewing screen, enclosed in inflatable shelters, will facilitate tactical aircraft control.

SATIN IV consists of five principal nodes, or subnet communications processors, located at four principal SAC bases (Offutt, March, Barksdale, and Grand Forks) and the alternate National Military Command Center at Ft. Ritchie, Md. Two other categories of nodes will have less equipment and capability. One category includes all SAC missile and bomber/tanker command posts and another involves the ICBM Launch Control Centers. The latter include sixteen key tie-ins with the Minuteman III's Command Data Buffer system, which permits rapid change in target assignments. SATIN IV can act as a damage-assessment system since terminals that drop out can be presumed destroyed.

SATIN IV will be deployed in hardened sites and have protection against electromagnetic pulse (EMP, generated by the detonation of nuclear weapons) built into its computers, communications terminals, printers, displays, and other ancillary systems. The equipment hardness standards match those of the Minuteman capsule, except for the landline communications subnets that work through DoD's AUTOVON system whose enormous redundancy automatically provides a high degree of survivability. SATIN IV's linkages with the E-4, while planned in principle, can't be developed fully until the latter's ADP features are decided upon.

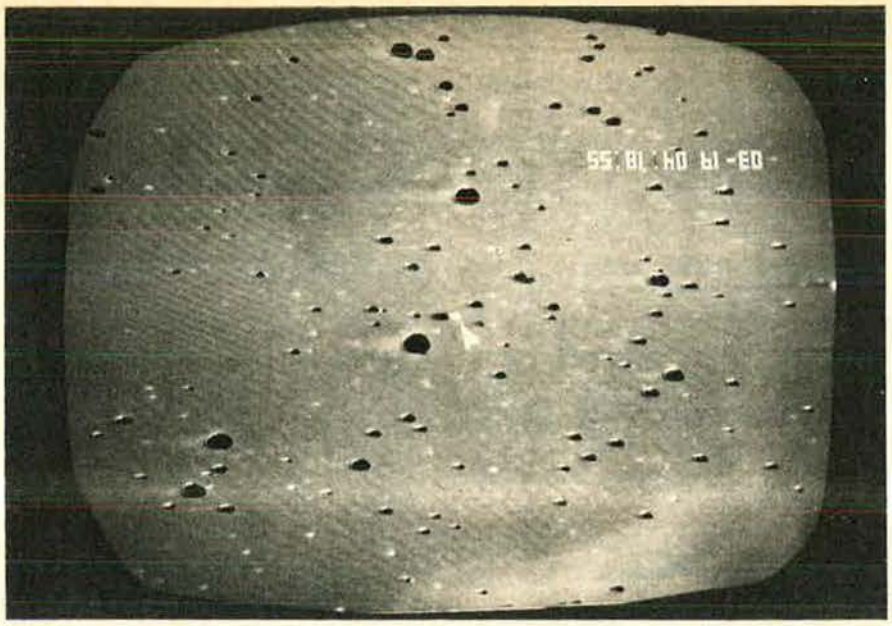
Air Force Satellite Communications

ESD's long-term efforts include the two-phased design and development of Air Force Satellite Communications, known as AFSATCOM I and II, that are being carried out in concert with SAMSO. AFSATCOM I is a $700 million program to provide the National Command Authorities effi-

cient, rapid command and control of SIOP (Single Integrated Operational Plan) forces through satellite-based UHF communications capable of operating at a rate of 100 *recorded* words per minute. The three principal contractors are TRW, Hughes, and Rockwell. The space segment of the system will be deployed on host satellites in equatorial, polar, and other orbits. ESD's specific task is to develop airborne terminals for B-52, EC-135, C-141, FB-111, and E-4B aircraft, as well as ground-based terminals for the Strategic Air Command, Air Force Communications Service, and USAF Security Service.

Revolutionary improvements to this system in the 1980s will be provided by AFSATCOM II and III, which will make maximum use of existing terminal hardware, but make the system more jam resistant and survivable. AFSATCOM II's basic concept formulation is to be completed in about eighteen months. Two specific phases will be involved in this development program, according to Col. (Brig. Gen. selectee) J. T. Buck, ESD's Deputy for Control and Communications Systems. One is concerned with protection against ECM, while the second step is keyed to physically surviving a nuclear attack. AFSATCOM II's key contractors are Lincoln Laboratory, TRW, and Rockwell; its cost should be about $1 billion.

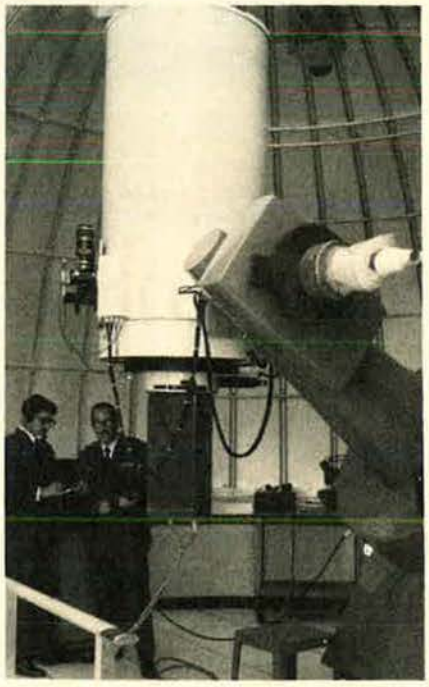
AFSATCOM II took a big step forward this year when two advanced satellites were launched to demonstrate the feasibility of satellite-to-satellite communications and communications with submarines, as well as to conduct various classified experiments. The two satellites, known as LES-8 and LES-9, for Lincoln Experimental Satellites, were placed in "near-geosynchronous orbit" in the spring of 1976, and have demonstrated that through interlinking they can provide jam-resistant communications among terminals located anywhere in an area covering more than three-fourths of the earth. Three-axis stabilization systems keep one end of each satellite pointed at the earth and a crosslink antenna system pointed at the other satellite. The orientation of the satellite is maintained by a momentum wheel that operates like a big gyroscope and in concert with attitude control thrusters.



GEODSS, the ground electro-optical deep space surveillance system developed by ESD and MIT's Lincoln Laboratory, processes photos in a split second, subtracts nonmoving star backgrounds, and pinpoints the remaining light speck on the screen as a satellite.

LES-8 and LES-9 are designed to work in conjunction with small, mobile terminals as well as transportable or fixed ground terminals. The two satellites' jam-resistant communications involve up-links and down-links in the "K" and military UHF bands. LES-8 and LES-9 incorporate and test techniques that help satellites survive and continue dependable operation in a hostile environment. Electric power is provided by sophisticated radioisotope thermoelectric generators rather than by solar panels and solar cells that are highly susceptible to EMP damage. In addition, all components are shielded against radiation damage. All signal-processing circuits resist electronic jamming.

AFSATCOM II's prototype terminals on the ground, in the air, and at sea are being developed by the Air Force and the US Navy. The orbits of the two satellites are arranged to keep them in a figure-eight pattern between the Tropic of Cancer and the Tropic of Capricorn, with LES-8 standing off the west coast of South America and LES-9 off the west coast of Africa.



GEODSS' telescope at White Sands Missile Range, N. M., is powerful enough to peer more than 20,000 miles into space.

\VE PAWS Attack Assessment d Warning System

On April 12, 1976, when a con- ıct was awarded to the Raytheon). of Wayland, Mass., ESD for- ally launched the development d acquisition of a phased-array dar warning system to detect a-launched ballistic missile LBM) attacks on the United ates. The system Raytheon is design, fabricate, and test is \VE PAWS, a high-priority addi- ɔn to the National Command uthorities' WWMCCS. According Col. H. J. McLoud, Jr., of ESD's eputate for Surveillance and Nav- ation Systems, there will be tes at Otis AFB, Mass., and eale AFB, Calif. Each site in- des a prime dual-faced facility, e 105 feet high and with a clock-like front containing 3,600 antenna elements generate a search beam with range of up to 3,000 miles. Ac- ally the system's range is "far reater, once we have locked on, ut does not extend to geosyn- hronous orbit [22,300 miles]," ac- ording to Colonel McLoud. PAVE AWS thus provides space track- g capability in addition to its pri- ary function of furnishing long- ange detection and warning of LBM attacks and raid charac- erization to the North American ir Defense Command's Chey- nne Mountain complex, the Stra- gic Air Command, and the Na- onal Command Authorities.

IBM is the PAVE PAWS soft- are developer. The system will e able to detect SLBM attacks n the US regardless of the tra- ectories of the reentry vehicles ofted, depressed, or minimum nergy) because one way or nother they have to come through AVE PAW's radar fan. The new ystem, whose IOC (initial operat- ng capability) date has not been released publicly, will replace the seven AN/FSS-7 sites of the limited-range 474N system.

PAVE PAWS relies solely on solid-state construction. Its thousands of radiating elements are steered electronically by a sophisticated computer. Like other national warning systems, PAVE PAWS will be linked to DoD's new Warning Information Correlation program to assure the clearest possible attack assessment information for the NCA, according to Pentagon spokesmen.

COBRA DANE, scheduled to achieve operational status late this year, is designed to monitor and evaluate Soviet ballistic missile firings into the Pacific area as well as to provide space surveillance. This ESD program uses phased-array radar coupled with traveling wave tube/power divider technology. Located at Shemya Island, Alaska, COBRA DANE was designed in 1973 and, technologically, is not as advanced as the newer PAVE PAWS all-solid-state system.

Another important ESD surveillance program is GEODSS, or Ground Electro-Optical Deep Space Surveillance system, which probes the skies for distant earth satellites at geosynchronous and possibly even higher altitudes. A prototype of GEODSS was developed by MIT's Lincoln Laboratory, which also operates the Experimental Test Site at the White Sands Missile Test Range in New Mexico. Eventually, GEODSS is to consist of five sites to provide worldwide space surveillance and augment the Aerospace Defense Command's SPACETRACK coverage.

The White Sands facility has demonstrated already that it can "see objects in geosynchronous orbit with the degree of clarity and resolution required by military users," according to Colonel McLoud. GEODSS consists of two sophisticated telescopes—a thirty-one-inch surveillance and a fourteen-inch tracking scope operating in tandem, associated electro-optics, a TV camera, a digital computer, and ancillary electronic and communications equipment. The GEODSS computer permits instant analysis and initial screening, and sounds an alarm upon detecting unknown objects. Its telescope spots space objects 10,000 times dimmer than the human eye can see, in one of two ways, according to Colonel McLoud: "We use a moving target indicator as a means for eliminating the star field by moving the telescopes at a rate corresponding to the movement of the stars, thus causing objects other than stars to stand out. The other option is to move the telescopes at a rate equal to that of the targets, in which case the conditions are reversed. Either way, we obtain the capability needed to detect man-made orbiting objects in the night sky." Augmenting GEODSS through low-altitude surveillance may be the SEEK SAIL radar, whose development DoD expects to initiate in the near future.

A step beyond these space surveillance systems is a family of new technologies of far greater capability than the current radar and electro-optical systems. The latter were characterized by Dr. George H. Heilmeier, Director of the Defense Advanced Research Projects Agency, as being able to "only marginally improve the ability of US space tracking systems to perform search at reasonable cost." Under active test, and recently transferred from DARPA to the Air Force, is a new data-processing technique that produces dimensionalized line drawings of satellites to permit more precise assessments of their military purpose. Also, according to Dr. Heilmeier, "we are developing the data base for microwave, millimeter, and laser radars that will significantly extend the range and information content of the satellite images." CCD (charge-coupled devices—a potentially revolutionary solid-state technique that vastly increases data density rates over current large-scale integrated circuit designs) readout and processing promise broad and signifi-

cant improvements in space object detection and identification, he told Congress. Further, DoD and USAF are pursuing development of spaceborne sensors, such as long-wave infrared (LWIR), to provide rapid surveillance coverage *without* the military vulnerability of ground-based systems located at foreign bases, according to DoD spokesmen.

The CONUS OTH-B Radar

One of the dimensionally largest programs under development by ESD is the CONUS OTH-B prototype radar near Moscow, Me., with a 2,500-foot transmitter antenna and a receiver antenna more than a mile long. The OTH-B's prototype radar is being developed by General Electric of Syracuse, N. Y. Only site clearing has taken place for this system that could provide all-altitude warning against aircraft over a range of about 2,000 miles. Deployment will depend on how severe the Soviet bomber threat may become in the next decade, and on how well technical problems such as ionospheric disturbances and data handling of the large volume of air traffic over the North Atlantic can be solved. Testing of systems hardware is to begin at the Maine site during FY '78. If deployed, the OTH-B program would include development of a second facility on the West Coast.

Closer-in airspace surveillance will be the job of the Joint Surveillance System (JSS) that is to replace the current SAGE/BUIC System and perform the peacetime air sovereignty mission in concert with NORAD, the Federal Aviation Administration, Canadian Forces, and the Alaskan Air Command. JSS will consist of forty-three FAA and five military long-range radars in the CONUS. These radars are currently in use but are to be upgraded by adding a height-finder capability and common digitizers to provide standardized air traffic information to four regional operations control centers (ROCCs). In addition, there will be one ROCC in Alaska and two in Canada. Annual operating cost of the completed system could be $100 million less than the SAGE/BUIC system.

One of the forty-eight radars will be the SEEK SKYHOOK aerostat-based look-down radar to be deployed in the Florida Keys. Looking down from a balloon perch several thousand feet up, this radar system will be able to detect low-flying aircraft more than one hundred miles away to provide coverage of the Caril bean, including Cuba. Reques for Proposals to industry for th system, which probably will co sist of three balloons, are to l issued this summer.

ESD's Deputy for E-3A, Maj. Gen. L. A. Skantze, stresses AWACS's potential as a "force multiplier."

The E-3A AWACS

The E-3A AWACS, a modifie 707-320B aircraft topped by thirty-foot rotodome and combi ing advanced radar, compute and communications technologie is "our No. 1 general-purpos forces priority," according USAF Chief of Staff Gen. Davi C. Jones. In addition, AWACS w play an important role in CONU air defense, permitting a sizabl cut in the number of JSS grou stations that otherwise would h been required, according to E Deputy for E-3A, Maj. Gen. Skantze.

With final approval of the '77 budget, total appropriat funds will provide for the acquis tion of the first twenty-five E-3 aircraft (nineteen aircraft ful funded and an additional six co ered by long-lead-time monie toward the FY '78 budget). A though the USAF-approved pr gram, calling for a total US forc size of thirty-four E-3As, is bud geted in the DoD five-year defens plan, the actual US acquisition w depend on further assessments changing requirements and pos sible purchase of the system b NATO. A recent letter of offer b DoD to NATO set forth the optio to buy between twenty and thirty two aircraft at a cost that may b "upwards of $2.3 billion in Jun 1976 dollars," General Skantz told AIR FORCE Magazine. Th NATO Defense Ministers are ex pected to act on the offer earl this summer and subsequently t request specific proposals for of set arrangements, he added.

The offset would approximat twenty-five percent of the tota purchase value and could con sist of collaboration (such as us of European engines), coproduc tion, or shared depot operations Unit procurement cost of th NATO AWACS under the offe would be on the order of $7 million, which includes a four per cent R&D surcharge in additio

TAC Working Toward E-3A's Joint Service Interoperability

Asked by AIR FORCE *Magazine about the E-3A's "interoperability," Gen. Robert J. Dixon, whose Tactical Air Command is the principal user of AWACS, said:*

In preliminary tests with the Army's TSQ-73 Missile Minder System in Florida in 1974, the E-3A (AWACS) demonstrated a potential to increase SAM survivability. We are now working with the US Army Training and Doctrine Command to identify technical interfaces between the E-3A and Army systems. Once the technical interfaces have been identified, further joint testing will take place to ensure that SAM-D has interoperability with the AWACS. Further, we will be working together to ensure that the required SAM-D Joint Service interoperability in the overall theater air defense system is achieved.

to the unit procurement cost that USAF is paying for its own aircraft. With between eighty and ninety percent of the program's R&D costs already sunk, "the US government could not justify offering the aircraft at full unit program cost [including the prorated share of the R&D investment] to NATO," General Skantze said.

The program's DT&E (Developmental Test and Evaluation) is progressing well and flight-test will be completed by the end of this year, with delivery of the first production aircraft scheduled for March 1977, and initial operational capability for September 1977.

The system's operational scope is evolving beyond the original mission as a result of recent demonstrations and current "interoperability studies" involving the US Navy and US Army, according to the E-3A Program Director. These missions will include maritime surveillance and close links with the Army's new SAM-D air defense system, especially in the NATO area. During the AWACS demonstration trip to Europe in April 1975, both the maritime surveillance and AWACS/Army HAWK interoperability were demonstrated convincingly. AWACS can detect, track, and direct a SAM launch against hostile aircraft while the ground-based system's radar remains quiet and, therefore, protected from antiradiation weapons.

Recent studies of the E-3A's relative vulnerability and effectiveness as a "force multiplier" produced startling results. Based on tests and extensive computer studies, it was found that in a NATO war environment between sixty and 100 Warsaw Pact fighters would have to be expended in order to bring down one AWACS. According to these studies AWACS would boost the kill ratio of friendly fighters by a factor of three.

Closely linked to AWACS but not a part of its development is another major ESD R&D program, the Joint Tactical Information and Distribution System, or JTIDS *(see p. 44, July '75 issue)*. Centered on digital data transmission by means of TDMA (time division multiple access) over jam-resistant broad bandwidths, JTIDS can provide secure digital communications for aircraft, ships, and ground sites, as well as some navigational capability. Principal information categories include such tactical data as aircraft tracks and SAM positions, and navigation data, including relative position and command guidance. The JTIDS development program is expected to cost $267 million. Hughes, ITT, and Singer-Kearfott are the key contractors.

JTIDS, according to Colonel Buck, could lead "to a change in the nature of air war involving a more cohesive, highly automated and jam-resistant battle area." Three types of airborne JTIDS terminals are envisioned: class I for large aircraft such as AWACS, class II for fighter aircraft, and class III for other applications such as man packs. Size, cost, jam-resistance, and capability of these categories would match the operational requirements of the three types of users, he added. Present tentative plans call for tests of JTIDS terminals on board four F-15s within about two years, he explained.

But before JTIDS can reach operational status in all its potential applications, it must meet the litmus test that General Creech applies to all ESD programs: "They must be affordable, they must be reliable and as survivable as possible, and they must make irrefutable sense from the operator's point of view." ■

ESD's Deputy for Control and Communications Systems, Col. J. T. Buck, predicts fundamental change in tactical air war from JTIDS program.

What's Happening in Electronics at ESD

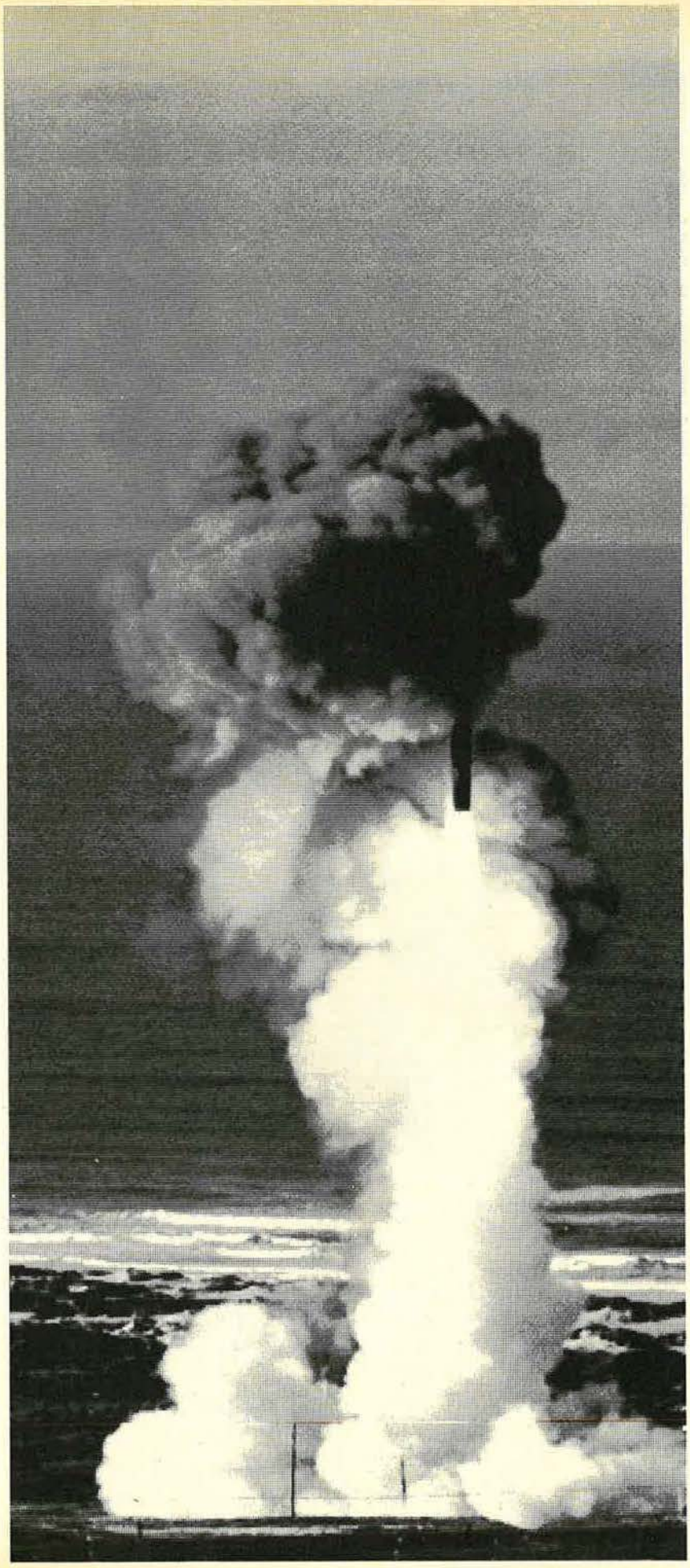
YSTEM NO.	NAME AND MISSION	STATUS	CONTRACTOR
404L	**Traffic Control Approach and Landing System (TRACALS):** TRACALS encompasses fixed and mobile ground facilities and equipment, with associated avionics, to update the USAF air traffic control function. The major systems currently being acquired as part of TRACALS include terminal navigation aids, radar approach control equipment, landing systems, and air traffic control simulators.	Continuing Acquisition	Many
407L	**Tactical Air Control System (TACS):** A highly mobile communications and electronics system for command and control of tactical aerospace operations. Capable of modular deployment by airlift, helicopter, and truck, 407L can be adapted to specific geographic requirements. The system will provide radar and communications in the tactical environment, airspace management, communications for Army support, and air traffic control.	Transitioned	Computer Sciences Corp., Hughes, ITT, General Dynamics, Systems Development Corp.
411L	**E-3A Airborne Warning and Control System (AWACS):** Provides a survivable airborne air surveillance capability and command control and communication functions. Its distinguishing technical feature is the capability to detect and track aircraft operating at high and low altitudes over both land and water. It will be deployed by TAC in both initial phases of hostilities and in protracted situations. For ADCOM, it provides an efficient solution to the requirement for survivable strategic air defense surveillance and control.	Acquisition	Boeing Aerospace Corp.
414L	**CONUS Over-The-Horizon Backscatter Radar:** Provides long-range detection of aircraft approaching North America. The OTH-B radars will be a part of the North American Air Defense Command (NORAD) system that provides an air surveillance and warning capability. The distinguishing technical feature of OTH-B is its capability to detect targets at all altitudes and at extended ranges. The present phase of this program is to build a prototype OTH-B radar, test it for a year, and then make a decision on building two fully operational radars.	Prototype Acquisition	General Electric
427M	**NORAD Cheyenne Mountain Complex Improvements:** A program to acquire new data-processing equipment, software, displays, and communications for the NORAD Cheyenne Mountain complex. The NORAD Computer System, Space Computational Center, and the Communications System will provide the NORAD Cheyenne Mountain complex with an integrated, responsive capability and a growth potential that will meet a projected life span of ten years without replacement of major equipment or major software changes.	Acquisition	Aeronutronic Ford, System Development Corp.
428A	**Tactical Information Processing and Interpretation System (TIPI):** The USAF TIPI/USMC MAGIS (Marine Air Ground Intelligence System) will provide more timely and accurate intelligence to USAF and USMC tactical commanders at various echelons of command. Air transportable and housed in mobile shelters, the various segments of the system employ automated aids to provide the capability for rapid processing, interpretation, and reporting of intelligence derived from airborne-collected electronic reconnaissance and photographic and radar imagery.	Definition, Development, Acquisition, and Deployment	Texas Instruments, System Development Corp., Fairchild, General Electric
433L	**Weather Observing and Forecasting System:** A system for the modernization of USAF's Air Weather Service to provide high-quality and timely weather observations, information, studies, advice, and forecasts in support of military operations and command and control systems.	Acquisition and Operational	Many
436M	**SACCS Computer Update:** Provided for the time-phased replacement of three SACCS (SAC Automated Command Control Systems) data-processing centrals by third-generation dual processor computers. The new computers interface directly with SACCS Electronic Data Transmission Communications Central (EDTCC), with SACCS Autodin Total Interface Network (SATIN) Computers, and with the 4000th Aerospace Applications Group Remote Terminal Facility.	Operational	Computer Sciences Corp.
450A	**Tactical LORAN:** A program for the development and acquisition of the AN/ARN-101(V) Navigation/Weapon Delivery System for the RF-4C and F-4E aircraft. This system will provide a modular digital avionics capability with LORAN for the above aircraft to satisfy tactical requirements for the 1978–1988 time frame. Development and acquisition of a Tactical LORAN C/D Ground Chain for worldwide deployment to provide LORAN environment for joint service common grid positioning in the tactical theater. Development of precise grid prediction and grid data management capability for joint service use.	Development and Acquisition	Sperry Gyroscope, Lear Siegler
451D	**COMBAT GRANDE:** Upgrading, modernizing, and semiautomating the existing Spanish Air Force aircraft control and warning network.	Acquisition	COMCO, General Dynamics
478T	**Combat Theater Communications:** A program to acquire new hybrid analog/digital and digital communications equipment for the tactical air forces. This equipment is acquired both for Air Force unique requirements and as part of the DoD Joint Tactical Communications (TRI-TAC) Program. Within the TRI-TAC Program, the 478T Combat Theater Communications Program Office is responsible for the development, testing, and production of the equipment assigned as Air Force responsibility and to ensure that the USAF requirements are met by all of the equipment procured through this joint service program. This program office also has the responsibility for the interoperability of the equipment procured under the TRI-TAC Program auspices with other communications equipment within the tactical air environment.	Definition, R&D, and Acquisition	Martin Marietta, Litton Industries
481B	**E-4 Advanced Airborne Command Post:** Provides the National Military Command System and Strategic Air Command with an improved airborne communications command and control system that will operate satisfactorily during the pre-, trans-, and postattack phases of a general war. The system will utilize some combination of automatic data processing and peripheral equipment accessed through remote terminals installed in a Boeing 747 aircraft that will provide the facilities for future growth and advanced equipment.	Acquisition	Boeing Aerospace, E-Systems
485L	**Tactical Air Control System Improvements (TACSI):** This program provides the Tactical Air Control System (TACS) with increased operational capabilities necessary for combat command and control of tactical aerospace operations. Improvements consist of mobile, automated air control centers, communications, and electronic systems capable of modular worldwide deployment that are compatible with the TACS and interoperable with Army, Navy, and Marine Corps tactical data systems.	R&D and Acquisition	ITT, Hughes, SDC, General Dynamics, Goodyear, Computer Sciences Corp.
490L	**Overseas AUTOVON Switches:** The key element of the overseas portion of the Defense Communications Agency's program to implement a worldwide Automatic Voice Network (AUTOVON). This system provides an automatically switched, wideband communications network.	Operational with improvements continuing	Automatic Electric Co.

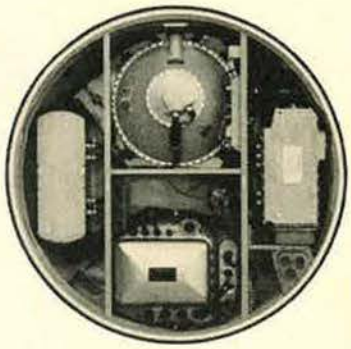
A CHECKLIST OF MAJOR ELECTRONICS PROJECTS

SYSTEM NO.	NAME AND MISSION	STATUS	CONTRACTOR
496L	**SEEK SAIL:** This program is the acquisition of a radar sensor for SPACETRACK. Implementation of this sensor will provide information to the Aerospace Defense Command on new satellites during the initial orbit. This sensor will extend the system coverage and provide data for updating the SPACETRACK catalog.	Development	To be determined
496L	**SPACETRACK Augmentation:** The mission of the SPACETRACK system is to detect, track, and identify man-made objects in space. Improvements are needed to expand the system's capability in terms of extended range, greater coverage, better accuracy, and more timely reporting. Several studies and projects are under way to determine future requirements for modifications to the sensor network, on-site data processing, operating procedures, and system communications. Large ground radars and electro-optical systems are being considered for performing the deep-space surveillance mission. Ground Electro-Optical Deep Space Surveillance (GEODSS) will provide an interim system with the capability to extend SPACETRACK surveillance to synchronous altitudes. System will be a global network of five sites (three overseas, two CONUS) to optically detect, track, and identify satellites in earth orbit.	Advanced Development	None
616A	**Air Force Support of MEECN:** A project to upgrade the Air Force Survivable Low Frequency/Very Low Frequency (LF/VLF) System as part of the Minimum Essential Emergency Communications Network. The LF/VLF System is designed to meet the requirements of CINCSAC and Joint Chiefs of Staff.	Development and Acquisition	Many
633A	**COBRA DANE:** A program to acquire a phased-array radar to be installed on Shemya AFB, Aleutian Islands, Alaska, for the purpose of collecting intelligence data on Soviet missile development tests. Corollary missions are early warning and satellite tracking.	Acquisition	Raytheon
634B	**Joint Tactical Information Distribution System:** A program to develop a high capacity, reliable, jam-protected, secure digital information distribution system that will provide an unprecedented degree of interoperability between data collection elements, combat elements, and command and control centers within a military theater of operations.	Engineering Development	Hughes, ITT, Singer-Kearfott
681E	**Base and Installation Security Systems (BISS):** An evolutionary program to provide a DoD standard electronic security system for physical security and ground defense of DoD resources worldwide. The system concept incorporated maximum commonality of major items and a variety of supporting subsystems, offering thereby a flexibility or choice of equipments that can be tailored to the unique physical characteristics of the system deployment location and to the threat.	Development, Acquisition, and Deployment	Many
968H	**Joint Surveillance System (JSS):** A program to replace the current SAGE/BUIC system with a peacetime air surveillance capability. In the CONUS, the system will utilize radars and other sensors at joint FAA/USAF sites to simultaneously fulfill the civil mission of air route traffic control and the military mission of continental air sovereignty.	Validation and Acquisition	None
1135	**Automated Armed Forces Examining and Entrance Station (AFEES):** The Automated Armed Forces Examining and Entrance Station (Automated AFEES) Program entails the design, development, test, and evaluation of a prototype Automated AFEES that will substantially improve examinee screening and administrative processing.	Completed	Computer Sciences Corp.
1136	**SAC Automated Total Information Network (SATIN IV):** A program to provide SAC with an integrated command-wide digital record communications system that will satisfy, with updating, SAC requirements for command control and support data transmission into the 1990s.	Validation	To be determined
1205	**Air Force Satellite Communication System (AFSATCOM):** The program is for the acquisition of UHF airborne/ground force terminals, airborne/ground command post terminals, ancillary equipment necessary for operational control and communications transponders on selected Air Force satellites. In addition, the associated family of modular UHF transceivers will provide a command communications capability in the line-of-sight mode. The full-grown family of modular UHF radios will result in a common base to provide the transceiver for the satellite SIOP and Force communications terminals and direct replacement of the AN/ARC-27, AN/ARC-34, and other obsolete UHF command units identified by AFLC.	Development and Acquisition	TRW, Hughes, Rockwell
1213	**Airborne Weather Reconnaissance System (AWRS):** A high-priority program to provide the WC-130 fleet of the Air Weather Service with improved meteorological data-gathering and information-processing equipment designed to respond to the weather-forecasting requirements of the 1970s.	Prototype Operational	Kaman Aircraft
1975	**Intra-Theater Imagery Transmission System (IITS):** The Intra-Theater Imagery Transmission System will provide a capability for the electronic transmission of selected reconnaissance imagery between reconnaissance/intelligence sources and principal users. It is a ground-to-ground dissemination system designed for use by deployed tactical forces.	Conceptual Phase	None
2009	**ANMCC Processing and Display System:** The system will receive, process, and display status warning and attack assessment data to support the National Command Authorities and the Joint Chiefs of Staff. The processing and display system for the Alternate Military Command Center will be a duplicate of the system previously installed in the National Military Command Center. The processing and display system is comprised of two display subsystems: the alphanumeric wall display subsystem and the large-screen wall display subsystem.	Acquisition	Aeronutronic Ford
2059	**PAVE PAWS:** Two dual-faced phased-array radars, one to be deployed on the East Coast and one on the West Coast. This system will be operated by the Aerospace Defense Command and will provide warning to the National Command Authorities of a sea-launched ballistic missile attack against the Continental United States.	Acquisition	Raytheon
2121	**SEEK SKYHOOK:** This program is for the development of a low-level surveillance radar. This system will provide Aerospace Defense Command with the capability of detecting and tracking low-flying aircraft approaching the CONUS.	Development	None
2128	**Ground-Based Deep Space Surveillance Radar (DSSR):** To verify the feasibility of ground-based radars for use in deep space surveillance. The results of this investigation will provide inputs to an Air Force decision on the configuration of a deep space surveillance system.	Conceptual Phase	None

A CHECKLIST OF MAJOR ELECTRONICS PROJECTS (Continued)

SYSTEM NO.	NAME AND MISSION	STATUS	CONTRACTOR
2167	**SPADATS Improvements:** The mission of the Air Force Space Detection and Tracking System (SPADATS) is to provide a primary national capability for surveillance, tracking, and identification of man-made space objects. Primary SPADATS missions include: cataloging of space objects, precision tracking of high-interest payloads, intelligence support, space object identification, maneuver detection, satellite decay and impact prediction, weapon systems support, and support for national space programs.	Advanced Development	None
2184	**Ground and Amphibious Military Operations (GAMO):** The GAMO Program is aimed at ensuring compatibility, interoperability, and operational effectiveness of tactical command and control systems that support ground and amphibious military operations.	Conceptual Phase	None
7820	**Communications Security (COMSEC):** A program to accomplish COMSEC RDT&E associated with protection of classified communications by electronic means. Efforts of the program respond to validated requirements identified by the USAFSS.	Continuing	Many
	Operational Applications of Special Intelligence Systems (OASIS): A program to develop the necessary hardware and software to provide the interface between operations and intelligence and make effective timely use of available perishable intelligence data in support of air battle management functions.	Engineering Development	None
	Digital European Backbone (DEB): A program that will incrementally transition portions of the European Defense Communications System from an analog to a predominantly digital transmission environment. This project will provide a wideband digital bulk encrypted terrestrial backbone for interconnect and alternate routing capability between the Defense Satellite Communications System's earth terminals and major commands in Europe.	Validation and Acquisition	Collins, VICOM, Aeronutronic Ford
	Command, Control, Communications, and Intelligence (C^3I) Architecture: The development and maintenance of an orderly C^3I structure based on assessing the impact of the introduction of new or modified capabilities into existing and future operational environments. Initial priority has been given to interoperability aspects of systems for which ESD has acquisition responsibility.	Continuing	None
	Catalog of Information Exchange and Message Standards (CIEMS): Provides the automated digital exchange of command management information among the elements of the tactical forces through data communications.	Conceptual Phase	None





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THE ELECTRONIC AIR FORCE

USAF IN THE FOREFRONT OF THE C^3 REVOLUTION

BY THE HON. THOMAS C. REED, SECRETARY OF THE AIR FORCE

US deterrence depends on reliable, survivable, and rapid command control and communications capabilities that span the gamut from early warning and attack assessment to SIOP execution. The Secretary of the Air Force describes new directions and policies that will affect DoD and USAF C^3 systems in coming years.

AMERICA'S strategic options in the future will depend on two factors of paramount importance: first, the quality and quantity of forces available to our operational commanders, and, second, how well we are able to control those forces in support of national policy.

Strategic forces continue to be the preeminent feature of our national security posture. Their direction and control by the National Command Authorities (NCA) is a topic of absolute importance to all of us, for upon them may rest our survival as a nation. Because of the stakes involved, the President and the Secretary of Defense must have at their disposal a full array of pertinent information about a potential or developing crisis, and, at the same time, they must have the communications capability to exercise command and control over our forces on an immediate, real-time basis. This is the primary purpose of WWMCCS—the World Wide Military Command and Control System.

The Air Force has important interests in WWMCCS. We provide about seventy-five percent of the total WWMCCS-unique resources. These resources cost about $1 billion a year to develop, procure, and operate, while the entire sphere of tactical warning, intelligence, data processing, and communications costs about $6 billion per year. In addition to the critical capabilities provided to our National Command Authorities, many of the major WWMCCS subsystems directly support Air Force missions.

In order to ensure that the President continues to have viable and responsive control over our forces in the future, we have been assisting OSD in developing an architecture for WWMCCS in the 1980s. This two-year effort is now in its final phase and a plan will be ready soon for appropriate action by the military departments and defense agencies. The architecture does not suggest radical or revolutionary changes in WWMCCS as it stands today. Neither does it significantly change the thrust of most command and control programs now being developed and deployed. It does, however, look at command and control from a national point of view. The architecture stresses the interfaces, standardization, and interoperability necessary to mold together a variety of decentralized command and control programs into a fully workable and responsive system for the future.

I believe that we in the Air Force must do a better job of understanding the requirements and managing these important programs. We sometimes have an unfortunate tendency to compartmentalize these systems, and forget that the lead time for a command and control and communications system is every bit as long as for an airplane, a ship, or a missile. Communications must support the operating forces, but we cannot wait until the weapon systems are built to add on the communications system. Information systems are just as much an Air Force mission as tactical air operations.

As the importance of the Air Force role in national command and control and communications grows, we will need ever more dedicated and knowledgeable people to carry out those responsibilities. I am convinced that those who pursue an Air Force career in the field of information systems will find difficult challenges but ample rewards. The importance and significance of these Air Force efforts is increas-

ing daily, and the long-term prospects for career specialists to contribute in a very significant way to national defense are indeed bright.

USAF Elements of WWMCCS

Some key Air Force systems are critical parts of the long-range WWMCCS plan.

The Air Force satellite communications system (AFSATCOM) will give us a survivable, reliable means of ensuring command and control of Single Integrated Operational Plan (SIOP) forces in pre-, trans-, and postattack environments. Phase I will use communications channels on satellites of the Navy Fleet Satellite Communications (FLTSATCOM) System, the Air Force Satellite Data System, and on other selected DoD satellite programs. UHF terminals in strategic aircraft, ICBM launch control centers, and other key ground locations will provide the NCA direct 100-word-per-minute teletype communication with each of the SIOP elements, and with other high-priority DoD and Air Force users.

The AFSATCOM Phase I system is planned to evolve into a more survivable Phase II communications system in the 1980s. AFSATCOM Phase II is intended to provide both improved electromagnetic protection and physical survivability for the communications links of the SIOP forces now served by AFSATCOM I.

One of the most important AFSATCOM terminals will be on board the E-4 Advanced Airborne Command Post. These modified Boeing 747s, fully equipped to function as the National Emergency Airborne Command Post and as the Headquarters SAC Airborne Command Post, are essential to high-confidence national control of our strategic forces. Compared to our current EC-135s, these systems will provide increased communications, improved hardness against electromagnetic pulse, greater flight endurance, and a larger battle staff area. With the E-4, the NCA and SAC will have a better capability to execute and control strategic forces in the transattack phase of general war. The current program calls for a total of six aircraft operating out of Offutt AFB, Neb.

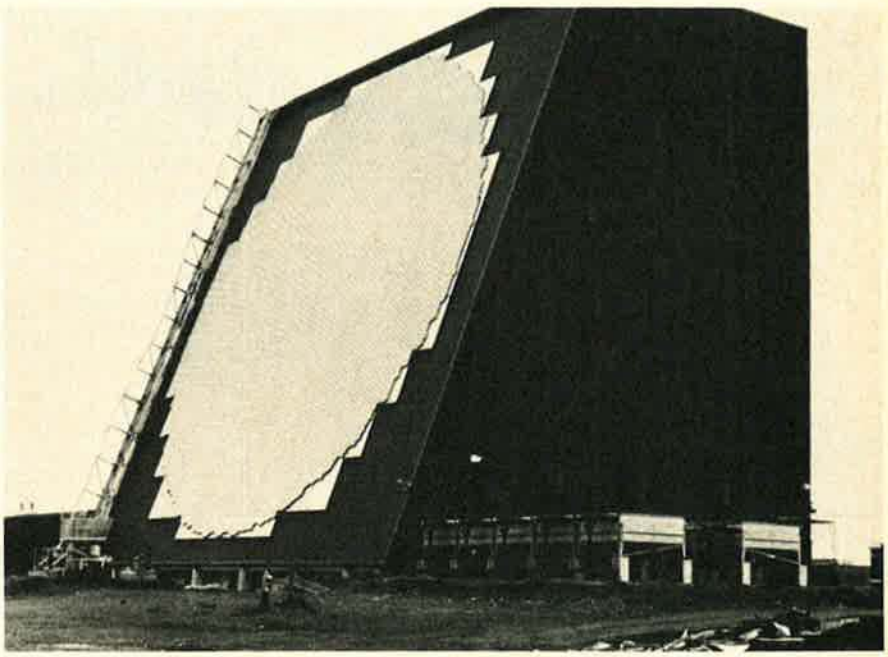
A third critical element of WWMCCS in which the Air Force has a major role is warning systems. Here we are talking about several systems, working in concert, to give us high-confidence information about any attack that might be on its way.

Credible bomber and missile warning is absolutely essential today. It adds several things to our deterrent capability.

It enhances the survivability of our strategic forces by providing warning to our alert bomber force, so they can be launched under positive control into their survivable airborne mode in minutes. A fast, but not irrevocable, launch is one of the great benefits of manned systems.

Improvements in Soviet offensive missile systems require that we keep pace to maintain the high survivability of our bomber alert force. That requirement leads logically to the B-1, which will have a much faster escape time—critical under the threat of a well-coordinated submarine-launched ballistic missile (SLBM) attack.

However, the full potential of the B-1's faster escape cannot be realized without concurrent improvements in our missile warning systems. In addition to evolutionary improvements in our space-based warning systems, we are upgrading our land-based radar sensors. The Spacetrack Radar at Eglin AFB, Fla., has just been modified to give it a capability against SLBMs launched from the south. We are completing development of Cobra Dane on Shemya Island in the Aleutians. In addition to its intelligence-gathering function, this large phased-array radar will improve our warning of a Soviet ICBM attack. We are initiating development of Pave Paws, a long-range, two-site, phased-array radar system for East and West Coast SLBM detection and warning. This radar system will have an East Coast site at Otis AFB, Mass., and a West Coast site at Beale AFB, Calif. When operational, Pave Paws will be a valuable complement to our satellite coverage and will permit real improvement in SLBM warning. We are also modifying our existing Ballistic Missile



Cobra Dane facility on Shemya Island in the Aleutians is nearing completion. This large phased-array radar will improve warning against Soviet ICBM attack.

Early Warning System (BMEWS) to help improve our total missile detection and warning capability.

Attack Characterization and Flexible Response

A discussion of warning systems inevitably raises the question of their value to our ICBMs. Nearly any weapon system has the inherent capability to be launched on certain and confirmed warning that an attack is under way. ICBMs, however, with a readiness rate of almost 100 percent, allow the National Command Authorities the option of firing out in minutes after a valid Presidential order. No matter how great his accuracy, no matter how high his reliability, an attacker cannot disregard the possibility that our ICBM force could be launched in retaliation before the first wave of enemy warheads began detonating on our missile fields. The incalculable consequences of employment of strategic nuclear forces demands high—even absolute—confidence in the warning and decision process.

Today we have the ability to detect, evaluate, and act—with very high confidence—upon a massive enemy ICBM attack.

But being able to do only that isn't good enough anymore. It might have been in the 1960s, but it won't be in the 1980s.

What we need to do, with some urgency, is improve our warning and associated command and control and communications systems so we can better characterize an enemy attack. We need to be able to better define where the attack is directed, and thereby better understand its nature—whether the enemy has launched his forces against our strategic forces, our population, our command and control and communications, or some combination of those.

Better characterization of the attack will permit us to more effectively tailor our response to such an assault, and thereby hopefully control escalation—the heart of the case for flexible response.

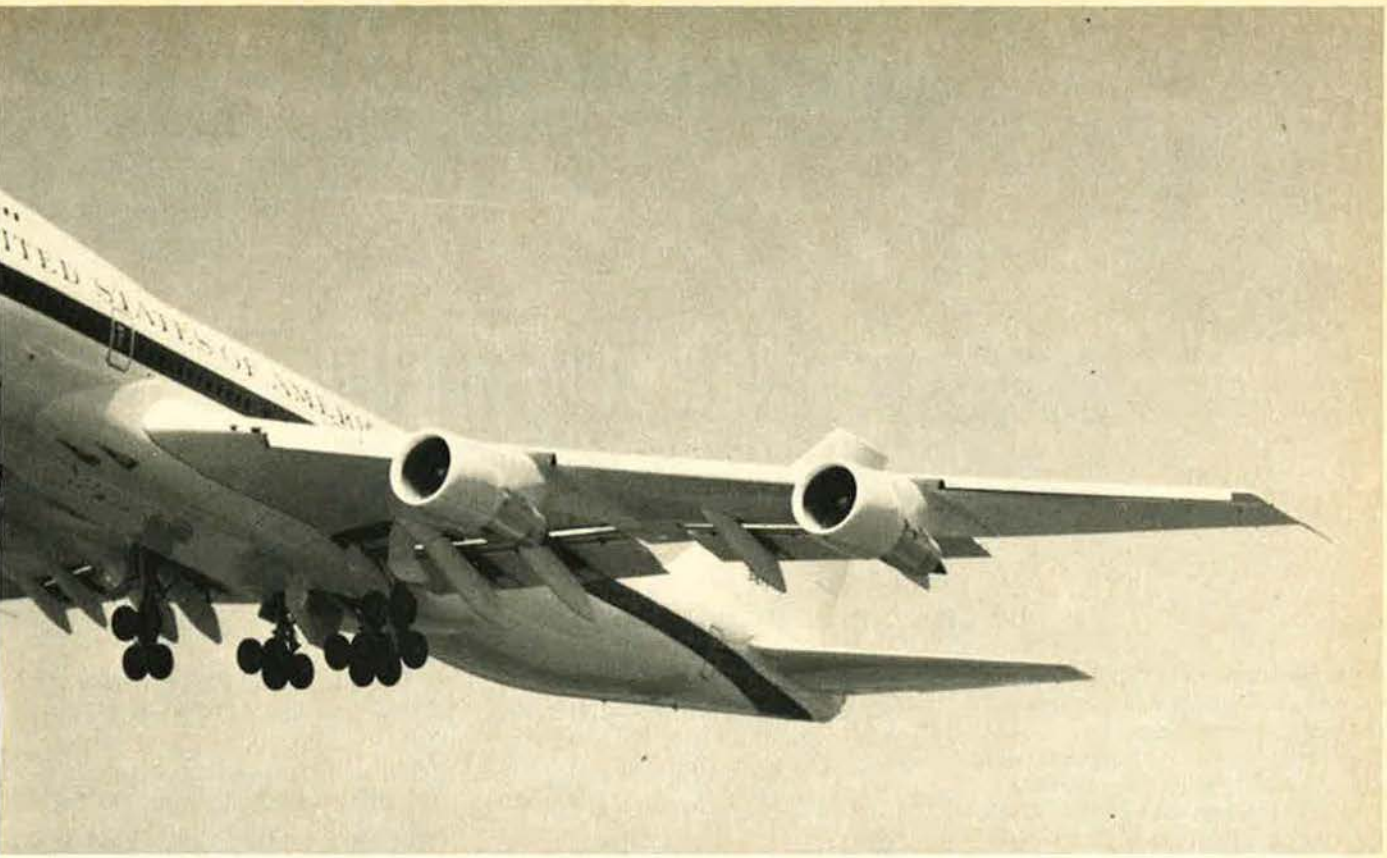
Linked to LES-8 and LES-9 satellites, USAF is testing a new secure, jam-resistant communications system involving a modified C-135 and a special EHF antenna.

The concept of flexible response means controlled response rather than a doctrinaire reflex reaction. It means being able to rapidly retarget our weapons and to selectively execute and withhold strikes against a full range of targets.

As we look forward to the 1980s, technology offers the possibility of operational systems with extremely high confidence attack analysis and characterization as well as warning. We can also foresee absolutely reliable and secure communications.

Such a combination of capabilities should introduce into Soviet attack calculations a great deal of uncertainty. That uncertainty should be a significant deterrent to any attack at all.

The high confidence and reliability we expect in our command and control systems in the 1980s should relieve concerns about a "hair-trigger" posture. In addition, the availability of a Presidential option to launch on certain warning could be a much less expensive way of maintaining our ICBM deterrent, when compared to some



E-4 Advanced Airborne Command Post, a modified 747 superjet, will serve both the National Command Authorities and SAC by providing a better capability to execute and control US strategic forces.

of the more expensive ICBM rebasing alternatives.

We should not, however, rely on any single solution to possible future silo survivability problems. The basic approach we have taken for nearly sixteen years with our strategic forces emphasizes diversity—diversity in systems, in basing modes, and in tactical responses. I believe we should continue to provide a number of options to our National Command Authorities. Among those is development of an alternative ICBM basing mode as a means of additional insurance for ICBM survivability in the future.

The ability to launch on certain knowledge of attack augments and enhances the survivability of our land-based ICBMs—whether they are in silos or in some alternate basing mode.

We must proceed now to develop the next generation warning and command and control and communications systems, because without them, the diversity of our future strategic options could be severely limited. ■

The author, Secretary of the Air Force Thomas C. Reed, a 1956 Distinguished AFROTC graduate of Cornell University and its top-ranking student in mechanical engineering, spent four years on active duty as AFSC project officer, and at Lawrence Radiation Laboratory. Subsequently, he organized and managed an engineering company in Texas and a development corporation in California. After serving for one year as Assistant to the Secretary and Deputy Secretary of Defense, he was named Director, Telecommunications and Command and Control, OSD, in 1975 and became USAF's eleventh Secretary on January 2, 1976.

THE ELECTRONIC AIR FORCE

MLS: BREAKTHROUGH IN LANDING SYSTEMS

BY DR. JOHN L. McLUCAS, FAA ADMINISTRATOR

A crucial vote, affecting commercial as well as military aviation around the world, will be taken in September 1977 in connection with the so-called "MLS Sweepstakes." The new landing system that ICAO, the UN's aviation arm, is expected to decide on could bring unprecedented flexibility to all airspace users.

NEXT year, the International Civil Aviation Organization (ICAO) is scheduled to make a decision of great importance to civil and military airspace users around the globe.

At issue is the selection of a new international standard approach and landing guidance system that will replace both the instrument landing system (ILS) at civil airports and Ground Controlled Approach (GCA) at military fields. Operating in the microwave frequency band, the new system will serve the full range of aircraft in all weather conditions.

ICAO's All Weather Operations Panel presently is completing its technical evaluation of candidate microwave landing systems (MLS) submitted by Australia, Britain, France, Germany, and the United States. The panel will make its recommendation this fall, and the matter will be voted on by the full ICAO membership in September 1977.

The two principal competitors in what some have called the "MLS Sweepstakes" are believed to be the Doppler technique, advanced by the British, and the Time Reference Scanning Beam (TRSB) system supported by both the United States and Australia. A third entry, submitted by the Federal Republic of Germany, is called DLS and has its own proponents. The initials DLS stand for Distance measuring equipment Landing System.

Basically, the TRSB equipment transmits two fan-shaped radio beams from the runway, one scanning from side to side and the other up and down. "Time reference" means that receiving equipment on board the aircraft will measure the time difference between successive "to" and "fro" sweeps of the scanning beams to determine the plane's position relative to the runway centerline and to a preselected glide path.

The Doppler technique is based on the Doppler principle that the frequency of radio waves changes as the distance between the transmitter and receiver changes. Instead of the sweeping beam used by TRSB, the Doppler system sends out a continuous flow of signals that are picked up by aircraft in the zone of coverage. Small airborne computers then determine position from the frequency shift caused by the movement of the airplane toward the runway or away from it.

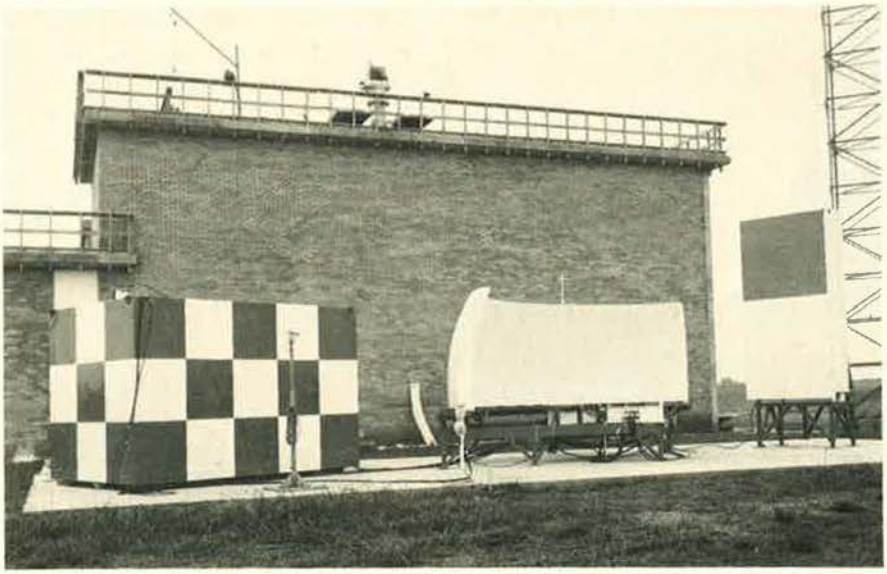
DLS is a "ground-derived" system, meaning the aircraft transmits signals to ground stations, which compute the position and send this information back to the aircraft. Both TRSB and Doppler are "air-derived" systems, in which position is computed in the air using signals transmitted from the ground.

As manager of the United States MLS program, FAA believes that TRSB best meets the ICAO requirements. It is low cost, easy to install and operate, requires less power consumption, and its flexibility allows easy expansion and control of coverage.

This view is based on an extensive US experience with both TRSB and Doppler over a multiyear period as part of our MLS candidate selection process. Although both systems exhibited good performance and were considered capable of meeting the ICAO requirements, TRSB finally was selected as the US candidate

system and continues to be vigorously advocated by this country and Australia because of its inherent technical superiority, maturity, and attractive implementation features.

But regardless of the ICAO decision—whether TRSB or Doppler is picked as the international standard—there is no doubt that MLS is the approach and landing system of the future for both civil and military aviation. If schedules are met, the first MLS units will be installed in 1979, beginning a twenty-year period during which ILS and GCA will be phased out of service. The MLS hardware is expected to continue to meet the needs of civil and military aviation well into the twenty-first century.



Engineering models of Time Reference Scanning Beam Microwave Landing System under development by Texas Instruments, Inc., for the FAA include azimuth (center) and elevation (right) antennas.

MLS Solutions to ILS Problems

ILS has served as the "universal" landing aid for civil aviation since its adoption by ICAO as the international standard in 1949. The United States alone has more than 500 systems installed at some 400 airports.

But total implementation of ILS throughout the civil community has not been possible because of siting difficulties and frequency problems. Moreover, ILS has a number of performance deficiencies that further restrict its application. The most serious of these stems from the fact that the equipment provides only a single approach path to the runway.

The military, of course, has made little use of ILS because the antenna assembly is too large for tactical application and the equipment performs poorly in rough terrain. For this and other reasons, the military has relied on GCA as the primary means of providing let-down guidance. This equipment has a history almost as long as ILS and shares many of the same deficiencies and limitations. The deterioration of the radar presentation in bad weather just when the equipment is needed most is but one example. Furthermore, it is becoming increasingly difficult to maintain these aging precision approach radar systems because of dwindling supplies of replacement parts and the high cost of training qualified operators. Finally, GCA, like ILS, provides only a single approach path.

MLS not only solves most of the major problems associated with ILS and GCA, but also offers a number of distinct technical and operational advantages, such as multiple approach paths and a more precise signal, that can be used to expand airport capacity and ease noise and other environmental impacts. This is especially critical in the civil sector, where community pressures have effectively stalled new airport development nationwide, mandating more efficient utilization of existing facilities.

The basic operational advantage of MLS is the broad area of signal coverage in comparison to existing landing aids. ILS, for example, transmits a six-degree radio beam that channels arriving aircraft into a narrow groove, requiring them to line up with the runway miles from the airport and fly straight-in approaches. This lack of flexibility leads to aerial stack-ups and delays in bad weather when all aircraft are on instruments and must fly the ILS.

MLS, on the other hand, radiates a fan- or funnel-shaped signal pattern that sweeps horizontally across an arc of up to 120 degrees and upward to an angle of twenty degrees. Aircraft entering this electronic funnel will have a broad choice of flight paths. They need not fly straight in to the

runway, as with ILS and GCA, but can follow curved flight routes intersecting the final approach path anywhere along the runway centerline, constrained only by the maneuverability of the particular aircraft. This will permit air traffic controllers to sequence traffic arrivals more efficiently and permit aircraft routings away from noise-impacted areas.

The MLS vertical coverage of one to twenty degrees also will make possible a range of approach angles tailored to the flight characteristics of each aircraft. It also permits segmented approaches for noise-abatement purposes. The idea here is to keep aircraft at higher altitudes over densely populated areas than is now possible with ILS/GCA and then bring them down at a steeper angle until they intercept the glide slope. Aircraft using ILS are locked into the three-degree glide slope through the entire approach.

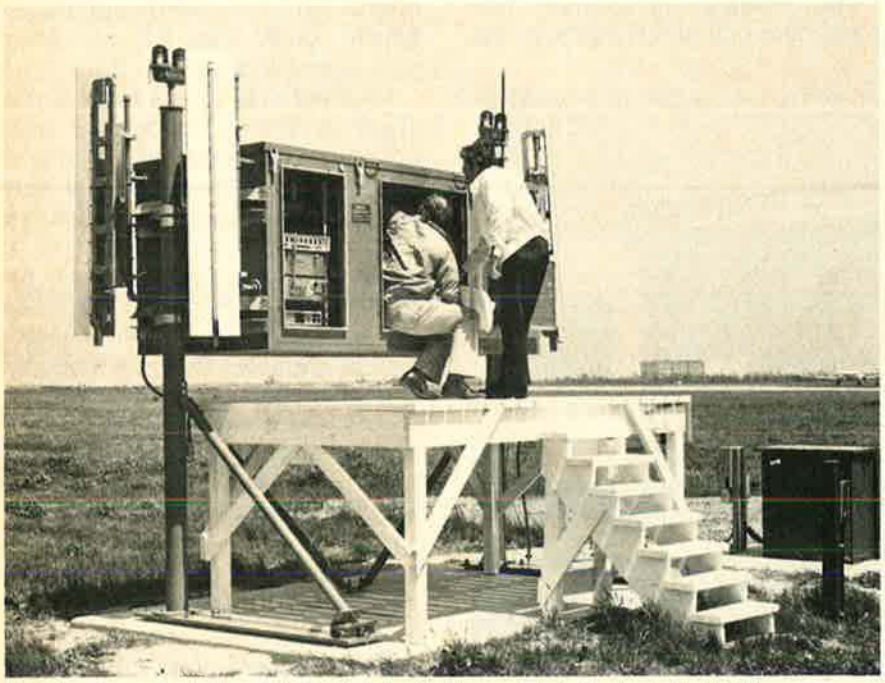
Reduced Signal Interference

MLS also will minimize the present signal interference problem caused by the reflection of ILS beams off hangars, hills, and other objects. Called "multipath," this phenomenon can cause erroneous readings when the reflected signals are picked up by arriving aircraft.

To reduce signal interference, ILS installations must be surrounded by large open areas, which precludes its use at many airports and requires extensive and expensive earth-moving operations at many others. Even so, it is estimated that ten percent of all ILS systems now installed are substandard because of terrain interference. This does not mean the equipment is unsafe—only that its full capability cannot be utilized. Landing minimums, for example, may have to be raised to compensate for the deficiencies of the installation.

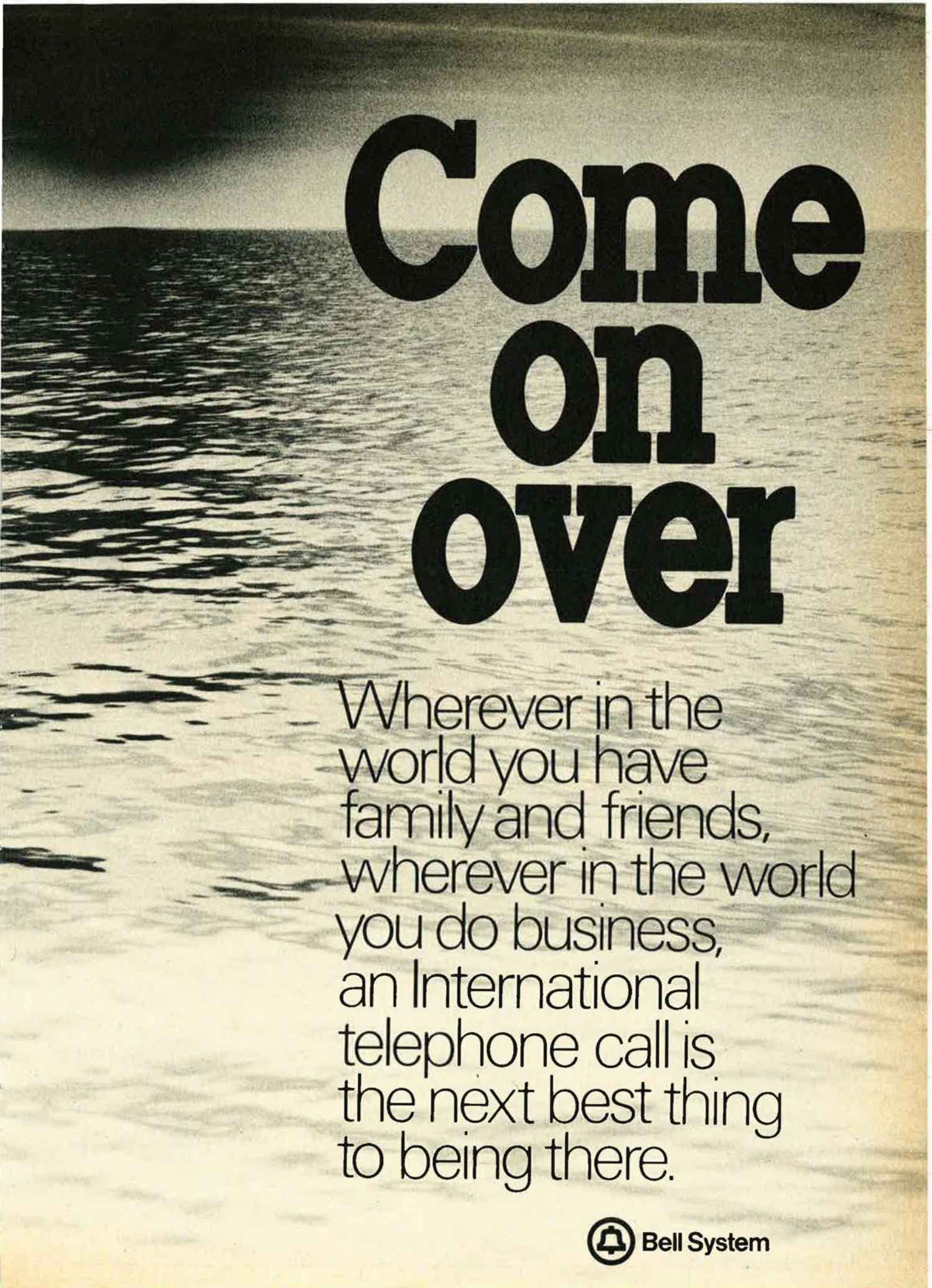
The higher frequency MLS microwave transmissions are much less susceptible to multipath interference than the VHF/UHF ILS beams because of the shorter wavelengths. In addition, the sweeping beam used in the TRSB system "illuminates" objects that might cause interference for only a relatively short time compared to the continuous ILS signal.

TRSB also uses "time gating" to reject reflected signals that arrive before or after the direct



MLS hardware, including this Back Azimuth Element, is being tested at FAA's National Aviation Facilities Experimental Center (NAFEC) near Atlantic City, N. J.

An Elevation Element demonstration model installed at NAFEC.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Dr. John L. McLucas was sworn in as FAA Administrator on November 25, 1975, after having served from March 1969 until that date as Under Secretary, Acting Secretary, and eventually Secretary of the Air Force. Prior positions included that of president and chief executive officer of MITRE Corp., and Deputy Director for Defense Research and Engineering for Tactical Warfare Systems, DoD.

signal and "multipath averaging" to cancel out those that arrive almost simultaneously. The latter technique is based on the effect the movement of the aircraft has on the relative phases of the two signals.

Because it transmits a cleaner, more precise signal, essentially free of multipath interference, MLS will permit simultaneous operations on parallel runways spaced much closer together than is now possible with ILS equipment. FAA presently requires 4,300-foot separation for parallel runway operations, and only a handful of airports qualify under this criterion. With the advent of MLS, this separation standard can be significantly reduced—perhaps cut in half—making parallel operations possible at a great many more locations. The effect will be to expand airport capacity without expanding airport boundaries.

MLS also will solve the frequency congestion problem that plagues ILS and limits its growth potential. ILS has only forty available channels because it operates in the congested VHF/UHF portion of the frequency spectrum. MLS will have five times that number—200 channels—utilizing the relatively uncluttered, much higher frequency C band (about four to six gigaHertz). This is more than enough to meet the growth needs of this equipment for the foreseeable future.

Another significant advantage of MLS is that distance information will be provided on a continuous basis, giving pilots essentially a three-dimensional picture of their position relative to the runway. Pilots can even receive "distance to go" information during rollout after touchdown, along with azimuth guidance, if needed because of poor visibility. ILS must rely on marker beacons placed at intervals along the approach path to tell the pilot how far he is from the runway. This is a far less satisfactory system and can involve considerable expense since real estate must be acquired in many instances for establishment of these facilities.

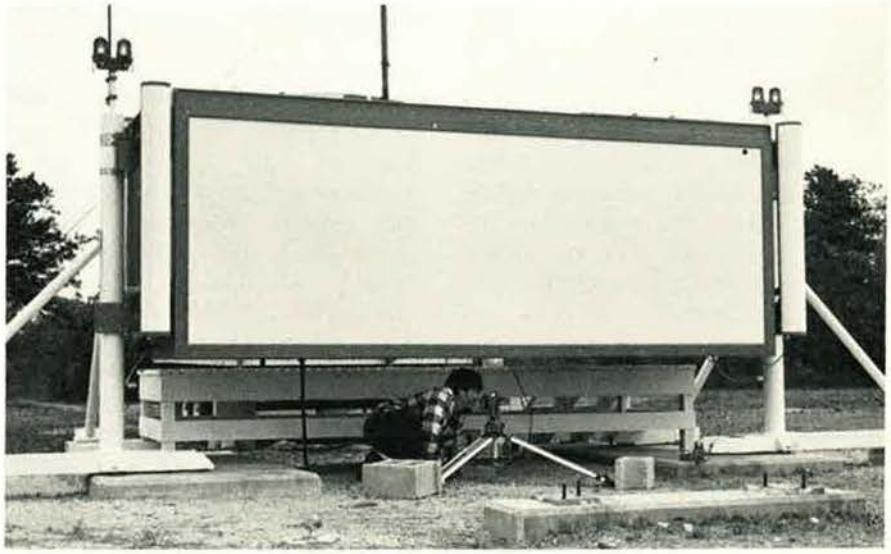
Evolution of the MLS Systems

The need for a new common civil/military approach and landing system to replace ILS and GCA has been recognized for a number of years. Although many improvements have been made in these equipments since their initial development in the 1940s, further redesign has become increasingly difficult and costly. As a result, a number of new systems have been developed and implemented to meet specific requirements—particularly those of the military. Although most of these units operate at microwave frequencies, they do not provide the full range of services offered by TRSB or Doppler equipment. They are basically ILS systems operating at microwave frequencies.

FAA recognizes the value of these "interim MLS" units in fulfilling a specific and limited role at civil airports. For example, they can be used at locations where terrain or other factors preclude the installation of a conventional ILS. However, we do not consider that this equipment offers a long-range solution to approach and landing problems and we expect that installations of this equipment will be phased out in the next twenty years, along with ILS and GCA, in favor of full-performance MLS.

The deficiencies of ILS and GCA and the proliferation of diverse interim systems prompted the Radio Technical Commission on Aeronautics (RTCA) to form a special committee—known as SC-117—in 1967 to explore the feasibility of developing a new universal approach and landing aid. Its report was issued in December 1970 and recommended development of a full-performance MLS utilizing either Doppler or Scanning Beam and incorporating the major features already described.

The US MLS effort began in 1971 with the formation of a joint planning group drawn from FAA, the Department of Defense, and the National Aeronautics and Space Administration. It drafted a five-year plan for development of a common civil/military MLS based on the SC-117 recommendation, and under FAA leadership. Similar



A demonstration model MLS azimuth antenna built by Bendix is also under test at NAFEC. About 1979, MLS will begin to replace ILS and GCA for all aviation.

efforts were launched by other nations, and ICAO undertook to coordinate these programs and developed a schedule for selection of a worldwide standard.

FAA mounted a three-phase program to bring MLS to fruition. Phase I, an investigation of basic engineering design, began in January 1972. This phase confirmed that critical technical problems could be solved and that the two candidate MLS techniques, Doppler and Scanning Beam, had the potential to satisfy all operational requirements.

In Phase II, four companies began working on the two MLS types under FAA contracts. Texas Instruments and Bendix separately developed the Scanning Beam system, and Hazeltine and ITT Gilfillan worked on Doppler.

Between Phase II and Phase III came the crucial decision on which technique to employ. Both systems performed well in Phase II tests, making the decision especially difficult. To assist with the selection, FAA brought together approximately 120 experts drawn from its own ranks and from other government agencies, the military, and other nations engaged in MLS development.

Dubbed the "Central Assessment Group," this core of specialists met in Washington from August to December 1974 to weigh the two techniques and to look at costs, performance, implementation, and integrity. Public status reports and a free flow of information marked the selection process, in sharp contrast to the usual procedure when the evaluators go into hiding and no one really knows afterwards just how the decision was reached.

The Central Assessment Group submitted its recommendation to the seventeen-member steering committee, which included two representatives from each of the military services. It, in turn, voted nine to six to recommend use of the Scanning-Beam system with two members abstaining because of the closeness of the issues. The choice fell to Scanning Beam on the basis of its twelve percent lower cost, lower power consumption, and less crowding of available frequencies (Scanning Beam requires only half the band width of Doppler per channel).

One more step still had to be taken for a final decision on the candidate system. This lay with the interagency MLS Executive Committee, which was chaired by FAA and included representatives from the Office of the Secretary of Transportation, Department of Defense, and NASA. After carefully reviewing the data, the Executive Committee decided in late February 1975 to uphold the recommendation of the steering committee. Thus, the US was officially committed to development of the time reference Scanning Beam system.

However, it should be noted that the US has continued to assess the various potential MLS techniques. Since the February 1975 decision, much additional data has been developed which corroborates the original choice of TRSB as the preferred technique and has prompted other ICAO member states to support this technique.

Prototype Hardware Tests

Phase III is aimed at producing and proving prototype hardware. The two companies involved, Bendix and Texas Instruments, are developing a variety of TRSB configurations to meet the needs of general, commercial, and military aviation. Included is the basic MLS designed to fulfill the requirements of most commercial and military fields, an expanded version for major terminals, and a low-cost version for small community airports. However, both the basic and small community MLS models can be upgraded to higher categories of performance through the addition of modular units.

In addition, the overall Department of Defense MLS program calls for the development of a "milspec" version of MLS. These will be rugged, portable, easy-to-assemble ground units for tactical use in the field by all the military services. Another MLS model is designed for use on aircraft carriers.

Testing the prototype units will begin this fall at FAA's National Aviation Facilities Experimental Center (NAFEC) near Atlantic City, N. J., and at a military test site yet to be selected. FAA will provide the services with ten airborne receiver-processor units, which will enable them to gain operational experience with this equipment while participating with civil aircraft in early compatibility testing. Following completion of the preliminary engineering test and evaluation activities at NAFEC, the TRSB units will be redeployed at various airports around the country to gain operational experience in different terrain and environmental conditions.

By any measure, the United States will be the biggest user of MLS, just as it is the primary user of ILS today. Preliminary FAA estimates indicate that more than 1,000 civil airports are candidates for MLS installations, with some in line for multiple units. In addition, there are a great many military airfields where MLS is likely to be installed. The Air Force alone anticipates a need for some 200 units to replace GCA equipment at more than 100 bases. The Army, Navy, and Marine Corps also are expected to phase out GCA in favor of MLS at more than 100 locations. Perhaps an even larger number will be purchased by the services for tactical use.

The transition from ILS and GCA to MLS will be a gradual process, spread over a period of perhaps twenty years. During this period, the present and future landing systems will "coexist" with each other at many locations to accommodate the needs of all airspace users and minimize the economic impact of converting to the new equipment. By 1990, however, MLS already should begin to outnumber ILS and GCA installations and, by the end of the century, it will have achieved the status of "universal" landing aid in fact as well as in name. ■

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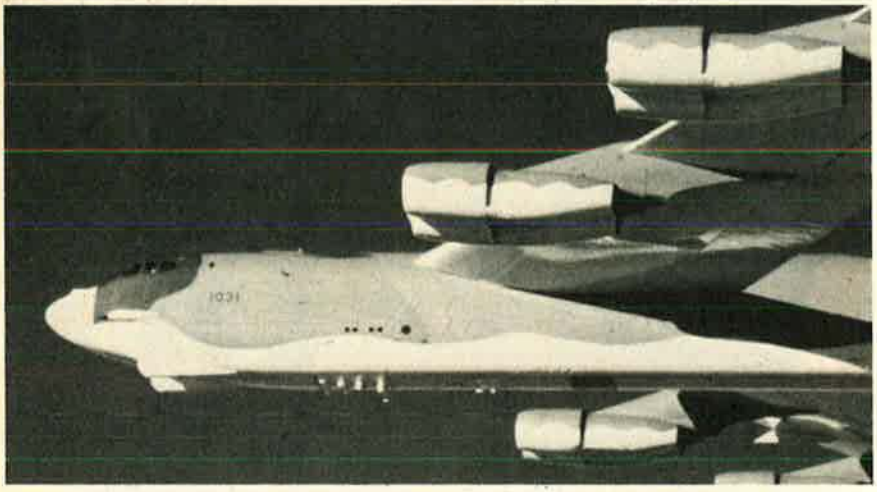

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A-10 PILOT REPORT

Four SEA combat veterans assigned to the A-10 Joint Test Force at Edwards AFB, Calif., assess USAF's new, specialized close air support (CAS) aircraft. Based on their combined total of nearly 500 hours in Fairchild's flying arsenal, they conclude that when it comes to CAS . . .

The A-10 Does It Better

BY MAJ. JOHN F. GULICK, USAF

"I WOULD like to say . . . the modern fighter-bomber must be maneuverable, relatively slow, rugged, and high-powered, also capable of carrying great loads long distances." That's the way one fighter pilot put it. "I believe that it will be this type of aircraft that will afford the greatest amount of cooperation for our ground armies. This is one phase of air warfare not requiring aircraft that invade the field of supersonic speed."

That was the prophetic judgment of Lt. Col. Ralph Jenkins, a P-47 pilot with seventeen months of combat experience in Europe. His statement appeared in the March–April 1946 issue of AIR FORCE Magazine and is now mirrored by new-generation fighter pilots who fly the close-support aircraft of today, the Fairchild A-10.

It's a new approach for the Air Force in fulfilling its assigned mission of providing close air support to our combat soldiers. For this aircraft has been designed and built primarily with one mission in mind: providing the optimum in aerial delivered firepower to support our Army, Marine, and allied ground forces in the combat theater.

The A-10 can loiter over the battlefield for extended periods, carries up to 16,000 pounds of mixed conventional ordnance, contains built-in survivability features to enhance its ability over the modern-day battlefield, and carries an internal 30-mm GAU-8/A gun system that has proved its effectiveness against tanks, including the Soviet T-62.

But in order to find out more about flying the A-10, we asked the pilots of the A-10 Joint Test Force who represent both the Air Force Systems Command (Lt. Col. Karl Jones) and the Tactical Air Command (Lt. Col. Dale Tabor and Majs. Roger Carleton and Al Barnes). This is their pilot report on the A-10.

The A-10 has been under flight test since 1972. In your opinion, will the airplane do the job it was designed to do?

Colonel Jones: Yes. But the real issue isn't so much a matter of whether the A-10 can do the

job—I think we all feel it can—but rather, the A-10 happens to be the only airplane that *will* do the job. There is not another aircraft—single or in combination—that can do the close air support mission like the A-10.

Colonel Tabor: I think it will do the job better than any other airplane. I'd like to point to the European environment with bad weather, and a situation in which there are ten enemy tanks. I've got to go in and kill all ten; I'll do it better in the A-10. I'll give you your airplane, and give you as many passes as you can live through—and I'll beat you at it.

A-10—Facts and Figures

Designer and Manufacturer	Fairchild Industries
Primary Mission	Sustained close air support
Powerplant	Two General Electric TF34-GE-100 turbofan engines, each about 9,000 pounds of thrust
Length	53 feet, 4 inches
Height	14 feet, 8 inches
Wingspan	57 feet, 6 inches
Internal Fuel Capacity	10,470 pounds
Operating Weight	24,000 pounds
Maximum Gross Weight	47,200 pounds
Armament	One 30-mm. General Electric GAU-8 seven-barrel Gatling gun
Ammunition Capacity	1,350 rounds
Firing Rate	2,000/4,000 rounds per minute
Ordnance Capacity	Up to 16,000 pounds of mixed ordnance on ten underwing pylon stations with partial fuel. Can include both free-fall and laser-guided weapons, rockets, Maverick missiles, etc.
Takeoff Distance (with 5,000 pounds of ordnance)	1,900 feet (unimproved runway)
Distance at Max. Takeoff Weight	4,000 feet
Ferry Range without Inflight Refueling	2,000 nautical miles
Speed	345–450 knots
Loiter Time with 250 NM radius, 18,750 lbs. bombs, 750 rounds 30 mm.	2.0 hours
Crew	Pilot only
Fire Control System	Head-up display, TV monitor and control, armament control system, and Pave Penny laser search-track set
Production Status	Currently producing one per month, going to two per month in August 1976, and three per month by January 1977. Maximum rate of 15 per month is to be achieved by 1979. Total Air Force buy is projected at 733 production aircraft
Deployment	As of June 1, 1976, the 355th Tactical Fighter Training Wing, Davis-Monthan AFB, Ariz., had six A-10s. First operational unit scheduled to receive the A-10 is the 354th TFW, Myrtle Beach, S. C., with an IOC of January 1978

One of the primary design considerations in the A-10 was that working under low ceilings and looking for tank-size targets, you don't need a 500-mph airplane. Do you agree with that?

Major Barnes: Very definitely. You hear some "bad mouth" on the A-10 because it doesn't go fast. But what is forgotten is that even if you had a 500-knot airplane, you'd still be at 300 knots in that environment. A high-speed airplane just isn't necessary to do the job.

Colonel Tabor: In order to kill the target, especially something like a small tank, you've got to pick it up with your eyeballs. We don't have a good capability to kill a target you can't see. You may be able to pick it up at 500 knots, but you probably can't bring the aircraft to the attack heading in time to bring your ordnance to bear. And, of course, the additional difference is the gun.

Do you feel comfortable in the airplane from a survivability point of view?

Colonel Jones: In a European scenario, I would feel that I had a better chance, given the constraints that the airplane was designed for, of surviving in the A-10 than anything else. I can't say I'd like to go Downtown [to Hanoi] in the airplane, but then again I didn't enjoy going Downtown in the F-4 either.

Major Barnes: I agree. I feel that I'll survive better than anybody else under those conditions.

Colonel Tabor: I can remember I was convinced, in my own mind, that the faster I could go the better my survivability. But what's important is that you may see a tank while going in at "Warp 9" [colloquial for "high rate of speed"], but trying to keep it in sight under Gs, and also trying to bring the ordnance to bear on it, you just can't do well with other aircraft.

Major Barnes: Velocity only gives you a decreased exposure time across a certain point. If you're going to set up a pattern, you're going to be exposed anyway. You can go into a displacement at 300 knots and four Gs as opposed to 600 knots and six Gs. How much angle rate do you generate with higher airspeed and G combination? I don't believe there is a significant difference. You've got to be able to maneuver the airplane. Velocity alone is not the answer.

Are you using standard TAC tactics with the A-10 or is the airplane making you rewrite the tactics manual?

Major Barnes: Well, we haven't rewritten it. We're probably going to revise some things and relearn a few that some people have forgotten. A lot of the tactics that applied to other slow movers, such as the A-1, A-37, and A-26, can be used again. But of course you have more capability in the A-10, and those tactics have to be modified. Basically, the goal is still to keep your energy up and keep the airplane loaded up—

don't fly around unloaded. That has not changed.

Would you say the A-10, for lack of a better word, is a more tactic-intensive airplane?

Colonel Tabor: It's going to require more pilot skill than most airplanes, if you use it effectively. However, it's a very simple airplane to fly. We're going to have to stress training. We'll have to train new pilots how to DR [dead reckon] the target again. Pilots are going to have to have enough training to instill not only the confidence but also the ability to use that gun. It's a good weapon. But if a pilot is not comfortable with the gun and doesn't have enough training to be able to employ it, what good is it? And he's got to rely on himself. There are no magic systems in the A-10. It's strictly up to the pilot to get the ordnance on target.

Major Barnes: The A-10 allows you to devote your attention to the job at hand rather than to flying the airplane. It's truly a head-out-of-the-cockpit airplane. You're not going to get yourself in trouble unless you fly it into the ground.

Could you cite some specifics as to the A-10's performance?

Major Barnes: Well, we stall them at very low altitudes, and, so what? You stall it so you back off a little bit. You don't have to be concerned about exceeding X-angle of attack, or any nasty characteristics the airplane has, because it just doesn't have any. It's all done by pilot feel. We've taken the A-10—during a simulated defensive break—from 1,000 feet to wings level at less than fifty feet off the ground in seven seconds. Now that requires pointing the airplane down and pulling on it pretty hard. I don't think I would want to try it in anything else.

Colonel Jones: I've flown the A-10 during a number of aerial demonstrations. In fact, I was probably more impressed than anybody watching, because when you see it from the cockpit you can't believe that the airplane is doing what it is. I've done low-altitude loops and, believe me, when you put in your mind the number that you're going to have for speed, you're not going to try it unless everything sorts out OK. You just don't think the airplane is capable of doing what you're asking, and yet, when you put your hand on the stick, the A-10 does more than you can possibly imagine.

We've read about the gun and the recent tests against Soviet tanks. How good is the GAU-8/A gun system?

Major Barnes: It's fantastic. We did most of our firings at 300 to 350 knots and thirty, fifteen, and forty-five degrees. A typical pass, and the one we liked best, was at thirty degrees. Slant ranges were from 6,000 and 4,000 feet down to about 2,500. Picking up the tanks under those conditions was no problem. Shooting from 6,000 feet, for example, it takes about 2.3 seconds for the rounds to impact. You can see there's not much delay there. On two-second bursts, I had rounds impacting on the tank before I let go of the trigger. The confidence you develop in the gun is amazing. We instructed one guy who had never fired the gun: "When you shoot the GAU-8, put the pipper on the target and shoot. Don't worry about airspeed and slant range." When he came back to debrief, he said, "You know, when you shoot the GAU-8, you put the pipper on the target and don't worry about airspeed and slant range." Sure, this is probably an oversimplification; however, this is the type of performance we expect from the gun. It's just amazing.

The A-10, the first aircraft designed specifically from the outset for the close-support mission, is scheduled to join the Air Force's operational inventory early in 1978.

Could you relate the A-10's performance to an operational situation?

Colonel Jones: It's important to relate the A-10's capabilities to the constraints that have been put on the airplane, working 1,000-foot ceilings and one-mile visibility, mountains, rough terrain, fog, etc. You can relate that very easily.

The author, Maj. John F. Gulick, is Special Assistant for Information, Deputy for A-10, at AFSC's Aeronautical Systems Division, Wright-Patterson AFB, Ohio. Following his initial assignment at Eglin AFB, Fla., he served for two years in Thailand as Deputy Director of Information, 7th/13th Air Force, and as aide to the Commander of that organization. Prior to assuming his present duties in 1974, he served for four years in the Office of Information, Hq. USAF. Major Gulick holds a bachelor's degree in journalism and an MS in public relations.

Because basically, we have designed the airplane to do a certain task—like a Volkswagen won't carry eighteen people or go 150 miles an hour—but it does a very certain, definite job. That's the way I feel about the A-10. If you want to go "Warp 9," you won't do it in an A-10. But to fight a close-in war, killing a tank in bad weather and rough terrain, there's nothing else that can do the job. It's that simple.

Colonel Tabor: I like the stick position in the airplane. It's up nice and high where you can get a good hold on it. Secondly, the harmony of the flight controls is very good and the visibility is outstanding. You can sit in the cockpit and actually turn around and maneuver the airplane. You've got a good capability to turn the airplane to keep any target in sight.

What are your feelings about the defensive air-to-air capability of the A-10?

Colonel Tabor: The A-10 is not an air-to-air machine. But it's not going to be a patsy in its own domain either. We flew the A-10 against both high-speed and lower-speed fighters. Generally, we found that with ordnance we could use the turning capability of the airplane and keep the attacker off our back. You just can't believe how you can rotate the nose of the airplane through the sky when you do a hard defensive turn. And another key point, even if you have to jettison your ordnance, you're not out of firepower because you've still got 1,350 rounds of 30 mm., which is fantastic.

How responsive is the A-10 with a large ordnance load?

Major Carleton: We've all flown the bird with eighteen MK-82 500-pound bombs, and even with this load the A-10 can maneuver. Sure, some performance goes down with that load just like any airplane, but the roll response of the A-10 is still high. You don't feel restricted. You can put the stick in and get the roll response you want.

Could you comment on how you see the A-10 employed as part of the USAF/Army combined armed team?

Major Carleton: It seems that in some articles I read on the A-10, there is a tendency to isolate it in the European environment. And what is for-

gotten, in my opinion, is the synergistic effects, the total effort that is going into defeating any invasion by the Warsaw Pact forces. The bad guys not only have to worry about A-10s, but also F-4s, F-111s, and A-7s. They also have to worry about the ground defense. Hopefully, the A-10 won't have to concern itself with the possible air-to-air threat because the F-15s and F-16s will be there, too. And the AWACS.

Does the fact that the airplane has been designed to sustain hits bother you?

Major Carleton: Not really, because in the real world we know the A-10 is going to take hits. When you take a look at the 1967 Israeli war, it lasted a little more than six days. You've got to generate a lot of sorties in six days, and that's what this airplane is all about.

Is it tough to check out in the A-10?

Major Barnes: Flying the A-10 is really a piece of cake. We have a three-ride checkout program and on the first ride we do stalls, some maneuvering and speed-brake exercises, and so on. We start off giving the student what we consider a very comfortable pattern in his first simulated weapon delivery; a base that's about 3,500 feet above the ground, and a release altitude of 2,000 feet. I say that's comfortable because we'll drop thirty-degree dive bombs at 1,500 feet using a 1,000-foot minimum. After ten minutes or so in the airplane, a student will be doing thirty degrees with simulated 2,000-foot releases and forty-five degrees at simulated 2,500-foot releases with the airspeed around 325 to 350 knots. Of course, when you feel the airplane do a nice four or five G pullout, a new guy tends to keep the G in as long as he's used to, and usually ends up doing a vertical recovery on top of the target. So we just tell him to come off the target, get your altitude, and when you start to come back in, just drop the nose first to pull it through. It normally takes about fifteen minutes on your first A-10 flight to feel like you've been flying the airplane for ten hours.

Colonel Jones: To me, one of the most impressive things about flying the A-10 is feeling comfortable from the start, even for the new pilots. During all the patterns, including simulated single engine, we just turn a new guy loose. And nobody has had any trouble with the airplane.

Major Carleton: I just want to mention that there are two things that are really nice about the A-10. First is the cockpit and crew station. It's just super. Second, it's difficult to get into trouble with this airplane. I think everybody has found this true. To get it into a spin, you've got to hold spin controls for ten to fifteen seconds. All you have to do is just let the controls go neutral and fly out saying, "There you go, dummy!" We've even done some training departing the airplane in vertical stalls, and it was easy—in fact, it was kind of fun.

Colonel Tabor: And you can get airborne in a hurry, too. Al Barnes and I clocked a simulated scramble. Standing sixty to 100 feet from the airplanes, we were airborne in three minutes and twenty-nine seconds. That's not too shabby. ■

An A-10 undergoes icing tests, with water sprayed from a KC-135 directly in the test plane's path. Note yellowish ice build-up on the leading edges of wings, tail surfaces, the nose, and engine cowlings.

AFA's Symposium, "Tomorrow's Strategic Options," involving ranking government and military experts, probed crucial issues associated with the nation's nuclear deterrence posture and arms-limitation problems. The first part of the proceedings, covered in the following article, focused on . . .

SALT II'S GRAY-AREA WEAPON SYSTEMS

BY EDGAR ULSAMER
Senior Editor

WITH the Soviet threat reaching proportions calculated to "intimidate us like we have never been intimidated before," the US needs an unmistakable national consensus supporting "those strategic options that will ensure that this magnificent nation of ours remains . . . clearly second to none and in absolute control of its destiny." Helping achieve such a consensus was the task assigned to the Air Force Association's Symposium on "Tomorrow's Strategic Options" by its keynoter, Gen. Russell E. Dougherty, CINCSAC. The two-day program, attended by about 700 aerospace industry executives and AFA and civic leaders from around the country, was held at Vandenberg AFB, Calif., April 28–29.

Asked whether the sixty additional Minuteman III ICBMs sought in President Ford's recent supplemental budget request should be deployed or kept in reserve, General Dougherty said that if it were up to SAC, "I would want to deploy them. . . . I would feel more comfortable with them in the ground." He added that the 341st Strategic Missile Wing at Malmstrom AFB, Mont., consisting of one Minuteman III and three Minuteman II squadrons, is undergoing major silo modification. Now "would be a very convenient time" to replace the single-warhead, older Minuteman IIs of that wing with the MIRVed Minuteman IIIs. Doing so would not affect the ceiling of 1,320 MIRVed central launch systems, set by the 1974 Vladivostok understanding, since, with current deployment rates, the US would not reach that number until about 1981, he said.

(Administration testimony in support of the supplemental budget request emphasized that if the national interest required additional Minuteman III deployment, "fifty missiles now in storage could become operational by the end of this calendar year. Additional deployments could be accomplished in increments of fifty over the next two and a half years. Thus, we could achieve a Minuteman III force of 700 by mid-calendar year 1979.")

"Deterrence in the Age of Détente"

"The choice is only between maintaining deterrence across the full spectrum of atomic weapons," or failing totally to provide credible deterrence. There are no alternatives to this continuum of deterrence, contrary to assertions by some critics of US defense policy, according to Dr. John Lehman, Jr., Deputy Director of the Arms Control and Disarmament Agency (ACDA). His presentation dealing with "Deterrence in the Age of Détente" rested on two basic definitions: *détente* in the language of the Defense Department denotes "the approach we use with nations who are not our friends . . . who don't share our principles . . . whom we are not sure we can trust . . . who have military power and have shown an inclination to use it to the detriment of freedom"; *deterrence* means attempts to *dissuade* inimical actions or policies of such an adver-

sary by *"persuading* him that the consequences . . . would outweigh the possible benefits."

Actions and policies that the Soviet Union, a "very formidable superpower," must be dissuaded from taking extend, according to Dr. Lehman, from all-out nuclear exchange to intimidation of US allies to attempted "Finlandization" of Europe, or even down to actions "rather marginal to the US national interest but nevertheless directed against Western interests," such as recent Soviet support of the leftist faction in the Angolan civil war. For this dissuasion/persuasion process to work, the US must project both the ability and the will to deter across the full range of potential Soviet challenge, he said.

The US ability and determination remained credible and, therefore, constituted effective deterrence until about 1970. Until then, the so-called assured destruction posture rested on this nation's strategic superiority. But by the end of the past decade, Dr. Lehman said, it became clear to US defense policy-makers that the two essential factors of strategic deterrence were in jeopardy. The Soviet numerical lead in strategic systems had made this nation's inflexible assured destruction policy irrational, reducing it to a mutual suicide posture, in the view of US policy-makers. On the one hand, US ability to inflict unacceptable damage on the USSR after absorbing a Soviet first strike had been put in serious question because of the Russian deployment of large throw-weight, high-yield weapons, coupled with the comprehensive and accelerating Soviet civil defense effort. On the other hand, US resolve was called into question, according to Dr. Lehman: "Is it rational [to assume] that any President would choose to order a second [retaliatory] strike against Soviet forces so large that our own counterforce capability was reduced to a point where cities and people were the only targets we could strike? . . . Under these circumstances, the remaining Soviet capability could not be taken out by our second strike, [thus virtually assuring] a Soviet third strike superior to our second strike."

Dr. Lehman pointed out the ironic inconsistency of US opponents to a strong strategic deterrence posture who, when the US had an undisputed lead in nuclear capability, charged that "this was destabilizing and wicked, and that the Soviets should be permitted to catch up. But when the Soviets, after 1962, indeed undertook a massive buildup program and kept going well beyond the gross number of delivery systems and throw weight of the US, these same voices were heard saying that superiority was meaningless and that it is really minimum deterrence that counts."

The assured destruction policy's lack of credibility led, early in the 1970s, to adoption of a much more flexible US strategic policy and a new targeting doctrine. These innovations were keyed to limiting casualties and collateral damage and to increased counterforce capability in order to redress the prevailing Soviet advantage in the second/third strike phase. For the US to deter in a flexible manner across the entire spectrum of potential Soviet provocations requires a broad mix of forces since there is "no firebreak" between strategic, theater, tactical, and seapower deterrence, involving nuclear weapons, Dr. Lehman told the AFA meeting. A case in point, he said, is the need for effective strategic deterrence "against possible scenarios involving attack on our European allies that can't be contained by our theater forces, even with tactical nuclear weapons."

In that context, Dr. Lehman theorized, there is "cause to question" US policy as well as the mix of forces and their deployment in the NATO area. The decision to redress the Soviet/Warsaw Pact lead in conventional forces through US reliance on tactical nuclear weapons can be seen as "a dangerous narcotic that created an easy addiction" by the European NATO nations to avoiding the high budgets associated with conventional forces, Dr. Lehman suggested.

The prudence of relying on US tactical nuclear weapons has been made even more questionable by the "substantial tactical nuclear capability developed and deployed recently by the Soviet Union. The question arises as to whose advantage it would be to initiate an exchange of tactical nuclear weapons in a NATO war. The crucial question that needs to be asked is whether deterrence is really being served by US emphasis of its tactical nuclear capabilities in Europe—and I mean by deterrence not just parrying Soviet thrusts across the border but the overbearance of Soviet influence and pressures on Western European affairs." This problem, and its impact on Western Europe in whose "backyard" these weapons would be used, have acquired a complexity that "has not yet been fully thought through in Washington," Dr. Lehman told the AFA audience.

Another critical form of deterrence, different in meaning to the US than to such countries as the Soviet Union and Red China, is seapower: "We depend on sea

ACDA's Deputy Director, Dr. John Lehman, Jr., assessed SALT II and the "gray-area" weapon systems.

lines of communications for our energy, for our trade, and especially in our European commitment," according to Dr. Lehman. This nation's principal adversaries do not share this vulnerability. The US problem is made worse, he claimed, because "it is easier for an adversary, such as the Soviet Union, to interdict [this nation's] sea lines than for us to maintain them."

"Gray-Area" Weapon Systems and SALT

The principal stumbling blocks delaying or jeopardizing conclusion of SALT II are the so-called "gray-area systems," Dr. Lehman said. These new weapons, in the main, are the Soviet "Backfire" bomber, cruise missiles, and the new Soviet SS-X-20—a MIRVed and nuclear-armed intermediate-range missile. The phrase "gray-area systems," he said, derives from the fact that they "are principally designed for theater application and less for central, intercontinental use [even though they have] undeniable application in a strategic exchange." These systems, which make verification extremely difficult, can neither be ignored nor treated exactly like the central systems dedicated to the intercontinental role.

The Soviet Union, he said, has in being a cruise missile force of "substantial" size involving "big machines, big warheads, and a great deal of volume. These missiles are deployed on submarines and are intended primarily for antishipping missions. But they also have an inherent strategic capability, since fifty percent of the US population and industrial base is located within 150 miles of our coasts. This means that a 600-km. cruise missile deployed in Soviet submarines has a soft-target capability, yet we can't tell through our national means of verification" what kind of cruise missiles and associated warheads are deployed aboard submerged Soviet subs.

The verification problems increase as the range limits stipulated by a prospective accord decrease. In the case of the 600-km. range limit proposed by the Soviets, the "fudge factor is at least two," meaning the US could not detect a doubling of the weapon's range, he said. If the limits are set high, the opportunity to "cheat" without detection is lessened because under such conditions the additional fuel volume would become noticeable, the ACDA official said.

The new SS-X-20 intermediate-range MIRVed ballistic missile, Dr. Lehman said, "has a great many potentially disturbing features . . . and if deployed in large numbers, say over a thousand, [creates] a potential breakout problem that could become very troublesome." With a range of about 2,500 miles, it is essentially a two-stage variant of the three-stage SS-X-16, a new ICBM capable of mobile deployment. The SS-X-20, according to the ACDA official, is apparently meant to replace older Soviet medium-range ballistic missiles targeted against Western Europe and mainland China. The new missile could be upgraded surreptitiously through the addition of a third stage, thus transforming it into an ICBM.

Also, the SS-X-20 increases the threat to our allies and exacerbates the so-called forward-based systems (FBS) problem, he said. In earlier rounds of the SAL talks, the Soviets attempted to include US nuclear-capable tactical aircraft based in Europe, US carrier-based aircraft, and French and British submarines carrying ballistic missiles, while refusing to count their own IRBMs and intermediate-range aircraft such as the Su-19 Fencer, Backfire, and other nuclear-capable attack forces directed against NATO and US forces in Europe, according to Dr. Lehman. "As we see them develop new gray-area systems that not only increase their capability against these targets but have an upgrade potential," the problem becomes worse. Further, it is "possible that the Soviets have targeted some of their ICBMs against Western Europe and China." With the introduction of the SS-X-20, these ICBMs "could be retargeted against the US," he suggested.

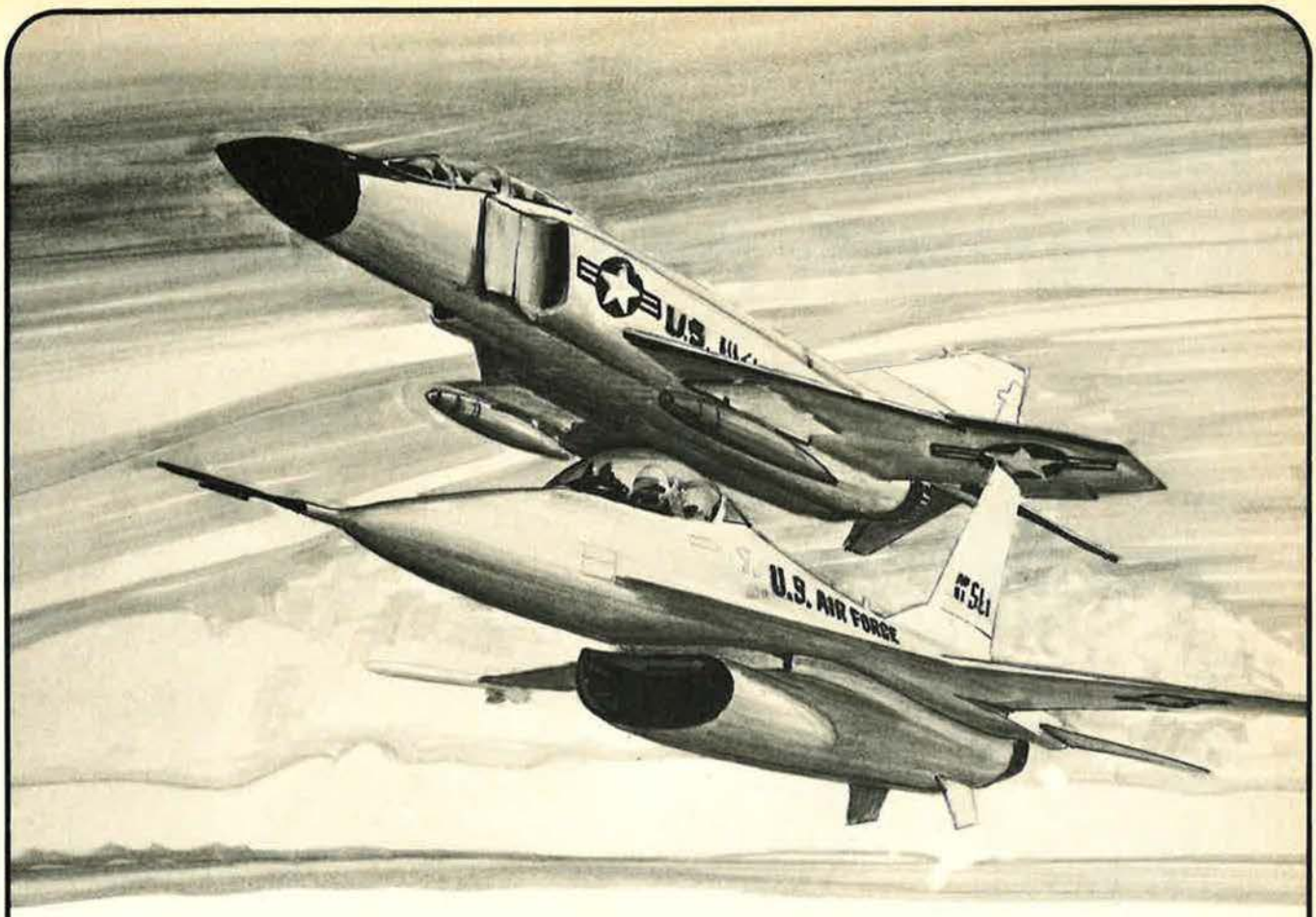
In discussing ACDA's new role regarding arms-control impact statements on new or proposed US weapon systems, Dr. Lehman explained that under recently passed legislation, the Defense Department and ERDA [Energy Research and Development Administration, in charge of all US nuclear warhead developments] have to submit to ACDA full information on R&D programs involving weapon systems that have nuclear applications or that affect arms control in other ways, and whose eventual acquisition cost might reach $50 million or a life-cycle cost of $250 million. ACDA, on the basis of this information, then prepares its own analysis and recommendations, which are forwarded to the White House and, presumably, through the National Security Council, are incorporated into the Administration's budget proposals.

Because of insufficient lead time, ACDA is assessing only twenty-five programs included in the current budget request, but will increase that number to 100 programs in the coming fiscal year, Dr. Lehman said. The original proposal that ACDA submit its findings directly to Congress was changed because of the agency's strong opposition to being cut out of "the executive branch's decision-making pattern."

US Nuclear Warhead Programs

By 1980, according to US intelligence estimates, the Soviet Union will have matched the US in the number of missile warheads. The average yield of Soviet MIRVs will be about three times that of the highest yield US MIRV, ERDA's Deputy Assistant Administrator for National Security, Maj. Gen. Edward B. Giller, USAF (Ret.), told the AFA Symposium. ERDA is developing several new warheads and studying others to prevent a major disparity in counterforce and other capabilities in favor of the Soviet Union, he said.

In engineering development are three new variants of the B-61 nuclear bomb that incorporate improved security and safety devices, including "a nonviolent command disablement." The new B-77 Full Fuzing



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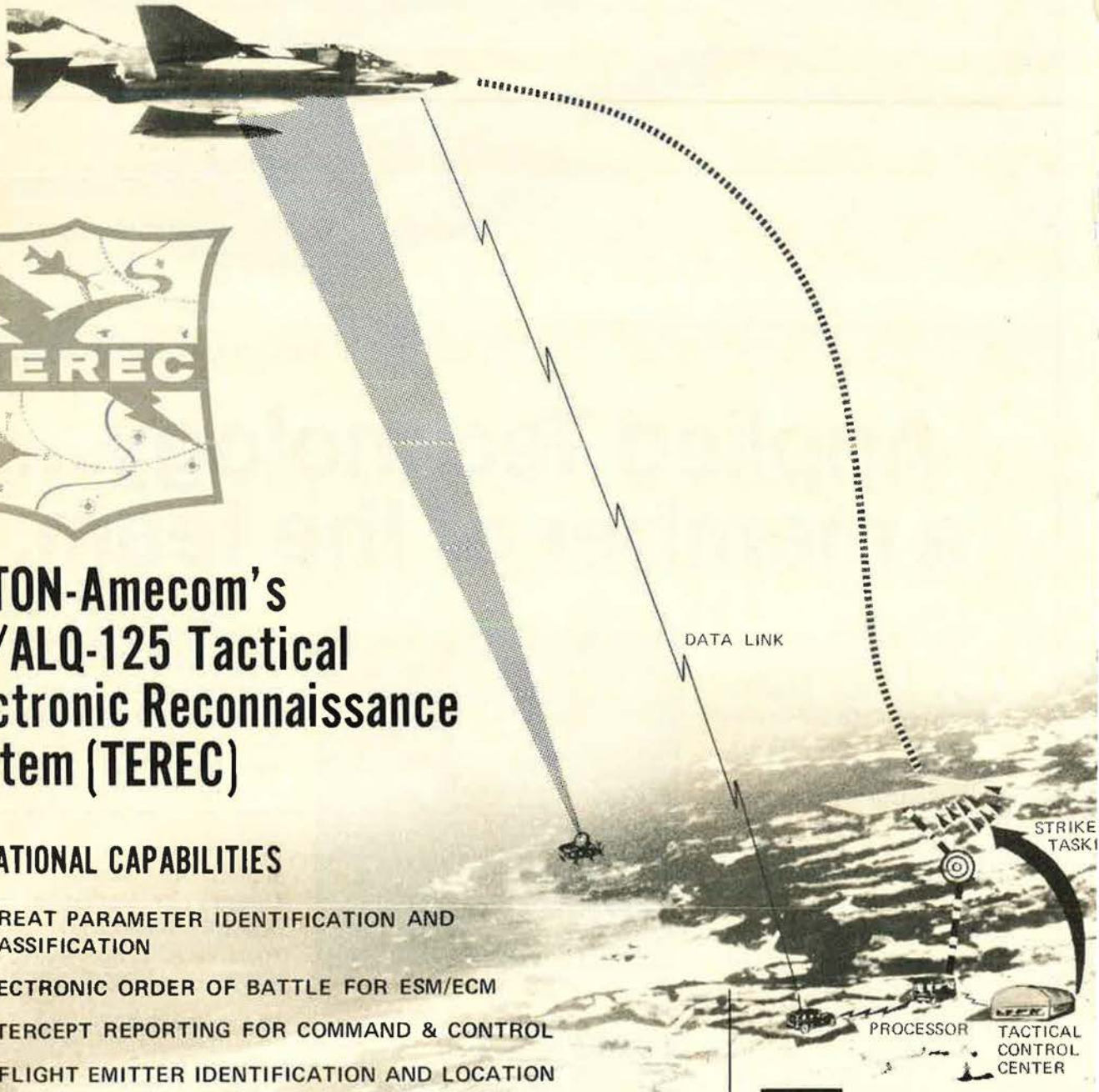

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Option (FUFO) bomb provides the Air Force with a weapon in the high-yield range yet is as flexible as the lower yield B-61, General Giller said. The B-77 bomb's design is tailored to the penetration requirements of the next decade and includes such advanced safety features as "insensitive high explosives to prevent fissile material scatter in case of a crash."

In addition, the W-76/MK 4 Trident warhead, the W-78/MK 12A improved warhead for Minuteman III ICBMs, and the W-79 eight-inch, low-collateral-damage artillery projectile also are in engineering development. Coming up behind these systems are five warheads whose advanced development has been completed: A high-yield MIRV suitable for deployment on Trident or MX, low-collateral-damage warheads for Pershing II, a warhead for future air-to-surface or cruise missiles, the MK-500 Evader MaRV, and low-collateral-damage bombs.

The most important advance in weapons design in the next decade, General Giller predicted, will come in areas other than simple yield-to-weight improvements, such as:

- Development of a variety of low-collateral-damage weapons with controlled radiation output, lower fission content, or earth penetrators.
- Still smaller and lighter weapons that can be adopted to a greater variety of delivery systems, including precision delivery weapons.
- Crashproof weapons that will not scatter radioactive material after impact.
- Cheaper weapons that require less special nuclear materials.
- Further advances in variable yield and insertable capsule weapons that might permit a reduction of stockpiles without impairing military effectiveness.

ERDA's Deputy Assistant Administrator E. B. Giller said Soviet nuclear technology rivals that of the US.

General Giller said that in spite of many unknowns there is evidence that Soviet nuclear warhead technology is "supported by a large . . . basic research [effort]. More than ten Soviet tests since 1970 have been in the megaton and multimegaton range, presumably related to" the new generations of Soviet strategic delivery systems. Over the same period, there has been only one US test involving a yield of more than one megaton, the warhead for the Spartan ABM system, he said. It is probable that Soviet high-yield warhead technology is "at least" on a par with the US. "They are getting better in electronics, which could lead to more yield and more RVs," in turn capitalizing on their far greater throw weight, he stressed.

"While we know comparatively little [about] Soviet tactical nuclear weapons, the variety of their . . . tactical delivery systems is visibly increasing. . . . As their tactical nuclear capabilities have improved, they have increasingly recognized a distinction between intercontinental and theater nuclear warfare. Early Soviet tactical nuclear systems were apparently high-yield weapons. We are much less certain about the systems they have introduced in recent years. Those who argue that US introduction of low-collateral-damage tactical nuclear weapons is meaningless as long as the Soviets maintain high-yield systems ignore the possibility that the Soviets have already moved toward lower yield systems or will do so in response to the US initiative," General Giller told the AFA Symposium.

The new Threshold Test Ban Treaty with the Soviet Union, limiting underground tests to 150 kilotons while curtailing the development of higher yield weapons, will not interfere with US strategic weapons requirements in the foreseeable future: "Under the . . . 150-kiloton limit, the US can still develop advanced penetrators as well as improved strategic and tactical warheads designed for lower collateral damage. We can, to a lesser degree, test the stockpile reliability of our nuclear systems," he said.

As part of the "threshold" treaty, the US is negotiating with the Soviets "the exploitation of what they believe to be the considerable economic potential of peaceful nuclear explosives while prohibiting their use as a cover" for the development of advanced military systems, the ERDA official said. ■

(THIS REPORT WILL BE CONCLUDED IN THE AUGUST ISSUE.)

Critics are again questioning the value of a code that is fundamental to the molding of professional Air Force officers . . .

The Academy Honor System

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

IN spite of their short haircuts and their choice of a Spartan life—Spartan, at any rate, by present-day standards—the cadets at the Air Force Academy are drawn from the mainstream of America. The very rich and overprivileged seldom apply, and the very poor and underprivileged seldom make it. Judged by the usual admission standards, it is a difficult school to enter, ranking just below the Ivy League, MIT, and Cal-Tech. This year more than 9,000 applied, and the quality of the applicants appeared to have been at an all-time high. And, at this moment, the first young women cadets are struggling through the miseries of Jack's Valley along with some 1,500 male classmates. Doubtless there are a few feminine tears as the obstacle courses take their toll, and rude voices yell at them.

It is a curious institution, this Air Force Academy. From an architectural standpoint it is a monument to modern design. The chapel, that celebrated series of wigwams, once the target of every congressman who knew what a church should look like, dominates the scene. All in all, a very modern place nestled against the Rampart Range of the Rockies.

It is modern, and yet quite old—the critics even say archaic—in its determination to hang on to certain standards. One of these standards is the honor system, a code of conduct that has been the subject of considerable publicity over the years. It is a system similar to the one at West Point, whence it was borrowed, and it provides a constant source of controversy for the critics of the service academies. West Point's current honor system difficulties inspired a particularly critical article that appeared a few weeks ago in a number of major newspapers. The author is one Andrew Greeley, who is billed as a sociologist and priest, and as the Program Director of the National Opinion Research Center of the University of Chicago. The article is a vitriolic assault, complete with inaccuracies and juvenile syntax, against all service academies. These schools turn out, says Greeley, goons, fascists, and killers.

There is, of course, no use arguing with people like that, although it is worth wondering why he is syndicated and printed in major newspapers. The facts about these Academies are somewhat different. This year, for instance, Air Force Academy graduates won two Rhodes Scholarships, one Fulbright Scholarship, and two from the National Science Foundation. The Guggenheim Foundation awarded forty engineering scholarships this year; the Air Force Academy won twelve of them. In the past ten years, the Air Force Academy has won nineteen Rhodes Scholarships, a number exceeded only by Harvard, Yale, and Princeton. And, incidentally, poor beleaguered West Point ranks fourth in total Rhodes Scholarships, followed closely by the upstart Academy in the Rockies.

All of this, however, is overshadowed by the fact that the honor system occasionally makes the news. The Air Force Academy, like West Point, has had a number of cheating scandals. With the schools now grown to 4,400 students, and an ever-more-permissive national environment, the chances are there for future scandals. Since these affairs are always traumatic, the question comes up as to the need, or the practicality, of this honor system. What sense does it make?

Before we can answer that question, we must be sure we know what the honor system is, and what it is not. Its basis is simplicity itself: no lying, or cheating, or toleration of anyone who does. It is a system that requires cadets to report themselves when they have violated the code and to report others whom they observe violating it. But—and this is the key point—the reporting and administering of the code are done within the cadet ranks. It is not a system for carrying tales to teacher or for informing to the authorities. It is not a code for snitchers, but a system for maintaining, within the cadet body, a standard for truth and honesty. The theory is that these habits will tend to carry on after graduation. As a matter of fact, they do tend to, and that is what sense the honor system makes.

However, like most things men devise, it is an imperfect system. There are undoubtedly people who go through the Air Force Academy with their lies and cheating undetected. From time to time, there may have been some overzealous reporting and some unfair accusations. I don't know these things, but it seems a fair speculation. Nonetheless, it is a system that works with what appears to be a high degree of effectiveness, a system the cadets give every evidence of supporting by a large majority. There is reassuring room in the system for the adventurous breaker of rules. Slipping out of barracks for a little diversion is a problem for the authorities, not the honor system. As the Air Force Academy operates things, the honor system is simple and open. It mainly boils down to your word being accepted.

Honor Board hearings are held by the cadets, and no stigma is attached to those charged unless they are found guilty. Those found guilty mainly leave quietly. About seventy-five in every class will find themselves unable to live up to, or under, the code, and so they leave, honorably discharged but not what the Air Force had in mind.

These days we seem bent on reducing whatever we can to a least common denominator. The idea seems to be to lower the standards until everyone can meet them. The Air Force Academy, like its sister Academies, has a volunteer student body. These students are, as we have seen, well above the national average in scholastic achievement. Being intelligent, they presumably came to the Academy seeking something other than affluence. And so, if they want to run their internal affairs on a basis of no lying or cheating, it would seem to be their business and to our profit.

There is only one catch. The cadets must run the honor system, not the authorities. If the system were to become a tool of the Academy administration, it would, as it should, collapse. ■

sys·tem (sĭs′təm) *n.* **1. A group of interacting, interrelated, or interdependent elements forming or regarded as forming a collective entity. 2. A functionally related group of elements, as: a. The human body regarded as a functional physiological unit. b. A group of physiologically complementary organs or parts. c. A group of interacting mechanical or electrical components. d. A network of structures and channels, as for communications, travel, or distribution. 3. A structurally or anatomically related group of elements or parts. 4. A set of interrelated**

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The Air Force Association Board of Directors, meeting in Colorado Springs in late May, unanimously adopted a Position Paper on Unionization of the Military. The action was taken on behalf of the 150,000 men and women who comprise the Association. Many of them are active members of established unions. In a letter to Clyde M. Webber, President of the American Federation of Government Employees, AFA President George Douglas said, "We hope that careful consideration of the factors discussed in this statement will lead the membership of the American Federation of Government Employees to decide that unionization of the military would not be in the best interest of all concerned. . . . The issue is a critical one and deserves full and impartial discussion and deliberation." Following is the text of the . . .

AFA POSITION PAPER ON UNIONIZATION OF THE MILITARY

Any plausible reaction to the military unionization movement must begin with the acknowledgment that unions are a fundamental element in our democratic system, and that organized labor is a major contributor to our defense posture.

Beyond that, the AFL-CIO must be recognized as a potent force in keeping our citizens alert to the threat posed by the Soviet Union and to the resulting need for a strong American military establishment. Indeed, during the past twelve months the Air Force Association has issued three special reports to its leaders, each directly related to the AFL-CIO, and each recommended as a valuable source for remarks in support of AFA objectives.

The first of these reports carried a message from the AFL-CIO Executive Council which called upon "the President, the Congress, and the American people to do what must be done to provide for the common defense." We hailed it as "a perceptive and concise analysis of our defense position vis-à-vis the Soviet threat."

The second report was the reprint of an article by Aleksandr Solzhenitsyn, the Nobel Prize-winning Russian author who was exiled from his native country in 1974. The article was entitled "The Third World War Has Ended." Author Solzhenitsyn had visited this country under the sponsorship of the AFL-CIO, and his message to America was a breakthrough in obtaining wider recognition of the nature and criticality of the Soviet threat.

Our third report carried excerpts from an article by George Meany, President of the AFL-CIO, which featured an incisive analysis of détente. It strongly supported the theme of our current Statement of Policy.

If, as surveys indicate, there has been a swing in public opinion toward greater recognition of the Soviet threat and greater interest in a larger US defense budget, the AFL-CIO deserves much credit for this important shift in public attitude.

Against this background, it would seem that Mr. Meany and the majority of other labor leaders, plus the rank and file of organized labor, will find it difficult to support the proposal to be considered by the American Federation of Government Employees, an AFL-CIO affiliate, at its convention in September. This proposal would have the AFGE serve as bargaining agent for uniformed military personnel.

Clyde M. Webber, the National President of AFGE, in testimony before the Defense Manpower Commission, reported that "the mutual benefits of bringing military personnel into AFGE" was based on the premise that the pay systems of uniformed military and civilian government employees were linked by statute. AFGE claims to represent more than 390,000 civilian employees in the Department of Defense.

Mr. Webber makes the point that pay scales for both civilian and uniformed government personnel are based on comparability with industry pay scales, and that budgetary considerations of defense personnel costs always include both the expenses for civilians and for the uniformed military as a single entity.

Although noting that the original concept of military unionization centered primarily on pay, Mr. Webber told the Commission that "other areas of mutual concern have also come to the fore." He identified several of these areas as "common or similar problems in the pension subsidies of both civilian and military personnel, changes in the health care system for both groups, identification of military and civilian positions in the regular operation of military installations. . . ."

In all of his statements on the subject, Mr. Webber has, in effect, configured military personnel in a peacetime setting, as civil servants in uniform.

Leo Pellerzi, General Counsel of the AFGE, put it more succinctly to *The Wall Street Journal* when he stated, "It is a volunteer Army, and that means people are selecting a military career as a means of livelihood, and not for patriotic reasons. Servicemen today aren't responding to an attack on the country. They want to be paid."

Our initial reaction to this is clear cut. If, as Mr. Pellerzi states, the all-volunteer force is producing people who select military careers merely as a means of livelihood, and "not for patriotic reasons," the nation has only one logical alternative: go back to the draft.

As for Mr. Webber's comparability

argument, we have long since noted that the comparability concept is based on the assumption that military and civilian jobs are "comparable" to begin with.

More than a year ago, in a special report to AFA leaders, we commented on this assumption with the question, "Are they?", and added: "Are many civilian employees called upon to uproot their families involuntarily every few years . . . to endure twenty-four-hour alert duty assignments . . . to work overtime without additional compensation . . . to serve in remote and isolated areas . . . to give up certain freedoms and rights . . . risk injury, personal disability, or death, in battle?"

Proponents of military unionization invariably respond to this with the argument that firemen and policemen are unionized, and even go on strike now and again. While we believe that these jobs, for which we have the greatest respect, can be compared to military service only in relation to hazardous-duty assignments, it behooves us to consider what can happen when firemen and policemen strike.

Adm. John S. McCain, Jr., USN (Ret.), in a recent newsletter published by the Public Service Research Council, describes an incident and poses a question that deserves serious consideration: "During the firemen's strike in Kansas City, Mo., late last year," the Admiral reports, "firefighters from surrounding communities would not cross the so-called 'picket lines' of the striking Kansas City firemen. The situation became so dangerous to the citizens that the National Guard was called in to help quell the raging fires throughout that city. If the military is unionized, this would also mean the National Guard. Would they, under unionization, eschew, as firemen in areas surrounding Kansas City, the moral law of helping a neighbor, and not cross the so-called 'picket lines'?"

When you project a military man's right to strike into a combat situation, you, of course, come up with an impossible situation that turns critics of military unionization into fanatics.

But the leaders of the American Federation of Government Employees have made it clear that they are referring to the peacetime training mode of military people when they talk about unionization—and we are inclined to believe them. We can't believe that union authority could extend into warfare, or that union leaders could sell the idea, or would even try.

The Supreme Court has repeatedly ruled that only the military has the constitutional authority to participate in defense activity. As recently as March of this year, the Court stated (*Greer* v. *Spock*): "One of the very purposes for which the Constitution was ordained and established was to 'provide for the common defense,' and this Court over the years has on countless occasions recognized the special constitutional function of the military in our national life, a function both explicit and indispensable."

It also seems logical to assume that union leaders, at least at the outset, would shy away from supporting the right to strike for unionized military personnel. The specter of a military unit being unable to cross a picket line to save lives, as projected by Admiral McCain, presents another unsalable item for union leaders. On the other hand, the right to strike (or sit-down, stay-home, play-sick maneuvers) is a union's ultimate weapon. This presents something of a dilemma. But it is not the immediate problem.

Assuming wartime duty and the right to strike are eliminated from the equation, how does military unionization stack up?

First, it's worth considering the observation of AFGE's legal counsel, Mr. Pellerzi, that "servicemen today aren't responding to an attack on the country" as part of his justification for unionizing servicemen.

This betrays complete misunderstanding of the training function in military life, and no appreciation of what military readiness really means. You can't separate training from combat that neatly—not without the danger of unnecessarily losing military lives and failing to carry out missions in the process. Again it points to the basic fallacy in the union's argument—that of thinking of military people as civil servants in uniform.

With this as a basic premise, AFGE leaders argue that uniformed military people deserve access to the same rights—through unionization—as those available to civilians who work for the Department of Defense. All this, presumably, as a part of the "democratic process" and supported by the First Amendment.

But the Supreme Court doesn't seem to agree. The Court stated (again in the *Greer* v. *Spock* decision of March 3, 1976): "A military organization is not constructed along democratic lines and military activities cannot be governed by democratic procedures. Military institutions are necessarily far more authoritarian; military decisions cannot be made by vote of the interested participants. . . . The existence of the two systems (military and civilian) (does not) mean that constitutional safeguards, including the First Amendment, have no application at all within the military sphere. It only means that the rules must be somewhat different."

In 1974, the Supreme Court enlarged on the latter point (*Parker, Warden, et al.* v. *Levy*) in these words: ". . . while military personnel are not excluded from First Amendment protection, the fundamental necessity for obedience, and the consequent necessity for discipline, may render permissible within the military that which would be constitutionally impermissible outside it."

Indeed, the Supreme Court, in repeated decisions over the last decade, has drawn a clear distinction between military people and civilians. The Court in 1955 (*U. S. ex rel. Toth* v. *Quarles*) had this to say on the subject: "This Court has long recognized that the military is, by necessity, a specialized society separate from civilian society. We have also recognized that the military has, again by necessity, developed laws and traditions of its own during its long history. The differences between the military and civilian communities result from the fact that 'it is the primary business of armies and navies to fight or be ready to fight wars should the occasion arise.' "

Note the reference to "or be ready to fight wars" in that decision. That's what the military training mission is all about. Anything that might compromise that mission presumably would not be upheld by the highest tribunal in the land.

Could unionization compromise it?

In 1953 (*Orloff* v. *Willoughby*), the Supreme Court had this to say: " 'An army is not a deliberative body. It is the executive arm. Its law is that of obedience. No question can be left open as to the right to command in the officer, or the duty of obedience in the soldier.' "

And the Court enlarged on this point in 1954 (*Parker, Warden, et al.* v. *Levy*) in these words: ". . . within the military community there is simply not the same autonomy as there is in the larger civilian community. The military establishment is subject to the control of the civilian Commander in Chief and the civilian departmental heads under him, and its function is to carry out the policies made by those civilian superiors."

What if union policies do not agree with those of the Commander in the field, or with those of the Commander in Chief in the White House, or with the "civilian departmental heads under him"?

The answer, of course, is that military people have no alternative but to fulfill "the duty of obedience in the soldier" or face prosecution under the Uniform Code of Military Justice—a code which the Supreme Court has ruled (*Parker* v. *Levy*, 1974) " 'cannot be equated to a civilian criminal code.' "

Military people must not be faced with this dilemma. If they are, something must give—and it could be national security. The stakes are too high for that risk.

In courtroom parlance, the evidence is overwhelmingly *against* military unionization, and adequate statutory provisions seem to exist to prevent it. Thus, in expressing our unalterable opposition to unionization of the military, the Air Force Association calls upon the Administration to exercise its authority and prohibit it. ■

The Bulletin Board

By James A. McDonnell, Jr., MILITARY RELATIONS EDITOR

Pilot Overage to Shortage?

Rated surpluses, possible pilot shortages later on, the RIF threat, early outs, and continued relaxation of retirement curbs—these are related officer personnel areas receiving close attention at Hq. USAF these days.

With some 4,000 pilots currently excess to rated requirements, USAF has grounded those nearing their dates of separation and assigned young pilots with more than 500 flying hours to operations staffs. It also recently reopened the Palace Furlough program, which encourages young rateds to leave service now with an option to return several years later.

In another move to trim the current pilot surplus, Headquarters may order a few hundred young surplus rated officers to take their flying with Air Reserve and Air Guard units (*see p. 93*).

These steps, along with severe cuts in new pilot production, will melt away the surplus, USAF officials say. However, what worries DCS/Personnel Lt. Gen. Kenneth L. Tallman is the extremely sharp cutback planned for Undergraduate Pilot Training (UPT). Production is slated to drop to fewer than 1,300 new pilots in FY '77 and to only 1,050 the following year.

"That's much too severe, and could send us into a shortage situation in three or four years," he told AIR FORCE Magazine recently. Such a position, of course, contains worrisome national security implications. General Tallman, who cited the rated manning and reduced flying hours picture as one of USAF's most pressing personnel problems, said he's trying to get approval to increase future UPT production above the 1,050 annual level.

Eligible for release now, with optional recall around FY '81 under the reopened Palace Furlough plan, are flyers who won their wings before November 1974. While there is every expectation they will be needed for flying positions on return to active duty, the lengthy Hq. USAF message explaining the program makes clear that future rated jobs can't be guaranteed.

In related developments, Hq. USAF opened the voluntary early-out doors for many officers, the objective being to avoid a RIF in FY '77. Though USAF is budgeted for a 1,100-officer RIF that year, General Tallman said he believes it can be avoided. The apparent leveling off of officer strength will prove helpful in avoiding or minimizing a RIF, he added.

Various rated and nonrated groups are now eligible for early separation, including some commissioned as recently as October 31, 1975. Separations begin this month and will continue through October. There are many exceptions, including Academy graduates who must serve five years before departing.

The Air Force also announced that waivers of various retirement restrictions for colonels and below will continue for the next fifteen months. Commitments resulting from promotions and government-sponsored education or training may be waived.

The service is estimating about 3,500 officer retirements a year; any additional ones it can induce will help erase lingering RIF threats.

The Air Force Flight Test Center, Edwards AFB, Calif., was the scene of the fourth annual Air Reserve General Officers' Symposium on April 8–9, where AFA President George M. Douglas, right, and AFRES Brig. Gen. Edwin Woellner, Jr., discussed the B-1, seen in the background. Mr. Douglas, recently promoted to major general, is Mobilization Assistant to the Vice Commander, ADCOM. General Woellner is Mobilization Assistant to the Chief of Staff, AFRES.

Pentagon Now Tourist Stop

The Pentagon, for most of its thirty-four years, has attracted few tourists; miles of offices and undecorated walls weren't very exciting. But suddenly the interior of the world's largest office building is sparkling like a Christmas tree, and Bicentennial visitors are joining the recently inaugurated conducted tours. Combat art now hangs on walls of dozens of corridors, and special displays and exhibits abound.

The tour begins with a film about the Pentagon, followed by visits to the Hall of Heroes (containing the names of all Medal of Honor winners) and to various corridors and



Three permanent AFA National Directors recently retired from key posts in the Air Reserve Forces. They are, from left, Maj. Gen. John Henebry, Mobilization Assistant to the Commander of Military Airlift Command; Maj. Gen. Howard Markey, MA to the Commander of Tactical Air Command; and Brig. Gen. William Spruance, Assistant Adjutant General for Air, Delaware Air National Guard. Generals Henebry and Markey received the Distinguished Service Medal; General Spruance had received the DSM earlier.

displays named for such wartime leaders as Gens. Dwight D. Eisenhower, George C. Marshall, and H. H. Arnold.

Another tour highlight is the Bicentennial Corridor, which contains twenty-eight exceptional paintings commemorating historical events involving the armed forces from 1776 to the present. Six of the paintings are the work of George W. Day, and three are by Kim R. Johnston. Both are USAF tech sergeants.

Pentagon tours start in the concourse every fifteen minutes beginning at 9:00 a.m. and continue to 3:15 p.m. There is some visitor parking in the building's North Parking section, but it is a half mile away and tricky for persons not familiar with the area. Best bet is a taxi. Advance tour reservations can be made by telephoning (202) 695-1776, or writing Pentagon Tours, Building Administrator's Office, Room 3C 1054, the Pentagon, Washington, D. C. 20301.

Promotion Tension Heightens

The annual temporary majors selection board is the USAF career officer's most crucial hurdle. So, it was not surprising that many captains sweating out the early August O-4 panel were shook up when it was postponed to October 18.

Despite some rumors, however, there was nothing sinister about the switch, and it won't add to promotion delays. Officials noted that some 2,600 captains are already on O-4 selection lists and months will pass before they can all advance. This October's selectees will then be next in line.

About 3,785 line captains are entering primary zone consideration in October for the first time, but only eighty percent will make it. And hundreds of previously deferred competitors will also suffer new passovers, some of whom will be forcibly separated.

Adding to the rising promotion tensions is the uncertain future of DOPMA, the legislation containing permanent grade tables USAF needs to maintain viable promotion programs. The current temporary grade ceiling expires September 30.

If Congress fails to enact DOPMA, or doesn't extend the temporary ceiling, Air Force on that date would lose more than 3,000 O-5 and O-6 spaces; by mid-fall it would start preparing for wholesale demotions and RIFs. The October board probably would be scratched and the O-4 waiting list placed in limbo.

At press time, the House Armed Services Committee was completing action on the 300-plus page DOPMA bill. Early approval of the full House was anticipated, but the question mark is in the Senate where support exists for placing generals under grade ceilings and removing up-or-out sections. Neither of these is in the House version.

This marks the eighth time in recent years that, because of congressional dawdling, expiring grade ceilings have posed threats of disastrous consequences to the USAF officer corps. Top Air Force personnel officials believe, however, that in the absence of early DOPMA approval, an eleventh-hour temporary solution will surface.

Other key officer boards will convene during the upcoming months. They include the temporary LC panel August 30 and the temporary colonel board November 29. In a related action, 638 Regular line officers were recently chosen—from 3,321 contenders—for permanent colonel. That's only a nineteen percent selection rate. As usual, all selectees were serving as colonel or higher.

Distaff Corner

The Directorate of Women in the Air Force, a separate office at Hq. USAF that monitored WAF policies, is being closed. Under the "full equality" theme, it's no longer needed. An adviser on women's matters will remain on the Air Staff, however. The directorate earlier provided the springboard for Jeanne Holm to become USAF's first and only female major general.

By mid-spring, only a handful of USAF female officers had applied for the twenty distaff pilot training spaces reserved for them late this year and early next. So, Headquarters went out with a plea for more applications and eased some of the qualification rules. The board was to meet this month. Army already has thirteen women in flying training.

Actives May Fly with AFRES/ANG

The latest plan to help trim USAF's rated overages (*see item on p. 90*) may result in about 250 young pilots and fifty navigators being assigned to Air Reserve and Air Guard units. The plan, which hasn't been completely nailed down yet, calls for various C-130 and KC-135 copilots to be so assigned—these groups were recently 134 and 128 percent manned.

Also involved would be instructor pilots who complete their ATC assignments next fiscal year and are looking for "weapons system identity." USAF wants to find them cockpit, not nonrated, jobs.

Flying some active-duty aircrews in Air Reserve Force outfits would help ease rated officer assignment problems. Officers would continue to gain flying experience, but not at the expense of the active force's restricted flying hour allocation. Their duties, besides flying, would parallel those held by company graders in regular squadrons.

The program would also strengthen the total force effort, authorities say.

The Bulletin Board

Reserve/TAC F-4 Test Readied

Recruiting of nearly 150 Reservists to participate in a two-year Tactical Fighter Augmentation Test at Moody AFB, Ga., is scheduled to begin next month. Participants will include aircrew members and maintenance and munitions people, all Category A mobilization assignees.

The Reservists will train with the Regular Air Force's 347th Tactical Fighter Wing and use its F-4Es and other facilities. The Chief of the Air Force Reserve, Maj. Gen. William Lyon, is enthusiastic about the project and the possibilities it holds for vital new Reserve missions. He said the test, which starts in October, could be expanded if it proves successful.

The augmentation plan contains some features of MAC's "associate" training program in which Air Reserve strategic airlift units fly active-duty C-141s and C-5s. However, it differs in that for those operations the AFRES units are separate organizations. Under the TAC augmentation, the Reservists will participate directly with the active-duty outfit.

New AFROTC Program

Fifty outstanding AFROTC cadets from about that many different units will spend short tours at active-duty bases this summer. The new program, modeled after the "third-lieutenant" plan long in use by Air Force Academy cadets, has been recommended by AFA for some time. If successful, it may be expanded later.

AFROTC cadets chosen for the program must have a B average or better. They will spend two weeks at bases that do not host regular AFROTC summer field training, and pull duty appropriate to what they can expect later on when they are on extended active duty.

CMSAF Named to Aid Society Board

USAF adopted a long-standing AFA resolution recently when it appointed Chief Master Sergeant of the Air Force Thomas N. Barnes to the Board of Trustees of the Air Force Aid Society. AFA has held that NCO representation was needed on the board and, because of his high office, the CMSAF was the desired appointee. Another AFAS board appointee is Judge Howard Markey, a former AFA National President and a permanent AFA Director, who recently retired from the Air Force Reserve.

As long urged by AFA, Chief Master Sergeant of the Air Force Thomas N. Barnes was recently named to the Board of Trustees of the Air Force Aid Society.

Utah School Cops AFJROTC Award

The AFJROTC unit at Clearfield High School, Clearfield, Utah, has won top honors in the annual contest sponsored by AFA through the Aerospace Education Foundation. This year's topic, which cadets were asked to prepare for public presentation, was the "Role of Aerospace in American History." The awards—a $4,000 scholarship and a distinctive plaque—will be presented to the unit at the AFA Convention in Washington, D. C., in September. The Clearfield entry is a color video tape in which two cadets narrate the highpoints of aerospace history from ballooning through the moon landings.

Runners-up, who will receive plaques, are (in order) Choctawhatchee H. S., Ft. Walton Beach, Fla.; Cambria Heights H. S., Patton, Pa.; West Mecklenburg H. S., Charlotte, N. C.; and Lafayette H. S., Ellisville, Mo.

AFJROTC units at the following schools will receive Certificates of Merit for honorable mention:

Upper Heyford American H. S., Croughton, England; Vero Beach H. S., Vero Beach, Fla.; Belton-Honea Path H. S., Belton, S. C.; Berkeley H. S., Moncks Corner, S. C., Unicoi County H. S., Erwin, Tenn.; Ottawa Township H. S., Ottawa, Ill.; Anderson Union H. S., Anderson, Calif.; Ft. Walton Beach H. S., Ft. Walton Beach, Fla.; Homewood H. S., Homewood, Ala.; S. R. Butler H. S., Huntsville, Ala.; Lowell H. S., Lowell, Ind.; Midview H. S., Crafton, Ohio; Torrejon American H. S., Spain; Randolph-Macon Academy, Front Royal, Va.; St. Paul's High School, Covington, La.; General H. H. Arnold American H. S., Germany; J. Frank Dobie H. S., Houston, Tex.; Del Norte H. S., Albuquerque, N. M.; Irmo H. S., Irmo, S. C.; and Westland H. S., Galloway, Ohio.

Forty-Six Uniform Changes Weighed

Boots for USAF women. Umbrellas for male members. A maternity uniform for the women. These are among forty-six proposed changes to the Air Force uniform that Headquarters recently asked commands to comment on. The suggested changes would also ease the rules on wearing hats and caps, limit rings worn while in uniform to three, and keep skirt lengths between two inches below the kneecap to two inches above. The Air Force uniform board will make the final decisions. Permitting umbrellas while in uniform would shatter one of the oldest traditions in the military service.

ANG Attacks NCO Manning Woes

The Air National Guard has come up with a package of solutions for its NCO manning and promotion problems, which has included a three-year freeze on hikes to E-9. Effective October 1, that freeze will be lifted and a quota of 100 advancements, controlled by the National Guard Bureau, will be authorized.

The ANG will also (1) reduce enlisted promotion phase points; (2) restrict reenlistment of surplus NCOs; and (3) establish a high year of tenure—a mandatory retirement point—for the enlisted force. The organization, as forecast in last month's AIR FORCE Magazine, also will review airmen for retention after they attain twenty years of satisfactory service for retirement.

Reenlistments to E-7 through E-9 will be limited to three years, and, if members are surplus in grade, they'll lose at least one stripe. However, surplus top-three graders will be encouraged to switch to "a valid vacancy, or retrain." The longer promotion phase points will be announced later.

The ANG's tough new program

Ed Gates . . . Speaking of People

Leveling on the Benefits Issue

One of the standout sections of the Defense Manpower Commission's recent report (*see last month's "Bulletin Board"*) tackles the "removal of real or perceived benefits" question.

This benefits-dilution matter is far and away the most explosive personnel-type issue in the minds of military members today. Each week, seemingly more and more of them are jumping on the government in protest; yet service and Defense Department leaders continue to treat the subject very gingerly. Many have shied away from it entirely, which is unfortunate; the troops want the issue faced.

The Manpower Commission's report addresses the problem head on and advances some thoughtful suggestions.

First off, the report scolded the Defense establishment for abruptly changing policies in order to save money, without fully considering the impact on morale or telling service people in some detail why the changes are deemed necessary. The commissary funding cutback drive is a prime example.

The report also hit "piecemeal changes" to personnel policies. And it said Congress and the executive branch should be sensitive to how military members and their families view such changes.

"Personnel policies and practices important to the individual should not be changed without adequate explanation and should be altered only in the context of a total review of policies and practices, taking into consideration the consequences of proposed changes," the report declared.

And when a policy decision is heavily influenced by cost considerations? "This should be stated openly, explained, and not obscured by promises. Members of the armed forces will appreciate the candor," the report added.

Good advice. Pentagon leaders should have followed it earlier when they tried to "sell" the proposed Retirement Modernization Act to the military community by sugarcoating unpopular sections of that legislation. Defense simply didn't level with the membership, and the sales job failed. Instead of achieving troop understanding, the Department incurred the wrath of thousands of rank-and-file people. And its credibility took a nose dive.

(The RMA legislation, which in addition to controversial sections contains numerous desirable and popular changes to the retirement system, was scheduled for House subcommittee consideration last month.)

The manpower report also correctly pointed out that Pentagon plans to cut benefits frequently produce personnel reactions "out of proportion to the savings involved." And when numerous members end their careers because they feel Uncle Sam has broken faith with them, the government's investment in recruiting, training, and experience "may well exceed any savings originally contemplated."

In addition, the Commission report noted that "the adverse impact on the morale of those remaining should be obvious and a cause for deep concern." It then advanced two positive proposals.

One urges the government to establish a service member's "Bill of Rights" that would specify the benefits that accrue from military service. It would provide "that such benefits would only be changed or eliminated prospectively and changes would not apply to those already in service.

"For whatever reasons," the report said, "the serviceman now feels that his benefits are in jeopardy. His trust and confidence in the system have been shaken to the point where legislation [the Bill of Rights] may be necessary to restore it."

There is some question, of course, about the practicality of the Rights proposal. It suggests a different slate of benefits for different people, based on service entry dates, and that may not be workable. But some modification of the idea might.

The Commission's second proposal appears entirely feasible. It would make the service chiefs the "ombudsmen and defenders" of their uniformed members. This plan, the Commission noted, will answer the long-standing question: "Who represents the interests of the serviceman at the seat of government?"

The report said, "It is important in the national interest that the men and women of his service perceive the service chief as their ombudsman. This role cannot be delegated. The service chief should declare himself on those issues that will greatly affect the morale of the men and women of his service."

The absence of such spokesmen for each service has been all too apparent. For years, numerous derogatory and erroneous statements issued about the service and service people by prominent public figures have gone unanswered. This unfortunate situation, of course, has done nothing for service morale.

The military community deserves the support implicit in the Commission-endorsed plan to permit service chiefs to speak out. And the step would also help fill a void that the unions, in contemplating the organization of military personnel, may be eyeing. The "chief-ombudsman" proposal could, in fact, be labeled a positive "stop-the-union" move.

The Commission's report, in short, is calling for reduced cuts in benefits, improved internal and external communications, and for leveling with the troops and defending them publicly when necessary.

While these proposals would break sharply with past practices, they are not the handiwork of starry-eyed liberals; they are the product of experienced, top-level management types. The Commission chairman, Curtis W. Tarr, it is remembered, is a corporation executive and former high Pentagon official; its executive director, retired Gen. Bruce Palmer, formerly was Army's Vice Chief of Staff; and the other members and key staffers came from lofty management posts in the military and business communities.

These particular proposals, furthermore, don't need congressional approval. They can be adopted any time the executive branch wishes. The sooner the better, we say. ■

The Bulletin Board

will result in some involuntary separations and retirements, but the component wants to make certain that overages in the higher NCO grades are reduced and will not recur.

Air Guard Director Maj. Gen. John J. Pesch, in a letter to state Adjutants General, said that without the changes, "there could be no promotions to E-9 for approximately two more years and freezes may be required to grades E-5 and E-7 during calendar 1976."

An earlier ANG move to demote some E-9s was scratched.

Mobilization Measure Enacted

The President has signed the measure allowing him to mobilize up to 50,000 Reserve Forces members for not more than ninety days, without declaring a national emergency. The new law, urgently sought by the Pentagon, increases the government's mobilization flexibility and adds credibility to the Reserve Forces.

Elsewhere on the military legislative front:

- Showdowns neared on Capitol Hill over commissary funding and continuation of the one-percent "add-on" to retired pay raises. A House Appropriations subcommittee was the latest group in that body to endorse full commissary funding. But there are strong anticommissary forces in the Senate.
- Both the Senate and the House have voted to remove the add-on for military members, on condition that it will also be scrubbed for federal civilian employees. That is yet to be decided. Meantime, federal unions are fighting removal of the add-on for State Department employees. Ahead are more votes on the tangled issue.
- House Armed Services Committee approval was nearing on DOPMA (*see earlier item*) and on the bill to improve the finances of the Soldier's and Airmen's Home in Washington, D. C. The latter plan will raise monthly contributions of Air Force and Army enlisted members from twenty-five to fifty cents and require Home occupants to pay modest rent. They now reside there free.
- The military per diem increase bill at press time was awaiting the President's signature. It allows total daily expenses of up to $33 except for certain high-cost areas where the limit will be $50. Civil servants got similar per diem raises a year ago.

Short Bursts

USAF's top personnel executive, **Lt. Gen. Kenneth L. Tallman,** believes that various "pay changes" will emerge in the wake of high-level compensation studies, such as the Quadrennial Review of Military Compensation, due out soon, and the recent Defense Manpower Commission report. But not right away. He says the Air Force is proceeding "very cautiously" before endorsing pay alterations, such as a single salary system, to make sure no members will suffer on take-home pay, pensions, etc. General Tallman is a member of the Quadrennial Review panel.

The Defense Department, meantime, is "staffing" the DMC report with its dozens of **recommended changes** to personnel-manpower policies and laws (*see June '76 "Bulletin Board"*). DMC's desire to eliminate the long-standing up-or-out feature of officer promotion programs, in favor of occasional "selection-out" authority, didn't go over big with Air Force officials who feel that up-or-out is a "proven" revitalization tool.

After months of delay, the Pentagon has issued **joint travel regulation changes** that okay cash benefits for service people who move their own household goods at transfer time. The payoff: seventy-five percent of what it would have cost the government to move the goods via conventional means, less costs incurred by Uncle Sam in providing a rental vehicle and packing materials. This can mean substantial cash payments to those electing to do-it-yourself. See the May '76 "Bulletin Board" for an earlier report.

Rep. Bill Chappell, Jr. (D-Fla.), believes there should be one Assistant Defense Secretary for Manpower, and another for Reserve Affairs. He's introduced a bill to that effect.

Senior Staff Changes

CHANGES: B/G Walter H. Baxter III, from V/C, Thirteenth AF, PACAF, U-Tapao Afld., Thailand, to Cmdr., 313th Air Div., and Cmdr., 18th TFW, PACAF, Kadena AB, Okinawa, replacing M/G Lynwood E. Clark . . . **B/G Robert W. Bazley,** from Insp. Gen., USAFE, Ramstein AB, Germany, to Asst. for Readiness, USAFE, Ramstein AB, Germany . . . **B/G George M. Browning,** from Cmdr., 26th TRW, USAFE, Zweibrücken AB, Germany, to Insp. Gen., USAFE, Ramstein, Germany, replacing B/G Robert W. Bazley . . . **M/G Lynwood E. Clark,** from Cmdr., 313th Air Div., and Cmdr., 18th TFW, PACAF, Kadena AB, Okinawa, to DCS/Log., Hq. PACAF, Hickam AFB, Oahu, Hawaii, replacing B/G Jack W. Waters . . . **B/G Gerald E. Cooke,** from Secy., JCS, and Dep. Dir., Joint Staff, OJCS, Washington, D. C., to Dep. Dir. (Recce), J-3, OJCS, Washington, D. C. . . . **B/G Donald M. Davis,** from Dep. Dir., J-3 (NMCC), Joint Staff, OJCS, Washington, D. C., to US DCS/Live Oak, SHAPE, Belgium, replacing B/G Robert F. Titus.

B/G James R. Hildreth, from Senior AF Member, WSEG, ODDR&E, Arlington, Va., to V/C, USAFTFWC, TAC, Nellis AFB, Nev., replacing B/G Robinson Risner . . . **Col. (B/G selectee) Leighton R. Palmerton,** from Dir. of Mat. Mgmt., Oklahoma City ALC, AFLC, Tinker AFB, Okla., to V/C, Oklahoma City ALC, AFLC, Tinker AFB, Okla., replacing B/G Charles E. Shannon . . . **L/G Bryce Poe II,** from V/CINC, USAFE, Ramstein AB, Germany, to Cmdr., AF Acqn. Div., Hq. AFLC, Wright-Patterson AFB, Ohio . . . **B/G Robinson Risner,** from V/C, USAFTFWC, TAC, Nellis AFB, Nev., to Sp. Asst. to the Cmdr., USAFTFWC, TAC, Nellis AFB, Nev. . . . **B/G Charles E. Shannon,** from V/C, Oklahoma City ALC, AFLC, Tinker AFB, Okla., to Asst. Dir. for Instlns. & Log., NSA, Ft. Meade Md. . . . **B/G Robert F. Titus,** from US DCS/Live Oak, SHAPE, Belgium, to Asst. DCS/Plans & Programs, J-5, NORAD, and Asst. DCS/Plans & Programs, Hq. ADCOM, Colorado Springs, Colo. . . . **B/G Jack W. Waters,** from DCS/Log., PACAF, Hickam AFB, Oahu, Hawaii, to DCS/Mat. Mgmt., Hq. AFLC, Wright-Patterson AFB, Ohio. ■

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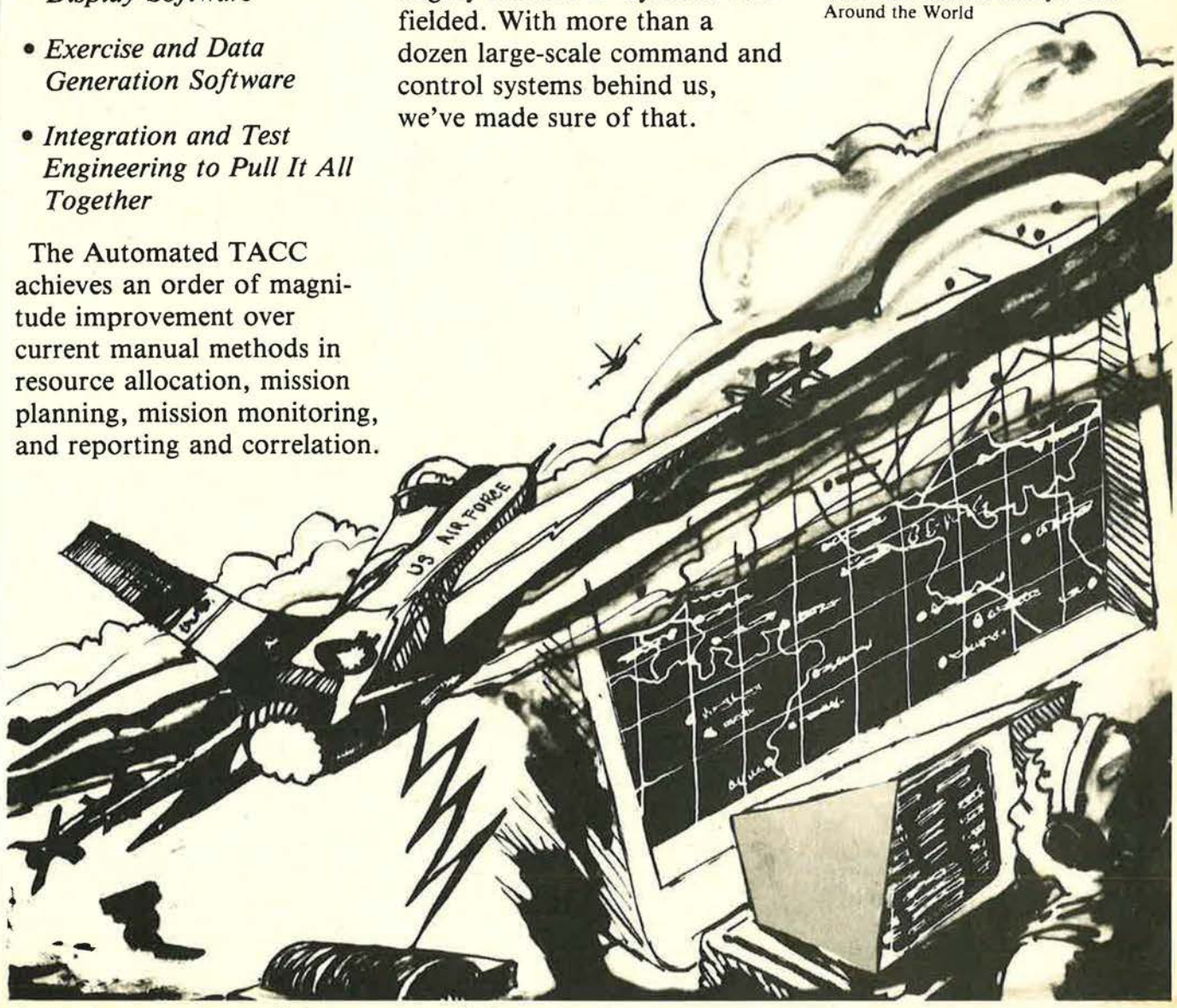

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Airman's Bookshelf

World War II: The First Two Years

The Last European War, by John Lukacs. Anchor Press/ Doubleday, New York, N. Y., 1976. 535 pages. $15.

John Lukacs sharply and convincingly presents the two years of war, September 1939–December 1941, in which the other European nations, though badly overrun, drove Hitler to a stalemate before America entered the conflict and it ceased to be a purely European war.

When the war broke out, the blunderings of the chancelleries became less significant than the will of the nations to survive. Ideologies disintegrated before that will, Lukacs believes. Old bourgeois complacency and Marxist internationalism both yielded to Hitler's drive, which was for German supremacy rather than National Socialism.

A factor in the continuance of the war was the many serious miscalculations regarding the balance of power. With the Allies' rearmament progressing, they told Hitler that to take over Poland would mean war, counting on Stalin to reconstruct the balance of power against Germany; but Stalin, harassed by Japan, opted for a cautious friendship with Germany. In breaking this relationship, Hitler failed in Russia and raised a new world balance of power against him.

Dismissing these matters somewhat briefly, Lukacs proceeds admirably to narrate the action in field and ministry. Although not a military historian, and painting on a vast canvas, he does his job well.

Surprisingly, he found good relations between German officers and enlisted men a factor in their advance across Europe. Their big drives were not crusades. The troops were deceived into thinking their country had been attacked. Hitler withheld his heavy forces to permit the Dunkirk withdrawal, hoping to make a deal with the British. Weather was not an outstanding element in turning back the Germans in Russia. It was a normal winter, but Hitler halted his advance too long, too near Moscow.

Except for the bombing raids that preceded initial German aggressions and for the air fighting in the Battle of Britain, Lukacs neglects air activity. By 1940, it was evident, he said, that dive bombing disrupted the daily lives and production of goods to a lesser extent than had been supposed. [Hitler never developed an effective heavy bomber force.]

In his discussion of air action during the last European war, Lukacs appears to forget the important role of Soviet close air support. And that air cover had something to do with the seemingly invincible advance of German columns on many fronts. Treatment of sociological factors in other chapters is more rewarding.

—Reviewed by Dr. John M. Baker, Col. USAR (Ret.).

Airborne All the Way

Dropzone Normandy, by Napier Crookenden. Charles Scribner's Sons, New York, N. Y., 1976. 304 pages with index. $12.50.

On June 5, 1944, began the most massive airborne assault in the history of warfare. Three full Allied divisions—two of them American and one British—dropped into occupied Normandy with the vital task of securing the flanks for the amphibious invasion that was to follow.

This is the story of the development of those specialized units—the parachute and glider troops and their equipment—and the key role they were to play in the first few crucial days that changed the course of the war and were prelude to the ultimate defeat of the Nazi war machine.

Illustrated throughout with photographs and maps, this book renders a detailed account of the fighting of units and individuals, the confusion, the determination, the tragedies and triumphs of a battle that remains unique in military annals.

The author, retired British Army Lt. Gen. Sir Napier Crookenden, is an expert on airborne forces, having commanded the 16th Parachute Brigade during his military career of thirty-seven years.

—Reviewed by William P. Schlitz, Assistant Managing Editor.

New Books in Brief

Aircraft in Profile, by Charles W. Cain. First in a series of twelve, this volume contains histories of military and civilian aircraft of many countries, from bi- and triplanes of World War I through combat aircraft of World War II and into the 1950s. Includes photos, color drawings, specifications, and markings. Doubleday & Co., New York, N. Y., 1976. 144 pages. $11.95.

The Army Air Forces: World War II Combat Chronology 1941–1945, compiled by Kit C. Carter and Robert Mueller of the Albert F. Simpson Historical Research Center, Air University, under auspices of the Office of Air Force History. This day-by-day chronology of AAF combat operations in World War II is designed as a companion reference to the seven-volume history of *The Army Air Forces in World War II.* An invaluable research tool that also includes a glossary of code names, abbreviations, and an excellent index. Superintendent of Documents, US Government Printing Office, Washington, D. C. 20402. 991 pages. $14.30.

Aviation Weather, by FAA Flight Standards Service and the National Weather Service. Violent, hazardous weather conditions are discussed to help pilots recognize when trouble

is in the air. Wind, temperature variations, clouds, icing, turbulence, thunderstorms, air masses, fronts, and their impact on flying are among items covered. Illustrations, photos, glossary of weather terms, index. Superintendent of Documents, US Government Printing Office, Washington, D. C. 20402, 1975. 219 pages. $4.55.

Aviation Weather Services, by FAA Flight Standards Service and National Weather Service. Companion to *Aviation Weather.* Details such products and services available from FAA and NWS as pilot, radar, and weather reports; wind, hurricane, and temperature forecasts; severe weather watch bulletins; and analytic and prognastic charts. Format allows easy updating as page revisions are issued periodically. Superintendent of Documents, US Government Printing Office, Washington, D. C. 20402, 1975. 117 pages. $1.95.

Black Americans in Aviation, by Raymond Peters and Clinton Arnold. As in other areas of American life, blacks struggled for the right to fly. Here is the story of their fight to participate equally in aviation, from Kitty Hawk to the space age. Included are profiles of today's black aviators along with a list of black airmen who are members or supporters of Negro American International, founded in 1967 to inspire the black community toward aviation as a career or hobby. Photos. Neyenesch Printers, Inc., P. O. Box 430, San Diego, Calif., 1975. 85 pages. $9.95 hardback. $4.95 paperback.

British Aircraft of World War II, by John Frayn Turner. Forty-nine aircraft types are described in three sections. The reference section contains photos, markings, and specifications. The second section has superb color photos of the forty-nine during the war, and the last section covers the aircraft in action, with pilot narratives of outstanding combat exploits. Stein and Day, Briarcliff Manor, N. Y., 1976. 144 pages. $10.95.

German Aircraft of World War II, by Christopher Shepherd. A companion to *British Aircraft of World War II.* This volume is similarly divided into three sections. Stein and Day, Briarcliff Manor, N. Y., 1976. 144 pages. $10.95.

Early Supersonic Fighters of the West, by Bill Gunston. The author describes in detail the design, performance, management, shortcomings, and contributions to fighter aviation of a dozen early supersonic fighters. Included are the BAC Lightning, Mirage III and 5, Saab-35 Draken, and USAF's F-100, F-102, and F-104, and the USN's F-8 Crusader. Photos, glossary. Charles Scribner's Sons, New York, N. Y., 1976. 256 pages. $10.95.

The Eastern Front, 1914–1917, by Norman Stone. The author describes and substantially reinterprets the battles of the Eastern front. He contends that German economic superiority has been greatly overestimated. Russia's economy, he says, suffered a crisis of growth, not a decline. As a result, capitalism died in Russia in 1915–1916, not 1917–1918. Notes, index, maps, charts. Charles Scribner's Sons, New York, N. Y., 1975. 348 pages. $15.00.

F-15 Eagle in Action, by Lou Drendle and Capt. Don Carson. Background, design of the F-15 with details on refueling and weapons. Captain Carson's pilot story is reprinted from this magazine's January 1974 issue. Photos, drawings. Squadron/Signal Publications, 3461 E. Ten Mile Road, Warren, Mich., 1976. 50 pages. $3.95.

The G.I.s: The Americans in Britain 1942–1945, by Norman Longmate. "Over-fed, over-paid, oversexed, and over here," went one British lament about the 2,000,000 American soldiers stationed in Britain during the war. Yet, as the author reveals, integration went smoothly and benefited both sides. Based on British and American reminiscences, the book is a touching, humorous social history. Photos. Charles Scribner's Sons, New York, N. Y., 1976. 416 pages. $12.50.

The Making of a Missile Crisis, October 1962, by Herbert S. Dinerstein. The author examines Cuban, Soviet, and American interaction demonstrating how assumptions and preconceptions, some drawn from the 1954 Guatemalan episode, influenced and even encouraged the crisis. Of particular interest is the three-way split that divided the Soviet political elite on how to respond to President Kennedy's demand that the missiles be removed. Appendices reprint the October 23 Soviet statement, Soviet editorials commenting on it, and analyze both. The Johns Hopkins University Press, Baltimore, Md., 1976. 302 pages. $14.95.

The Next Fifty Years in Space, by Patrick Moore. The author, involved in astronomical research since 1952, speculates about what will happen in space and the order of events during the next half century. Photos, illustrations. Taplinger Publishing Co., New York, N. Y., 1976. 144 pages. $12.95.

The Pilot's Night Flying Handbook, by Len Buckwalter. Step-by-step techniques and safety procedures, including what a private pilot should know about outfitting his plane, aircraft and ground lighting systems, navigation, emergencies, instrument proficiency, etc. Photos, drawings, charts. Timely as a result of the recent FAA requirement that all new pilots obtain certification for night flying. Doubleday and Co., New York, N. Y., 1976. 175 pages. $8.95.

The Story of the Texan. One of the most durable planes ever built, the AT-6 advanced trainer has been used throughout the world. Here are details, complete with photos, drawings, and charts. "Texan" is used as a generic name for all models. Aviation Publications, Milwaukee, Wis., 1975. 40 pages. $3.95.

Supermarine Spitfire Remembered, by Philip J. R. Moyes. Monograph detailing production and development, model modifications, construction details as well as the Spitfire in World War II. Photos and drawings. Vintage Aviation Publications, Oxford, England, 1976. 17 pages. $2.00 postpaid.

Twelfth Air Force Story, by Kenn C. Rust. Second in a planned series of books on AAF combat air forces in World War II. From activation in 1942 to V-E Day, the Twelfth's story is detailed chronologically. Photos, charts, markings, and aces. Historical Aviation Album, Temple City, Calif., 1975. 64 pages. $6.50.

—Reviewed by Robin Whittle

AFA News

By Don Steele, AFA AFFAIRS EDITOR

Sen. John G. Tower (R.-Tex.) was the guest of honor and speaker at a recent dinner meeting of the Delaware Galaxy Chapter. Shown are, from left, Senator Tower; Dover Mayor Charles LeGates, behind the Senator; Delaware State AFA President George Chabbott; Col. Click D. Smith, Commander, 436th Military Airlift Wing, Dover AFB; Chapter President O. B. Williams; Col. Harold H. Hester, Commander, 436th Air Base Group, Dover AFB; and Sen. William V. Roth, Jr. (D-Del.).

At the H. H. Arnold Chapter's Annual Awards Dinner, held recently at the Salisbury Club in East Meadow, N. Y., Sen. Barry M. Goldwater (R-Ariz.) was named the Chapter's "Man of the Year," in recognition of his "dedication and outstanding service to the Air Force Association and its Aerospace Education Foundation, as well as his efforts toward a superior United States Air Force." In the photo, Senator Goldwater accepts the award from Rep. Lester L. Wolff (D-N. Y.), a member of the Chapter's Executive Council and a past recipient of the Chapter's "Man of the Year" award.

During the past several months, AFA leaders across the country have been presenting the AFA Silver Medal to the Outstanding Cadet in each of the many AFROTC units. At the University of Arizona, AFA National Director Hugh W. Stewart, left, and University President John P. Schaefer, right, congratulate AFROTC Cadet Robert A. Persichini, recipient of the medal during the university's annual President's Review.

Maj. Gen. William R. Hayes, left, Commander, Warner Robins Air Logistics Center, Robins AFB, Ga., the speaker at a recent meeting of AFA's Middle Georgia Chapter, accepts a plaque from Chapter President H. C. "Butch" Strawser, right, in appreciation of his outstanding support of the Chapter's activities.

chapter and state photo gallery

Lt. Gen. Ray B. Sitton, Director of Operations, Joint Chiefs of Staff, was the guest speaker at the Annual Spring Banquet of AFA's Florida Gulf Coast Chapter at Sarasota. Shown during the banquet reception are, from left, William A. Williams, Jr., Karen Kennedy, General Sitton, Carola Williams, and Chapter President James E. Kennedy.

AFA National President George M. Douglas, right, a speaker at the Alamo Chapter's Annual Awards Banquet, is shown congratulating Jerry S. Crenwelge, left, winner of the Chapter's annual High School AFA Essay Contest. A student at New Braunfels High School, Jerry went on to win the Texas State AFA's Earle North Parker Scholarship Award of $1,000, which was presented at the State AFA's Executive Committee meeting in Del Rio.

At the graduation banquet of the Air Training Command's NCO Academy Class 76-02, which was held at the Officer Training School Open Mess, Lackland AFB Annex, Tex., James C. Shutt, left, Alamo Chapter Awards Committee Chairman, and Col. Lawrence D. Garrison, right, Commander, 47th Flying Training Wing, Laughlin AFB, present the coveted ATC Commander's Trophy to TSgt. David L. Griffith, center, for having been selected first honor graduate of his class. The trophy, which was donated by the Alamo Chapter to signify its avid support of professional NCO education, was awarded in the name of Lt. Gen. John W. Roberts, ATC Commander.

—PHOTO BY LEWIS R. BERLEPSCH

Rep. Robert N. Giaimo (D-Conn.) was the featured speaker at the Connecticut State AFA's convention dinner in West Haven. Shown with Congressman Giaimo, right, are Connecticut State AFA President Margaret McEnerney, left, and State AFA Treasurer Bernard Stein, who received a citation in recognition of his dedicated service as Chapter and State Treasurer.

INTERESTED IN JOINING A LOCAL CHAPTER?

For information on AFA chapters in your area, write:
Assistant Executive Director/Field Operations
Air Force Association
1750 Pennsylvania Ave., N. W.
Washington, D. C. 20006

AFA's 30th Anniversary National Convention and its 1976 Aerospace Briefings and Displays will be held at the Sheraton-Park and Shoreham-Americana Hotels, September 20-23. Accommodations are limited at the Shoreham-Americana Hotel and will be used primarily by other organizations meeting in conjunction with AFA's 1976 National Convention.

All reservation requests for rooms and suites at the Sheraton-Park Hotel should be sent to: Reservations Office, Sheraton-Park Hotel, 2660 Woodley Road N.W., Washington, D.C. 20008.

Be sure to refer to AFA's National Convention when requesting reservations. Otherwise, your reservation requests will not be accepted by the Sheraton-Park.

AFA's National Convention activities will include luncheons for the Secretary of the Air Force and the Air Force Chief of Staff, and the Air Force Anniversary Reception and Dinner Dance. The National Convention will also include AFA's Business Sessions, Conferences, and several invitational events, including the President's Reception, the Annual Outstanding Airmen Dinner, and the Chief Executive's Reception and Buffet.

We urge you to make your reservations at the Sheraton-Park Hotel as soon as possible to ensure obtaining your reservations. Arrivals after 6:00 p. m. require a one-night deposit for the night of arrival.

PLAN NOW TO COME TO WASHINGTON, D.C., TO ATTEND . . .

AFA's 30th Anniversary National Convention September 20, 21, 22 and its 1976 Aerospace Briefings and Displays September 21, 22, 23

AFA News

OFFICIAL USAF PHOTO BY A1C WALTER JENKINS

AFA's Board Chairman, Joe L. Shosid, was the speaker at a kickoff luncheon for the recent AFA membership drive at Sheppard AFB, Tex. Mr. Shosid, center, is shown visiting with Maj. Gen. Cecil E. Fox, left, Commander, Sheppard Technical Training Center, and Lt. Col. (colonel selectee) Robert Osborne, right, the volunteer AFA membership chairman at Sheppard AFB.

OMAAC PHOTO

AFA's Greater St. Louis Chapter President, Richard Gerber, left, presents a Chapter plaque to SSgt. Edward R. Cortes, right, designating him the St. Louis Area Outstanding Airman of the Year. Sergeant Cortes is assigned to the 1814th Communications Squadron, supporting the Defense Mapping Agency Aerospace Center in St. Louis. The presentation was made at the Chapter's annual awards banquet.

Lt. Gen. John W. Roberts, Commander, Air Training Command, was the guest speaker at the Texas State AFA's recent Executive Committee Meeting Luncheon at Laughlin AFB Officers' Club. Shown are, from left, Del Rio Chapter President Bob Mosher; Del Rio Mayor Dr. Alfredo Gutierrez; Texas State AFA President Vic Kregel; and General Roberts.

When you need dependable electric power, Bendix can turn it on.

It all started nearly fifty years ago, when we built the first battery-charging generator for the Lockheed VEGA.

Ever since, we've been generating, regulating, distributing, converting and connecting electric power for a variety of different airborne, land and marine uses.

Our 60KVA air-cooled brushless generator and distribution logic system delivers dependable electric power on the Boeing 747. And the Air Force and Navy rely on Bendix generators to provide power on F-4s and F-14s and emergency power on F-15s.

On the ground, the Army's M-60 tank uses a completely sealed, oil-cooled version of our 60KVA unit. And Washington, D. C.'s new subway cars use Bendix connectors to carry power throughout the trains.

The future? We're developing and producing more advanced systems and components. Like our Constant Frequency Generator (CFG) for aircraft. It provides precise frequency output when driven by a variable-speed input shaft. And our new electrical connector, TRI-START, which gives a quick disconnect capability in high vibration areas without the need for safety wiring.

These are products of two Bendix divisions—Electric & Fluid Power and Electrical Components. And they're just two of the many divisions which combine technological expertise through the Bendix Aerospace-Electronics Group.

If you would like additional information on the capabilities of the Bendix Corporation's Aerospace-Electronics Group, write for our brochure "Worlds of Creativity" at 1911 North Fort Myer Drive, Arlington, Virginia 22209.

Bendix

This Is AFA

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OBJECTIVES

The Association provides an organization through which free men may unite to fulfill the responsibilities imposed by the impact of aerospace technology on modern society; to support armed strength adequate to maintain the security and peace of the United States and the free world; to educate themselves and the public at large in the development of adequate aerospace power for the betterment of all mankind; and to help develop friendly relations among free nations, based on respect for the principle of freedom and equal rights to all mankind.

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US AIR FORCE ANNIVERSARY ISSUE

The September "Anniversary" issue of AIR FORCE Magazine will be distributed to those attending AFA's 1976 Aerospace Development Briefings and Displays. In addition to this bonus readership, all advertisements in this issue will be prominently displayed in our "Industry Salutes the Air Force" exhibit at the entrance to Exhibit Hall. Closing for reservations is July 30. Why not join us? It is a good advertising buy!

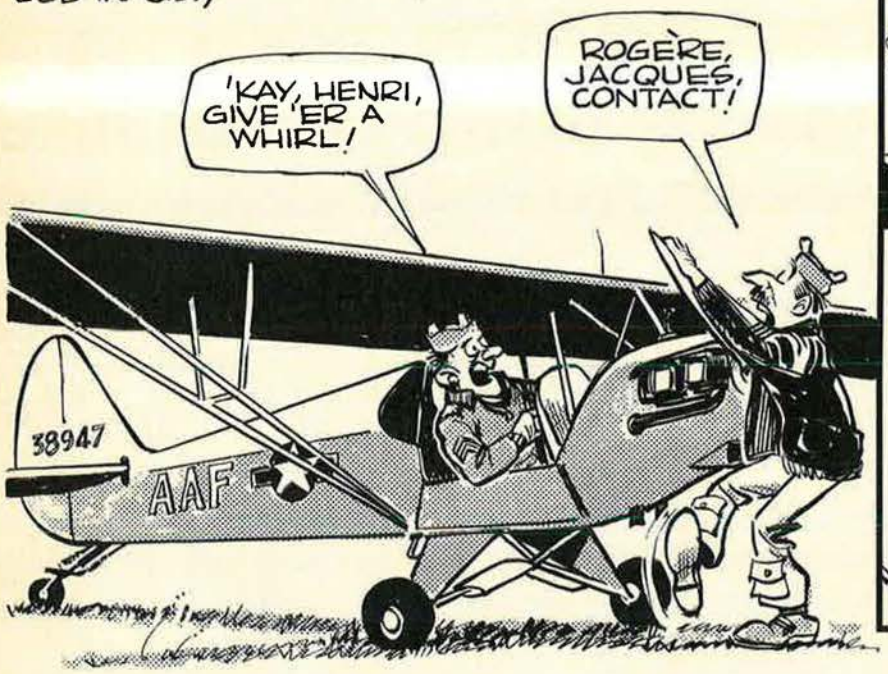
AIR FORCE

Bob Stevens'

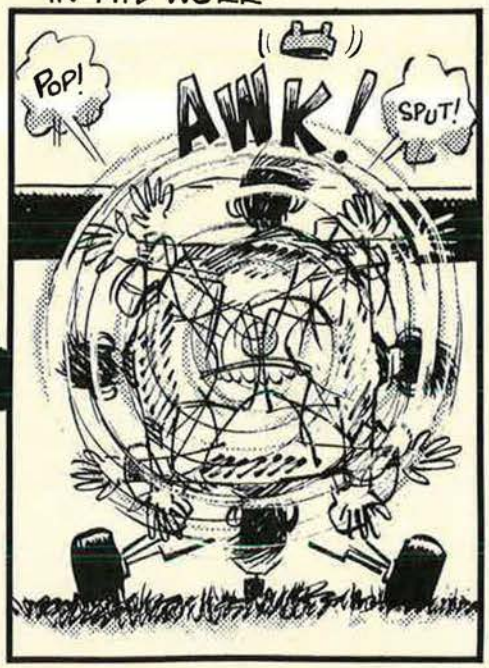
"There I was..."

ONCE UPON A TIME THERE WERE NCO PILOTS; "FLYING SGTS". THEY FLEW ANYTHING THAT HAD WINGS and WAS PAINTED OLIVE DRAB. AS MORE 2ND LTS WERE MINTED, THE SARGES WERE RELEGATED TO "GARBAGE FLYING"- SLOW TIMING ENGINES, FERRYING, TOWING TARGETS and FLYING LIAISON BIRDS — and THAT'S WHAT OUR STORY'S ABOUT.

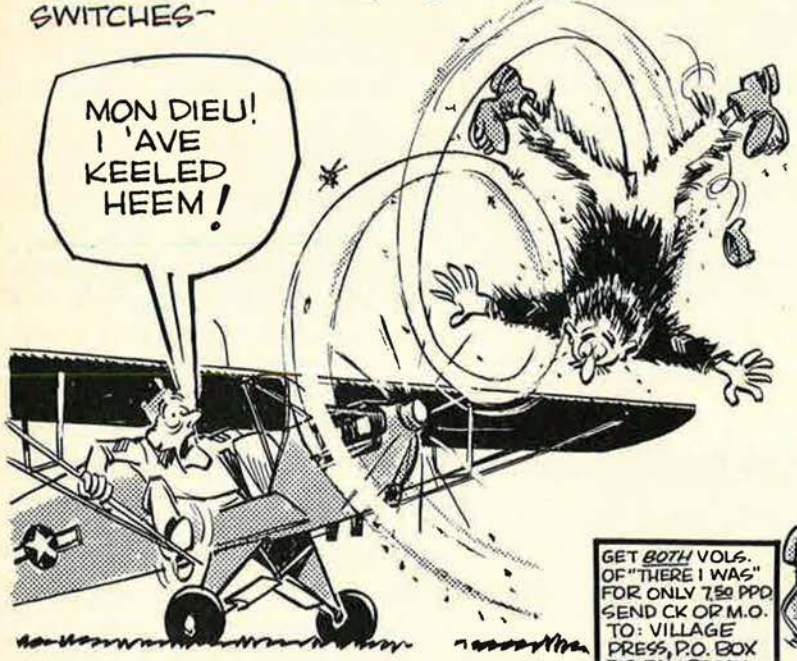
TWO OL' CAJUN-TYPE 3 STRIPERS ARE PROPPING AN L-4 "GRASSHOPPER" (MR. PIPER'S CUB IN O.D.)

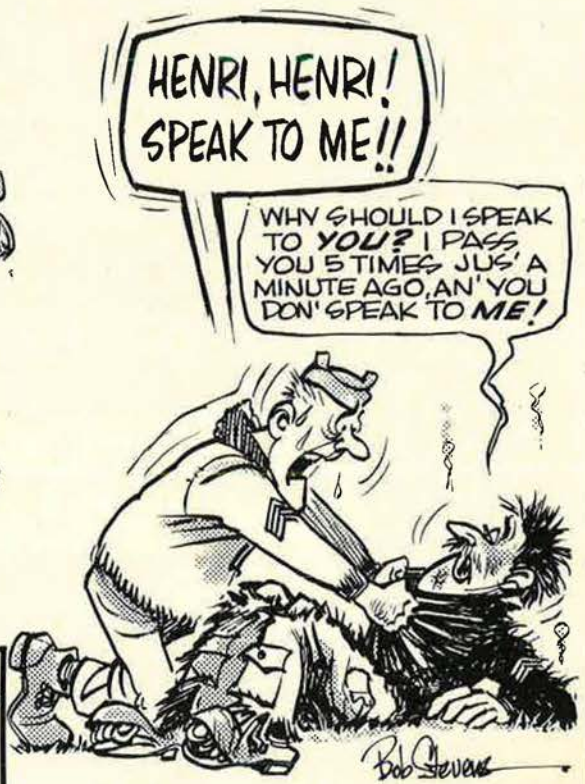


HENRI GETS "CAUGHT UP" IN HIS WORK-



THE CONTINENTAL 4 BANGER HITS ABOUT 5 LICKS BEFORE JACQUES CAN CUT THE SWITCHES-






HAVE A NICE YEAR.
76
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We solve problems...systematically
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This is the F-15 ground attack fighter.

It doesn't look any different from the F-15 air superiority fighter because it isn't. Every F-15 ever made has built-in ground attack capabilities that don't have to be added on later.

The same look-down radar, central computer, head-up display and weapons delivery system that make the F-15 an air superiority fighter, give it the accuracy demanded for attack missions. Demonstrations of its accuracy have proven the F-15 to be as accurate as today's leading attack aircraft.

The F-15 can deliver up to 15,000 pounds of ordnance in five different modes and is qualified for delivery of conventional and guided air-to-surface weapons. It is an extremely stable platform for its 20mm cannon.

The F-15 Eagle. Air-to-air or air-to-ground, it's the same fighter.

The F-15

MCDONNELL DOUGLAS