AIR FORCE

PUBLISHED BY THE AIR FORCE ASSOCIATION MAGAZINE

USAF Training—The World Leader

The GE technology edge: durable fighter turbofans with turbojet characteristics.

General Electric's new supersonic fighter turbofans benefit from technology that is *five years more advanced than any competitive engine.* And these advances are proven by endurance testing far more severe than previous standards. Accelerated Mission Testing (AMT), for example, subjects an engine to over 30 times the number of full throttle cycles and 12 times as many afterburner lights as traditional 150-hour qualification tests.

The F404 is a 16,000 lb. thrust engine in production for the U.S. Navy F/A-18 multi-mission aircraft. It has also been selected for the Canadian CF-18, the Australian F/A-18, the Swedish JAS aircraft, and is being offered in several other fighter competitions. The F404 has also been selected for the new F-5G intermediate fighter.

The F101 DFE, a derivative of the F101 developed for the U.S. Air Force B-1, is in the 27-30,000 lb. thrust class. It has been funded by the USAF and USN in a development and flight test program to provide competitive production alternatives in the large fighter engine thrust class. This engine has met all its fixed price contract requirements, completed its flight clearance tests, and conducted outstandingly successful flight test programs in both the USAF F-16 and USN F-14.

F101 DFE-powered General Dynamics F-16 — Flight Test

General Electric is truly setting *new standards* for fighter turbofans:

• **OPERABILITY:** Exceptionally stall-free engine operation and stable afterburner operation through the entire fighter envelope, with no throttle restrictions. Pilots report that F404 and F101 DFE turbofans behave like General Electric's famed J79 fighter turbojet. As one pilot said, "I can really fly the aircraft up to its capabilities." Said another, "Amazing response for a turbofan — as good as a turbojet."

• **DURABILITY AND RELIABILITY:** Proven by record-breaking AMT tests on both engines. Hot section lives equivalent to 2,000 mission hours of the toughest fighter operation were demonstrated on the F101 DFE without significant distress — and the parts will be put back in engines for more testing. With their preeminent hot section technology, GE engines offer *twice* the hot section life of any other engine in service.

F404-powered McDonnell Douglas F/A-18 — Production

• **OPERATING COSTS:** From simpler design through advanced technology. For example, GE engines feature single-stage turbines, machined ring combustors, mixed flow afterburners, and thousands fewer parts than other engines. Simplicity *plus* durability provide low maintenance costs. This is a direct result of low engine removal rates, where General Electric's engines have a preeminent record: The J79 removal rate in the F-4 is three per 1,000 flight hours. The TF34 in the A-10 is under two per 1,000. And the F404 and F101 DFE are on track for two per 1,000. Truly new industry standards!

F101 DFE-powered Grumman F-14 — Flight Test

When you need advanced fighter capability, GE gives you the technology edge...durable turbofans with turbojet characteristics.

Great Engines From General Electric's Advanced Technology

GENERAL ELECTRIC

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

AIR FORCE Magazine (formerly including SPACE DIGEST) (USPS 010-280) is published monthly by the Air Force Association, Suite 400, 1750 Pennsylvania Ave., N.W., Washington, D.C. 20006. **Phone:** (202) 637-3300. Second-class postage paid at Washington, D.C., and additional mailing offices. **Membership Rate:** $15 per year (includes $9 for one-year subscription); $36 for three-year membership (includes $24 for subscription). **Life Membership:** $200. **Subscription rate:** $15 per year; $25 per year additional for postage to foreign addresses(except Canada and Mexico, which are $8 per year additional). Regular issues $1 each. Special issues (Soviet Aerospace Almanac, USAF Almanac issue, Anniversary issue, and "Military Balance" issue) $3 each. **Change of address** requires four weeks' notice. Please include mailing label. Publisher assumes no responsibility for unsolicited material. Trademark registered by Air Force Association. Copyright 1982 by Air Force Association. All rights reserved. Pan-American Copyright Convention.

BPA Circulation audited by Business Publication Audit

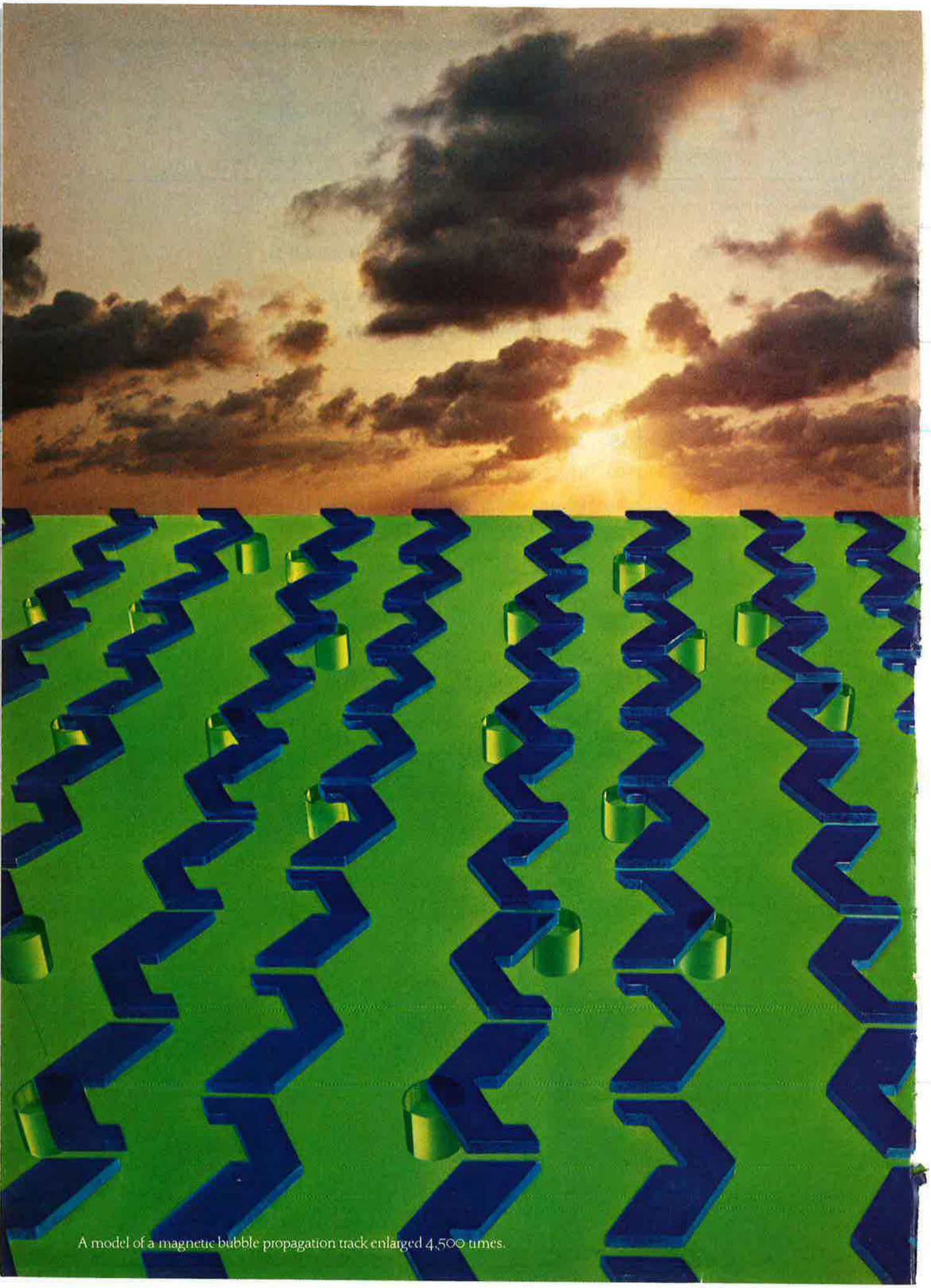
This Month

FEBRUARY 1982 • VOLUME 65, NUMBER 2

ABOUT THE COVER

More than 50,000 pilots have earned their wings in the supersonic T-38A Talon, Air Training Command's premier jet trainer for the past two decades. A special Air Force training section begins on p. 38. (USAF photo by Walt Weible)

Departments



A model of a magnetic bubble propagation track enlarged 4,500 times.

Who will help the military put bubble technology into the field?

WE will. We're Western Electric. And we're ready to put bubble memory technology to work for you.

Western Electric bubble memories are tailor-made for scores of military applications. They're non-volatile and modular with a capacity that's expandable from 2 to 120 megabits. And they'll stand up under harsh field conditions with easy maintenance and repair.

When you want to get the most out of bubble technology, Western Electric is your best partner. After all, Bell Labs invented magnetic bubbles and today Western Electric is a leader in the field.

We're ready to take your order for bubble memory systems right now. So for more information, contact our Magnetic Bubble Consultant, P.O. Box 20046, Greensboro, North Carolina 27420. Telephone: (919) 697-6587.

Western Electric

Government and Commercial Sales Division

AN EDITORIAL

Air Force Training Leads the Way

THIS issue's theme is Air Force training, and several feature articles are devoted to the topic. All of them touch upon one or more aspects of training in the Air Force—past, present, and future. Gen. Thomas M. Ryan, Jr.'s overview of "The Education Factor," beginning on p. 39, is especially useful for Air Force leaders and educators, because it sets out signposts along the education and training road ahead. Brig. Gen. William M. Charles, Jr.'s article ("Pilot Training, 1986 and Beyond," p. 42) highlights and illuminates a current major issue. The Next Generation Trainer (NGT) competition will be in the news when AFA members receive this issue; General Charles's explanations will help you understand the considerations behind the news.

Also, articles on current navigator training and realistic SAC aircrew training are presented, plus a perceptive analysis of simulator trends being shaped by technology and the Air Force—the simulator industry's toughest (and best) customer. John Frisbee tells about the miracle of WW II pilot training, while Contributing Editor Capt. Phil Lacombe covers the many challenges faced by the Air Force Institute of Technology (and the opportunities therein for Air Force men and women). Senior Editor Bill Schlitz shows how a partner in airpower, US Marine Corps Aviation, stays abreast of the profession.

A problem with concentrating on a theme such as training is that so much must be left out. It certainly affected the authors of these articles. They had to omit, prune, and squeeze to stay within the limits imposed by the editors. The editors, for their part, had to omit many topics that could be included. Those are constraints that require explanation and planning. As you see in this issue, the focus has been on aircrew training. That means not covering such important topics as basic military training, technical training, commissioning training programs, or on-the-job training in operational units, to name a few.

The remedy is to use the same building-block approach that is so much a part of Air Force training—aircrews this year, other training aspects next year and the year after. Over time we hope this approach will build a fairly complete body of information for AFA members. On training in this case; on engines, or readiness, or electronics in others.

Mention of aircrew training brings up the positive results of the Air Force way: In 1981, USAF's Class A aircraft accident rate was the second lowest in history (only 1973 was lower). This remarkable achievement was reached although the pilot experience level is lower than before, the aircraft are being maintained by entry-level maintenance technicians, and more stressful and potentially hazardous flying is being done. That's testimony to Air Force training methods.

Your editor, like so many others of the AFA staff, has been a beneficiary of USAF training over the years. It was always effective and appreciated. Never more appreciated, though, than in earning the Private Pilot certificate through the Andrews-Bolling Aero Club in November 1981. The aero clubs provide an example of blending USAF methods with minimum requirements set down by the Federal Aviation Administration, leading to safer general aviation flying.

The Air Force has forty-eight aero clubs whose 7,880 members fly 375 aircraft. The aero clubs' safety record every year is better than general aviation's norms. Part of the credit for that goes to the more stringent training requirements USAF imposes on its aero club flyers. As a personal observation, I believe a large share of the better safety record also results from an Air Force frame of mind imbued in the instructors and pilots of the aero clubs. They are more accustomed to the careful building-block approach, objective standards, frequent checks, and high criteria demanded in Air Force training. When that is added to the FAA's minimum requirements, the result is a flyer who has been evaluated more often against more stringent standards than required for the mass of general aviation.

The aero club system also makes use of one of USAF's hidden resources: the flying and instructing skills of many hundreds of noncommissioned officers. Two chief flight instructors in a row at Andrews are senior NCOs, and I was privileged to learn from both Drake Conklin and Jay Melrose. Both serve USAF in sensitive posts full-time, and spend most of their remaining hours raising the standards of general aviation flying. I am grateful to them, and to instructors Rex Taylor (Army officer and system analyst) and Doug Blake (former fighter pilot).

Those fine instructors who lead us to achieving the pilot certificate also try to instill humility and precision in their students. They succeeded in this case, while building a sense of pride in doing it right. It makes a difference in flying, as so many thousands know who have learned the Air Force way.

A parting note: I am grateful to AFA's Chairman, President, and Executive Director for their encouragement and support in this endeavor. We all believe it will improve my coverage of the Air Force for AFA.

—F. CLIFTON BERRY, JR., EDITOR IN CHIEF

C^3I Key to Battlefield Effectiveness

From small-unit commanders to generals and admirals, military decision makers are swamped with communications. Blizzards of intelligence, operations, and logistics data pour into their command centers, afloat and ashore.

That's why TRW has committed first-line talent and other major resources to the development of tactical C^3I systems. Like I^2S^2, for example, the Intelligence Information Sub-System now in operation at USAREUR headquarters, or BETA, the Battlefield Exploitation and Target Acquisition system developed under joint service sponsorship. Or PCOTES,

a prototype C^3I test-bed for the Navy's Carrier operations, and MIFASS for the Marines. These processing centers exploit data collected by mobile intercept and direction-finding systems like Guardrail and EH-1X, developed by our ESL subsidiary.

These systems and future systems now under development reflect the skill and experience of our C^3I specialists...specialists who have designed new software and hardware to process floods of data from all kinds of sensors, rapidly, flexibly, and efficiently...men and women who are developing advanced maxi, mini, and micro computer networks to process information economically and in

near-real time.

If you're interested in applying TRW's tactical C^3I expertise, contact Stan Cochran, TRW Systems, 75/1900, One Space Park, Redondo Beach, California 90278. Phone: (213) 535-3625

C^3I SYSTEMS
from

A COMPANY CALLED

TRW

ELECTRONICS AND DEFENSE

NAVSTAR GPS

Global Positioning System

In-flight refueling.

Anytime
Anywhere
Any weather

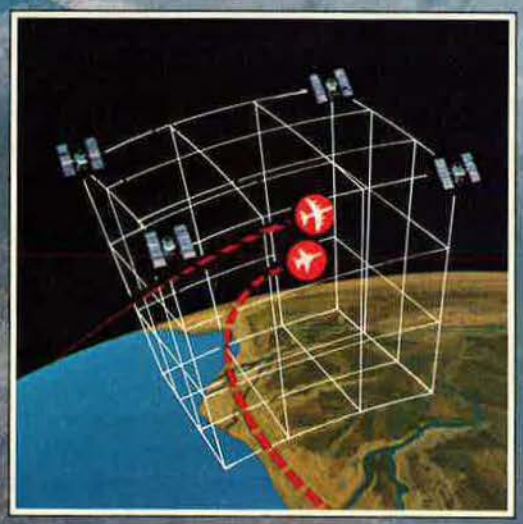
At last it's possible. How? Navstar GPS will give pilots a global, all-weather, precise moving waypoint capability. Six recent joint service-sponsored tests dramatically demonstrated this capability. Overall results showed rendezvous within the wing span of the tanker aircraft.

The procedure is simple: the user receives and processes the time and position signals from the GPS constellation of satellites to obtain current position, velocity and GPS time. An operator enters the desired waypoint into a Navstar computer. Pilot's steering display has cross-track, vertical track, and time-to-go/distance-to-go needles which visually direct the pilot to the waypoint.

GPS will be an important asset to U.S. and NATO air force commanders for other reasons as well. Greater accuracy for precision weapons delivery, target acquisition, barebase recovery, air interdiction and close air support, to name only a few.

Commanders will also lock into a common reference grid worldwide.

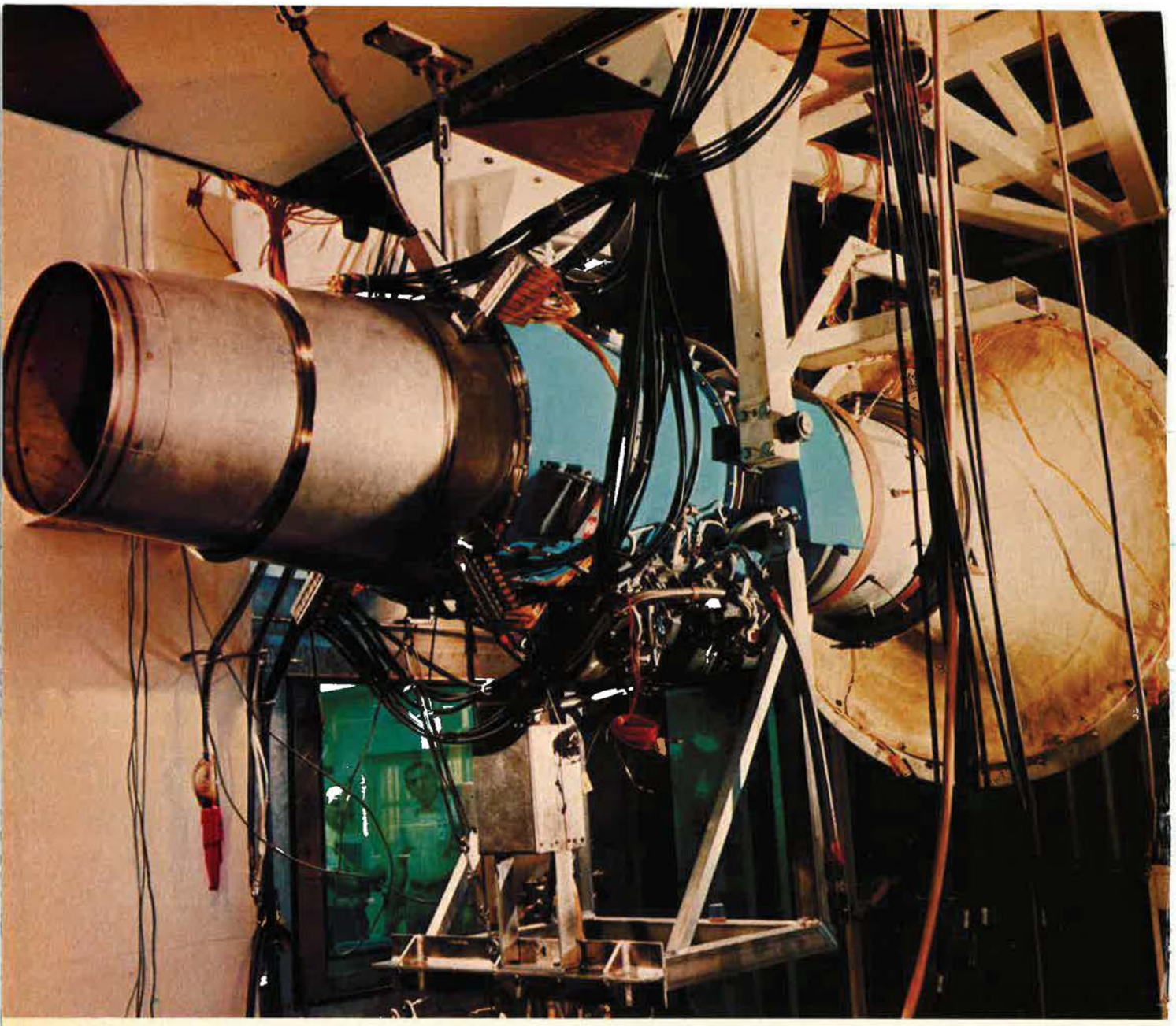
DoD's Navstar Global Positioning System (GPS) provides continuous and worldwide navigation and more accurate target acquisition. Navstar delivers. Space Operations/ Integration and Satellite Systems Division, North American Space Operations—builders of the Navstar GPS satellites.



Rockwell International

...where science gets down to business

M. Alvarez



THE TFE76: NOW RUNNING FOR THE NGT

The Garrett TFE76 turbofan engine is already running, meeting or exceeding all predicted operational characteristics.

On November 4, 1981, the TFE76 began this significant phase in its development. The engine will continue to run for further substantiation of component performance.

Why such confidence in this Next Generation Trainer engine? Designed specifically for use as a trainer engine, the TFE76 is a derivative of already proven Garrett T-76 and TPE331 engines. With Garrett's TFE76, the Air Force can have the best of both worlds—advanced technology in a very low-risk, low life cycle cost engine. Furthermore, the TFE76 should easily meet the 1987 target for operational service of the NGT.

The TFE76 is the result of a six year company funded project. And with Garrett's 25 million operating hours experience on 12,000 turbofan and turboprop engines in this power category, you know the expertise is as strong as the commitment. This expertise provides every confidence the TFE76 will meet all Air Force specifications for durability, damage tolerance, performance, maintenance and low fuel consumption.

The TFE76 will give the Air Force NGT the power for high altitude operations, dependable performance, and the growth capability to even higher thrust levels, while operating with a noise level which is 20 dB lower than the existing trainer engine.

Because of our demonstrated, low-risk, proven approach, both Fairchild-Republic and Rockwell International have chosen Garrett power for their NGT aircraft. They know the logical choice is Garrett. For more information, write: Propulsion Engine Sales, Garrett Turbine Engine Company, P.O. Box 5217, Phoenix, AZ 85010. Or call (602) 267-4035.

GARRETT

The Garrett Corporation
One of The Signal Companies

AIRMAIL

"Get On With the Job"

Maj. Paul T. Burnett's letter, "Flatten the Pyramid?" *(p. 5, Nov. '81),* ought to be required reading for every career-oriented member of the United States Air Force. While his letter will undoubtedly have its opposition, Major Burnett is to be commended for succinctly identifying problems *inbred* in today's Air Force personnel programs. His comments are as applicable to the enlisted force as officer, though it might easily be agreed that greater attention is momentarily due officer programs.

Some of Major Burnett's proposals are not new, but they are better articulated than ever before. The change to our personnel programs must come soon, and should our current leaders fail to take heed, they will find themselves out to pasture, watching the farsighted assuming leadership—which is as it should be.

Today's Air Force doesn't lack for gifted and motivated people, but some need to learn that it is not disloyal to occasionally take exception to the corporate point of view and try to market one's own. We continue to advance the state of the art in technological systems at the expense of adopting realistic personnel programs geared to assuring a fit fighting (or if you prefer, peacekeeping) force for this unique age we live in.

Not only are more realistic personnel programs due the Air Force, but the taxpayer as well. Let's drop our adversary relationship with the US Congress and get on with the job.

It will take more officers the likes of Major Burnett.

MSgt. George R. South, USAF
Viborg, Denmark

AFA's Skewed Priorities?

In reference to your AFA Policy Paper "Defense Manpower Issues," *(p. 38, Nov. '81)*: I am extremely disappointed that AFA would support legislation to repeal the five-step rate system for civilian employees, and I am angry that AFA would also support repeal of the Monroney Amendment.

With some minor exceptions, every one of the issues listed under "Civilian Personnel" on p. 43 supports legislation designed to help high-level mobile executives. I would hope that AFA would be just as concerned for plain old "blue-collar" civilian employees. Let's face it, gentlemen—these are the people who, along with the "stripers," keep them flying.

Instead, it seems that AFA is only worrying about getting more pay for the senior executives, bonuses for the senior executives, and travel and relocation allowances for mobile employees (who more than likely are also senior executives).

As a supervisor for a group of blue collars who will start their careers and most likely end them in the same place of employment, I cannot agree with AFA's priorities.

Arnoldo A. Muniz
San Antonio, Tex.

Kind Words

I liked your "Season's Greetings" on the first page of the "Intercom" section in the December issue of AIR FORCE Magazine. It was a very nice page.

I just wanted to write a short note to say that I like the new "Intercom" section a great deal. I thought that you covered the AFA Convention very well in the first "Intercom" section in the November issue. (In fact, the Convention was well-covered throughout the entire November issue.)

Best wishes to the Air Force Association for a very successful 1982.

Henry S. Dunning, Jr.
Norwalk, Conn.

Oops!

I read with interest and appreciation your October 1981 issue, which was devoted to the Reserve Forces.

I recalled that when I served my initial tour of active duty from 1958 to 1961 at Ellington AFB, Tex., as a member of Continental Air Command, one of the sore points of the day was the mispronunciation of CONAC's Bakalar AFB. However, we were under the impression it was located in Indiana. Therefore, I suppose you've heard, by now, from former members of that base who were surprised to read in the caption on p. 46 that they had been in Florida all that time! . . .

Thanks for the memories and the recognition of the Air Force Reserve program.

Lt. Col. Donald E. Davison, USAFR
Puyallup, Wash.

Keeping It Straight

The Focke-Wulf German fighter airplane displayed at the Air Force Museum is a FW 190D-9. It is not a FW 109D-9 as stated on p. 129 of your article, "A Living History" *(Dec. '81).*

The captured German FW 190D-9 fighter on display there was assigned to the *JG3 Udet Geschwader,* a famous Luftwaffe fighter unit. More than 20,000 FW 190s were built. (However, there also was a Messerschmitt fighter, the Me 109.)

Former B-17 combat crew members: The passage of time heals many things—the FW 190D-9 is displayed at the Air Force Museum under the right wing of a beautiful B-17G.

Dr. Jerry Zapp
Chippewa Falls, Wis.

A New Title?

Regarding the "Intercom" section, p. 165 of the December '81 issue: I believe the picture entitled "22-42-52" is in error, as the P-12 airplane was not even a dream in somebody's brain at that time.

At Kelly Field, Tex., at the Air Corps Advanced Flying School in 1931 and 1932, the P-1 was used for training pursuit pilots. When those pilots were detailed to a year of active duty—some of them, that is—they were sent to Langley Field, Va. There, the equipment of the 33d Pursuit Squadron was the P-12. The 1st Pursuit Group at Selfridge Field was equipped likewise.

So-o-o, maybe the picture should be entitled "32-42-52"?

Loren Cornell
Birmingham, Ala.

• *The first P-12 flew at Seattle on April 11, 1929.*—THE EDITORS

AIRMAIL

Not the Only One

I was surprised when reading your September '81 issue about "The Marvelous Mustang," written by Jeffrey L. Ethell, who states: "Gordon [Plaskett] owns the only operational dual-control Mustang, a TF-51D . . ." *(p. 144).*

Just for the record, we (the Dominican Republic Air Force) have a dual-control Mustang. I have been an instructor pilot in this beautiful machine for many years, logging 500 hours plus. It is a real love affair.

If there is one thing I agree with, it is Mr. Plaskett's advice not to let the airplane go too slow. I know from a personal experience that almost cost me my life! . . .

Lt. Col. Rafael Diaz Bonilla
Dominican Republic Air Force
Santo Domingo, D. R.

The Soviet Mystery Man

I have served in three branches of the armed forces, yet I have read little about the murky figure—the Soviet enlisted man.

My son is presently in the US Army, and I find that there is little I can tell him about the Soviet enlisted force.

Perhaps even a grade structure chart in the Soviet Aerospace Almanac would be of interest to your readers. I've never even seen such a chart, much less any in-depth information about the mystery man of the Soviet Union—the enlisted man.

Milton M. Futch
Jacksonville, Fla.

Battle of Hamburg

German television will be making an hour-and-a-half long film on the Battle of Hamburg this spring. Any members of the 8th AAF with stories to tell and/or souvenirs to show, please contact me at the address below.

Liesel Friedrich
German Television, Suite 427
251 West 57th St.
New York, N. Y. 10019
Phone: (212) 307-0242

A Positive Force

Having been trained and educated in a past generation, I have been having trouble accepting the use by USAF of young women on the flight line. No good reason, just a built-in bias. But that has changed.

While engaged in an aircraft installation at Edwards AFB, Calif., several of us engineers noticed that the crew chief of the F-4 next to us was a young lady. We were working in shifts so there was time to observe her activities. It was impressive. She was not only continuously on the move, but she went about the job of getting the aircraft ready with an air of confidence and authority. She knew her job.

However, it was her final gesture that convinced us that she had a genuine appreciation and feeling for her job and the aircraft. After directing the aircrew from their parking place on the ramp and clearing them on to the taxiway, she gave the crew as sharp a salute as we have ever seen in the military. Then, as the wing of the aircraft passed over her head, she kissed her fingertips and pressed the kiss to the aircraft wing. It was a totally female gesture, but to those of us observing the activity it demonstrated a people/machine relationship that was heartwarming to see still existing in this modern world.

We never spoke to the young lady and we don't know who she is. But we do know that she changed the minds of several engineers about females on the flight line. With that kind of dedication they are a positive force. We now have no problem accepting young ladies on the flight line—this one-time observation has made converts of all of us.

John McCarty
Baltimore, Md.

Lieutenant Karman

I would like any help with details or knowledge of 2d Lt. Albert M. Karman, of Brooklyn, N. Y. Lieutenant Karman was the copilot of a B-17G downed over Germany on August 27, 1944.

This fine young man was a friend of my family, and I am attempting to form a more complete picture of him or a biographical sketch that would stand for the record.

Anyone having any information can contact me at the address below.

Alvin Babich
114 Margaret Keahon Dr.
Pearl River, N. Y. 10965

WW II Night Fighters

Here at the US Air Force Museum, we're developing a display highlighting the role of the AAF night fighter squadrons in World War II.

Squadron patches, a flight jacket with a unit insignia on it, an escape and evasion kit—these are examples of items that would be very welcome. In particular, we're anxious to acquire memorabilia unique to night fighter operations, such as red-lens glasses that perhaps were worn while preparing for night intercept missions.

Inquiries concerning possible donations should be addressed to me personally.

(P. S.: Thanks for the fine article on the Museum, "A History Lesson," in the December '81 issue.)

Charles G. Worman
Chief, Research Division
Air Force Museum
Wright-Patterson AFB,
Ohio 45433

Military History Symposium

The Department of History at the US Air Force Academy will host its Tenth Military History Symposium on October 20–22, 1982. The theme of the tenth symposium will be "The Home Front and War in the Twentieth Century." Session topics include: the task of forging national unity and mobilizing public opinion in total war; the mobilization of men, money, and materiel for total war; the social effects of war on civil liberties, civil rights, and the role of women; and the interplay between limited war and domestic politics.

The Twenty-fifth Harmon Memorial Lecture, the symposium keynote address, will be presented by Professor John Morton Blum of Yale University. Professor Blum will speak on the impact of World War II on American society.

For further information, please contact me at the address below.

Maj. James R. W. Titus, USAF
Executive Director
Tenth Military History Symposium
Department of History
USAFA, Colo. 80840
Phone: (303) 472-3230
AUTOVON: 259-3230

Sloan Tonis?

During a visit to Shanghai in October 1981, I talked to a Mr. Bo Ven Gu there. He is trying to contact one of the American airmen he knew during World War II, a Slinger Tonis or Sloan Tonis, who Mr. Gu thinks is in the silk business in the Los Angeles area.

Mr. Gu may be reached at the following address: Bo Ven Gu, First Silk Weaving Mill, 468 Yan Sze Pu Road, Shanghai, China.

Lt. Col. F. Arnold Grim, USAF (Ret.)
La Jolla, Calif.

Anybody Seen . . . ?

I am trying to locate an Army Air Forces friend named James Trammel.

Our nation's global mobility is greatly enhanced by the new McDonnell Douglas KC-10A. The tanker/cargo aircraft enables the USAF to rapidly deploy tactical aircraft and support equipment to any trouble-spot on the planet, using only U.S.-controlled bases.

When the mission comes, the KC-10A crew will be ready

...because of PLATO® training.

American Airlines *has a contract to train combat crews for the KC-10A. One of the key elements of the training method selected by* American Airlines *to train combat crews for the KC-10A is the Control Data PLATO computer-based education system. PLATO simulates KC-10A system operations to accomplish Part-Task Training at a fraction of the cost of actual aircraft for full-scale flight simulators.*

Training never ends for the members of a combat crew. They must be ready to respond. Instantly. Appropriately. Effectively. Ready for any contingency – either routine or extreme.

The KC-10A crew practice their skills on the Control Data PLATO system. PLATO's interactive graphics and touch-sensitive screen simulate situations and shows how the aircraft systems would react to commands.

PLATO training is individualized. Materials are assigned according to each student's needs.

The PLATO system also measures the performance of each crew member and the training system itself. This automatically generates student records for the Air Force, while it eases updates and improvements to flight training.

To learn more about how we're applying the world's most advanced learning technology to the needs of our Armed Forces, call us. 612/853-5000. Or write Control Data, Government Systems Marketing, P.O. Box 0, Minneapolis, MN 55440.

CONTROL DATA CORPORATION

CLASSROOM WITH CLOUT.

The Hawk is unrivalled in its class. An advanced trainer and a weapons trainer all in one.

It's a powerful ground attack fighter too.

Better still, it needs very little maintenance, so it spends more time in the air, keeping your pilots' morale high, and your costs low.

That's why it's top of its class.

HAWK

BRITISH AEROSPACE

unequalled in its range of aerospace programmes

Richmond Road, Kingston upon Thames, Surrey KT2 5QS.

We were together in aviation cadet training at Penn State College, Class of '43. We flew Piper Cubs for ten hours at Belfort Airport. We were shipped to Nashville, Tenn., in January 1944 for classification for pilot training. We were delayed from going on to Maxwell, Ala., since they could not give us preflight training. We were shipped to Courtland, Ala., for three months, doing KP and washing aircraft. We were finally shipped to Santa Ana, Calif., for preflight.

From there Jim Trammel became a pilot, and I became a tail gunner on a B-25. The last time (June 1945) I was with him, he was a flight officer flying AT-6s at Lincoln, Neb.

I would appreciate any information readers could give me as to his whereabouts today.

James W. Stout, Jr.
144 Warrior Rd.
Drexel Hill, Pa. 19026

We are trying to locate a survivor of a B-18 crash on January 14, 1942, at North Woodstock, N. H. He is Robert P. Picard, formerly of Dickenson Street in Springfield, Mass.

If anyone knows his whereabouts, could they please have him contact us at either address below for a possible reunion?

Richard G. Chubb
6 French Rd.
Billerica, Mass. 01821
or
Woodward A. Kantner
5600 S. Federal Hwy.
Stuart, Fla. 33494

I am trying to find some leads on what happened to my uncle. Could anyone who knew Sgt. Harry Furden, 844th Bomb Squadron, 489th Bomb Group, Eighth Air Force, please contact me at the address below?

Ron Furden
3841 West Seagull Dr.
West Valley City, Utah 84120
Phone: (801) 968-5672

Aero'N'Photos

Congratulations on a fine publication. I really enjoyed your October '81 issue on the Air Force Reserve and the Air National Guard.

During my spare time I publish an aviation-type publication called *Aero'N'Photos*. I am looking for photographs of B-17s, B-25s, and B-26s in Air National Guard markings for a future article.

Please contact me at the address below.

Lionel N. Paul
Aero'N'Photos
P. O. Box 1841
Springfield, Mass. 01101

AIRMAIL

Blackbirds

I am both an aircraft enthusiast and scale modeler doing research on the Lockheed A-11 and its variants, the YF-12A interceptor and the SR-71 Blackbird reconnaissance aircraft.

If anyone has worked with these aircraft, or has photos or information, please contact me at the address below. Any photos will be copied and safely returned.

Erich Linder
4624 West 11th St.
Cleveland, Ohio 44109

Stansted Mountfitchet

I am trying to research and finally write the history of Stansted Mountfitchet Airfield, or, as was the official title, AAF 169.

At the moment I have hardly any information about this station, apart from the group which flew from there (344th Bomb Group). I would be very grateful if any readers who were there during 1954 to 1956 could send me any documents, information, photographs, or anything else that might help me in my research.

T. E. Weller
2 High Lane
Stansted Mountfitchet
Essex CM24 8QL
England

B-25 Cannon

I found recently a copy of the Primary Class Book 44-B—Curtis Field—from Brady, Tex. I'll be happy to send it to anyone from this class who contacts me first.

I am compiling information on the 75-mm cannon as used in the B-25H aircraft. I have plenty of flying information but sadly lack technical data. I would appreciate hearing from anyone who has some specs as to the weapon, boresighting, munitions, etc.

MSgt. Chuck Baisden, USAF (Ret.)
109 Wales Ct.
Savannah, Ga. 31410

Der Bingle

I have a homemade recording by the late Bing Crosby.

In a statement prior to singing a song, Mr. Crosby states, "Welcome to General Hale and the Seventh Air Force." He then says that the song he is about to sing was written only the night before by Jimmie McHugh, and that they have never had the chance to rehearse it.

He then sings a few verses about what General Hale's Seventh is going to do to the Japanese. The language he uses in a couple of parts can only be described as "salty."

My question is whether there are any readers who may be able to fill me in on where this scene took place and on what date—presumably somewhere in the South Pacific.

Further, if there is anyone who would care to have a recording; I would be happy to forward a cassette of the song, for the cost of the tape and postage only.

Lt. Col. Rodney T. Stewart, USAF (Ret.)
116 West Main St.
Grass Valley, Calif. 95945

WW II Aircraft Nose Art

We try to feature color photos of World War II aircraft nose art and other markings on the covers of our Bomber Books historical monographs, in an effort to preserve and publish this unique art.

Kodachrome slides taken during World War II still have amazingly good color, and we are constantly copying slides for future use, giving credit to the lender of the original slide.

We would welcome the opportunity to borrow, copy, and return WW II aircraft slides taken by AIR FORCE Magazine readers, in the interest of saving as much of this photography as possible before it is lost.

Frederick A. Johnsen
Bomber Books & *Echelon* Magazine
Box 98231
Tacoma, Wash. 98499

499th Bomb Group

AIR FORCE Magazine readers who served with the Twentieth Air Force's 73d Bomb Wing on Saipan during World War II (and aviation history buffs) will be glad to know that the unofficial history of the 499th Bomb Group has been published. The Group, flying B-29s, began operations against the Japanese homeland in November 1944, and continued until the end of the war.

The book offers a glimpse of the 499th's tough ten months of action during the closing months of the war. It includes a map of operations; an operations listing giving all mission dates, targets, and results; and 171 photos.

Prentiss "Mick" Burkett, 499th Group historian, compiled and edited the history, and the book can be

purchased by contacting the address below.

Paul R. Matt
Historical Aviation Album
P. O. Box 33
Temple City, Calif. 91780

F-105 Thunderchiefs

I am doing research on F-105 Thunderchief squadrons during 1961–74. Color photos, slides, and black-and-white photos are needed to help illustrate a pictorial unit history through photographs and art work.

Of main interest are the F-105s of the Pacific Air Force during 1962 to 1970. Aircraft of the 8th and 18th Tactical Fighter Wings suffered heavy losses during 1964 through 1966, and photo material as well as operational histories and combat narratives on them are scarce. Also of interest are photos of F-105s of the 4th, 23d, 355th, and 388th TFWs, also rotated to Southeast Asia.

Aircraft at this time were still in natural metal and aluminum finish, and carried distinctive unit color bands on the nose radome, tail, and unique striping on the rear fuselage. I need also serial numbers and the fate of aircraft originally equipping these squadrons.

All material will be handled carefully and returned on request.

Ray Murman
7230 North Ottawa
Chicago, Ill. 60648

History of NATO

I am a senior at Texas Lutheran College in Seguin, Tex., and am an AFROTC cadet at Det. 840 at Southwest Texas State University in San Marcos, Tex. In order to fulfill my requirements for graduation this coming May, I am taking an independent study course in my major of Political Science.

I will be attempting an in-depth history and analysis of NATO, and would appreciate any information on this subject that readers might have. Please contact me at the address below.

Richard F. Robb
Box 3543
Seguin, Tex. 78155

***Life* at Class 43-G**

During primary flight training of Class 43-G at Carlstrom Field, Arcadia, Fla., a writer-photographer team from *Life* magazine did a news feature write-up on our class. They interviewed several of us and took pictures. That was in February–March 1943.

I was so preoccupied with the rigors of becoming a military pilot that I never thought to inquire into the publication results. I think it would be very interesting to see some of those pictures today, and would appreciate hearing from anyone who may have copies.

Lt. Col. John D. Burnett,
USAF (Ret.)
P. O. Box 241
Bellevue, Neb. 68005

AIRMAIL

Bomarc Units

I wish to contact anyone who was associated with operational Bomarc units, such as the 26th Air Defense Missile Squadron and Mace B units based on Okinawa.

In particular, I wish to obtain copies of photos showing these missiles in their operational mode (I will pay the postage both ways). This information is vital for a historical project concerning USAF missiles of the early 1960s.

Ron Andrini
238 State St.
San Mateo, Calif. 94401

Mixed Drinks

I am working on a new book, and would appreciate any information readers may be able to provide.

The book will be a compilation of unique mixed drinks that are characteristic of specific flying units, past and present. I want to publish not only the recipes for the drinks, but also any special formalities involved in their use, and the history of the drink as it pertains to the unit claiming it.

Don Berliner
1202 S. Washington St.
Apt. 227
Alexandria, Va. 22314
Phone: (703) 548-0405

With Mondale in Norway

I was wondering if any readers can help me get in contact with the aircrew that stayed at the Sogndal Hotel in Norway—they were the crew of two Bell Hueys (96607/96808) who participated in the visit of former Vice President Walter Mondale to Norway on April 7–15, 1979.

Any help would be appreciated. Please contact me at the address below.

Rolf Liland
Hovdenveien 12c
N-5043 Hop
Norway

Experimental Aircraft

Two historical reference books are being prepared—one on the development of aircrew equipment (from 1945), and another on the "X-series" of aircraft tested at Edwards AFB, Calif., from 1945 (X-1 through X-20).

Anecdotes, personal recollections, photographs, and any other information concerning these two topics are being sought for these books. Please share your interesting experiences with us.

C. T. Carey
Highland General Hospital
Box 19
1411 East 31st St.
Oakland, Calif. 94602

Douglas C-124

I am presently working on a book on the Douglas C-124, A and C models. I need more photos and information on this aircraft. I would appreciate any help readers can give me in this area.

I would also like to hear from members of the Air Force who worked on or flew the C-124, including members of SAC, Air National Guard, and Air Force Reserve. I would also like to buy squadron patches of C-124 units.

All photos will be returned and credited if used.

Nick Davis
5676 Meadow Lane, #104
Ogden, Utah 84403

Collectors' Corner

I am trying to put together a collection of Vietnam items, especially patches. If anyone has any patches or other items they would like to get rid of, I am willing to pay a fair price.

If anyone has any of these items, please contact me.

Rick Szulczynski
28 Willowood Dr.
Apt. 102
Hampton, Va. 23666

I have been in the Air Force for a little more than a year, and am very much planning on the Air Force as a career. I am just starting to collect Air Force patches.

My problem is that both my resources and contacts are very limited. I would like to ask readers who have patches that they don't want to send them to me. I would appreciate it and would be more than happy to reimburse mailing cost.

Also, I would like any patch-collecting ideas or club contacts from anyone who would care to write. I will answer all letters.

A1C David A. Chandler, USAF
6 Overstreet Dr.
Mary Esther, Fla. 32569

aerospatiale

military pilot training

Epsilon

basic military trainer ordered by the French Air Force

Société Nationale Industrielle
aerospatiale
DIVISION AVIONS
37, bd de Montmorency - 75781 Paris Cedex 16 - France

444/NGT

Model 444 Turbofan by TELEDYNE CAE for the NGT by CESSNA

Training jet pilots in the Cessna T-37 powered by the J69-T-25 by Teledyne CAE has become an Air Force tradition.

Now Teledyne CAE and Cessna Aircraft Company are teamed once again to translate that 25 years of service and reliability into a new tradition – the **N**ext **G**eneration **T**rainer.

The Teledyne CAE model 444 turbofan is engineered specifically for durability in the rugged military environment and, yet, designed for low cost, easy maintenance in the field. A prototype model 444 engine has already completed initial shakedown tests, demonstrating significant engineering achievement.

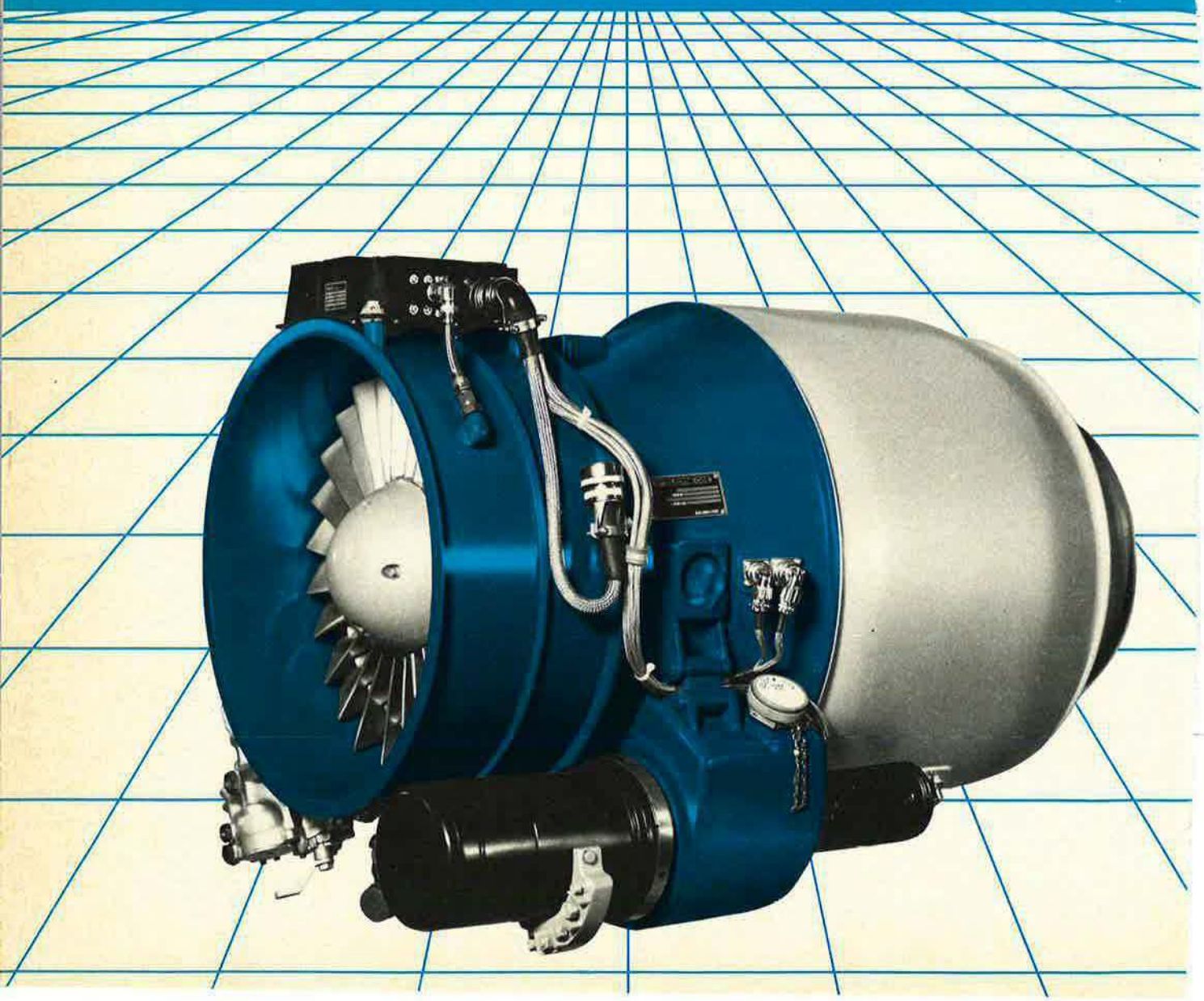
Model 444 turbofan – ready today for the challenge of tomorrow.

Ideas With Power

TELEDYNE CAE

Turbine Engines

P.O. BOX 6971
TOLEDO, OHIO 43612



IN FOCUS...

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

Washington, D. C., Dec. 31

Dawn of a New Space Age

The Administration's decision to invest some $18 billion in strategic command control and communications (C^3) over the next few years—as part of a five-pronged strategic force-modernization package—has given impetus to the Air Force's Milstar program that by the end of this decade will provide US strategic nuclear and *all* theater forces with reliable, two-way communications on a sustained, survivable basis.

The Milstar satellite network will serve the Army, Navy, and Air Force and, according to Lt. Gen. Richard C. Henry, Commander of the Air Force Systems Command's Space Division, which builds the system, has been accorded a program priority "competitive with that of the B-1B." The roots of the new program go back to the SSS, the Air Force's Strategic Satellite System that Congress scuttled for a variety of reasons, extending from extreme assumptions about Soviet space threats to schisms in the scientific and technical community over how the system ought to be designed.

SSS was to have been positioned at an altitude of some 110,000 miles (or roughly five times higher than geosynchronous orbits where spacecraft remain "stationary" relative to a given spot on the earth's surface) in order to increase survivability against ground-launched interceptors or other threats. Milstar's operational satellites—at least four in geostationary orbit at 22,300 miles hovering over the Indian Ocean, the East Pacific, the West Pacific, and the Atlantic, respectively, as well as two or more in highly elliptical orbits to cover the polar regions—will be equipped with substantial maneuver capabilities and sufficient propellants to carry out evasion and escape frequently and flexibly to elude Soviet ASATs (space interceptors). The Milstar satellites will also be hardened to as high a degree as possible against nuclear effects and radiation from future directed-energy weapons.

To further reduce the system's vulnerability—and thus Soviet incentive for attacking it—Milstar will rely on an unspecified number of "high orbital spares," meaning dormant, dark satellites parked at "supersynchronous" altitudes of up to 110,000 miles, which can be brought down to geostationary altitudes on command to augment the network.

Over the long term, as Soviet ASAT and related capabilities grow, it might become necessary to deploy new generations of Milstar satellites only in supersynchronous orbit, according to General Henry. But such an eventuality is probably a long time off and would not require a major redesign of the Milstar system, according to Air Force analyses. In the meantime, Milstar, operating at stationary equatorial orbits, is expected to be at least as survivable as SSS would have been at supersynchronous altitudes.

Lastly, the Milstar network is to incorporate "cross-orbital relay" features that couple the satellites with each other by laser or other data links. As a result, flexibility, redundancy, and survivability are boosted while dependence on ground-based foreign relay and tracking stations is reduced or eliminated.

Bugbear of Milstar—as it was in case of SSS and AFSATCOM II (a proposed survivable version of the Air Force Satellite Communications System)—are larger-than-life-size threat assumptions, in particular direct-ascent Soviet ASATs that reach geosynchronous altitudes—for the time being outside the reach of space interceptors—without need of time-consuming orbital staging. The designers of Milstar, on the other hand, remain confident that this network will remain viable even under worst-case scenarios for many years to come.

As General Henry points out apperceptively, 22,300 miles up is a long way away, and what's up there—or beyond—is hard to see. Further, the high-altitude Soviet ASAT thought to be in development is the size of the Saturn V Apollo moon rocket and, thus, represents "a pretty vulnerable target itself." Lastly, the considerable span from an ASAT launch of this type—and its instant detection by DSP and other sensors—to the weapon's arrival at the target's orbital altitude leave time for evasion or escape.

The US, by dint of Presidential Decision (PD) 37 issued by the Carter Administration, claims categoric sovereignty for its spacecraft. Current reviews of the national space policy seem certain to stiffen this rule even more and to outline retaliatory steps to be taken if other nations' spacecraft violate the *cordon sanitaire* claimed for US spacecraft. Beyond that, the distances between the individual satellites of vital US space systems are maintained at levels that preclude destruction of more than one satellite by a single nuclear-armed ASAT.

Milstar, according to General Henry, benefited from unprecedentedly harmonious cooperation between the services and the Defense Department in setting up standards of interoperability and joint use. This made possible a quick agreement on Milstar's EHF (extremely high frequency) "signal structure," meaning the network will operate uniformly in the twenty to forty gigaHertz frequency range for all its users, whether they be terminals in ICBM launch control centers, aboard ships, on Army tanks, aboard various aircraft types, or elsewhere.

Selection of this frequency range resulted from a painstaking scientific review of the bandwidths most suitable for reliable signal propagation in a nuclear environment, as well as in terms of jam-resistance and communications security. The latter is the responsibility of the National Security Agency. While there are certain imponderables about communications "blackouts" that can be induced by high-yield nuclear detonations in the upper atmosphere, there is high confidence that the EHF signal structure, combined with Milstar's redundancy, will provide a network that continues to function during the trans- and post-attack phases of nuclear war.

The Milstar program, which is ex-

pected to enter full-scale development in 1983 and reach operational status in the second half of this decade, is undergoing program definition and validation. The program represents a "first step" in the development of a "system of systems so that over the long term we will have on orbit a communications architecture of global scope with the same kind of flexibility and capability as we have on earth," according to General Henry. Whether the Milstar user wants to dial an aircraft carrier on the high seas, a B-1B in flight, or a command post in Europe, "he will know that he will get through," he added.

In terms of strategic nuclear war requirements, another crucial C^3 system is the Defense Support Program (DSP, also known as the Early Warning Satellites that report ballistic missile launches in nearly real-time). The Space Division's DSP Upgrade effort, which seeks to modernize and refine the performance of this network, poses major challenges. The basic problem is that the upgrading has to take place without impairing the operational status of the system's orbital segment. Key objectives of this project are greater survivability of the system's message traffic, higher assurance that the system sees what the users want it to see, and, if technically feasible, higher resolution. DSP is now flawed, in the view of congressional experts, by its inability to pinpoint individual silos from which Soviet ICBMs might be launched. As a result, the US ICBMs—if used in counterforce fashion against withheld portions of the Soviet ICBM force—probably would have to attack empty as well as loaded silos, since DSP can't tell which missiles in a given field have been launched and which are being kept in reserve.

Following behind the DSP Upgrade project is the DSP II program, which aims at the development of an advanced warning system of markedly higher performance than the present generation of Early Warning Satellites. Carried out jointly by the Air Force and the Defense Advanced Research Projects Agency (DARPA), the DSP II program concentrates initially on the development of a "staring mosaic sensor" that "sees" instantly anything worth observing over a wide arc. Currently used sensors "sweep" in searchlight fashion and thus can't detect missile launches as quickly and reliably as a sensor with a panoramic view.

A technology demonstration on the ground of the staring mosaic sensor, involving arrays of electronic eyes with a dynamic range and augmented by advanced signal-processing techniques, is to be carried out by the Air Force to set the stage for a DSARC (Defense Systems Acquisition Review Council) decision on full-scale program go-ahead for DSP II by the middle of this decade. Concurrent with and complementing the Air Force's work on an advanced strategic warning system are DARPA efforts that aim toward the development of an advanced sensor system that goes beyond the objectives of the advanced warning system. These efforts are centered on the so-called HALO (High Altitude Large Optics) program and are meant to provide the means to upgrade DSP in the 1990s.

A type of spacecraft that could revolutionize detection of a variety of moving targets from space under all weather conditions that the Space Division is clearly eager to tackle—but has not yet been funded for—involves radar satellites. In a technological sense, these systems, which would replace the Distant Early Warning (DEW) Line across North America and furnish beyond-the-horizon warning of naval battle groups, "are as far away as the money to build them," according to General Henry. That money, however, amounts to several billion dollars, and there are questions about whether such an investment should be made at this time.

One of the Space Division's most politically vexing programs—and one of Congress's most favorite targets for funding cuts—is the Navstar Global Positioning System (GPS). Barely alive at this time—USAF was authorized only funds available from reprogramming, meaning robbing Peter to pay Paul—the Navstar baseline configuration envisions deployment of eighteen satellites in three orthogonal planes at an altitude of 11,000 nautical miles to provide a global common grid for many varied military and possibly civilian users who can obtain precise three-dimensional position and velocity information.

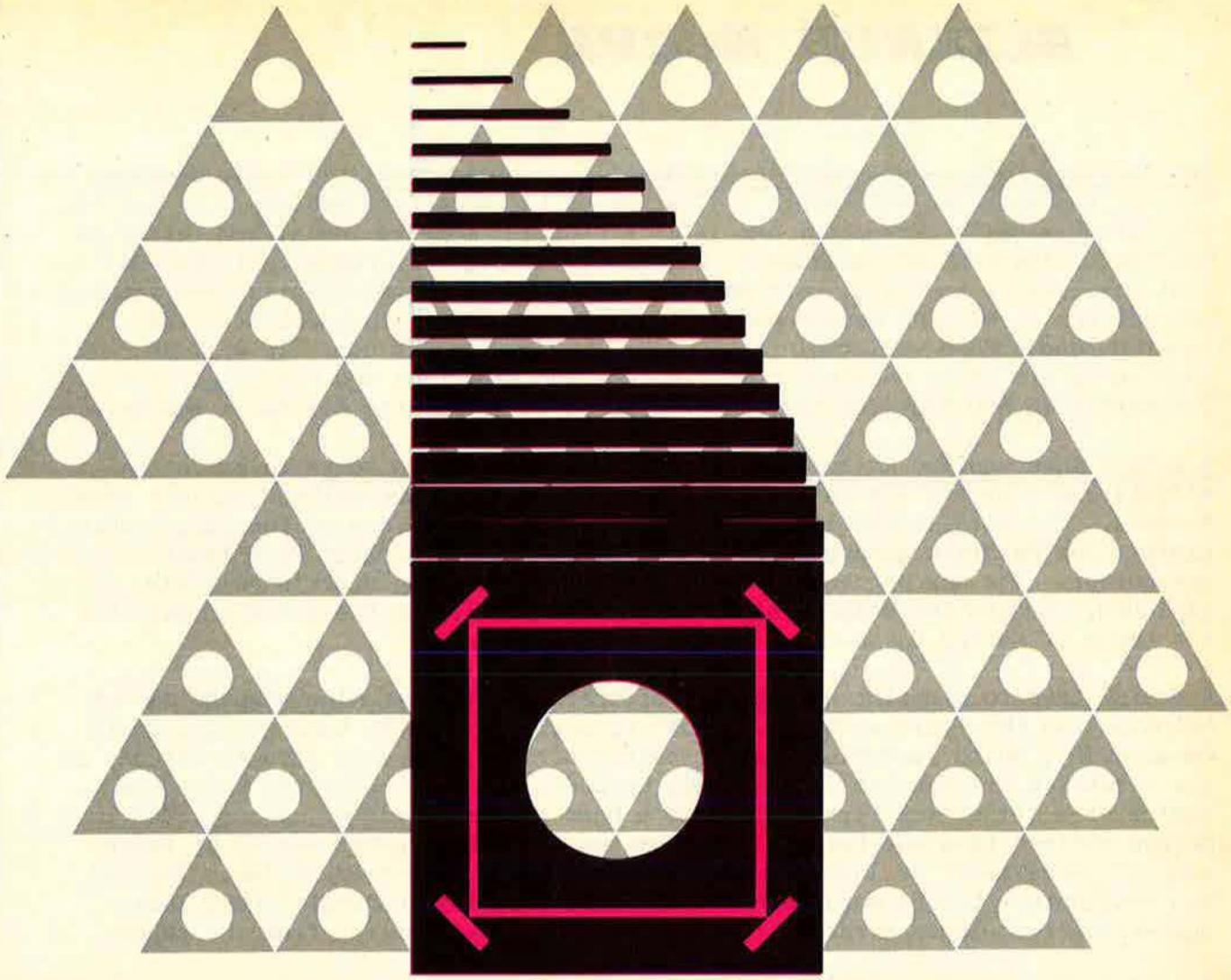
Combat and support aircraft, vehicles, ships, and troops will be able to obtain this information without "radiating" potentially compromising signals, as is the case with most currently deployed systems. GPS is also scheduled to carry nuclear detonation detection sensors of the Integrated Operational Nuclear Detection System (IONDS) that is to monitor the effects of nuclear strikes against as well as by this country to provide real-time strike assessment information.

Congressional reservations concerning GPS center on questions about Soviet military systems "plugging" into the grid as well as why the Defense Department should pay the whole freight for a system of potentially broad value to civilian users, both in the US and abroad. The Air Force's contention is that GPS, like the Space Transportation System (the Shuttle), is a national system and that questions about licensing fees and other cost-sharing arrangements with foreign and domestic civilian users ought to be resolved at a national level.

So far as the Soviets benefiting from the system in a parasitic fashion is concerned, there is no denying that this could occur. But to siphon off truly high resolution data—such as required for all-weather bombing—the Soviets would require specialized, sophisticated terminals and knowledge of the code structure, neither of which would be available to them. The next session of Congress is likely to determine the fate of GPS, meaning whether it will be kept in its present, truncated state (six satellites are in orbit) or will grow to full capacity.

AFSC's Space Division, at this time, is clearly not in favor of plans circulating in Washington to set up a separate Air Force Space Command *(see p. 22, January '82 issue)*. The notion of an operational space command, in General Henry's view, is being fed by two "myths." One holds, incorrectly, that space systems—because of their research and development nature—are intrinsically fragile. That myth, he argued, begets another, *i.e.*, that there is a compelling case for separating R&D from operations, so far as military space efforts are concerned. The underlying contention is that the developer is not sufficiently responsive to the operational commands and that, hence, a separate space command is the answer. General Henry rejected this claim, asserting that "any operational inadequacies we have today are purely a function of the budget cuts of the past few years and were forecast by us at that time."

The users of military space systems, be they the Defense Communications Agency, the Strategic Air Command, or the Navy, "have their own networks for payload and operational control," he asserted. But the acquisition of a spacecraft, its integration with its booster, its launch on orbit, and its checkout, tracking, and control telemetry are inseparable functions. "Trying to make any of



Litton's square RLG leapfrogs 10 years

The MRASM/Tomahawk II selection and contract spotlights Litton's astounding achievement in Ring Laser Gyro technology.

By addressing RLG accuracy versus size from a fundamental point of view, Litton scientists abandoned a 10-year triangle mindset. By using a square rather than a triangular configuration, mirror performance was enhanced and pathlength increased for a given volume. This concept, combined with Litton's superior mirror technology, provides unprecedented performance.

Accuracy achieved in flight proved the concept correct, and these gyros are now in production for military and commercial applications.

The square RLG is the latest in our long line of continuing successes which began in the early fifties when we pioneered Inertial Navigation for manned aircraft. Since then we have delivered over 17,000 inertial systems for aircraft, cruise missile, shipboard and land applications.

Litton success in the Inertial Navigation field has earned world-wide acclaim. It is a Litton inertial navigation system in the U.S. Government cruise missiles, the ALCM, SLCM, and GLCM, that contributes directly to their excellent performance.

For advanced technology and leadership you can look to Litton.

Litton **GUIDANCE & CONTROL SYSTEMS**
5500 Canoga Avenue, Woodland Hills, California 91365

SCIENCE/SCOPE

The Advanced Medium-Range Air-to-Air Missile is undergoing full-scale development at Hughes after a 33-month evaluation of two competing designs. It employs the latest missile technology and is more capable, more reliable, and easier to maintain. The contract awarded to Hughes by the U.S. Air Force calls for 94 test missiles to be built, with options for 924 operational missiles and future options for developing second-source or follow-on missile production. The radar-guided AMRAAM will replace the AIM-7 Sparrow now in use. It will be carried by Air Force F-15 and F-16 fighters and Navy F-14 and F/A-18 aircraft. Ultimately 20,000 missiles are expected to be built for the Air Force and Navy.

A single laser-guided Maverick missile sank a ship during tests to prove the effectiveness of the air-to-surface weapon's new 300-pound warhead against naval targets. The missile was launched from a U.S. Air Force F-4 at the target ship Ozark. The Maverick guided itself to a laser spot illuminated by a laser designator. The new penetrator/blast warhead pierced the Ozark's hull and exploded, causing the ship to sink. Hughes is developing the AGM-65E Maverick for the U.S. Marine Corps under an Air Force contract.

A device used to pinpoint targets for aircraft and laser-homing weapons is now being put in the field with U.S. combat troops. The Hughes Laser Target Designator (LTD), which resembles a short-barreled rifle, can mark targets for any of the country's tri-service laser-homing weapons. Forward observers point the device at a target and fire an invisible beam of laser pulses. These coded pulses reflect from the target like a beacon and are detected easily by laser sensors in aircraft or laser-homing missiles, bombs, and projectiles. The LTD can designate a target more than 6 kilometers away for "hand-off" to a laser-spot-tracker-equipped aircraft flying more than 20 kilometers from the target.

The sixth launch of an AIM-54C Phoenix demonstrated the radar-guided air-to-air missile's enhanced ability to detect, track, and intercept a target that tried jamming the missile's guidance system with electronic signals. The unarmed missile -- using its new digital electronics unit, inertial navigation reference system, and a solid-state radar transmitter -- scored a direct hit on a QF-86 drone. The missile was launched from a U.S. Navy F-14 Tomcat at a range of 70 nautical miles and guided by the aircraft's AN/AWG-9 weapon control system. The AIM-54C is the improved version of the Hughes Phoenix, the Navy's primary fleet air defense long-range weapon.

A new adaptive radar, using technology that could be applied in the future to many different weapon control systems, has completed feasibility tests. The radar, called FLEXAR (Flexible Adaptive Radar), uses a multimode transmitter and a programmable signal processor that are now in production, plus a new lightweight, low-cost electronically-scanned antenna. The antenna rotates once each second while the beam electronically scans up and down and back and forth. Waveforms are selected automatically to match the environment. Such flexibility enables the radar to adapt its waveform beamwidth and scan rate as needed to acquire and track targets. Hughes developed FLEXAR for the U.S. Navy.

Creating a new world with electronics

HUGHES

HUGHES AIRCRAFT COMPANY
CULVER CITY, CALIFORNIA 90230

(213) 670-1515 EXTENSION 5964

them separate from the acquisition process would be a tragic mistake," the Commander of the Space Division suggested.

The present way of doing business in space has led to a "distributed resilient" arrangement that provides great survivability and cost-effectiveness. Creation of an operational space command could negate these advantages and delay the onset of a new era of military space utilization, which he predicted would "bring the use of space down to ships, squadrons, and battalions," and the people who actually have to fight and win wars.

Washington Observations

★ At this writing, a heterogeneous group of prestigious defense supporters is about to go public with "Project High Frontier," a colossal, complex space-based weapon system claimed to be capable of revolutionizing strategic warfare within five years. Funded by the politically conservative Heritage Foundation and aided by the ready access to the White House of some of its politically prominent members, "Project High Frontier" promotes an elaborate "Global Ballistic Missile Defense" system (GBMD), consisting of 432 "space trucks." In turn, these trucks whirling about the globe in twenty-four orbital planes at an altitude of 300 nautical miles would carry a combined total of 21,600 miniature vehicles (patterned after Vought's terminal homing kill vehicle to be used by both the Air Force's ASATs and the Army's ballistic missile defenses), ready to zap Soviet ICBMs, SLBMs, or intermediate-range ballistic missiles in the post-boost phase.

The project's aficionados claim the system could be operational in five years at a cost of $5.2987 billion. Defense Department analyses suggest that, not counting ancillary C^3 and other support equipment or operational and life-cycle costs, that figure would be $300 billion, and that the underlying technology is "one vugraph deep" and unencumbered by practical engineering considerations or the laws of physics. Congressional defense experts, nevertheless, are concerned that "Project High Frontier" will turn into a successful media event and weaken support for such "mundane" components of the Administration's strategic force modernization package as a survivably based MX and the D-5 SLBM.

★ The new Soviet strategic bomber—referred to in this space last month—is thought to be larger than the B-1B. As yet, the aircraft, a prototype, has not been flight-tested. It is probable that the Soviets wanted the US to "see" the aircraft at this time since it was displayed in a way that, according to US experts, would have made it next to impossible for US spy satellites to miss observing it. Best educated guess in Washington is that by showing their new strategic bomber the Soviets hope to gain leverage at arms-control negotiations with this country. Other experts speculate that the Soviets might have wanted to influence the US political process toward resolute development of the B-1B instead of launching a crash program aimed at fielding a "Stealth" bomber as soon as possible.

IN FOCUS...

★ Last-minute cuts by House/Senate conferees—hammering out the Defense Appropriations bill—of the FY '82 funding of the B-1B program put in jeopardy the very cost ceilings and production schedule mandated by Congress for the Air Force's new strategic bomber. By Congress cuting R&D funding by about $170 million (and procurement by $100 million), the Air Force's commitment to produce 100 aircraft at a cost of $20.5 billion (in FY '81 dollars) and deliver the first aircraft in four years can't be met. As a remedy, the Air Force cut the initial buy of B-1Bs from nine to eight aircraft. Because the cut stretches out the program by at least nine months, overall costs will rise. The Air Force hopes to arrange for some reprogramming of funds to minimize setbacks to the B-1B program.

★ The Reagan Administration's recent decision to promulgate without fanfare a global strategy of meeting adversaries head-on and simultaneously—as opposed to the two-and-a-half and one-and-a-half war postures of previous administrations—may lead to geostrategic overextension on the part of the United States. Concerned military leaders fear a strategy/force level mismatch and prefer the option of countering Soviet-instigated aggression not merely at the point where it occurs but also through retaliatory action under conditions chosen by the US. This approach, so the reasoning goes, would enable the US to pick conditions that are unfavorable to the USSR, rather than the other way around.

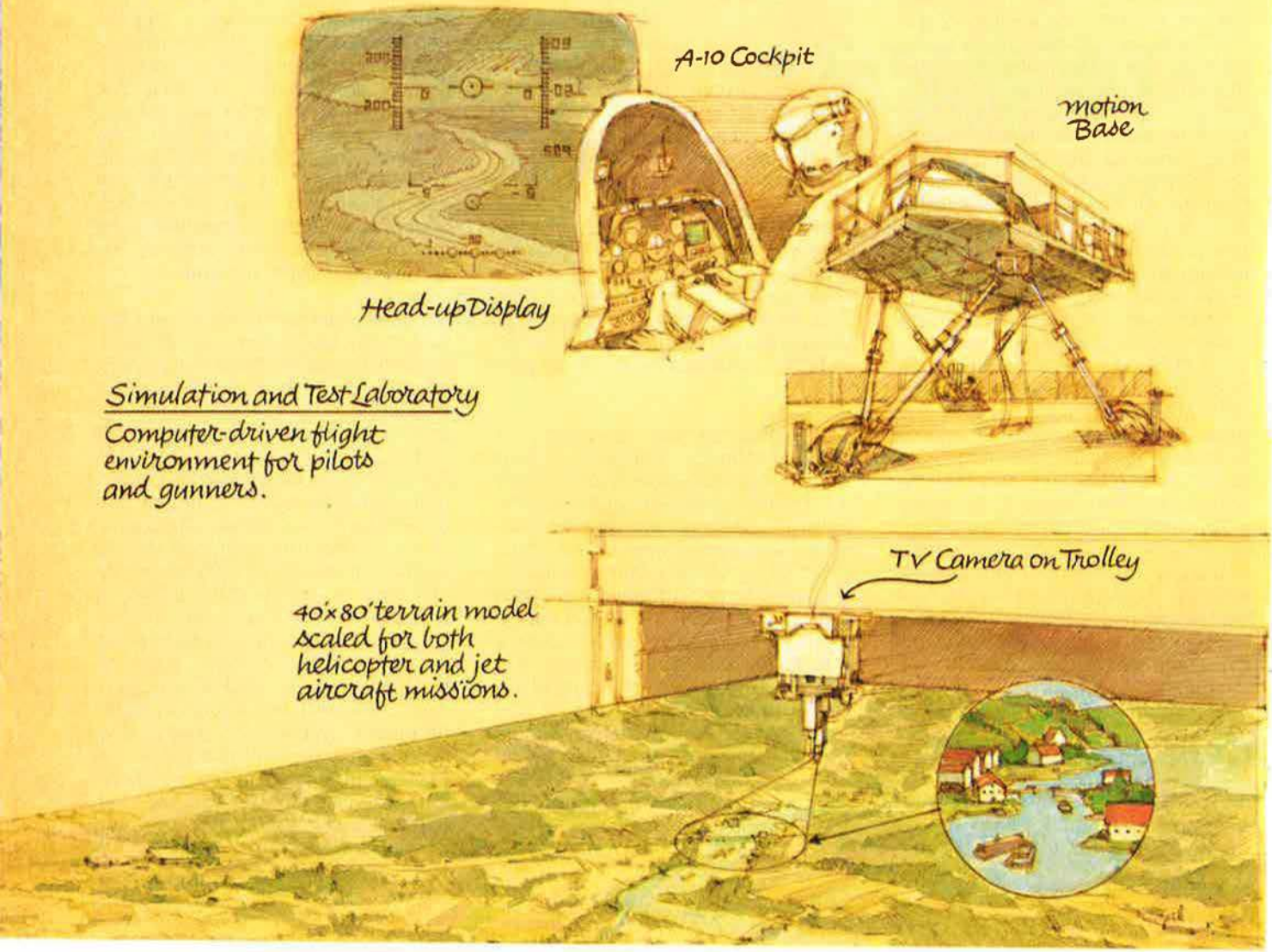
★ The Office of Management and Budget (OMB) is advocating that no funds be allocated by the Air Force to construct superhardened fixed silos for MX. OMB's logic—apparently seconded by the Defense Resources Board—is said to pivot on the assumption that Congress will refuse to spend significant funds for such a questionable basing effort. OMB counseled, therefore, that the money be allocated to a politically viable purpose rather than be lost.

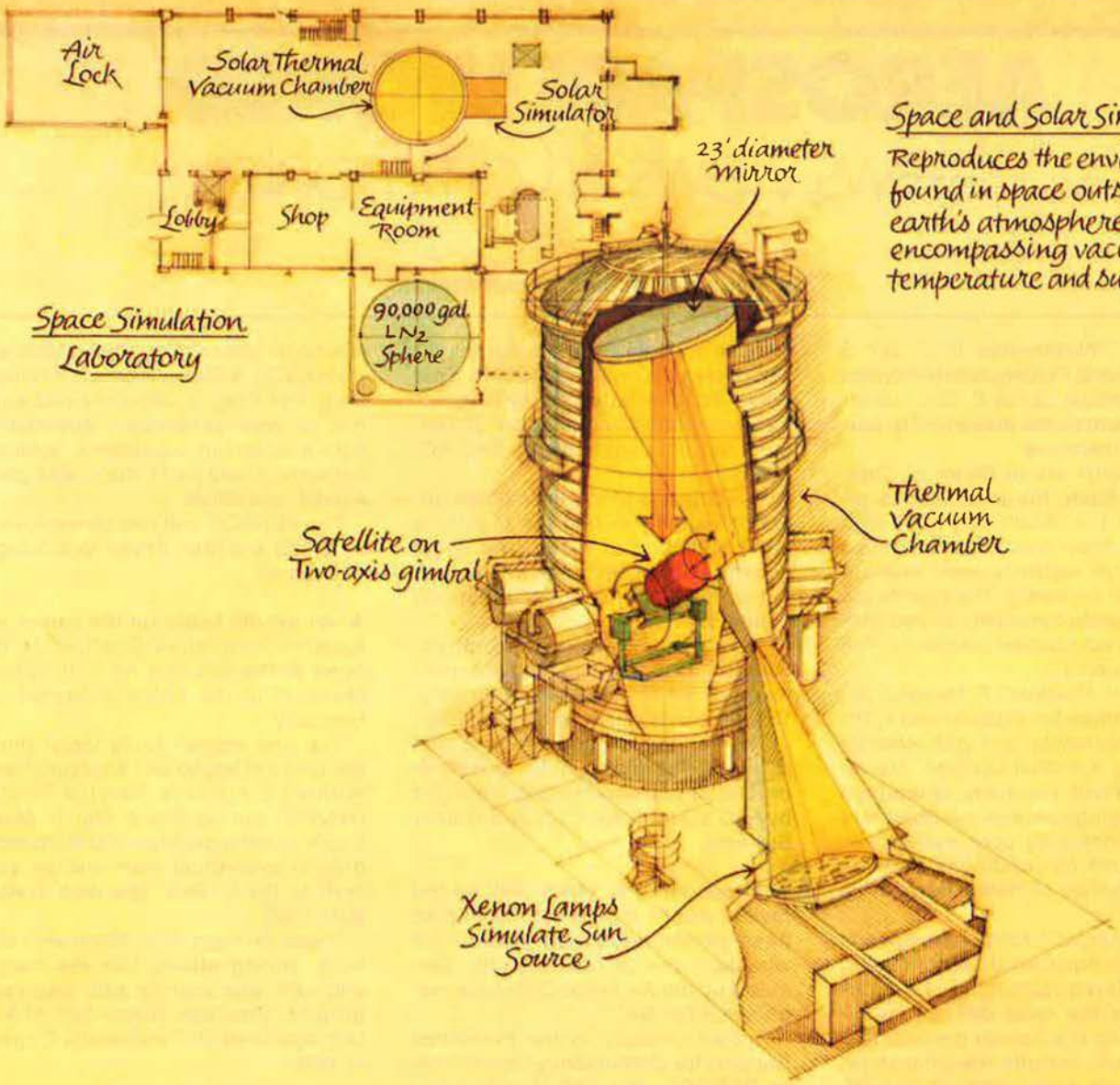
★ If the Administration succeeds this year in abolishing the Department of Energy, the White House plans to transfer the national security programs (in the main, nuclear warhead development and nuclear propulsion systems for submarines) to the Department of Commerce. Thirteen members of the Senate Armed Services Committee, including Chairman John Tower (R-Tex.), dispatched a protest letter to President Reagan, asserting "we strongly object to such a move. . . . We would offer two options. The first would be to return to an agency much like the former Atomic Energy Commission. This option appears to be politically acceptable and has been shown to be functionally appropriate in the past. The second option would be to establish a semi-independent agency within the Defense Department. This would have to be carefully and deliberately accomplished, but we believe any concerns could be accommodated if the agency was established in law and civilian control guaranteed."

★ The triservice research and development program ASMS (Advanced Strategic Missile Systems, previously known as ABRES) is being reoriented to promote greater interplay and synergism between ICBM and SLBM R&D and ballistic missile defense technology. Heeding a recommendation by the Defense Science Board, the Senate Appropriations Committee doubled FY '82 funding of ASMS (to $100 million) to "improve the ability of US ICBMs to respond to advanced Soviet antiballistic missile threats and to improve US offensive capabilities." ASMS is the sole source for advanced technology development of future US ballistic missile systems and subsystems, such as ICBM penetration aids, defense suppression maneuvering reentry vehicles (MaRV), advanced ballistic reentry fuzing systems, and guidance subsystems. ■

On what are successful systems built?

Proven experience, thorough testing.





The ability to model any unfriendly or unusual environment is a key element in our successful record of systems development over three decades.

Typical of this process are computers that fly missiles still on the drawing boards; acoustic and vibration laboratories to reproduce the myriad stresses of flight and trajectory; electronic simulators to portray the dense and confusing radio frequencies in which command and control links must operate.

The resulting level of performance and reliability can be seen in such projects as our Titan series, which has evolved into the primary launch vehicle during the transition to the Space Shuttle's reusable boosters; in the Pershing, NATO's principal tactical surface-to-surface deterrent, for which we are integrating contractor; and in the complex instrumentation we help develop for interplanetary exploration programs.

As diverse as they may be in missions and technologies, every Martin Marietta system shares in the stringent, uncompromising testing that produced it and the proven experience that preceded it.

MARTIN MARIETTA

Martin Marietta Aerospace
6801 Rockledge Drive, Bethesda, Maryland 20034 U.S.A.

AEROSPACE WORLD
News, Views & Comments

By William P. Schlitz, SENIOR EDITOR

Washington, D. C., Jan. 5

★ In year-end Pentagon ceremonies, the first annual Lance P. Sijan Leadership Awards were presented to four Air Force members.

The awards are in honor of Capt. Lance P. Sijan, the posthumous recipient of the Medal of Honor who was shot down over Southeast Asia and died in captivity after evading capture for six weeks. The awards are to be presented annually to two officers and two enlisted members. The 1981 recipients:

- Lt. Col. Frederick F. Haddad, Jr., while Commander, Detachment 2, 7th Weather Squadron and staff weather officer, 3d Armored Division, Hanau Army Air Field, Germany, is credited with reversing numerous problems at the unit, including poor morale, living and working conditions, and "instilling a sense of dedication" in its members.
- Maj. Gerald J. Uttaro, 8th Special Operations Squadron, Hurlburt Field, Fla., displayed leadership and courage under the most difficult conditions during the Iranian hostage rescue attempt. Despite the inferno resulting from a collision of aircraft, Major Uttaro ensured that all survivors were rescued, at the risk of his own life. Subsequent to the mission, he was selected to brief top government officials on all aspects of Air Force participation in the mission.
- CMSgt. Charles H. Pettit, Senior Enlisted Advisor, 5010th Combat Support Group, Eielson AFB, Alaska, was cited for his continuing efforts to motivate, inspire, and reward his subordinates as well as for his institution of programs to improve the quality of life on the base.
- MSgt. Donald V. Green was cited for heroism while serving with the 308th Security Police Squadron, Little Rock AFB, Ark., during the Titan missile accident in September 1980. Despite personal danger, Sergeant Green and his team conducted a prolonged search of the site and finally located the only missing person. He also volunteered to escort other base personnel to the complex for the transport of critical equipment.

★ In an unusual program, Aeronautical Systems Division's 4950th Test Wing, Wright-Patterson AFB, Ohio, has completed installation of tail-mounted floodlights on six SAC KC-135As.

The object is to increase boom operator visibility during the nighttime aerial refueling of F-16s. The lights generate about twice the intensity of illumination found under full-moon conditions.

The aircraft received the prototype, lead-the-fleet modifications in expectation of the retrofit of the entire KC-135 force to begin in December 1982.

The floodlight modification is part of the KC-135 Improved Aerial Refueling Systems program being managed by ASD's Deputy for Airlift and Trainer Systems.

★ Hanscom AFB, Mass., will be the review site of the new consolidated base personnel office "CBPO on wheels," one of four recently procured by the Air Force Computer Acquisition Center.

Known formally as the Personnel Support for Contingency Operations, or PERSCO, the unit is computer-equipped to process personnel data at a home site or at remote locations.

PERSCO, a converted mobile home thirty feet long, is self-contained and has its own generators, automatic data-processing equipment, system software, spare parts stock, and personnel specialists.

The PERSCO unit can be deployed by C-130 and then driven to a designated area.

★ An exhibit featuring the career of aviatrix Jacqueline Cochran is to open at the National Air and Space Museum in the nation's capital in February.

The first woman to fly faster than the speed of sound and director of the Women's Airforce Service Pilots (WASPs) during World War II, Miss Cochran set more than 200 flight records in everything from civilian aircraft to the F-104G. She died in August 1980.

It was through Miss Cochran's efforts, among others, that the fledgling AFA was kept on firm financial ground. She was presented AFA's Distinguished Civilian Service Trophy in 1948.

★ The Air Force is taking steps to fill

Thunderbirds Tragedy

The Air Force continues to mourn the loss of four of its finest in the aftermath of the fiery disaster that occurred in the Nevada desert on January 18.

The members of the Air Force Association extend their sympathy to the families of the four members of the Thunderbirds demonstration team killed in the flying accident: Team Leader Maj. Norman L. Lowry III, Capt. Willie Mays, Capt. Joseph Peterson, and Capt. Mark E. Melancon.

We were proud of them and reveled in their flying. Through their magnificent flying they showed us the true meaning of flight—and beyond that, a renewed feeling of freedom. We owe them much.

The skills they demonstrated and inspired among all military aviators are those necessary to fight and win in aerial combat with any enemy over any battlefield.

The career of aviatrix Jacqueline Cochran is the subject of a new exhibit at the National Air and Space Museum. See page opposite.

the gap in the wake of the nationwide air traffic controllers strike, as more of its controllers are shifted to civilian posts.

For example, Air Force Communications Command, parent organization of USAF's controllers, is moving earlier than planned to equip fourteen air bases with the latest state-of-the-art GPN-T4 radar signal simulator/trainer.

The device creates simulated aircraft images on actual radar screens, allowing air traffic control trainees to practice handling traffic and cutting such training time by as much as twenty-five percent, according to officials. Trainees must meet FAA requirements and be certified before being deemed controllers.

The trainee can also be confronted with peak loads even when there is little or no actual traffic and any type of wind or emergency can be programmed into the system. The "T4" system can be used as well to hone the skills of qualified controllers.

While trainees and controllers can't tell the difference between T4-simulated aircraft images and the real thing, identifying codes make clear which is which.

Some thirty control facilities have been equipped with the T4 thus far.

Acquisition of the simulators is being supervised by AFCC's Engineering Installation Center, Oklahoma City, Okla. The Center was established last June when AFCC deacti-

USAF's latest electronic warfare aircraft, the Grumman EF-111A Tactical Jamming System, recently completed its initial operational flight at Mountain Home AFB, Idaho. The aircraft joined the 366th Tactical Fighter Wing there after nearly five months of testing and signals a dramatic mission alteration for the unit, which is to receive a complete electronic warfare capability.

INTELLIGENCE BRIEFING...A ROUNDUP

According to *Foreign Report*, published by London's *Economist*: The Soviet Union is making a major effort to steal sensitive technology that the US will not sell or give away. Sometimes bribery, blackmail, collusion with unscrupulous businessmen willing to violate export laws, and outright theft are involved. The main Russian target is the advanced technology in which Americans have a clear lead—microcomputers, microelectronics, semiconductors, integrated circuits, optical fibers, and lasers. All are vital components of advanced weapon systems.

The Russians have been extremely successful in this clandestine offensive, according to intelligence sources, but the FBI has managed to limit what many believe has been a steady loss of technical equipment and know-how.

The old image of a Russian in an ill-fitting suit, with a heavy sense of humor and a strong taste for vodka, has been replaced by a new breed of Soviet spies as slick as silicon chips, one senior FBI official said recently. "We are blessed with the very best agents the KGB has to offer," he said. "They are smooth and very westernized. . . ."

The FBI Director, William Webster, regularly warns groups of American businessmen that technology has replaced military weapons and strategy as the principal Soviet espionage target. "I think you would be astonished by the voraciousness of their appetites," he said.

Between one-quarter and one-third of the 3,000 Russian and East European officials in the US under diplomatic protection are involved in the drive to acquire American technology, according to an FBI source.

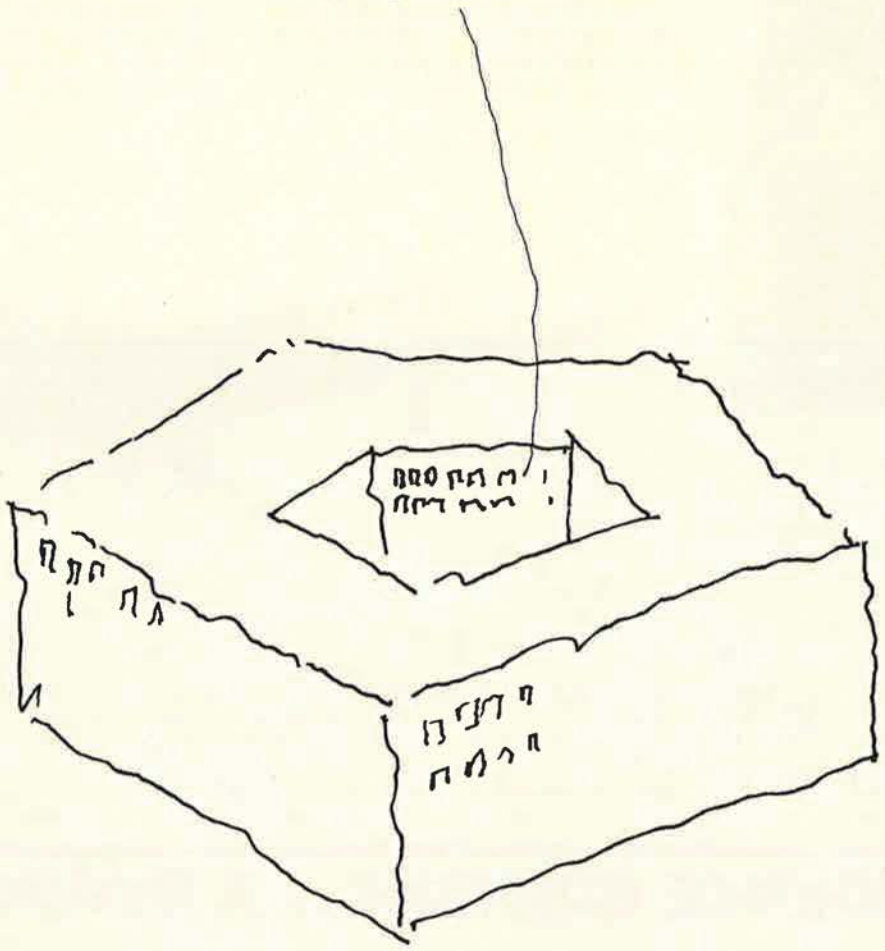
The other focus of Soviet interest is the area south of San Francisco known as "Silicon Valley," a string of suburbs that houses hundreds of electronics and computer companies involved in some of the most advanced research and manufacturing in the world. More than 400 companies in the area are working on classified projects and some forty of them are top secret. The large Soviet trade mission in San Francisco has electronic eavesdropping apparatus and is heavily staffed with scientific experts.

Reservoirs of Oil

Saudi Arabia is taking active steps to build up a network of strategic reservoirs as a precaution against external or internal threats to production and export of its oil. The project is secret. But informed sources say Saudi authorities are finalizing a contract with a large construction company to build reservoirs holding the equivalent of 1,500 million barrels of oil, worth some $45 billion at current prices.

The Saudis want to hold some 150 days of oil production in reserve in case of trouble.

King who?



King Radio, the company that's been quietly changing the shape of avionics for two decades. For general, commercial and now, military aviation.

We're a vital company, with the bottom line strength for top flight electronics system development. Or for executing challenging technical programs, quickly and cost-effectively.

A dynamic company. In just twenty years we've grown to 5 facilities covering 575,000 square feet; our sales to $100 million; and our work force to over 3,000.

And we continue to grow in other ways, as well. Expanding our technical leadership beyond the realm of civil aviation. Beyond our role as a valued teammate of some of the most respected names in aerospace. To emerge now as a very capable primary contractor. In our own right.

Ask us what we can do for you. Write Dan Rodgers, Director Special Programs Department, King Radio Corporation, 400 North Rogers Road, Olathe, Kansas 66062. Or call (800) 255-6243. Telex: WUD (0) 4-2299. Cable: KINGRAD.

You won't have to ask twice.

KING

vated its "Areas" and formed six Divisions and one Center as immediate subordinate management subcommands.

Commanded by Col. James S. Cassity, Jr., the Center provides the full range of planning, programming, engineering, materiel acquisition, installation, and depot maintenance services worldwide for USAF communications-electronics systems and facilities. The services are also provided on a case-by-case basis to the other military services, selected DoD and other federal agencies, and to foreign nations through the security assistance program.

The jobs performed by Center personnel vary from installing a radar atop a mountain peak to repairing an undersea cable. The Center's force of more than 4,200 active-duty and 3,500 ANG people travels around the world in performing their mission.

★ The Air Force Orientation Group, a unit that creates exhibits for recruiting and other public-affairs activities, has earned one of the top awards at

AEROSPACE WORLD

New York's annual International Film and TV Festival.

AFOG was presented a silver medal for its "Pioneers of Flight," a multi-image presentation that highlights the progress of aviation in the US.

In its twenty-fourth year, the Festival is supported by all segments of the communications industry, the trade press, and government agencies in the US and abroad. Its purpose is to recognize and showcase achievements in creativity and communication in film, television, and related media.

"Pioneers of Flight" is AFOG's primary show for high school audiences and is presented across the country in forty-seat, mobile vans. Combining slide projectors, multiple screens, and a stereo sound system, the program highlights US progress from the beginnings of powered flight through the space age, with a preview of likely aerospace advances to come. The story is told via the exploits of key aviation pioneers, with their voices adding a special dimension.

For example, viewers see and hear Jimmy Doolittle describe his record-setting experiences and the 1942 Tokyo raid. The late Jackie Cochran, first woman to fly faster than sound, tells of her commitment to aviation and the place women have made for themselves in the field. Astronaut Charles Duke describes his sensations walking on the moon.

The show concludes with a brief reference to Air Force people and job opportunities.

AFOG is headquartered at the Gentile Defense Electronics Supply Center, Kettering, Ohio.

★ With the new year, the Air Force Medical Service has initiated a program to identify and reduce the incidence of coronary heart disease throughout the service.

Flying the Finnish Air Force L-70 Trainer

The Finnish Air Force (FAF) has put its L-70 "Vinka" miltrainer into service, with half of a total order of thirty delivered by late 1981. The remainder are to be delivered and flying at the Finnish Air Force Academy by the middle of 1982. *(See Jane's Supplement, p. 103, for background and specifications on the aircraft.)*

Finnish pilots log about forty hours on the L-70 before switching to Fouga Magister jet trainers for advanced flying training. (The British Aerospace Hawk will replace the Magisters as they are acquired by the FAF from BAe and VALMET Oy.)

An AIR FORCE Magazine editor had the opportunity to fly the L-70 with Maj. Paavo Janhunen, the FAF's Chief Test Pilot, during the 1981 Paris Air Show. He found its control pressures and handling characteristics on the ground and in the air more similar to jet aircraft than piston-engined conventional general aviation planes. That is, of course, intentional; FAF and VALMET Oy's designers want the L-70 pilot to be able to transition into the Magister (and Hawk) with confidence and smoothness. The L-70's ailerons, elevators, and rudder are all mass-balanced to provide light yet effective and stable control responses.

Rudder steering is available almost from the start of taxi, and nosewheel steering is quick and positive. After being cleared for takeoff on Runway 25 by Le Bourget tower, power was applied to the Avco Lycoming AEIO-360-A1B6 flat-four engine. The aircraft tracked the centerline with minimum control inputs, and rapidly accelerated to 95 km/hr. Back pressure was applied, the aircraft rotated, and took off at 105 km/hr in a distance of less than 400 feet.

Paris Center cleared Major Janhunen to a nearby aerobatic maneuver area, while his guest climbed the aircraft and turned to the headings designated. Maximum rate of climb at sea level is 1,120 ft/min. In the area, Major Janhunen demonstrated a maneuver, then had his guest perform it. We did inverted flight, spins, and inverted spins with clean, positive recoveries (on Major Janhunen's part), stall series, inside loops, rolls, barrel rolls, snap rolls and turns, climbs, and descents. The aircraft is certificated for a G-load factor of +6 in the aerobatic category; we did not exceed four Gs in these evolutions.

After nearly an hour of maneuvers, the aircraft was cleared for return to Le Bourget and to expect landing on Runway 25. Nearer the field, it was ordered to hold, giving the opportunity to perform 360 and 720-degree turns to left and right. Once in the turn and trimmed, the L-70 held bank angle, altitude, and airspeed as steadily as an F-16.

Directed to land, we flew a right-hand pattern for Runway 25, turning on final approach with forty-five degrees of flaps. Touchdown speed was 115 km/hr, comfortably above the flaps-down stalling speed of 100 km/hr (54 kts).

VALMET Oy officials say that the L-70 is well-suited for building under license in countries wishing to start their own aircraft manufacture.

—F.C.B., Jr.

The cockpit of the new Finnish L-70 miltrainer is equipped so that night and instrument flying can be taught.

AEROSPACE WORLD

Coronary heart disease (CHD) is the leading cause of nonaccidental death in the Air Force, with mortality or disability afflicting 500 to 800 members annually.

The new program, entitled CARE for coronary artery risk evaluation, will involve all blue-suiters over the age of twenty-five. Primarily, three risk factors are to be considered: high blood pressure, cigarette smoking, and high serum cholesterol. These can be readily identified.

Under the program, a CHD assessment is to be made during a complete physical examination and those found at risk will be advised as to what action to take to reduce the CHD potential. Further, follow-up visits will be scheduled to observe progress.

"Those found to have a significant risk and who enter an intervention program will be followed annually with CARE assessments," officials said. CARE program data will be stored by computer and over time a variety of clinical correlations will be possible, including the effects of the intervention programs.

"Although the results of the CARE program will not be seen immediately, the long-term benefits to Air Force members and their families could be significant," officials noted.

★ A huge fireball of flaming aviation fuel signaled the onset of a community-wide disaster management exercise conducted at Hickam AFB, Hawaii, in late November.

Objective of the exercise was to test the capabilities of some twenty local military, medical, and civilian agencies to respond to and cope with the aftermath of a major airliner crash.

First on the scene of the simulated disaster were 15th Air Base Wing fire fighters, security police, and medical personnel whose immediate function was to establish an emergency control group.

Care had to be provided for about 400 "passengers" (from the Army's 25th Infantry Division) with more than half requiring hospitalization and the rest designated either fatalities or ambulatory patients. In the interests of realism, the "casualties" were moulaged (makeup applied to simulate burns and other injuries), triaged

Bolling Personnel Help Avert Tragedy

Quick reaction and training were cited in forestalling tragedy in the aftermath of an accident at Bolling AFB, D. C., in late December.

Air Force personnel from the base were first to respond when a MetroBus went over a guard rail and plummeted twenty feet near Bolling's main gate. The crash injured the driver and all twenty-eight passengers.

"I'd just finished filing some personnel records when I looked out the window and saw the bus crashing over the guard rail," recalls SSgt. Merlin Ford of the 1100th Air Base Wing Personnel Office. "I really didn't believe what I was seeing until I heard the loud bang of the bus hitting the road."

"A group of us ran outside to see what happened not knowing what to expect," remembers SSgt. Elmo Tolbert, Jr.

Several Security Policemen from the base's main gate were first on the scene to pull people from the bus and put out a smoldering engine fire.

"There were bloodied bodies everywhere, but the people from the base remained calm and seemed to know exactly what to do," Sergeant Tolbert recalls.

Overall, 100 base personnel assisted at the accident, including providing blankets, directing traffic, and comforting the victims. Crucial services were provided by an Air Force doctor and six medical technicians from the base clinic. "We had just completed a training exercise similar to this accident last week," said Dr. (Maj.) Anthony Fasano.

First aid in the December chill. (Photos by SrA. Kent K. Brown, USAF)

Bolling personnel prepare accident victim for helicopter evacuation.

Military helicopters and ambulances also transported many of the injured to civilian hospitals. Although several of the accident victims were critically hurt, no one died, hospital officials said.

A prime factor that contributed to Bolling's efficient response, according to those first on the scene, was the training received in the Air Force WARSKIL Program. In that program, selected Air Force members are given training in the medical technician field as supplementary duty during times of national emergency. Many of the people in the Bolling personnel office had received such training at the Malcolm Grow Medical Center at Andrews AFB, Md., earlier in the year.

—By Sgt. David W. Givans, USAF

Gulfstream American's Next Generation Trainer.

How it stacks up financially is impressive, too.

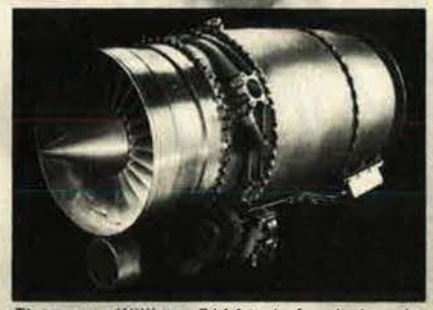
Exceeding the Air Force's NGT performance specifications is one thing. Impressive financial performance is another.

Gulfstream American's NGT/Peregrine is strong on both counts.

With its own R&D funds, Gulfstream American designed and built a flying test bed to assure a successful full-scale Peregrine development program.

Peregrine combines an innovative business approach with state-of-the-art technology to offer an off-the-shelf price. Savings: substantial reductions in RDT&E funding requirements.

Peregrine also boasts an innovative contractor approach to logistics and support. Savings: a 51% reduction in maintenance costs.



The proven Williams FJ44 turbofan designed for the Gulfstream NGT/Peregrine.

Peregrine's proven composite technology soars far above metal skin birds to provide substantial weight reduction. Savings: fuel savings of up to 65% over the present T-37 primary trainers.

Peregrine's powerplant is the proven Williams FJ44 turbofan. Simpler and substantially lighter than the current competitive engines. Result: still more savings.

NGT/Peregrine. Aerodynamically and financially, it's a beautiful bird.

For more detailed information, contact Gulfstream American's Washington Headquarters: (703) 276-9500. Or Peregrine marketing, Bethany, OK: (405) 789-5000, ext. 357.

Gulfstream American

62% scale
flight demonstrator

FAIRCHILD'S PROPOSAL FOR THE ULTIMATE AIR FORCE TRAINER

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

(degree of injury assessed), and evacuated by Army and Coast Guard helicopters to area hospitals. Ambulance service was provided by the 25th Infantry Division medical battalion and the city and county of Honolulu.

As a reflection of the broad scope of the exercise, about 750 people were involved as participants or players.

★ **NEWS NOTES**—The **Euro-NATO Joint Jet Pilot Training** program is in full swing at Sheppard AFB, Tex., and by October 1982 will be turning out about 310 student pilots and 110 student instructor pilots a year. Scheduled for the fighter-pilot-oriented program will be 260 hours of flight time.

USAF has awarded Atlantic Research Corp., Alexandria, Va., a contract to develop and test **a high-energy propellant based on a non-hazardous metal fuel** that burns vigorously in a ramjet combustor. If

AEROSPACE WORLD

successful, the fuel could substantially improve the performance of US tactical missiles becoming operational in the 1990s.

Hq. AFSC, Andrews AFB, Md., has established an **Office of New Concepts and Initiatives** charged with the **rapid assessment of innovative technological concepts** and the implementation of the most promising. NCI is visualized as perhaps trimming as much as two years off the normal process to full-scale development. A recent AFSC-wide call for ideas has resulted in a list of more than 100 proposals that address a wide range of tactical and strategic needs. Additionally, the NCI will interface with industry and the universities.

Treating simulated injured during a unique exercise in disaster management at Hickam AFB, Hawaii, in which the military and civil communities mounted a common effort. See item.

USMC **Col. Jack R. Lousma** and USAF **Col. Charles G. Fullerton** have been named commander and pilot, respectively, **for the third orbital flight of the Space Shuttle** currently scheduled for March. Lousma logged 1,427 hours in space aboard Skylab in 1973. Fullerton was pilot aboard three approach and landing tests in 1977 when the Shuttle *Enterprise* separated from atop a 747. The third test flight is to last a bit over seven days in 116 earth orbits and involve further manipulation of the Shuttle's mechanical arm.

Two cadets of the senior class were added to the growing list of **Rhodes Scholars at the Air Force Academy: Heather A. Wilson,** Vice Wing Commander, from Keene, N. H., and **David S. Fadok,** of Phoenix, Ariz.

Died: William P. Gwinn, who ran Pratt & Whitney Aircraft during the prodigious World War II engine production effort, and who later headed United Aircraft (now United Technologies) until 1972. He died in Palm Beach, Fla., in late December. He was seventy-four. ■

INDEX TO ADVERTISERS

CAPITOL HILL

By Kathleen G. McAuliffe, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., Dec. 28

Silo Hardening Questioned

Congress overwhelmingly voted a $200 billion FY '82 Defense Appropriations Bill containing a carefully worded provision questioning *although not prohibiting* superhardening of existing ICBM silos as an interim basing solution for the MX.

The intent of the provision's authors, Sens. William Cohen (R-Me.) and Sam Nunn (D-Ga.), was to concentrate efforts on a permanent basing mode for MX, and toward this end they directed the Secretary of Defense to recommend a final basing solution to Congress no later than July 1, 1983. This represents a significant change from the Administration's plan for sometime in 1984.

According to Senator Cohen, deployment of "MX in fixed superhardened silos is the most ill-advised and ill-conceived portion" of the President's strategic force modernization program. Amendment supporters averred that MX in existing silos, whether hardened or not, simply are not survivable. This was confirmed by the majority of experts testifying before the Senate on this subject.

Thus the measure, while supporting expeditious deployment of the MX missile, provides that, in the interim, $334 million in MX R&D funds that had been earmarked for silo hardening be used to study other basing options. Any interim basing mode must be compatible with a permanent basing solution, which could include some form of ballistic missile defense for existing silos, mobility, deception, and/or hardened silos.

Unofficially, the Air Force is not necessarily unhappy over the setback to silo-hardening plans.

The Big Loser

Despite two years of a hard-sell campaign for a long-range, outsize cargo transporter, the C-17, formerly known as the CX, the Air Force couldn't convince Congress of its merits. The Administration request of $169 million for further R&D on the program was zeroed by Congress although the Air Force was directed to spend $50 million on procurement of existing wide-body aircraft (C-5s, 747s, and DC-10s) to help redress the severe airlift shortfall.

The reasoning centered on cost—overall about $12.9 billion—and still-unanswered questions about adapting existing aircraft to this role and extended use of the Civil Reserve Air Fleet.

General budget trends would seem to militate against rapid resurrection of the C-17 program.

ATB Concerns

Congressional concern over the future of the Advanced Technology Bomber (ATB), when the Pentagon's belt is tightened as expected in FY '83 and '84, was manifested in the appropriations bill. At the initiation of Sens. Henry Jackson (D-Wash.) and John Warner (R-Va.), a provision protecting the level of ATB funds *at least* equal to the amount in the bill was adopted in order to focus attention on the program. Funds may be transferred into the ATB account, but none may be taken out of the R&D program to be used for other purposes.

The provision, in effect only for this fiscal year, is intended to send a signal to the Administration that Congress views ATB as a priority program. The Secretary of Defense earlier assured the Senate that the radar-evading bomber would be funded in future budgets so as to achieve the earliest prudent operational date.

B-52Ds Revived

Sen. Carl Levin (D-Mich.) succeeded in getting the Senate to follow the House lead and provide $62 million to keep three B-52D squadrons in the operational inventory rather than retire them early as the Administration proposed in a budget-cutting move. The added funds will buy spares and modifications for the aircraft.

The Senator, a strong opponent of B-1B development, expressed concern over the phaseout of the D model as serving only to widen further the impending "window of vulnerability" in the mid-1980s. With a replacement system not coming on line until 1986, his colleagues concurred.

B-1B Moves Ahead

The Air Force got its wish—$2.1 billion for B-1B development. A reduction of about $200 million in R&D money was attributed to unobligated funds from FY '81 remaining in the account.

Originally, opposition to the B-1B was strongest in the Senate where Sens. Ernest Hollings (D-S. C.) and Carl Levin unsuccessfully led some Democrats in a two-part effort to kill the B-1B. The strategy consisted of offering several combat-readiness amendments and proposing to offset those costs by killing the B-1B program.

Congress voted itself close oversight of the B-1B program by adopting an amendment requiring the President to certify to Congress the cost of 100 aircraft and the Secretary of Defense to report quarterly on the unit cost forecast of the B-1B. Future pressure on DoD budgets is expected to increase, and congressional skeptics feared diversion of other program funds to pay for the bomber.

KC-135 Reengining

The Senate compromised with the House to allot about $85 million to buy commercial Boeing 707s and use their JT3D turbofan engines for the KC-135 reengining program. Using the JT3D is seen as a cost-effective alternative to reengining the entire KC-135 fleet with the planned CFM56 fuel-efficient engine. The airlines were forced to retire the B-707s because of federal noise and pollution regulations. The Air Force is not subject to the same stringent controls.

The Congress felt using the JT3D engines would ensure that all 625 KC-135s get reengined. This takes on added importance since the KC-10 tanker program is being terminated. Congress continues to support vigorous development of the CFM56 reengining, but considers the JT3D as a stopgap measure until delivery of the newer engine. ■

Seeing is believing with General Electric mission simulators

F-5 Mission Simulator in formation flight.
Lead aircraft is computer-generated model of F-5E.

With simulator instruction, the eyes have it. What you see determines how far the illusion can go. Thus, the key to effective training is a good visual system.

Increasingly, air crews must be supported on the ground by devices that not only provide transition and instrument training, but enable pilots to rehearse the fundamentals of ground attack, air-to-air combat and formation flying. That's why you need the best high-fidelity visual system available.

General Electric demonstrates full-mission capability with a computer-generated-image visual system that has been field-proven in extensive transition and mission training situations.

Mission simulator capability for today's fighter aircraft

- One-on-one air-to-air combat between two student pilots or between student pilot and instructor pilot
- Two-on-one air-to-air combat
- Combat air patrol
- Radar interception and visual conversion
- Air-to-air missile and gun operation
- Attack positioning
- Air to ground weapons delivery
- Armament orientation and weapons employment
- Weapons scoring
- Low-level navigation
- Cross-country navigation
- Aircraft and weapon system malfunctions
- Cockpit orientation
- Takeoff and landing
- Taxi, brake and park operations
- IFR/VFR transition

For more information on GE mission simulators, write or call G. R. Maness, Manager, Simulation Sales.

General Electric Company • Electronic Systems Division
Simulation and Control Systems Department • Daytona Beach, Florida 32015 • Tel. (904) 258 2331

GENERAL ELECTRIC

Two U.S. Air Force F-15's patrol high over Germany during a NATO maneuver. Under their wings, a full complement of Sparrow AIM-7F and Sidewinder AIM-9L missiles—a potent team for air-to-air defense, not only for NATO but throughout the free world.

The Raytheon-developed Sparrow AIM-7F serves as the primary air-to-air weapon on the F-15 and is deployed on other first-line aircraft. In more than 21,000 hours of captive flight-testing, it has achieved over 880 mean flight hours between failures.

That same high reliability is also going into the next generation of Sparrow, the AIM/RIM-7M. Now in production for both air-to-air and surface-to-air applications, AIM/RIM-7M features an advanced monopulse seeker and a digital signal processor for improved look-down, shoot-down performance and greater immunity to counter-measures.

Sidewinder AIM-9L—the free world's most advanced short-range, air-to-air missile—is operational on U.S. Air Force and Navy fighter aircraft. Raytheon, as prime industrial support

Sparrow and Sidewinder: a pair of aces for air defense

contractor, is in full production on the missile's guidance and control section. And we continue to support the Navy in the development of advanced Sidewinder concepts.

For details on Sparrow and Sidewinder, please write on your letterhead to Raytheon Company, Government Marketing, 141 Spring Street, Lexington, Massachusetts 02173.

RAYTHEON

LINK & B-1B: A NATURAL!

The B-1B can achieve maximum effectiveness only if its crews are as technologically advanced as this new long range combat aircraft.

Simulation training is the answer—training that can best be supplied by Link. Only Link is experienced in the type of total systems integrated training which the B-1B will require.

Link gained its unrivaled experience by undertaking such programs as the B-52 Weapons Systems Trainers—the largest simulation contract ever awarded.

B-52 WST's provide fully integrated training, coordinating crews of the flight deck, offensive weapons station and defensive avionics station.

They also provide, for the first time, completely integrated representations of out-the-window visual scenes, landmass radar return, low light level TV and forward-looking infrared. The visual scene and displayed imagery (shown above in the WST cockpit) remain correlated and in proper perspective throughout the entire takeoff, landing and low-level terrain-following modes of operation.

This advanced technology is readily adaptable to training pilots of the nation's newest aircraft.

Predestined partners: Link & B-1B!

Binghamton, N.Y. 13902

Full crew coordination, full visual integration

Link
FLIGHT SIMULATION DIVISION
THE SINGER COMPANY

It is easy to forget that the beautiful Caribbean is a troubled area these days, teeming with squalor, poverty, and drug traffic. The US has little military presence in the area, and thus little clear evidence that we will be around if needed.

Are We Being Outflanked in the Caribbean?

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

WITH all eyes on Poland it is easy to forget that the beautiful Caribbean is a troubled area nowadays. Cruise ships avoid Haiti out of deference to passengers whose vacations would be ruined by seeing the poverty and squalor of Port-au-Prince. Yachtsmen sail those waters on the lookout for murderous pirates, and those innocent-looking private aircraft buzzing up and down the Antilles are too often engaged in that slimiest of trades, drug smuggling.

Cubans are hard at work on the heretofore insignificant island of Grenada preparing what is clearly a military airfield. When the runway and facilities are finished, presumably sometime this year, the oil fields of Venezuela, as well as the mouth of the Orinoco River, will be in easy range. Probably it is straining at things a bit to make Venezuela a likely target, but the capability from Grenada will exist as soon as the airfield is completed. And, as any military planner knows, enemy capabilities are what you must take into account.

There can be no doubt that Cuba, the Soviet surrogate on our doorstep, is the enemy of all non-Communist countries in the Caribbean. It is Cuba that supplies weapons to the insurgents in El Salvador and Guatemala. Cuba gave training and support to the Sandinistas, and Cuban military advisors are a visible presence in Nicaragua today. Whether or not Castro has any designs on Venezuela is, then, almost beside the point, for it is clear he has designs on the Caribbean and those Central American countries on or near its shores. What is more, the Cuban strategy for the Caribbean begins to emerge, and it is a very sensible strategy, for it seems Fidel Castro or, more likely, his Soviet masters, have concluded that the Caribbean is an air and naval theater, with air the dominant factor.

The Windward, Mona, Yucatan, and a few lesser passages are the gateways for vessels entering or leaving the Caribbean, whether they be tankers from Venezuela, Panama Canal traffic, or combat ships from our own or anyone else's navy. Since the chain of islands known as the Greater and Lesser Antilles begins with Cuba and ends pretty much with Grenada, the concept of controlling both ends of this natural barrier is a nice one, thoroughly in keeping with the teachings, as brought up to date, of Alfred Thayer Mahan.

Our counter, at least thus far, to this Cuban/Soviet strategy has been to establish a headquarters or two, and even here we seem in doubt as to which of the various commands is finally responsible for the Caribbean area. The Air Force has long since given up its superb base, Ramey, on the western end of Puerto Rico. While the Navy still hangs on at Guantanamo, the military value of that facility is clearly limited.

We have, in short, little military presence in the Caribbean and thus little clear evidence that we will be around if needed. It is a curious situation when one considers how much importance we have attached over the years to a military presence in another sea, the Mediterranean, a presence designed at least as much to reassure our friends as for any war-fighting objectives.

El Salvador is the present focus of Cuban attention and, in a frustrated sort of way, of our own. A visit to San Salvador stirs up memories of Saigon in the early sixties. There is the evidence, here and there, of guerrilla activity: a small factory dynamited, a highway bridge dropped into the river, repair work going on at the US Embassy after a rocket attack, the pervasive air of caution and heightened security. Nonetheless, El Salvador is not Vietnam revisited. There is, as one significant difference, nothing like a North Vietnam on its border to make logistics simple for the ultimate supplier, the USSR, though Nicaragua does show signs of military aspirations with an army three times the size of Somoza's and late model MiGs on the way.

To further diminish the Vietnam Once Again image, El Salvador is no place for us to go ashore with US troops. There are a number of reasons why this is so, but the simple one is that they are not needed. If the support for the insurgents were to dry up, or even be substantially reduced, there is good reason to believe the El Salvador government, with our help in the form of aid and a few advisors, could win in a few years. The question is how to stop the flow of weapons.

If Cuba can build a base on Grenada, we should be able to put in an austere base somewhere along that island chain. Nothing fancy, you understand, with no great numbers of people permanently on station. The mere fact of American airpower operating in the Caribbean might be a real signal—to resurrect that word, despite the futility of our Vietnam strategy of sending signals—to the nations bordering the Caribbean that Uncle Sam was around keeping an eye on things. Once we showed we were serious, we might even get some help. We would, in any case, begin to get a handle on the problem.

As a side, and by no means minor, benefit, an air presence might also have a discouraging effect on those reptiles in the drug trade. ■

USAF Training–The World Leader

Air Force training methods have led the field for decades, producing skilled persons for a myriad of tasks. The Air Force's qualified people are unsurpassed in the world. This special section looks ahead to training challenges, examines some current programs (including work with US Marine aviation), and also covers the "miracle" of World War II training.

Training pervades every aspect of Air Force life, from entry to retirement. It imparts the necessary skills to quality people who are enhanced by quality training and education. Air Training Command's triple mission of recruiting, training, and education influences the Air Force through . . .

The Education Factor

BY GEN. THOMAS M. RYAN, JR., USAF, COMMANDER, AIR TRAINING COMMAND

ONE OF the more striking impressions of my first six months at the helm of Air Training Command is how the breadth of ATC's mission affects all Air Force people through the education factor.

The process actually starts sometime before or during high school, when our youngsters begin to develop an Air Force awareness from many sources. We hope, of course, that it's a positive awareness, and that it reaches its peak during the high school or college years.

Recruiting

But awareness and positive perceptions are not enough in themselves to ensure that our youngsters "think Air Force" when considering their futures. So, we identify the promising ones and reach them by mail as early as their junior year. If they show interest, our recruiters contact them. Then, if the chemistry is right, they make a commitment in their senior year and we welcome new Air Force members.

In an academic sense this process sounds simple: Create an awareness, stimulate a positive perception, make contact, enlist the individual. In reality the task is complex and demanding. First, we must attract 70,000-plus young men and women annually to keep the Air Force manned with qualified enlisted members from the bottom up. That's a lot of faces, personalities, histories, and medical and mental exams. Second, since we're interested in quality people, we face stiff competition for a limited resource. And the competition will get tougher downstream because America is running out of potential recruits at an alarming rate.

Demographers tell us that by 1990, for example, our armed forces will have to recruit one of every three enlistment qualified seventeen- to twenty-one-year-old male high school graduates. To further complicate matters, the most recent propensity-to-enlist survey revealed that only thirty percent of the young people contacted felt a career in the military was worth considering.

Well, you can't just go out and buy a strong Air Force, but some things are working in our favor. A big one has a direct tie to the education factor. Studies of new recruits indicate the opportunity for training and education is the most important reason young people join the Air Force. They see us as a source of marketable skills and experience, and that's great.

But the fact that education is so important to our youth works against us too. Some of our toughest competition comes from colleges, universities, and vocational and technical schools. We counter this competition, to some extent, by telling potential recruits that their Air Force training and experience can earn them college credit toward an Associate Degree in Applied Science through our Community College of the Air Force. Some 136,000 Air Force people currently enrolled make CCAF the largest community college in the world.

Always optimistic, we'll continue to focus our recruiting effort at enlisting the best of the best—with emphasis on the high school graduate. Why stress high school grads? Because if experience is worth any-

Intensive physical training is part of the six-week basic military training course at Lackland AFB, Tex. It is a tough program designed not only to train, but also to identify early those who can't adjust to the Air Force life. (USAF photo by MSgt. Buster Kellum)

thing, our experience tells us that recruiting more non-high school graduates is clearly not the answer. Half our first termers without diplomas, for example, don't complete their first four-year enlistments. Discharge-for-cause actions are twice as high for non-high school graduates. We want people who have demonstrated they can make it to a significant level in the academic world. We find this level has been reached by those who have worn the cap and gown.

Enlisted Training

Once individuals are recruited, the education factor continues, as our newest enlisted members face the rigors of Basic Military Training at Lackland AFB, Tex. There, at the "Gateway to the Air Force," they get six weeks of training, including customs and courtesies, discipline, wearing of the uniform, drill and ceremonies, heritage, and physical conditioning.

And we intentionally make those six weeks tough. We find it best for the individual and the Air Force to identify and separate early those unable or unwilling to adapt to our lifestyle.

If you are concerned about the caliber of our youth, you should visit Lackland and take a look at these young men and women. They are patriotic, and we do everything we can to build on this basic love of country. It's very satisfying to see how quickly and completely most of our young trainees develop or increase their pride in self and nation. You can probably tell that I'm optimistic about our young people.

After basic training, the vast majority of our new airmen receive technical training in one of more than 1,400 courses and skills at either Lackland, Goodfellow, or Sheppard AFB, Tex., or Keesler AFB, Miss., Chanute AFB, Ill., or Lowry AFB, Colo. As with basic military training, we're proud of the way our technical training centers have handled the large and changing loads while continuing to provide quality training.

Technical training has undergone some significant changes lately. We suffered heavy losses in mid-career level supervisors and managers. So we had to train more people to replace them. But there's a kicker.

At Chanute AFB, Ill., one of six technical training centers, fire-fighting students build confidence in themselves under realistic conditions. (Photo by Walt Weible)

When we lost the ten-year NCO, we lost the very person who could augment our training efforts through effective on-the-job training. We had to compensate for that loss by making our initial technical training more intensive.

We've done this by stripping down training to its essentials. We've worked toward adding instructors, equipment, and facilities. Some of our most demanding courses have had to be lengthened. Thanks to a lot of hard work at the centers, our graduates now arrive at their new assignments with considerably better developed skills than five years ago.

Continued Training

Though most airmen leave the command when they complete tech training, they don't leave the training arena. No one in the Air Force does; the education factor remains omnipresent throughout every career.

For example, ATC has ninety field training detachments and operating locations worldwide, plus the world's largest correspondence school—the Extension Course Institute. ECI, offering more than 370 professional, specialized, and career development courses, averages some 250,000 enrolled Air Force members at any given time.

One thing in continuing education has become very clear—we can't afford to concentrate on making people technicians and managers to the exclusion of making sure they are also becoming military professionals. The Air Force needs leaders at all levels, and you don't always pick up leadership skills from experience. So our professional military education tries to fill this need.

Professional Military Education

Perhaps no organization better exemplifies the pervasiveness of the education factor than ATC's Air University (AU).

Professional Military Education (PME) heads AU's list of progressive programs. Emphasizing the nature and importance of sound leadership and enlightened management, PME challenges students to explore the principles underlying leadership and to develop their own styles. They learn how to motivate subordinates and focus on the timeless virtues of teamwork and commitment.

As an aside, I recently had an interesting discussion with the chairman of the board of a large aerospace corporation. He told me one of his biggest problems was getting his foremen to act like foremen. They have no trouble teaching their people how to operate the equipment and keep their drill bits clean. But when it comes to leadership—motivating their workers to the point where they want to do a quality job everyday—the foremen come up empty-handed. I gave him the curriculum for our NCO Leadership School and he jumped at it.

Officer Training

The education factor is also very

much present in ATC's precommissioning programs. Air Force Reserve Officer Training Corps detachments nationwide (and in Puerto Rico) are a major source of the some 9,000 new officers the Air Force needs each year. Since the demand for new officers will remain relatively high, the Officer Training School at Lackland AFB—the most flexible of our commissioning programs—will also continue as a major contributor.

AFROTC and OTS teach officer candidates communication skills, defense studies, professional development, and leadership. Leadership training, by the way, has been expanded significantly in recent years to help counter a growing negative perception that the Air Force is just another job.

One of the problems we discovered in officer development training is the gap existing between the time an individual is commissioned and attendance at Squadron Officer School. While the command had incorporated officer development into our undergraduate flying training programs, we had no such standardized training in our tech training courses.

We now have a major officer qualities enhancement effort under way in our basic officer technical courses. We aim to foster *esprit de corps* by increasing our new officers' understanding of their role in their career field and the Air Force and their relationship to supervisors, peers, and subordinates. Instructors are emphasized as role models.

As a result, all of ATC's precommissioning programs, as well as all PME, tech training, and undergraduate flying training courses, now nurture and enhance the development of officer qualities.

Flight Training

We have almost doubled the number of young officers entering our undergraduate flying training programs during the past few years. Although this was necessary to make up for the large group of pilots and navigators who left the Air Force in the late seventies, the increase in flying training rates created some management difficulties. For example, added pilot production has accelerated the T-37 and T-38 aging process. Thousands of takeoffs, rolls, dives, loops, aerobatic maneuvers, and landings during their two decades of faithful service have taken much of the starch out of them. So, our deliberations and search for solutions became quite interesting.

When the dust cleared, two fundamental requirements were painfully obvious. We needed a new aircraft to replace the T-37, or a major modification of that trainer. And we needed to find economical ways to extend the life of the T-38 and still meet our dramatically increasing pilot training goals.

Because it was more cost-effective, we opted to replace the T-37 with an aircraft we refer to as the Next Generation Trainer (NGT), and we'll go to a dual-track training program that includes the acquisition of tanker, transport, and bomber (TTB) training aircraft *(see related article immediately following)*.

Education Factor Pitfalls

While finding the solution to the pilot training problem was perplexing at times, it also served to point out an idiosyncrasy of the Air Force education factor. We encourage (in fact, insist) that our people have the best training and education of any air force in the world. However, by training our people to high skill levels, we also make them more marketable in the civilian world. This confronts our young people with a tough decision: to remain in the Air Force, or get out. In the late 1970s, far too many officers and mid-level NCOs chose the latter option, and left us for high-paying jobs with civilian business and industry.

Certainly, this was a bonanza for industry. But in direct proportion we were the losers. Although our recruiting and training efforts could replace the departees in numbers, we could not replace their experience.

We, of course, don't intend to reduce the education factor as a means of slowing any drain of experienced Air Force technicians to the civilian labor pool. We have attacked the problem from a different angle by concentrating on the development of better programs and incentives to keep our good people at home in the Air Force. Recent increases in pay and allowances will do much to help win this campaign. So will programs aimed at increasing job satisfaction, and those that focus on Air Force family and quality-of-life issues. Programs to return former members to active duty—pilots in particular—have been reasonably successful. And we'll come up with scores of new ideas and programs to make the lives of our people more comfortable, their contributions more rewarding, and our retention rates higher. As we do these things, the Air Force will become an even greater way of life for those of us in it, and a stronger fighting force for those Americans who trust us with their defense.

Above all, we will keep our education factor high, because we know that our strength and freedom have their roots in quality education and training. ■

Gen. Thomas M. Ryan, Jr., became Commander of ATC last August.

Gen. Thomas M. Ryan, Jr., began his military career as an aviation cadet in September 1949. After completing pilot training at Reese AFB, Tex., he was commissioned in October 1950 and entered on a series of flying assignments with the Strategic Air Command over the next eighteen years. He flew RF-4C aircraft in Southeast Asia, then served on the Air Staff in Washington. After command of a SAC bomb wing and participation in "Linebacker II," December 1972, he commanded an air division, served at SAC headquarters, and again at Hq. USAF. Before assuming command of ATC he was Vice Commander in Chief, Military Airlift Command, for four years.

The key to winning in the air is capable pilots in the numbers needed. That is ATC's challenge. To meet the challenge, ATC needs the Next Generation Trainer, the Tanker-Transport-Bomber trainer, and Specialized Undergraduate Pilot Training. All are part of ATC's plans for . . .

Pilot Training, 1986 and

BY BRIG. GEN. WILLIAM M. CHARLES, JR., USAF

BECAUSE of highly visible Administration and congressional efforts to revitalize the US military and improve its combat capability, the abbreviated names of many weapon systems have become virtual household words to anyone who reads a newspaper or watches television. The MX, B-1, and CX are such examples.

The Air Force's combatant commands have always been active players in the new system acquisition marketplace. Now a new player, Air Training Command, is beginning to play an important role in the decisions involved with allocating research, development, and production funds to new systems.

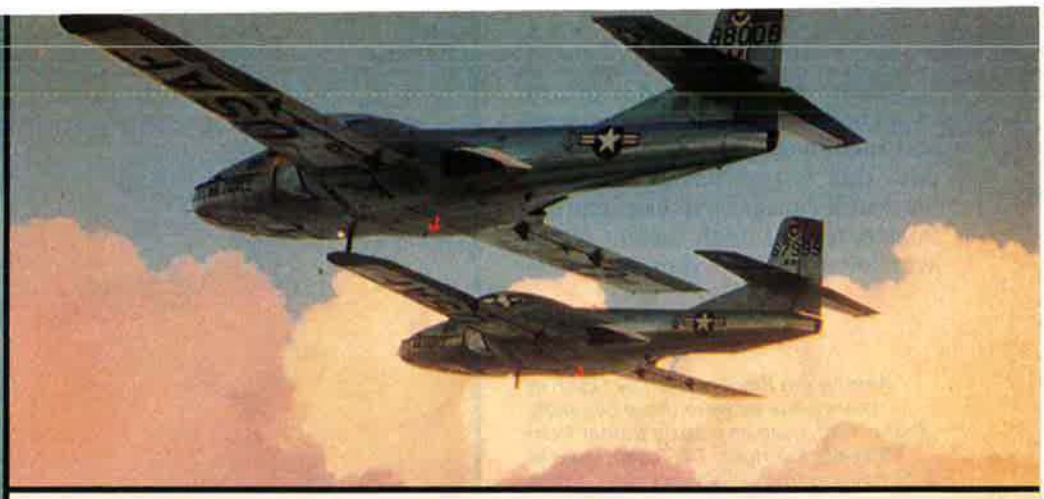
Not since the late 1950s, when the Air Force began development of the T-38 as a replacement for the aging T-33s, has ATC had a requirement for a new aircraft. Its participation in acquisition programs since that time has been mainly that of a supporting command involved with activities related to training people to maintain new systems acquired for other commands.

Not anymore! ATC now has its own alphabet soup, and while acronyms like NGT, TTB, and SUPT will never become household words, they are becoming very familiar to military planners from the Office of the Secretary of Defense on down. A key part of the effort to improve our combat capability is related to increasing the size and the capability of our fleet of combat aircraft. However, increases in the number of our newest, most sophisticated combat aircraft will be virtually useless unless we have enough trained pilots to fly them.

The approved pilot production rates contained in the Five-Year Defense Plan (FYDP) require ATC to produce 2,200 pilots per year beginning in FY '84. The Extended Planning Annex forecasts an even greater rate—2,400 per year—beyond the FYDP to meet programmed force increases. Therein lies the problem. ATC will not have enough aircraft to provide those trained pilots.

Fleet Insufficiency

By 1987 for the T-37, and by 1986 for the T-38, we will reach a "window of vulnerability" that we call "fleet insufficiency." It means we will not have enough aircraft available to train the number of pilots we need to maintain our operational forces. The reason isn't that the aircraft are reaching the end of their service life—for example, we can extend T-37 aircraft service life at a



Left: T-38 Talon, ATC's premier jet trainer for the last two decades. More than 50,000 pilots have earned their wings in the T-38. (USAF photo by MSgt. Buster Kellum) Above: T-37 two-seat primary trainers, in use by USAF since 1954.

Beyond

relatively modest cost—but because we will simply not have enough "rubber on the ramp," even if all the aircraft are healthy.

At the same time, the increased complexity of the Air Force's current and future operational aircraft, the steadily increasing cost of pilot training, and the scarcity and cost of fuel dictate that we have the most cost-effective training program possible. It is precisely for these reasons that ATC is back in the aircraft acquisition business, and it is why the Next Generation Trainer (NGT), the Tanker-Transport-Bomber (TTB) trainer, and Specialized Undergraduate Pilot Training (SUPT) are vital to ATC and the Air Force.

Why the NGT?

Our requirement for the NGT—and this is an important point—is completely unrelated to SUPT and the procurement of the TTB necessary for its implementation. Even if we were not facing a T-37 insufficiency problem, there are several key operational reasons why we need the NGT.

While the T-37 has been an excellent primary trainer since we began using it in 1954, the fact remains that it is a 1950s design and is beginning to have operational deficiencies that affect its effectiveness today—and will affect its future utility to an even greater extent.

Because the aircraft is not pressurized, it is limited by safety considerations to altitudes below 25,000 feet. Since the low thrust of the T-37 engines allows only limited maneuvering above 20,000 feet, we are effectively bounded by the airspace between 5,000 and 20,000 feet. This is a critical problem, because it is precisely at those altitudes that we are seeing a steady increase in both commercial and private aircraft activity.

Most of our training bases are located either in, or close to, areas that have high concentrations of civil traffic. Notable examples are Williams AFB in Phoenix, Ariz., and Randolph AFB in San Antonio, Tex. Even Reese AFB near Lubbock, Tex., is greatly affected by flights into and out of the Dallas-Fort Worth Metroplex area.

Since civil traffic cannot be restricted from pilot training airspace, there has been a significant increase in flights through the training areas. We expect this trend to continue. FAA has projected an average of about a seventy percent increase near our UPT bases by 1991. Most of that will be concentrated at 12,000 feet and below.

When an ATC pilot either sees another aircraft in his airspace, or is advised of that aircraft by an FAA air traffic controller, he must either change his training profile, *i.e.*, do level turns instead of aerobatics, or stop training and move to another section of the area until the traffic is clear. This is the only safe approach to take, since in the majority of cases the pilot of the civil aircraft is either unaware of the trainer's presence or, as in the case of an airline pilot, is not in a position to take evasive action.

The dual penalty here is in the lost training time and in the increased potential for midair collisions and loss of lives. The pressurized NGT, with more efficient turbofan engines, along with improved climb rates and maneuverability at altitude, will allow us to adapt to the traffic congestion by moving our training airspace up to as high as 35,000 feet.

Incidentally, lack of pressurization in the T-37 has made it the worst airplane in the Air Force for inducing physiological problems and pilot fatigue. Over the years we have experienced a significant number of serious situations involving hypoxia, the "bends," and other disorders that adversely affect the pilot's ability to fly his aircraft safely. This problem is especially acute for ATC because of the low experience level of our student pilots. We consider it essential that the NGT design eliminate this problem.

The short range of the T-37 is a

significant deficiency and is caused by a combination of a low fuel load and fuel-hungry engines. Not only does this restrict navigation training, but it causes us to lose approximately ten to fifteen percent of our scheduled missions during periods

Among the trainers used by USAF in years gone by were these beauties. Right: T-33, used as a basic trainer from 1950–65. Far right: T-6 Texan, used in pilot training from 1940 until 1956. Those completing T-6 training went on to either the B-25 (below) or T-Bird. The B-25 provided multiengine training between 1944–60. Its phaseout signaled the start of Generalized UPT.

of bad weather. Many flights, particularly in the winter, cannot be launched because there is no suitable alternate airfield within the range of the T-37. In the winter, we also lose missions because the T-37 has virtually no anti-icing capability. Also, at such bases as Vance and Reese, we are plagued throughout the year by crosswinds that limit both dual and solo flying.

With the NGT's improved range, anti-icing, and crosswind capabilities, we expect to reduce significantly training losses caused by bad weather and high winds.

Significant Savings

The cost of jet fuel today is approximately $1.18 per gallon. Despite the recent leveling of fuel prices, we must anticipate significant future price increases.

The T-37 uses approximately 185 gallons of fuel per hour. The fuel usage for the candidate NGTs ranges between ninety and 110 gallons per hour. This reduction will save the Air Force from 26,000,000 to 33,000,000 gallons of fuel per year. At $1.18 per gallon, that is $30 to $40 million. At $1.90 per gallon, not at all out of the realm of possibility in the next few years, we would save $49 to $63 million.

We also expect to realize a significant savings in our most expensive resource—manpower. Because the NGT will be designed to take advantage of the recent technological advances in airframe structures, avionics, and engine design, we are confident we can reduce maintenance manpower needs by about 700,000 man-hours per year, saving another $8 million.

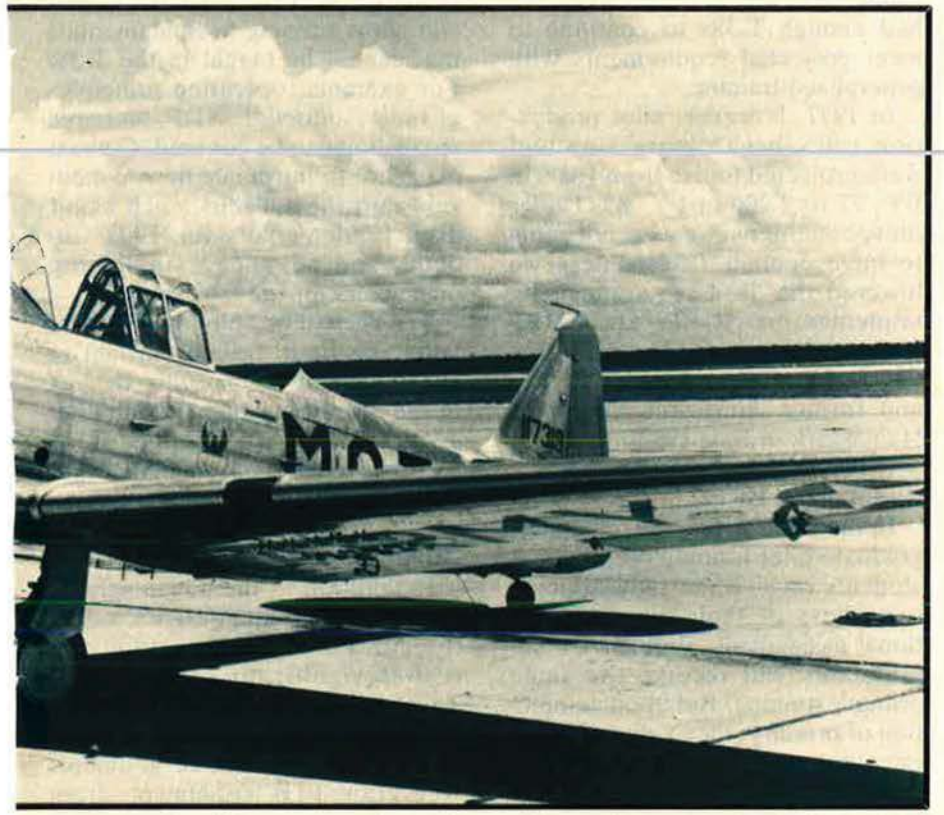
Design Requirements

Although we want the NGT to be an aircraft whose performance exceeds that of the T-37, we have insisted from the beginning that the side-by-side seating arrangement and the twin-engines of the T-37 be retained. Twenty-five years of experience with the side-by-side T-37 cockpit has convinced us that, beyond a doubt, this is the most effective cockpit configuration for a primary trainer aircraft.

Teaching a new student to fly in a tandem cockpit, like that of the

T-38, is like trying to teach a person to drive from the back seat of a car. Once a person has learned to drive, however, his or her skills can be polished by instruction from someone in the back seat. But while the new driver is still in the learning stage, having the driving instructor in the front seat is the only thing that makes sense.

Students in the T-37 are just learning the basics of flying. It is the first time they have worn parachutes, helmets, and oxygen masks, and it is their first experience with high G forces and flying "upside down." This situation produces apprehension and, in many cases, airsickness. The instructor, by sitting next to the student, can reduce that anxiety and instill confidence through direct verbal and nonverbal communication, while providing immediate feedback on how well the student is doing.



From a safety standpoint, the instructor sitting next to the student can better anticipate errors and can more easily prevent dangerous situations from developing. In emergency situations, where the instructor cannot communicate verbally with the student, he can use hand gestures to show the student the appropriate actions to take.

ATC, beginning in 1954, was the first to adopt side-by-side seating in pilot training, and eleven of the fourteen NATO pilot training programs have since followed our lead and changed to side-by-side trainers.

The other feature we are insisting on is the twin-engine design. Our safety record with twin-engine trainers, the T-37 and T-38, has been excellent, particularly when the low experience level of our student pilots is considered.

The one-vs.-two engine controversy has been a source of considerable study over the years. The bottom line of all the studies is that two engines are safer than one. An example of the findings is that engine-related losses for single-engine aircraft are approximately 1.7 to four times greater than for two-engine aircraft. In fact, one single-engine primary trainer has an engine-related accident rate approximately eighteen times that of the T-37.

Aside from safety considerations, a single-engine aircraft would increase the cost of our training program by causing us to teach "engine-out" landing maneuvers. Otherwise, every time the pilot experienced a serious engine malfunction or lost the engine, he would be forced to bail out. The result would be the loss of an aircraft and the chance of injury to the aircrew.

Engine-out training consists primarily of gliding the aircraft to a landing on a suitable runway. By disrupting the normal traffic pattern training at the home and auxiliary fields, this maneuver increases the total training time required for each student.

NGT Status

We are working very hard with Air Force Systems Command to ensure that we will be ready to train in the NGT in FY '87. The acquisition program is well structured to provide us with what we need.

Five contractors completed "concept studies" in October 1980 and gave us their views as to potential designs and costs. Since then, they have revised and refined their designs. Additionally, ATC performed an extensive evaluation of an existing turboprop trainer to ensure that we were not overlooking a possible cost-effective solution. At first glance, this option appeared attractive since turboprop engines are more fuel efficient than the fanjets used by the other candidates. Also, by buying an off-the-shelf aircraft, we could avoid considerable "up-front" development costs.

Our evaluation, however, revealed that a slow speed, single-engine turboprop aircraft was just not a cost-effective approach. The turboprop's lower performance resulted in an increase in the time needed for primary training and in a significant increase in the training required for transition into the higher performance T-38.

This increased flying time would require more manpower, would reduce the production capacity of current training bases, and would mean the opening of additional bases to meet our pilot production goals. Using an off-the-shelf single-engine turboprop over a twenty-year period would cost the Air Force about $3 billion more than using the NGT. Of equal importance, we would not have corrected any of the T-37's operational deficiencies, and we

would have sacrificed the training and safety advantages of a side-by-side cockpit and a two-engine aircraft.

Air Force Systems Command (AFSC) released a "Request for Proposal" to industry in October 1981, and we are currently in the process of evaluating each contractor's submission. After the evaluation is complete, AFSC will present the results to the Secretary of the Air Force, who will select the contractor to develop and produce the NGT.

Specialization Is Not New

The ATC initiative that will cure both our T-38 insufficiency problem and at the same time give us a more cost-effective training program is our "dual track" specialized program, or SUPT.

This idea of specialization in flying training is not, by any means, new. From the beginning of World War II until the late 1950s we used a multitrack program. Earlier in the period, our specialization was engine-related: single-engine, twin-engine, and four-engine. All students were trained in the PT-13 and AT-6, and then received their advanced training in the P-47, P/F-51, B-25, B-17, or C-54. Later, when the first jet, the P-80, began replacing conventional aircraft, the single-engine track became even more specialized as we divided it into a conventional track using the F-51, and a jet track using the F-80 and later the T-33.

When the multiengine trainer, the B-25, reached the point where it needed to be replaced, the decision was made to phase out multitrack training and to convert to a single-track program using the T-37 and the T-33. This decision, made in 1955, was based mainly on the fact that the operational fleet projected for the future was to be primarily jet-powered rather than conventional, and that jet-qualified students could more easily convert to conventional aircraft than vice versa. Additionally, the Air Force could not, at that time, afford the development and procurement of a jet multiengine trainer.

In January 1969, the Air Force began a full-scale mission analysis to examine the UPT for the 1975–90 period. While it was primarily an AFSC and ATC analysis, the major commands, the Rand Corp., and the USAF Scientific Advisory Board also participated. This group reached the conclusion that ATC should place more emphasis on simulation and that a specialized multitrack pilot training program could improve graduate quality at reduced costs. This report provided the impetus for our Instrument Flight Simulator program, and further "generalized vs. specialized" studies. These studies also confirmed the cost-effectiveness of SUPT, but because the Air Force budget was severely strained with F-15, F-16, B-1, and A-10 costs, we could not afford the multiengine trainer we would need. Also, we had enough T-38s to continue to meet projected requirements with generalized training.

In 1977, however, pilot production rates began increasing and were projected to rise from 1,000 in FY '77 to 2,200 in FY '85. Under those conditions, we were not going to have enough T-38s unless we lowered the T-38 requirement by implementing SUPT. The SUPT concept was approved by Air Force Chief of Staff Gen. Lew Allen, Jr., and former Air Force Secretary Hans Mark in June 1980.

Specialized UPT

In the current generalized undergraduate pilot training program, all students receive the same training regardless of their future operational assignment. With SUPT, all graduates will receive the same primary training. But upon completion of primary, they will move into one of two basic tracks for advanced training—the Fighter-Attack-Reconnaissance (FAR) track for those selected for similar end assignments, and the TTB track for those selected for assignment to the heavier multiengine aircraft operated by SAC and MAC. Graduates of SUPT will thus be able to adapt more readily to their follow-on assignments—for three important reasons:

- Students in either basic track will be able to concentrate their efforts on those skills that would be used most often in their follow-on operational assignments. For example, formation training in the FAR track can emphasize close and tactical formation, while formation training in the TTB track can concentrate on extended en route trail formation, both IFR and VFR.
- ATC will be able to provide training in concepts and on equipment that is currently not possible under the generalized program. The new equipment will be associated primarily with the TTB track, and will allow training in fundamentals that cannot be taught in the T-38. For example, operating principles of radar, autopilot, ADF, and area navigation can be covered. Current plans are to introduce new maneuvers into the syllabus, such as air drop fundamentals for TTB students and advanced single-ship maneuvers for the FAR students.
- ATC will be able to adjust and tailor the basic training syllabi to accommodate the specific desires of the operational command, either as deficiencies are identified or as their particular mission changes require new flying skills.

SUPT Saves Dollars

In addition to the advantages of specialized training, SUPT offers the Air Force an opportunity to realize significant cost savings. These will come about as a result of transferring training for the fifty-five to sixty percent of graduates who draw TTB assignments from the high cost per flying hour, fuel-hungry T-38, to a current technology TTB trainer with a lower cost per flying hour and whose turbofan engines will consume less than one-half the fuel for an hour of flying time than does the T-38.

Brig. Gen. William M. Charles, Jr., is DCS/Plans, Air Training Command. Commissioned from West Point in 1954 after earlier USAF enlisted service, 1948–50, he earned his pilot wings in September 1955 and began flying B-47s at Little Rock AFB, Ark. He then flew B-52s from 1959 to 1962 before service as an air officer commanding at USAFA, 1962–65. He flew combat missions in Vietnam in the F-100 fighter, and was an advisor and planner with the Royal Thai Air Force after that. He is a graduate of the Army's Command and General Staff College and the Naval War College, whose later assignments included staff duty at SAC headquarters and the Air Staff, and operational duty with SAC bomb wings. He commanded the 320th Bombardment Wing, 1977–79, before assuming his present post. He is a command pilot and parachutist.

A typical business aircraft has the characteristics necessary to make a good TTB trainer. It must be multiengined with seating for a minimum of three crew members and have handling qualities representative of mission aircraft.

Currently, we estimate that we can save approximately $50,000 per TTB graduate, which translates into a significant $55 million per year savings in our pilot training program. Of perhaps even greater importance is the reduction of approximately 30,000,000 gallons of fuel in our annual fuel requirement, and the decrease in maintenance personnel required because of the relative simplicity of the modern TTB compared with the more complex T-38.

SUPT, with a TTB aircraft, provides another cost-saving bonus for the Air Force. As mentioned earlier, by FY '86 ATC will not have enough T-38s to continue our current generalized pilot training program. Without SUPT, we are faced with the need to replace the T-38 with a comparable, expensive aircraft, such as the Navy's proposed VTX. By implementing SUPT and acquiring a less expensive TTB aircraft, our T-38 aircraft requirement would be reduced by approximately forty percent, and we would extend the life of the T-38 as a viable FAR trainer until beyond the year 2000.

To be more specific, acquisition of an off-the-shelf business jet type aircraft, a representative TTB candidate, would cost approximately $600 million; however, replacing our fleet of T-38 aircraft with a VTX-type trainer and continuing generalized UPT would increase the bill to approximately $3 billion. Therefore, aside from the training quality advantages of SUPT, the aircraft development and acquisition cost picture argues overwhelmingly in favor of SUPT.

TTB Trainer

We believe an off-the-shelf corporate-type aircraft will make an excellent TTB trainer. SAC and MAC have spelled out the type of training they want us to do in the TTB track. From that, our operations people have developed a preliminary syllabus to provide that training. The TTB trainer must have operating and design characteristics that will support that syllabus, and we are now in the process of identifying these features. Basically, though, the aircraft must perform in a manner representative of the operational TTB fleet.

Crew coordination is important in TTB operation. We believe we can improve our training in this area by having two students on each instructional sortie. One will be flying the aircraft under the supervision of the instructor pilot, while the other acts as a third crew member. In addition to acting as a third crew member, the second student can be exposed to the procedures and techniques used by both the other student and the instructor.

The aircraft we are considering must offer adequate asymmetrical thrust training to prepare students for emergency "loss of engine" conditions in operational TTB aircraft. The ability to cope with these conditions is especially critical in the operational fleet.

We need an aircraft that is capable of high-speed, low-altitude flight for our training missions in low-level navigation, simulated bombing, and simulated airdrop. The TTB trainer should build on the skills developed in the primary trainer and should prepare students for the speed and pacing necessary in operational aircraft.

Navigation training and missions that teach airborne rendezvous procedures will define the required avionics equipment. At present, it looks as if we will need weather radar and such standard navigation and instrument approach equipment as VOR, TACAN, and ILS, and UHF and VHF communications radios.

Although the TTB aircraft will be essentially off-the-shelf, a certain amount of testing and some minor modifications may be necessary. Corporate aircraft have not been exposed to repeated high-speed, low-altitude flight, nor have they been exposed to the intense and sometimes "rough" use that comes in a student training environment.

In September 1981, AFSC issued a Request for Information to potential TTB contractors. The responses we received in November indicate clearly that we can purchase a suitable TTB trainer at a minimum cost.

Need for Action

ATC's flying training programs have always been, and must continue to be, dynamic. Our experience with the past has taught us the necessity of modifying our flying training programs to keep pace with external influences. We expect the future to demand this same flexibility. We are rapidly approaching the point, however, where we will no longer be able to make the necessary changes and still train the number of quality pilots the Air Force needs.

Five factors are working against us: (1) a limited and decreasing number of trainer aircraft; (2) increasing pilot production; (3) shrinking airspace; (4) operational limitations of the T-37; and (5) rapidly rising training costs, primarily fuel and manpower. All point to a need for action now. Buying the NGT and converting to a cost-effective SUPT program will ensure that ATC has the capability to accomplish its training mission for the foreseeable future. To do otherwise would erode the very foundation of Air Force combat readiness—a continuing supply of well-trained pilots. ■

Twice yearly, a US Marine Corps aviation squadron based in Arizona conducts a six-week course designed to turn out instructors in threat evasion techniques and low-level ordnance delivery. Provided with the most up-to-date lore in these martial arts, the instructors then return to their home units fully qualified to undertake . . .

Advanced Aviation Weapons Training—USMC Style

BY WILLIAM P. SCHLITZ, SENIOR EDITOR
Photos by Harry Gann

CONSIDER this anomaly: A United States Marine Corps aviation squadron that doesn't own a single aircraft and has no aircraft maintenance personnel assigned. Furthermore, a squadron stationed smack in the Arizona desert.

A squadron deemed so essential, however, that it reports directly to Hq. USMC in Washington, D. C., and has concurrent operating links not only with Marine Corps Intelligence but with the entire US intelligence community.

The unit in question—Marine Aviation Weapons and Tactics Squadron One (MAWTS-1)—also is unique in that it has forty-three officers assigned and only twenty-five enlisted Marines—a very high ratio of chiefs to braves.

This tilt in manning is understandable in light of the squadron's mission: to conduct a graduate course in aerial tactics and ordnance delivery designed to turn out *instructors* fully qualified to return to their home units with the most up-to-date lore in these martial arts. In this, MAWTS-1's faculty is handpicked, and its students comprise the most highly qualified and capable company-grade officers throughout USMC's aviation and ground communities. *(For a rundown on Marine Corps Aviation, see box on p. 51.)*

Generally, Marine Aviation training is conducted on three levels. The first—which includes schools, naval flight training, and Marine replacement aircrew training squadrons—brings the new pilot to Military Occupational Specialty competence. The second stresses unit training to full combat qualification. From these top-notch "gun squadrons," then, come the candidates for the third—and highest—level: the course at Yuma and other supplemental instructor courses MAWTS-1 has developed.

"The overall mission of MAWTS-1 is to provide *standardized training* in all aspects of the employment of Marine Aviation units, and, as directed, to assist in the development of aviation weapon tactics. We also assist in the evaluation of other Marine Aviation units," said MAWTS-1 Commander Col. B. G. Butcher.

The MAWTS-1 course taught at Marine Corps Air Station Yuma spans six weeks and includes academics and simulated combat missions, making use of the air station's adjacent ranges and those at nearby Luke AFB, Ariz. Conducted twice yearly, the course is comprehensive in terms of organic Marine Corps Aviation assets—both fixed wing and helicopters—and ground-to-air weaponry such as I-Hawk and Redeye/Stinger missiles, and mobile tactical radar units. An essential ingredient is extensive instruction in and exercise of command control and communication procedures.

The objective of the course is to train one pilot or aircrew from each Marine squadron (or ground unit) per year in the most advanced low-level, high-threat evasion tactics. The students include aircrews from USMC's fixed-wing and rotary-wing "communities," as well as infantry, artillery, and air-defense ground officers, not to mention forward air controllers, and the like. Prospective students must have at least a "Secret" clearance to be considered.

Students are assigned from each of the three CONUS-based Marine Corps Aviation wings (two active duty, one Reserve). Usually available are a sprinkling of course slots for Air Force, Army, and Navy aircrews (Naval Aviation's primary missions are power projection and fleet defense, although it is possible that Navy Air might have to assume the comprehensive "close-support" of ground troops role customarily played by Marine Aviation).

USAF participation in the full course thus far has been mostly confined to C-130 and helicopter aircrews from the active and Reserve units of the Aerospace Rescue and Recovery Service. Because of their mission, these units are keenly interested in the latest information on a possible adversary's threat potentialities and just what tactics the Marines have devised to thwart them. A number of Air Force folks have sat in on the academic segment of the course without participating in the flying.

Academics and Flying

The student body in each of the Weapon and Tactics Instructor (WTI) courses runs from sixty-five to seventy-five. Following three weeks of intense class work, representative aircraft are flown to Yuma from tactical units to give students the means to participate in the three-week flying segment. Also brought in are about 700 maintenance people to keep the aircraft fully operational, as well as graduate instructors to beef up the faculty to an almost one-on-one instructor-to-student ratio. The object is to involve, at a minimum, every type of aircraft in the Marine inventory.

In the WTI course, the instruction follows a "building-block" approach. Initially, the entire student body receives a series of lectures by guest intelligence experts that might include, for example, an address by a representative of the Joint Rapid Deployment Force planning staff. The course is famed for the high quality of its guest lecturers.

The lectures include the latest information on Soviet and Warsaw Pact aerial defense systems, their fixed-wing and helicopter attack tactics, electronic warfare capabilities, and even personality profiles on Soviet-bloc aircrews. The Third World threat is also explored.

Next, the students are separated into the two fixed-wing and rotary-wing flying "communities" *(see p. 51)* and the ground elements for more intensive instruction on both enemy and friendly capabilities.

During the final period of academics, the students are divided yet again into their specific communities, such as fighter, attack, and tanker, as well as air-defense ground people, forward air controllers, and tactical air control personnel.

Marine Air's helicopter aircrews are handled similarly. Reflecting their nap-of-the-earth flying tactics, they are given intensive instruction in map interpretation and terrain analysis, day and night (through the use of special night-vision goggles) maneuvering, and evasion techniques including terrain masking.

Threat Developments

MAWTS-1 staffers are experts assigned to these different aircraft and aircraft-related sections. They usually serve three-year tours and, while stationed at Yuma, are charged with keeping current in the latest in threat developments.

With this they have considerable help. The S-2 Section maintains an extensive library that has more than 100,000 microfiched documents alone. This lode of information is used not only to remain current on developing enemy threats but also to plan tactics to deal with them.

The MAWTS-1 library—regarded as one of the finest threat libraries of any graduate-level school of any of the services—is on routine distribution from more than ninety agencies.

MAWTS-1 is also plugged into the data bank at Air Force Systems Command's Foreign Technology Division at Wright-Patterson AFB, Ohio, with its 7,500,000 items of intelligence. (Thus MAWTS-1's system for keeping abreast of intelligence documentation of such magnitude, to say the least, is in a constant state of evolutionary improvement.)

Then there is the acid test—combat experience. As did the other services, Marine Air during the Southeast Asian conflict necessarily evolved weapons and tactics to contend with evolving enemy threats. Many of these lessons still have relevance. MAWTS-1 can also draw on the combat experience of others. For example, how Israeli helicopter forces learned to cope with the threat of TOW-type wire-guided missile weapons during the warfare in the Mideast. MAWTS-1 staffers are keen students of the fighting in the Middle East, with its many lessons in aerial combat in a desert environment.

Following the WTI course's three weeks of academics comes—with the arrival of the aircraft—three weeks of flying activities that gradually become more complex as the breakdown into the various communities is reversed. "First of all, after the layoff, we let the pilots just

Above, a column of USMC helicopters represents the types participating in the course: Cobra, Huey, Sea Knight, and Sea Stallion. Left, a USAF F-15 from Holloman AFB, N. M., in formation with USMC A-4s over the Arizona maneuver area.

fly the aircraft again to regain the feel of it," said MAWTS-1 staffer Maj. Dell Davis.

It is at this juncture too that the students begin to plan and conduct their missions, under close instructor supervision. "Instructors will fly in the right-hand seat with them and if it's a single-place aircraft we'll 'chase' them in another plane to see how they do," said Major Davis.

During the flying phase, the training objectives become multiple, with the overall aim to have students perfect airborne instructional and evaluation techniques—in short, "training management" with additional stress on integrated operational planning.

Once full combat qualification flying is realized, other dimensions are added. Both ground and air threats are more fully defined, with Hawk missiles simulating antiair, and aggressor aircraft (that could include Air Force A-10s, F-15s, and T-38s) begin to appear. The fixed-wing threat is usually supplemented by a helicopter threat consisting of Navy H-3s and H-53s.

RF-4s fly reconnaissance missions, while KC-130 tankers are on hand to sharpen low-level aerial refueling techniques. Airborne command and control, electronic warfare (including enemy communications jamming), and air support radar teams come into play.

In the helicopter community, troop carriers begin flying with either AH-1 gunships or A-4s or F-4s as escorts.

If available, Air Force E-3As (AWACS) begin to give warning of hostile air threats.

During this phase of the WTI course, about 1,100 sorties consuming some 1,500 hours are flown by students in about seventy aircraft and involve total integration of all the Marine Aviation assets on hand.

The emphasis is on low-level flight, with fixed-wing aircraft operating down to 200-foot altitudes. Helicopter pilots are trained to fly at fifty-foot altitudes during daylight and at night using night-vision goggles, and at 200 feet without aided sight at night.

All this leads up to the sixth week of the WTI course when all prior ground and air training is put to the test.

The Final Exercise

The climax of the MAWTS-1 Weapons and Tactics Instructor course is a final exercise (finex) aimed at integrating all the organic Marine air and ground elements participating in the course.

Finex gets under way with a staff-prepared operation order that organizes course participants and equipment into a "Provisional Marine Air Group." (Because of logistics problems that in the past overtaxed MAWTS-1's limited support resources, Marine infantry are usually simulated during the flying segment and finex.)

Framework for the finex—which usually lasts five days, depending on the elements participating—is an intelligence scenario prepared by MAWTS-1 S-2 that requires a combined arms reaction. Students are tasked with leadership and other roles in the planning and execution of each day's missions.

The scenario is necessarily sketchy, with the student planners themselves charged with filling in the blanks. MAWTS-1 staff observers help out by feeding into the planning "real-time intelligence" to account for "contingencies" and assure that all Marine Aviation assets are utilized.

A common theme—and one in line with USMC's mission—is the requirement to land a (simulated) blocking force (say in the desert terrain of a Mideast ally) and then protect and support it.

Key elements in the finex—from the MAWTS-1 instructors' point of view—is that the students grasp the techniques and essentiality of thorough briefings and debriefings.

During the finex, live artillery fire is available and, depending on aircrew training requirements, live ordnance can be dropped on targets. Typically, 350 sorties are flown, with additional Air Force and other "adversary" aircraft providing about 250.

In view of the WTI course objectives, particular emphasis is put on ground-to-air and air-to-air threat avoidance.

Following a request for assistance by a small desert country after the outbreak of hostilities with a neighbor, the 75th Marine Amphibious Brigade (WTI Class 1-81) was organized as a rapid reaction element, along with its supporting aviation. Combat operations conducted by the 75th MAB were directed at reducing enemy ground and air threats by reinforcing existing ground units under assault and/or conducting a mobile defense.

Two USMC A-4M Skyhawks of VMFA-214 ("Black Sheep") flank a Marine AV-8A Harrier during the Weapons and Tactics Instructor course.

Without presenting a lengthy description of how WTI Class 1-81's finex unfolded but to give some indication of the scope of operations, here is a list of the types of missions accomplished:

Close air support; combat air patrol; electronic warfare support (EA-6B); tactical air coordination (airborne); airborne direct air support center; helicopter assault; artillery raid and reposition; medevac; resupply; deep air support; sector air defense; multisensor reconnaissance (RF-4); airborne forward air control; aerial refueling; aerial re-

supply (KC-130); helicopter escort; combat search and rescue operations.

And with fixed wing to fixed wing, helicopter to helicopter, and fixed wing to helicopter encounters at varying altitudes during the finex, is flying safety jeopardized?

"Not really," explained Colonel Butcher. "We have complete control of the airspace over the 1.5 million acres that make up the Yuma ranges, and the same holds true for Luke. We are guided by rigid rules of engagement that we adhere to strictly. Furthermore, we've been through the drill a number of times by now. We've only lost three aircraft since MAWTS-1 began the exercises in 1978, and those mishaps were unrelated to the tactical flying program."

In any event, a brace of Flying Safety Officers—fixed-wing and helicopter—report three weeks before the WTI flying segment commences. Among other things, they screen student records to assure qualifications, conduct classes for supervisory personnel in course mishap planning, and oversee the organization of the maintenance detachment. In a related, medical, matter, each MAWTS-1 flying segment has a flight surgeon assigned to it.

MCAS Yuma is not only home base for MAWTS-1 and scene of the twice-a-year WTI courses, but other Marine and Navy aircrews train there because of its flight-instrumented air combat maneuvering range, which affords real-time monitoring of aircraft positioning, altitude, and speeds during air-to-air engagements and air-to-ground missile strikes.

While not capable of monitoring

US Marine Corps Aviation at a Glance

To the uninitiated, the US Marine Corps—and Marine Corps Aviation—are simply adjuncts of the US Navy. But there is a clear delineation that gives USMC and Marine Aviation their special independence and autonomy.

Reflecting this is that while US Marines train aboard Navy ships, the Leathernecks have their own bases in CONUS and abroad. (While the traditional primary mission of USMC has been amphibious assault, in terms of its prominent role in the Joint Rapid Deployment Force it can be expected to engage in sustained ground combat. In the Southeast Asian conflict, USMC fought throughout the war on the ground.)

And while Marine aircraft operate from Navy carriers for training and in time of crisis, the two active-duty wings and one Reserve wing in CONUS maintain their own bases. (A third active-duty wing is stationed in the Pacific, with air stations in mainland Japan and Okinawa. Besides a permanent headquarters and administrative staff, this wing is manned with active-duty squadrons and detachments rotated from CONUS on six-month tours. A practical way of keeping deployment muscles tuned.)

The two active-duty wings in the US each are assigned as the air arm of a Marine Amphibious Force. The 2d Marine Air Wing is headquartered at Cherry Point MCAS, N. C., and the 3d MAW at MCAS El Toro, Calif.—one on each ocean.

Underlining USMC's special role in the Joint Rapid Deployment Force is that the Marine Commandant, who once filled only an advisory post, now has equal status and voting authority among the Joint Chiefs of Staff.

For its part, Marine Aviation has as its sole primary mission the close support of Marine ground troops. And the term "close support" is far more expansive than merely the delivery of ordnance on target.

To perform its mission, Marine Aviation has developed a comprehensive mix of tactical aircraft, divided into fixed-wing and rotary types, or, in Marine lingo, "communities."

These, too, break down into communities of specific types of aircraft with specific roles.

For example, the Marine Aviation "Fighter Community" currently consists of F-4 Phantom IIs for combat air patrol and the like. (These are scheduled to be replaced beginning in 1982 over a four-year period by F-18 Hornets. The F-18s will be built by McDonnell Douglas.)

The "Attack Community" consists of A-4 Skyhawks, a light-attack and close-support aircraft built by Douglas Aircraft Co., the AV-8 Harrier (Hawker Siddeley), and the A-6 Grumman Intruder. The Harrier jump jets can be based aboard helicopter carriers or fly from pads or forward field positions and provide quick response in requests for close air support. (The "A" version is to be replaced by a completely redesigned and reengined "B" version to be built by McDonnell Douglas. Under USMC's "conversion in lieu of procurement program," the As will then be reengined and converted to a version designated "C.") The Intruder is a deep air support aircraft with a 28,000-pound payload, roughly twice that of the A-4. The A-6 is a "medium bomber" with all-weather capability much the same as the FB-111, which means it, too, can fly at 500-foot altitudes and home in on such radar-significant targets as SAM sites and ships, and bomb without ever seeing them.

In a special community of its own is Marine Aviation's EA-6B, an electronic countermeasures aircraft capable of jamming enemy airborne and ground radars and other communications.

For reconnaissance is the RF-4B with its photographic and infrared capabilities.

For command control and communications is the OA-4M, a twin-seated A-4 with room for a "TAC(A)/FAC(A) combination (an airborne tactical air controller to direct aircraft and an airborne forward controller to spot artillery and naval gunfire).

Two other aircraft complete Marine Aviation's fixed-wing communities: the KC-130 can aerial refuel all the aircraft types listed above. Built by Lockheed, the KC-130 is also capable of refueling the Marines' H-53 helicopters while airborne. The tanker can also refuel other aircraft while on the ground. The North American-built OV-10, for its part, performs a FAC(A)/NODS mission—an airborne FAC plus a Night Observation and Detection System used in the direction of artillery and aircraft.

In the "Rotary Community" are the CH-46 Sea Knight troop carrier (Boeing's Vertol Division) that can be armed with two .50-caliber machine guns on swivels for standoff capability during deep thrusts, or M-60s for a higher cyclical rate of fire during close-in operations.

The Sikorsky CH-53 Sea Stallion is a heavy-lift helicopter used to haul artillery and ammunition pallets, among other things. Latest versions have a 32,000-pound payload.

Rounding out the Rotary Community is the Bell UH-1N Huey helicopter used for command and control, and the AH-1T or J Cobra gunships. The "T" is an antitank platform armed with the TOW wire-guided missile. The "J" takes a weapons mix, including rocket launchers on wing stations.

Bearing in mind that, like the other services, Marine Aviation may have aircraft in the pipeline for maintenance or otherwise unavailable, here is a look at the breadth of Leatherneck airpower.

In the fixed-wing community:

Twelve F-4 squadrons, each with twelve aircraft; six A-4 squadrons, each with nineteen aircraft; five A-6 squadrons, each with ten aircraft; three AV-8 squadrons, each with fifteen aircraft; one RF-4 squadron with twenty-one aircraft; one EA-6 squadron with fifteen aircraft; three KC-130 squadrons, each with twelve aircraft; two OV-10 squadrons, each with eighteen aircraft; and two OA-4 squadrons, each with eight aircraft.

The helicopter community:

Fifteen CH-46 squadrons, each with twelve aircraft; eight CH-53 squadrons, each with sixteen aircraft; three UH-1 squadrons, each with twenty-four aircraft; and three AH-1 squadrons, each with twenty-four aircraft.

the complexity of a finex, it does come into play during the initial flying segments of the WTI course. Claim to fame for the Yuma Tactical Aircrew Combat Training System is that it was the first of its kind to become operational among the US military services.

Yuma is also ideally located to take full advantage of the best training ranges in the US.

Air Force Comes to Play

Since the initiation of MAWTS-1 at Yuma in 1978, there has been considerable give and take with the Air Force. For example, almost every tactical combat aircraft in USAF's inventory has participated at one time or another as aggressors in the flying exercises. "Air Force pilots like to fly in such an integrated operation where they come up against a wide assortment of aircraft. It's a golden opportunity for an additional—and rich—training experience," said Col. G. J. Shaver, Jr., with USMC's training staff in Washington.

Another welcome participant when available from a taxing training schedule is the Air Force E-3A Airborne Warning and Control System aircraft. "Supplementing our capability-limited ground radar may very well be Air Force AWACS to give advanced warning of enemy air activities in a real war," commented Capt. J. Troy Turner of the MAWTS-1 staff.

USAF also provided a helping hand to get the WTI course off the ground. "With the emphasis on low-level flying, we searched for materials that might have already been developed elsewhere," said Colonel Butcher. "Not only did the Air National Guard at Davis-Monthan AFB, Ariz., come through with data we could incorporate into our syllabus, but they also provided ground and flight training for our instructor cadre."

And MAWTS-1 access to USAF ranges has not been confined to those at Luke AFB. This past fall, the MAWTS-1 staff, augmented by course graduates well versed in the tactics, took almost fifty Marine Corps aircraft to Nellis AFB, Nev., to conduct an extraordinary flying program there. It constituted a major test of Marine Aviation-developed tactics in an electronic warfare environment.

Two Marine Corps OV-10D Bronco night observation surveillance aircraft bank in formation over the maneuver area. The Bronco was first used by USAF and USMC as forward air control aircraft. The North American-built aircraft carries a wide range of weapons and sensors in the NOS role.

The Marine aviators tested their skills and theories against an assortment of obstacles, including simulated SAMs and communication jamming in the near-laboratory conditions provided by the Nellis ranges, under the electronic warfare/close air support (EW/CAS) program.

Flying at the electronically monitored Nellis ranges during the three-week course "may be the most significant real-time tests of our tactics yet undertaken," said MAWTS-1 staffer Maj. Barry Knutson.

"From the results of the data acquired we will be able to determine what the most effective command and control package is," said Major Knutson. "Another objective was to determine—in a heavily jammed communications environment—how responsive we are in working a tactical air request back through the system in order to put ordnance on the target in timely fashion."

The workout at Nellis, continued Major Knutson, "gave us a feel for which tactics are more survivable and what modifications should be made in such things as our mix of aircraft. We hope to develop a 'menu' for every type of sortie flown."

A similar joint Air Force and Army endeavor has also taken place at Nellis.

Another cooperative USAF/USMC venture concerns the scheduled replacement, beginning this year, of Marine mobile radar units with an upgraded system. The Marines will be getting a modified AN/TPB-1, a system that already equips Air Force tactical air control units. In preparation, MAWTS-1 air and ground staffers have traveled to USAF installations to receive tutoring in the system's operation for test and evaluation purposes.

For its part, MAC is hoping to continue to send Aerospace Rescue and Recovery Service aircrews to the WTI course. These may well become the cadre of a new school—the Rescue Advanced Tactics School (RATS)—that the Rescue Service is hoping to establish. It, too, would be a six-week course, with three weeks of academics at Kirtland AFB, N. M., followed by three weeks of flying at Nellis. To a substantial degree, the syllabus would incorporate WTI course materials.

USMC: Light Infantry

Unlike most Army ground units, USMC is considered "light infantry," and as such has no organic heavy artillery. The Corps relies on its Marine Air to deliver a punch that will fill that role.

That is why USMC's tactical air control system is flexed to the fullest extent during the MAWTS-1 WTI course, and why Colonel Butcher's use of the phrase "standardized training" in describing the MAWTS-1 mission takes on a fuller meaning.

In many respects, USMC's tac air control system parallels USAF's huge, in-depth apparatus. At the wing level is a Tactical Air *Command* Center that runs the show and also interfaces with the other ser-

vices. Subordinate to it is a Direct Air Support Center that is linked directly to the Marine ground forces to provide timely close air support. The DASC coordinates the tactical air control parties, airborne and ground FACs, the radar teams, and the Redeye/Stinger SAM missiles.

The TACC, with its antiair warfare function, also controls a Tactical Air Operations Center that would interface with Air Force-committed AWACS aircraft and also controls the improved Hawk and smaller SAM missiles. In addition, it controls aircraft in an air-defense role.

That's it in a simplified nutshell, although much more could be said about USMC's tac air control system including that because, under it, Marine is talking to Marine, response time in requests for air support is optimum, Marines believe.

"The WTI graduates go back to the Fleet Marine Forces thoroughly versed in USMC C^3 to conduct training programs that diagram the threat, the interrelationships within the Marine Air command and control system, and the interoperability with the sister services," said Captain Turner. "We take field trips to the 607th Tactical Control Training Squadron at Luke to learn about Air Force C^3 and its interface with the Army. We also visit Navy facilities to explore the USMC/Navy interface."

Explained Captain Turner, "During the WTI's integrated exercises and finex, the students manage assets through a Tactical Air Command Center with simulated interface with adjacent commands." Stressed here is that aircraft are controlled through "time-sequence tracking" out and back through a series of control points spread over the area of operations.

According to Captain Turner, "During WTI, communications interfaces between AWACS and the Marine airborne Direct Air Support Center are being looked at as an aid to more positive control, protection of strike aircraft and helicopters, and early warning to the ground element of enemy attacks. This type of coordination may develop along the lines of AWACS/ABCCC."

Added Captain Turner, "Further interface and coordination must be researched to enhance US forces' C^3 capabilities to operate autonomously but still interface when fighting in adjacent areas and possibly utilize common assets."

Under the Marine Aviation training system, the WTI graduate instructors return to their own units equipped with "Take Home Packages" of course materials that can be used as texts in their own instructional efforts.

Air Force graduates (a number don't "graduate" but do attend the academic/intelligence segment of the WTI) have the option of a Take Home Package of just the material they believe will prove useful once home.

Marine Aviation training is tailored to its resources, and the Marines are not afforded the luxury of deploying an entire squadron to MAWTS-1 in Yuma for the advanced training. Once at home, the graduate instructor will undertake to qualify other individual unit pilots.

WTIs returning to home units following graduation from the course at Yuma are guaranteed a minimum of a one-year tour.

MAWTS-1 staffers are on the road about fifty percent of the time, either touching base with their contacts in the intelligence community for information updates or visiting units in their particular community as a check on the performance of the graduate instructors. There, they actually operate with "students" to "certify" them as to proficiency in advanced training. Marine Aviation is a small community, by Air Force standards. Not unlike the pre-war US Army, it is small enough so that "everyone knows everyone else"—more or less. During these periodic visits to the units, MAWTS-1 staffers get a reading on those who would make likely candidates for the instructor or student slots at Yuma.

Since MAWTS-1 has no aircraft, its instructor visits to operational and Reserve units neatly dovetail with keeping the instructors up to the mark in flying proficiency since the units are required to provide flight time for them.

A USMC KC-130R aerial tanker refuels a Marine F-4J Phantom. The F-4J carries more internal fuel than the F-4B in USMC service, as well as advanced radar and fire-control avionics.

Normally, the visits are in conjunction with the supplementary instructor certification or other training support needs, but the goal is to visit each unit once per quarter.

As an adjunct to MAWTS-1-inspired advanced combat flight training, 3,834 lessons and 150,000 35-mm slides have been distributed to 104 units throughout USMC's Aviation community. To save WTI's time in preparing for and conducting lectures, an effort is now under way to convert presentations to videotape.

Another MAWTS-1 manner of keeping the troops informed is its annual Marine Corps Aviation Weapons and Tactics Newsletter. Supplementary issues are published as the need arises.

Other time is spent planning the upcoming WTI, initiated about four months before the event. All elements of Marine Aviation, ground or air, contribute to the planning sessions and are urged to make recommendations regarding procedures or course materials. ■

Computer-Generatec
The Cost o

USAF is the simulator industry's best and most demanding customer. In pushing the computer-generated imagery (CGI) industry to the limits, it achieved sophistication at a cost that is proving burdensome. The lessons learned may mean that tomorrow's CGI systems will be simpler, yet as effective.

BY GEORGE C. LARSON

EFFECTIVENESS is the measure of success in any training program, including those using simulators. But to measure effectiveness with a scale of values convenient to use and both fair and equitable to the customer and the simulator manufacturer alike is a problem.

Past attempts to measure effectiveness using the number of flight hours saved ran into trouble when the definitions of "hours" and "saved" became elusive because of the nature of simulation training and the ways in which it differs from flight training. The characteristics of the simulator alter the training program and obscure the data.

Even "effectiveness," though, becomes a fractionalized concept when a command must evolve a design and a policy for simulator-based training. Effectiveness is directly and proportionally related to the realism produced by the training system in the sense that thc simulator experience must transfer to the ultimate goal of combat effectiveness.

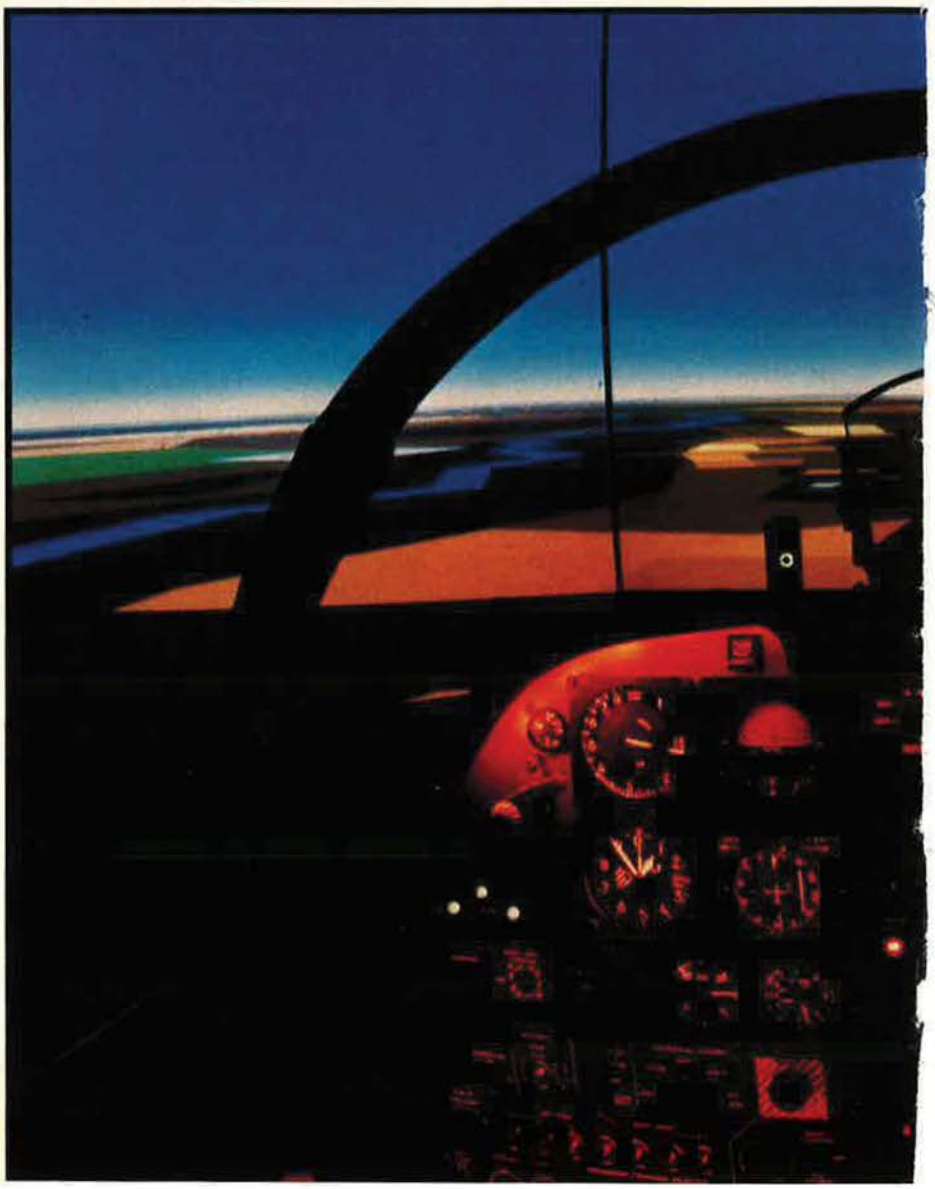
In other words, the ideal simulator would enable a pilot to make his debut in combat feeling he had been there many times before. Obviously, this opens up complex issues that seem likely to be debated eternally with as much heat as they are being debated today.

While the earliest "simulators" were severely restricted devices that amounted to what would today be described as "part-task trainers," the goal of today's simulator designer and user is nothing less than a total substitution of the real-world environment. The drive for realism has been closely coupled to advances in electronics, particularly digital computers.

The expansion of realism in simulation has also driven costs to a point where they are presently the central concern of both manufacturer and customer. Effectiveness, after all, is also measured in terms of accessibility, a parameter in direct conflict with the realism-cost relationship. It does the Air Force little good to own the world's most realistic and sophisticated simulator if there are not enough of them to provide all of its crews with sufficiently frequent access.

Start-up to Shutdown

At present, the development of flight simulator training devices for the Air Force concentrates heavily



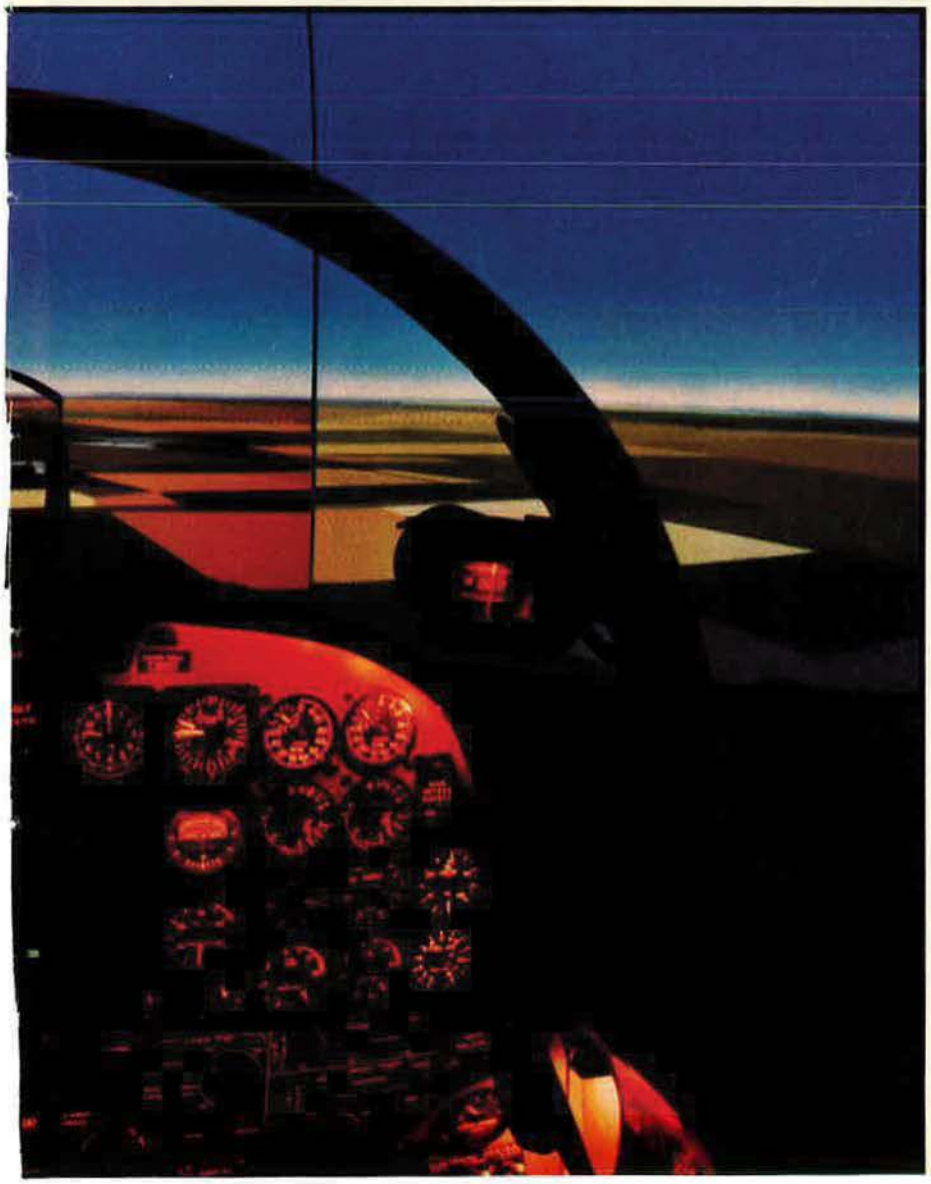
mages for Simulators: Technology

upon very high-realism, full-mission systems. The B-52 mission crew trainer is illustrative of one weapon system's minimum requirement for a training device. It is capable of operating as a trainer for individual crew stations as well as providing a complete crew with the opportunity to improve total crew coordination by training as a unit. Its sophistication allows it to duplicate every aircraft function from start-up to park and shutdown.

Fighter and ground-attack trainers, while configured around only a single seat, represent an even higher state of the art in simulator development. At the upper end of the spectrum is General Electric's F-5 Mission Simulator, available with a two-cockpit configuration that allows each pilot his own unique perspective of the visual scene; in this way, formation flying cues and even air combat skills can be developed with close instructor supervision, complete with such features as "freeze" and "replay." Actual weapon dynamics are faithfully reproduced through the aerodynamics loop to generate the real effect upon the airplane (weight and drag changes, for example) as well as duplicating ballistic performance.

Even simulators with restricted functions, such as navigation and bombing radar operator trainers, utilize the digital computer's immense data base capacity and high-speed processing to reproduce with startling fidelity such effects as "far shore brightening" over terrain models based upon actual Defense Mapping Agency data, thereby allowing crews to train in the "real world," but with all the advantages of a ground-based simulator.

But while the Air Force exploits to the maximum the distant boundaries of the most high-powered technology available, new approaches to simulation, emphasizing the lower-cost end in an effort to increase accessibility through greater numbers of trainers, are opening up opportunities at the opposite end of the spectrum. (Interestingly, at the recent Third Interservice/Industry Training Equipment Conference and Exhibition at Orlando, Fla., an arcade of $4,000-per-unit video games in the hotel lobby offered some disturbing comparisons to the million-dollar hard- and software on the exhibit floor. One tank warfare game called *Battlezone* has already been modified for training use by the US Army at Fort Eustis, Va. With its targets altered to mimic Warsaw Pact silhouettes, the game essentially duplicates a tank gunner's task, complete with vehicle motion and terrain barriers.)



The pilot's view from the General Electric F-5 Mission Simulator indicates that the aircraft is on its final approach before touchdown.

At minimum, computer-based trainers are capable of programmed instruction. An example of such a device was presented at I/ITEC by members of the 4235th Strategic Training Squadron in the form of a celestial navigation trainer based on an off-the-shelf North Star Horizon, a 48K personal computer. The device presents a series of programmed problems in celestial navigation and grades a student on his responses.

But "simulation" implies a greater degree of duplication of the real world, and in examining lower-cost solutions, the requirements of Air Force training and their implied complexity must be kept foremost in mind, lest low cost become an end in itself that blinds us to the real goal: effectiveness. It seems clear that no simulator at the level of sophistication of a video game will provide stand-alone training for a task as complex as, say, ground-attack weapons delivery.

Simulator Foundations

The architecture of the modern simulator is based on the following building blocks:

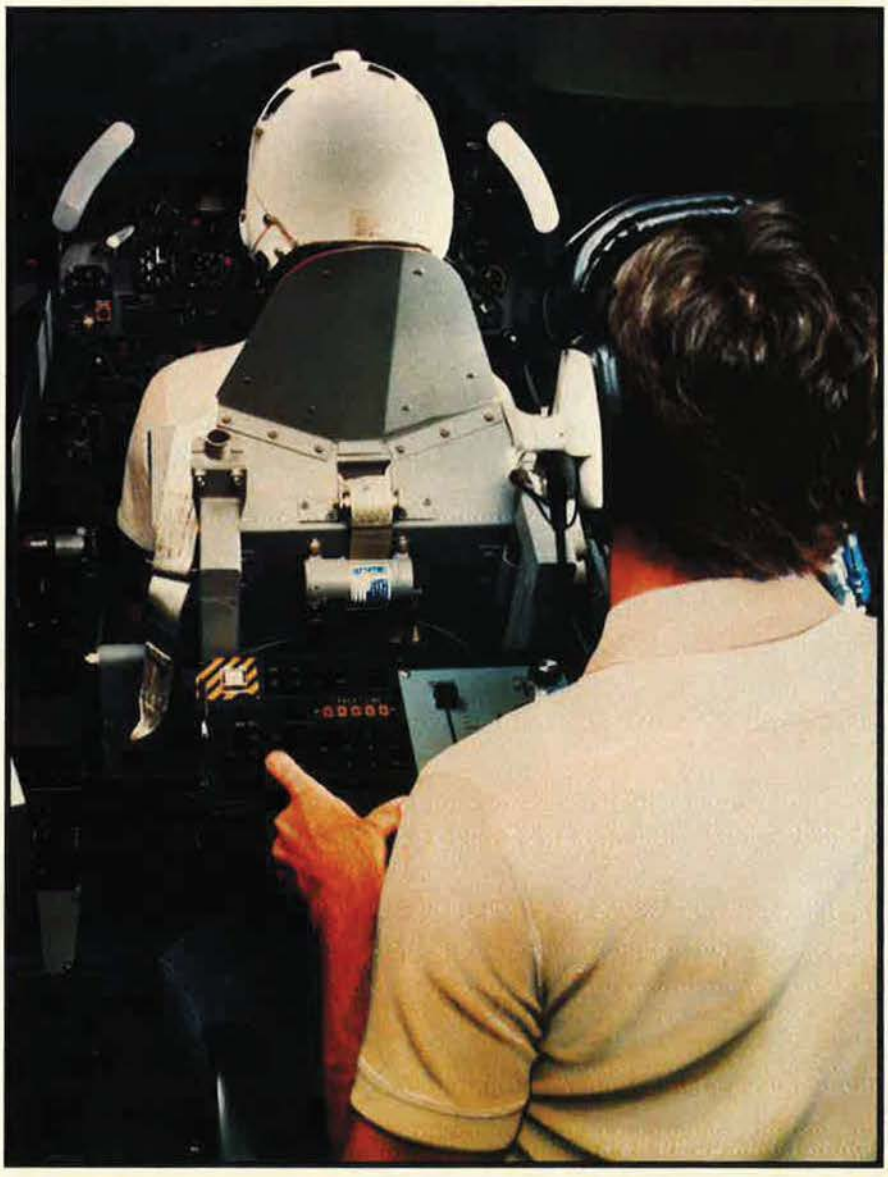
- A realistic cockpit or other crew station environment and its allied support equipment to provide motion, ventilation, power, etc.
- An instructor's station with supporting equipment to provide control over the training task as well as recording results.
- A data base for storage of simulator dynamics and a general-purpose computer to translate the data base into appropriate real-time responses to pilot inputs.
- A visual system to display the scene a crew member might expect to find in an actual aircraft under infinitely variable conditions.

While we list the visual system last, it is by no means the least important element. Where early simulator-based training placed a high premium on "realism" through the duplication of motion in an otherwise blind environment, the evolution of modern simulator technology has been written in the increasing importance of visual imaging, to a point where the visual display is now the dominant element in any simulator system and full motion functions are beginning to disappear as their cost is displaced by the visual system.

In a recent Vanguard analysis performed by USAF, visual systems were established clearly as the No. 1 priority for future development. Interestingly, some of the most advanced simulators, such as General Electric's F-5E system for Thailand, delete motion entirely based on the perception that *acceleration* cues through G seats and cushions are more useful; but their visual systems are the most advanced available for their cost.

Visual systems now represent sixty percent of the cost of a complete simulator. Clearly, the visual display has become the tail that wags the dog, and manufacturers of such displays are moving rapidly to the fore as the prime movers in development and procurement of future simulators. But how should that development proceed so as to optimize the bottom line—effectiveness—in simulator training? Since training effectiveness must be measured in numbers of crew members trained as well as in training realism and ultimately transfer to actual combat effectiveness, sophistication must be coupled with producibility and low cost.

In examining the vast gulf between the $4,000 video game mini-simulator and the multimillion-dollar full-mission crew trainer that can cost many times the price of the airplane it duplicates, it seems obvious that some unexplored terri-



View from behind the student pilot and an instructor at his station in the General Electric F-5 Mission Simulator.

tory exists. And since visual displays will continue to enjoy a growing role as the pivotal elements in a simulator trainer, it is worthwhile to examine these systems and their potential for providing improved realism, thereby yielding increased training effectiveness, but at lower cost.

Mechanical Limitations

The first visual systems used motion picture or still film images, which responded crudely to pitch and roll inputs. That era lasted for about five years and soon gave way to moving-map gaming areas, at first revolving drums, then later very large flat model boards transmitted by video camera for projection to the cockpit. The model boards had obvious mechanical limitations despite generally favorable fidelity to the real world; the detail in their display was limited only by the dexterity of the model builder. The use of aircraft models is a simpler form of the same concept and has enjoyed considerable success in such tasks as aerial refueling training. The model-board era lasted from approximately 1955 through 1975, when the computer-generated image (CGI) was introduced.

The first flight simulator to use a digital computer as the source for images for a visual display was built by General Electric in 1958. It provided a kind of patchwork terrain that moved in response to the pilot's inputs. In 1962, the firm responded to a NASA request for a docking-maneuver trainer for the first orbital rendezvous missions; that system established the current geometric model for digital computer-based imaging systems, called "edge-generated" systems.

Computer-generated imagery is, therefore, a fairly new art, and since it has risen to dominate simulation systems overall, the art of *simulation itself* is in a state of metamorphosis at the end of which things are expected to be vastly different from the way they are today; hence, our statement that simulation—by today's definition—is a new technology.

In an edge-generated system, the visual scene is stored as a series of numerical expressions that describe each edge of a terrain feature or cultural object in relation to the origin of a three-axis geometric model. This *numeric modeling* is currently the only way to translate the geometries of complex shapes into a language the computer can understand. The edges are connected to form surfaces or *faces*. If color is available, a shade or hue can be assigned to each individual face. In this way, a hypothetical "terrain" can be drawn and stored in a data base dedicated to the visual system. (This data base should not be confused with that dedicated to the simulator's aerodynamics program, which contains the equations of motion for the aircraft being duplicated.)

Further, if a digitized data base is available from such sources as synthetic aperture radar maps, vast areas of real terrain may be modeled and written into a form usable by the visual system in the simulator. In this way, DMA data has been utilized successfully to provide terrain models.

If Air Force missions involved only high-altitude flight, the visual system could easily accommodate those training requirements; of course, the Air Force mission involves considerably more than that and the training requirements drive simulators to adapt to more difficult chores. Low-level flight imposes a considerably more complex chore on the CGI system because of the required detail in the image.

One complaint about CGI images in general is a kind of "cartoon" quality that is distracting in its lack of realism and therefore deleterious to training effectiveness. The "cartoon" quality is inherent in the edge-generated system, of course, because each image is described by a series of straight lines.

Fighter and ground-attack aircraft alike provide the pilot with a virtually unlimited field of view in a surrounding hemisphere atop the aircraft. The most advanced flight simulators that duplicate these aircraft have thus been driven to offer a similar field of view, generally through the use of spherical environments on which images are projected, or, in the case of the Advanced Simulator for Pilot Training at Williams AFB, Ariz., around which are mounted very large (thirty-six-inch, the largest built to date) cathode-ray tubes and associated optical systems.

But it has been said that if the instantaneous field of view before a human were entirely translated into data, it would take at least fifty

Realistic simulation in a B-52 WST cockpit with digital-image generated aircraft underbody during aerial refueling scenario.

hours to read the printout word for word. So the challenge of offering increasing areas of visual images and increasing detail in those images is monumental. Still, USAF argues persuasively that in order to provide realism and effectiveness in its training for the low-level mission, the subtle cues inherent in such visual characteristics as "texture" are absolutely critical for a simulator's visual system.

"Leaves on Trees"

This drive for ever-increasing detail in the scene—what one manufacturer describes as "the leaves on the trees"—can be realized in only one way given an edge-generated CGI system: increase the number of edges. This drive expressed itself in an experience that USAF and the industry shared in the late 1970s when both parties explored the outer limits of their capabilities in a trend that has become known as "The Edge War."

In brief, it was an era during which the seemingly infinite capacity of a CGI system was found to be not so infinite without an infinite budget to match. General Electric's Robert Witsil characterizes the era as one in which the developers simply responded to the user, increasing costs in an effort to satisfy him. The result, of course, was the $50 million visual system on a $20 million simulator. Typical of this category is the C-130 low-level mission trainer and the developmental visual systems for the A-10/F-15/F-16 (Project 2360). Witzil characterized 1978 as the watershed year for CGI: "It was an exceptional year for orders and a terrible year for delivery."

If you want detail in your visual scene, of course, each "leaf on the tree" must be described as a series of edges. Assuming you could build a data base sufficiently large to store, say, a C-130 low-level mission gaming area of many thousands of square miles, with enough through-put edge capacity to produce an image that literally gave the crew each leaf, you will end up processing an information base the size of a public library about thirty times each second (in order to avoid flickering and image delay). If it is not obvious by now, both the Air Force and the CGI industry explored that outer limit and have since backed away to look for alternatives.

Present CGI systems can theoretically handle 8,000 edges, and one Air Force test for acceptance requires the maker literally to display a thousand octagons for compliance with the specifications. (In addition to edges, CGI systems also display point images—light sources at night, for example—and can now generate actual spheres and cylinders without using edge capacity, but edge capacity of a CGI system persists as a figure of merit for system power and level of detail despite considerable debate as to its worth as a measure.)

Edge capacity translates directly into cost. As field of view expands and the requirement for detail expands with it, the number of individual display systems, whether CRTs or light-valve projectors, goes up, also adding to cost. When the number of displays, each with its own channel, increases sufficiently, a second computer must be added. In this fashion, the Air Force suddenly finds itself with a $50 million visual system on its hands. Currently, the CGI industry, notably including General Electric, Singer/Link, Evans and Sutherland, and McDonnell Douglas, is competing actively in an expanding market, and as a spokesman for GE stated, "The competition is creating the alternatives [to the edge war]."

One avenue by which the Air Force can back away from the imposing costs of field/detail complexity is by limiting the field of view and accepting a lower level of display sophistication. In fact, when C-5 aircraft commanders discovered a sudden requirement for aerial refueling training during the airlift in the 1973 Yom Kippur War, a YC-14 cockpit at Boeing, equipped with a KC-707 (a KC-135 variant) image, was pressed into service.

Although that experience seemingly violated most of the premises under which simulator specifications are written these days, namely a complete lack of cockpit and aerodynamic fidelity, restricted field of view, limited gaming area, and a relatively crude CGI, both the command and the aircrews themselves were overwhelmingly favorable in their response, and the results supported them.

This is not to suggest that the right-now, cobbled-up approach will work every time, but in that instance, with more than 450 aircraft commanders trained, it certainly did. Boeing says the program has led to the idea of a generic aerial refueling trainer at low cost. Boeing Aerospace's Dr. Tom Sitterley characterized the system as a "step backward. . . . Five years of use shows that its effectiveness was not related to technology. Effectiveness of training may be what defines the 'state of the art' and not the technology of the device."

Edge Capacity

One likely avenue by which the desired level of detail can be achieved without generating overwhelming requirements for edge capacity is through use of new imaging techniques that show great potential, the foremost among them being *texturing*. Texturing is a technique by which regular patterns can be generated entirely independent of the edge capacity of the CGI computer, then assigned to individual surfaces. General Electric has demonstrated a texturing technique that mimics characteristics of such common terrain categories as desert or swampland, then attaches these textures to the proper areas.

One prototype graphic that would be applied to a low-level C-130 trainer shows a drop zone based on real map data and complete with textures characteristic of forested areas and mowed grassland. Although no one at GE is claiming that the texturing technique provides the leaves on the trees, it may represent the best cost-compromise solution while retaining the *functional* goal of the Air Force requirement for low-level training that pilots can accept.

George C. Larson is Technical Editor of Business & Commercial Aviation *Magazine. He was a member of the editorial staff of* FLYING *Magazine for six years. His book,* Fly on Instruments, *published in 1980 by Doubleday & Co., won an Aviation/Space Writers Association award for excellence. He is a commercial, multiengine, and instrument-rated pilot. He has a book on avionics in progress for Doubleday.*

Another avenue that will require considerably more research than has been accomplished to date is to divide a display into two functional parts:

- The area of interest: a limited field that would follow the pilot's eye movement and offer the highest attainable level of detail.
- The instantaneous field of view: a larger field that would also follow eye movement but represent the area outside his center of focus and offer markedly reduced detail.

This technique would reduce the waste of detail where the pilot isn't looking, thereby reducing the demand upon scene content capacity and the image generator. So far, a lag in the eye-following system has been an obstacle to an acceptable visual display, but the effort continues. Other solutions involve the restriction of the actual display to the size of a set of goggles or a faceplate, with fiber bundles or lasers as the imagers. Other alternatives include an acceptance of field of view limited to about 120 degrees horizontally for an aerial combat trainer.

The equipment likely to fill the middle-cost area is typified by the 2,000- to 4,000-edge systems presently in use. Such visual systems today cost about $3 to $5 million and represent only ten percent of the cost of the simulator system, as opposed to the sixty percent in the most sophisticated CGIs. In terms of technology and the industry's "comfort" with these devices, they can be considered mature, in use today, deliverable, and supportable with a high degree of confidence. But can they be accepted, and will the Air Force be able to "make do" with what's available?

Sophisticated Customer

As a buyer of simulator-related technology, USAF is the most sophisticated customer the industry encounters. The Air Force virtually invented simulation and has maintained its expertise as the technology has expanded. Now that both USAF and its suppliers have experimented with the upper limit of the cost envelope, additional understanding has led to identification of cost factors:

- Documentation, originally a necessity for software control, can be modified; it is considered a major cost item that can, for example, double the cost of a full-mission simulator.
- Acceptance procedures, more intricate for USAF than for international customers (one of whom recently accepted a system after only five days of evaluation) is a major pacing item.
- Data base growth, now threatening to rise up as the driver toward higher cost, must be controlled; engineering time mounts up rapidly as gaming areas expand.
- Functional specifications rather than detailed specs might allow industry more leeway in innovating solutions that will provide the desired level of effectiveness but at lower cost.
- USAF can increase its expertise in effectiveness to a level equal to its expertise in technology through research in perception and skill measurement.

Cost considerations are beginning to open doors. Part-task trainers are gaining acceptance; an example is TAC's GBU-15 trainer. The meaning of "realism" is being altered subtly by the realities of technology. One final example that may be illustrative of what the future holds was narrated by Dr. Robert T. Hennessy of the National Research Council in a recent paper. Citing a carrier-landing simulation system that ran up against pilot rejection because of image contrast problems, Hennessy described the solution: "[The answer] was to make the landing area white, [distort the size] of the FLOLS (the optical landing system), and portray the ocean surface with black and white checkers . . . it was the *departure from realism* that made this visual scene acceptable to pilots and presumably effective for training." (Emphasis added.)

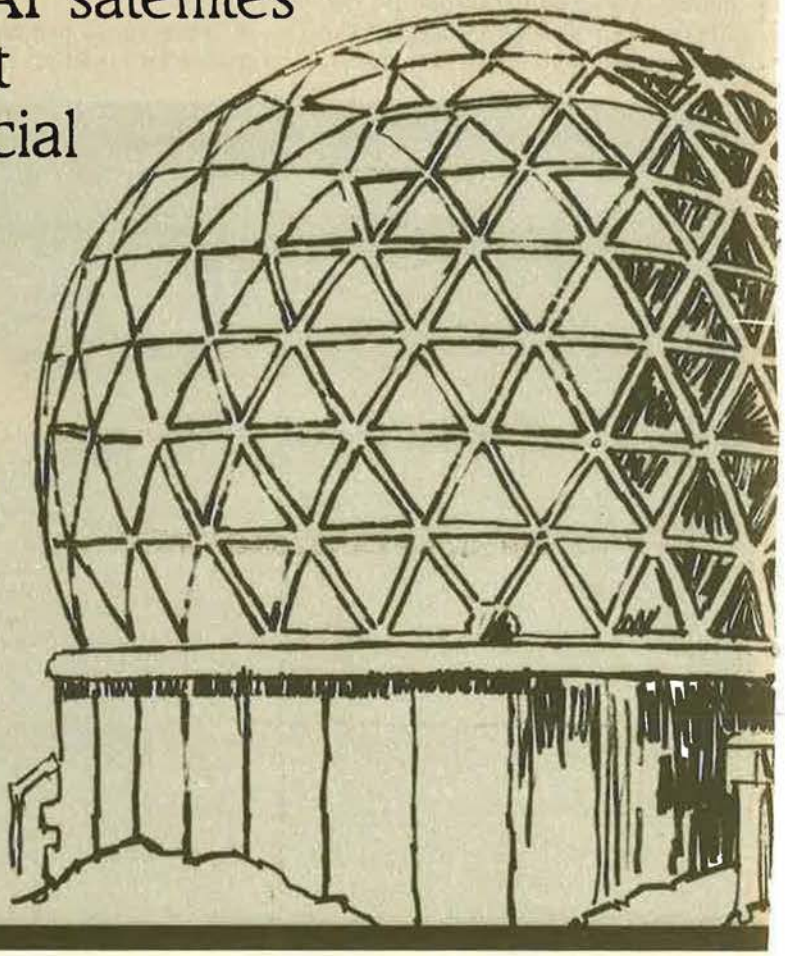
Forcing the computer to reproduce images of photographic clarity and detail has been proven to be expensive when the image size increases. In backing away from those costs, a renewed effort to understand how we acquire skill through training may provide new ways to exploit the mid-cost CGI, eliminate the technology chase, and get effective simulators on line now. Improved readiness is the ultimate payoff. ■

An F-15 pilot and his wingman pursue simulated enemy projected on the interior dome of this Manned Air Combat Simulator at McDonnell Douglas Corp.

Our track record is out of this world.

We're Ford Aerospace. The company that accomplishes things. Impressive things in Telecommunications, Defense, and Space Mission Support.

Our track record in satellite communications began almost twenty-five years ago. In that time, we've built 65 satellites, and our total in-orbit performance exceeds 200 years. Today, our INTELSAT satellites are the world's most advanced commercial communications satellites.



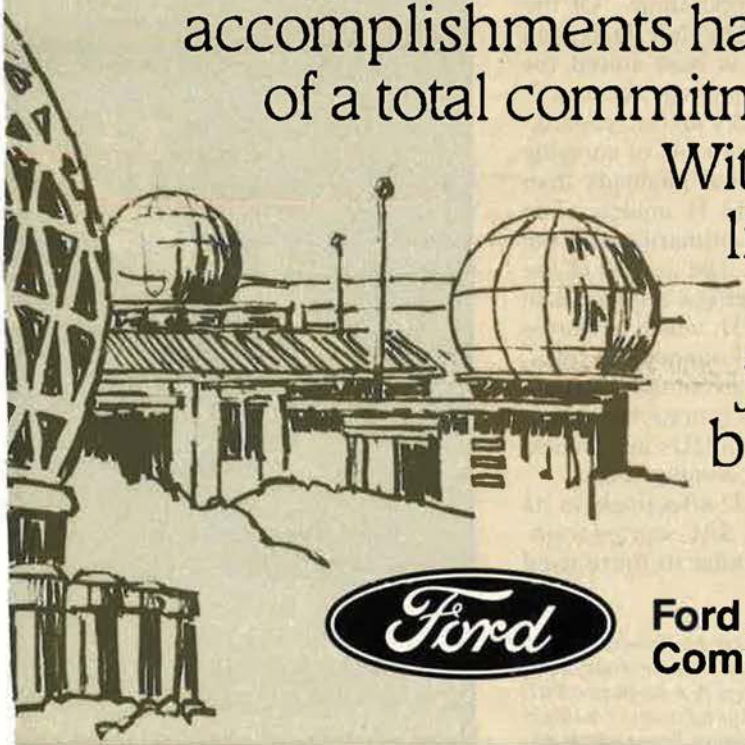
In 1957, we helped design and develop the world's first major space-craft tracking network. We still support that network –

now the USAF Satellite Control Facility. And since 1965, we've provided primary system support to NORAD's Cheyenne Mountain Space Defense Facility.

Our track record in manned Space Mission Support began back in 1963. Since then, Ford Aerospace has served as a prime contractor for engineering and support services for every manned space flight from Gemini 4 to the recent flight of the Space Shuttle.

Meeting future challenges successfully depends on more than just past experience. For over a quarter-century, Ford Aerospace accomplishments have been the result of a total commitment to succeed.

With a track record like ours, any less of a commitment just wouldn't be on-track.



Ford

Ford Aerospace & Communications Corporation.

Realistic, mission-oriented training keeps SAC aircrews and supporting elements ready to keep the peace, both in nuclear and nonnuclear roles assigned to the command.

SAC Trains the Way It Would Fight

BY MAJ. BRUCE EICKHOFF, USAF

STRATEGIC Air Command has made sweeping changes in its training philosophy during the past few years. Particularly affected are the crews of the aging B-52. In an increasingly complex battlefield environment, these crews face far more potential challenges to their airmanship and professional expertise than their predecessors faced in the mid-1970s.

To meet these challenges, SAC emphasizes more realistic training at all levels of command. Maj. Gen. Andrew Pringle, Jr., SAC's Chief of Staff, describes the new training philosophy: "Some believe more and better equipment is all that is needed to have an effective fighting force. Often overlooked is the key element of a fighting force—the individual who operates the equipment. The individual must be able to extract the full capability of the machine in order to beat the enemy in his machine. This is why we train hard, why we train often, and why we train the way we will fight."

Parallel with the evolution of the new training philosophy, SAC has given top priority to significant technological improvements in the B-52. The offensive avionics sytem, for example, will increase the accuracy and reliability of the bombing/navigation system. Integration of the cruise missile will enhance B-52G survivability and flexibility. But the ultimate effectiveness of these improvements will depend heavily on the ability of the crews to operate the system in combat.

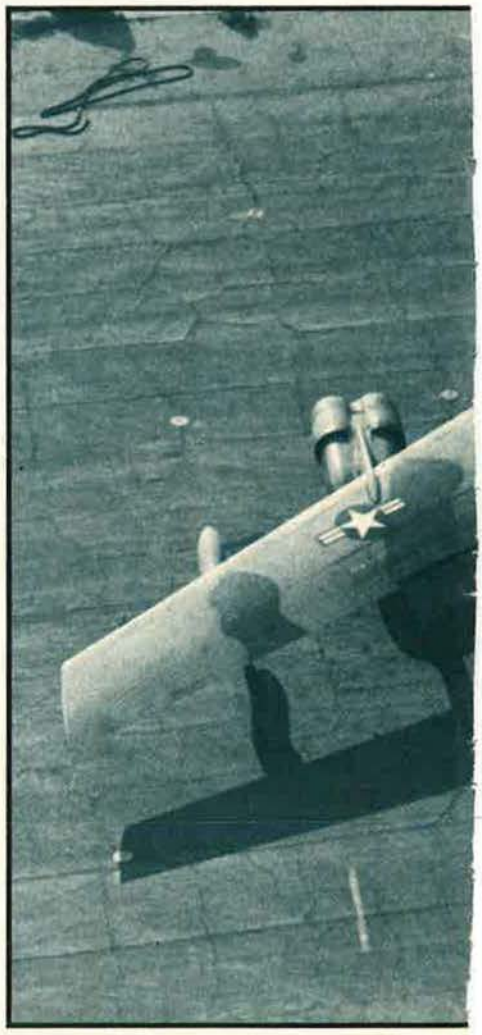
On the other hand, emphasis on readiness has been timely because the modernization effort will not be completed until the mid-1980s. And rapid Soviet modernization of defensive weaponry against the B-52's antiquated technology simply does not justify the luxury of conservative training techniques. A review of today's training innovations and future initiatives should comfort the skeptics about the effectiveness of the "old BUFF."

Exercising Contingency Missions

The B-52 was originally designed as a high-altitude delivery platform for nuclear weapons, but it has been proven in several nonnuclear applications, particularly in delivering massive conventional firepower during the Vietnam War. After the war, SAC sought to rebuild its nuclear capability and refocused B-52 training almost entirely on the traditional nuclear role. In the past several years, however, it has again taken advantage of the B-52's versatility by including both nuclear and nonnuclear roles in its wartime mission.

B-52Ds are used most frequently for nonnuclear operations. Of the three active B-52 models (D, G, and H), the B-52D is best suited for conventional bombing because it has external racks and a reconfigured bomb bay capable of carrying larger conventional payloads than the newer G and H models. The B-52G is tasked primarily with the nuclear mission. The newest of the B-52s ("new" being a relative term here) is the B-52H, which performs both nuclear and nonnuclear roles. The B-52H will eventually assume the command's nonnuclear commitment as the B-52Ds are phased out of service in coming years.

To use the B-52 effectively in its nonnuclear role, SAC started training programs similar to those used by Tactical Air Forces to test capability in actual theaters of potential conflict. One such program is Busy Brewer, which normally involves three to five B-52s deploying to the UK to support NATO exercises throughout Allied Command Europe. These two- to five-week deployments, which are conducted several times per year, provide units' staffs and aircrews the opportunity to plan, brief, and execute B-52 conventional exercise missions from forward operating bases in the UK.



A B-52H of the 57th Air Division on the ramp at Biggs Army Air Field, Tex., during Busy Prairie II, a no-notice SAC exercise designed to test Strategic Projection Force elements.

In addition, B-52s regularly participate in Pacific theater exercises. For example, in Team Spirit, in support of Combined Forces Command, Korea, several B-52D crews from CONUS joined crews from the 43d Strategic Wing on Guam. Flight profiles used allowed the practice of nonnuclear tactics that would help sustain contingency operations in the Pacific area.

Recent creation of the Strategic Projection Force (*see January '81 issue, p. 26*) expanded SAC's role in any worldwide contingency—to support the Rapid Deployment Joint Task Force by employing airpower over great distances on short notice. Two B-52H wings of the 57th Air Division at Minot and Grand Forks AFBs, N. D., are assigned this mission in addition to their primary nuclear mission. SAC selected the B-52H for this role because of its long range and updated penetration capabilities.

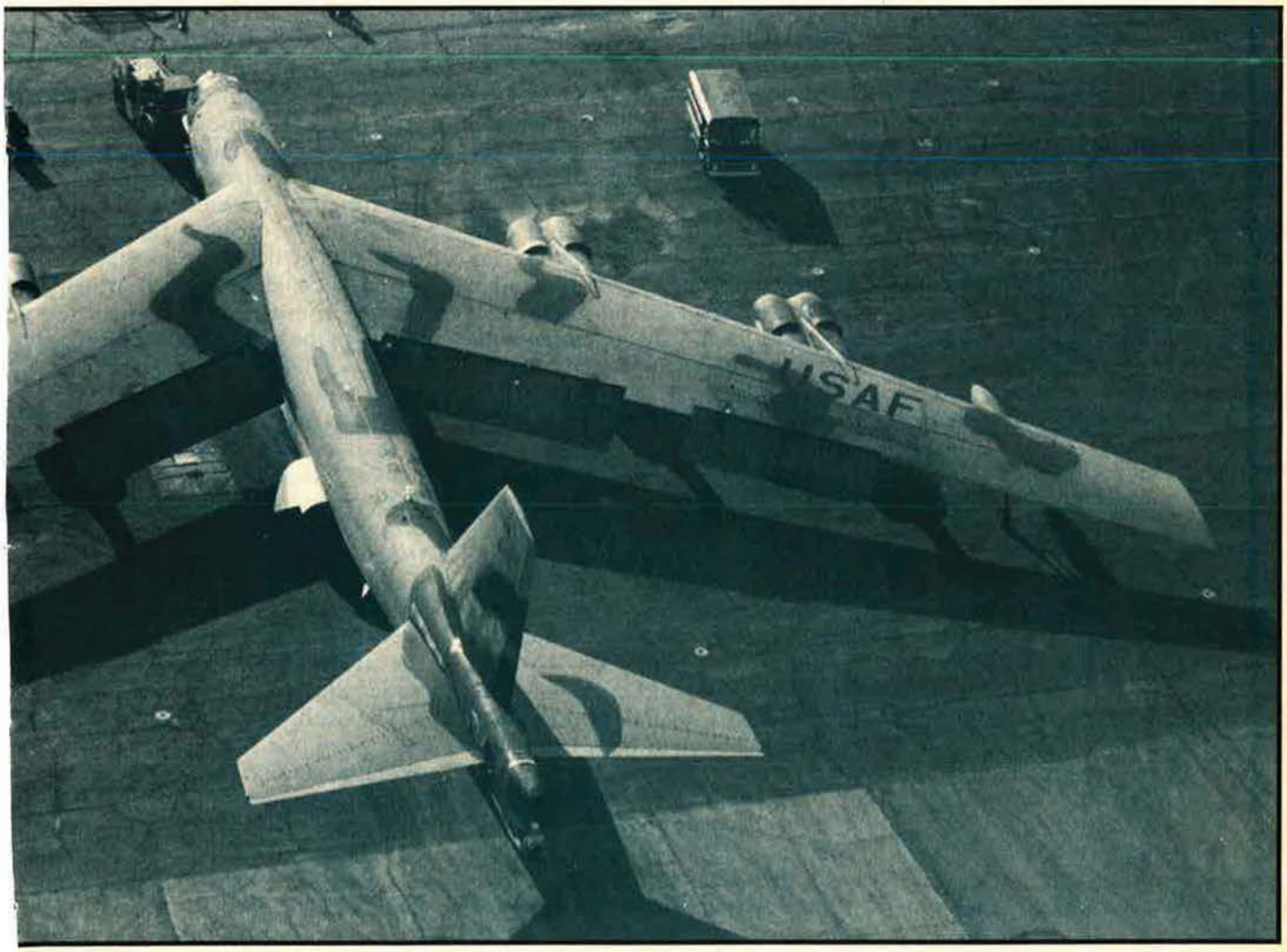
The Strategic Projection Force capability was displayed for the whole world during November's Exercise Bright Star in Egypt, when six B-52Hs of the SPF flew nonstop from North Dakota to the Western Desert of Egypt. After entering Egyptian airspace, the crews practiced low-level tactics and ECM against Egyptian fighters. Upon reaching the target, the B-52s dropped their conventional bomb loads and returned nonstop to home base, thus successfully completing a thirty-two-hour mission with five aerial refuelings. The 55th Strategic Reconnaissance Wing also played a key role in Bright Star, by providing an EC-135 to the RDJTF commander for command control and communications support.

To prepare the SPF units for this mission, SAC initiated a no-notice exercise, Busy Prairie, in late September 1980. In the exercise, Minot deployed its B-52Hs to a forward operating base at Whiteman AFB, Mo.; forward operations were simulated at Grand Forks AFB. Mobility teams were quick to establish a "bare-bones" support base at Whiteman. Support crews subsequently launched sixty-eight sorties in three nights. The objective was to attack three simulated airfields on the Red Flag range near Nellis AFB, Nev. The crews used low-altitude penetration to bomb targets while under simulated attack by various ground threats and aggressor aircraft.

The short-notice nature of these exercises places great demands on both aircrews and support personnel, because SAC's nuclear alert commitment has not diminished and its resources have not been substantially increased. Obviously, the new training also requires dedicated staffs and maintenance personnel.

Frequent Training Improves Tactics

Following the Vietnam War, SAC entered a period of severe constraints on B-52 training. First, guidelines for conserving aviation



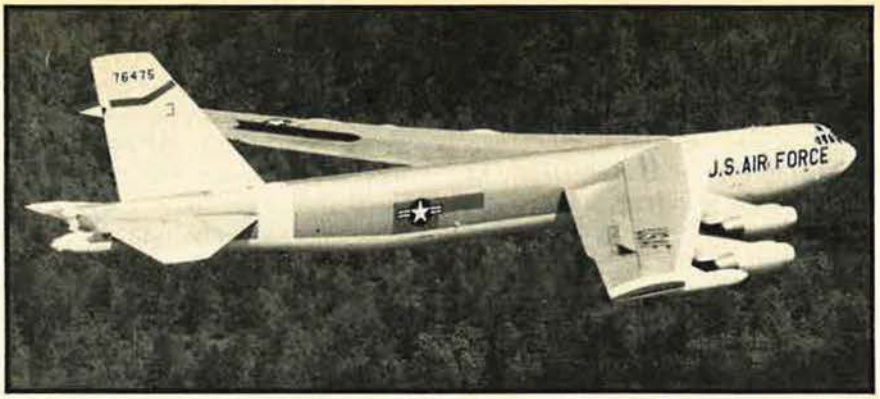
fuel forced marked reductions in flying. This policy was particularly significant to SAC because the eight-engine B-52 is the largest consumer of fuel in the Air Force inventory. Second, the war's end left large overages of rated officers requiring flight training.

In response, SAC experimented with alternate methods of conducting B-52 training. Earlier training was conducted by formed crews without considering proficiency differences among the six members. This resulted in some inefficiency because "older heads" generally needed less training than the less-experienced. Thus, in 1975, SAC implemented a concept that emphasized an even flow of training using multiple proficiency levels for B-52 aircrew members. The concept, however, proved very difficult and cumbersome to manage.

In July 1976, SAC returned to training aimed at meeting the needs of crews as units. Unit commanders were given the flexibility to allocate scarce training resources to less-experienced crews while maintaining the experienced crews at acceptable proficiency levels. Although the concept improved training flexibility, another scheduling problem remained.

This stemmed from the tendency to conduct small numbers of long missions, about three per month. This program requires a longer interval between flights than desired and diluted overall quality of the aircrews. To alleviate the problem, SAC investigated increasing the average number of flights per crew from nine to twelve in a calendar quarter. Although flights would be shorter, crews would concentrate on key training, such as low-altitude penetration and weapon delivery. The program would provide more frequent flights and allow greater flexibility in apportioning sorties to crews needing them.

Since additional maintenance capability was lacking, SAC headquarters devised a procedure for reducing the impact of increased sorties: Supervisors would pick the better of two aircraft launched early in the day for a subsequent sortie, with the initial crew briefing the second crew on aircraft status while minimum maintenance was performed.



Low-level penetration is a way of life for SAC aircrews and their B-52 bombers. Here a B-52G streaks over the trees on a low-level training exercise typical of flights performed day and night as part of SAC's realistic training.

Successful Tests

Following tests at Fairchild AFB, Wash., and Griffiss AFB, N.Y., between September 1978 and February 1979, each reported increased crew coordination and low-level bombing and navigation proficiency. Crews found the shorter sorties less fatiguing, and proficiency improved because of more frequent repetition of tasks. This success led SAC to implement the concept command-wide.

Another important change has provided greater diversity in low-altitude routing. Schedulers traditionally chose routes as near as possible to their bases to reduce transit flying time. This deprived crews of essential experience with diverse targets because they attacked the same targets time after time. SAC resolved this problem by "pairing" B-52 units to increase diversity. For example, Blytheville AFB, Ark., and Fairchild AFB, Wash., might be "paired." Each calendar quarter, crews from the "paired" bases fly a low-level route near the other's base. The sorties end at the "paired" base to eliminate transit time returning home. Subsequently, the crews fly a return mission, again over an unfamiliar low-level route to home station. In addition to the "first-look" benefits such flights provide, crews have the opportunity to operate with staffs of different units and from unfamiliar airfields.

Although diversity and increased training have improved proficiency, SAC requires crews to "train the way they will fight." It has structured training to simulate the combat environment within safety bounds. This requires practicing combat tactics in training exercises, daily operations, and operational readiness inspections.

Realistic Combat Training

Perhaps the best-known training exercise is TAC's Red Flag, held at a military test range near Nellis AFB, Nev. B-52 crews have participated regularly in Red Flag since 1976.

At Red Flag, the B-52 crews practice defensive tactics under simulated combat conditions, as do TAC crews. For example, they frequently deal with threats from TAC's "aggressor" aircraft by initiating appropriate defensive actions. Additionally, ground threats are simulated by the range's surface-to-air missile and antiaircraft artillery radars. These realistically test the ability of the crews to react correctly and positively in the bomber's defense.

The exercises also enable crews to practice navigation and weapon-delivery tactics at low altitudes. B-52 crews flying at Red Flag can operate over rugged terrain at altitudes necessary to penetrate the simulated threats. The payoff is the improved coordination within the crew that results from reacting to the stresses of this demanding environment.

The Red Flag experience has been such that SAC is now participating in Maple Flag, a similar exercise in northern Canada. In this, B-52 crews fly over vast, unpopulated areas covered with thousands of lakes, geographic features that don't exist in the US. Maple Flag also provides for tactical forces to

practice air intercepts against the penetrating B-52s.

A third exercise, related to the nuclear mission, is Global Shield, which involves SAC's entire force of reconnaissance, tanker, and bomber aircraft, as well as its support and staff organizations. Conducted in the summers of 1979 and 1980 and in January 1981, Global Shield simulates the emergency war order (EWO) mission from early preparation through execution. Global Shield '81 also included a contingency exercise for the B-52Ds and Hs. It has been remarkably effective in correcting deficiencies in previously untested plans. After the first exercise in 1979, Gen. R. H. Ellis, then-CINCSAC, commented: "Initial evaluation of the exercise indicates that all of our objectives were achieved. Everyone had an opportunity to gain valuable training in the performance of our EWO mission and, at the same time, to help identify ways to improve our plans and procedures."

This was especially true in B-52 operations. For the first time in many years, for example, large numbers of B-52 crews executed minimum interval takeoff (MITO) procedures. The MITO procedure requires close spacing between aircraft on takeoff to speed departure under attack. Prior to Global Shield, only two or three aircraft normally practiced these procedures. During Global Shield, crews flew most of the aircraft in their units, more than twenty in some cases, to accomplish MITO. The exercise helped identify and correct problems associated with MITO and also improved the confidence of the crews in its execution.

Additional realism was introduced in late 1979 with terrain avoidance (TA) training over mountainous areas at night. TA is a system that projects a portion of the B-52's radar energy ahead of the aircraft at low altitude. The beam reflects off the geographic contours and the return is converted into an electronic "terrain trace." Maintaining this trace coincident with a reference line ensures a preset altitude above the terrain.

Before 1979, SAC limited such night training. Yet skillful execution of this tactic could be required during a combat mission.

Although crews have always practiced TA in daytime, night training is beneficial because the lack of visual cues forces crews to use information presented in the cockpit and rely less on external references. Thus, increased use of TA presentations has led to better instrument interpretation and improved TA performance both day and night. Second, increased dependence on TA cockpit presentation has prompted crews to evaluate more critically the TA equipment, helping maintenance personnel to analyze and correct malfunctions.

Most important, however, the night training has increased crew confidence in their ability to accomplish the wartime mission under other conditions that restrict visibility, such as adverse weather and thermal curtains. (Thermal curtains would be used in combat to cover the window areas to protect the crews from the heat and intense light of nuclear weapons.)

Encouraged by this nighttime TA success, SAC recently lowered minimum altitudes in low-level operations both day and night. Of prime importance, however, is safety. The squadron commander must certify each pilot's proficiency before unrestricted flight. This, coupled with the common sense of supervisors and crews, is essential to maintain a safe flying environment.

The Role of ORIs

Operational Readiness Inspections determine the readiness of SAC units to accomplish their wartime mission. Normally, units

Night and adverse weather terrain avoidance penetration is possible through use of the B-52's electro-optical viewing system, shown here.

"generate" all aircraft to full alert status, and crews then fly simulated wartime missions without nuclear weapons. These flights involve low-altitude penetration of a predetermined target area and electronic scoring of simulated releases of nuclear weapons.

Before 1979, these "releases" were scored on the basis of a fixed circular radius from the target. Scores inside the circle were "reliable" deliveries. Conversely, any outside were "unreliable" and counted against a unit's bombing effectiveness.

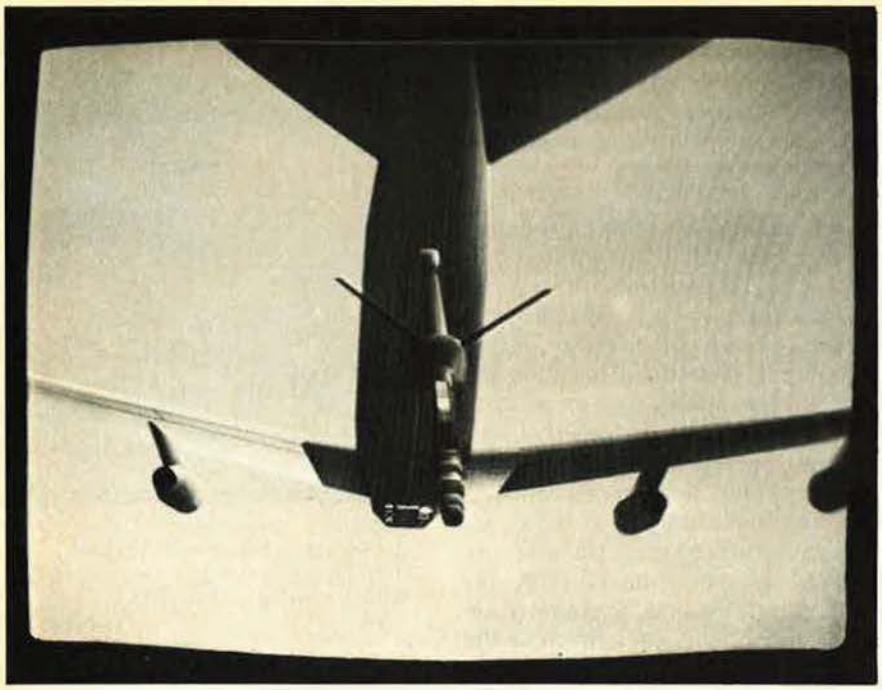
This arbitrary measurement also limited assessments of a unit's combat effectiveness. In combat, a large miss distance could result in damage to "soft targets," but would probably cause insufficient damage to "hard targets."

SAC's scoring system now accounts for these variables through statistical tools that measure probabilities of bomb damage against both types of targets. Probabilities are also assigned to other important variables, such as pre-launch survivability, weapon system reliability, and defense penetration. The cumulative effect of each variable leads to the final score—damage expectancy—which provides the mathematical probability of success for judging the combat readiness of a unit.

The new scoring system gives SAC commanders a much clearer assessment of crew performance. Former SAC Inspector General

---

Maj. Bruce Eickhoff is an instructor pilot and flight commander in the 62d Bombardment Squadron of SAC's Eighth Air Force, Barksdale AFB, La. His total flying time of nearly 3,800 hours includes more than 1,270 in the B-52 and nearly 1,700 as an instructor. Commissioned through ROTC from the University of Nebraska in 1968, he earned his pilot's wings in 1969. He flew as an instructor in T-38s, then in EB-66s, including a combat tour in Southeast Asia in the latter aircraft. He was an aircraft commander instructor pilot on B-52Gs, 1974–77, and an air operations staff officer at SAC headquarters, 1977–80, before attending the Air Command and Staff College, from which he graduated in 1981.



Top, out-of-the-windshield digital image-generated view of a KC-135 tanker seen from the cockpit of a B-52, part of SAC's Weapon System Trainer, now operational at Castle AFB, Calif. In the lower photo, B-52 crew members practice low-level flight via computer-generated imagery showing terrain ahead (daylight) and also repeating information on senior displays in the cockpit, for low-light, night, and adverse weather penetration.

Maj. Gen. R. A. Burpee said, "The formula measures total performance beginning with the battle staff and permeating throughout the unit." Another recent event demonstrated SAC's interest in realistic evaluations.

In December 1979, a no-notice deployment of fourteen B-52H aircraft from Ellsworth AFB, S. D., to Guam reflected a dramatic departure from other ORIs. Previous inspections tested a unit's nuclear mission and were conducted in CONUS, but the Ellsworth inspection tested the capability of an entire unit to respond rapidly over great distances. Moreover, the B-52 crews practiced nonnuclear tactics instead of the usual ORI nuclear procedures. And, early in 1980, the remaining three B-52H units subsequently flew similar no-notice deployments to Guam as part of their ORIs.

Whether they participate in ORIs, daily training, or joint and combined training exercises, today's B-52 crew members engage in more realistic training than their predecessors were able to do. In the process, they have become a force of highly proficient crews able to perform multiple roles across the combat spectrum.

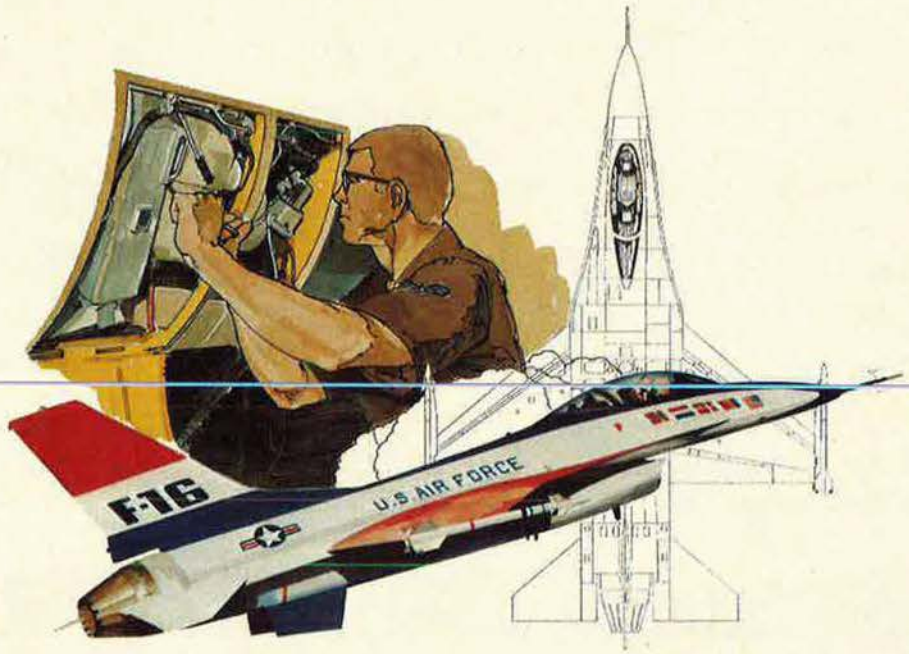
Future B-52 Training

The realistic training philosophy also provides a sound foundation for the future, but is costly in fuel. For example, the consumption rate during a typical low-altitude run is roughly ten to fifteen tons *per hour*. This rate will increase pressures to reduce training hours; thus, SAC is actively seeking ways to maintain readiness while reducing flying costs.

One such program is the Weapon System Trainer (WST), to be installed at each B-52G/H unit in the early 1980s. The first unit became operational at Castle AFB, Calif., in late 1981. The simulator has three stations, duplicating each crew station in the aircraft. The pilot's station has six-degree motion and full visual capability, and the navigator and defensive stations can each be used independently or integrally with the other crew stations. Once all are operational, the simulators should enhance training and increase overall aircrew proficiency.

Another SAC proposal includes a facility similar to that at Red Flag, but on a broader scale. Crews would rotate periodically to a strategic training center that teaches combat tactics, both in the classroom and through an intensive flying schedule. The SAC staff frequently refers to this as the future "SAC Graduate School of Flying," and is working to begin operation of such a center in the near future. Its range complex in Montana is already operational. ■

Proficiency!



Complex operational equipment like the F-16, F-15, and E3A AWACS requires high level skills by the ground support personnel who maintain them. These people must be more than familiar with aircraft maintenance.

They must be proficient in their knowledge.

Because there's no room for mistakes. No margin for error.

The Air Force recognizes that the most sophisticated equipment is only as good as the people who maintain it are capable. That's why Honeywell's Simulated Maintenance Training Systems are so important to the Air Force.

These systems teach proficiency. And, they do so without tying up the three or four operational aircraft per training site which would normally be performing other critical roles. Plus, maintenance technicians who have trained on simulated systems generally show high proficiency levels.

Find out more about our growing line of maintenance training systems. Call Larry Roush, Manager, Training Systems Marketing, (213) 331-0011.

Honeywell

Write us on your letterhead for a complimentary print, suitable for framing, of the F-16 painting.

These Simulated Maintenance Training Systems are built by Honeywell Training and Control Systems Operations, West Covina, California 91790, a division of Honeywell Aerospace and Defense Group.

Pilotage is an important method of aerial navigation, a fundamental to understanding the more complicated and sophisticated methods Air Force navigators practice. That it can also be fun and exciting is proved in Flight No. 3 of the navigator course at Mather AFB.

Navigating Can Be Fun, Too

STORY AND PHOTOS BY THOMAS M. CLEAVER

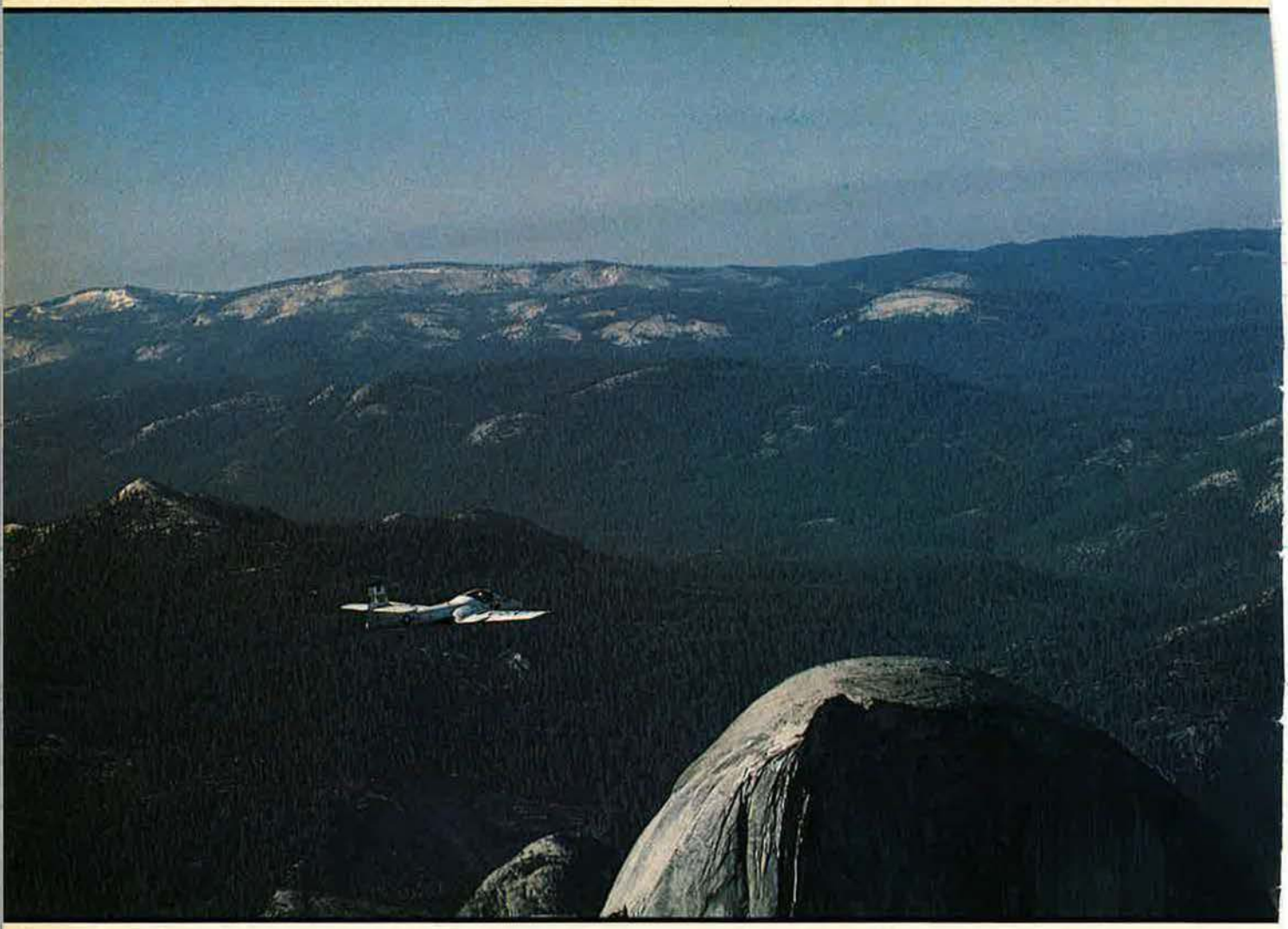
Since the late 1970s, all student navigators of the US services and several foreign air forces have received their training at Mather AFB, Calif.

Located a few miles southeast of the state capital, Sacramento, the base is home to the 453d Flying Training Squadron and its T-43As and the 454th Flying Training Squadron using the old Cessna T-37 "Tweety Bird." The T-37 is the oldest, slowest, and smallest jet in the Air Force inventory, but the nine hours the navigator students spend in this airplane are probably the high point of the training in terms of just plain fun flying.

For the student, the T-37 course puts him "on his own." Rather than the flying classroom of the T-43, which isn't much more of an introduction to flying than the T-45 simulator, there are just two people on board: the student and instructor pilot. The student plots his own courses—using the on-board navigation equipment without the back-up of an instructor to point out mistakes—taking the little planes up and down the great Central Valley of California.

Perhaps the high point of all nine hours in the T-37 is Flight No. 3: the introduction to high-speed, high-G, low-level flight maneuvering. Here, the student receives his introduction to the press of the G on the back of a loop, the head-wrenching gut-turning pullout from a spin, the beauty of the aerial ballet of two airplanes cutting through space together, the joy of playing "tag" over some of the most magnificent scenery in America. For this introduction to what tactical flying is like, the T-37s head up into the high Sierra Nevada, away from popu-

At left: Playing "tag" over the mountains, we create our own "up" and "down." At right, top to bottom: (1) We accelerate for takeoff as Colonel Myers rotates his T-37 on Mather's main runway. (2) We roll over the top in a fingertip barrel roll. The deep blue of the Sierra sky is a contrast to the haze we've left behind. (3) Colonel Myers and Captain Stroud fly such tight formation during our aerobatics that the only sensation of motion is the change of light and shadow on the lead plane. (4) Down among the cliffs of the Tuolemne River Canyon, our airplanes are dwarfed by the splendor of nature.



lated areas and skies crowded with other airplanes.

For the instructor pilots of the 454th Flying Training Squadron, Flight No. 3 is just as much fun for them as for the students. "Our job," says Lt. Col. Gus Myers, "is to just go up and fly the wings off the airplanes. This part of the job is what makes working in this squadron probably the best IP duty in the Air Force. We aren't up there teaching someone else to do those maneuvers; we're flying them ourselves."

As part of my research on navigator training, I was afforded this opportunity. As a civilian pilot, this romp over the crags and peaks in the "Tweet" was one of those flights that got a long comment in my logbook. I've since flown with the Canadian Armed Forces "Snowbirds" aerobatics demonstration team, but nothing quite matches those fingertip barrel rolls in the early morning summer sunshine as performed by Colonel Myers and Capts. Terry Childress and Bob Stroud, instructor pilots with the 454th.

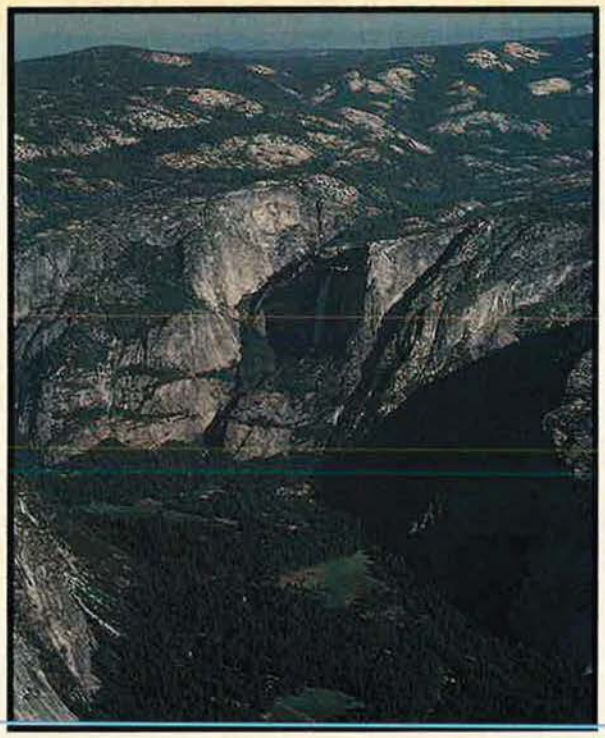
Dryness of Mouth

As a tyro jet flyer, I went through everything a navigation student is run through before going flying in the T-37: introduction to the ejection seat, life-support equipment fitting-out, and probably the same exhilarated dryness of the mouth in anticipation of what was to come. Suitably decked-out, we are bused to the flight line as the sun comes up over the Sierras to the east. I strap in as my pilot, Captain Stroud, performs the preflight walk-around. When he reaches into the cockpit and pulls the arming pin on my ejection seat, I try to sit a little lighter, as though I were dealing with a carton of eggs. Satisfied with the plane's condition, Stroud enters and straps in; we await Colonel Myers's lead.

The lead ship of our two-ship element pulls out ahead, and we're into line for takeoff. Pulling on the runway, we're granted clearance and are rolling in a formation takeoff. There's a much greater feeling of acceleration than in any piston-engine airplane I've flown in except a P-51; we're off well before midpoint of Mather's Runway 23. Climbing at more than 3,000 feet a minute, we're soon above the sum-

---

Thomas M. Cleaver is a California-based free-lance writer and photographer. He holds a BA degree in social sciences and journalism from San Francisco State University and an MA in public administration from Golden Gate University. He served in the US Navy, 1962–65 in Southeast Asia and the Western Pacific. He is active in the restoration and operation of antique and warbird aircraft, and is doing publicity writing for the forthcoming movie "Gypsy Angels," about barnstorming and air racing.



Left: One of the joys of Sierra flying is a view like this: 1,000 feet above and two miles away from Yosemite's Half Dome. Right: Yosemite Valley beneath us. Below: Our mission ends with the chirp of the wheels on the runway.

mer haze layer at 3,500 feet, and turning southeast toward our assigned area. Today, we're going to Aerobatics Area Hummer 6/7, a box of airspace over the Tuolemne River Canyon, just north of Yosemite National Park.

The World Turns Upside Down

I'm used to getting places quickly in an airplane, but the T-37s are half again as fast as the fastest airplane I've flown, and I'm surprised when I hear Myers inform Mather that we've reached our area as he cancels IFR. Stroud informs me we'll start with some fingertip barrel rolls. I unlimber my cameras, and quickly inform him we'll have to fly a looser formation if I'm to get any worthwhile shots; the standard formation with wingtips ten feet apart is too close! Down comes the nose, then up into the roll. With positive G all the way around, the world turns upside down.

The two pilots maintain such perfect formation that the only sense of motion is the change of light and shadow on the other plane and the change of scenery behind. A few more of these, and we move into trail position for some loops. Down we go to gain maneuver entry speed, then up and over; the world turns above me as I'm jammed into my seat by the G force on the back of the loop.

We roll out of the bottom of the second of these, to try and catch the leader in a game of tag played against the granite peaks. A quick turn after them, but we've lost them momentarily in the immensity of the sky. Bob climbs for altitude, executes a half roll to inverted, and we spot the glint of their canopy in the sunlight. We pop the dive brake and landing gear quickly as we nose over, then we're sliding downhill, approaching them rapidly. "If he was a MiG, I'd have him cold!" Stroud exults as he mimics the sound of machine gun fire over the radio; I'm reminded that all this fun has an ultimately serious purpose.

Myers drops down toward the Tuolemne River Canyon below, and we slide below the canyon rim. The granite walls glide in and out of shadow as our two planes slip on through the bright sunlight. This is one of the real payoffs for being a pilot. Who but the flyer can see such a sight? After mere minutes, we climb back up, and there is Half Dome of Yosemite. We circle the magnificent peak a few times for photographs. As we slip over the beautiful Yosemite Valley, I hear Stroud: "Lead . . . Two. 800 pounds remaining." It's hard to believe we've been airborne nearly an hour and that it's time to turn for home.

On the way back, the two pilots continue the game of skill-building. Stroud brings us up below the lead plane, closer and closer, until we're rocking gently in the wake of its slipstream, and I can nearly see the flame of the engines inside their exhausts. A last roll around the leader, and we slip back into wing formation for entry into the traffic pattern.

Our landing is instructive to me as a civilian pilot. The tower informs us of traffic from nearby Phoenix Field, and I see a Cherokee slip past the "boundary" of US 50. He's five miles away from us, probably unaware of us. We're landing at nearly his cruising speed, and would be on him before he was aware of it, had he not quickly turned back north of the freeway.

As we walk away from the airplanes, Colonel Myers says, "I can hardly believe this is working for a living." I agree; it's been a demonstration of real professionalism. ■

Hazeltine

helps train the USAF pilot.

Hazeltine's TICCIT® computer-based training systems will play an important role in the Air Force Time Related Instruction Management program, Project TRIM, aimed at increasing the efficiency of pilot training.

TRIM is a resource management system that utilizes student progress data to coordinate the administration and scheduling of training resources. The Hazeltine TICCIT systems not only track student progress, but also deliver much of the academic instruction for pilot trainees.

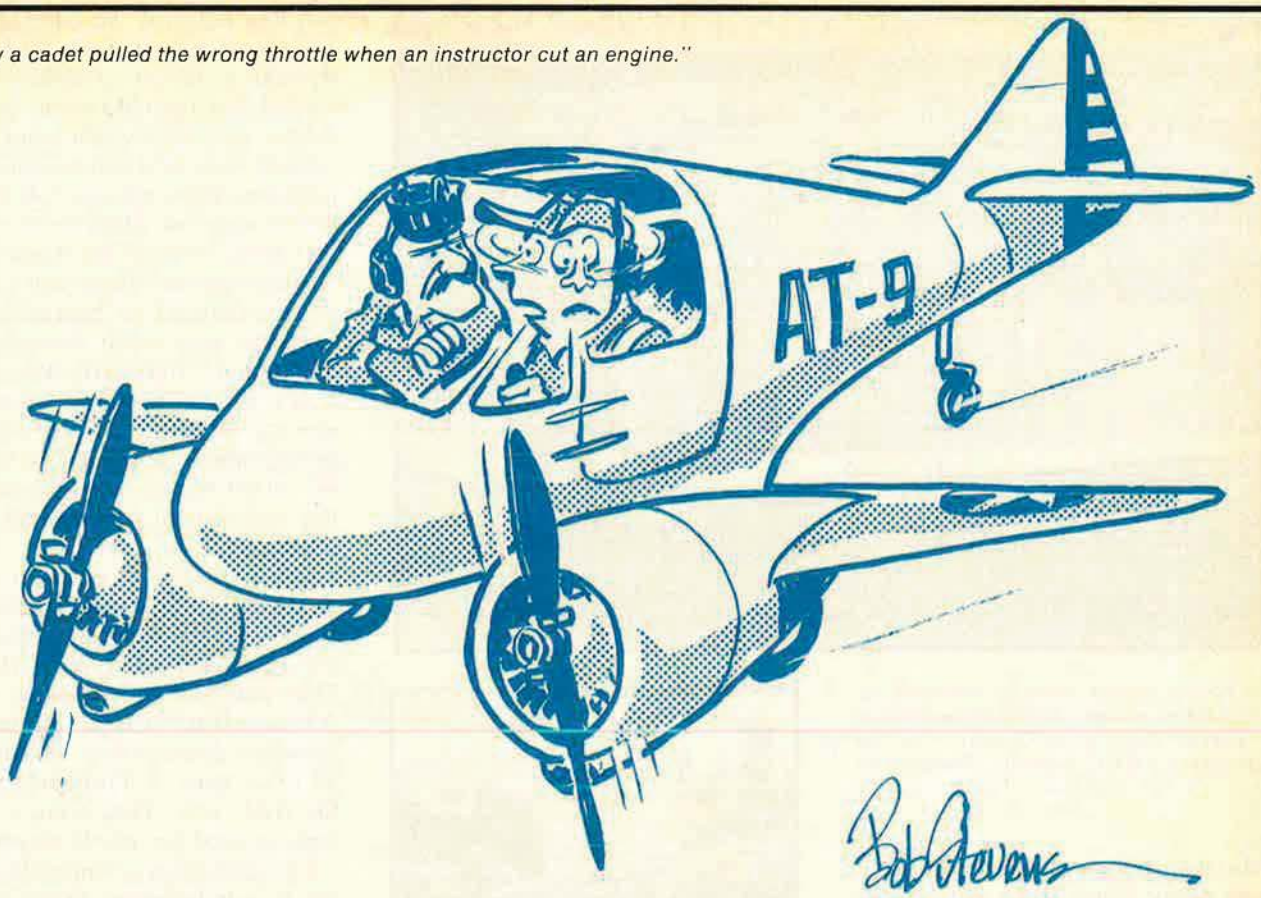
TRIM optimizes the value of Air Force flight training dollars, by quickly and efficiently scheduling the utilization of available flight hours, simulator time and instructor pilot time to the individual needs of pilot trainees in the ever-changing training environment.

Because skilled manpower is our most vital defense resource, training of young pilots is one of Hazeltine's most vital contributions for the decade ahead.

Hazeltine Corporation
TICCIT Marketing Manager
7680 Old Springhouse Road
McLean, Virginia 22102
(703) 827-2300 Telex: 82-4435

Hazeltine and the
Pursuit of Excellence.

Hazeltine Answers for the 80's



"Many a cadet pulled the wrong throttle when an instructor cut an engine."

One of the miracles of World War II was the astounding production of aircraft by US industry. An equally stunning miracle was the production of aircrews by USAAF's Flying Training Command. One of the 190,000 pilot graduates tells of funny things that happened . . .

On the Way to a Miracle

BY JOHN L. FRISBEE

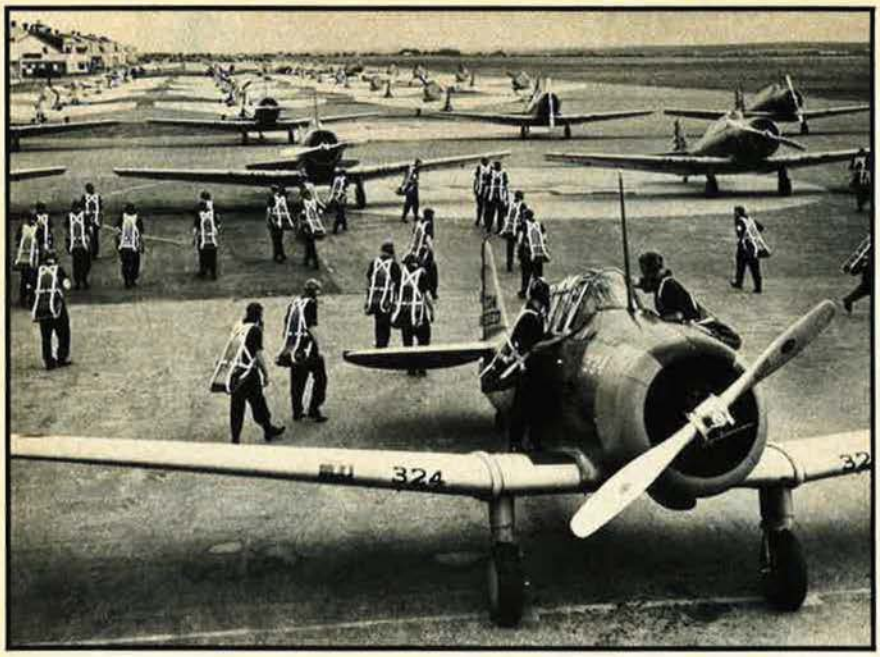
WORLD War II was a time of miracles great and small. Not the least of them was the Army Air Forces's explosive growth in the three years between mid-1941 and mid-1944, from 150,000 officers and men to more than 2,300,000.

AAF expansion started in 1939 from a base of 23,455 people, about 700 bombers and 475 fighters—most of them not combat ready—and annual production of 300 pilots. At the end of December 1941, three weeks after Pearl Harbor, the inventory stood at 2,800 combat planes, fewer than half of them fully operational, and some 9,000 pilots. The pilot training system included forty-one contract primary schools and eight basic and advanced schools, with twenty more in various stages of construction. Then all hell broke loose as training programs for pilots, navigators, bombardiers, maintenance people, logisticians, and a host of other specialties surged into high gear.

The growing pains for those who had to fit all the pieces together must have been excruciating. Nowhere in my experience as an aviation cadet were they more evident than in the Preflight School at Maxwell Field, Ala., when I arrived, along with a trainload of newly sworn-in cadets, late on a January night in 1942.

We were herded unceremoniously aboard a convoy of trucks, driven to a just-completed area of the base set in a sea of red Alabama mud, and assigned six to a room. The rooms were, to put it charitably, sparsely furnished. In one corner was a pile of unassembled double-deckers, and along the walls stacks of mattresses and bedding. We were ready for the Air Force, but was the Air Force ready for us?

After a short night, much of it spent putting the bunks together, we were routed out in the dark, lined up in something resembling a formation by a somewhat uncertain upperclassman, and marched off to a warehouse to be outfitted before breakfast. The cadet in charge of the formation was never cut out to be an upperclassman. He confided to some of us that he had been at



Above, sleeves rolled up and ready for business, aviation cadets make for their aircraft. Right, an NCO instructs on the innards of a BT-13 fuselage. (National Air and Space Museum photo)

Maxwell only a couple of weeks, and really didn't know much more about military life than we did. He soon proceeded to prove it.

When everyone had put on his cadet uniform, the upperclassman formed us up again and off we marched toward the mess hall before there was time to remove the manufacturer's tickets stapled liberally on our uniforms. Then, in the dim light of dawn, we encountered a real, live officer. After he had chewed out the upperclassman for this disgracefully unmilitary scene, the officer ordered us to pull off the tickets from ourselves and our neighbors. It must have looked like a World War I delousing formation.

After we sat down to our first GI breakfast, I turned to one of my roommates, an impressively large cadet who had been both Phi Beta Kappa and a college hockey star.

"What do you think, George?"

"I'd rather be home with a good book and an apple," George replied.

We both were gigged by an upperclassman for unauthorized talking, and I decided George had a point.

That January, it wasn't true what they say about Dixie. The sun didn't shine all the time. As a matter of fact, it rained nearly every day. For each hour of drill or physical training, you could count on an hour cleaning Alabama clay from shoes, clothes, equipment, and floors. That left just enough time for ground school, which became one of my favorite institutions.

Most of the ground-school instructors were civilians who had been recruited from high school classrooms and given a quick course in whatever subjects they were to teach. We learned early on that the function of observation aviation was to observe, and that the mission of the mess hall was not, as one would suspect, to feed the troops, but rather to supply them with "enrugy." After these revelations, and buttressed by the book-learning parts of the Civilian Pilot Training program I had gone through a year or so earlier, I concluded that I could use the ground-school period to catch some much needed sleep and still pass the daily multiple-choice quizzes—if George would wake me when the instructor was ready to issue the tissue.

After supper, lower class cadets were confined to barracks. The evenings were spent cleaning mud, learning to field-strip the World War I rifles we had been issued, and griping. That was the time when upperclassmen would burst in for a little verbal hazing that included giving memorized answers to stock questions.

Our barracks was shared with a group of former Royal Canadian Air Force cadets who had transferred to the AAF right after Pearl Harbor. They had been in Advanced, flying AT-6s—Harvards to them—but someone decided they should start all over again in Preflight to learn the AAF way. They were a pretty high-spirited lot, partly responsible for a breakdown of upperclass hazing in our building. When one of them was asked, "What can you do, Mister?" he replied—very positively—"I can roll a Harvard off the top and kick the stuffing [loose translation] out of you."

About the same time, my Phi Beta Kappa roommate, George, politely declined to give the prescribed answer to the question, "Why did you leave home, Mister?" George explained patiently that the canned answer was an affront to one's family, that the family is the basic social unit of our society, and that when one demeans the family he is attacking the foundation of a society we all were sworn to defend. The upperclassmen slunk away like kids who had been caught pilfering the church poor box.

Word got around, and I don't recall our barracks being visited by upperclassmen very often after that.

In a few weeks, my class—42-I—became upperclassmen, the sun came out, the mud turned to dust, and we had our first open post and discovered the delights of the Cadet Club at Montgomery's Jefferson Davis Hotel. We also discovered the Elite (pronounced E-light)

Cafeteria, which was a social center in its own right, though not necessarily blessed by the chaplains.

Finally, late in March, orders came through scattering us out to various primary schools throughout the Eastern Training Command. Several of us drew Carlstrom Field at Arcadia, Fla.—the country club of the command's civilian-operated primary schools.

The Washing Machine

At the first meeting with Carlstrom's operations types, we heard the by-then familiar greeting: "Look at the man on your right and the man on your left. Only one of you will be here at graduation." That may have been true a few years earlier, but actually the elimination rate between 1942 and early 1945 was about forty percent. Percentages aside, we knew that most of the washouts would be right there in Primary. The Stearman PT-17 was not known as The Washing Machine for nothing.

The Primary instructors were civilians, ranging in age from gray to green. Three other cadets and I were assigned to an instructor who, I'm sure, was never eligible to vote for Roosevelt. He was filled with the enthusiasm, and the impatience, of youth, and the firm belief that he could make a pilot of anyone who, as the saying goes, could walk and chew gum at the same time.

We were issued fatigues for flying, leather helmets with little brass pipes attached to the ear pieces, and goggles. In the plane, you slipped rubber tubes over the brass pipes. Those tubes connected to another that ran to the instructor in the front cockpit. It was strictly a one-way communication system that never worked very well, to the annoyance of impatient instructors like mine.

My first impression of the Stearman was—BIG. It was, compared to the only plane (a Piper Cub) I had ever been in. On our first takeoff, it seemed that big brute would never get airborne, and the roar of its 220-hp engine was awe-inspiring. But after a few hours of dual, the cadets who made it learned that the Stearman was a stable, forgiving airplane once it left the ground. Its only bad habit was a pronounced tendency to ground loop, which ended the flying careers of a lot of cadets early in the game.

With the hood down, the Link trainer provided an overheated and uncomfortable ride—but proved to be a technological breakthrough and the precursor of today's cockpit simulators. (National Air and Space Museum photo)

Most of the instructors, particularly the younger ones, liked to break the tedium of flying with beginners by wringing out the Stearman for a few minutes after an hour of S-turns, chandelles, stalls and spins, and other pre-solo maneuvers. One of them who was adding a few thrills to the life of a cadet hadn't fastened his seat belt securely. He rolled the plane over on its back, and left his cadet to bring it home alone. The cadet wasn't credited with soloing on that flight since he made only one landing.

Fortunately, I not only had a good primary instructor, but my earlier CPT instructor had taught flying "the Army way"—precision, precision, precision. "Someday," he used to say, "you may be flying with the Army." That seemed an unattainable goal in late 1940, when aviation cadet quotas were small, indeed.

Even with a little civilian flying time behind you, there were a lot of new things to learn—aerobatics, night flying, spot landings. One of the most difficult was learning to keep your head on a swivel. The air was always full of Stearmans. That lesson probably was the most important of all for a potential World War II combat pilot. In my time at Carlstrom there was only one midair collision, but a lot of gas was burned looking for a clear spot to do stalls, spins, loops, or Immelmanns.

"Climb Back in the Cockpit"

With Primary drawing to a close, the next thing to think about was the BT-13, the Vultee Vibrator. Among cadets who hadn't flown it, the BT-13 had the reputation of being a very tricky airplane—a cadet killer. In reality, the wartime accident rate in Basic was twenty-seven per 100,000 flying hours, compared to forty-eight in Primary and fifty-five in Advanced. There were 1,175 fatalities in Basic—certainly not an insignificant number—but 1,888 in Advanced, and only 439 in Primary. Incidentally, the highest accident rate, 245 per 100,000 flying hours, was in the P-39.

Late in June, we were shipped off to Basic, most of us to Gunter Field near Montgomery, Ala. For several days after we arrived the weather was so bad that we new Basic cadets didn't fly. That gave time to learn where some of the new gadgets in the cockpit were located—mixture and two-position prop controls, manually operated flaps, light switches, radio, and intercom. No more hot leather helmets and Gosport tubes. The BT's 450-hp radial engine looked pretty impressive, and the airspeed indicator was redlined at—wow!—230 mph. Flaps-up stalling speed was close to the cruising speed of the old Stearman.

While we were grounded by weather, the upperclass was cleared for a night cross country. Some of them tangled with a line squall and didn't come back. Not a confidence builder for seventy-hour cadets waiting to check out in a new and allegedly dangerous airplane.

Finally, the weather broke, and again I was blessed with an outstanding instructor—a sort of quiet Alan Alda. He was supremely con-

fident of his ability and he imparted some of that confidence to us. On my first flight—and it seemed to take forever to get off the ground (probably about 500 feet)—we did stalls and spins that weren't all that different from the Stearman, except for the BT-13's characteristic vibration and a lot more loss of altitude. With its wide undercarriage, the -13 was almost impossible to ground loop.

A few hours after we had soloed, our instructor told us we were going to do some three-ship formation flying. He explained the hand signals he would use. "We'll fly around for awhile until you get the hang of it," he said, "then go over to an auxiliary field and shoot touch-and-go formation landings." I wouldn't have done that with two green cadets on their first formation flight for a Rolls-Royce and a month's leave.

Another innovation of Basic was instrument flying under a hood. Most of the BTs had artificial horizons, as they were then called, but few ever worked. It was basically needle, ball, and airspeed, plus a lot of time in Mr. Link's sauna with the stubby wings and tail. The Link trainer was good for learning procedures, but it lurched and jerked around like no real airplane, except perhaps a Noordyne Norseman.

That reminds me of the only time I flew one of those things, ferrying a British lieutenant general from Frankfurt to Luxembourg. When the operations officer told me he had a Norseman set up for the trip, I asked who was going to check me out. I had never seen one before.

"We don't check people out in the Norseman," he said.

"Why not?"

"We're trying to get rid of it," he replied.

But back to Gunter Field.

The hairiest part of Basic was the traffic pattern. As I remember it, Gunter was a squarish field with a taxiway around the perimeter and one diagonal runway. Frequently, there were thunderstorms in the area, and the old SCR-182 "coffee grinder" radio became virtually useless because of static. Add to that forty or fifty cadets screaming at the tower and the whole mess often broke down into one massive game of chicken, with everyone fighting for a piece of the runway or a good slice of sod to the side of it.

Top, then as now, instruction in cockpit procedures was a prerequisite to flight training. Above, when rain interrupted the flying schedule and grounded aircraft equipped with only primitive instruments, training activities were moved indoors. Here, a blindfolded aviation cadet, practicing radio navigation techniques, learns to "fly the beam," turning right or left under the guidance of classmates' vocal approximations of quadrant beam signals.

The worst traffic hassle I was in was on the night of our introduction to "blackout" landings. The event took place at a sod auxiliary field with a "runway" marked out by smudge pots, and an instructor controlling traffic from a BT parked near the end of the runway. We weren't allowed to use landing lights, and it was a very dark night.

When the period began, the faint glow of lightning was already visible in the distance, adding to the tension. On my first landing, I must have set an altitude record for bouncing. I can still hear the instructor's voice over the radio, heavy with sarcasm: "All right, 530, climb back in the cockpit and take it around again!"

The lightning kept getting closer and brighter. At last, through the crackle of static, came the order, "All cadets return to Gunter *immediately*." The cadets in the air had a running start on those of us lined up on the ground, waiting to take off on another circuit.

Well, the BTs from the auxiliary field and others in different phases of night flying merged on Gunter in one great swarm. By that time, radios were useless, and the turbulence was increasing. Under the circumstances, nobody wanted to go around. The competition for a spot on final approach—rather, final approaches—got downright keen.

Somehow everyone got down before the storm hit, and spent the next couple of days swapping embroidered stories about close calls.

That traffic pattern wasn't much better in good weather, especially at the end of a flying period. Once I got cut out a couple of times in the late afternoon. On the third circuit, I decided to squeeze into a corner of the field, which wasn't very smart since the perimeter taxiway was full of trainers returning to the ramp. Anyway, the brakes held and I bucked to a stop just short of the taxiway.

A clipped British voice came over the radio: "Pilot of the plane that just landed in the corner of the field report to the tower."

There, when I had climbed the stairs, was an RAF officer who had tower duty.

"Mister," he said, "don't you know you can't land a BT-13 in that corner?"

"But, Sir, I just did."

He looked at me thoughtfully for a moment. "So you did," he said. "Don't try it again."

I left, mentally thanking the RAF for not giving me a month's worth of tours.

Getting Close

After that landing, I should have been pegged as a potential fighter pilot and shipped off to Single Engine Advanced. As it turned out, most of my closest friends and I went to Twin-Engine Advanced at Columbus, Miss. It was a relatively new base with two-story cantonment-type buildings. Not the worst of all worlds, compared to the tar-paper-covered buildings heated by pot-bellied stoves that were springing up on the newest bases. The food was good, we were allowed a lot more freedom, and the weather was perfect most of the time.

Going from single-engine to twin-engine aircraft with retractable gear, constant speed props, and more complicated systems was the most difficult transition of the entire flying training program. Single-engine operation took some getting used to. Many a cadet pulled the wrong throttle when an instructor cut an engine.

After wallowing around for a few hours in the Cessna AT-8—the infamous Bamboo Bomber—we moved up to that little humpbacked, all-metal Curtiss AT-9, which was a joy to fly. It had hydraulically operated gear and flaps, a business-like pedestal, and a panel of switches overhead. For the first time, it seemed that we were getting close to the real thing.

The AT-9 was designed with flying characteristics similar to light bombers of that time. It stalled at eighty-five to ninety clean; about eighty with gear and flaps down. Final approach speed was 100 mph—pretty hot for a 1940s trainer—and it was solid, light on the controls, and very responsive.

Our first instructor checked us out in the AT-8. He had one memorable peculiarity. He insisted that we taxi using only throttle to make turns—no brakes. He was a pro at it, but most of us cadets pirouetted all the way from the parking ramp to the end of the runway.

When it came time to check out in the AT-9, the instructor flew once with each cadet and then called the four of us together. "I don't like that AT-9," he said. "It's a dangerous airplane. Brennan, you check Frisbee out, then Frisbee, you check Brennan out."

A few days later, not having flown with our instructor in the meantime, night flying came up on the schedule. He told Brennan to fly the AT-9 to the sod auxiliary field where we would shoot night landings, then instructed Brennan and me to check each other out again. The next day, we had a new instructor. Instructor A disappeared. I guess his one claim to fame was taxiing without brakes.

Our new instructor was older, right out of Central Casting, and a fighter pilot at heart. He loved the AT-9 and taught us to get maximum performance out of it without killing ourselves. Formation flights usually ended with him leading a rat race through towering cumulus clouds. Racing down those endless cloud canyons was a beautiful experience. Exciting, too. You knew other AT-9s were doing the same thing, and that there'd be no traffic lights at the corners.

My last flight in Advanced was with the former RCAF type who could "roll a Harvard off the top." I don't remember why we were flying together since we didn't have the same instructor. Anyway, after I had my turn in the left seat, we swapped and he lit out for the boonies. He found a narrow dirt road with trees on both sides and dived into it with throttles firewalled. On we charged, blowing dust and gravel and clipping branches with our wingtips until we came to a sharp turn. He hauled back on the column, stood that AT-9 on its tail on the verge of a high-speed stall, and we came out through the top of a tree. We weren't going to miss graduation, after all.

* * *

On October 9, 1942, 199 cadets of Class 42-I at Columbus Army Flying School got their wings and commissions—two-thirds as many pilots in one class at that one school as the Air Corps had trained in a year, up to 1940. Twenty-five of us were plowed back into the Training Command as instructors. The rest, with 200 hours under their belts, fanned out to B-17, B-24, B-25, and B-26 transition schools to fly aircraft that a few years earlier would have been entrusted only to seasoned pilots. Within six months, many of them were in combat, flying in some of the world's worst weather, against flak and veteran enemy pilots—and winning.

The World War II flying training program might look pretty crude to graduates of today's UPT. Groundschool courses were sketchy, pilot training techniques unscientific, many of the instructors right out of flying school themselves. One of its major weaknesses was instrument training. There was almost never a full panel of working instruments. Cadets flew in good weather, so few of them had any actual weather time when they graduated. They had to learn later, the hard way.

In spite of its shortcomings, the AAF's pilot training program was one of the miracles of World War II. More than 300,000 cadets started in Primary and nearly 190,000 graduated with wings. Those who were a part of it look back on their cadet experiences through a filter of time that turns the goofs, annoyances, moments of terror, and near tragedies into treasured and often humorous memories.

It was a miracle, all right—one that never will happen again. And in retrospect, some funny things happened on the way to that miracle. ■

With engineers, scientists, and technicians in such high demand today, the Air Force faces a shortage of technical officers. Countering that shortage are the engineering and technical education programs of the Air Force Institute of Technology.

AFIT: The Technical Challenge

BY CAPT. PHIL LACOMBE, USAF, CONTRIBUTING EDITOR

"NO MAN can efficiently direct work about which he knows nothing," wrote Col. Thurman H. Bane, head of the Technical Section of the Military Aeronautics Division at McCook Field, Dayton, Ohio, in a 1918 letter urging his superiors to establish a technical school for Air Service officers. A year later, Colonel Bane was charged with solving that problem as the first commandant of the Air School of Applications. More than sixty years later, the school, now known as the Air Force Institute of Technology (AFIT), is still solving that problem.

AFIT is the scientific and technical education arm of Air Training Command's (ATC) Air University system. The Institute's staff of more than 500 provides scientific and technical education to Air Force people and others. Maj. Gen. Stuart H. Sherman, Jr., Commandant of AFIT, describes the Institute's mission: "We take engineers, logisticians, civil engineers, health services professionals, and a variety of technically oriented people and add to the intellectual tools they use to accomplish the Air Force mission. We prepare new officers to hit the ramp running and experienced officers to be even more productive than they were before entering AFIT programs."

The educational philosophy of AFIT resembles that of any civilian university. Like a civilian university, the Institute comprises different schools, each specializing in particular academic areas. But there is a fundamental and important difference: AFIT educational programs are focused directly on Air Force problems.

AFIT has four major educational organizations. Three of them—the School of Engineering, the School of Systems and Logistics, and the School of Civil Engineering—are resident schools. The fourth organization is the Civilian Institution Programs (CI), which administers a variety of educational programs at civilian colleges and universities.

AFIT is accredited by the North Central Association of Schools and Colleges. Engineering programs are also accredited by the Accreditation Board of Engineering and Technology (formally the Engineers Council for Professional Development). The School of Engineering and the School of Systems and Logistics have programs at the master's degree level. The School of Engineering also grants doctoral degrees and recently added a bachelor's degree program. Degrees earned through AFIT resident schools are actually granted by the Commander of Air University under authority provided by Congress.

The Faculty

Contributing to AFIT's educational reputation are the high quality and unique nature of the faculty. About half of the more than 200 faculty members are Air Force officers. The constant influx of new Air Force faculty members is a valuable asset, according to Col. Edwin D. Lewellyn, Director of Admissions. These military faculty people, most of whom hold doctoral degrees, come from technical Air Force fields where they were actually doing the work that AFIT is teaching its students. This provides fresh insight, a constant updating of knowledge for the faculty, and ensures that AFIT's programs are "painted blue." The remaining fifty percent of the faculty is civilian and provides the Institute with the continuity and stability it needs to educate properly. Unlike many civilian colleges and universities, AFIT's faculty has not drastically dwindled due to "industry enticing engineering and technical instructors to leave academia for the more profitable commercial world," according to Colonel Lewellyn.

Also contributing to the high quality of the faculty is AFIT's location. Wright-Patterson AFB is also the home of two Air Force Systems Command (AFSC) organizations: Aeronautical Systems Division and the Wright Aeronautical Laboratories. "Forty percent of the Air Force's development engineering and scientific capability is here," says Col. Ralph E. Adams, AFIT Vice Commandant. "Many of these people, who are actively involved in the work that we are preparing our students to do, become adjunct faculty members." Adjunct faculty members teach courses and work with the students on various research projects. Colonel Adams continues, "They can describe the real technical problems to their students—they can say, 'This is what I am facing right now!' "

The Students

AFIT's reputation for excellence could not have been earned solely by the faculty or its resources—the students are also a part of that equation. Dean J. S. Przemieniecki describes AFIT students as "as good as you can find at the top institutions in the country. They can compete with students at the top schools. They are serious, dedicated, and talented students."

AFIT's School of Engineering, School of Systems and Logistics, and Civilian Institution Programs

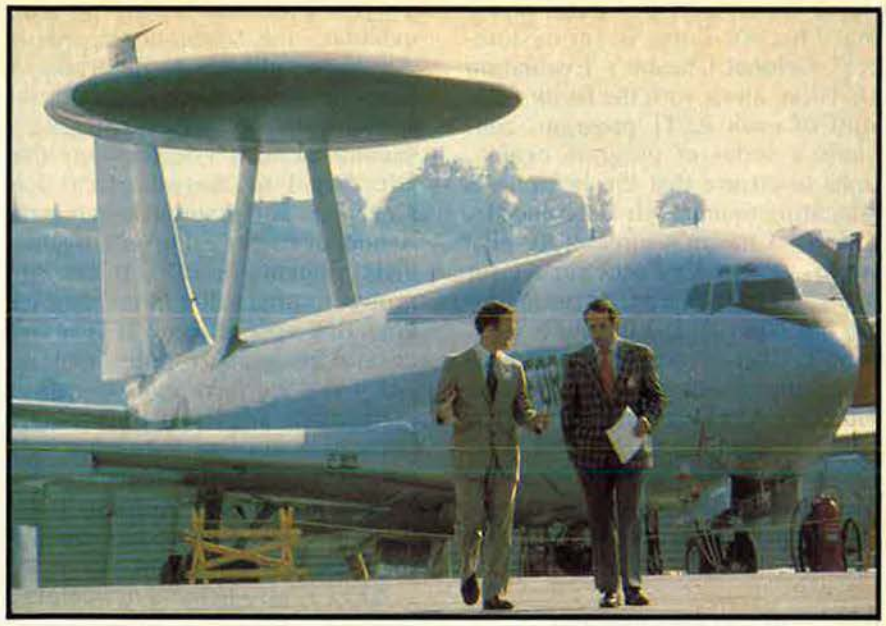
have two kinds of students—regular students, who are seeking degrees or attending extended educational programs (such as a physician's residency program or the Education With Industry program) and Professional Continuing Education students, who are attending either resident or nonresident courses of various lengths to keep up to date in their particular specialties or gain additional understanding about subjects of interest. Although the School of Civil Engineering has no resident degree program, it provides an extensive Professional Continuing Education program for military and civilian employees of the Air Force civil engineering career field.

In Fiscal Year 1981, AFIT had 5,451 degree students enrolled. Of those, 829 were in the Engineering and Systems and Logistics schools and the remainder were in various CI programs. In addition, AFIT had more than 18,400 Professional Continuing Education students—more than 7,000 of whom participated in AFIT resident programs.

Eligibility for AFIT Programs

One of the reasons for the high quality of AFIT students is the screening process that they go through—not only to receive commissions or enter a commissioning program, but in competing for AFIT slots as well. AFIT students are selected by a board at the Air Force Manpower and Personnel Center (AFMPC) at Randolph AFB, Tex. However, before officers can meet this board, they must be certified as academically qualified for specific AFIT programs and nominated by their resource managers at AFMPC. The AFIT Directorate of Admissions determines whether or not an individual is academically qualified and eligible for an AFIT program.

"We're very selective," says Colonel Lewellyn. Basically, his staff evaluates individuals' degrees for suitability to the graduate school or program that they are applying for; determines that applicants had a minimum 2.5 grade point average (3.25 for doctoral programs); and ensures acceptable Graduate Record Examination (GRE) or Graduate Management Aptitude Test (GMAT) scores.



Above, Maj. Mark Froehlich, an Education With Industry student, discusses the AWACS program with a Boeing employee. Left, Capt. Susan E. Allen at Cornell, where AFIT sponsored her for a Doctorate in Operations Research.

Another factor in determining eligibility for AFIT is the time individuals have already spent in AFIT programs. There is a cumulative forty-eight-month limit on Air Force people. "Long enough for the average person to have a chance at a Ph.D. degree," according to Colonel Lewellyn. There is one exception to this rule: Time spent in an AFIT pre-commissioning program, such as the Airman Education and Commissioning Program (AECP), does not count toward the forty-eight-month limit.

A final criterion is the military record. Such things as officer effectiveness reports and other documents must indicate that applicants are promotable.

Colonel Lewellyn says that all officers should request evaluations to determine whether they are academically qualified for a specific AFIT program. Officers need only send a standard request letter, as outlined in Air Force Manual 50-5, Vol. 1, Chapter 4. He also indicates that anyone can call the Admissions Directorate and receive qualification information on the phone. "If someone is not qualified for a particular program," Colonel Lewellyn says, "we'll gladly counsel them on how to become qualified for an AFIT program." In fact, the Colonel emphasizes, "My job is to get everyone qualified." (The telephone number: (513) 255-6231 commercial, or 785-6231 AUTOVON.)

Program Evaluation

Although there are other factors involved, Air Force requirements determine the size of the student population and the specific subjects covered in each AFIT program. AFMPC and Air Staff functional managers set the requirements based on the projected needs of the Air Force and the budget approved by Congress. Quotas are then established for each AFIT program and filled through the selection process.

AFIT administrators like Col. L. Ralph Chason, Director of Educa-

tional Plans and Operations, stress that "the Air Force is our customer." Colonel Chason's Evaluation Division, along with the faculty and staff of each AFIT program, conducts a series of program evaluations to ensure that the Institute is educating to meet Air Force needs. Colonel Chason's directorate also surveys every Air Force supervisor of an AFIT graduate after the graduate has been on the job for a year. Supervisors evaluate the importance and effectiveness of the individuals' AFIT education to their jobs. The feedback received from these evaluation efforts provides the basis for decisions to change, strengthen, eliminate, or add programs.

AFIT and the Engineering Shortfall

AFIT's attempts to meet the Air Force's requirements for engineers, scientists, and technical officers have been complicated by more than a decade of declining authorizations for AFIT programs. Colonel Adams notes that AFIT's graduate student quotas have dropped from a high of more than 1,300 students to a low of about 500 in 1979. During that time, the Air Force reduced its total officer corps by approximately twenty-five percent, while AFIT participation was reduced by sixty-five percent. As the pool of officers with technical and engineering expertise got smaller, so did the service's ability to "grow its own engineers and scientists."

However, the trend has reversed, and AFIT has made a number of changes in its programs. First, since the number of nontechnical degrees held by Air Force officers is quite high (and complicates the issue because forty-three percent of Air Force officers do have advanced degrees, but many in noncritical/nontechnical areas), AFIT has reduced all nontechnical degree programs. Within CI, for instance, master's degree quotas have been realigned to concentrate almost exclusively on technical areas, and AECP is available only to enlisted people pursuing degrees in engineering, scientific, and technical areas.

Another major effort under way at AFIT is called the Undergraduate Engineering Conversion (UGE) program. Basically, this program evaluates the academic records of Air Force officers to determine if they have sufficient quantitative background to quickly acquire a second bachelor's degree—in either Electrical or Aeronautical Engineering. The program began in the School of Engineering with twenty-eight students in 1979. It has now grown to about 200 in the two engineering specialties. "It is a successful program," notes Colonel Adams. "We have everyone from mathematicians to an Egyptologist in the program now." Another measure of the program's success is that civilian schools like Auburn, Texas Tech, and Oklahoma State are now involved in the program.

AFIT is also helping to operate a program called the College Senior Engineering Program. This program allows college students majoring in engineering to enter the Air Force as Airmen First Class at the beginning of their senior year and receive full pay and allowances during their last year of school. It is designed primarily for schools that do not have an Air Force ROTC program. The program is now commissioning about seventy engineering officers per year.

The School of Engineering

Like all AFIT programs, the School of Engineering's curriculum is designed specifically to meet Air Force needs. In addition to the UGE baccalaureate programs, the school offers master's degrees in Electrical, Aeronautical, Astronautical, Systems, and Nuclear Engineering; Computer Systems; Electro-Optics; Engineering Physics; Operations Research; Strategic and Tactical Sciences; and Space Operations. The school also has a doctoral program and an extensive continuing education program.

What makes AFIT's School of Engineering different from civilian schools is the concentration on application to the Air Force and DoD. Although the basics are taught, the advanced courses are military-oriented. For example: Nuclear Engineering students study nuclear weapons, nuclear effects, and hardening, and Computer Systems students study embedded computers for Air Force weapon systems.

The unique character of the school is also reflected in the faculty. Dr. Przemieniecki notes, "We have developed a faculty in critical need areas, with expertise in nuclear weapons, nuclear effects, and so on—we cover the whole gamut of disciplines of interest to DoD."

The school's concentration on defense application extends to some special master's programs. One of these is the graduate program in Strategic and Tactical Sciences. Col. Donald D. Stevens, head of the Department of Operational Sciences, describes the program as educating officers to apply quantitative and scientific analysis techniques to military operations planning. He says, "We are concerned with the decisions made in the employment of weapons and forces, in how you get the bombs on target most effectively."

Designed for officers with operational experience, the course is still new—only three classes have been through it. It concentrates on analysis techniques, modeling techniques, and studies of tactical and strategic weapons capabilities and effectiveness. Critical Air Force issues, optimum strategic force deployment, and developing the proper fighter mix are also addressed.

Another new program in Colonel Stevens's department is the Space Operations degree program. He describes this program as "going from zero to 'X' and nobody knows what 'X' is. We are not trying to create a space scientist. Rather, we are trying to create mid-level managers with a broad interdisciplinary base able to manage whatever direction space takes." Quite a challenge.

Adding to the challenge, the Air Force determined that it could not wait until the first scheduled class in June 1982 and asked AFIT to begin the program earlier. Seventeen students entered the Space Operations program this past year—all of them with space-related backgrounds.

Test Pilot Teamwork

A third new venture at the school is a joint effort with the Air Force Test Pilot School. "We are combining two very rigorous and related, though different, programs," says Dr. Peter J. Torvik, head of the Department of Aeronautics and Astronautics. "We are combining the

Lt. Col. Thomas D. Clark, Associate Professor of Systems Management in the School of Engineering, lectures graduate students. Half of AFIT's faculty members are USAF officers, many with doctorates. (USAF photo by MSgt. Buster Kollum)

Test Pilot course, which essentially produces a skilled observer of aircraft, with our program, which provides the capability to design aircraft."

The program just began and has only two students this year—it will always be limited to a small number of students by the special academic and operational requirements of the two schools. Part one of the program involves a year at AFIT for intensive course work toward a master's degree in Aeronautics with a major in Aircraft Flight Mechanics. Also during the year at AFIT, the student will select a thesis/research topic acceptable to the faculties of both schools and accomplish the simulation and analytic aspects of the thesis.

Following the year at AFIT, the student enters the normal course of study at the Test Pilot School. While there, the student will develop a test plan and then direct the test program to acquire the data necessary for the thesis. When the thesis is accepted by the AFIT faculty, the student will receive a master's degree.

The School of Systems and Logistics

AFIT's School of Systems and Logistics opened its doors in 1955 and, according to Acting Dean Jerome G. Peppers, is the oldest logistics school in the world, with more than 100,000 alumni (degree and continuing education students).

The school offers three master's degrees designed to meet the Air Force's requirement for officers with knowledge about quantitative analysis, management, accounting, and other subjects they will need to manage a broad spectrum of Air Force programs.

One of the problems in an Air Force logistics management course is that traditional logistics, business, and management disciplines rely on profit levels to measure program effectiveness for decision-making. In the Air Force there is no profit motive, so the school teaches students to adapt traditional economic analysis techniques, like marginal analysis, to the Air Force system, according to Lt. Col. Arthur King, deputy head of the school's System Acquisition Management Department.

The three degree programs at the school are dedicated to Air Force requirements. The Logistics Management degree has six separate majors: International Logistics, which includes course work on the US role in foreign military sales and accompanying logistics support; Acquisition Logistics Management, which is tied closely to AFLC's Acquisition Logistics Division and focuses on such things as life-cycle cost and reliability, and cost-estimating techniques; Contracting and Acquisitions Management, which includes four specially developed contracting courses; Maintenance Management, which includes engineering concepts for maintenance managers and other unique subjects; Transportation Management, which focuses on the study of transportation systems, policies, technology, and strategic mobility; and the general Logistics Management major, which covers the overall logistics system with electives tailored to the specific interests of the students.

Another school degree program is in Engineering Management. This program is designed primarily for Air Force civil engineers and focuses on the skills and knowledge required to manage the resources associated with military real property, facilities, and related systems.

The third degree program within the school is the Systems Management degree. In this program the faculty presents courses that prepare students for technical management positions within research and development, engineering, and other Air Force technical activities.

The School of Civil Engineering

The School of Civil Engineering differs from the other two resident schools in that it does not offer a resident degree program. Maj. Gary A. Nichols, Chief of the Department of Technical Applications, describes the program as geared toward updating technical expertise and broadening the management skills of Air Force civil engineers during their entire career. Included in the curriculum are courses on the application of the latest engineering technology, contingency engineering, construction, cost estimating, energy management and control systems, management, contracting, and a basic entry-level course on Civil Engineering in the Air Force.

Some of the school's twenty-six courses are directed at Air Force civil engineers during their first ten years of service. These courses concentrate on providing or updating the technical background necessary for the various engineering positions within base civil engineering organizations, and preparing civil engineers for Base Civil En-

gineer assignments. This program is especially valuable for new people entering the career field, according to Major Nichols, because Air Force Civil Engineering has no single counterpart—rather, it incorporates a variety of disciplines or specialties including architecture; civil, electrical, mechanical and industrial engineering; contracting; management; construction; emergency actions during disasters; and others.

A second portion of the school's curriculum provides educational opportunities for civil engineers between their tenth and eighteenth years of service. These deal primarily with management subjects and "bringing the civil engineers up to speed on the technical aspects of what people are doing in the field," says Major Nichols.

While the school doesn't offer a resident degree, its 2,000 or so students each year have the opportunity to enter the school's Master of Engineering Applications Program. This program allows civil engineers (about half of whom are civilians) to combine graduate-level course work taken at the school with various courses at schools near them. The program requires about five years to complete. While no one has graduated yet, one student has completed course work and is writing his thesis.

In addition, the School of Civil Engineering offers an extensive nonresident continuing education program. Among the most significant offerings within that program is the Civil Engineering Management Applications Regional Seminar. This annual program is conducted at a different location each year. The seminar lasts one week and is offered twice on consecutive weeks to allow students from a specific geographic region to attend. J. Richardson Johnson, Professor of Management at the school, says the learning doesn't take place only in the classroom: "We get to know each other during the week. We live together in the VOQs, and it becomes an intense learning experience as we exchange information all week long, not just in class."

Former AFIT student Capt. Ernie Kunstadt talks with a coworker at the Continuous Wave Laser System Console at AFWL, Kirtland AFB. (USAF photo by TSgt. Bob Wickley)

The Civilian Institution Programs

The final AFIT educational program is the Civilian Institution (CI) Programs, consisting of a number of nonresident courses and experiences that may or may not lead to a degree. CI differs markedly from the other AFIT educational arms—there is no faculty, only a staff, and CI doesn't offer courses.

The staff is organized functionally to manage the variety of CI programs. In most cases, the people managing individual CI programs have been through that program. Among the most significant CI programs are:

- *Officer Degree Programs:* Basically, these involve Air Force officers earning advanced degrees at civilian colleges and universities. These officers are working toward master's and doctoral degrees in subject areas required by the Air Force. Various management, engineering, science, communications, and other degrees are included here. In addition, CI administers the educational programs of officers preparing for assignments as instructors at the Air Force Academy or AFIT.
- *Airman Education and Commissioning Program (AECP):* AECP is a very competitive program that places qualified enlisted men and women into civilian schools to complete undergraduate engineering and computer sciences degrees in preparation for OTS and commissioning. Approximately 400 people entered this program in FY '82.
- *Education With Industry:* EWI is a nondegree program that provides an opportunity for more than 130 officers to spend nine months working in civilian industry. The officers are assigned to a specific company, following a selection process and approval from the sponsoring company. Their programs consist of observation and participation in the company's activities. Companies participating in the program include several major aerospace industry organizations, airlines, food service companies, health service organizations, and—not to be forgotten—AIR FORCE Magazine.
- *Medical Programs:* Medical Programs, like the Armed Forces Health Professional Scholarship Program (AFHPSP), Physician and Dentist Residency and Fellowship Programs, and Allied Health Education Programs are also monitored by CI. Lt. Col. Reginald P. Gibson, Chief of the Health Care Education Division within CI, notes that his division spends more than $12 million each year on tuition, fees, and other reimbursements to educate more than 2,000 physi-

cians, dentists, nurses, health service administrators, and biomedical science corps professionals. At present, AFHPSP provides medical school expenses, stipends, and active-duty pay (during periods of active duty associated with the program) for about 1,575 Air Force-sponsored medical, osteopathic, optometry, clinical psychology, podiatry, and veterinary students. By 1984, Colonel Gibson estimates that more than fifty percent of all active-duty Air Force physicians will be AFHPSP alumni.

The overall physician crunch within the Air Force has eased, and Capt. Paul T. Williamson of CI's Health Care Education Division said future HPSP efforts will be to maintain the best of physicians and educate them in subspecialties that are still undermanned—surgery and obstetrics/gynecology, for example.

Approximately 260 practitioners are also engaged in graduate medical and dental residency/fellowship programs in preparation for American Specialty Board qualification.

CI's Allied Health Education Program sponsors more than 260 Allied Health (nursing, medical service, and biomedical science corps) Officers studying at civilian universities for health-related degrees from bachelor of science to doctorate. CI also provides continuing education short courses for medical personnel. "The practice of medicine and dentistry, with their respective complex technology, is so dynamic," Colonel Gibson says, "that continuing education is a critical and integral necessity for the practitioner in order to maintain the highest quality of health care possible in the Air Force."

- *Other CI Programs:* CI operates and administers a number of other programs, including: Bootstrap Education, Minuteman Education, Education Delay Program, Scholarships and Grants, Legal Education, Area Specialist Program, and the Senior Commander Sponsored Education Program.

Like AFIT's three resident schools, CI also has a continuing education program. Almost 2,200 officers attend these programs conducted at civilian institutions each year. There are 131 different offerings of thirty-nine courses in such areas as safety, drug/alcohol abuse, senior government management, mass communication, and so on. Participating schools include the Massachusetts Institute of Technology, Cornell, Harvard, the Foreign Service Institute, and others.

Research and Consultations

AFIT's contribution to the Air Force and its response to Air Force requirements is not limited to educating Air Force officers. Talented and active faculty members are also heavily involved in their own research projects, and directing student research. The faculty also lends its expertise to Air Force commands and bases for consultation on a variety of subjects.

Each AFIT resident student in a degree program is required to prepare a thesis or dissertation on a subject related to the Air Force. Following completion of a thesis or research project, a questionnaire is sent to the organization that would most likely benefit from the research to determine whether the research was valuable.

The results of the survey show that almost ninety-five percent of the organizations responding indicated they would have contracted for the research or done it themselves, if AFIT had not accomplished it. In addition, more than eighty-seven percent of those surveyed about School of Engineering research programs indicated the research was "significant" or "highly significant."

Similar results were found from a survey of CI-produced technical research. Based on those surveys, AFIT estimates that the Air Force avoids more than $10.5 million in research costs annually.

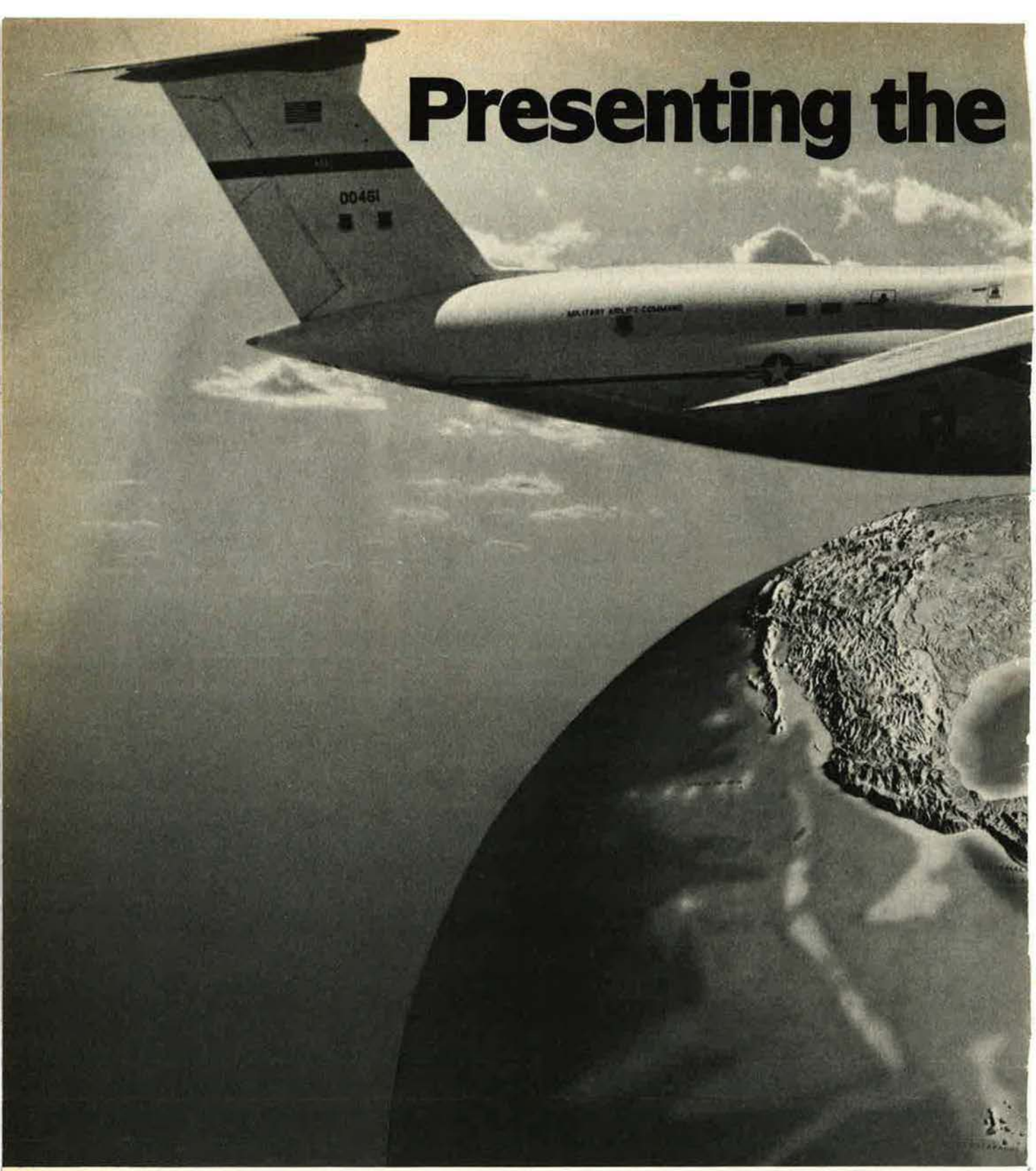
The Air Force also benefits from AFIT students' research by assigning students to the same programs that they did their research in. In fact, Colonel Adams says, AFSC estimates an annual savings of $1 million in on-the-job training costs for AFIT graduates because they hit the ground running.

AFIT research also yields information that increases the body of knowledge and has application, in some cases, beyond the military. One example is the Pattern Recognition work being done by Dr. Matthew Kabrisky in the School of Engineering's Department of Electrical Engineering. Dr. Kabrisky and his students have been investigating how people see. If they can find the method used for physical transmission of images and the chemical-electrical actions that interpret the image, they might be able to copy it with a computer that could then interpret patterns to identify targets.

A farfetched idea? Perhaps, but the work they are doing isn't. They have already succeeded in finding and identifying some targets in realistic science with a computer-optical scanning system believed to incorporate some aspects of the human eye-brain system.

One part of the work in Dr. Kabrisky's lab is to build a computer chip that can interface directly with the brain, but still be protected from the saline solution that surrounds the brain. They think they have succeeded in this. If it works, they will be able to sample and measure electric impulses from the brain's surface at the point where image interpretation takes place. Using the same computer chip, Dr. Kabrisky says there is no reason to believe that they couldn't use a television camera or other device to input electrical impulses to the brain. The possibilities of this computer chip are almost endless—perhaps a prosthesis for blindness could even be developed. In addition, there may be the potential for interfacing the brain directly with aircraft systems. Perhaps some day Dr. Kabrisky's research will lead to thinking an airplane through the air, or flying like birds do.

The contributions of AFIT go beyond defense applications, but they concentrate on defense issues. Has the Air Force benefited from AFIT? General Sherman says, "If the contributions of our graduates reflect credit upon the Institute, you get an unqualified yes to that question. Leaders like Doolittle, Fairchild, Harris, Borman, Holloman, Kenney, Schriever, and a legion of others have left their mark on the development of both the Air Force and aerospace technology. All are AFIT grads. I have no doubt whatsoever that the current generation of graduates will make an equally important mark on tomorrow's Air Force." ■

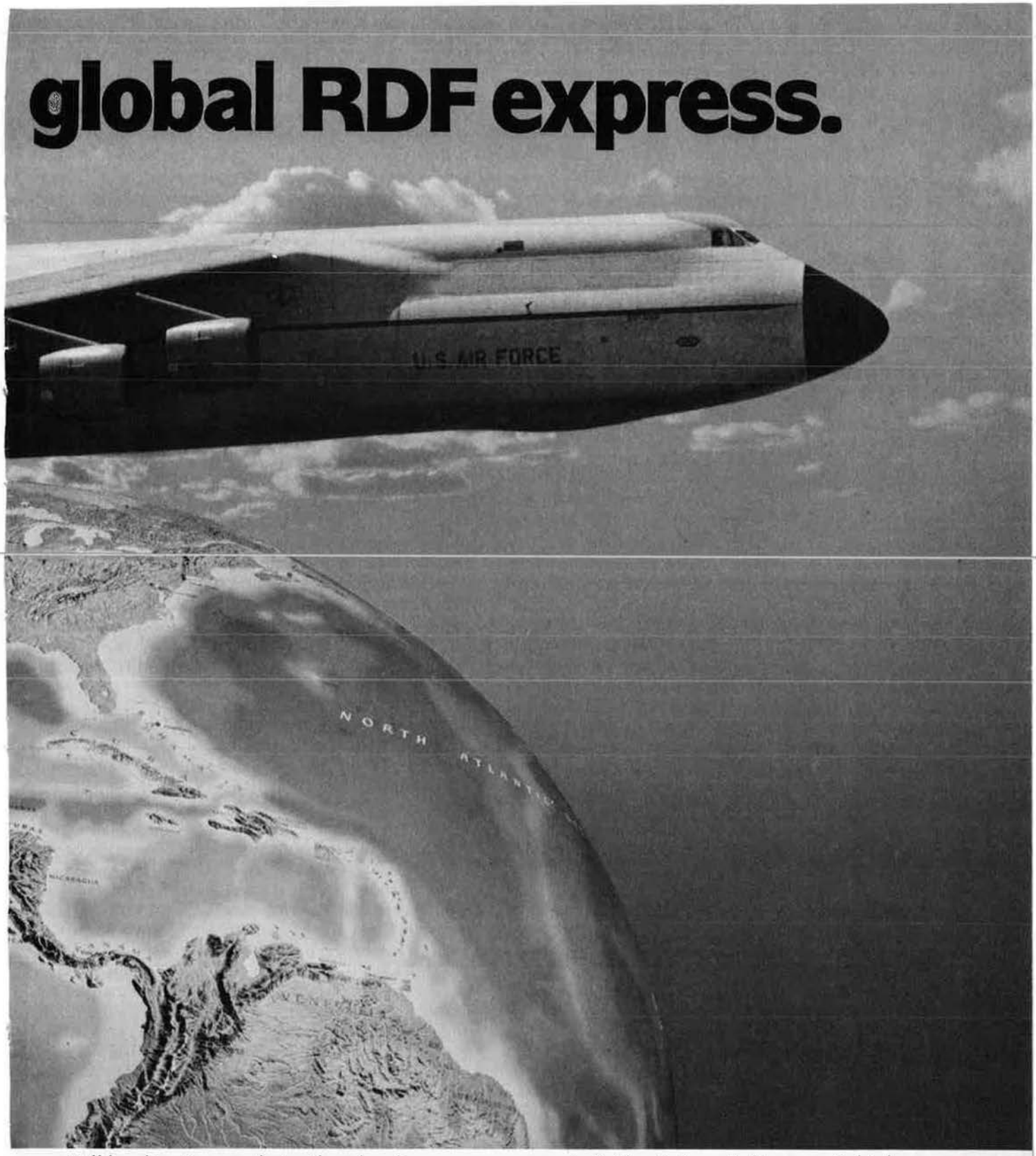


Speed is the driving idea behind the Rapid Deployment Force, and speed is the basic idea of the Lockheed C-5. From loading to off-loading.

With its shoulder-high cargo deck, the C-5 loads fast. And it loads a lot—three OH-58 light observation helicopters plus six AH-1 Cobra attack helicopters in one load. Or two rows of five-ton trucks. Or 36 463L pallets.

The C-5 also saves time in another way. Its huge cargo capacity reduces the number of flights that are needed. In-flight refueling also adds to the C-5's delivery speed. It doesn't have to land en route to its destination to take on more fuel.

global RDF express.



Off-loading is even faster than loading. When seconds count, armored cars and trucks can drive off two at a time.

In actual crisis situations, more than 200,000 pounds of precious cargo have been off-loaded in well under 30 minutes.

But suppose the runways are small and congested. The C-5 capitalizes on its high flotation landing gear to taxi off runway, in snow, sandy soil or even mud. Then it lowers ramps at both ends of its low cargo deck for fast unloading.

The C-5. It's ready now to put the express into the Rapid Deployment Force. Anywhere.

Lockheed C-5

To mark the fortieth anniversary of the Joint Chiefs of Staff, its history and current structure are examined, as well as proposals for changes that may presage a . . .

New Life for JCS at Forty

BY JOHN L. FRISBEE

FORTY years ago this month, on February 9, 1942, the Joint Chiefs of Staff met for the first time. The JCS had been established on an *ad hoc* basis by President Roosevelt following the Arcadia Conference of December 1941–January 1942. There, Roosevelt and Prime Minister Churchill agreed to form the US-UK Combined Chiefs of Staff as the military organization that would provide wartime strategic direction for American and British forces. The JCS became the US counterpart to the British Chiefs of Staff Committee that had existed since 1923.

That decision by President Roosevelt set in motion a series of administrative and legislative actions that was to change forever the management of US defense affairs.

From the late 1700s until 1903 direction of the American armed forces in wartime had been through a loose process of "mutual cooperation," which was notably ineffective in the Spanish-American War. Following that war, the Joint Army-Navy Board was created to coordinate military policy. It comprised two Army and two Navy officers who served on a part-time basis, with no staff. In 1919, the Joint Board was reorganized and given a small staff. It operated in an advisory capacity until early 1942, but was manifestly incapable of directing vastly expanded military forces in a global war, nor was it comparable in prestige and authority with the British Chiefs of Staff Committee. Hence the need for the Joint Chiefs of Staff.

Since the end of World War II, the JCS organization has undergone many changes that have reflected the US position as a superpower with a requirement for strong forces-in-being equipped with both conventional and nuclear weapons. The organizational trend, in keeping with the constitutional mandate for civilian control of our military forces, has been toward increased centralization of civilian authority. The Joint Chiefs have remained from the outset either primarily or exclusively an advisory body in deference to that mandate, and a committee structure in deference to the deep-seated American suspicion of a "Prussian-type general staff" (often cited but seldom understood), and to irrational fears of the rise of "a man on horseback." The committee nature of the JCS has been called a form of checks and balances on the military, characteristic of the US system of government.

Inherent in the role of the JCS as an advisory committee is the strength of corporate expertise, but also some serious weaknesses. One of its frailties is illustrated by this story from a former defense official who prefers anonymity.

Early in his administration, President Kennedy met with Secretary of Defense Robert McNamara, the Joint Chiefs of Staff, and the service secretaries to discuss what course of action the US should follow in Southeast Asia. The Chiefs were unanimous in their advice that the US not become involved in a land war in Asia. Each of them, however, had a different recommendation as to what should be done.

An annoyed Kennedy then began taking his strategic advice largely from one man—Secretary McNamara, who himself often was unreceptive to professional military counsel. Nearly a decade and 57,000 US deaths later, the country brought home the last of 1,200,000 military people who had served in the Vietnam War which, during most of its tragic course, was essentially a land war.

As the late Gen. George Brown, who was JCS Chairman from July 1974 to June 1978, once observed: ". . . the Joint Chiefs of Staff have functioned primarily as each commander in chief wanted them to function. . . . The law is silent on whether [JCS] advice must be accepted."

The Evolutionary Process

Before considering some recent commentary on the Joint Chiefs of Staff, it will be useful to trace briefly its evolution within the broader context of the Department of Defense. Between 1947 and 1958, the JCS was transformed from a simple organization with straightforward procedures to its current much more complex organization and relationships with civilian decision-makers and other advisory bodies, most of which did not exist until after World War II.

The original Joint Chiefs of Staff consisted of Gen. George C. Marshall, Army Chief of Staff; Adm. Ernest J. King, Commander in Chief of the US Fleet and Chief of Naval Operations; and Gen. Henry H. Arnold, Commanding General, Army Air Forces. At General Marshall's suggestion, Adm. William D. Leahy was recalled from his post as Ambassador to the French government at Vichy, ostensibly to be chairman of the JCS and to give that body equal Army and Navy representation. Admiral Leahy's position quickly changed to that of Chief of Staff to the President and his function became mainly liaison between the White House and the JCS. After Admiral Leahy's retirement following the war, the position of Chief of Staff to the Commander in Chief was not again filled.

Throughout the war, the Joint Chiefs operated as both a planning and a command agency, with no charter defining their responsibilities. They dealt directly with the President rather than through the Secretaries of the Army and Navy. The Chiefs were served by a secretariat and standing committees on planning, transporta-

tion, logistics, communications, and other support functions, rather than by a formal staff.

The JCS continued to operate after the war, while postwar organization of the armed forces was being debated in Congress and the media. The unified commands in overseas areas that were created during the war were retained and expanded, and the Strategic Air Command, which was established in March 1946, became the first specified command.

(*Unified commands* have a continuing mission, are made up of components of two or more services under a single commander, and generally have been established on a geographical basis. The five unified commands today are European, Atlantic, Pacific, Southern, and Readiness Commands. *Specified commands* normally include the forces of only one service. The three specified commands are Strategic Air Command, Military Airlift Command, and Aerospace Defense Command.)

National Security Act

Congress passed the National Security Act of 1947 in July of that year. The Act, which became effective on September 17, created a National Military Establishment headed by a Secretary of Defense; gave the Joint Chiefs of Staff legal status as the principal military advisors to the President and Secretary of Defense, but with no provision for a budgetary function; authorized a Joint Staff of not more than 100 officers headed by a director appointed by the Chiefs; established the Departments of the Army, Navy, and Air Force as executive, cabinet-level departments of the government; and created the National Security Council and the Central Intelligence Agency.

The Joint Staff was organized along lines similar to the structure that had supported the wartime JCS. It had three staff groups—Intelligence, Strategic Plans, and Logistics Plans—that served senior part-time joint committees. Other joint committees that also were not part of the Joint Staff (communications, civil affairs, transportation, meteorology, munitions allocation, and the Army-Navy Petroleum Board) were supervised by the Director of the Joint Staff.

The 1947 Act severely limited the authority of the Secretary of Defense. All powers not specifically delegated to him remained with the service departments. He was given only *general* authority and control over the three services, authorized no more than three special assistants, and provided with no military staff.

The new JCS was made up of the Chiefs of Staff of the Army and Air Force and the Chief of Naval Operations, but did not include the Commandant of the Marine Corps. In 1952, the Commandant was given "coequal status" when the Joint Chiefs were dealing with matters of direct concern to the Marine Corps, but it was not until 1978 that he became a regular member.

In 1948, the Key West Agreement on service roles and missions, signed by the Joint Chiefs and the Secretary of Defense, also specifically stated that JCS responsibility for strategic direction of the armed forces included general direction of all combat forces.

The 1947 Act was a compromise between those who supported and those who opposed a genuine unification of the armed forces. It preserved the integrity of the individual services and retained some measure of their command responsibilities while providing limited coordinative authority under a weak Secretary of Defense. It was a loose federative structure that did little to control unbridled interservice rivalry in a period of rapid technical advances in weapons and long-range delivery systems, extremely limited defense budgets, and already deteriorating relations between the US and its erstwhile Soviet ally. The first Secretary of Defense, James Forrestal, soon recommended increasing the authority and the staff of the Secretary, and the establishment of a single officer within the Joint Chiefs of Staff organization to advise him on military matters and serve as his liaison with the Joint Chiefs.

The 1949 amendments to the National Security Act of 1947 strengthened the Secretary's central authority and transformed the National Military Establishment into the Department of Defense. The Departments of the Army, Navy, and Air Force became military, rather than executive, departments. They lost cabinet rank and representation on the National Security Council. The Secretary of Defense was clearly designated principal assistant to the President in all matters relating to the Department, and authorized an under secretary and three assistant secretaries. A Chairman of the JCS was created with responsibility for presiding without vote over JCS meetings and for formulating agendas for the meetings, but with no command authority. His term of office was set at two years, and he could be reappointed only once except in time of war. The Joint Staff was increased from 100 to 210 officers and the JCS advisory function extended to include the National Security Council.

Neither Robert Lovett, who became Secretary of Defense in 1951, nor the first JCS Chairman, General of the Army Omar Bradley, was satisfied with the operation of the JCS under the 1947 Act and its amendments. Both felt that the Chiefs were spending too much time on interservice issues and administrative matters at the expense of national strategic planning.

JCS Reorganization

In his campaign for the presidency, Dwight Eisenhower had been critical of Department of Defense operations. On June 30, 1953, six months after he took office, his Reorganization Plan No. 6 was announced. The JCS Chairman's position was strengthened by assigning him responsibility for managing the Joint Staff. The Service Chiefs no longer would act as executive agents for the unified and specified commands, but rather the command line would run from the President

Chairmen of the Joint Chiefs of Staff

General of the Army Omar N. Bradley, USA	8/16/49	8/14/53
Adm. Arthur W. Radford, USN	8/15/53	8/14/57
Gen. Nathan F. Twining, USAF	8/15/57	9/30/60
Gen. Lyman L. Lemnitzer, USA	10/1/60	9/30/62
Gen. Maxwell D. Taylor, USA	10/1/62	7/3/64
Gen. Earle G. Wheeler, USA	7/3/64	7/2/70
Adm. Thomas H. Moorer, USN	7/3/70	6/30/74
Gen. George S. Brown, USAF	7/1/74	6/20/78
Gen. David C. Jones, USAF	6/21/78	present

With the exception of Admiral Radford, all Chairmen served previously as Chief of a military service. On completion of his four years as Chairman in June 1982, General Jones will have served on the Joint Chiefs of Staff for eight years—longer than any of his predecessors.

through the Secretary of Defense and the responsible service secretary to the commands. Under this arrangement, the service chiefs still retained some command authority since not all combat-ready units were then assigned to the unified and specified commands. Finally, the Secretary of Defense was authorized six additional assistant secretaries and a general council.

Some five years later, President Eisenhower characterized this command arrangement as "cumbersome and unreliable in time of peace and not usable in time of war." He submitted to the Congress a reorganization proposal that was approved by the Congress on August 6, 1958. It was by far the most important of the reorganization measures so far as centralization of civilian authority is concerned.

The military departments were removed from the chain of command so that it ran from the President to the Secretary of Defense and through the Joint Chiefs of Staff to the unified and specified commands. All orders to the commands were to be issued by the JCS in the name of the Secretary. All operating forces were assigned to the unified and specified commands. The service secretaries lost their role as executive agents for these commands, but retained responsibility for recruiting, training, logistic support, and administration within their services, and for preparation of service budget requests. The authority of the Secretary of Defense over the defense budget was enhanced, and his right to transfer, abolish, or consolidate functions was confirmed.

The JCS Chairman was given a vote on JCS issues and authorized to assign tasks to the Joint Staff, as well as to appoint its director, subject to approval of the Secretary of Defense. The Joint Staff was enlarged to 400 officers and became a fully integrated staff, rather than the committee-style organization established in 1947. The staff was reorganized in J-Directorates similar to the joint staffs of the unified and specified commands. It was forbidden to "operate or be organized as an overall Armed Forces General Staff." The Chiefs were encouraged to delegate day-to-day operation of their respective services to their vice chiefs, thus providing more time for their primary duty as members of the JCS.

The principal functions of the JCS under 1958 legislation may be summarized as preparing strategic plans and arrangements for strategic direction of the armed forces; recommending establishment and force levels of the unified and specified commands and reviewing their plans and programs; performing logistic and mobilization planning; providing the Secretary of Defense military requirements and strategic guidance for developing the defense budget; and establishing joint doctrine for the unified and specified commands. In short, the Joint Chiefs of Staff were clearly restricted to the staff functions of planning, and advising civilian decision-makers. They were not in the chain of command, except for their task of translating directives from the President and Secretary of Defense into military orders and transmitting those orders to the unified and specified commanders (CINCs).

The responsibilities of the JCS have remained fundamentally unchanged since 1958, though there have been organizational changes in the Joint Staff in the interests of better management and to meet changing security demands. For example, the J-2 Intelligence Directorate was abolished in 1963 and the Defense Intelligence Agency, which had been established in 1961, was charged with providing intelligence staff support to the JCS. In 1976, the Operations Directorate (J-3) absorbed the work of the Communications-Electronics Directorate (J-6), and the Plans and Policy Directorate (J-5) took over most of the responsibilities of the Personnel Directorate (J-1). A new Command Control and Communications Systems Directorate was set up in 1979. *(See JCS organization chart, p. 89.)*

Department of Defense agencies, including the Defense Communications, Defense Nuclear, Defense Logistics, and Defense Mapping Agencies, that formerly reported to the Secretary of Defense through the JCS now report to an Under Secretary or Assistant Secretary of Defense. The Chairman of the JCS continues to supervise the military work of the Defense Nuclear Agency, however.

The Root of Controversy

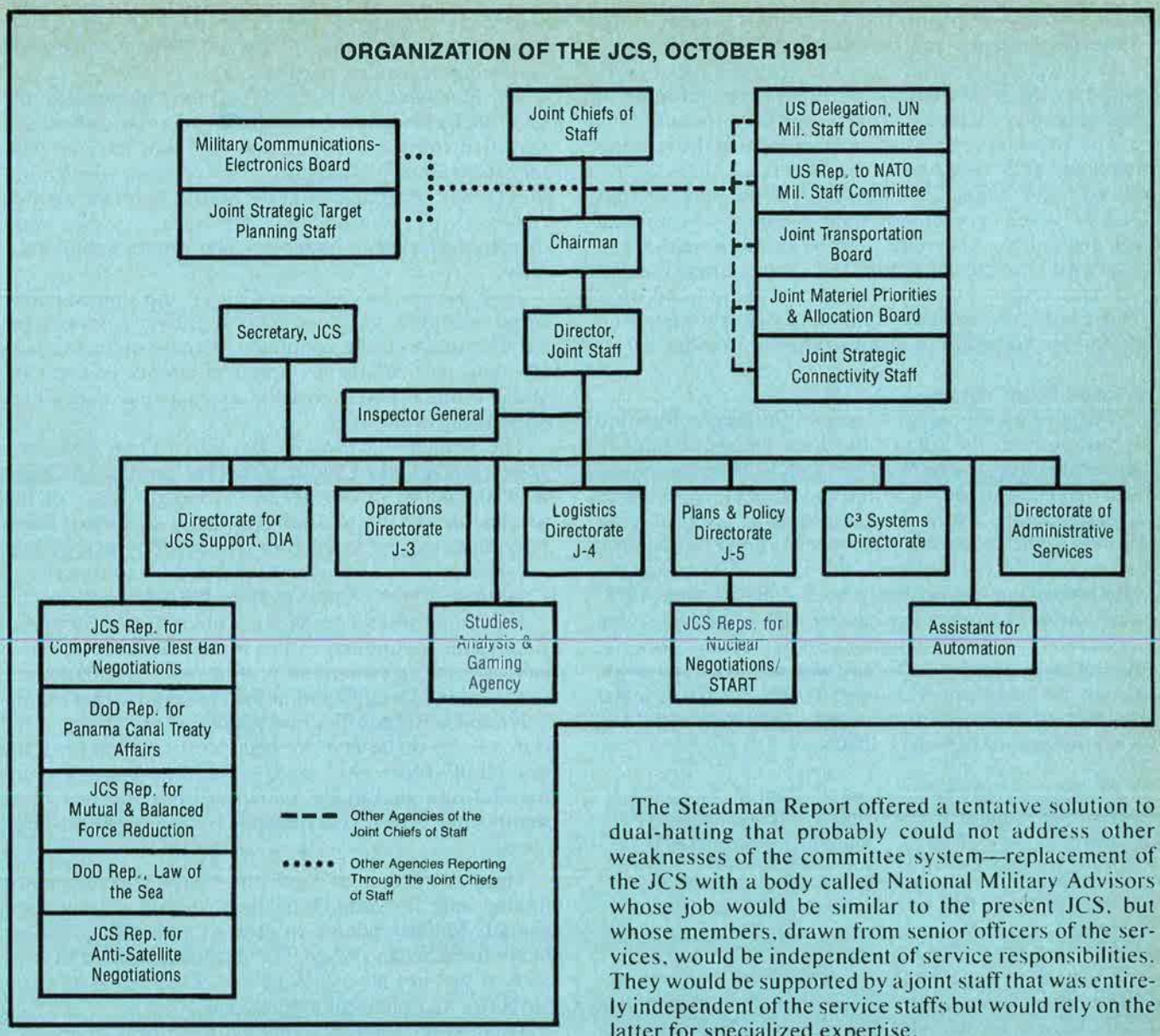
Throughout the post-World War II years, the Joint Chiefs of Staff organization has been little understood by the general public; frequently criticized for performing as the Congress intended it to perform (*i.e.*, as an advisory committee concerned with the military factors of national security policy); often blamed for decisions over which it had little or no control; and seldom praised for the genuine contributions it has made to the management of defense affairs.

There has been relatively little criticism of JCS performance in contingency planning and in the conduct of military operations. In his July 1978 *Report to the Secretary of Defense on the National Military Command Structure*—the most recent of many studies of the Defense Department—Richard C. Steadman, a former Deputy Assistant Secretary of Defense, said: "In general, we found that during crises the system has provided a range of military options sufficiently broad to satisfy the decision-makers." The Joint Chiefs have seldom received the credit that is due them in that respect.

On the other hand, many people in uniform who are acquainted with the JCS system and most knowledgeable civilian observers believe the quality and responsiveness of JCS advice can and must be improved. This is especially applicable to JCS strategic assessments and recommendations on allocation of resources among the services—two essential elements in formulating the defense budget—and to resolving policy differences among the services.

There is wide agreement that the tap root of JCS

John L. Frisbee, Colonel, USAF (Ret.), was on the staff of AIR FORCE *Magazine from December 1969 until he retired from the Editorship in June 1980. During a distinguished Air Force career, he served as a fighter and bomber pilot, planner on the Air Staff and at major commands, and as a teacher and leader of young men at West Point and the US Air Force Academy. He was speechwriter, sounding board, and mentor for a series of senior uniformed and civilian Air Force leaders while special assistant to the Secretary of the Air Force. He holds bachelor's degrees in economics and Latin American studies, a master's degree in international relations, and is a graduate of the Armed Forces Staff College and Canadian National Defence College.*



shortcomings is its committee structure, but less agreement about what could be done about it administratively or within the probable limits of congressional tolerance.

Since the Joint Chiefs of Staff function as a committee, the Chairman and each Member have a single vote. Positions taken by the Members are inevitably affected by the fact that the Chiefs are in the difficult position of having to fight on the one hand for their respective service programs and, on the other, are expected, while wearing their JCS hats, to judge those same programs objectively in the light of the national interest and against competing programs of other services. This dichotomy also embraces policy issues where there may be marked differences among the services.

In earlier years, the frequent result of this "dual-hatting" was split decisions that had to be resolved by the Secretary of Defense, at the expense of JCS influence. In recent years, the result more often has been decisions watered down to the least common denominator of agreement. It is arguable whether, from the viewpoint of decision-makers, compromised decisions are preferable to splits.

The Steadman Report offered a tentative solution to dual-hatting that probably could not address other weaknesses of the committee system—replacement of the JCS with a body called National Military Advisors whose job would be similar to the present JCS, but whose members, drawn from senior officers of the services, would be independent of service responsibilities. They would be supported by a joint staff that was entirely independent of the service staffs but would rely on the latter for specialized expertise.

This proposal, which has been aired before in different forms, is opposed strongly by most military men and by many civilian analysts. Adm. Thomas Moorer, a former Chairman of the JCS, termed it "disastrous." It is absolutely essential, in his view, that JCS members have the intimate knowledge of programs, readiness, and problems of their respective services that comes only from constant contact with their service staffs and commanders. None of the service chiefs seems to feel that dual-hatting imposes on them an intolerable work load, as some critics have held. It is doubtful, too, that there would be much enthusiasm in the Congress for such a drastic change.

Another frequent criticism of the JCS system, closely related to its committee structure, is aimed at the Joint Staff. There is a general feeling that its work is impaired by a lack of initial guidance from senior levels, and by cumbersome staffing procedures, including detailed coordination with the service staffs that sometimes stifles initiative and smothers useful dissent in a quest for unanimity. In an absolute sense, these charges probably have merit. However, retired Air Force Maj. Gen. Robert N. Ginsburgh, who served on the JCS Chair-

man's Staff Group, the Policy Planning Group of the State Department, and the National Security Council staff, says that Department of Defense staff papers prepared by the Joint Staff for the NSC were uniformly of higher quality than those from other Departments.

The Steadman Report recommended that the requirement for JCS coordination with service staffs be reduced by including differing views in the body of staff papers rather than diluting their usefulness by striving for unanimity. Also suggested were more analysis of alternative courses of action, and a requirement that the services assign only their top officers to the Joint Staff. These latter recommendations were strongly supported by former Secretary of Defense Harold Brown.

A Look From Within

Three years ago, at an American Enterprise Institute symposium on the role of the Joint Chiefs of Staff in national policy, Curtis W. Tarr, who has been an Assistant Secretary of the Air Force and Director of Selective Service, said: "There is no question . . . that the authority of the Joint Chiefs has been eroded through the years, to the disadvantage of the nation." Although the rate of erosion has probably been reduced since 1978, most serious commentary has been aimed at preserving the military voice in national security policy. John G. Kester, a Washington attorney who was a special assistant to the Secretary of Defense in 1977–78, wrote in the American Enterprise Institute's *Foreign Policy and Defense Review* of February 1980:

> National security policy is the resultant of many influences, brought to bear from many different angles. The military consideration . . . must not get lost in the shuffle if the product is to stay balanced. To assure that contribution, the senior military staff should be organized to do the best possible job. It is not so organized today. . . .

Suggestions for amplifying the military voice in defense affairs have ranged from relatively minor alterations, such as former Air Force Secretary Eugene Zuckert's judgment that the Chairman should be given a four-year term of office, to some truly drastic changes. Admiral Moorer, for example, believes that the Secretary of Defense should be removed from the military chain of command, and John Kester holds that the time has come to debate seriously transforming the JCS into a defense general staff. Neither of these positions would be likely to strike a responsive chord on Capitol Hill, short of a complete breakdown of the command structure.

One widely supported recommendation for improvement within the existing system is to increase the authority and responsibilities of the JCS Chairman. The Steadman Report notes that "a committee structure is not effective for the exercise of military command and management authority. Such authority could be more effectively exercised by the Chairman, who . . . should also be directed to act in consultation with other JCS members *when time permits*." (Emphasis added.)

The Report suggested that the Chairman, who now advises the Secretary of Defense on budget and force structure issues "on an informal and personal basis," should be formally designated "as responsible for providing military advice from a national viewpoint" on these matters. He should be given adequate analytical staff support for that purpose.

Mr. Steadman also believes that the Chairman should be formally designated as spokesman for the unified and specified commanders in chief, who now have no military superior in Washington. In his opinion, which is not universally shared, this move would improve combat readiness by assuring that the CINCs' views were directly reflected in budgetary and programming decisions.

John Kester has observed that "the unmistakable trend over time has been toward greater authority for the Chairman. And a continued increase of that authority—and particularly his practical control of the joint staff—offers the only possible alternative to a major restructuring of the JCS. . . ."

The present Chairman, Air Force Gen. David C. Jones, has told the Congress that the position of Chairman should be strengthened to remedy some of the weaknesses of the present committee structure. Since that might require legislative action, it obviously could not come to pass during General Jones's tenure as Chairman, which expires in June 1982.

In an interview with Edgar Ulsamer, Senior Editor for Policy and Technology of this magazine, General Jones said: "In the last few months of my time as Chairman, I plan to think through and initiate specific actions to resolve some of the difficulties plaguing the JCS organization. . . . I do believe we need to strengthen the joint operation" *(May 1981, p. 52)*. The Chairman's recommendations should be known within the next few months, perhaps by the time this issue reaches readers.

★ ★ ★

The Joint Chiefs of Staff often have played a more limited role in formulating defense policy than they should. Military advice to civilian authorities is most likely to be heeded when it is objective, clear, and incisive. It has not always been that, because of diffused authority and restrictive practices.

There is no assurance that even the best of military advice will be accepted. The degree of its acceptance depends in part on its compatibility with political and economic factors and in part on the receptiveness of a President and his Secretary of Defense to professional military counsel. In Admiral Moorer's view, the JCS reached its nadir in the McNamara era. Some observers believe that Harold Brown did more than any other recent Secretary to enhance the effectiveness of the JCS organization. Still, General Jones told Congress that in his first two and a half years as Chairman, he had more influence "individually than institutionally."

With no apparent movement on Capitol Hill for an official review of the Joint Chiefs of Staff organization and procedures, the impetus is coming from within. What General Jones's recommendations will be, or whether they will be supported by Secretary of Defense Caspar Weinberger, is not now known. It seems likely that the Chairman will address in evolutionary rather than revolutionary terms some of the institutional weaknesses that have been outlined here. The right small changes can produce large results.

Conceivably, a new and more influential life for the Joint Chiefs of Staff could begin at forty. ■

At GTE, simulation is no game.

At GTE we don't treat simulation like a game because we know that some day the problems could be real.

GTE Sylvania Systems Group is a leading supplier of radar effects simulators to the U.S. Military.

Tactical Air Controllers and Tactical Weapons Controllers are, or soon will be, training on GTE designed and built systems in the U.S. Marine Corps and U.S. Air Force.

If you have a radar training problem, contact us. We think we can help because we don't treat simulation like a game.

GTE | **Systems**

Sylvania Systems Group
Communication Systems Division
GTE Products Corporation
77 A Street
Needham Heights, Mass. 02194 U.S.A.
Area Code 617 449-2000
TELEX: 92-2497

(This is the concluding report on the AFA symposium. Part I of the report appeared in the January '82 issue of AIR FORCE *Magazine.)*

A LOOSE grouping of defense critics bent on turning the clock back in military technology to simpler, cheaper weapons that can be acquired in large numbers was a prominent topic of AFA's national symposium, "The New Imperatives of US Aerospace Power," held November 12-13, 1981, in Los Angeles, Calif.

Gen. Wilbur L. Creech, the Commander of the Tactical Air Command, warned that these reformers "would not only grant the quantitative edge to the enemy but the qualitative edge as well. They would turn the clock back to cheap and simple systems." Charges by these critics that the Air Force has an unrelenting bias toward high technology systems are unfounded, he said, stressing that "we want nothing that is more sophisticated than it need be to get the job done." He cited the A-10, "a fine weapon system for the close air support mission for which it was designed," as an example of the Air Force's commitment to a balanced force.

In designing a modern force structure, the obvious and dominant factor is the nature of the threat to be countered. Advocates of simple, cheap systems, affordable in large quantity, tend to forget that the Soviet Union relies heavily on sophisticated technologies to provide its weapon systems with high performance and great lethality.

We Can't Afford to Lose the Technological Edge

BY EDGAR ULSAMER
SENIOR EDITOR (POLICY & TECHNOLOGY)

Brig. Gen. Robert A. Rosenberg, USAF's Assistant Chief of Staff for Studies and Analyses, pointed out that the "self-proclaimed reformers" fight technological progress and categorically favor quantity over quality. He made a clear distinction in labeling this unique group who abuse and misuse analysis when he said: "The Air Force leadership fully supports the goals of the Congress and the American people whose legitimate efforts seek reform in the defense establishment to enhance our national security in an affordable way." On the other hand, the arguments that the reformers make rest largely on analytical legerdemain and have been around "since the first cavemen commissioned a cost-benefit analysis for proposed improvements of the Mk-1, mod zero club," he said.

The basic fallacy of the quality vs. quantity argument is that the Air Force should fly day, clear-weather aircraft only—"nice simple fighters"—while the Soviets use all-weather, night-capable aircraft. The reformers, General Rosenberg suggested, have not learned the historic lesson that "armies move forward under darkness and bad weather." The reformers cement their case for simplicity with the contention that the Air Force's allegedly congenital addiction to technological complexity "provides us less capability for more money," General Rosenberg explained.

In order to make this point, these defense critics fabricate data suggesting that USAF's advanced aircraft are marred by unacceptably low readiness and that the cost of tactical aircraft is headed out of sight. The reality of the situation, the Air Force's chief analyst pointed out, is that "if you had to go up against modern Soviet fighters with lots of low-cost fighters, we would end up with lots of low-quality planes getting killed."

General Creech pointed out that the Soviet Union is producing annually about 1,300 fighters and "they are first-rate systems. . . . So the quality edge has been slipping away. The edge in some areas is razor-thin, and in others it's completely gone. All of their current production fighters are technologically sophisticated." Three of the four fighter types rolling off Soviet production lines have swing wings, and all incorporate "increasingly sophisticated avionics," according to the TAC Commander.

Other Soviet technological advances are manifest by operational deployment of precision-guided munitions and development of a number of new fighters. The US, by contrast, General Creech pointed out, is not developing a single new fighter. The Soviets, he suggested, are not impeded by Luddite qualms and, instead, follow Lenin's dictum that "one must either master modern technology or be crushed."

Why "Low Cost" Costs More

The low-cost aircraft option is also a charade in an economic sense when measured in operational as well as initial acquisition costs, according to General Rosenberg: "Since low-cost planes mean less capable planes, you need more of them. In turn, you need more pilots, more maintenance people, more bases, more chow halls, more training, more fuel, more spares, more munitions, and so on. When you put it all together, the 'low-cost' approach costs more in the long term."

The mix of US fighter aircraft in terms of high performance and more modest systems is bounded by the threat and by cost-effectiveness, the Air Force's chief analyst told the AFA meeting: "As to the threat, you must be able to satisfy minimum requirements. . . . If the enemy has a beyond-visual capability, you should too—or you may never get into visual range. If you get into a dogfight, I agree you want a plane that can outfly the enemy, but you don't want to take a chance on getting blown out of the sky before you see him, and you don't want him to be able to avoid you because he can find you when you can't find him."

The cost-effectiveness claims made by the Luddites in behalf of low-cost, low-performance systems is based

on another canard, General Rosenberg suggested. "We found that if you replaced F-15s with an equal cost force of day/VFR fighters, the overall capability actually declined, even though you could buy four day fighters for the cost of an F-15." He underscored the difference quality makes by citing USAF's experience of destroying the Thahn Hoa bridge in Vietnam during the Southeast Asian war. US aircraft flew 873 sorties, dropping unguided bombs. The US lost eleven planes and failed to destroy this strategic bridge. "When we got laser bombs," General Rosenberg explained, "eight F-4s with two bombs each destroyed the bridge in one mission with no losses."

The reformers' tendency of "touting the glories of simple low-cost aircraft and condemning the technology of our modern aircraft" is tantamount to promoting a force structure that "would sacrifice more of our planes in combat and it would cost us more to boot," according to General Rosenberg. At the same time, USAF's best planes are not needed for all missions: "The bottom line is that a high-low mix of weapons is the most cost-effective approach to countering a spectrum of threats, and you can't forego the high end of the mix because the enemy will take advantage of your weakness and attack where you leave an opening."

The critics' skewed analysis forgets that USAF's F-15s constitute less than one-fifth of the service's fighter force, a ratio that General Rosenberg pointed out is not "unreasonably high for an around-the-clock capability for air defense and for an ability to mount offensive operations without waiting for daylight or good weather."

Another factor taking the wind out of the reformers' sails is that the Air Force has demonstrated that its "two most sophisticated planes, the all-weather, 'complex' F-111s and F-15s can exceed planned sortie rates when the proper logistics are available. During exercises, the F-15 has flown over three sorties per day for two weeks, and the F-111 has doubled its [programmed] wartime rate," according to General Rosenberg.

Today's Harsh Realities

One of the horror stories the reformers dwell on in their presentations to the Defense Department, other elements of the executive branch, and Congress is that the F-16 has experienced an "uncontrolled" cost growth of fifty percent in only two years. Their argument is that this hike reflects an unplanned increase in complexity and that this complexity will actually lower effectiveness. Both contentions are specious, General Rosenberg told the AFA meeting, and confuse conditions prevalent at the time of the program's inception in 1972 with the harsh realities of today, induced by massive growth in Soviet technology.

In 1972, he explained, "the threat was MiG-19s and MiG-21s, but by the time of the F-16 production decision we were worried about the MiG-23, or Flogger. And, since Soviet avionics and munitions have progressed over time, the Flogger will have the first shot opportunity in an engagement with F-16s." Further, the 1972 concept defined the low side of a high-low mix for a prototype flyoff stressing air-to-air capability in the form of aerodynamic performance in a close-in, visual turning engagement.

The basic fallacy of the quality vs. quantity argument is that the Air Force should fly day, clear-weather aircraft only—"nice simple fighters"—while the Soviets use all-weather, night-capable aircraft.

"If you had to go up against modern Soviet fighters with lots of low-cost fighters, we could end up with lots of low-quality planes getting killed."

The ultimate production design, by contrast, was based on USAF's force structure requirements for the 1980s, which mandated additional dimensions for the F-16. A key consideration, General Rosenberg said, was that the "F-4 fleet, with its air-to-ground capability, had been aged by the Vietnam War and needed replacement. The F-16 was found to be a suitable airframe for the job, and its role was thus expanded from the low end of the air-to-air mix to include a significant air-to-ground mission. As with almost all systems, we will continue to improve the F-16, but we will do it based on analysis and reasoned judgment—not a blind pursuit of technology."

The pivot of the reformers' argument on behalf of the "simple and cheap" approach, General Rosenberg charged, is the contention that "we as a country won't support substantial defense increases, so we should acquiesce to their low-cost approach to war. They don't seem to recognize that we will spend more when the country agrees on the need, such as in wartime. Nor do they think that the current upturn in defense spending is anything more than an aberration. Unfortunately, if their gospel is accepted, it may become a self-fulfilling prophecy."

The crucial question is this, General Rosenberg said: "Should we accept the fiscal fatalism of the [critics] and opt for the quantity approach to war? Personally, I believe you will get the same results we got at the Thahn Hoa bridge in Vietnam—ineffective forces and an inability to do the job. I also know how the Russians would like us to answer that question."

Tactical Imperatives

US loss of strategic nuclear superiority and the prospect of shaky, uncertain parity with the Soviets puts

added strains on the other two elements of this country's deterrent capability—theater nuclear and conventional forces—according to General Creech. In the past in the NATO arena, he said, "we had tactical nuclear superiority. That is no longer the case. Our one-time edge has gone away and now the other side enjoys superiority to the tune of about two to one in most measurable areas such as throw-weight, number of weapons, and delivery systems." Even with the advent of Pershing II and ground-launched cruise missiles in 1983—assuming resolution of the political problems in Europe that threaten their deployment—"there are no serious prospects for us to again attain superiority and, indeed, the long-range outlook is for us to be at a qualitative and quantitative disadvantage. That, in turn, puts additional strain on the third element—conventional deterrence," according to the TAC Commander.

Among pluses accruing to this country's tactical airpower from the ability to operate at night is a "sanctuary . . . where our technological edge can be put to work."

In the field of conventional warfare capabilities, "strategic mobility" is likely to remain the central criterion throughout this decade, he predicted. The reason is that because of the strategy of forward defense and rearward basing practiced by the US—and after a fashion by the USSR—only "a small fraction of the forces available to each side are actually located in forward locations—and the remainder of these forces must be brought forward."

Explaining that forces not available to the combined air-land, maritime battle at the point of contact are "essentially irrelevant," he said, "we will need to move out in days—not weeks or months—and, once the fighting starts, we may well measure success, for replenishment and resupply, in terms of hours rather than days." Stressing that US strategic mobility must be at least as efficient as the Soviets', General Creech pointed out that the USSR "enjoys the geographic advantage of being seven times closer to West Germany, for example, and eight times closer to the Arabian Gulf" than the US.

The second major challenge confronting US conventional forces in the years ahead is enhanced tactical mobility, because modern battlefields represent a "dynamic environment. We must be able to go shallow or go deep, as well as have good lateral mobility and the ability to switch from role to role with our aircraft," according to General Creech. Lastly, conventional forces in the future will have to be able to "fight around the clock. The side that can best fight at night has the best chance of carrying the battle."

The Soviet Union, according to the TAC Commander, is focusing combat training and equipment on fighting at night within a concept of "continuous combat." The advantage of continuous combat is that it gets the most out of available weapon systems by boosting sortie rates and firepower, General Creech pointed out. Among the pluses accruing to this country's tactical airpower from the ability to operate at night is a "sanctuary . . . where our technological edge can be put to work." US fighters or bombers penetrating at night at low altitude are beyond the reach of Soviet interceptors lacking look-down, shoot-down capabilities. Even though the Soviets are developing this capability, the bulk of their aircraft will lack look-down, shoot-down features for years to come, he suggested.

Electronic Battle

Another growth sector for conventional warfare is the "electronic battle. . . . The side that does best in the electronic battle will probably do the best in the overall battle—and it may well decide the battle. Certainly, if one side or the other does very poorly in the electronic battle, it has little hope of winning the overall conflict. We are paying lots of attention to electronic warfare, for example, in the development of the Compass Call jamming system that exploits the [Soviet Union's] heavy dependence on command and control. Other examples are the EF-111, the Precision Location Strike System (PLSS), and the other electronic warfare systems that we are hoping to field."

Terming EW systems highly critical, he said that PLSS, by pinpointing ground threats, is to the electronic battle as AWACS is to the air battle. "We must know where they are so we can destroy some, disrupt many, and avoid the rest until we can take care of them." Information generated by PLSS will flow directly to the Army's artillery units in the battle. As the Soviets bring their SAMs forward, General Creech said, they thus will become targets for both the Army and the Air Force.

The F-4G Wild Weasel was singled out by General Creech as one of USAF's primary EW systems that "will be around for years to come." TAC, he said, plans to upgrade the F-4G by adding the digital avionics ARN-101 system. Eventually, a Wild Weasel derivative of the F-15 or F-16 might supplant the F-4G.

One of the Air Force's serious setbacks in the current budget cycle was denial of funds for the development of an advanced tactical fighter. Gen. Robert T. Marsh, the Commander of the Air Force Systems Command, told the AFA meeting, "while we are very disappointed that we lost these funds this year, we plan to fight hard next year to recoup. We believe we can improve our F-15s and F-16s over the near-term—between 1985 and 1990—but in the 1990s we will need an advanced tactical fighter." General Creech concurred, saying, "we

"The side that does best in the electronic battle will probably do the best in the overall battle—and it may well decide the battle."

should have a new tactical fighter under development now." The characteristics of such an aircraft are not certain at this time, but might include supersonic cruise capability and forward-swept wings. If the principal role of the Air Force's next tactical fighter is seen as being in the area of close air support or deep, second echelon interdiction, "we probably won't need any esoterica in technical approach or materials; if the mission is air superiority, on the other hand, we will need advanced technologies," General Creech said.

Runway interdiction, especially the development and deployment of munitions tailored to this task, is an area of increasing importance, according to General Creech. The JP-233 Low-Altitude Airfield Attack System under joint development with Britain—initially deemed a promising candidate for this mission—was scuttled by Congress. The result is a void that, as yet, has not been filled. As the TAC Commander put it, "JP-233 is buried, and the mourners have left the cemetery—but they are still mourning. We do need runway defeat munitions." Congress killed the program because of "very significant cost growth" and on grounds that JP-233 "requires direct overflight of highly defended enemy airfields when in fact this mission can be performed at significant standoff ranges by the Medium Range Air-to-Surface Missile (MRASM)." As a result, the Air Force is looking for alternatives. Over the short term, these include a French design, involving a retarded bomb; over the long term, there is the prospect of completely new runway defeat munitions coupled either to MRASM or, in a complementary fashion, to aircraft, according to General Creech.

The demand for yet more outsize cargo capacity will swell because, by 1986, the airlift requirements of each mechanized Army division are expected to increase in total weight by about twenty percent and by about sixty percent in outsize equipment.

The Airlift Imperatives

This country's ability to project force, "by itself, could provide a significant element of deterrence to Soviet military adventurism and, concurrently . . . bolster friendly governments that might be subjected to political and military pressure," Gen. James R. Allen, Commander in Chief of the Military Airlift Command, told the AFA meeting. Ironically, the US is in "an unbalanced posture in which our mobility forces are inadequate to meet the deployment needs of our combat forces." As a recent congressionally mandated mobility study concluded, there is a clear-cut need for a 20,000,000-ton-mile-per-day increase in overall military airlift capacity of which at least half should be in the so-called outsize category, meaning the ability to accommodate such large and heavy items as the infantry fighting vehicle, self-propelled howitzers, and attack helicopters, the MAC Chief reported.

The demand for yet more outsize cargo capacity will swell because, by 1986, the airlift requirements of each mechanized Army division are expected to increase in total weight by about twenty percent and by about sixty percent in outsize equipment.

The Air Force's solution to the problem, General Allen told the AFA meeting, is a new airlifter, the C-17 (formerly known as the CX), which if "purchased in adequate numbers . . . could eliminate the current airlift shortage." Describing the aircraft as being capable of rapid intertheater delivery of troops and all types of cargo directly to forward bases in the deployment theater, the MAC Chief said the C-17 will operate from small, austere airfields and runways as short as 3,000 feet, thus qualifying for both inter- as well as intratheater airlift operations. (Congress dealt the program a severe setback by eliminating funding this year.) As Secretary of the Air Force Verne Orr told the symposium, USAF's decision concerning the C-17 may come to naught. The Defense Department is to decide in a binding fashion which of three approaches offers the most effective solution to the airlift shortfall: the acquisition of modified C-5s; modification of wide-body commercial airlifters; or development of the C-17.

The Logistics Challenge

From the viewpoint of the Air Force Logistics Command, the imperative of this decade is to breathe "new life and ability into old and tired weapons. . . . Whether we are strengthening the wings of a transport to extend its lifespan, or modifying a thirty-year-old bomber to retain its deterrent credibility, AFLC will do what needs to be done," Gen. James P. Mullins, the AFLC Commander, told the AFA meeting.

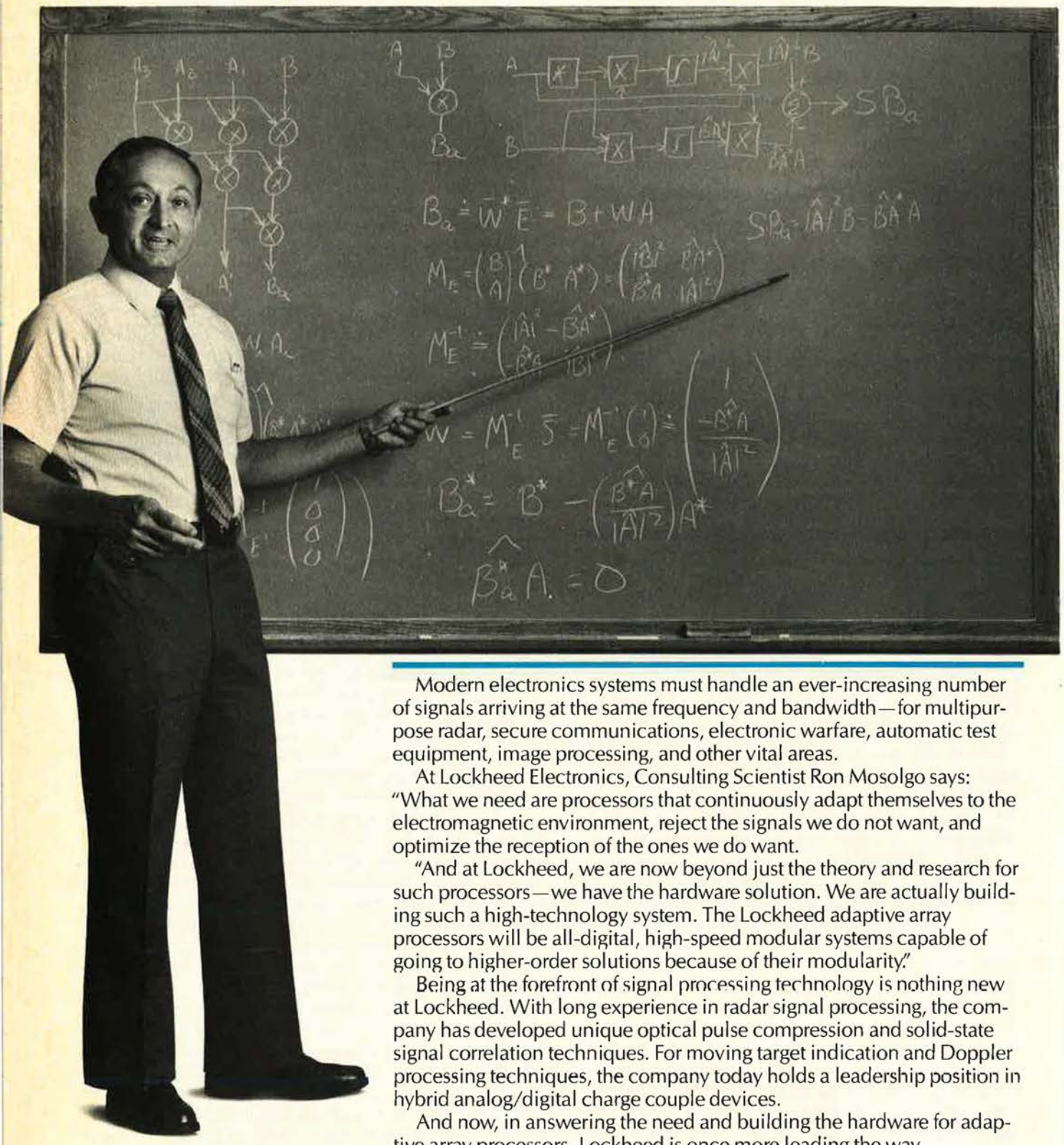
Another key challenge facing AFLC, General Mullins said, is modernization of its facilities to improve efficiency and lower cost. By plowing about $364 million into depot plant modernization in the 1970s, the command has already realized savings in excess of $1.2 billion. The command is pursuing modernization of its facilities through its "LIFT" program, which stands for Logistics Improvement of Facilities and Technology, and puts primary emphasis on technology. Under LIFT, he said, the command is "taking technology right out of the textbooks [and] moving it to the industrial floors of our nation's defenses where it will provide our using commands with better products . . . and where it will provide these products faster."

Capstone of the symposium was Secretary Orr's speech dedicated to the people of the Air Force. "We can have the best planes and the most accurate missiles that the world has ever seen," he said, "but if we don't have the dedicated, competent personnel to man them, to see that they are in a good state of repair, and to see that the necessary parts are available when needed, then we will not have an effective Air Force."

AFA's next national symposium in Los Angeles will be held October 21–22, 1982. ■

Signal processing technology on the move.

Ron Mosolgo on turning adaptive processing theory into the reality of hardware.



Modern electronics systems must handle an ever-increasing number of signals arriving at the same frequency and bandwidth—for multipurpose radar, secure communications, electronic warfare, automatic test equipment, image processing, and other vital areas.

At Lockheed Electronics, Consulting Scientist Ron Mosolgo says: "What we need are processors that continuously adapt themselves to the electromagnetic environment, reject the signals we do not want, and optimize the reception of the ones we do want.

"And at Lockheed, we are now beyond just the theory and research for such processors—we have the hardware solution. We are actually building such a high-technology system. The Lockheed adaptive array processors will be all-digital, high-speed modular systems capable of going to higher-order solutions because of their modularity."

Being at the forefront of signal processing technology is nothing new at Lockheed. With long experience in radar signal processing, the company has developed unique optical pulse compression and solid-state signal correlation techniques. For moving target indication and Doppler processing techniques, the company today holds a leadership position in hybrid analog/digital charge couple devices.

And now, in answering the need and building the hardware for adaptive array processors, Lockheed is once more leading the way.

Lockheed Electronics

JANE'S

ALL THE WORLD'S AIRCRAFT SUPPLEMENT

FEBRUARY 1982

The fourth Rockwell International B-1 prototype, fitted with offensive and defensive radar systems, advanced terrain-following radar, and improved electronics/avionics package

ROCKWELL INTERNATIONAL CORPORATION

ROCKWELL INTERNATIONAL AIRCRAFT OPERATIONS; Executive Offices: 2230 East Imperial Highway, El Segundo, California 90245, USA

ROCKWELL INTERNATIONAL B-1B

The original B-1 was the outcome of a succession of defence studies, begun in 1962, and leading to the AMSA (Advanced Manned Strategic Aircraft) requirement of 1965, for a low-altitude penetration bomber to replace the Boeing B-52s of USAF Strategic Air Command by 1980. It was to be the third and most flexible component of the US Triad defence system, comprising also land-based and submarine-launched ballistic missiles.

Research, development, test, and evaluation contracts were awarded on June 5, 1970, to North American Rockwell's Los Angeles Division for the airframe, and to General Electric for the F101 turbofan engine. The original contracts were for five flying prototypes, two structural test airframes, and 40 engines; in January 1971, these quantities were reduced to three flight test aircraft, one ground test aircraft, and 27 engines. Procurement of a fourth flight test aircraft, as a pre-production prototype, was approved under the FY 1976 budget. The US

Air-to-air refuelling capability gives the B-1 virtually unlimited range

Air Force then hoped to order 244 B-1s, including prototypes.

The first B-1 prototype made its initial flight at Palmdale, California, on December 23, 1974. This occasion was also the first flight of the YF101 engine. The third B-1, used as a testbed for the avionics systems, made its first flight on April 1, 1976, and was followed by the first flight of the second B-1 on June 14, 1976. The fourth B-1 (76-0174), which flew for the first time on February 14, 1979, represented an operational configuration, with both offensive and defensive avionics systems installed.

After completing its test programme in 1978, the first prototype was placed in storage. The second prototype completed its testing during 1979 and has been stored in a flyable condition. A total of 687 h 48 min flying, in 139 sorties, was achieved by these two prototypes.

The third prototype was modified by the addition of an advanced ECM system, and with a Doppler beam sharpening modification to the forward-looking attack radar. Continued testing of the third and fourth B-1s was concentrated on defensive system performance, and advanced ECM development. Testing was carried out against simulated enemy threats, defence systems, and against US surrogate threats. By April 30, 1981, when the authorised test programme ended, the third prototype had made 138 flights, totalling 829 h 24 min in the air; the fourth B-1 had accumulated 378 h flying time in 70 flights. In addition to the total of just on 1,900 flight test hours that had then been accumulated by these four aircraft, 24,900 wind tunnel test hours had been recorded, and airframe structural testing exceeded three times the design life.

In May 1981 it was reported that authorisation for a new bomber aircraft based on the B-1, or a version of the B-1, had been recommended by the House Armed Services Committee. Subsequently, another source reported the initiation of a US Air Force study to finalise the configuration of such a combat aircraft, comprising a longer-range high-subsonic version of the B-1. This latter aircraft would appear to be the USAF's interim Long Range Combat Aircraft (LRCA) which, according to the Reagan Administration's Strategic Program, announced on October 2, 1981, is to be developed and put into production, with procurement of 100 aircraft planned at a 1981 cost of $19,700 million.

Although now intended for operation at a speed just below Mach 1.0, in its aerodynamic form the B-1B will not differ substantially from its predecessor and, in any event, will still be capable of supersonic performance. Important features of this aircraft, by comparison with the USAF's B-52s, include an ability to: (i) become airborne more quickly, giving greater pre-launch survivability; (ii) operate from less sophisticated airfields with shorter runways; (iii) carry considerably more payload, despite a lower overall gross weight.

It has been decided to retain the full wing sweep capability (from 15° to 67.5°), and modifications will include structural strengthening for operation at an estimated gross weight of some 216,360 kg (477,000 lb), which is about 20% higher than the take-off weight of the original B-1. The B-1B will have fixed-geometry air intakes, together with simplified nozzles for the engine tailpipes, and a movable bulkhead will enable the three equal-length internal weapons bays of the B-1 to be replaced by a forward two-section bay with a length of 9.53 m (31 ft 3 in), and an aft bay 4.57 m (15 ft 0 in) long. These will not only give greater flexibility in weapon loading, enabling the B-1B to deploy the Boeing AGM-86 ALCM, but also allow more fuel to be carried, extending considerably the unrefuelled flight range. Power plant is to comprise four General Electric F101-GE-102 turbofans, each rated at 136.7 kN (30,750 lb st) with afterburning, these replacing the slightly lower rated F101-GE-100s that powered the B-1 prototypes.

Far more extensive is the work involved in the design and installation of the offensive and defensive avionics systems that will provide the capability to penetrate enemy air space at very low level (as low as 60–90 m; 200–300 ft). It is planned to integrate an updated version of the Offensive Avionics System (OAS) under development for the Boeing B-52G/H aircraft in current USAF usage. Other avionics to be installed include an advanced inertial navigation system (eventually to be duplicated), Westinghouse ALQ-153 pulse-Doppler tail warning radar, ALQ-161 radio frequency surveillance/electronic automatic jamming system, and a communications system able to operate via the USAF's communications satellites. The Westinghouse multifunction radar, derived from the AN/APG-66 fitted to the F-16, will provide automatic terrain-following and precise navigation functions. It is anticipated that avionics systems carried by the B-1B will weigh more than four tons. 'Stealth aircraft' techniques are also to be adopted for use on the B-1B, to ensure that it presents a minimum signature to enemy radars. The original B-1 was reported to have a radar signature ten times less than that of the B-52, and it is believed that the B-1B will be ten times better than the B-1. This is to be achieved by special attention to engine air intakes, wing leading-edges, and the use of surface materials that minimise the reflection of hostile radar emissions.

It is planned to use three aircraft for B-1B development, comprising the second B-1 prototype (last flown in February 1979), the fourth B-1 prototype (which was flying until April 1981), and the first production B-1B. The first will be used to complete aerodynamic and weapon separation testing that was incomplete when the original programme was terminated by the Carter Administration, and is expected to resume flight testing in mid-1983. The second, flying about a year later, will serve as the primary avionics development aircraft. The first B-1B is to be used for aerodynamic and performance testing, and it is anticipated that these three aircraft will collectively accumulate some 1,000 flight hours during this phase of the programme.

Current plans envisage delivery of the first B-1B in December 1984, with IOC following some 18 months later. Planned procurement covers two, seven, nine, 36, and 46 examples in the Fiscal Years 1982, 1983, 1984, 1985, and 1986, respectively, with production peaking at four aircraft per month in 1986, and in which year it is anticipated that the first B-1B squadron will become operational. Delivery of all 100 production examples is scheduled for mid-1988. It is reported that Pentagon studies expect that the B-1B will be able to penetrate anticipated Soviet air defences well into the 1990s, and that it will be capable of operating effectively as a cruise missile carrier, or as a conventional bomber in less well defended areas, into the next century.

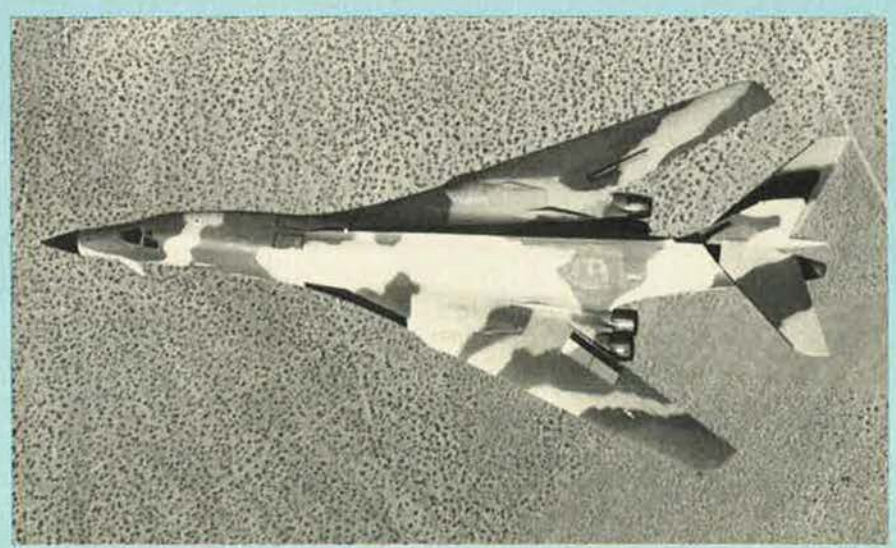
A full description of the B-1 can be found in the 1977–78 *Jane's*. The following provisional details apply to the B-1B:

ARMAMENT (nuclear): 8 cruise missiles in a rotary launcher, or 12 B-28 bombs, or 24 B-61 or B-83 bombs, or 24 AGM-69 SRAM missiles in weapon bays; plus 14 cruise missiles, or 14 AGM-69 SRAM, or 14 B-61 or B-83 bombs, or 8 B-28 bombs on underfuselage hardpoints.

ARMAMENT (conventional): 24 AGM-84 Harpoon air-to-ground missiles, or 84 Mk 82 bombs, or 24 Mk 84 bombs, or 21 CBU-58s, or 36 SUU-65s in weapon bays, plus 14 AGM-84 Harpoon missiles, or 44 Mk 82 bombs, or 32 CBU-58s, or 32 SUU-65s on underfuselage hardpoints. Carrying 128 Mk 82 bombs, the B-1B would have a weapons load of some 30,000 kg (65,000 lb).

DIMENSIONS, EXTERNAL:

Wing span:	
fully spread	41.67 m (136 ft 8½ in)
fully swept	23.84 m (78 ft 2½ in)
Wing area, gross	approx 181.2 m² (1,950 sq ft)
Length overall, incl nose probe	44.87 m (147 ft 2½ in)
Height overall	10.24 m (33 ft 7¼ in)
Tailplane span	13.67 m (44 ft 10 in)
Wheel track (c/l of shock-absorbers)	4.42 m (14 ft 6 in)
Wheelbase (c/l of shock absorbers)	17.21 m (56 ft 5¾ in)



With its variable-geometry wings fully swept, the B-1 was designed to fly a Mach 2 when required. Such performance is not specified for the new B-1B version

WEIGHTS (estimated):

Weight empty	81,640 kg (179,985 lb)
Max payload	56,700 kg (125,000 lb)
Max T-O weight	216,360 kg (477,000 lb)

BAe

BRITISH AEROSPACE AIRCRAFT GROUP: Headquarters: Richmond Road, Kingston upon Thames, Surrey KT2 5QS, UK

BAe HAWK

RAF Designation: Hawk T. Mk 1

In October 1971 the British Ministry of Defence selected the Hawker Siddeley 1182 to meet an RAF requirement for a basic and advanced jet trainer to replace the Jet Provost and Gnat. A contract for one pre-production and 175 production aircraft, subsequently named **Hawk T. Mk 1**, was announced in March 1972, as was the selection of the Rolls-Royce Turboméca Adour turbofan engine to power the aircraft. The pre-production Hawk (XX154) first flew on August 21, 1974, and was joined in the development programme by the first five production aircraft.

The first two production Hawks (XX162 and XX163) were delivered to No. 4 Flying Training School at RAF Valley, South Wales, on November 4, 1976, and nearly 170 T. Mk 1s had been delivered by the end of 1981. Hawk T. Mk 1s now serve also with the Central Flying School at RAF Valley; No. 1 Tactical Weapons Unit at RAF Brawdy, South Wales; No. 2 TWU at RAF Chivenor, Devon; and, since August 1979, with the RAF's premier aerobatic team, the Red Arrows. They are used for advanced flying training; for radio, navigation, and weapons training; and 90 are to be modified to carry two AIM-9L Sidewinder air-to-air missiles, to supplement UK home defence fighter squadrons in an emergency. An RAF follow-on order for 18 more Hawks is currently in abeyance, for budgetary reasons. RAF Hawks have accumulated more than 100,000 flight hours since entering service in 1976, and not one aircraft has been lost through engine or airframe failure.

The Hawk is fully aerobatic (it is cleared for operation to +8/−4*g* and has been flown to higher *g* numbers), and was designed for a fatigue life of 6,000 hours. Under a continuing development programme, the more powerful Adour Mk 861 engine of 25.35 kN (5,700 lb st) has been installed in BAe's demonstrator aircraft G-HAWK/ZA101, providing some 8% more thrust at take-off and, in conjunction with engine control refinements, more than 15% increase at high speeds. Wing development is continuing, to improve lift at both high and low speeds while maintaining the present excellent handling characteristics.

Export orders for the Hawk have been placed by several countries. First of these was Finland, whose 50 **Hawk Mk 51s** are intended to replace Fouga Magisters in Finnish Air Force service. They comprise four BAe-built aircraft and 46 of which component manufacture and final assembly are undertaken in Finland by Valmet. Deliveries began with two BAe-built Hawks (HW302 and HW303) on December 16, 1980, and by October 1981 four BAe-built and two Valmet-built Hawks had been delivered.

During the second half of 1980 the Kenya Air Force received 12 **Hawk Mk 52s**, these differing from the RAF version in avionics and in having a tail braking parachute. A tail-chute is also fitted to the Indonesian Air Force's **Hawk Mk 53s**, the first eight of which (ordered in early 1978) were delivered from September 1980. These eight aircraft are each fitted with smoke-generation equipment, for display purposes. Indonesia placed a follow-on order in 1981 for five more Hawks, and eight have been ordered by Zimbabwe; British government approval has been given for the sale of an undisclosed number (reportedly 24) to the United Arab Emirates Air Force (Abu Dhabi); and negotiations have also taken place with Egypt and other countries.

The largest potential export customer for the Hawk has, for many years, been the US Navy, whose VTX/TS programme (Carrier-operable Experimental Trainer/Training System) was initiated to select a single new undergraduate pilot jet trainer to replace its Rockwell International T-2C Buckeye basic and McDonnell Douglas TA-4J Skyhawk advanced trainers for service in the late 1980s. Among the design targets set by the US Navy in the VTX programme were an in-service date of 1986–87; a gross weight in the region of 4,536 kg (10,000 lb); approach speed of 105 knots (195 km/h; 121 mph); low specific fuel consumption; an MMH/FH (maintenance man-hours per flight hour) ratio of 5:1; and head-up and head-down multi-function CRT displays in both cockpits. Entrants in the competition included all-new designs by Grumman/Beech, McDonnell Douglas, Northrop/Vought, and a modified T-2 by Rockwell International. In addition, two European-designed aircraft, the Hawk and the Dassault-Breguet/Dornier Alpha Jet, were entered under teaming arrangements with McDonnell Douglas and Lockheed-California respectively.

The US Naval Air Development Center awarded BAe a contract in 1979 to study the modifications necessary to make the Hawk capable of operation from aircraft carriers. These include a strengthened landing gear, including twin nosewheels and provision for catapult launch; installation of an arrester hook; an avionics fit and cockpit display compatible with future US Navy operational aircraft; two fuselage side-mounted airbrakes instead of the current underfuselage single airbrake; and use of carbonfibre composites (CFC) for the nosecone, nosewheel doors, and equipment bay access doors.

In June 1981 BAe's demonstrator—without these modifications—undertook a month-long US tour which included visits to Andrews AFB, Washington, D. C.; NAS Pensacola, Fla.; NAS Corpus Christi, Kingsville, and Beeville, Tex.; Randolph AFB, Tex.; NAS Meridian, Miss.; and MCAS Cherry Point, N. C. During the course of this tour, with minimal technical support from four fitters, one electrician, and a radio technician, it flew more than 8,685 nm (16,095 km; 10,000 miles), including two transatlantic crossings, and over 100 sorties in the USA. Up to seven sorties were flown in a single day, and only one sortie was lost through unserviceability.

On November 19, 1981, it was announced that, instead of the expected selection of two finalists for competitive evaluation, the **Hawk VTX** had been selected outright for further development to fulfil the US Navy's requirement. Under the original partnership agreement BAe had remained prime contractor in the initial stages of VTX/TS bidding, but with the award of the US Navy contract the Douglas Aircraft Company division of McDonnell Douglas Corporation becomes prime contractor, with British Aerospace as principal subcontractor for the airframe and Sperry Corporation for the training system (simulators, instructional material, training management system, and logistic support system).

Work-split on the Hawk VTX airframe is 55% to McDonnell Douglas, 45% to BAe. The initial USN contract is worth $300,000; the current phase of the programme, valued at $15.5 million, will end in 1983, when full-scale engineering and development are due to begin. Potential value of the VTX programme, which is believed to involve approx 250–300 Hawks, is about $2,200 million at 1980 prices.

The following description is based primarily on the RAF Hawk T. Mk 1, modified where possible to apply also to the Hawk VTX and other export versions:

TYPE: Two-seat basic and advanced jet trainer, with capability for air defence and ground attack roles.

WINGS: Cantilever low-wing monoplane. Thickness/chord ratio 10.9% at root, 9% at tip. Dihedral 2° from roots. Sweepback 26° on leading-edge, 21° 30′ at quarter-chord. One-piece wing, with six-bolt attachment to fuselage, employing a machined spars-and-skin torsion box, the greater part of which forms an integral fuel tank. Small boundary layer fence on each leading-edge. Hydraulically operated double-slotted flaps and aluminium honeycomb ailerons, the latter operated by Automotive Products tandem actuators.

Selection of the Hawk VTX follows a highly successful US tour by British Aerospace Hawk demonstrator ZA101

FUSELAGE: Conventional structure of frames and stringers, cut out to accept the one-piece wing. Carbonfibre composites used for nosecone, nose landing gear doors, and equipment bay access doors of Hawk VTX; other Hawks are of all-metal construction. Large, hydraulically actuated airbrake under rear of fuselage on standard Hawk, aft of wing; on Hawk VTX, this is replaced by twin airbrakes, one on each side of rear fuselage. Hawk VTX has slightly deeper nose than other models.

TAIL UNIT: Cantilever all-metal structure, with moderate sweepback on all surfaces and 10° of tailplane anhedral. One-piece all-moving power-operated tailplane, with Automotive Products tandem hydraulic actuator. Manually operated aluminium honeycomb rudder, with electrically actuated inset trim tab. Small strake under each side of rear fuselage, forward of undertail bumper. Due to airbrake relocation, this feature is replaced on Hawk VTX by a larger, single ventral strake, contoured to accommodate the arrester hook when retracted.

LANDING GEAR: Wide-track retractable tricycle type, with single wheel on each main unit. Single steerable nosewheel on standard Hawk, with shimmy damper; twin-wheel nose unit, with catapult launch drag link and holdback, on Hawk VTX. Oleo-pneumatic shock-absorber in each unit. Main units on Hawk VTX strengthened for landings at higher rate of sink. Hydraulic actuation, using Automotive Products jacks. Main units retract inward into wings, ahead of front spar; forward-retracting nosewheel(s). Main

British Aerospace Hawk demonstrator ZA101 proves its combat potential with a warload of eight bombs and a 30 mm Aden cannon pack, totalling 6,800 lb

wheels and tyres on RAF Hawk are size 6.50–10, pressure 9.86 bars (143 lb/sq in); nosewheel and tyre are size 4.4-16, pressure 8.27 bars (120 lb/sq in). Hydraulic disc brakes, with anti-skid units. Tail bumper fairing under rear fuselage. Undertail arrester hook on Hawk VTX. Tail braking parachute standard in Hawks for Kenya, optional for other models.

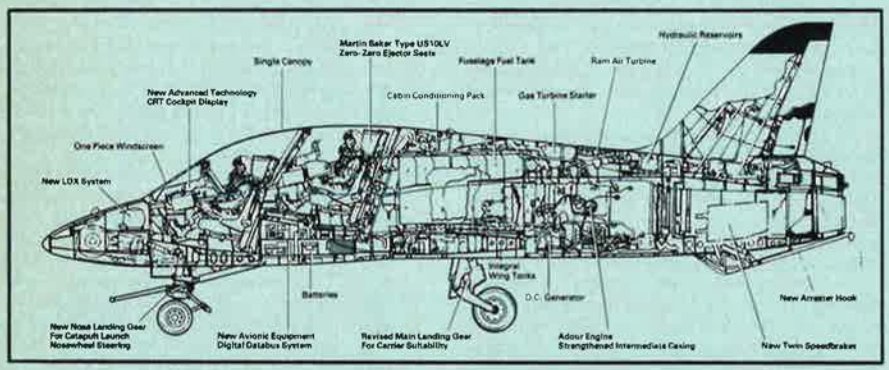
POWER PLANT: One Rolls-Royce Turboméca Adour Mk 151 (RAF) or Mk 851 (export versions) non-afterburning turbofan engine, rated at 23.75 kN (5,340 lb st); Adour Mk 861 (25.35 kN; 5,700 lb st) optional for export versions. Air intake on each side of fuselage, forward of wing leading-edge. Engine starting by Microturbo integral gas-turbine starter. Fuel in one fuselage bag tank of 868 litres (191 Imp gallons; 229 US gallons) capacity and integral wing tank of 836 litres (184 Imp gallons; 221 US gallons) capacity; total internal fuel capacity 1,704 litres (375 Imp gallons; 450 US gallons). Pressure refuelling point near front of port engine air intake trunk. Provision for carrying one 455 or 592 litre (100 or 130 Imp gallon; 120 or 156 US gallon) drop-tank on each inboard underwing pylon.

ACCOMMODATION: Crew of two in tandem under one-piece fully-transparent canopy which opens sideways to starboard. One-piece wraparound front windscreen; separate internal windscreen in front of rear cockpit. Rear (instructor's) seat elevated. Martin-Baker Mk 10B zero-zero rocket-assisted ejection seats (Martin-Baker US10LV in Hawk VTX), with MDC (miniature detonation cord) system to break canopy before seats eject. The MDC can also be operated from outside the cockpit in case of a ground emergency. Dual controls standard. Entire accommodation pressurised, heated, and air-conditioned.

SYSTEMS: BAe Dynamics cockpit air-conditioning and pressurisation systems, using engine bleed air. Duplicated hydraulic systems, each 207 bars (3,000 lb/sq in), for actuation of control jacks, flaps, airbrake(s), landing gear, and anti-skid wheel brakes. Pop-up Dowty Rotol ram-air turbine in upper rear fuselage provides emergency power for flying controls in the event of an engine or No. 2 pump failure. Compressed nitrogen accumulators provide emergency power for flaps and landing gear. Hydraulic accumulator for emergency operation of wheel brakes. No pneumatic system. DC electrical power from single 24V 9kW brushless generator, with two static inverters to provide 115V AC power, and two batteries for standby power. Twin-bottle gaseous oxygen system, capacity 1,400 litres (308 Imp gallons; 370 US gallons), in standard Hawk; Hawk VTX will have new liquid oxygen system.

AVIONICS AND EQUIPMENT: All-new advanced-technology avionics for Hawk VTX, utilising CRT displays. Standard flight instrumentation in RAF Hawks includes Ferranti gyros and inverter, two Sperry Gyroscope 4 in RAI-4 remote attitude indicators and a magnetic detector unit, and Louis Newmark compass system. Radio and navigation equipment includes Sylvania UHF and VHF, Cossor CAT.7000 Tacan, Cossor ILS with CILS.75/76 localiser/glideslope receiver and marker beacon receiver, and IFF/SSR (Cossor 2720 Mk 10A IFF in aircraft for Finland). Landing lamp in extreme nose, beneath pitot probe. Engine fire extinguisher.

ARMAMENT AND OPERATIONAL EQUIPMENT: Up to five attachment points for external stores, each capable of carrying a nominal 454 kg (1,000 lb) load: one on fuselage centreline, and two (RAF T. Mk 1) or four (export versions) under wings. Total external stores load for ground attack role is 2,567 kg (5,660 lb), although Hawk has demonstrated its ability to carry a total external load of 3,084 kg (6,800 lb). In RAF training roles the normal max external load is about 680 kg (1,500 lb). Underfuselage point can carry a 30 mm Aden gun/ammunition pod; reconnaissance pod; a free-fall or retarded bomb of 250, 500, or 1,000 lb; or a cluster bomb. Loads for the four underwing points can include eight 250 or 500 lb (or four 1,000 lb) free-fall or retarded bombs; six cluster bombs; eight 50 Imp gallon fire bombs; eight launchers for 2.75 in or 68 mm rockets; four launchers each with nine 80 mm or four 5 in rockets; four pods each with twin 7.62 mm machine-guns; eight Lepus flares or four 5 in flare dispensers; two Sidewinder air-to-air missiles; multiple carriers for practice bombs and/or air-to-surface rockets; or (inboard stations only) two underwing drop-tanks. Typical underwing armament training loads include two Matra 155 launchers, each with eighteen 2.75 in air-to-surface rockets; or two clusters of four practice bombs. AIM-9L Sidewinders will be carried by 72 RAF Hawks out of 90 which are to be fitted with missile launching rails for an operational air defence role in an emergency. Ferranti F.195 weapon sight and camera recorder in each cockpit of RAF T. Mk 1; Saab RGS2 sighting system in aircraft for Finland.



Cutaway shows details of the British Aerospace Hawk VTX

DIMENSIONS, EXTERNAL:

Wing span	9.39 m (30 ft 9¼ in)
Wing chord:	
at root	2.65 m (8 ft 8¼ in)
at tip	0.90 m (2 ft 11½ in)
Wing aspect ratio	5.284
Length overall:	
incl probe	11.95 m (39 ft 2½ in)
excl probe	11.17 m (36 ft 7¾ in)
Height overall	3.99 m (13 ft 1¼ in)
Tailplane span	4.39 m (14 ft 4¾ in)
Wheel track	3.34 m (10 ft 11½ in)

AREAS:

Wings, gross	16.69 m² (179.6 sq ft)
Ailerons (total)	1.05 m² (11.30 sq ft)
Trailing-edge flaps (total)	2.50 m² (26.91 sq ft)
Ventral airbrake (T. Mk 1)	0.53 m² (5.70 sq ft)
Fin	2.51 m² (27.02 sq ft)
Rudder, incl tab	0.58 m² (6.24 sq ft)
Tailplane	4.33 m² (46.61 sq ft)

WEIGHTS (standard Hawk except where indicated):

Weight empty:	
standard Hawk	3,647 kg (8,040 lb)
Hawk VTX	3,956 kg (8,723 lb)
T-O weight (trainer, 'clean'):	
standard Hawk	5,035 kg (11,100 lb)
Hawk VTX	5,501 kg (12,129 lb)
T-O weight (standard trainer, armed)	5,572 kg (12,284 lb)
Max T-O weight	7,750 kg (17,085 lb)
Max landing weight	4,649 kg (10,250 lb)

PERFORMANCE (standard Hawk):

Max Mach number (in dive)	1.2
Max level speed Mach number	0.88
Max speed (in dive)	572 knots (1,060 km/h; 658 mph)
Max level speed	560 knots (1,038 km/h; 645 mph)
Approach speed	112 knots (208 km/h; 129 mph)
Max rate of climb at S/L	2,835 m (9,300 ft)/min
Time to 9,145 m (30,000 ft)	6 min 6 s
Service ceiling	14,570 m (47,800 ft)
T-O run	550 m (1,800 ft)
Landing run	488 m (1,600 ft)
Combat radius:	
with 2,540 kg (5,600 lb) weapon load	300 nm (556 km; 345 miles)
with 1,360 kg (3,000 lb) weapon load	560 nm (1,038 km; 645 miles)
Range, 'clean', with max internal fuel	1,256 nm (2,327 km; 1,446 miles)
Ferry range 'clean'	1,313 nm (2,433 km; 1,510 miles)
Ferry range with two 100 Imp gallon drop-tanks	1,669 nm (3,093 km; 1,922 miles)
Endurance	4 h 26 min
g limits (cleared)	+8.0/−4.0

CHINA: STATE AIRCRAFT FACTORIES

SHANGHAI Y-7 and HANZHONG Y-8

Spokesmen for CATIC, the China National Aero Technology Import and Export Corporation, confirmed recently in London that two turboprop-powered transport aircraft of Soviet origin are currently in production in the Chinese People's Republic.

First of these, which is being built in the state

Assembly line of Hanzhong Y-8 transports, Chinese versions of the Antonov An-12BP

aircraft factory at Shanghai, is the twin-engined Antonov An-24 (NATO reporting name 'Coke'), production of which in the Soviet Union ended in 1978 after about 1,100 had been delivered. Of these, some 750 were exported, recipients including the Chinese state airline CAAC (which currently has about 20), and the Air Force of the People's Liberation Army. The Shanghai version of the An-24 has the Chinese designation Y-7 (Yunshuji = transport aircraft), or C-7 in its westernised form.

More importantly, China is now known to be building—and offering for export—its own version of the four-turboprop civil/military Antonov An-12BP (NATO reporting name 'Cub-A'), in a hitherto unidentified factory at Hanzhong (Hanchung), near Xian, in Shaanxi Province. The An-12, which also serves with the country's air force and national airline, is known in China as the Y-8, or in westernised form as the C-8. Production in the USSR, which totalled about 850, ended in 1973.

It may be assumed that the Ivchenko turboprop engines that power these aircraft (1,901 kW; 2,550 ehp AI-24A and 2,983 kW; 4,000 ehp AI-20K respectively) have also been copied and placed in production in China, probably at Harbin; the engines installed in the Y-8 were stated by CATIC officials to have the designation T-6.

Data quoted for the Y-8 include the following:

WEIGHTS (An-12BP and Y-8):

Max payload	20,000 kg (44,090 lb)
Max T-O weight	61,000 kg (134,480 lb)

PERFORMANCE:

Max cruising speed:	
An-12BP	361 knots (670 km/h; 416 mph)
Y-8	368 knots (683 km/h; 424 mph)
Econ cruising speed:	
An-12BP	not known
Y-8	278 knots (515 km/h; 320 mph)
Service ceiling:	
An-12BP	10,200 m (33,465 ft)
Y-8	11,100 m (36,415 ft)
Range with max fuel:	
An-12BP	3,075 nm (5,700 km; 3,540 miles)
Y-8	3,085 nm (5,720 km; 3,555 miles)

TUPOLEV

TUPOLEV DESIGN BUREAU; USSR

In the Autumn of 1981, the authorities in Cairo invited photographer Denis Hughes to make a return visit to Egypt, on behalf of *Jane's All the World's Aircraft*, to photograph types of combat aircraft that could not be made available on an earlier occasion. They included the missile-armed Tupolev Tu-16 twin-jet bombers which form that nation's heavy attack force, and which had flown into Cairo West to participate in the military parade during which President Sadat was so tragically killed.

A short time earlier, *Jane's* had obtained from an unclassified source in Eastern Europe additional details of the structure of the Tu-16, which continues to equip important elements of both Dalnaya Aviatsiya, the Soviet long-range strategic air force, and Aviatsiya-Voenno-Morskovo Flota, the naval air fleet. All new information is embodied in the following description of the Tu-16 series:

TUPOLEV Tu-16

NATO reporting name: Badger

The prototype of this bomber, which had the Tupolev design bureau designation Tu-88, was flown for the first time by test pilot N. Rybko in the Winter of 1952. The original strategic bomber version entered series production as the Tu-16 in 1953, and made its first public appearance on May 1, 1954. Nearly half of the total of about 2,000 that were built remain operational. Some 400 are deployed with medium-range units of the Soviet strategic bomber force, as carriers of both nuclear and conventional weapons. They are supported by a few Tu-16 in-flight refuelling tankers, more than 90 of various versions equipped for ECM duties, and a few available for reconnaissance. Naval units have about 275 Tu-16s for maritime attack, 70 tankers, and 40 reconnaissance and ECM models.

Early production Tu-16s had Mikulin AM-3 turbojet engines. These were superseded in later aircraft by improved RD-3M (AM-3M) engines, which increased maximum speeds by up to 54 knots (100 km/h; 62 mph), and range with max fuel to 3,885 nm (7,200 km; 4,470 miles). Eleven versions of the Tu-16 have been identified by unclassified NATO reporting names. All except 'Badger-B' (see 1975–76 *Jane's*) remain in first-line service, as follows:

Badger-A. Basic strategic jet bomber, able to carry nuclear or conventional free-fall weapons. Glazed nose, with small undernose radome. Defensive armament of seven 23 mm cannon. Some equipped as flight refuelling tankers, using a unique wingtip-to-wingtip transfer technique first demonstrated publicly in 1956. Nine supplied to Iraq. More than 80 operational with Chinese Air Force, and production continues in China under the designation Xian H-6.

Badger-C. Anti-shipping version, first seen at 1961 Soviet Aviation Day display. Large air-to-surface winged missile (NATO reporting name 'Kipper') carried under fuselage. Wide nose radome, in place of glazing and nose gun of 'Badger-A'.

Badger-D. Maritime/electronic reconnaissance version. Nose similar to that of 'Badger-C'. Enlarged undernose radome; three blister fairings in tandem under centre-fuselage.

Badger-E. Similar to 'Badger-A' but with cameras in bomb bay.

Badger-F. Basically similar to 'Badger-E' but with electronic intelligence pod on a pylon under each wing.

Badger-G. Similar to 'Badger-A' but with underwing pylons for two rocket-powered air-to-surface missiles (NATO reporting name 'Kelt'). Inverted-T device mounted externally on glazed nose of some aircraft may help to ensure correct attitude of Tu-16 during missile launch. One 'Badger-G' photographed by the pilot of a Japanese F-86F in December 1977 carried a newer missile (NATO 'Kingfish') on port underwing pylon. Others seen subsequently with a 'Kingfish' under each wing. Majority of 'Gs' serve with anti-shipping squadrons of Soviet naval air force. Some were included in the 25 Tu-16s supplied to Egypt as replacements for aircraft lost in the October 1973 war with Israel, and form the subject of illustrations to this feature.

Badger-G modified. Specially equipped carrier for 'Kingfish' air-to-surface missiles, of which first photograph was released, by Swedish Air Force, in mid-1981. Large radome, presumably associated with missile operation, under centre-fuselage. Inverted-T device on nose, as basic 'Badger-G'.

Badger-H. Stand-off or escort ECM aircraft, with primary function of chaff dispensing. The chaff dispensers are probably located in the weapons bay area. Hatch aft of weapons bay. Two teardrop radomes, fore and aft of weapons bay. Two blade antennae aft of weapons bay.

Badger-J. Specialised ECM jamming aircraft, with at least some of the equipment located in a canoe-shape radome inside the weapons bay.

Badger-K. Electronic reconnaissance variant. Two teardrop radomes, inside and forward of weapons bay.

Maritime reconnaissance versions of 'Badger' make regular flights over units of the US Navy and other NATO naval forces at sea in the Pacific, Atlantic and elsewhere, and have been photographed repeatedly while doing so. The aircraft often operate in pairs, with one 'Badger-F' accompanied by a different version. They also make electronic intelligence (elint) sorties around the coastlines of NATO and other non-Communist countries.

TYPE: Twin-jet medium bomber and maritime reconnaissance/attack aircraft.

WINGS: Cantilever high/mid-wing monoplane, with slight anhedral and with 35° of leading-edge sweep on outer panels; 42° sweep on inboard panels. Thickness/chord ratio 12.5%. Two-spar light alloy structure, with two fences on each wing. Entire trailing-edge made up of slotted flaps (max deflection 35°) and mass-balanced

Tupolev Tu-16 ('Badger-G') of Egyptian Air Force, photographed at Cairo West aerodrome. Small wheels visible under the wings belong to handling trolleys for the 'Kelt' missiles on underwing pylons *(Denis Hughes)*

ailerons, each with trim tab. Heavy engine nacelles form root fairings. Aircraft equipped to receive fuel in flight have a curved extension of the rear part of the port wingtip fairing. This carries the device to engage a hose trailed from the starboard wingtip of a tanker Tu-16, and upper and lower surface red lights, each protected by a heavy wire mesh guard.

FUSELAGE: All-metal semi-monocoque structure of oval cross-section, made in five sections. The nose section houses the navigator's pressure cabin with double-glazed nose panels in a magnesium alloy frame, the pilots' pressure cabin, the forward gunner's cabin, and radar equipment. The second and fourth sections house the aircraft's fuel tanks, with the weapon compartment between them. The tail section contains a pressure cabin for the radio operator and rear gunner. Skin panels made of 3 mm light alloy sheet.

TAIL UNIT: Cantilever all-metal structure, with 42° leading-edge sweepback on all surfaces. Trim tabs in rudder and each elevator.

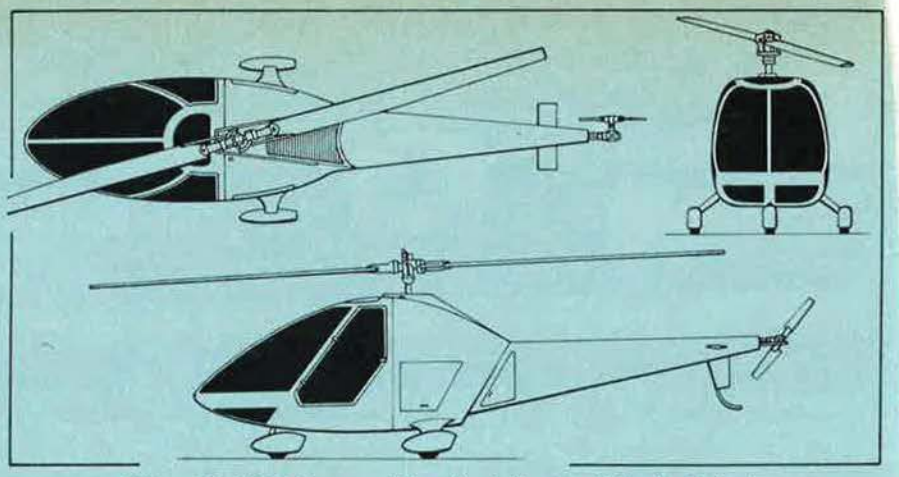
LANDING GEAR: Retractable tricycle type. Twin-wheel nose unit retracts rearward. Main four-wheel bogies retract into housings projecting beyond the wing trailing-edge.

POWER PLANT: Two Mikulin AM-3 turbojet engines, each rated at 85.8 kN (19,285 lb st) at S/L, in early Tu-16s. Later aircraft fitted with RD-3M (AM-3M) turbojets, each rated at 93.19 kN (20,950 lb st). Engines semi-recessed into sides of fuselage. Divided air intake ducts: main duct passes through wing torque box between spars; secondary duct passes under wing to feed into primary airflow in front of engine. Engines separated from wings and fuselage by firewalls. Jetpipes inclined outward 3° to shield fuselage from effects of exhaust gases. Fuel in wing and fuselage tanks, with total capacity of approx 45,450 litres (10,000 Imp gallons). Provision for underwing auxiliary fuel tanks and for flight refuelling.

ACCOMMODATION: Normal crew of six, with two pilots side by side on flight deck. Navigator, on seat with armoured sides and base, in glazed nose of all versions except 'Badger-C' and 'D'. Manned tail position plus lateral observation blisters in rear fuselage under tailplane. Entry via two front-hinged hatches in bottom of fuselage, in front and rear structural sections.

AVIONICS AND EQUIPMENT: Radio and radar include HF and VHF R/T equipment, as well as IFF and a radio compass and radio altimeter. Other equipment differs according to role.

ARMAMENT: Forward dorsal and rear ventral barbettes each containing two 23 mm NR-23 cannon. Two further cannon in tail position controlled by an automatic gun-ranging radar. Seventh fixed cannon on starboard side of nose of versions without wide nose radome. Bomb load of up to 9,000 kg (19,800 lb) delivered from weapons bay 6.5 m (21 ft) long in standard bomber, under control of navigator. Some versions carry air-to-surface winged stand-off missiles *(see list of variants)*.



Hillman Model 360 three-seat light utility helicopter *(Michael A. Badrocke)*

DIMENSIONS, EXTERNAL ('Badger-A'):

Wing span	32.93 m (108 ft 0½ in)
Wing area, gross	164.65 m² (1,772.3 sq ft)
Length overall	34.80 m (114 ft 2 in)
Height overall	10.80 m (35 ft 6 in)
Basic diameter of fuselage	2.50 m (8 ft 2½ in)
Tailplane span	11.75 m (38 ft 6½ in)
Wheel track	9.775 m (32 ft 0¼ in)

WEIGHTS (with AM-3 engines):

Weight empty, equipped	37,200 kg (82,000 lb)
Normal T-O weight	72,000 kg (158,730 lb)

PERFORMANCE (estimated, with AM-3 engines, at max T-O weight):

Max level speed at 6,000 m (19,700 ft)
535 knots (992 km/h; 616 mph)
Service ceiling 12,300 m (40,350 ft)
Range with max bomb load
2,605 nm (4,800 km; 3,000 miles)
Range with max fuel
3,110 nm (5,760 km; 3,579 miles)

HILLMAN

HILLMAN HELICOPTER ASSOCIATES; FLIGHT TEST CENTER: Stellar Air Park, Chandler, Arizona 85224, USA

In 1972 Mr Douglas Hillman began the design of the WankelBee, the first helicopter to be powered by a rotating combustion engine, which flew successfully for the first time in July 1975. This aircraft was superseded by a two-seat helicopter named Hornet, which was powered by a 112 kW (150 hp) Avco Lycoming engine. The Hornet was first flown in February 1978, and won the Best Operational Helicopter award at the EAA Fly-in, Oshkosh, that year, followed by the Outstanding Design award at Oshkosh in 1979. In September 1979 Mr Rudolph Enstrom, designer of the Enstrom helicopter, joined Hillman's company as Chief Engineer, and this has led to development of the Hillman Model 360, first presented at the Paris Air Show in June 1981. Designed as a lightweight, sturdy, but mechanically simple helicopter requiring minimum maintenance, the prototype of this aircraft was undergoing preflight trials at Stellar Air Park near Phoenix, Arizona, in the Summer of 1981. Development is under the auspices of the FAA, with certification under FAR Pts 21 and 27 anticipated in late 1982.

HILLMAN MODEL 360

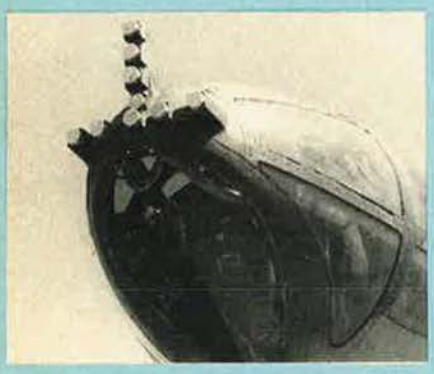
TYPE: Three-seat light utility helicopter.

ROTOR SYSTEM: Two-blade main rotor, with a semi-rigid underslung teetering hub to reduce rotor vibration and control force feedback. Tapered-chord main rotor blades are mounted 3° above horizontal to minimise blade flexing, and have 3° of twist. Construction is of glassfibre, with stainless steel leading-edge. Two-blade teetering tail rotor, with glassfibre blades which have leading-edges of stainless steel. No rotor brake at present.

ROTOR DRIVE: Eight-grooved common-back V-belt drive, with a sprag-type overrunning clutch in the driven pulley. Right-angle spiral bevel gear reduction in an aluminium gearcase. Tail rotor driven via spiral bevel gears. Main rotor/engine rpm ratio 1:5.5; tail rotor/engine rpm ratio 1:1.

FUSELAGE: Welded chrome-molybdenum steel tube centre-section and tailboom. Glassfibre cabin structure, and light alloy tailboom skin.

LANDING GEAR: Non-retractable tricycle type. Nose unit has oleo-pneumatic shock-absorption and a castoring and self-centering nosewheel. Main wheels carried on multiple spring steel leaves. Hydraulic brakes. Steel/aluminium tubular skid landing gear optional. Wheeled landing gear al-



Left: Purpose of the 'inverted-T' device on the extreme nose of late production Tu-16s is classified. Above: Port wingtip extension contains device for engaging flight refuelling hose trailed by Tu-16 tanker. Above and below are red lights protected by heavy mesh guards. Right: Manned tail gun position on Tu-16, with twin 23 mm NR-23 guns and, above windows, a tail warning and gun control radar known to NATO as 'Bee Hind' *(All photos by Denis Hughes)*

lows the Hillman 360 to take off with greater loads at higher density altitudes by making a short forward run.

POWER PLANT: One 153 kW (205 hp) Avco Lycoming HIO-360-C1A flat-four engine, mounted horizontally in the lower rear section of the fuselage pod. Exhaust is muffled, and sound-dampening foam is installed on firewall. Robertson crashworthy fuel system with single standard tank, capacity 265 litres (70 US gallons). Four optional tanks are being developed to provide a total max optional capacity of 591 litres (156 US gallons). Oil capacity 7.5 litres (2 US gallons).

ACCOMMODATION: Pilot and two passengers, side by side on contoured bench seat, with dual controls standard. Fully enclosed cabin with overhead eyebrow window. Removable door on each side of cabin. Baggage space at rear of cabin and around engine compartment. Cabin heating optional; ventilation standard.

SYSTEM: Electrical system includes a 12V 60A engine-driven alternator.

AVIONICS AND EQUIPMENT: Optional avionics include a King KY 197 com transceiver, KN 53 nav receiver, KT 76A transponder and K2 87 ADF, or similar installations by Edo or Narco. Standard equipment includes sensitive altimeter, low rpm warning lights, and anti-collision and navigation lights. Optional equipment includes amphibious floats, a lighting package, agricultural spray system, cargo racks, a cargo hook, and stretcher kits.

DIMENSIONS, EXTERNAL:

Main rotor diameter	8.15 m (26 ft 9 in)
Main rotor blade chord:	
at root	0.289 m (11.375 in)
at tip	0.143 m (5.625 in)
Tail rotor diameter	1.22 m (4 ft 0 in)
Distance between rotor centres	4.88 m (16 ft 0 in)
Length overall, rotors turning	9.47 m (31 ft 1 in)
Length of fuselage	7.62 m (25 ft 0 in)
Height overall	2.54 m (8 ft 4 in)
Wheelbase	2.18 m (7 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin: Max width	1.40 m (4 ft 7 in)
Baggage hold volume	0.17 m³ (6.0 cu ft)

AREAS:

Tail rotor blades (each)	0.05 m² (0.56 sq ft)
Main rotor disc	52.21 m² (562 sq ft)
Tail rotor disc	1.17 m² (12.57 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	499 kg (1,100 lb)
Fuel weight, standard	185.5 kg (409 lb)
Max T-O and landing weight	998 kg (2,200 lb)
Max disc loading	19.05 kg/m² (3.91 lb/sq ft)
Max power loading	6.52 kg/kW (10.73 lb/hp)

PERFORMANCE (estimated, at max T-O weight):

Never-exceed speed	113 knots (209 km/h; 130 mph)
Max cruising speed	100 knots (185 km/h; 115 mph)
Max rate of climb at S/L	457 m (1,500 ft)/min
Service ceiling	4,575 m (15,000 ft)
Hovering ceiling IGE	3,050 m (10,000 ft)
Hovering ceiling OGE	2,440 m (8,000 ft)
Range with max optional fuel and max payload	1,355 nm (2,511 km; 1,560 miles)

MBB

MESSERSCHMITT-BÖLKOW-BLOHM GmbH: Head Office: Ottobrunn bei München, 8000 München 80, Postfach 80 11 09, West Germany

MBB BO 105 GIRAFFE

Under a programme sponsored by the Federal German Ministry of Research and Technology, MBB is developing as a joint venture with various equipment manufacturers a version of the BO 105 helicopter with a stabilised mast-mounted visual aid that allows day and night observation in flight.

Intended originally for use on the projected Franco-German PAH-2 anti-tank helicopter, the system is now being developed for military scout missions and civil rescue operations by night. It

When the tall mast-mounted sight of this BO 105 scout helicopter caused it to be named 'Giraffe', MBB added unique and appropriate camouflage *(Air Portraits)*

was first flown on a BO 105 (D-HABV) on May 21, 1981. Because of the high viewpoint of the new sensor package, 0.89 m (2 ft 11 in) above the rotor plane, this helicopter is not inappropriately named Giraffe. Weight of the complete package above the rotor hub is 115 kg (254 lb).

The sensors are contained in a spherical housing, carried on a mast that passes through the rotor head and is rigidly attached to the airframe. Thus, the sight does not turn with the rotor, but its weight is supported through a thrust bearing by the rotor head, which means that the installation is not weight limited. The housing contains a package developed by SFIM as Ophelia *(Optique Platforme Hélicoptère Allemand)*, comprising a two-axis stabilised platform carrying FLIR and TV cameras, and a laser rangefinder, with provisions for TV and infrared tracking. The sphere can be traversed through ±120° in azimuth and −30°/+20° in elevation. Associated equipment in the helicopter includes a sensor steering stick on the centre console, laser rangefinder control stick on the port door pillar, FLIR and TV electronics, sensor control unit, and a 20 cm (8 in) monitor.

During the development programme the electro-optical sensor images are being tested in conjunction with various display systems. These include VDO head-up and head-down displays that are each able to provide IR and TV images using TV raster techniques, with superimposed symbology generated by stroke-writing techniques. A Thomson/CSF head-down display, able to present coloured areas and symbology in 15 different colours, is also being evaluated, as is a Ferranti helmet-mounted sight and display, used in conjunction with a second stabilised platform beneath the nose of the helicopter, carrying a wide-angle FLIR sensor for low-level navigation.

VALMET

VALMET OY KUOREVESI WORKS: Office and Works: 35600 Halli, Finland

Valmet Oy, a state-owned Finnish industrial enterprise, has more than 17,000 employees and is organised into six product-related groups. Of these, the Defence Equipment Group is the main supplier to the Finnish armed forces, with three main factories: Tourula (for light infantry weapon, hunting and sporting guns), Jyskä (for ammunition), and Kuorevesi (for aircraft manufacture, maintenance, overhaul, and repair). Aircraft jet engines are overhauled and repaired at the Linnavuori factory. Since 1922, the Kuorevesi Works and its predecessors have built 30 different types of aircraft, of which 18 have been of Finnish design. Among the more recent programmes was the final assembly of the 12 Saab Draken fighters ordered from Sweden by the Finnish Air Force (Ilmavoimat) in 1970.

A major current programme, involving both Kuorevesi and Linnavuori, is the manufacture and assembly of 46 of the 50 British Aerospace Hawk Mk 51 jet trainers and their Adour Mk 851 turbofan engines, ordered by the Finnish Air Force in early 1978. The four British-built Hawks have already been delivered, and the first to be completed by Valmet was handed over on February 20, 1981; deliveries are scheduled to continue until 1985. For these aircraft, Valmet manufactures the wing flaps, ventral airbrake, tailplane, and fin.

The latest aircraft of Finnish design to be produced by Valmet is the L-70 Miltrainer. Known originally as the Leko-70 (an abbreviation of 'Lentokone', the Finnish word for aeroplane), it was designed by the IKO (Ilmailuteollisuuden Kehitysosasto), an aeronautical research and development group established in September 1970 to study the Finnish Air Force's requirement for a basic trainer to replace its Saab Safirs. The decision was reached to produce an entirely Finnish design to fulfil this need, and a development contract was placed with Valmet on March 23, 1973. The prototype made its first flight at Kuorevesi on July 1, 1975, and on January 28, 1977, the Finnish Air Force placed an order for 30 production L-70s. Finnish AF L-70s are known as Vinka, a cold Arctic wind.

Manufacture of the Ilmavoimat's 30 Vinkas began in January 1977, and the first made its initial flight on December 29, 1979. Deliveries, originally due to begin in February 1980, were delayed by a fire in the assembly hangar, but on October 7, 1980, the first two Vinkas were handed over to the Finnish Air Force. By mid-1981 five had entered service at the Ilmasotakoulu, the Air Force's Air Academy at Kauhava, and all 30 are due to be delivered by the Summer of 1982. Finnish military pilots fly about 40 hours on the Vinka before switching to Fouga Magister jet trainers. Later on, the Hawk will replace the Magister and pilots will switch from Vinka to Hawk after 40–60 flying hours. The director of the Air Academy, Col Pertti Tapanainen, has said: "On the basis of our experience with the Vinka thus far, I can say that it has excellent flying characteristics, and that its high load factor limits, its possibility for inverted flying, and the good equipment standard make it suitable not only for primary but also for basic training of military pilots. The aircraft is easy to handle, and in difficult manoeuvres it warns the pilot of faulty handling. The Air Academy has accepted the Vinka with satisfac-

tion and believes that it will be able to fulfil its ever-increasing training duties based on this aircraft."

The normal roles of the L-70 include primary flying training, aerobatic training, night and instrument flying training, observation and liaison, tactical training, and ambulance duties. Secondary roles can include search and rescue, supply dropping, weapon training, photo reconnaissance, television monitoring/transmission, glider or target towing, and agricultural operations. The design permits the use of a ski landing gear, a feature which further enhances the versatility of the aircraft.

In keeping with the philosophy that a neutral country like Finland must be able to fend for itself even in exceptional circumstances, the Finnish aircraft industry aims at maximum independence in terms of design know-how and manufacturing technology. The design of the L-70 also reflects this philosophy: simple and economical to build, it is well suited for building under licence in countries wishing to start aircraft manufacture of their own. It fulfils the airworthiness requirements of FAR Pt 23 in the Aerobatic category as a two-seater and in the Utility and Normal categories as a four-seater. In addition to these requirements, the Finnish Air Force specified some special military strength and other requirements for the aircraft. For instance, the L-70 has a fatigue life of more than 8,000 flight hours in heavy military use.

First production Valmet L-70 trainer, in service with the Finnish Air Force as the Vinka

VALMET L-70 MILTRAINER

TYPE: Two-seat training or two/four-seat touring aircraft.

WINGS: Cantilever low-wing monoplane. Wing section NACA 63_2A615 (modified). Dihedral 6° from roots. Incidence 2°. Fail-safe structure comprising main spar, auxiliary spar, ribs and stringers, of constant chord except for forward-swept wing-root leading-edges, and attached to fuselage by steel fittings. Riveted aluminium alloy skin (fluted on flaps and ailerons). Electrically operated slotted flaps, and mass-balanced ailerons, on trailing-edges, all of aluminium alloy riveted construction. Ailerons actuated by stainless steel control cables. Spring tab in each aileron.

FUSELAGE: Conventional aluminium alloy semi-monocoque, fail-safe structure of frames and longerons, with riveted skin. Welded steel tube engine mount and wing carry-through structure; stainless steel firewall. Cockpit floor panels of bonded sandwich.

TAIL UNIT: Cantilever aluminium alloy structure, with riveted skin (fluted on fin, rudder, and elevators). Slight sweepback on vertical surfaces; shallow dorsal fin. Elevators and rudder aerodynamically and mass balanced, and actuated by stainless steel control cables. Geared trim tabs in rudder and each elevator.

LANDING GEAR: Automotive Products non-retractable tricycle type. Cantilever main legs. Automotive Products oleo-pneumatic shock-absorber in each unit. Cleveland 40–75S main wheels with Goodyear 6.00–6 six-ply tyres, pressure 1.86 bars (27 lb/sq in); Goodyear 395-32926 castoring and self-centering nosewheel, with Goodyear 5.00–5 four-ply tyre, pressure 2.07 bars (30 lb/sq in). Nosewheel steering optional. Cleveland 30-52K hydraulic disc brakes and parking brake. Provision for fitting Finncraft skis.

POWER PLANT: One 149 kW (200 hp) Avco Lycoming AEIO-360-A1B6 flat-four engine, driving a Hartzell HC-C2YK-4F/FC 7666A-2 two-blade constant-speed propeller with spinner. Christen-801 fuel and oil systems permit up to 1.5 min of continuous inverted flight in Aerobatic category. Semi-integral bonded sandwich fuel tank in each wing root ahead of main spar; total capacity 170 litres (37.4 Imp gallons). Gravity fuelling point in top of each tank. Safom reticulated polyurethane foam filling for fuel tanks is optional. Oil capacity 7.5 litres (1.65 Imp gallons).

ACCOMMODATION: Side-by-side seats for instructor and pupil in trainer version, with integral longitudinal central console which serves also to reinforce fuselage floor. Dual controls standard, but instructor's or pupil's control column can be removed if desired. Windscreen and one-piece rearward-sliding fully transparent jettisonable canopy, with steel tube turnover frame. Canopy can be locked in partially open position if required. Provision for two more seats at rear which can be removed to make room for additional baggage. Up to 280 kg (617 lb) of baggage or freight can be carried internally, or externally if flown as a single-seater. As ambulance, can accommodate one stretcher patient and a medical attendant in addition to pilot. Cockpit heated and ventilated.

SYSTEM: 28V DC electrical system, with Prestolite 24V 70A alternator and 25Ah nickel-cadmium battery. Ground power receptacle. No hydraulic or pneumatic systems.

AVIONICS AND EQUIPMENT: Standard avionics include two VHF transceivers, one ADF, one VOR/ILS with indicator, two RMI, one gyrosyn compass system, and intercom. Standard equipment includes accelerometer, dual airspeed indicators, dual artificial horizons, clock, magnetic compass, cylinder head temperature gauge, dual rate of climb indicators, dual turn and slip indicators, outside air temperature gauge, and tachometer; electrically heated pitot static head; inertia-reel shoulder harnesses for front seats; first aid kit; internal and external corrosion proofing; instrument lighting; cockpit utility lights for map-reading and as standby instrument lighting; warning lights for alternator, battery temperature and directional gyro; anti-collision beacon; landing and taxying lights in starboard wing leading-edge; navigation lights; and fire extinguisher. Equipment for secondary roles may include reflex gunsight and external load control panel; glider or target towing hook; one long-focus or four short-focus vertical cameras (provision for 35 × 40 cm; 13.8 × 15.75 in aperture, with hinged doors, in floor of rear cockpit); four underwing pylons (total capacity 300 kg; 661 lb; see following paragraph) for stores; and dispersal equipment for agricultural missions.

ARMAMENT AND OPERATIONAL EQUIPMENT: Four underwing attachments, the inner pair each stressed for 150 kg (330.5 lb) and the outer pair for 100 kg (220 lb) each; max external load 300 kg (661 lb). As single-seater, can carry four 50 kg bombs; two 100 kg bombs plus two flare pods; four pods each with eighteen 37 mm or six 68 mm rockets; two pods each with twin 7.62 or 5.56 mm machine-guns and 1,000 rds/pod; two such gun pods and two flare pods; two pods each with single 12.7 mm machine-gun and 150 rds/pod; or two reconnaissance or photographic pods. As two-seater, typical loads can include four or eight anti-tank missiles, depending upon type and size; one TV pod (with transmitter) and one searchlight pod; three 10-person life rafts and a searchlight pod; or three 6-person emergency rescue packs and a searchlight pod.

DIMENSIONS, EXTERNAL:

Wing span	9.85 m (32 ft 3¼ in)
Wing chord (constant over most of span)	1.53 m (5 ft 0¼ in)
Wing aspect ratio	6.93
Length overall	7.50 m (24 ft 7¼ in)
Height overall	3.31 m (10 ft 10¼ in)
Tailplane span	3.60 m (11 ft 9¼ in)
Wheel track	2.30 m (7 ft 6½ in)
Wheelbase	1.61 m (5 ft 3½ in)
Propeller diameter	1.88 m (6 ft 2 in)
Propeller ground clearance	0.25 m (9¾ in)

AREAS:

Wings, gross	14.00 m^2 (150.70 sq ft)
Ailerons (total)	1.412 m^2 (15.20 sq ft)
Trailing-edge flaps (total)	1.90 m^2 (20.45 sq ft)
Fin	0.87 m^2 (9.36 sq ft)
Rudder, incl tab	0.79 m^2 (8.50 sq ft)
Tailplane	2.01 m^2 (21.64 sq ft)
Elevators, incl tabs	1.01 m^2 (10.87 sq ft)

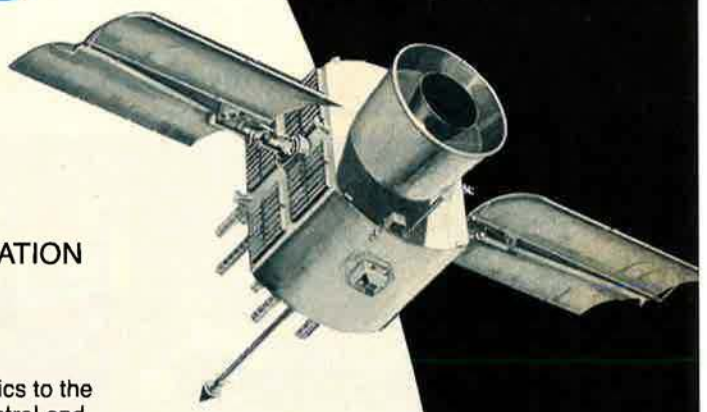
WEIGHTS AND LOADINGS:

Operating weight empty, equipped	767 kg (1,691 lb)
Max payload with full fuel	380 kg (838 lb)
Max T-O weight:	
Aerobatic	1,040 kg (2,293 lb)
Utility	1,050 kg (2,315 lb)
Normal	1,250 kg (2,756 lb)
Max wing loading:	
Aerobatic	74.3 kg/m^2 (15.22 lb/sq ft)
Utility	75.0 kg/m^2 (15.37 lb/sq ft)
Normal	89.3 kg/m^2 (18.29 lb/sq ft)
Max power loading:	
Aerobatic	6.97 kg/kW (11.45 lb/hp)
Utility	7.04 kg/kW (11.57 lb/hp)
Normal	8.38 kg/kW (13.77 lb/hp)

PERFORMANCE (at max Aerobatic T-O weight):

Never-exceed speed	193 knots (360 km/h; 223 mph)
Max level speed at S/L	129 knots (240 km/h; 149 mph)
Cruising speed (75% power) at 1,525 m (5,000 ft)	120 knots (222 km/h; 138 mph)
Stalling speed, flaps up, power off	53 knots (98 km/h; 61 mph)
Stalling speed, flaps down, power off	46 knots (85 km/h; 53 mph)
Max rate of climb at S/L	342 m (1,120 ft)/min
Service ceiling	5,000 m (16,400 ft)
T-O run	180 m (590 ft)
T-O to 15 m (50 ft)	260 m (855 ft)
Landing from 15 m (50 ft)	300 m (985 ft)
Landing run	150 m (490 ft)
Min ground turning radius	8.00 m (26 ft 3 in)
Range with max fuel	547 nm (1,015 km; 630 miles)
Range with max payload, no reserves	464 nm (860 km; 534 miles)
Endurance at S/L (65% power)	4 h 48 min
g limits at appropriate max T-O weight:	
Aerobatic	+6.00; −3.00
Utility	+4.40; −2.02
Normal	+3.80; −1.80

ELECTRONICS AND THE AIR FORCE



A NATIONAL SYMPOSIUM OF THE AIR FORCE ASSOCIATION

Hilton at Colonial, Wakefield, Mass. (near Hanscom AFB on Route 128)
April 26-27, 1982

An authoritative review and expert preview of the importance of electronics to the Air Force with special emphasis on electronic warfare and command control and communications (C^3) for national security. Participants will include senior Defense Department and Air Force officials and advisors, and the symposium will be held in conjunction with the Air Force Systems Command. Timed to coincide with congressional hearings on the Administration's proposed $18 billion upgrade of strategic C^3, this program is a must for planners in government and industry concerned with the scope and trends of military electronics, and will provide excellent background for all those interested in the role of electronics in future planning for our nation's security.

SPEAKERS AND PANELISTS INCLUDE:

Dr. Robert S. Cooper
Director, DARPA

Dr. Robert S. Everett
President, MITRE

Dr. Alexander H. Flax
President, IDA

Dr. Robert J. Hermann
Special Assistant to the
Under Secretary
of Defense
for R&E

Dr. Alton G. Keel
Assistant Secretary of the
Air Force, R&D/Logistics

Dr. Donald C. Latham
Assistant Secretary of
Defense/R&E for C^3

Dr. James P. Wade
Principal Deputy Under
Secretary of Defense/R&E

Gen. Bennie L. Davis
CINC SAC

Gen. Charles A. Gabriel
CINC USAFE

Gen. James V. Hartinger
CINC NORAD/ADCOM

Gen. Robert T. Marsh
Commander AFSC

Lt. Gen. Hillman Dickinson
Director for C^3 Systems, JCS

Lt. Gen. Lincoln D. Faurer
Director, NSA

Lt. Gen. Richard C. Henry
Commander, Space Division

Lt. Gen. Lawrence A. Skantze
Commander, Aeronautical
Systems Division

Lt. Gen. James W. Stansberry
Commander, Electronic Systems
Division

Maj. Gen. Doyle E. Larson
Commander, Electronic
Security Command

Registration fee for all Symposium events is $175.00. This fee includes all presentation sessions, coffee breaks, continental breakfast, lunch, and a dinner with a major speaker. For information and registration, call Jim McDonnell or Dottie Flanagan at (202) 637-3300, Air Force Association, Suite 400, 1750 Pennsylvania Avenue, N.W., Washington, D.C. 20006.

THE BULLETIN BOARD

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

A new uniform for a new member. That's what Brig. Gen. David L. Patton, Commander of Hq. CAP/USAF, is presenting to Secretary of the Air Force Verne Orr. Secretary Orr was made an honorary member of the Civil Air Patrol and presented the CAP flight suit at a recent Pentagon ceremony commemorating CAP's fortieth anniversay. See item below.

CAP Marks Fortieth Anniversary

The Civil Air Patrol, USAF's official auxiliary, completed forty years of service to the nation this past December (*see photo*). This congressionally chartered, nonprofit volunteer group, with the three prime roles of search and rescue, cadet programs, and support of community emergency services, boasts some 65,000 members in all fifty states, the District of Columbia, and Puerto Rico; nearly 23,000 are cadets under the age of eighteen.

A typical recognition of the anniversary was that of the District of Columbia, where D. C. Mayor Marion Barry, Jr., proclaimed the week of December 1–7 Civil Air Patrol Week. CAP's National Capital Wing has fourteen squadrons within the Washington area. It racks up quite a bit of time in support of community activities since the Nation's Capital hosts a myriad of events, including Presidential Inaugurations.

The Wing's 285 senior members and 235 cadets have helped set up communication networks, first-aid stations, and other emergency-service-support activities. The Wing's Commander, CAP Col. Ronald A. Quander, a D. C. public school teacher of Spanish, is a prime example of CAP's dedicated volunteers. He's been one since the tenth grade. He met his wife at a CAP summer encampment, and she too is still in CAP. He told AIR FORCE Magazine, "I want to give back to CAP what I've gotten from it all these years." AFA wishes him and all CAPers even more success in the future.

VA Looking for POWs

The Veterans Administration is trying to locate about 57,000 very special veterans, some of the almost 100,000 living American former prisoners of war who are potentially eligible for benefits from recent legislation. The new law requires VA to search out the former POWs and advise them of their new benefits. VA has the names of about 43,000 of the group because they filed claims of one sort or another and were identified as former POWs. Others must be found.

The POW Health Care Benefits Act of 1981 makes it easier for former POWs, held by the enemy for as short a period as thirty days, to establish entitlement to compensation for certain psychological and nutrition-related disorders regardless of when in their lifetimes they first appear. Eligibility for inpatient and outpatient medical care, on a priority basis, now exists for all ex-prisoners of war. A recent study found that POWs whose confinement was characterized by starvation diets, lack of medical care, and inhumane treatment have a higher incidence of physical and psychological disabilities.

The largest group of former POWs is from World War II—some 93,000. There are an estimated 4,000 ex-POWs from the Korean conflict, perhaps 800 living from World War I, 642 known from the Vietnam-era fighting, and eighty from the USS *Pueblo*, the ship seized by North Korea.

Finding all eligibles is not an easy task, and VA is asking members of the public to advise any former POWs they know to contact VA. All VA Regional Offices can answer questions. Toll-free numbers are available in each state.

DoD Pleased With All-Volunteer Force Success

Secretary of Defense Caspar W. Weinberger has summed up FY '81 as "one of the best recruiting and reenlistment years since the inception of the All-Volunteer Force, both in terms of quantity and quality.

"Each service met its strength objectives," he said, and "there was a significant improvement over FY '80 in the number of new recruits who scored average or above on the enlistment test. In addition, the armed services as a whole recruited a higher percentage of high school graduates than ever before, even during conscription." Of equal significance, reenlistment rates also improved for

Air Force recipients of the Presidential Rank Award for Meritorious Senior Executives are, from left, Walter Singlevich, Wayne D. White, D. K. Jones, Everett C. Hopson, Janusz S. Przemieniecki, and Don A. Hart, Jr. Not in photo: Donald L. Haas and James E. Williams. See adjacent item for details.

every service. Sharing the improved situation was the Selected Reserve, particularly Army.

The Secretary cited a number of reasons for this year's strong performance. These included congressionally provided boosts in pay and total compensation, increased recruiting resources, improved enlistment options for training and assignments, enhanced educational benefits, and the growing support and appreciation of the American public.

Looking toward the rest of the 1980s, the Secretary is optimistic about manning the All-Volunteer Force *if* it continues to receive the support of Congress and the American people. However, he cautioned that a shrinking pool of military-age youth and a dramatic expansion of requirements could exacerbate the situation. "To meet these challenges," he said, "military service must remain an attractive option to our youth, and we must maintain the management flexibility to react to unforeseen events."

Congressman Presses Suit

In 1976, two young men from the state of Michigan came to Washington as freshmen Congressmen. Democrat David Bonior has, in the ensuing years, emerged as a vocal champion of veterans' rights, especially those of Vietnam vets. He was the founder and first Chairman of the Vietnam Veterans in Congress group.

Republican David Stockman has, meanwhile, moved on to become President Reagan's appointee as head of the Office of Management and Budget (OMB). Now, in a historic suit (Bonior vs. Stockman), the Congressman is seeking a declaratory judgment that OMB illegally impounded appropriated funds, including $6 million for the Vietnam Veteran Readjustment Counseling Program.

"The fundamental principles of congressional control over spending are at stake in this suit," declares Representative Bonior.

The tangled history of this action provides an interesting view of another chapter in the long-time struggle between the executive and legislative branches as to who controls funding. Briefly, in 1979, after an earlier hassle, Congress passed a law requiring that the OMB Director *must* provide to the VA, for health-care positions, the congressionally approved personnel authorizations and the funds appropriated for such hiring. Thus, the funds could not be "impounded," a status denoting that the Administration has decided not to use funds, even though Congress has appropriated them.

Then in 1981, President Reagan's hiring freeze impeded the hiring for positions associated with the VA's popular Vet Centers, and the freeze was thereafter replaced by a deferral of funds by OMB of some $6 million appropriated for these centers. It was at this point that Representative Bonior filed his suit, which challenged both the hiring freeze and deferral of funds.

Subsequently, with the support of other key congressional leaders, including Sen. Alan Cranston (D-Calif.), former Chairman and now ranking Minority Member of the Senate Veteran's Affairs Committee, the funds were released. However, Representative Bonior feels that the impoundment had a disastrous effect on Vietnam veterans' programs, and that his suit should go on to its conclusion, both to prove unequivocally that the freeze and the deferral violated the OMB Director's mandate as directed by the 1979 statute and also to serve as a deterrent to future such actions.

An OMB spokesman, asked to comment, has told AIR FORCE Magazine that the suit "is dead in the water" and has been made "moot by subsequent release of funds." A Federal Court judge will rule on this. The suit is being brought, on a *pro bono* basis, by Joseph Zengerle, Esq., a Washington lawyer, Vietnam veteran, and former Assistant Secretary of the Air Force for Manpower and Reserve Affairs.

Senior Civilian Employees Honored

Eight senior civilian Air Force employees have received Meritorious Senior Executive Presidential Rank Awards as a result of their sustained contributions to the Air Force. Only ninety-six employees from throughout the entire federal government received the award for 1981, which includes a $10,000 stipend for each winner.

These Presidential Rank Awards are presented annually to employees in the Senior Executive Service (SES), a gradeless system authorized in 1978 where pay is based on personal and organizational performance.

The Air Force recipients joined other winners at the awards ceremony (*see photo*). The Hon. Edwin Meese III, Counselor to the President, told the group, "The service, the experience, and knowledge that you and your fellow workers possess is a valuable national resource and one we wish to preserve."

Air Force executives receiving the honor this year were: Donald L. Haas, Deputy Under Secretary of the Air Force (Space Systems), Washington, D. C.; Don A. Hart, Jr., Director, Air Force Rocket Propulsion Laboratory, Edwards AFB, Calif.; Everett G. Hopson, Chief, General Law Division, Hq. USAF, Office of the Judge Advocate General, Washington, D. C.; D. K. Jones, Assistant Deputy Chief of Staff for Logistics Operations, Wright-Patterson AFB, Ohio; Janusz S. Przemieniecki, Senior Dean of the Institute and Dean of the School of Engineering, Air Force Institute of Technology, Wright-Patterson AFB, Ohio; Walter Singlevich, Assistant Technical Director, Air Force Technical Applications Center, Patrick AFB, Fla.; Wayne D. White, Assistant Deputy Chief of Staff for Contracting and Manufacturing, Hq. AFLC, Wright-Patterson AFB, Ohio; and James E. Williams, Jr., Deputy Assistant Secretary of Acquisition Manage-

ment, Office of the Assistant Secretary of the Air Force (Research, Development, and Logistics), Washington, D. C.

Meanwhile, at a White House ceremony, three Air Force civilians received the prestigious Distinguished Senior Executive Presidential Rank Award: Jimmie D. Hill, Director, Office of Space Systems, Office of the AF Secretary, Washington, D. C.; Frederick T. Rall, Jr., Technical Director, Aeronautical Systems Division, Wright-Patterson AFB, Ohio; and Dr. Henning E. Von Gierke, Director, Biodynamics and Bionics Division, Wright-Patterson AFB, Ohio. The Distinguished Presidential Rank Award includes a $20,000 bonus for each winner.

WW I Boy-Hero Recognition Sought

Californian Ernest L. Wrentmore was thirteen years old during World War I—and serving as a private with the American Expeditionary Forces in France. How he got there is lost forever in recruiting office archives, but what he did there is something Rep. Gene Chappie (R-Calif.) thinks should be awarded—albeit belatedly—the Medal of Honor.

The Representative has introduced legislation toward that end to honor Mr. Wrentmore—who served again in World War II as an Army Air Forces captain—for his "great courage on October 14, 1918, when he was dispatched by his company commander to carry messages across a bullet-swept field to another unit of our troops, thus permitting his company to advance." Mr. Wrentmore was wounded and gassed during this action. Representative Chappie believes that proper recognition for his valor was overlooked because of a technical error at the time of his discharge and that, in light of his contribution, "better late than never" is particularly appropriate.

The 1982 March of Dimes National Poster Child, 5½-year-old Richard Wagner of Vancouver, Wash., salutes USAF Chief of Staff Gen. Lew Allen, Jr., during a recent Pentagon visit.

THE BULLETIN BOARD

Commenting to the Representative on the steep odds usually encountered in bills of this nature, AIR FORCE Magazine asked him to assess the chances of success. "I'll tell you," he said, "this fellow should get this, and I'm an eternal optimist."

USAF Civilian Wins National Suggestion Award

John H. Garner, an equipment specialist at Barksdale AFB, La., has been named one of the nation's top three suggesters for 1981 by the National Association of Suggestion Systems, a nonprofit service organization composed of members from industry and government with formalized suggestions systems.

This recognition was based on his suggestion that saved the Air Force close to $20 million—the largest amount ever to result from an employee's suggestion, according to the Office of Personnel Management. He formulated a method to detect in-flight engine failures in KC-135 and B-52 aircraft before they occur.

He is also the SAC and Air Force Suggester of the Year for 1981.

VEAP Extended

The Veterans' Educational Assistance Program (VEAP), which in 1977 replaced the old GI Bill, was due to expire last December. However, since no subsequent GI Bill legislation was passed, although exhaustive congressional hearings were held, the VEAP has been extended another year.

VEAP, which requires the service member to contribute a set-aside from pay, which is then matched two-for-one by Uncle Sam, has not proved too popular. The latest VA-DoD joint study shows that only about a quarter of the eligible Army, Navy, and Marine Corps troops participate and that Air Force members sign up at less than a ten percent rate.

Overall, all services are generally dissatisfied with the program. This lends impetus to continuing efforts to come up with a truly effective "GI Bill." Congress will tackle it again this year. Air Force Secretary Orr has said, "I can tell you that the three service secretaries and Secretary Weinberger are agreed that we need some sort of GI Bill . . . carrying on the type of thing we used to have. . . . " The Secretary further noted that transferability—the feature that would let a member transfer some or all of the benefit to either a spouse or children—is a key need. AFA agrees.

The other services do not necessarily share that view, however, which is one reason congressional debate bogged down in 1981. In fact, there is some evidence that the Army and Marine Corps would like to see a GI Bill only for those services, as a recruiting edge. Some advocates of this position aver that Army and Marine Corps skills with a rifle or in a tank crew don't translate into civilian skills easily and that, therefore, GI Bill monies should be targeted toward soldiers and Marines who don't have the in-service opportunity to learn civilian-oriented jobs. The year 1982 should be crucial for resolving the debate on this issue.

Air Force Retirees Asked to Update Data

The Air Force Accounting and Finance Center wants retirees to update beneficiary information. This tells who gets any retired pay or any money the Air Force owes the retiree upon his or her death.

Members filled out a Record of Emergency Data form (DD Form 93) when they retired, but few have updated it. This means the right person may not receive the back pay. Payments under the law go, in order, to the: (1) person named in a written designation, (2) surviving spouse, (3) children, (4) father and mother in equal shares, (5) legal representative, (6) person entitled under the law of the domicile of the deceased person.

Retirees uncertain their Emergency Data is correct should visit the nearest Air Force base military personnel office. Those not living near a base may write to AFAFC (AFAFC-RPT), Denver, Colo. 80279.

Short Bursts

All four services now have a common policy concerning **wear of uniform on MAC or DoD contract aircraft**—wear it. The only exception is when civilian garb is authorized in the travel orders. This policy also applies to active-duty space-available travel. Military members who are on pure commercial flights need not wear the uniform, but, if they do, it must be Combination One.

After working hard for a number of years at making **assignments to Turkey** more attractive, the Air Force is pleased that the volunteer rate has tripled. More and better family and sin-

gle-type housing and improved recreational facilities are among the initiatives that helped.

VA is cracking down on its employees who have been getting free medical treatment at VA facilities for **nonservice-connected ailments.** VA is launching a nationwide effort to recover the cost of medical care from ineligible veterans, and points out, "we must clean our own house first." Stressing that service-connected care for all, and nonservice-connected care for the truly indigent veteran, will not be affected, the Agency notes that "compassion and care" are still the watchwords.

New Mexico has upped the allowable exemption from state income tax of federal and military retired pay to $6,000 at age sixty-five. Retired couples may claim a $12,000 exemption on joint state returns.

Sen. Barry Goldwater (R-Ariz.) wants to make permanent a one-time congressional designation in 1981 of **National Patriotism Week,** noting that "Goodness knows, there can never be enough of patriotism." The week would be the third week in February of each year.

An Air Force type, **Col. Charles L. Flynn,** is now Director of DoD's Electromagnetic Compatibility Analysis Center in Annapolis, Md. The Center gives advice and assistance to all DoD users on more effective operation of communications-electronics equipment.

Lt. Gen. Lawrence A. Skantze, Commander of the Aeronautical Systems Division at Wright-Patterson AFB, Ohio, was recently presented the Air Force Distinguished Equal Employment Opportunity Award, Commander Action Category, for 1981. The Hon. Edward C. Aldridge, Jr., Under Secretary of the Air Force, presented the award to General Skantze at a recent Pentagon ceremony. The General's continual promotion and support of equal opportunity resulted in ASD's surpassing all previous Air Force equal-opportunity accomplishment records in significantly increasing minority employment, mostly in professional occupations. General Skantze was also the 1981 recipient of the Department of Defense's Special Achievement Award for significant advancement of black employees.

The Air Force is looking for 700 registered nurses to **become Air Force nurses** in 1982. Although there's a special need for specialists in anesthetics, nurses in specialties across-the-board are welcome. ■

SENIOR STAFF CHANGES

PROMOTIONS: To **Brigadier General:** Joseph A. **Ahearn;** Thomas A. **Baker;** Thomas P. **Ball,** Jr.; Richard S. **Beyea,** Jr.; Robert C. **Beyer,** Jr.; Anthony J. **Burshnick;** Henry D. **Canterbury;** Vernon **Chong;** Donald L. **Cromer;** James L. **Crouch;** Alexander K. **Davidson;** James B. **Davis;** Lee A. **Denson;** Larry D. **Dillingham.**

Robert D. **Eaglet;** George E. **Ellis;** Jack K. **Farris:** Eugene H. **Fischer;** Gordon E. **Fornell;** Wilfred L. **Goodson;** Lee V. **Greer;** Albert C. **Guidotti;** Ralph E. **Havens;** Donald W. **Henderson;** Jerry D. **Holmes;** Charles A. **Horner;** Bradley C. **Hosmer;** Wayne O. **Jefferson,** Jr.

Kenneth R. **Johnson;** Robert L. **Kirtley;** Donald J. **Kutyna;** Wayne W. **Lambert;** Thomas A. **LaPlante;** Mary A. **Marsh;** Paul H. **Martin;** Monte D. **Montgomery;** Donald L. **Moore;** Stanton R. **Musser;** Robert A. **Norman;** Robert W. **Norris;** Kenneth W. **North;** Richard M. **Pascoe.**

Richard A. **Pierson;** Albert L. **Pruden,** Jr.; Clifford H. **Rees,** Jr.; Robert L. **Rutherford;** Paul N. **Scheidel;** John C. **Scheidt,** Jr.; Alexander M. **Sloan;** Donald C. **Smith;** Leo W. **Smith** II; Ralph E. **Spraker;** Samuel H. **Swart,** Jr.; John H. **Voorhees;** Claudius E. **Watts** III; David H. **Williams,** Jr.

CHANGES: M/G Bill V. Brown, from DCS/Plans, Hq. SAC, Offutt AFB, Neb., to C/S, AAFSE, Naples, Italy . . . **Col. (B/G selectee) Henry D. Canterbury,** from Cmdr., 56th TTW, TAC, MacDill AFB, Fla., to Cmdr., 26th AD/NORAD Rgn., Luke AFB, Ariz., replacing B/G Thomas W. Sawyer . . . **Col. (B/G selectee) Eugene H. Fischer,** from Cmdr., 31st TTW, TAC, Homestead AFB, Fla., to Cmdr., 1st TFW, Hq. TAC, Langley AFB, Va., replacing B/G William T. Tolbert . . . **B/G (M/G selectee) Monroe T. Hatch, Jr.,** from Cmdr., 14th AD, SAC, Beale AFB, Calif., to DCS/Plans, Hq. SAC, Offutt AFB, Neb., replacing M/G Bill V. Brown . . . **B/G Jesse S. Hocker,** from Dir., Command & Control, Hq. SAC, Offutt AFB, Neb., to Cmdr., 14th AD, SAC, Beale AFB, Calif., replacing B/G (M/G selectee) Monroe T. Hatch, Jr.

M/G William W. Hoover, from Dir. of Mil. Application, DoE, Washington, D. C., to Dep. Ass't Sec. for Mil. Application & Dir. of Mil. Application, DoE, Washington, D. C. . . . **Col. (B/G selectee) Wayne O. Jefferson, Jr.,** from Ass't DCS/Plans & Policy, Hq. SAC, Offutt AFB, Neb., to Dir., Command & Control, Hq. SAC, Offutt AFB, Neb., replacing B/G Jesse S. Hocker . . . **Col. (B/G selectee) Stanton R. Musser,** from Cmdr., 33d TFW, TAC, Eglin AFB, Fla., to Vice Cmdr., Ogden ALC, AFLC, Hill AFB, Utah . . . **B/G Thomas W. Sawyer,** from Cmdr., 26th AD/NORAD Rgn., Luke AFB, Ariz., to DCS/Ops., J-3, NORAD, & DCS/Ops., ADCOM, Peterson AFB, Colo., replacing M/G Bruce K. Brown . . . **B/G William T. Tolbert,** from Cmdr., 1st TFW, Hq. TAC, Langley AFB, Va., to Spec. Ass't to DCS/Ops., Hq. TAC, Langley AFB, Va.

SENIOR ENLISTED ADVISOR CHANGES: CMSgt. Frank T. Guidas, Jr., to SEA, Hq. ATC, Randolph AFB, Tex., replacing CMSgt. Emory E. Walker. ■

INTERCOM

Enjoying a lighter moment with the four SCAMP recipients are AFA's President John G. Brosky (center) and SCAMP President and AFA National Director Martin M. Ostrow (right). SCAMP winners include (from left): Alan Dean Davis, Kernersville, N. C.; Terri B. Nellans, Dover, Del.; Kathleen Marie Nakagawa, Fairfax, Va.; and Maura Anne Bonnarens, Staten Island, N. Y.

General and Mrs. Jimmy Doolittle receive the plaudits of the Ball audience on their upcoming sixty-fourth wedding anniversary. General Doolittle served as AFA's first National President.

Top military leaders were on hand to support the fund-raising effort. Shown here are (from left): Air Force Chief of Staff and Mrs. Lew Allen, Jr.; Secretary of the Air Force and Mrs. Verne Orr; and Chairman of the Joint Chiefs of Staff Gen. David C. Jones.

Hollywood and other celebrities turned out for the Air Force Ball. Pictured are (from left): Lorne Greene, with Moya Olsen Lear; AFA National President and Mrs. John G. Brosky; and military co-hosts Lt. Gen. and Mrs. John J. Murphy and Lt. Gen. and Mrs. Richard C. Henry. Mrs. Lear, LearAvia Corp. Board Chairman, served as Ball Honorary Chairman.

SCAMP Again Benefits From the Air Force Ball Held in Los Angeles

Circus, Circus! That was the decorative theme for the tenth annual AFA Air Force Ball, held in Los Angeles's Century Plaza Hotel last November. Once again this prestigious charity event raised funds for Scholarships for Children of American Military Personnel (SCAMP) and AFA's educational affiliate, the Aerospace Education Foundation. To date, more than $750,000 has been raised for these organizations.

Moya Olsen Lear, Chairman of the Board of LearAvia Corp., served as Honorary Chairman, following in some

AFA AUTOMOBILE LEASE-PURCHASE PLAN
A NEW SERVICE FOR MEMBERS

In keeping with the Air Force Association's determination to provide the best in member services, we are happy to announce the Automobile Lease-Purchase Plan.

PES, Inc. of Falls Church, Virginia is the program administrator. Over 5000 automobiles have been delivered to Military Personnel through the Plan. Charles R. Jones, the Automobile Plan Director, states, "there is a bright aspect to the automobile industry. Used car values are high enough to cushion the impact of new car prices and high interest rates". PES suggests some 1982 models which provide excellent fuel efficiency, low maintenance costs and high resale value.

1982 MODEL VEHICLE COST EXAMPLES
(All Domestic and Import Models Available)

Cost examples include standard options, manufacturer's destination charge, and dealer preparation. Additional options selected (at dealer cost) will increase the delivered price and monthly cost. Tax and license fees payable by member on delivery. Personal property tax, when applicable, payable by member. Delivery only within Continental U.S.

	Basic Fleet Price to Member	*36 Monthly Payments w/50% Down	*36 Monthly Payments w/No Down Payment	Balance After 36 Payments
GENERAL MOTORS				
Skylark 4 Door	$ 7486	$132	$264	–0–
Regal 2 Door	8119	143	286	–0–
Cimarron 4 Door	11,724	206	412	–0–
DeVille 4 Door	14,478	255	510	–0–
Chevette 4 Door.	5513	97	194	–0–
Celebrity 4 Door	7996	141	282	–0–
Omega 4 Door.	7420	131	262	–0–
Cutlass Sup. Coupe	8012	141	282	–0–
Cutlass Ciera 4 Door	8457	149	298	–0–
J2000 4 Door	7133	126	252	–0–
Bonneville 4 Door.	8059	142	284	–0–
DODGE/PLYMOUTH/CHRYSLER				
Omni/Horizon 4 Door	6401	113	226	–0–
Aries/Reliant 4 Door	6807	120	240	–0–
LeBaron 4 Door.	7817	138	276	–0–
LeBaron Convertible	13,587	239	478	–0–
FORD				
Escort L 3 Door.	5845	103	206	–0–
Mustang L 2 Door.	6466	114	228	–0–

* The monthly costs are based on estimated January 1982 interest rates and are subject to change if actual interest rates are less or greater than 16.00% APR.

Make _____ **Model** _____ **Body Style** _____

Color _____ **Interior** _____ **Vinyl Roof** _____

EQUIPMENT SELECTION

A. ☐ 4 Cylinder ☐ V-6 ☐ Other _____
B. ☐ Automatic Transmission ☐ Other _____
C. ☐ Power Steering
D. ☐ Power Brakes (Disc on most models)
E. ☐ AM Radio ☐ AM-FM
☐ AM-FM Stereo ☐ Stereo Tape ☐ CB
F. ☐ Front Floor Mats ☐ Door Edge Guards
G. ☐ Protective Body Moldings
H. ☐ Air Conditioning ☐ Automatic Control
I. ☐ Tinted Glass
J. ☐ Full Wheel Covers ☐ Other _____
K. ☐ WSW Tires ☐ Fiberglass ☐ Steel Radial
L. ☐ Vinyl Top ☐ Full ☐ Landau
M. ☐ Power Windows
N. ☐ Power Seat
☐ Bench ☐ Driver ☐ Passenger
O. ☐ Cruise Control
P. ☐ Divided Front Seat ☐ Passenger Recliner
Q. ☐ Tilt Steering Wheel ☐ And Telescopic
R. ☐ Bucket Seats
S. ☐ Console
T. ☐ Luggage Rack
U. ☐ California Emission
V. ☐ Remote L.H. Rear View Mirror ☐ R.H. ☐ Sport
W. ☐ Vinyl Interior Trim ☐ Leather ☐ Cloth & Vinyl
X. ☐ Rear Window Defroster or Defogger
Y. ☐ Power Door Locks
Z. ☐ Bumper Impact Strips ☐ Bumper Guards
☐ _____ ☐ _____
☐ _____ ☐ _____

PROCEDURE FOR ORDERING VEHICLES

To place an order for a 1982 model shown above or any other car (subject to your approval of the cost), complete the Vehicle Selection Form and mail to PES at the address indicated below, along with the $150 service fee.

PES will promptly advise you of the delivered price and monthly payment. Upon your approval, PES will then request credit information and order the vehicle selected, or upon your rejection, will return your check for the service fee.

AFA Automobile Lease-Purchase Plan
c/o PES, Inc., 2 Skyline Towers
5203 Leesburg Pike, Suite 708
Falls Church, Va. 22041
Phone: (703) 671-0060

☐ Please advise me of the delivered price and monthly cost for the above listed vehicle. The $150.00 Service Fee (payable to PES, Inc.) is attached. Upon my approval of the costs, I will promptly submit the credit information needed by PES to order the vehicle.

☐ Please send the AFA Automobile Lease-Purchase Plan Brochure for current model vehicles. (Vehicle Selecton Form and Service Fee are not required.)

Name _____ Rank _____

Address _____

City _____ State _____ Zip _____

Phone: Office _____ Home _____

illustrious footsteps. Last year's Chairman was Brig. Gen. Charles E. (Chuck) Yeager, USAF (Ret.), the first person to fly faster than the speed of sound. The very first Honorary Chairman was then-California Gov. Ronald Reagan.

The guest list rivaled "Who's Who" as AFA, military, industry, and community leaders from across the United States joined in the festivities. President Reagan sent greetings that were read to the assemblage *(see box)*. Hollywood celebrity Lorne Greene opened the charity fund-raiser.

Through SCAMP, more than thirty children of persons who served in the armed forces of the United States in the Southeast Asian conflict and who were killed in action, held prisoner of war, or missing in action, have received four-year scholarships, currently at the rate of $1,500 per year.

This year's Ball is scheduled for Friday, October 22.

—James A. McDonnell, Jr.

Pictured are Mr. and Mrs. K. Robert Hahn. Mr. Hahn, a Lear Siegler executive, served as the 1981 Ball General Chairman.

THE WHITE HOUSE

WASHINGTON

September 25, 1981

Dear Mr. Hahn:

Nancy and I are delighted to extend our congratulations and warm personal regard on the tenth anniversary of the Air Force Ball.

I well remember the opportunity I had to serve as Honorary Chairman for the first Air Force Ball in 1972 when I was Governor of California and know how proud you must be that this fine tradition has continued for a full decade.

You have our best wishes for continued success and, again, congratulations.

Sincerely,

Ronald Reagan

Mr. K. Robert Hahn
General Chairman
Air Force Ball
Air Force Association
2850 Ocean Park Boulevard
Santa Monica, California 90405

An AFA Salute to the Agnew Ellis Family, Solidly Air Force

Agnew Ellis of Chattanooga, Tenn., is an AFA member who believes firmly in helping Air Force recruiting—so much so, in fact, that he and Mrs. Ellis are the proud parents of four—that's right, count 'em, four—Air Force sons.

The careers of these young men amply demonstrate the diverse and effective educational and professional advancement opportunities available in the Air Force. Here are their stories, as reported by Mr. and Mrs. Ellis:

A1C Tom E. Ellis presently attends Tennessee Technological University at Cookeville, Tenn. He is part of the Air Force's College Senior Engineering Program and hopes to be part of the Officer Training School class of June 1982.

SSgt. Ted J. Ellis is an instructor on Attack Radar Systems at Cannon AFB, N. M. He's earned forty hours of credit from the Community College of the Air Force and two Air Force Commendation Medals.

Lt. Jerry L. Ellis serves as a communications-electronics officer at MacDill AFB, Fla. After attaining the rank of staff sergeant in the Air Force, he went to college under the GI Bill and was commissioned as a top honor graduate from OTS in 1979.

Capt. Gary R. Ellis is an electronics engineer at Kapaun AFS, Germany. After a short stint at the Air Force Academy, he enlisted in the Air Force and reached the rank of senior airman. He was accepted in the Airman Education and Commissioning Program, graduating with a degree with honors in electrical engineering from the University of Florida, and a master's degree in electrical engineering from the same school. He then became a distinguished graduate of the OTS class of March 1977. He, too, holds the Air Force Commendation Medal.

Mr. and Mrs. Ellis—and all the Ellises—AFA salutes you.

How Our Report Boosted Membership in Bombardiers Alumni Association

An article, "The Bombardier and His Bombsight," appeared on p. 106 of the

INTERCOM

A meeting of the presidents: National Guard Association President Maj. Gen. Edward R. Fry (left) and AFA National President Judge John G. Brosky.

September 1981 issue of AIR FORCE Magazine. It included descriptive information on the World War II Bombardiers Alumni Association (BAA) and a contact to write to for further information. That is Mr. William Burmester of Mount Vernon, N. Y., one of the founders of BAA as well as its permanent National President. He and his wife, Dotty, really keep the Association going.

Periodically, Bill and Dotty publish the "official" newspaper of BAA, appropriately entitled "On Course." Its latest issue not only contains drawings and cartoons, it is chock-full of pertinent information on BAA, its members, and other matters of interest.

A quote from the BAA periodical, under the caption "From the Desk of the Prez," went something like this: "It has been a busy year. I am still trying to dig out from under the paperwork. Thanks to Mike Nisos [author of the article "The Bombardier and His Bombsight"], our mail box is filled to the brim almost daily with requests for information or membership applications."

The article continues: "I am pleased to announce that forty-four new members have joined the ranks, bringing our total membership to 220." Burmester attributes the increase in membership directly to the September 1981 article that appeared in this magazine.

Burmester went on to say that other reunion groups continue to contact him and recently he has reciprocated by sending them copies of "On Course."

Burmester stated that the tenth reunion of BAA is scheduled to be held in Ocean City, Md., September 9–12, 1982. He went on to say that the Reunion Committee is busy with the planning to come up with activities to please all tastes and pocketbooks—including BAA's own secret operation that no bombardier can resist.

He said also that the 1982 reunion will be the "Year of the Shack" and will represent "Nostalgia and Friendships—A Winning Combination."

AFA is pleased that the Bombardiers Alumni Association has increased its membership.

The Return to China, Forty Years Later, of Gerhard Neumann

Editor's note: Gerhard Neumann, who headed General Electric's jet engine business before retirement in 1979, recently toured China upon the invitation of the Chinese government. We asked him to sketch his main impressions for AFA members in a letter, which follows, on p. 114.

Mr. Neumann was born and educated in Germany. He flew to China in 1939 to maintain aircraft for the Chinese Nationalist Air Force. In 1941, he joined Gen. Claire L. Chennault's American Volunteer Group—the original "Flying Tigers"—as an engineering specialist. After disbandment of the AVG in 1942, he enlisted in the US Army Air Corps with special permission from the Secretary of War.

That year, he assembled and put into flying condition a crashed Japanese "Zero" fighter, the first to fall into Allied hands. In recognition of this important work and his close connection with the OSS, he became a US citizen by special Act of Congress. After WW II, he came to the US, then returned to China as Chief Engineer for General Chennault's airline.

After the incredible Jeep trip he mentions below, Gerhard Neumann joined General Electric's fledgling Gas Turbine Division in Lynn, Mass. He rose through a series of engineering and management positions of increasing responsibility, eventually heading the

company's entire jet engine business.

Mr. Neumann is the recipient of the 1958 Collier Trophy, the 1969 Goddard Gold Medal, and the 1979 Daniel Guggenheim Medal.

★ ★ ★

My wife and I went to China last October 4, following an invitation by their government. Our last visit and stay on the mainland was in 1947—when I worked with General Chennault's private airline CNNRA, and later, CAT. When we were moved further and further south due to the advance of Mao's troops, CAT wound up in Hong Kong and then moved to Taipei; my wife and I, however, decided to call it quits, bought two Jeeps from the RAF in Hong Kong, made one out of it, and drove all the way through Thailand, Burma, India, and Afghanistan (in winter, with no roads but deep snow), then crossed the whole Mideast into Palestine from where we took TWA to Paris, and a boat back home.

Anna Chennault, President Reagan's Vice Chairman on International Trade and wife of my late commander during the days of the "original" Flying Tigers and later the Fourteenth USAAF, helped us a lot in getting VIP treatment from the people in Beijing and wherever else we flew, took a hovercraft, or overnight train. We visited Shanghai, Beijing, Xian, Kunming, Kweilin, and Canton before going on to Hong Kong and Taiwan. Summing up an exciting and nostalgic trip lasting six weeks, I would say this:

The Chinese people are still as nice as they ever were. They do like Americans. They are better off than they were when I lived with them in 1940–45, or 1947—not in wealth or personal property, but in health, education, and a determination to "make good."

People don't spit any longer, don't pull rickshaws any more, look clean, have a roof over their heads, and are anxious to go to schools and learn. I gave two lectures before aeronautical engineering students in Beijing and Xian, had an overflow crowd in each place, and very lively and intelligent questions on the American way of doing things—how to organize people, for example, and their work which culminates in a jet engine. We talked for two hours and could have continued into the night. Everyone would have stayed, I bet.

Much new building is going on, from roads to high-rise apartments; but you can imagine what has to be done to house one billion people. There are only government-owned private cars, and taxis can be hailed in Canton only. Sure, the whole country seems a cen-

INTERCOM

J. Raymond Bell, AFA's Man of the Year in 1972, was appointed recently by President Reagan as Chairman of the Foreign Claims Settlement Commission. An AFA Life Member, Mr. Bell was twice President of AFA's Iron Gate Chapter and thrice Chairman of that Chapter's Air Force Salute.

tury behind Taiwan, which is overflowing with energy, success, hotels, and motorcycles instead of the millions of bicycles you see on the mainland. Yet I saw a girl putting on lipstick, my wife spotted a full beauty parlor, and I followed a dame with high heels (maybe she was an "Overseas Chinese"?). They showed me their engine factory where they manufacture Rolls-Royce Spey engines. They would like to buy some CFM56s to reengine their thirty-three British twin-engine planes. The rest of their commercial fleet has, as you know, some 707s, 747s, and then many Russian planes.

Watch for the year 2000 or 2010, not very far from now. I bet that—unless we wake up, talk sense into management and labor, shareholders and people responsible for R&D and quality—the center of gravity of all types of technological subjects will have moved from the USA (and perhaps also Europe) to the Far East: Japan, Korea, China, Taiwan. All these countries are working harder than we do, and with greater efficiency. This, of course, is a general statement and will be denied over here! Look what has happened to the German cameras, the American automobiles, electronics, TV, and now major appliances. We are lucky that we have a superior agricultural base.

Kunming, which had perhaps some 125,000 to 150,000 people in 1941, now has more than 2,000,000. Incredible. All is changed: no more city wall or the four gates through which you entered and left the town. Big industries now, and the British are pouring their investments into the Kunming area. MiG-15s still line the runway, but the Russians are hated and won't sell another thing.

In Kweilin, I was terribly disappointed when practically no one ever heard of any Americans being over there during WW II. "Flying Tigers? Who are they?" And then it occurred to me that a person has to be more than fifty-five years old to still recall those good old times. We looked for an old guy, then, with a white beard—and found one. And "Yes, indeed," he did remember, because he used to live in a village just at the end of our fighter strip. He pointed out where the roads were (they aren't any more, and we had destroyed the barracks ourselves when we evacuated Kweilin for Liuchow in the Southwest, in October 1944). Scorched earth policy. . . .

So, we headed in the direction he indicated (the present Kweilin runways, for commercial and military traffic, are at a less mountainous location) and pretty soon I began to recognize some of the hills, and what seemed to be the

Coming Events

March 13, **Iron Gate Chapter 19th National Air Force Salute,** Sheraton Center, New York City . . . April 26–27, **AFA Symposium, "Electronics and the Air Force,"** Colonial Hilton, Wakefield, Mass. . . . May 7–8, **South Carolina State Convention,** Myrtle Beach . . . May 14–15, **Tennessee State Convention,** Chattanooga . . . May 28, **AFA Nominating Committee and Board of Directors Meeting,** The Broadmoor, Colorado Springs, Colo. . . . May 29, **Twenty-third Annual Outstanding Squadron Dinner,** The Broadmoor's International Center, Colorado Springs, Colo. . . . June 18–19, **Ohio State Convention,** Columbus . . . June 24–25, **AFA Symposium, "Airlift—The Key to Modern Military Mobility,"** St. Louis Marriott Hotel at Lambert International Airport, St. Louis, Mo. . . . June 25–27, **New Jersey State Convention,** Cape May . . . July 9–11, **Texas State Convention,** Kerrville . . . July 16–18, **Pennsylvania State Convention,** Coraopolis . . . August 27–28, **Colorado State Convention,** Vail . . . September 12–16, **AFA National Convention,** Washington D.C. . . . October 21–22, **AFA Symposium,** Hyatt House Airport Hotel, Los Angeles, Calif.

AFA STATE CONTACTS

Following each state name, in parentheses, are the names of the localities in which AFA Chapters are located. Information regarding these Chapters, or any place of AFA's activities within the state, may be obtained from the state contact.

ALABAMA (Auburn, Birmingham, Huntsville, Mobile, Montgomery, Selma): **Don Krekelberg,** 904 Delcris Dr., Birmingham, Ala. 35226 (phone 205-942-0784).

ALASKA (Anchorage, Fairbanks): **Frank X. Chapados,** 1426 Well St., Fairbanks, Alaska 99701 (phone 907-452-1286).

ARIZONA (Phoenix, Sun City, Tucson): **John P. Byrne,** 9318 Country Club Dr., Sun City, Ariz. 85373 (phone 602-974-1349).

ARKANSAS (Blytheville, Fayetteville, Fort Smith, Little Rock): **Arthur R. Brannen,** 605 N. Hospital Dr., Jacksonville, Ark. 72076 (phone 501-982-2585).

CALIFORNIA (Apple Valley, Edwards, Fairfield, Fresno, Hawthorne, Hermosa Beach, Long Beach, Los Angeles, Merced, Monterey, Novato, Orange County, Palo Alto, Pasadena, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, San Mateo, Santa Barbara, Santa Monica, Yuba City, Vandenberg AFB): **Richard C. Doom,** P. O. Box 2027, Canyon Country, Calif. 91351 (phone 213-887-2923).

COLORADO (Aurora, Boulder, Colorado Springs, Denver, Fort Collins, Grand Junction, Greeley, Littleton, Pueblo, Waterton): **Karen M. Kyritz,** 17105 East Bethany Circle, Aurora, Colo. 80013 (phone 303-690-2920).

CONNECTICUT (East Hartford, North Haven, Storrs, Stratford, Westport, Windsor Locks): **Frank J. Wallace,** 935 Poquonock Ave., Windsor, Conn. 06095 (phone 203-688-3090).

DELAWARE (Dover, Wilmington): **John E. Strickland,** 8 Holly Cove Lane, Dover, Del. 19901 (phone 302-678-6070).

DISTRICT OF COLUMBIA (Washington, D. C.): **Bob Givens,** 1750 Pa. Ave., N. W., Suite 400, Washington, D. C. 20006 (phone 202-637-3346).

FLORIDA (Broward, Cape Coral, Fort Walton Beach, Gainesville, Jacksonville, New Port Richey, Orlando, Panama City, Patrick AFB, Redington Beach, Sarasota, Tallahassee, Tampa, West Palm Beach, Winter Haven): **Lee R. Terrell,** 39 Hemlock Dr., N. W., Fort Walton Beach, Fla. 32548 (phone 904-882-4486).

GEORGIA (Athens, Atlanta, Columbus, Rome, Savannah, St. Simons Island, Valdosta, Warner Robins): **Lee C. Lingelbach,** 217 Ridgeland Dr., Warner Robins, Ga. 31093 (phone 912-922-7615).

GUAM (Agana): **Joe Gyulavics,** P. O. Box 21543, Guam 96921 (phone 671-734-2369).

HAWAII (Honolulu): **Don J. Daley,** P. O. Box 3200, Honolulu, Hawaii 96847 (phone 808-525-6296).

IDAHO (Boise, Mountain Home, Twin Falls): **John W. Logan,** 3131 Malad St., Boise, Idaho 83705 (phone 208-385-5475).

ILLINOIS (Belleville, Champaign, Chicago, Decatur, Elmhurst, Peoria): **Richard H. Becker,** 7 Devonshire Dr., Oak Brook, Ill. 60521 (phone 312-654-3938).

INDIANA (Bloomfield, Indianapolis, Lafayette, Logansport, Marion, Mentone, South Bend): **Richard Ortman,** 2607 Sunrise Ave., Lafayette, Ind. 47905 (phone 317-743-3896).

IOWA (Des Moines): **Carl B. Zimmerman,** 608 Waterloo Bldg., Waterloo, Iowa 50701 (phone 319-232-2650).

KANSAS (Topeka, Wichita): **Cletus J. Pottebaum,** 6503 E. Murdock, Wichita, Kan. 67206 (phone 316-683-3963).

KENTUCKY (Louisville): **Elmo C. Burgess,** 116 S. 5th St., Louisville, Ky. 40202 (phone 502-585-5169).

LOUISIANA (Alexandria, Baton Rouge, Bossier City, Monroe, New Orleans, Shreveport): **Thomas L. Keal,** 404 Galway Dr., Shreveport, La. 71115 (phone 318-797-9688).

MAINE (Limestone, N. Berwick): **Arley McQueen, Jr.,** 153 Jelliegh Dr., Wells, Me. 04090 (phone 207-646-2718).

MARYLAND (Andrews AFB, Baltimore): **Thomas W. Anthony,** 4111 Carriage Dr., Temple Hills, Md. 20748 (phone 301-894-0067).

MASSACHUSETTS (Bedford, Boston, Falmouth, Florence, Hanscom AFB, Lexington, Taunton, Worcester): **Zaven Kaprielian,** 428 Mt. Auburn St., Watertown, Mass. 02172 (phone 617-924-5010).

MICHIGAN (Battle Creek, Detroit, Kalamazoo, Marquette, Mount Clemens, Oscoda, Petoskey, Southfield): **Jeryl L. Marlatt,** 740 S. Cranbrook Rd., Birmingham, Mich. 48009 (phone 313-494-8232).

MINNESOTA (Duluth): **Edward A. Orman,** 368 Pike Lake, Duluth, Minn. 55811 (phone 218-727-8381).

MISSISSIPPI (Biloxi, Columbus, Jackson): **Don Wylie,** P. O. Box 70, Biloxi, Miss. 39533 (phone 601-374-3611).

MISSOURI (Kansas City, Knob Noster, Springfield, St. Louis): **William A. Dietrich,** P. O. Box 258, Kansas City, Mo. 64141 (phone 816-561-2134).

MONTANA (Great Falls): **Dick Barnes,** P. O. Box 685, Great Falls, Mont. 59403 (phone 406-727-3807).

NEBRASKA (Lincoln, Omaha): **Edward A. Crouchley,** 514 Ridgewood Dr., Bellevue, Neb. 68005 (phone 402-291-4780).

NEVADA (Las Vegas, Reno): **James L. Murphy,** 2370 Skyline Blvd., Reno, Nev. 89509 (phone 702-786-1520).

NEW HAMPSHIRE (Manchester, Pease AFB): **Charles J. Sattan,** 53 Gale Ave., Laconia, N. H. 03246 (phone 603-524-5407).

NEW JERSEY (Andover, Atlantic City, Belleville, Camden, Chatham, Cherry Hill, E. Rutherford, Forked River, Fort Monmouth, Jersey City, McGuire AFB, Middlesex County, Newark, Trenton, Wallington, West Orange): **John P. Kruse,** 1022 Chelten Pkwy., Cherry Hill, N. J. 08034 (phone 609-428-3036).

NEW MEXICO (Alamogordo, Albuquerque, Clovis): **Ken Huey, Jr.,** P. O. Box 1946, Clovis, N. M. 88102 (phone 505-769-1975).

NEW YORK (Albany, Brooklyn, Buffalo, Chautauqua, Garden City, Hempstead, Hudson Valley, New York City, Niagara Falls, Plattsburgh, Queens, Rochester, Rome/Utica, Southern Tier, Staten Island, Suffolk County, Syosset, Syracuse, Westchester): **Thomas J. Hanlon,** P. O. Box 400, Buffalo, N. Y. 14225 (phone 716-632-7500).

NORTH CAROLINA (Asheville, Charlotte, Fayetteville, Goldsboro, Greensboro, Kitty Hawk, Raleigh): **William M. Bowden,** 509 Greenbriar Dr., Goldsboro, N. C. 27530 (phone 919-735-5584).

NORTH DAKOTA (Concrete, Fargo, Grand Forks, Minot): **Maurice M. Rothkopf,** 3210 Cherry St., Grand Forks, N. D. 58201 (phone 701-746-5493).

OHIO (Cincinnati, Cleveland, Columbus, Dayton, Newark, Youngstown): **Francis D. Spalding,** 718 Martha Lane, Columbus, Ohio 43213 (phone 614-866-9381).

OKLAHOMA (Altus, Enid, Oklahoma City, Tulsa): **Aaron C. Burleson,** P. O. Box 757, Altus, Okla. 73521 (phone 405-482-0005).

OREGON (Eugene, Portland): **William Gleaves,** 2353 Oakway Terrace, Eugene, Ore. 97401 (phone 503-687-2269).

PENNSYLVANIA (Allentown, Beaver Falls, Chester, Dormont, Erie, Harrisburg, Homestead, Lewistown, Philadelphia, Pittsburgh, Scranton, State College, Washington, Willow Grove, York): **Tillie Metzger,** 2285 Valera Ave., Pittsburgh, Pa. 15210 (phone 412-884-5257).

RHODE ISLAND (Warwick): **King Odell,** 413 Atlantic Ave., Warwick, R. I. 02888 (phone 401-941-5472).

SOUTH CAROLINA (Charleston, Columbia, Myrtle Beach, Sumter): **William B. Gemmill,** 11 Victoria Ave., Myrtle Beach, S. C. 29577 (phone 803-626-9628).

SOUTH DAKOTA (Rapid City, Sioux Falls): **L. J. Reiners,** 4907 Copper Hill Court, Rapid City, S. D. 57701 (phone 605-343-2538).

TENNESSEE (Chattanooga, Knoxville, Memphis, Nashville, Tri-Cities Area, Tullahoma): **Arthur MacFadden,** 4501 Amnaicola Highway, Chattanooga, Tenn. 37406 (phone 615-622-6262).

TEXAS (Abilene, Amarillo, Austin, Big Spring, College Station, Commerce, Corpus Christi, Dallas, Del Rio, Denton, El Paso, Fort Worth, Harlingen, Houston, Kerrville, Laredo, Lubbock, San Angelo, San Antonio, Waco, Wichita Falls): **John Sparks,** P. O. Box 360 San Antonio, Tex. 78292 (phone 817-723-2741).

UTAH (Brigham City, Cedar City, Clearfield, Ogden, Provo, Salt Lake City): **Charles E. Walker,** 1243 E. 3075 North, Ogden, Utah 84404 (phone 801-782-7826).

VERMONT (Burlington): **John D. Navin,** 350 Spear St., Unit 64, South Burlington, Vt. 05401 (phone 802-863-1510).

VIRGINIA (Arlington, Danville, Harrisonburg, Langley AFB, Lynchburg, Norfolk, Petersburg, Richmond, Roanoke): **Ivan R. Frey,** 73 James Landing Rd., Newport News, Va. 23606 (phone 804-595-5617).

WASHINGTON (Seattle, Spokane, Tacoma): **William C. Burrows,** 6180 93d Ave. S.E., Mercer Island, Wash. 98040 (phone 206-773-5395).

WEST VIRGINIA (Huntington): **James Hazelrigg,** Rte. 3, Box 32, Barboursville, W. Va. 25504 (phone 304-736-9337).

WISCONSIN (Madison, Milwaukee): **Kenneth Kuenn,** 3239 N. 81st St., Milwaukee, Wis. 53222 (phone 414-871-3766).

WYOMING (Cheyenne): **R. S. Rowland,** P. O. Box 811, Cheyenne, Wyo. 82001 (phone 307-638-3335).

INTERCOM

runway, and revetments, and pillboxes. Then we came upon Chennault's command post cave in one of the steep mountains alongside the runway. All overgrown, but not destroyed. The cave still had five steps inside, was clean and empty—with no Coke bottles or debris of any kind. It was a wonderful, but eerie, feeling. I could not believe that it was forty years ago that I was sweating here, and that we were expecting our daily visits by the Japs or by their Photo Joe.

But the highlight of this visit was an old truck slowly rumbling by; I stopped it and had my interpreter ask the only old man aboard (there were thirty young men on the truck bed) some pertinent questions. Then they took off along the runway, and just as we were ready to turn our van around to go back to Kweilin, the truck came back, slowed down as it passed us, and *everyone* aboard raised their right thumb and yelled "Ding Hao, Ding Hao, Ding Hao!" I could have cried, honestly; it was such a nice gesture. The old man must have told them that "Ding Hao" and a raised right thumb was the standard greeting between GIs and the Chinese people.

("Ding Hao" means "Very Good.")

—Gerhard Neumann
Swampscott, Mass.

UNIT REUNIONS

8th Fighter Group
Hq., 33d, 35th, 36th, and 80th Fighter Control Squadrons, and attached units from World War II will hold a reunion June 4–6, 1982, at the Hotel Chamberlin in Hampton, Va. **Contact:** Vincent W. Stefanic, 21 Curson St., West Warwick, R. I. 02893.

63d Station Complement Sqdn.
The 63d Station Complement Squadron, Ninth Air Force (World War II), will hold its eighth biennial reunion on June 11–13, 1982, at the Falcon Inn in Monument, Colo. **Contact:** Lt. Col. J. T. Gilmore, USAF (Ret.), 24 Wedge Way, Littleton, Colo. 80123.

307th Bomb Group (H)
Members of the 307th Bomb Group will hold their reunion on May 29–30, 1982, in Reno, Nev. **Contact:** Mrs. Cena Marsh, 1923 Atkin Ave., Salt Lake City, Utah 84106. Phone: (801) 466-5805 (home) or (801) 298-6665 (office).

325th Fighter Group
The "Checkertail Clan" reunion will be held June 24–27, 1982, at the Imperial House, North Dayton, Ohio. **Contact:** Dan Penrod, 69 Keswick Ave., Pittsburgh, Pa. 15202. Phone: (412) 766-6190.

345th Fighter Sqdn.
The 345th Fighter Squadron "Devil Hawks" of the 350th Fighter Group will be holding a reunion in San Diego, Calif., on June 3–5, 1982. **Contact:** Jake Kingsbury, 2106 Wesley Ave., Collinsville, Ill. 62234. Phone: (618) 344-0131.

390th Bomb Group (H)
The 390th Bomb Group will hold a reunion on March 11-14, 1982, in Tucson, Ariz., in conjunction with Davis-Monthan AFB and the opening of the combined 390th Bomb Group and 390th Missile Wing Museum. **Contact:** Roger "Hap" Howell, 245-B Boxwood Rd., #107, Annapolis, Md. 21403. Phone: (301) 268-9220. Robert "Dutch" Waltz, 3529 E. Cannon Dr., Phoenix, Ariz. 85028. Phone: (602) 996-9677.

760th Bomb Sqdn., 460th Bomb Gp.
A reunion will be held in June 1982 at Disney World, Fla., for members of the 760th Bomb Squadron and the 460th Bomb Group who served in Spinazzola, Italy, during WW II. **Contact:** Robert Cutler, 1335 US Hwy. 19 South, Apt. A-16, Clearwater, Fla. 33516.

Ascension "Wideawake" Airfield
Would aircrew members who flew through Ascension during WW II, or individuals who were stationed there, contact me for information concerning a fortieth anniversary celebration to be held on Ascension?

Jerry L. Bennett
ESMC/FA
Patrick AFB, Fla. 32925
Phone: (305) 494-6471

Narsarssuak AB
The first reunion of former Narsarssuak AB, Greenland, members, held in October 1981, was thoroughly enjoyed by all who made it. The final dinner dance was attended by 100 members and wives, most of whom had spent a year or two "in the land of ice and snow where it's ninety-nine below."

At the reunion, a Narsarssuak Air Base Greenland Association was formed and a second reunion was unanimously agreed upon, time and place to be determined. We are trying to contact all former NAB members, whether interested in a reunion or not.

If you ever spent time on the "rock" or know of someone who did, please contact our association.

Col. Art Turner, USAF (Ret.)
10218 Willowick Lane
San Antonio, Tex. 78217

AFA CHAMPLUS ... New, Strong Protect

When a Single Accident or Illness Could Cost *You* Thousands of Dollars, You Need AFA CHAMPLUS . . . for *Strong* Protection against Costs CHAMPUS Doesn't Cover!

For military retirees and their dependents . . . and dependents of active duty personnel . . . more and more medical care is being provided through the government CHAMPUS program.

And, of course CHAMPUS pays 75% of allowable charges.

But today's soaring hospital costs—*up to $500 a day* in some major metropolitan medical centers—can run up a $20,000 bill for even a moderately serious accident or illness.

Your 25% of $20,000 is no joke!

AFA CHAMPLUS protects you against that kind of financial catastrophe *and* covers most of your share of routine medical expenses as well.

HOW AFA CHAMPLUS WORKS FOR YOU!

WHO IS ELIGIBLE?

1) All AFA members under 65 years of age who are currently receiving military retired pay and are eligible for benefits under Public Law 89-614 (CHAMPUS), their spouses under age 65 and their unmarried dependent children under age 21 (or age 23 if in college).
2) All eligible dependents of AFA members on active duty. Eligible dependents are spouses under age 65 and unmarried dependent children under age 21 (or age 23 if in college).

EXCEPTIONAL BENEFIT PLAN

(See chart at right)

FOUR YEAR BASIC BENEFIT. Benefits for most injuries or illnesses may be paid for up to a four-year period.

PLUS THESE SPECIAL BENEFITS . . .

1) Up to 45 consecutive days of in-hospital care for mental, nervous, or emotional disorders. Outpatient care may include up to 20 visits of a physician or $500 per insured person each year.
2) Up to 30 days care per insured per year in a Skilled Nursing Facility.
3) Up to 30 days care per insured per year and up to 60 days lifetime in a CHAMPUS-approved Residential Treatment Center.
4) Up to 30 days care per insured per year and up to 60 days lifetime in a CHAMPUS-approved Special Treatment Facility.
5) Up to 5 visits per insured per year to Marriage and Family Counselors under conditions defined by CHAMPUS.

YOUR INSURANCE IS NON-CANCELLABLE

As long as you are a member of the A Force Association, pay your premiums time, and the master contract remains force, your insurance cannot be canc ed.

ADMINISTERED BY YOUR ASSOCIATION . . . UNDERWRITTEN BY MUTUAL OF OMAHA

AFA CHAMPLUS insurance is admir tered by trained insurance profession on your Association staff. You get prom reliable, courteous service from pec who know your needs and know ev detail of your coverage. Your insuranc underwritten by Mutual of Omaha, largest individual and family health ins ance company in the world.

AFA OFFERS YOU HOSPITAL BENEFITS AFTER AGE 65

Once you reach Age 65 and are cove under Medicare, AFA offers you pro tion against hospital expenses covered by Medicare through the *Ser Age Benefit Plan* of AFA Hospital Ind nity Insurance. Members enrolled in A CHAMPLUS will automatically receive information about AFA's Medicare s plement program upon attainment of A 65 so there will be no lapse in coverag

AFA CHAMPLUS BENEFIT SCHEDULE

Care	*CHAMPUS Pays*	*AFA CHAMPLUS Pays*
	For Military Retirees Under Age 65 and Their Dependents	
Inpatient civilian hospital care	CHAMPUS pays 75% of allowable charges	CHAMPLUS pays the 25% of allowable charges not covered by CHAMPUS.
Inpatient military hospital care	The only charge normally made is a $5.00 per day subsistence fee, not covered by CHAMPUS.	CHAMPLUS pays the $5.00 per day subsistence fee.
Outpatient care	CHAMPUS COVERS 75% of outpatient care fees after an annual deductible of $50 per person ($100 maximum per family) is satisfied	CHAMPLUS pays the 25% of allowable charges not covered by CHAMPUS after the deductible has been satisfied.
	For Dependents of Active Duty Military Personnel	
Inpatient civilian hospital care	CHAMPUS pays all covered services and supplies furnished by a hospital less $25 or $5.00 per day, whichever is greater.	CHAMPLUS pays the greater of $5 per day or $25 of the reasonable hospital charges not covered by CHAMPUS.
Inpatient military hospital care	The only charge normally made is a $5.00 per day fee, not covered by CHAMPUS.	CHAMPLUS pays the $5.00 per day subsistence fee.
Outpatient care	CHAMPUS covers 80% of outpatient care fees after an annual deductible of $50 per person ($100 maximum per family) is satisfied.	CHAMPLUS pays the 20% of allowable charges not covered by CHAMPUS after the deductible has been satisfied.

NOTE: Outpatient benefits cover emergency room treatment, doctor bills, pharmaceuticals, and other professional services.

There are some reasonable limitations and exclusions for both inpatient and outpatient coverage. Please note these elsewhere in the plan description.

Against Costs CHAMPUS Doesn't Cover

APPLY TODAY!

JUST FOLLOW THESE STEPS

Choose either AFA CHAMPLUS In-patient overage or combined In-patient and Out-atient coverage for yourself. Determine ie coverage you want for dependent iembers of your family. Complete the nclosed application form in full. Total the emium for the coverage you select from e premium tables on this page. Mail the plication with your check or money der for your initial premium payment, ayable to AFA.

Get AFA's new

CHAMPLUS

MITATIONS

erage will not be provided for condi-is for which treatment has been re-ed during the 12-month period prior to effective date of insurance until the iration of 12 consecutive months of in-ance coverage without further treat-nt. *After coverage has been in force for consecutive months, pre-existing* con-ons will be covered regardless of prior tment.

CLUSIONS

is plan does not cover and no payment all be made for:

- routine physical examinations or immu-zations
- domiciliary or custodial care
- dental care (except as required as a cessary adjunct to medical or surgical eatment)
- outine care of the newborn or well-by care
- njuries or sickness resulting from clared or undeclared war or any act ereof
- njuries or sickness due to acts of inten-nal self-destruction or attempted sui-'e, while sane or insane
- reatment for prevention or cure of al-holism or drug addiction
- ye refraction examinations
- rosthetic devices (other than artificial bs and artificial eyes), hearing aids, nopedic footwear, eyeglasses and con-t lenses
- xpenses for which benefits are or may payable under Public Law 89-614 IAMPUS)

QUARTERLY PREMIUM SCHEDULE

Plan 1—For military retirees and dependents

In-Patient Benefits

Member's Attained Age	*Member*	*Spouse*	*Each Child*
Under 50	$19.03	$23.30	$11.00
50-54	$23.78	$29.10	$11.00
55-59	$30.13	$36.90	$11.00
60-64	$39.65	$48.55	$11.00
In-Patient and Out-Patient Benefits			
Under 50	$26.80	$31.05	$27.50
50-54	$33.48	$38.80	$27.50
55-59	$42.43	$49.18	$27.50
60-64	$55.83	$64.73	$27.50

Plan 2—For dependents of active duty personnel.

In-Patient Only	None	$ 8.80	$ 4.40
In-Patient and Out-Patient	None	$35.20	$22.00

Note: Plan II premiums are listed on an annual basis. Because of the very low cost, persons requesting this coverage are asked to make annual payments.

APPLICATION FOR
AFA CHAMPUS SUPPLEMENT INSURANCE

Group Policy GMG-FC70
Mutual of Omaha Insurance Company
Home Office: Omaha, Nebraska

Full name of Member _____
Rank Last First Middle

Address _____
Number and Street City State ZIP Code

DATE OF Birth _____ Current Age _____ Height _____ Weight _____ Soc. Sec. No. _____
Month/Day/Year

This insurance coverage may only be issued to AFA members. Please check the appropriate box below:

☐ I am currently an AFA Member. ☐ I enclose $13 for annual AFA membership dues (includes subscription ($9) to AIR FORCE Magazine).

☐ I am over 65 years of age. Please send information on AFA's Medicare Supplement.

PLAN & TYPE OF COVERAGE REQUESTED

Plan Requested (Check One)
☐ AFA CHAMPLUS PLAN I (for military retirees & dependents)
☐ AFA CHAMPLUS PLAN II (for dependents of active duty personnel)

Coverage Requested (Check One)
☐ Inpatient Benefits Only
☐ Inpatient and Outpatient Benefits

Person(s) to be Insured (Check One)
☐ Member Only ☐ Member & Children
☐ Spouse Only ☐ Spouse & Children
☐ Member & Spouse ☐ Member, Spouse & Children

PREMIUM CALCULATION

All premiums are based on the attained age of the AFA member applying for this coverage. Premium payments are normally paid on a quarterly basis (see table for rate table). Upon request, however, they may be made on either a semi-annual or annual basis.

Quarterly premium for member (age ____) $ _____

Quarterly premium for spouse $ _____

Quarterly premium for ____ children @ $ ____ $ _____

Requests for active duty dependent coverage under Plan 2 should include annual premiums.

Total premium enclosed $ _____

If this application requests coverage for your spouse and/or eligible children, please complete the following information for each person for whom you are requesting coverage.

Names of Dependents to be Insured	Relationship to Member	Date of Birth (Month/Day/Year)

(To list additional dependents, please use a separate sheet.)

In applying for this coverage, I understand and agree that (a) coverage shall become effective on the last day of the calendar month during which my application together with the proper amount is mailed to AFA, (b) only hospital confinements (both inpatient and outpatient) or other CHAMPUS-approved services commencing after the effective date of insurance are covered and (c) any conditions for which I or my eligible dependents received medical treatment or advice or have taken prescribed drugs or medicine within 12 months prior to the effective date of this insurance coverage will not be covered until the expiration of 12 consecutive months of insurance coverage without medical treatment or advice or having taken prescribed drugs or medicine for such conditions. I also understand and agree that all such pre-existing conditions will be covered after this insurance has been in effect for 24 consecutive months.

Date _____, 19____ _____
Member's Signature 2/82

NOTE: Application must be accompanied by check or money order.
Send remittance to:
Insurance Division, AFA, 1750 Pennsylvania Ave., NW, Washington, D.C. 20006.

Form 6173GH App.

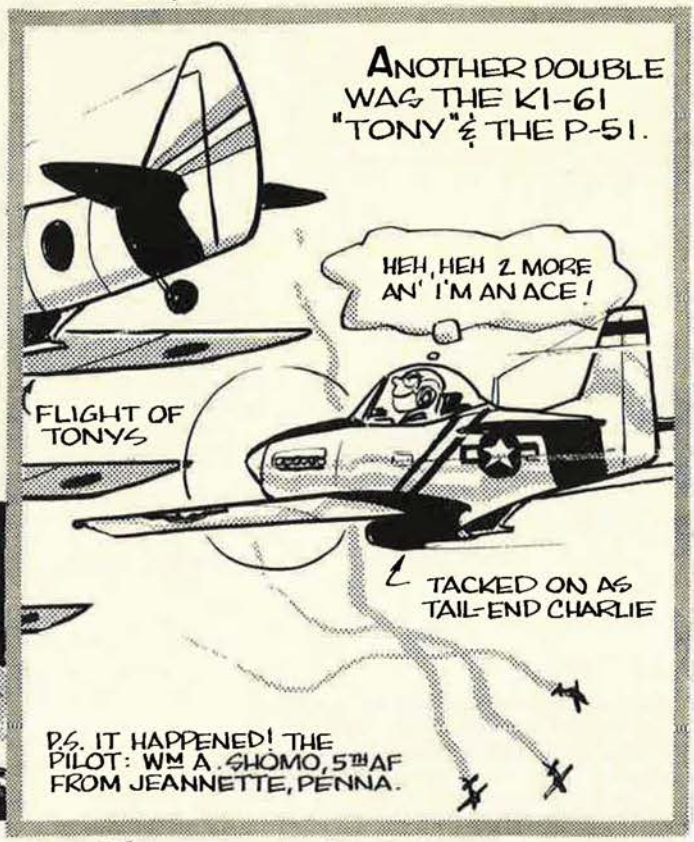
Bob Stevens'

"There I was..."

LOOK-ALIKES IN A WAR CAN CAUSE A ***LOT*** OF TROUBLE! OFTEN IT WAS SHOOT FIRST, *THEN* IDENTIFY. THE FACT THAT GOOD DESIGNS, PARTICULARLY IN FIGHTER AIRCRAFT, WERE COPIED BY THE GOOD GUYS *and* BAD GUYS ALIKE, DIDN'T HELP THINGS A BIT, EITHER!

IN THE PACIFIC IT WAS THE JAPANESE KI-44 "TOJO" THAT GAVE THE P-47 JUG PILOTS FITS-

ANOTHER DOUBLE WAS THE KI-61 "TONY" & THE P-51.



IN THE ETO, THE SPITFIRE *and* ME-109 WERE DEAD RINGERS FROM BEHIND-

THE ITALIAN MACCHI C.202 *and* EARLY MUSTANGS (P-51A, B) COULD HAVE BEEN TWINS-

because someone asked Sperry.

Up to now, this Navy EA-6B flight team could hardly operate in four oceans in one day. But today, a Sperry simulation system enables them to practice ECM missions in a variety of realistic worldwide scenarios... without ever leaving the ground.

Considered to be the U.S. Navy's most technically advanced simulator, Sperry's EA-6B Weapon System Trainer provides a practical supplement to onboard flight exercises. Risks to crews and aircraft are minimized. Fuel is saved. Prime equipment is spared wear and tear.

Crew members develop team skills which previously were impossible to acquire short of combat situations. They operate actual EA-6B equipment, including computerized tactical and defensive jammers, communications jammers and chaff dispensers. The Navy combines these realistic exercises with aircraft flight time to achieve optimum crew proficiency.

The EA-6B trainer is one example of Sperry aircraft trainer technology. Our flight simulator for the Navy/Marine Corps' newest fighter—the F/A-18 Hornet—will have the features necessary to qualify pilots in normal and emergency operations of the aircraft.

Our A-6E trainer realistically portrays night carrier launch and recovery functions. Our A-4 attack aircraft simulators cover the entire range of aviator training.

Sperry math modeling techniques are being incorporated in our design of the operational flight trainers for the CH-53 helicopter. Our conversion of U.S. Air Force B-52 trainers to the latest digital systems is a cost-efficient alternative to the design and construction of new trainers.

And we've developed a wide range of simulators for other applications—from improving the firepower accuracy of infantry and armor to assuring the combat readiness of shipboard crews; from enhancing the skills of commercial ship pilots to researching the behavior of deck officers.

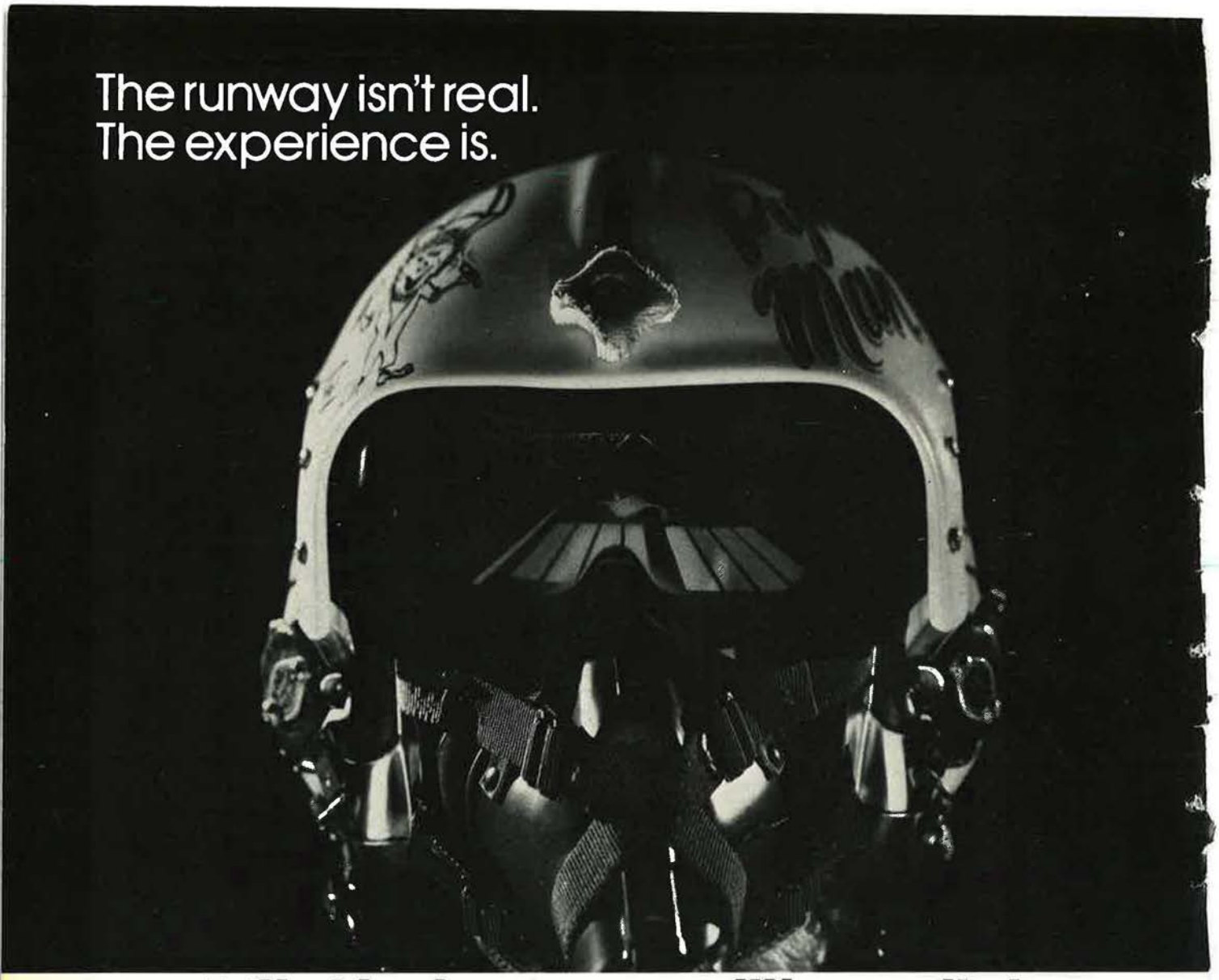
This technology is making training more practical and less expensive—often at one-tenth the cost of actual exercises.

For more information on what we're up to in simulation, just ask us...we understand how important it is to listen.

Write to: Sperry Division Headquarters, Systems Management Marketing, Great Neck, NY 11020. Or call (516) 574-1543.

SPERRY

SPERRY IS A DIVISION OF SPERRY CORPORATION



Vital trains more military pilots worldwide than any other visual system.

Every new U.S. Air Force pilot trains on our Vital visual system. Realistic takeoff and landing, air-to-ground, and air-to-air Vital simulation makes an even more effective pilot in the air.

For advanced training in Air Force F-4s, A-7s, or A-10s, Vital is there, too.

The Air Force pilot is not alone in relying on Vital. Navy F-14, S-3A, P-3C, SH-2, SH-3 and SH-60B pilots are doing the same thing. F-18 pilots in the Navy, Marine Corps and Canadian Forces soon will.

Dutch, Israeli, Danish, Egyptian, and Belgian F-16 pilots also will fly their aircraft with Vital. The Swedish Air Force JA-37 pilot gets his first air-to-air engagement with Vital.

Vital trains more military pilots than all other visual systems combined. Thirteen services train pilots in 28 aircraft types with Vital. At five research centers, test pilots are learning to fly tomorrow's aircraft with Vital. We're very big with commercial pilots, too. In all, there are 200 Vital visual systems operating at 45 sites around the world.

But we're not finished yet. To find out what Vital is now, *and what it's going to be,* drop a note to Vital Marketing, McDonnell Douglas Electronics Company, Box 426, St. Charles, MO 63301. Phone (314) 925-4467. Telex 447369.

VITAL™

MCDONNELL DOUGLAS