DECEMBER 1985/$2

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Training, Technology, and Money

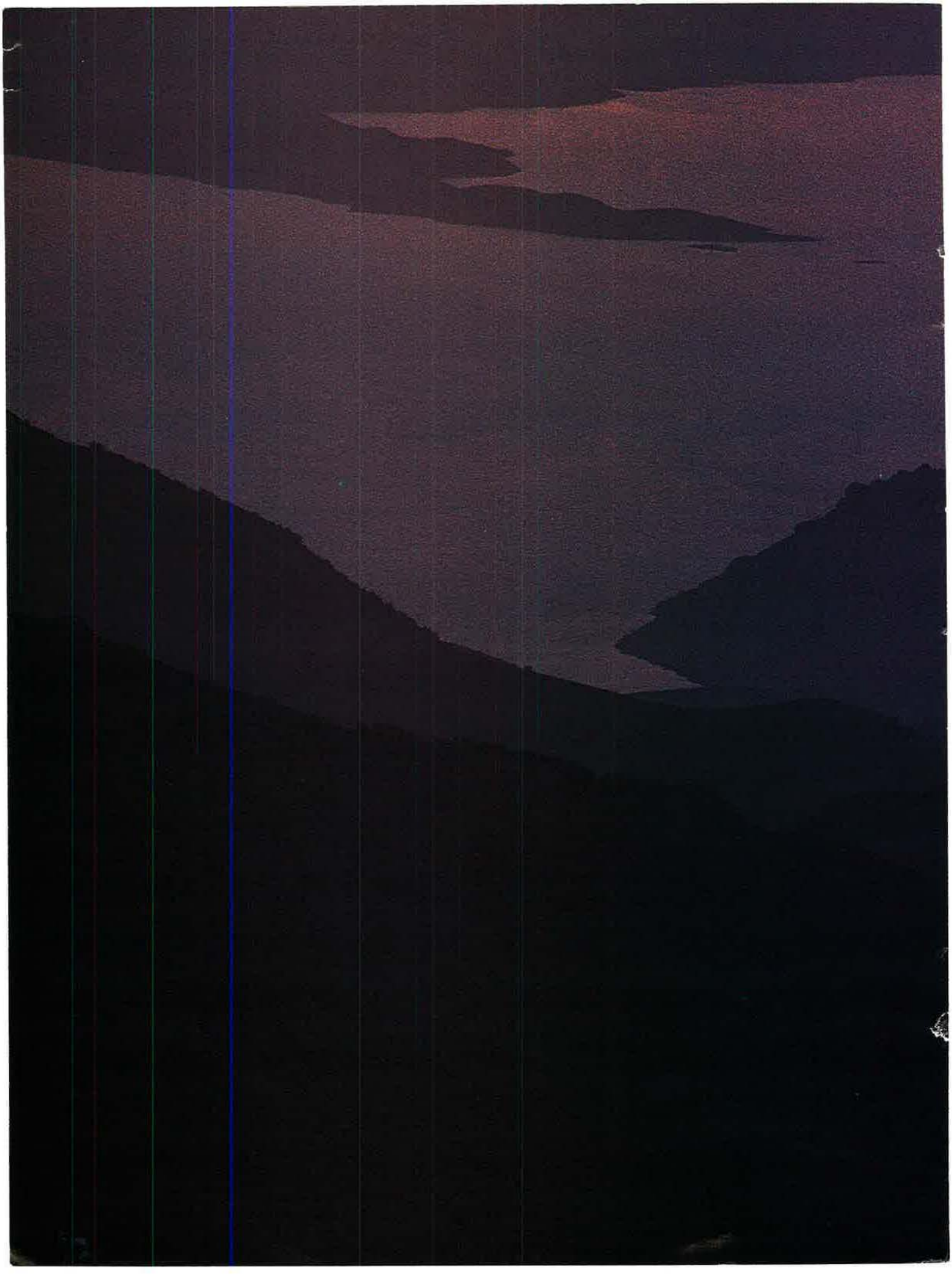
Also:

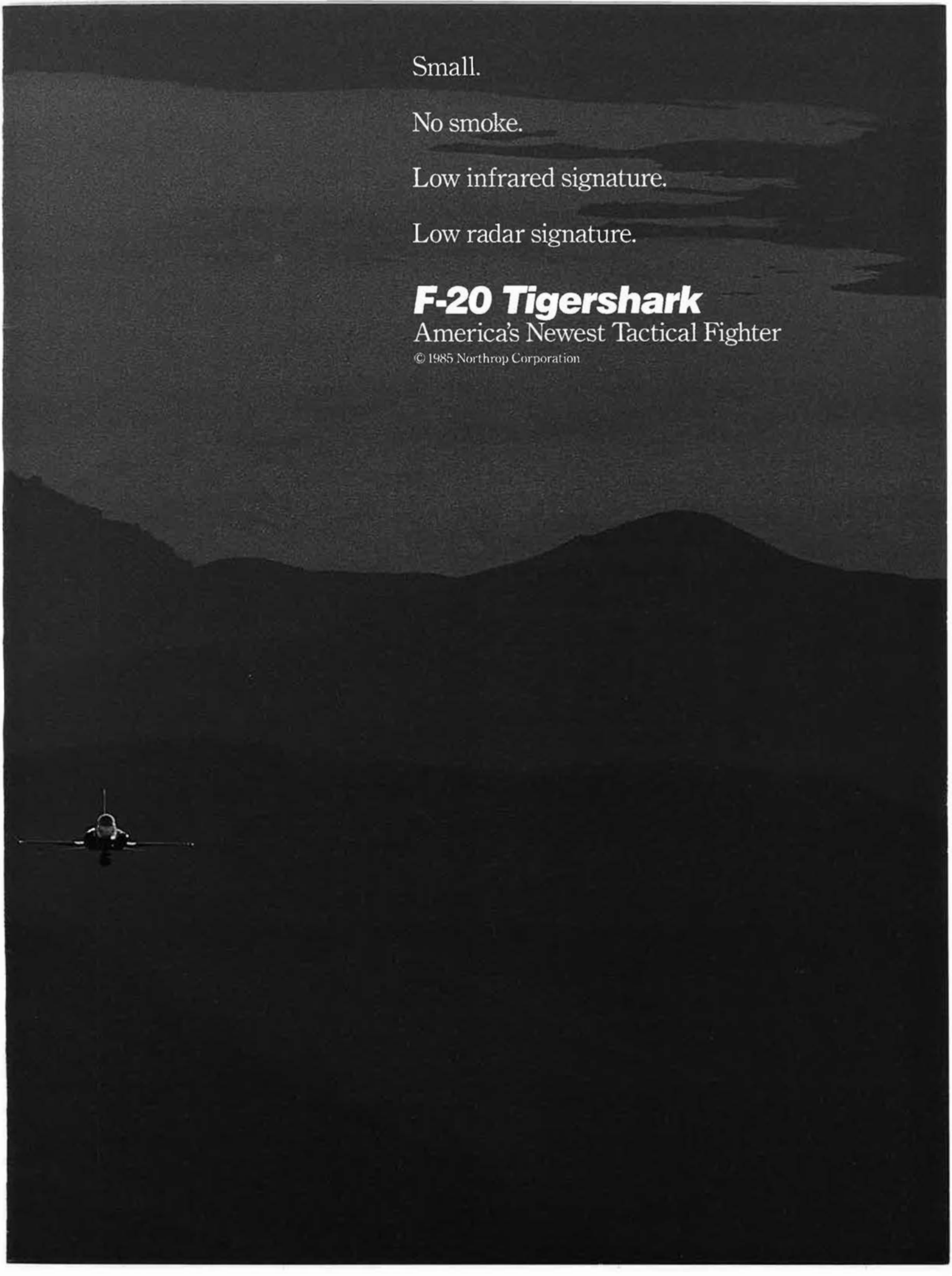
The Evolution of USAF Armaments

Europeans Look at Strategy

The Military-Media Wars

The Grand Old Gooney Bird

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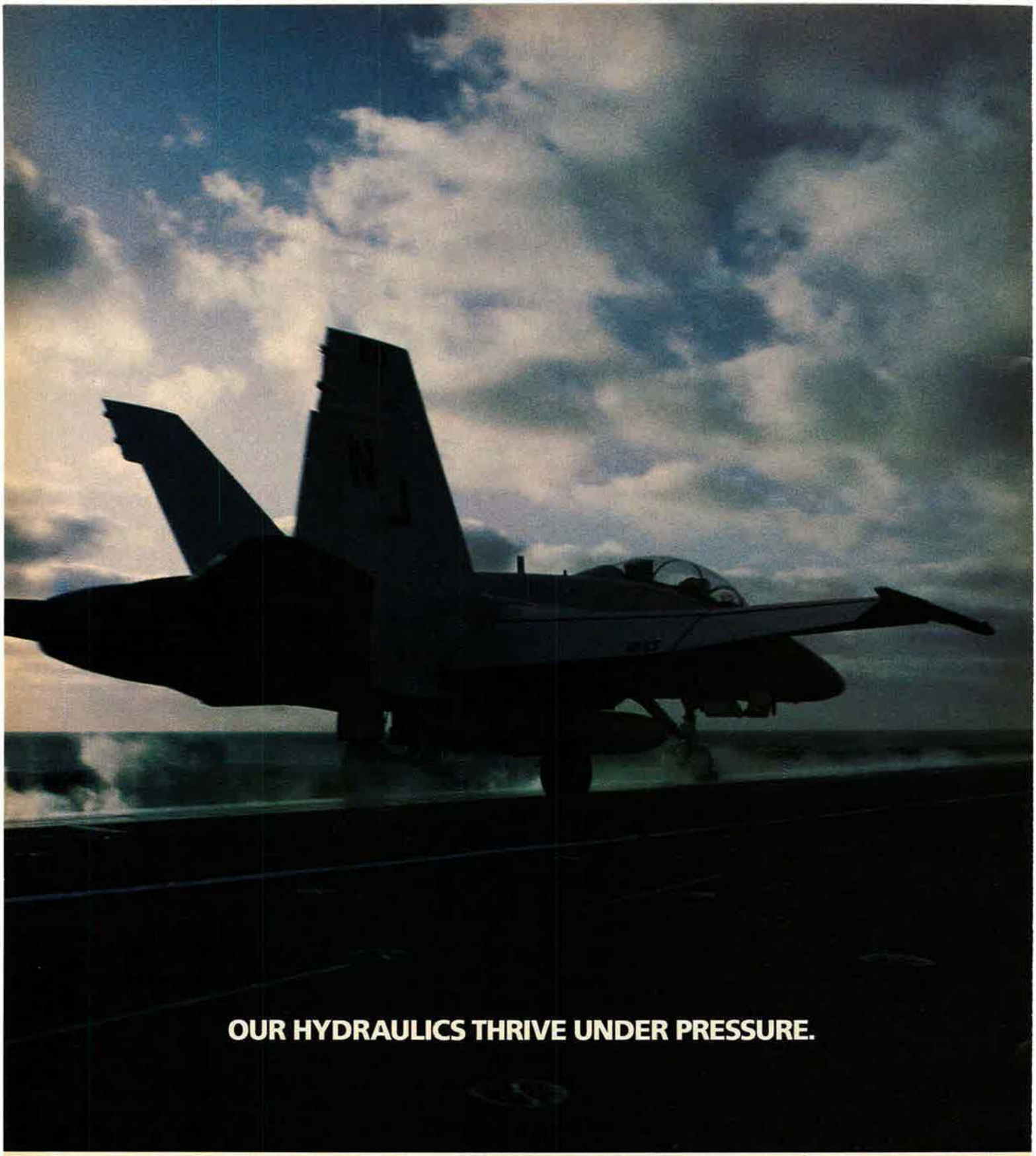

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DECEMBER 1985
VOLUME 68, NUMBER 12

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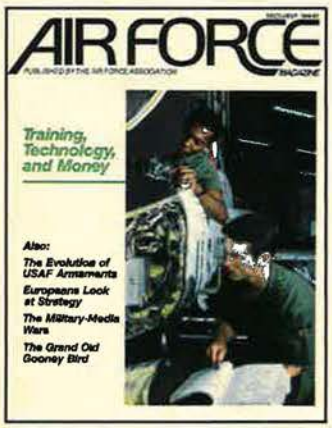

About the cover: Technicians at the 12th Flying Training Wing, Randolph AFB, Tex., inspect one of the unit's T-38 Talons. Effective training brings success in maintenance and many other USAF missions. A special section on training begirs on p. 46. (USAF photo by SMSgt. Buster Kellum)

Special Section: Training and Technology

Features

Departments

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Raytheon-produced Digital Group Multiplexers are an integral part of the AN/TRC-170 system.

Raytheon

AN EDITORIAL

In Search of the News

By John T. Correll, EDITOR IN CHIEF

ELSEWHERE in this issue *(see p. 89)*, we report on the latest round of truce talks in the Military-Media Wars. In that session, the participants came to the table with about as much good will as either side can muster—and even then found themselves groping for a few points on which they could agree.

The real loser in these wars is the public, which is not as well informed as it ought to be on matters of national defense. The public might be better served if the military and the media thought seriously about the problem in its fundamental parts.

• *The Nature of News.* There is a belief, widely held among journalists, that reporting of good news should not be a major function of the media. Why not? The usual explanation is that only those events that depart from the expected or the normal are worth bringing to the public's attention. This assumes, of course, that the public is already sufficiently informed on the basic situation to interpret the bad news in context. And if the media disdains the reporting of good news, where is the public to get such an understanding? Surely news consists of more than scandals, freak events, and peripheral developments.

Balanced reporting is further hampered by the limited amount of air time or page space allotted to a single story. Long newspaper pieces that explore all aspects of a subject are hooted at in the trade as "thumbsuckers." Unless a thumbsucker is very lively—a condition sometimes difficult to distinguish from sensationalism—its chances for publication are slim. On television, a thumbsucker is a five-minute segment. Defense issues are usually complex, often dull, and seldom captured well in short, breezy reports.

• *The Media Mystique.* Pursuit of the news is exhilarating, and it is easy for reporters, the younger ones especially, to get caught up in self-righteous, romantic images of themselves. The US Constitution has seven articles and twenty-six amendments, but only one of these—the First Amendment, which guarantees freedom of the press—has transcended further discussion. The military can be arrogant and self-righteous, too, but it can't hold a candle to the media.

Crusading spirit counts for too much in the media world, and subject-matter competence counts for too little—particularly on the defense beat. A sportswriter who can't tell a screen pass from a lateral will soon be fired. On the other hand, skimpy knowledge is often tolerated in reporters working on military stories.

• *The Need to Know.* Originally, this phrase codified the sensible rule that dissemination of classified material should be limited to those who need it for official purposes. There is a strong inclination among some in the military to extend the concept. Any information—including unclassified information—about defense matters is of potential military value to the enemy. The Russians keep such information under wraps. Why shouldn't we?

The reason lies in the basic differences in the two societies. We cannot imitate the superficial efficiency of a totalitarian state without changing the nature of our own society in unacceptable ways. In the United States, public opinion is a legitimate part of the decision-making process. If the process is to work, it requires an informed public. It is the will of Congress, expressed in the Freedom of Information Act and other pronouncements, that the government be as open as possible. The military wants the public to understand its problems and support its requirements. It is not going to achieve that objective by giving the taxpayers the idiot treatment.

• *Managing the News.* The readiness of the media to traffic in classified documents is despicable. But public officials forfeit the moral high ground when they selectively leak classified information as it suits their purposes—for example, to give a last-minute publicity boost to a piece of pending legislation.

Government spokesmen no longer talk openly, as they did to their distress twenty years ago, about "managing the news," but attempts to manipulate information still go on. When people say, "We don't want to wash our dirty linen in the front yard," they may have more in mind than the location of the laundry.

Managing the news, propagandizing, and attempts at cover-ups have never worked very well in the United States. These practices are at odds with our national character, and Americans have never been very good at them. Those unpersuaded on moral grounds can consider the practical implications instead. Some cover-ups may work, but others will be discovered. When that happens, public trust in government is eroded and the managers of the news—and all of us—lose big. ■

THE COLLINS DF-206A. IT CAN SAVE YOU A BUNDLE.

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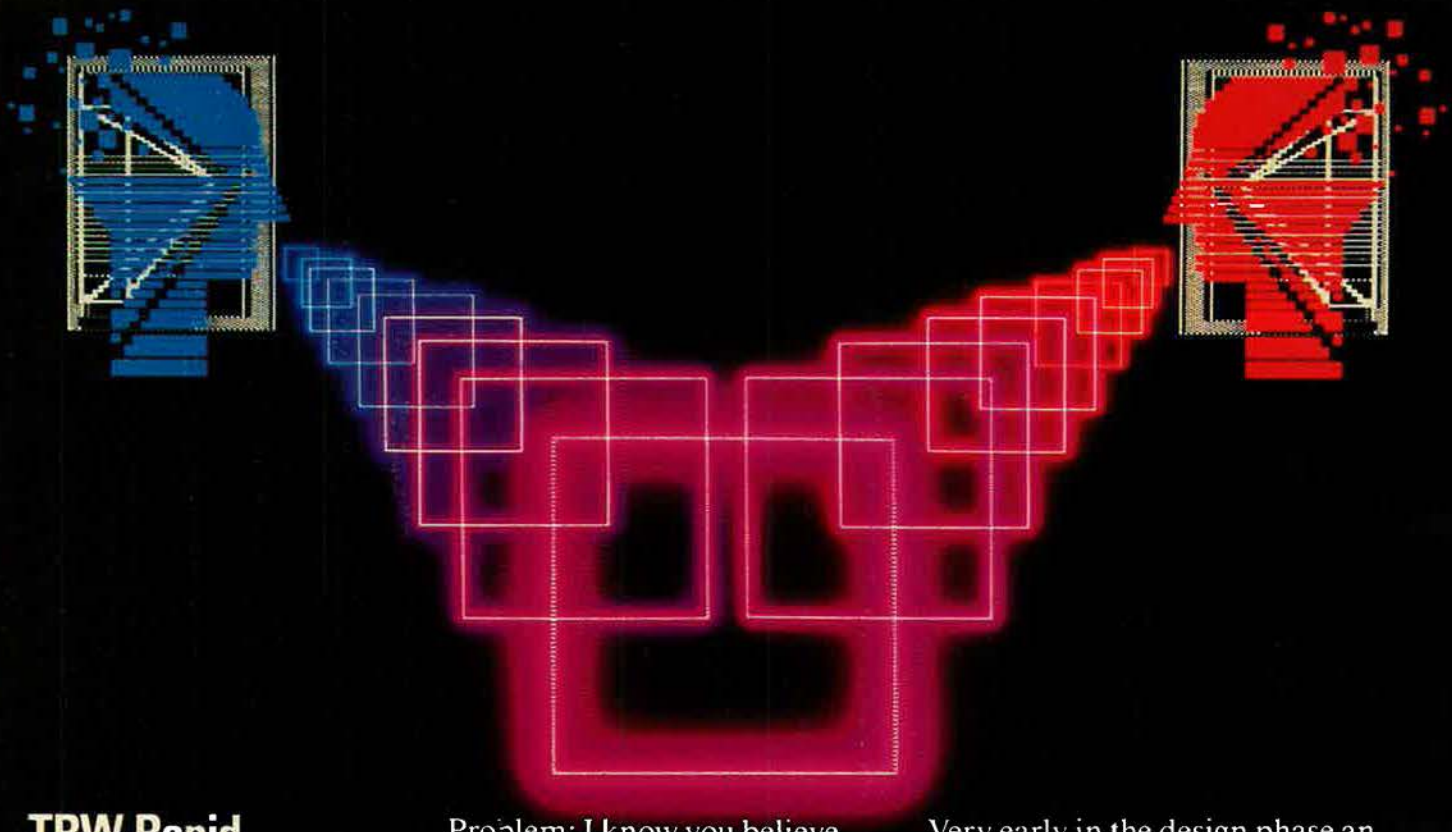

TRW Rapid Prototyping

Problem: I know you believe you understand what you think I said, but I am not sure you realize that what you heard is not what I meant.

Solution: TRW Rapid Prototyping.

The systems TRW builds today differ markedly from those of even the recent past. The strength of these new systems derives from their interactive nature, supporting human users, automating a variety of data processing tasks. Yet it is this human component which makes these systems so complex. Requirements are often subjective, vague, unknown or incompletely defined. Our best methodologies fail to grapple fully with the intricacies of the human/machine relationship. Yet it is upon this point that ultimate success or failure turns.

TRW solves this problem by rapidly building system prototypes to allow user/designer interaction. State-of-the-art man-machine interface technology combined with a vast library of applications software modules serve as a sketchpad for system designers. The process is called user engineering.

Very early in the design phase an interdisciplinary team of software engineers, system designers and psychologists meets with users to analyze their tasks, define scenarios of operation and build prototypes which look and feel like the real thing. The prototypes become vehicles for communication with users who help determine how the system must function.

With user guidance the prototype is refined, step-by-step, until it closely reflects the final proposed system design. TRW is dramatically reducing the risks of system development through rapid prototyping and user engineering. We can quickly discover and validate user needs, make better tradeoffs among alternatives, and much increase the probability of users' ultimate satisfaction.

Yes, now that's what I meant.

TRW

TRW Defense Systems Group

AIRMAIL

Jointness

I just finished reading the series of articles on "jointness" in the October 1985 issue and found each to be an accurate reflection of current thinking. However, by exception, these articles also point out two fundamental flaws in current joint doctrine development.

The first is that weapons programs have become an end in themselves and are often developed without the supporting doctrine or procedures to provide for proper employment of these weapons. Instead of getting wrapped up in what technologies are available, we need first to define our warfighting objectives and then procure the weapons and develop the procedures to ensure that the US is capable of carrying out these objectives.

Secondly, regardless of how good joint Army-Air Force doctrine looks on paper, it is not the panacea in a multination or multiservice environment. The close proximity of TAC and TRADOC may be desirable from the standpoint of meeting deadlines for getting joint documents on the street, but it fosters the proliferation of close-minded and parochial thinking. Most likely, the US will not fight its next major war unilaterally. Therefore, our doctrine must be fully integrated or at least compatible with that of other nations with which we have alliances.

US doctrine must include the Marines and Navy to ensure that we minimize fratricide on the battlefield. The voice of TAC must not be thought of as infallible, and US doctrine development must pay more than lip service to the views of USAFE and PACAF, which operate daily with other nations' services.

"Jointness" is a nice buzz word and is the right direction for US military thinking to be headed, but let us be sure that we are not rushing ahead to meet artificially established suspense dates at the expense of substantive doctrine.

Lt. Col. James V. Kelso III, USAF
Columbus, Miss.

The Air-Ground Battle

I enjoyed the article "Coordinating the Air-Ground Battle" in the October 1985 issue of AIR FORCE Magazine *(p. 64)*. However, I was surprised and disappointed that you did not mention the Airborne Battlefield Command and Control Center (ABCCC). Fielded to support the Vietnam conflict during the mid-1960s, the ABCCC is still commonly known by its original radio call signs: Cricket, Hillsboro, Alleycat, and Moonbeam.

The ABCCC is a capsule that fits snugly into the back of a modified C-130E aircraft. It is equipped with four HF, four VHF-AM, four VHF-FM, and eight UHF Have Quick radios, exclusive of those used by the aircraft flight crew. Carrying a battle staff of twelve and a flight crew of four, the ABCCC acts as an extension of the TACC to provide improved communications with Army units along the FEBA. However, the ABCCC and crew are capable of a versatile array of operations, including limited TACC current operations and ASOC roles. The battle staff includes a two-person intelligence section that receives and validates immediate air requests. If Army artillery support is unavailable, the command section then secures approval for the request, and the operations section diverts or scrambles the necessary assets.

Future improvements for the ABCCC include a replacement capsule (funding is in the current budget before Congress), digital communications terminals, SINCGARS, and improved dual-band VHF-FM/AM radios.

ABCCC is a very important part of the TACS system. Together with AWACS, it can also provide a rapidly deployable command and control function when traditional ground TACS elements are unavailable. A few weeks after the ABCCC was employed in the Grenada assault, I heard that Gen. W. L. Creech remarked to a meeting of TAC commanders that they should find out who and what ABCCC is. I hope this letter encourages those interested in Air Force support for Army operations to "find out."

Thank you for an otherwise excellent article.

SMSgt. Mark D. Doiron, USAF
Oklahoma City, Okla.

I found James Coyne's article on "Coordinating the Air-Ground Battle" in your October 1985 issue to be particularly well done. The author took a complicated and timely issue and laid it out in a very clear and logical order.

James W. Connally
Bethesda, Md.

Shot *Up*

Congratulations to you and Irene McPherson for the excellent article on my friend, General Adolf Galland *(see "Galland of the Luftwaffe," October 1985 issue, p. 102)*. I would, however, like to speak for him in the matter of his being "shot down" on his last combat mission.

One evening at a small dinner gathering honoring General Galland and his friend and traveling companion, retired RAF Wing Commander Robert Stanford-Tuck, someone at the table asked "Dolfo" about his last mission and made several references to his being "shot down." After about the third such mention, Galland stopped him and, with his characteristic charm, said, "Sir, I was not shot down. I was shot *up*, and I was wounded. But I retired from the battle under my own power, returned to my own airfield, and made a normal landing—when you can do that, you're not 'shot down.' "

What Galland did not mention was the circumstances under which he

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

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AIRMAIL

landed—one engine of his Me-262 would not respond to throttle control, his nosewheel was flat, and the airfield was under heavy attack by P-47s. He went in through the attacking fighters, landed, and rolled out. When the ship stopped, he jumped out and took cover in a nearby bomb crater. Then, while still under fire, a ground crewman drove an armored tractor out to the crater to pick up Galland and drive him to shelter.

This action, I think, speaks more eloquently than any words about Galland and the respect and affection that he inspired among those who served with him.

Robert E. Cunningham
Fort Worth, Tex.

The Young Astronauts

Re: The article "The Young Astronauts" on page 84 of the October 1985 issue.

I was pleased to see that an interest is being taken in stimulating young people toward math, science, and technology. The article was full of wonderful details about what is being done and about plans for the future for existing chapters, but I was disappointed to find no information in the article about where to go to get instructions on starting a Young Astronaut chapter.

I'm sure that many great opportunities exist in this center of the aerospace industry for nurturing and supporting a Young Astronaut chapter. Further information would be appreciated.

Joan M. Adams
Los Angeles, Calif.

• *For more information about the Young Astronaut program, contact the Young Astronaut Council, P. O. Box 65432, Washington, D. C. 20036.*—THE EDITORS

Re: The article "The Young Astronauts" in the October 1985 issue.

The first thing that my high school journalism instructor taught me was to "get the name right!" There is no excuse for calling Niki Wenger (née Nancy Mason) *Mickey.*

Bud Martin
Charleston, W. Va.

• *Reader Martin is correct. Our apologies to Ms. Wenger.*—THE EDITORS

Tooling Into Pearl

Re: "There I Was . . ." by Bob Stevens in the October 1985 issue.

I would like to see the crews and planes that "tooled into Pearl" given proper identification. This group of B-17s was flown by members of the 88th Reconnaissance Squadron.

This squadron was attached to the 7th Bomb Group at the time, and the ground echelons of both units were on the way to the Philippines as reinforcements for the Army Air Corps in the Far East. I was with the ground echelon, having been removed from combat crew status so that my communications section chief could go as a member of the air echelon. We left Honolulu on November 28 and wound up at Brisbane, Australia, in late December. Most of the ground crews eventually went to India.

The air echelon eventually did join the 19th Bomb Group in the Philippines and Java and wound up in Townsville, Australia, where I was stationed with the 39th Fighter Squadron in May 1942. I learned of all this when I read an order giving decorations to members of the squadron for having flown General MacArthur from the Philippines to Australia.

The 88th Reconnaissance Squadron was an old World War I unit formed from the Wyoming National Guard. Our insignia was an orange disc with the same mustang silhouette still used on Wyoming license plates. Our plane's engine cowlings were painted with a black-and-orange checkerboard. It was the only Air Corps unit ever to take part in keeping order during a labor strike, which took place sometime during the 1920s, I believe.

I would be interested in hearing from any old members of the squadron from its days at Hamilton Field and Salt Lake City.

Also, in the same issue, there was an article about Grant Mahony titled "Crusade in the Pacific" *(p. 124).* I didn't recognize his name, but I served under him in Java for about ten days as a member of the 17th Pursuit Squadron, which received one of the first Presidential Unit Citations issued for action in the Java campaign in February 1942.

I would also appreciate hearing from any of the former members of this squadron.

James A. Schott
P. O. Box 53627
Lafayette, La. 70505
Phone: (318) 837-6003

• *For more on the Java campaign, see "Journey to Java" on p. 166 of the November 1984 issue.*—THE EDITORS

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An Amraam air-to-air missile can be fully tested in only one minute with a sophisticated test station. A typical station consists of 17 bays of state-of-the-art computer-controlled instrumentation and is designed for use in the development lab, military depot, or factory. Due to the thermal time limitation of the missile hardware, it examines all of the missile's functions in about 60 seconds—digital, analog, radio frequency, telemetry, and built-in-test capabilities. The central computer saves all information and analyzes it after the test is completed. The test stations are part of a full-scale development contract the U.S. Air Force awarded to Hughes Aircraft Company for the advanced medium-range air-to-air missile. Each station can be expanded into a diagnostic station to pinpoint problem areas down to the smallest replaceable assembly and tell which repair should be made.

A new generation of powerful, ultrafast semiconductor microchips can soon be produced at rates required for commercial manufacturing, using the world's most sophisticated electron beam lithography system. The system is capable of writing circuit patterns with features as small as 0.5 micrometers—about 1/200th the diameter of a human hair. It was accepted recently by the U.S. Department of Defense for its VHSIC (very high speed integrated circuit) program. The acceptance culminates four years of development by Hughes Research Laboratories and Perkin Elmer Corporation leading to the direct-write system.

Technological enhancements have improved the performance of a system used in U.S. Navy ship-to-ship and ship-to-shore communications. The secure voice switch (SVS), designed and built by Hughes, is a processor-controlled, solid-state radio telephone switching system that allows simultaneous transmission of clear and secure voice messages. New large-scale integrated circuit devices, using the latest HCMOS technology, now provide expanded switching capacity in the same space, plus nonsecure switching between encoding and transmitting equipment. The new system also adds data switching to SVS voice capability. The hardware was developed for the Navy's new Landing Helicopter Dock Ship.

To meet the challenges of testing increasingly complex missiles, a test equipment design department at Hughes in Tucson, Arizona, has become a manufacturing operation within a larger manufacturing operation. The organization occupies about half of a new 106,000-square-foot facility that includes an office area, training rooms, computer center, CAD/CAM (computer-aided design/computer-aided manufacturing) center, engineering labs, and test equipment construction areas. With its own engineering staff, drafters, buyers, procurement follow-up group, production planners, clerks, technicians, and assemblers, the department has more capability than some small corporations.

A near-field testing system offers savings in excess of 1 % of an antenna's value and allows troubleshooting on each individual element of an antenna. Hughes developed the system as a cost-effective, highly accurate way of testing many shipboard and air defense antennas. It is more practical than far-field testing and allows a greater degree of complexity than previous near-field test systems, while easily duplicating the test data that would be obtained by both methods. Housed in an anechoic chamber, the computer-controlled system moves a waveguide probe through measurement positions as close as a few thousandths of an inch within a 19x26-foot area. The probe position is monitored with a laser interferometer. Information on the antenna's vector radio frequency field is then measured and converted to equivalent far-field pattern data by the system's software.

For more information write to: P.O. Box 45068, Dept. 76-2, Los Angeles, CA 90045-0068

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AIRMAIL

Blue-Suit Blunders

I am writing in reference to your October 1985 issue, specifically with reference to the back cover. It seems that the Air Force uniform is not properly represented.

I have noted the following discrepancies: The bottom edge of the US insignia is not parallel with the ground; the ribbons are not grounded with the top edge of the pocket; the ribbons are not centered on the pocket; there is a gap between the two top ribbons, showing metal; and the individual is wearing two Outstanding Unit Citation ribbons in the middle row, where only one should be worn with an oak leaf if earned twice. . . .

TSgt. Fulvio A. Fontana, USAF
Bolling AFB, D. C.

• *Many readers have contacted us to point out the apparent errors on the back cover of the October 1985 issue. We appreciate the many responses from our sharp-eyed readers and have passed on those comments to the advertiser.*—THE EDITORS

Outstanding!

Your September 1985 issue was outstanding! As a Navy radioman who was assigned to the Merchant Marine, I hauled the chow to all those West and South Pacific islands in World War II to feed the Army Air Forces jocks. Your many articles brought back vivid memories.

Again, well done!

Kenneth T. Dowling
Santa Maria, Calif.

Lauding O'Loughlin

I read your article "Five Priorities for Logistics" with interest, primarily because of its author, AFLC Commander Gen. Earl T. O'Loughlin *(see September 1985 issue, p. 92).* I am proud to have known General O'Loughlin during the 1960s, when he was a B-52 aircraft commander with the 479th Bomb Wing, Wurtsmith AFB, Mich. I had a feeling at that time that he would go on to "bigger and better things," but I never dreamed that he would go so far.

I was a tech sergeant in plans and scheduling, and one of my duties was to conduct maintenance debriefing after an aircraft mission. My job was to question the aircraft commander on any problems with the aircraft's general systems (hydraulics, electrical, fuel, etc.). We debriefers knew which aircraft commanders were truly interested in and knowledgeable about the maintenance problems of these systems. Major O'Loughlin would take the time to explain, in detail, all writeups, major or minor, so that the mechanic got a thorough briefing on all malfunctions.

As a secondary responsibility, Major O'Loughlin was in charge of operations scheduling. I was the maintenance scheduler, and, as anyone who knows about the "knockdown and dragout" sessions between operations and maintenance, getting the required aircraft utilization for both was quite a struggle. I remember him as an operations scheduler who bent over backwards to schedule his aircrew training so that maintenance could also get maximum aircraft utilization to accomplish their requirements. He was one of the few operations schedulers I have known who realized that aircraft maintenance was as important as aircrew training.

It's assuring to me that the head of AFLC is well indoctrinated and has always been truly concerned with both operations and maintenance.

SMSgt. McClellan Bresee, USAF (Ret.)
Newport News, Va.

The Organization

Just a short editorial comment on your September 1985 issue of AIR FORCE Magazine. It also applies to your September issues of past years, wherein you have kept us abreast of key USAF officials. This year, the mistake appears on page 88.

There is no *Office* of the Joint Chiefs of Staff. This is an extremely common mistake. OJCS stands for *Organization* of the Joint Chiefs of Staff. There is an office of the Chairman, JCS, and an office of the Director, Joint Staff, but no office of the JCS. I'd also add that, technically, your listings of the major generals is also slightly off. Maj. Gen. Bradley Hosmer, for instance, is the Vice Director, Joint Staff, *OJCS,* Washington. "Joint Chiefs of Staff" refers only to the four service Chiefs!

I only ask you to double-check on these technicalities. I like to keep *my* magazine on the accurate beam.

Col. James L. Altemose, USAF
Osan AB, Korea

Slipping Standards?

I am very disappointed with the photograph on page 237 of the September 1985 issue. Once again, you have let slip by a photograph of someone obviously not within standards. I am referring to the photo of Cadet Lorrie Hall from the University of Pittsburgh.

I believe that you have a responsibility to refuse to publish those pictures that indicate an obvious AFR 35-10 violation. I am referring to Cadet Hall's hair, which is not even close to the standard. I believe that having one's picture printed in AIR FORCE Magazine is a privilege and that major violations should be rejected. I am confident that you receive more copy than can be printed and that there are many worthy cadets who maintain the high standards required of an Air Force officer.

I remember a similar incident not too many years back, and the editorial response was that a closer look would be taken. I'm sure you will.

Marybeth Coffer
Del Rio, Tex.

• *Angel Flight is the women's auxiliary of the Arnold Air Society, but Angel Flight cadets are not members of ROTC and are not pursuing Air Force commissions. Angel Flight cadets do wear uniforms and must adhere to their own dress standards; however, they are not subject to AFR 35-10.*—THE EDITORS

Pacific Fighter Ops

I would like to ask for assistance in research for a manuscript. Primarily, it will be a narrative of Seventh and Twentieth Air Force fighter operations in the Western Pacific during the last six months of the conflict.

I would be interested in contacting any readers who have had experience in or who could provide information on the following areas:

• Intelligence evaluations and analyses of Japanese home defense fighter units in general and the 302d and 343d Naval Air Groups in particular.

• Air technical intelligence flight-test evaluations of the Kawanishi N1K1-J and N1K2-J (George 1 and 2) and the Mitsubishi J2M (Jack) series aircraft.

• Evaluation of Japanese electronic capabilities: radar, jamming of VHF and DU frequencies, spurious transmissions, etc.

• English-language summaries or extracts of material published recently in Japan regarding the units and aircraft noted above. Perhaps a reader in Japan could provide assistance with this.

All letters will be answered. Any materials sent for examination will be treated with care and returned without delay, insured at such rates as requested by their owners. Any assis-

tance in any form will be most appreciated and gratefully acknowledged in the narrative upon publication.

Neil J. McKenzie
272 South Broadway
Yonkers, N. Y. 10705

Aviation Museum

We are in the process of forming an aviation museum at the Indianapolis Metropolitan Airport. We are asking anyone interested in such a project, in any form, to contact us.

At this early stage of planning, we are looking for any items having to do with aviation history: clothing, aircraft parts, pictures, military aviation equipment, airplanes (in any condition), etc. Any items loaned to the museum will be taken care of and will be returned upon request. Donations are also welcomed. Those who donate items will have their name listed with the item at its exhibit.

We can use all the help we can get. The first 100 people signing up to aid the museum will be listed as charter members of the museum. We are also seeking any financial grants that could be used to help open the museum. Anyone who might be interested in helping us with this project is asked to contact the address below.

Indiana Aviation Museum of Flight
P. O. Box 22413
Indianapolis, Ind. 46222
Phone: (317) 924-9203

727th TCS

I am researching the unit history of the 727th Tactical Control Squadron (Test) from August 30, 1950, to the present.

The mission of the 727th TCS is to conduct operational tests and evaluations on command control and communications equipment associated with the Tactical Air Control System (TACS). The unit supports the Tactical Air Warfare Center at Eglin AFB, Fla., in developing and testing tactics, techniques, and concepts relating to the TACS.

This unit has been known as the 727th Aircraft Control and Warning Squadron, the 727th Tactical Control Squadron, and the 727th Tactical Control Squadron (Test). This unit was stationed at Shaw AFB, S. C., in September 1950, Myrtle Beach AFB, S. C., in September 1954, Bergstrom AFB, Tex., in November 1966, and Hurlburt Field, Fla., in October 1979.

I am interested in hearing from anyone who has been assigned to this squadron or any of its detachments. I would also appreciate any slides, photographs, newspaper or magazine clippings, and patches that could be lent or donated to the 727th TCS for a display case at the squadron. All photos will be carefully handled and professionally copied. Those loaned will be promptly returned. All donors will be credited in the display.

Any assistance will be greatly appreciated. Please contact me at the address below.

Sgt. Stan Merideth, USAF
727th TCS(T)/PA
Hurlburt Field, Fla.
32544-5000
Phone: (904) 884-6733
AUTOVON: 872-6733

AIRMAIL

Automated Blind Landings

I was with the Army Air Forces Tactical Center at Orlando, Fla., and attached to the 901st AAF Base Unit, Squadron H, at Pinecastle Army Air Field. Maj. Thomas R. Waddleton was the commanding officer, and Capt. Edward R. Neff, Jr., was the test and development officer.

In late 1944 or January 1945, while assigned to the "All Weather Project," I worked with two electronic engineers from Wright Field whose names, I think, were Logan and Setzer. We were working on a blind landing system that used the localizer and glide path beams to feed signals to the automatic pilot. After much debugging, I made either three or four consecutive takeoffs and landings in a B-17G in fog so thick that I had to open the side window and look down to follow the painted line on the taxi strip.

I reported the event personally that day to Col. Earl R. Tash of the Air Forces Board. In his company at the time was a colonel in charge of an instrument school in Texas (possibly Colonel Duckworth of the Bryan School). Shortly thereafter, I was transferred to England and thought no more about it.

In 1952 or '53, an article in the *Saturday Evening Post* gave credit to a Navy pilot who had just done the same thing, but not under the zero-zero conditions. I would like to establish the Air Force as being first to make an automated blind landing under zero-zero conditions.

If any readers can tell me how to get in touch with any of the aforementioned people or how, in any way, I can verify this event, I would like to hear from them.

C. W. Rothrock, Jr.
309 Park Lane
Cantonment, Fla. 32533

Joltin' Josie

On April 1, 1945, at 2100 hours, *Joltin' Josie* (the first B-29 to land on the Marianas in October 1944) ditched at the end of Isley (Saipan) airstrip in the Lau Lau (Magicienne) Bay because of a dead calm. The War Department accident report was wrong, as it stated that the cause for the accident was mechanical failure and that the aircraft exploded immediately. Three of us witnessed this accident. It is important that I contact the other two because of the following:

- The US Army's Memorial Affairs and Casualty Support Division is interested in recovering the bodies, if bodies are recoverable. If there was no explosion or fire, the bodies would be recoverable. There was no explosion.
- At one time, someone in the government was looking into the possibility of locating and raising *Joltin' Josie* for use as a static display on Isley Field. Also, the Submerged Cultural Resources Unit of the National Park Service is in the planning stages of a project that would attempt to locate and assess B-29 wreckage in Lau Lau Bay. If *Joltin' Josie* did not explode, then these two projects might continue.

If anyone knows of the whereabouts of two sergeants from the 869th Bomb Squadron by the names of Vern Bailey (who once worked at the Rome Air Development Center) and Trombetti (I forget his first name), please have them contact me to confirm the events I have described.

Haman W. Douglas
880 Mandalay Ave.
C-1109
Clearwater Beach, Fla. 33515
Phone: (813) 441-3249

Tactical Recce

I am a student at the Air Command and Staff College and am preparing a paper on the evolution of the roles and missions of tactical reconnaissance from World War I to the present. My paper will be primarily historical, but I would greatly appreciate hearing from anyone who could help me fill in some of the rationale behind the decisions that have been made concerning aircraft and mission choices.

I am particularly interested in talking with anyone who could offer reasons for the decision to go from light observation planes to bombers and

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fighters around 1930, anyone having information about the P-51 as a recce airplane in World War II, anyone having information about the transition from fighters to dedicated reconnaissance aircraft after the war, and anyone having information about the selection process for the RF-4C in the early 1960s.

My paper will be published soon, and it is important that I receive any input as soon as possible. Please write me or call me at the address or phone numbers below.

Maj. James H. Barnes, Jr., USAF
5749 Hitching Post Ct.
Montgomery, Ala. 36116
Phone: (205) 277-5284
AUTOVON: 875-6794

Flak Bait

I am searching for pictures or snapshots of a B-26 Marauder called *Flak Bait.* This aircraft is currently on display at the Smithsonian's Air and Space Museum. Only the forward section of this bird is there; the balance still has to be done.

I need a picture that was taken in her early days and, most importantly, that shows the names of her ground crew on the nosewheel cover.

The current "model" out is not correct as far as we of the 449th Armament Section are concerned. We are trying to remedy this. This B-26 served with the Ninth Air Force, 322d Bomb Group, 449th Bomb Squadron.

I will be most careful with any prints sent and will make copies and return the originals to the sender.

Any information will be appreciated. Please contact me at the address below.

E. A. Maglietta
825 Elm St.
Roselle Park, N. J. 07204

B-52 Ops in SEA

I am researching information on B-52 operations conducted in Southeast Asia from January 1965 to December 1972. I am particularly interested in the Arc Light missions.

I would like to ask for assistance from any former members of the 4252d, 4258th, and 307th Strategic Wings of the Eighth Air Force. I am seeking answers to questions about basing, development, flight operations and problems, weapons used and considered, and mission profiles.

I am also looking for photos of aircraft and bases. If you so request, I will copy all information and photos sent and will return the originals to the sender.

S. W. Macy
14135 Mulberry Dr.
Whittier, Calif. 90605

AIRMAIL

Chinese-American Wing

I am presently researching the history of the Chinese-American Composite Wing and its component groups (1st Bomb Group, 3d Fighter Group, and 5th Fighter Group). The unit histories at the USAF Historical Research Center contain very few photographs. I am seeking photographs of wing and group facilities and aircraft in India and China and would also like to obtain photographs of the Chinese-American Composite Wing's commanding officers, Brig. Gen. Winslow C. Morse and Col. Allen T. Bennett.

I will copy and return all photographs that I receive. Please contact me at the address below.

A. Timothy Warnock
USAFHRC/RI
Building 1405
Maxwell AFB, Ala. 36112-6678
Phone: (205) 293-5963
AUTOVON: 875-5963

Roll Call

I am trying to locate William J. Moser, the only unaccounted-for cadet graduate from the class at Kelly Field in October 1935, regarding reunion plans.

Anyone having knowledge of his status or location is asked to contact the address below.

Col. Evart W. Hedlund,
USAF (Ret.)
1330 University Dr., #38
Menlo Park, Calif. 94025

I am researching the Army Air Forces service of my father, SSgt. Nicholas V. Azzollini. I would like to hear from anyone who might have flown with him in the Fifteenth Air Force, 98th Bomb Group, 345th Bomb Squadron.

I am especially interested in learning about his last mission on June 24, 1944, to Ploesti. Please contact me at the address below.

Michael J. Azzollini
449 East Hudson St.
Long Beach, N. Y. 11561

I joined USAF in October 1963 and was schooled at Chanute AFB, Ill., from January to April 1964. I served the rest of my four years (including TDY tours to Eielson AFB, Alaska, Castle AFB, Calif., and Kadena AB, Japan) at March AFB, Calif., as an aircraft instrument repairman with the 22d Field Maintenance Squadron.

I would like to hear from any Air Force friends who knew me during those years.

Ken Vaughn
16909 Purche Ave.
Torrance, Calif. 90504
Phone: (213) 532-2076

I would appreciate help in locating Ray R. Rubel. We last served together in 1970–71 at Pope AFB, N. C. After that, I understand that he was assigned to Greece. Prior to our service at Pope AFB, we served together in the 8th Aerial Port Squadron in South Vietnam between 1968 and 1970.

Please contact me at the address below.

James T. Knight
5837 Cypress Circle
Tallahassee, Fla. 32303

I would like to hear from anyone connected with the 5th Tow Target Squadron based in Neubiberg, Germany, during 1955–58.

Please contact me at the address below.

Richard K. Cooke
Rte. #4, Box 745
Moneta, Va. 24121

I have searched for forty years for my crew chief, Carl G. Fleming, who used to live in the San Diego area.

Anyone knowing the whereabouts of Mr. Fleming is asked to contact me at the address below.

Robert W. Boydston
156 Lynx Dr.
Sedona, Ariz. 86336

Collectors' Corner

I am in the process of building a model of the black-and-white A-10 of the 18th Tactical Fighter Squadron, 343d Composite Wing, at Eielson AFB, Alaska, that was used during Exercise Cool Snow Hog 82-1.

If anyone has any pictures, slides, or negatives of this particular aircraft, I would appreciate hearing from them. Please contact me at the address below.

John Spencer
303 Pine Cone Ct.
Haughton, La. 71037

Can anyone help me locate an aircrew member badge as worn during World War II by Army Air Forces personnel?

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

Charles A. Baisch
1828 Seneca Rd.
Vestavia Hills, Ala. 35216

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IN FOCUS...

ASATs and Countermeasures

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

OTA says that the range of Soviet space weapons is greater than previously estimated and that both the US and the USSR are capable of fielding a new generation of antisatellite systems.

Washington, D. C., Nov. 4 Soviet antisatellite weapons (ASATs) appear to be capable of attacking US satellites and other space assets at altitudes as high as 5,000 kilometers (or some 3,000 statute miles), according to a recently released report by Congress's Office of Technology Assessment (OTA). Previous testimony before congressional panels had pegged the altitude reach of this coorbital Soviet space weapon at around 600 miles.

The OTA study, carried out with the assistance of an advisory panel consisting of ranking military and scientific experts, pointed out that Soviet ASATs, at present, are confined to two launchpads at the Tyuratam spaceport and are only effective against low-altitude US military satellites. If existing Soviet space weapons (kept grounded since August 1983 under a self-imposed Soviet test moratorium) were mated with larger boosters, they might be able to reach vital US early warning and communications satellites at geosynchronous altitudes.

While the OTA study found no evidence suggesting that the Soviets might soon be able to deploy directed-energy weapons with an "all-altitude, instantaneous-kill" capability against US spacecraft, the report asserted that the USSR could "attack low-altitude satellites with its nuclear ABMs, ICBMs, and SLBMs." The OTA study warned that, with some modifications, "these nuclear assets might also be used to attack satellites in higher orbits." The study found furthermore that the Soviets have "the technological capabilities to conduct electronic warfare against space systems."

Both the US and the Soviet Union appear capable of developing and deploying a "new generation of highly capable ASATs," including space mines, high-power radio-frequency weapons, high-energy laser weapons, neutral particle beam weapons, and kinetic energy weapons. Space mines, or "fellow-travelers," the OTA assessment suggested, could be deployed within lethal range to trail their targets continuously. Using a conventional or nuclear explosive charge, a space mine could destroy its quarry almost instantly on command or, when "salvage-fuzed," if approached by a threatening space object.

OTA's catalog of future ASATs—and of technologies that can disable hostile spacecraft by other means—includes the closely held field of high-frequency weapons. According to OTA's analysis, these devices produce intense, damaging beams of electromagnetic radiation that could be used at low power levels to jam communications and radar systems or to overload and burn out satellite electronics at higher power levels. Dividing the high-energy laser field into space- and ground-based designs, OTA suggested that the latter category "would have infrequent opportunities to attack satellites but, unless attacked themselves, could shoot inexpensively and repeatedly," especially if space-based reflectors were used to direct laser beams from the ground to individual targets.

The advantage of space-based directed-energy weapons, on the other hand, could be the ability to attack several satellites in quick succession. Space-based X-ray and gamma-ray lasers could do even better, since they are deemed capable of attacking several satellites instantly and simultaneously. Senior Administration officials believe that "bomb-pumped X-ray lasers" will potentially have pervasive military importance in the decades to come.

The OTA report pointed out that the Department of Energy has succeeded in demonstrating "lasing," the emission of coherent light, by a nuclear-explosion-powered X-ray laser in an underground nuclear test site near its facility at Jackass Flats, Nev. Nuclear-explosive pumping holds great promise for future space weapons, according to OTA, because "even if only a small fraction of the energy of a nuclear explosion could be converted into X-ray laser beams, they would be lethal at great distances." X-ray laser weapons could be of relatively simple design, using thin fibers of lasing material powered by intense, pulsed radiation from a nuclear burst. Other nuclear-explosive-powered directed-energy weapons (NDEWs) under investigation in the Department of Energy's weapons program include kinetic energy weapons, visible-light weapons, microwave weapons, and neutral charged particle beam weapons.

While the OTA report suggested that future space-based, nuclear-powered, directed-energy weapons might be effective over ranges of up to 40,000 kilometers, it also pointed out that each type of ASAT weapon appears to be vulnerable to countermeasures that reduce or negate its effectiveness. Included here are various forms of protection against gamma and other radiation, magnetic shielding, and the use of fault-tolerant electronics to reduce vulnerability to system-generated electromagnetic pulse (EMP).

Also, sophisticated space warfare capabilities on one side would almost certainly be met by "shoot-back" measures by the other power, the OTA study suggested. As in the terrestrial environment, however, many weapons capable of shooting back would themselves be subject to such attacks, "making the effectiveness of shoot-back highly dependent on the types and numbers of ASAT and other weapons deployed and on the incentives for preemptive attack that

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[ASATs vulnerable to preemptive attack] could create."

Such NDEWs as X-ray laser weapons, which can only fire simultaneous, multiple bursts before they themselves are consumed by the nuclear detonation that powers them, obviously cannot be deterred by the other side's shoot-back capability in space. OTA, therefore, classifies these weapons as playing the role of a hair-trigger; either they shoot first, or they are vulnerable to preemptive attack, first and foremost by hostile weapons of their own kind.

The risk of preemptive attack on one side's ASATs by those of the other creates, in and of itself, a degree of instability. This instability would be intensified if these weapons were "salvage-fuzed," the OTA analysis suggests. While salvage-fuzing would reduce the risk of preemptive attack, it creates "the risk of space war breaking out by accident. For example, if a meteoroid destroyed a satellite, it might set off a chain reaction of salvage-fuzing that would destroy all satellites."

Passive countermeasures appear to provide the most effective protection against current and perhaps future Soviet ASAT weapons. Key players in the passive arena are decoys and "stealthy, dark" spare satellites, or even decoys of such "spares," according to the OTA analysis. Spare satellites could be predeployed in orbit, where they could remain dormant except for occasionally reporting their status. In general, they would require little power generation, cooling, attitude control, or exposure of antennas and could be made harder than operational satellites. Their armor, the OTA study suggested, could have a simple shape, "easily mimicked by inexpensive decoys." As a result, "proliferation of on-orbit spares would work more efficiently in conjunction with hiding, deception, and hardening measures."

Because nuclear-armed ballistic missiles and ballistic missile defense weapons have an intrinsic ASAT capability, OTA suggests that across-the-board ASAT bans appear neither enforceable nor verifiable. In addition, modern technology offers a range of nondestructive ASAT capabilities, such as electronic countermeasures (ECM), electro-optical countermeasures (E-OCM), and spoofing.

The OTA analysis found merit in negotiating a set of "rules of the road" for space operations, including "keep-out zones." Specific rules concerning space defense might include defended keep-out zones, provisions governing the rights of inspection, and limitations on high-velocity flybys or the trailing of foreign satellites.

IN FOCUS...

Congressional Study Calls For Defense Reform

On October 16, 1985, the Senate Armed Services Committee (SASC) released a massive staff report entitled "Defense Organization: The Need for Change." The report culminated in twelve fundamental, specific recommendations. Department of Defense reaction to the SASC report was guarded and centered on the formation of a special panel to review the Committee's premises and conclusions.

The central recommendations of the report, which was released by the Committee's chairman, Sen. Barry Goldwater (R-Ariz.), and Sen. Sam Nunn (D-Ga.), its ranking minority member, were to:

- Form, in the Office of the Secretary of Defense, three mission-oriented under secretary positions for nuclear deterrence, NATO defense, and regional defense and force projection.
- Disestablish the Joint Chiefs of Staff; by extension, this would enable the Chiefs of the services to devote all their time and efforts to their service.
- Establish a Joint Military Advisory Council consisting of a Chairman and a "four-star" military officer from each service on his last tour of duty. The members of this Council would serve as the principal military advisors to the President, the National Security Council, and the Secretary of Defense.
- Authorize the Chairman of the Joint Military Advisory Council to furnish military advice in his own right.
- Designate as Deputy Chairman one of the members of the Joint Military Advisory Council from a different "service pair (Army/Air Force and Navy/Marine Corps)" than the Chairman.
- Charge this Council with the responsibility to inform the National Command Authorities of alternative solutions—in addition to what that body recommends—to specific military scenarios.
- Authorize the Chairman of the proposed new Council to develop and administer a special personnel management system to cover all military officers assigned to joint duty and establish in each service a joint-duty career specialty.
- Make the Chairman of the Joint Military Advisory Council the principal military advisor to the Secretary of Defense on operational matters and the sole command voice of higher authority within the system. Pains should be taken to ensure that the Chairman is not part of the chain of command, either in fact or in perception.
- Remove the service component commanders within the unified commands from the operational chain of command.
- Fully integrate the Secretariats and military headquarters staffs in the Departments of the Army and Air Force and partially integrate these functions in the Department of the Navy. (The Senate Armed Services Committee's study recommended that the Department of the Navy be treated differently because of its dual-service structure.)
- Create the position of Assistant Secretary of Defense for Strategic Planning, who would be responsible for establishing and maintaining a well-designed and freely interactive strategic planning process.

The study, which was launched in 1983 at the behest of the Committee's then-chairman, Sen. John Tower, and the then-ranking minority member, the late Sen. Henry M. "Scoop" Jackson, was prompted by perceived deficiencies and failures that, in combination, "suggest the need for a comprehensive review of DoD organizational structure and procedures," according to the SASC report. Under the heading of operational shortcomings, the Committee report claimed that "poor interservice coordination during the Vietnam conflict, the Iranian hostage rescue mission, and even the intervention in Grenada suggest deficiencies in the planning and preparation of employment of US military forces in times of crisis." With regard to the Pentagon's track record in buying weapons and materiel, the Committee report pointed out that the Pentagon has been regularly pilloried for alleged cost overruns, program stretch-outs, and unsatisfactory weapons performance.

The study also alleges that incoherent strategic direction and poor interservice coordination are two other fundamental flaws afflicting DoD. The programs of the individual services "do not appear to be well integrated around a common purpose that clearly ties means to goals." The Senate Armed Services Committee's findings assert that the Defense De-

partment's long-range policies and strategies often seem to lack consistency and cohesion as well as coordination in terms of subsequent resource allocations.

Drafted without benefit of any official Pentagon contributions, the Committee's 645-page report drew a gelid response from the Defense Department. Secretary of Defense Caspar Weinberger appointed a panel of Pentagon officials to review the Committee's recommendations, but, at the same time, he took pains to let it be known that the Pentagon had repeatedly tried in vain to participate in the study effort. Heading the panel is DoD's General Counsel, Chapman Cox. Among its members are Assistant Secretary of Defense for Legislative Affairs Russell A. Rourke (who has subsequently been nominated to serve as Secretary of the Air Force; *see coverage on p. 37*), Assistant Secretary of Defense for International Security Affairs Richard L. Armitage, as well as representatives of each of the three service Secretaries and of the Joint Staff.

The basic Pentagon premise is that both its civilian and military components are "functioning very effectively" and that cooperation and coordination between them is more harmonious than ever before.

The Defense Department also pointed out that the Administration is already in the midst of an exhaustive review of the Pentagon's organizational structure and acquisition process under the auspices of the President's Commission on Defense Management, which is chaired by former Deputy Secretary of Defense David Packard. While that group—at this writing—has not yet submitted any formal recommendations to the President, it is known to favor the notion of consolidating Air Force Systems Command and Air Force Logistics Command. Senior Air Force officials, including the heads of the two commands involved, have expressed opposition to such an arrangement. The Air Force's position is that the current approach provides more efficiency than could be obtained under the proposed reorganization.

Washington Observations

★ While not authenticated by either side, a conversation between USAF Chief of Staff Gen. Charles Gabriel and his counterpart, the Commander of the Chinese People's Liberation Army Air Force, Wang Hai, provided reasonable grounds for the assumption that the former shot down the latter in a dogfight near the Yalu River during the Korean War. During General Gabriel's recent China trip, a discussion of the details of the air battle in question brought out the likelihood that one "chief" bested the other at that time. Commander Wang Hai drew this philosophical bottom line during the conversation: "From an exchange of blows comes friendship."

IN FOCUS...

★ Secretary of Defense Caspar Weinberger recently announced that the Soviets, in "unquestionable violation of Soviet assurances given to us under the SALT II accord," are deploying a new, fifth-generation ICBM, the SS-25. The new mobile missile is approximately the same size as Minuteman III, but initially carries only one warhead. A new version of the SS-25 that could carry a MIRVed (probably three warheads) payload is under development. Thought to be a replacement for the older SS-11, the SS-25 is designed for road-mobile deployment similar to the intermediate-range SS-20.

Because of the new missile's flexible basing characteristics, US intelligence experts credit the SS-25 with high survivability as well as an inherent refire capability. At least two bases for the new missile are known to US intelligence and include launcher garages with sliding roofs to permit launches from the sites as well as from mobile launch systems. The introduction of this missile into the operational inventory represents an unambiguous violation of the SALT II understanding, because the Soviets earlier deployed another brand-new ICBM, the mobile ten-warhead SS-24. The accord prohibits the deployment of more than one new ICBM type.

★ The government-wide Technology Transfer Intelligence Committee recently issued an updated report on the widening scope of Soviet purloining of US technology. The report points out that "more than 5,000 Soviet military research projects each year benefit directly" from the illegal acquisition of US and other Western technology. As Secretary Weinberger put it, "We are subsidizing the military buildup of the Soviet Union, and the costs have been staggering." The Soviet "dragnet" of advanced US technologies extends from microelectronics to ICBMs and as of late has put special emphasis on applied research efforts conducted by major US universities.

★ US intelligence has found evidence that the Soviets have developed antitactical ballistic missile systems (ATBMs) that appear capable of intercepting the warheads of the US Army's new Pershing II IRBM. While the US has no such system under development, several members of Congress are working toward the launch of a US ATBM program as an ancillary element to the Strategic Defense Initiative (SDI). The development of such weapons might increase political support for SDI among European NATO members. A US ATBM, in the view of its congressional advocates, should be a point defense system to shield NATO forces against Warsaw Pact medium-range ballistic missiles.

The Administration reaction to this concept has not been entirely favorable. For one, there is concern that the development of such a point defense weapon might impede the SDI program, which centers on far more demanding technologies and tasks, including interception of MIRVed ballistic missiles during their boost phase. Another factor that is known to militate against Pentagon support of ATBMs is the notion that the job of neutralizing Soviet theater nuclear forces can be done more cheaply by other means. Key here is the negation of the command and control apparatus associated with Soviet theater nuclear weapons.

★ The Administration is on the verge of significant, long-term commitments to extensive feasibility studies involving "aerospace planes," also referred to as transatmospheric vehicles. This program will probably be launched by the President personally.

The main attraction of such a concept is its potential to serve as a cost-effective and versatile follow-on to the Space Shuttle. The Defense Department and NASA are working on an accord aimed at the launch of a prototype development program patterned on the X-15 hypersonic vehicle effort of nearly two decades ago. Up to $50 million in FY '86 funds might be reprogrammed—mainly from the SDI program—to launch this long-term program, which could have comprehensive military utility.

Originally, NASA had been considered as the lead agency for the aerospace plane research effort. Current plans envision the Defense Department—in the main, the Defense Advanced Research Projects Agency (DARPA) and the Air Force—as the executive agency for this project. ■

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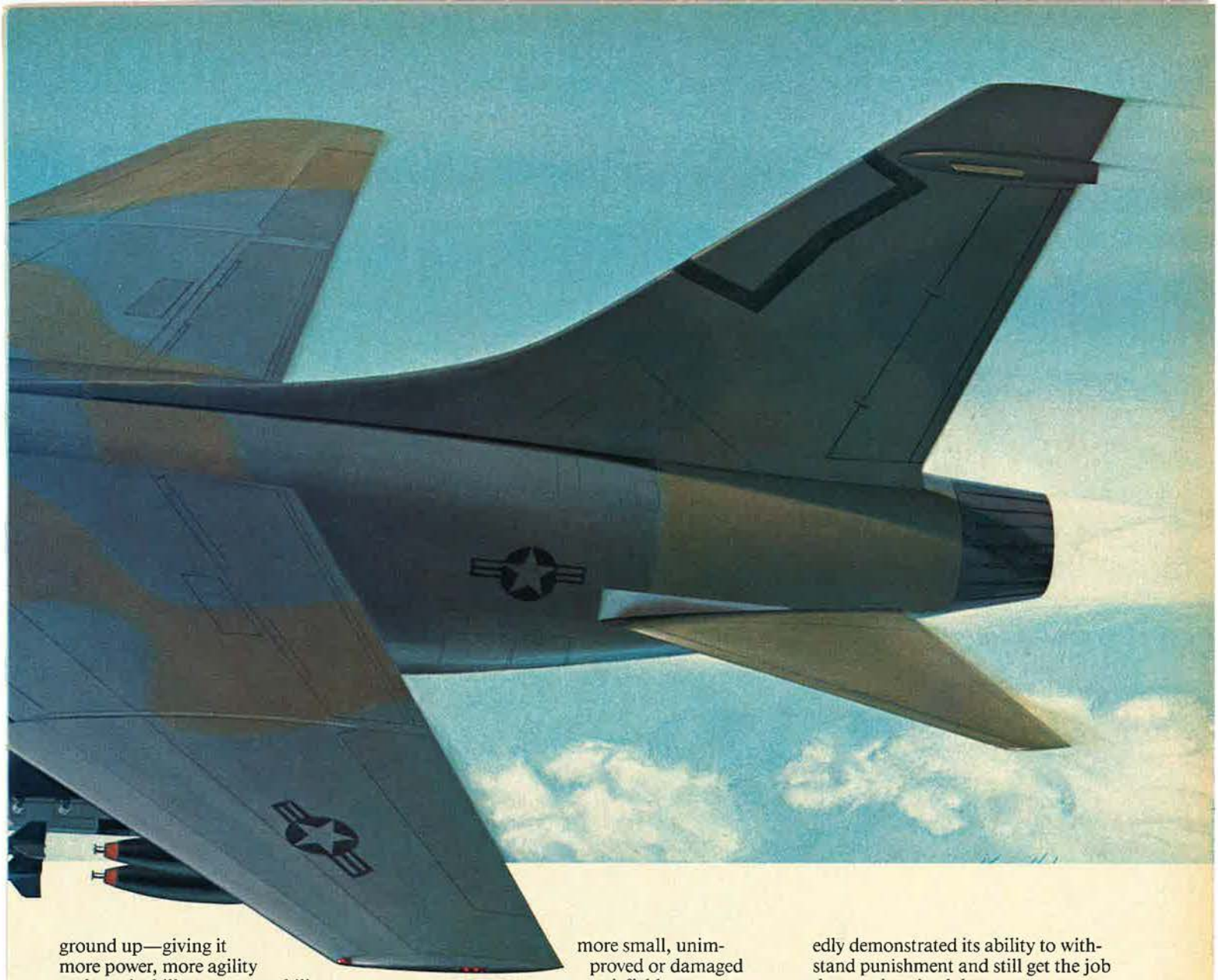

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CAPITOL HILL

By Brian Green, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., Oct. 28

House Committee Moves on Defense Bill

The full House Appropriations Committee completed its work on the defense appropriations bill on October 24. The bill was to go to the full House the last week of October. The committee:

- Deleted the $98 million earmarked for procurement in the anti-satellite weapon (ASAT) program, but provided $150 million for continued R&D. The committee upheld the decision of its Defense Subcommittee to ban further ASAT tests against objects in space unless the Soviets resume similar tests.
- Rejected, by a 31–23 vote, a measure to reduce funding for the Strategic Defense Initiative (SDI) from the Defense Subcommittee level of $2.5 billion to $2.1 billion. The Administration had requested $3.7 billion, and the authorization conference had settled on $2.75 billion.
- Concurred with the defense authorization compromise on MX, which limited FY '86 procurement to twelve missiles and capped MX deployment in Minuteman silos at fifty.
- Deleted all procurement funds for the Advanced Medium-Range Air-to-Air Missile (AMRAAM), USAF's air-superiority missile of the future. The Air Force recently conducted four successful AMRAAM tests. The sum of $101 million was provided for continuing AMRAAM R&D.
- Approved only $60 million for R&D on the Joint Surveillance and Target Attack Radar System (JSTARS) program to design an airborne radar system capable of detecting moving or stationary ground targets. The Administration requested $260 million; the authorization conference had approved $240 million. A reduction this large will slow the program dramatically, according to the Air Force, and runs counter to the trend encouraged by Congress toward "jointness."
- Denied funding for the production of new binary chemical weapons. The committee agreed that if conditions previously approved by the House were met, including NATO approval of new production and acceptance of the new munitions on NATO soil, Congress should "consider" funding binaries.
- Restored (with minor exception) the language of the House authorization bill on defense procurement reform. The authorization compromise had eased some of the more stringent House provisions. These issues include the so-called "revolving door" between defense officialdom and defense contractors; allowable costs that a contractor can pass on to DoD; the "should-cost" provision, which provides for the use of "standard labor hours" to determine defense contractor efficiency; and measures to encourage competition in defense procurement.

Amendment Impact on Defense Budget Unclear

On October 9, the Senate passed the so-called Gramm-Rudman-Hollings amendment—named after its sponsors, Sens. Phil Gramm (R-Tex.), Warren Rudman (R-N. H.), and Ernest Hollings (D-S. C.)—that would mandate elimination of the budget deficit by 1991. The deficit would be limited to $180 billion in FY '86 and reduced thereafter by $36 billion a year. The measure forces congressional or Presidential action to reduce the deficit further if it exceeds the target figure for a given year.

The potential impact of the measure on the defense budget is uncertain, but could be dramatic. One assessment by the Congressional Budget Office (CBO) indicates that almost $80 billion in outlays might have to be cut from projected defense budgets through 1990, a reduction in budget authority of $150–160 billion. Other analyses show a range of possible results, from reduced defense budget increases to severe reductions. If congressional and Administration support for the defense budget is strong enough, the measure may have only minor impact.

Senate Delegation Meets Soviets

A Senate delegation led by Sens. Strom Thurmond (R-S. C.) and Robert C. Byrd (D-W. Va.) that visited the Soviet Union in September provided interesting background to recent Soviet arms-control proposals.

The delegation spoke to senior Soviet defense officials concerning the ongoing Geneva arms-control talks. Those officials made the following points.

- Control of space weapons is the key arms-control issue.
- SDI research is first-strike-oriented.
- The demand that the US abandon its SDI research before Moscow submits firm proposals on offensive arms was not a precondition to negotiation. They argued that Secretary of State George Shultz and then-Foreign Minister Andrei Gromyko had earlier agreed that talks on offensive forces could not proceed if the US was developing "space weapons."
- Their proposal to ban SDI would permit "thinking" about defensive systems, but apparently very little else. Though admitting that the ABM Treaty did not restrict research, they refused to draw any distinction between research and development. They also argued that the goal of SDI research rendered it impermissible under the terms of the ABM Treaty.

The Senators challenged the Soviets on each of these points. Sen. Sam Nunn (D-Ga.) pointed out that if the Soviets curbed their offensive buildup, the US would not feel so compelled to research defenses. Others pointed out that the ABM Treaty does not restrict research and that research and development are distinguishable. Senator Byrd wondered why US research *was* development while Soviet research was not and why US research *was* for first-strike purposes while Soviet research was not.

The heavy emphasis these Soviet defense officials placed on banning SDI is reflected clearly in the terms of the latest Soviet arms-control proposals. The Soviets offered to reduce their offensive strategic forces by fifty percent if the US would abandon SDI and reduce its theater and strategic nuclear forces by fifty percent. ■

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SINGER

AEROSPACE WORLD
News, Views & Comments

By James P. Coyne, SENIOR EDITOR

Washington, D. C., Nov. 4 ★ US Air Force transports played a leading role in bringing relief supplies, equipment, and rescue workers to earthquake-ravaged Mexico City in September and October. Lockheed C-5s, C-141s, and C-130s, as well as C-130s from several other nations, participated in the airlift. Civilian versions of the C-130 were also employed.

Following the earthquake, numerous fires broke out in the city. Aftershocks posed the threat of more fires and raised fears that they would rage unchecked. Almost immediately, a C-5A of the 349th Military Airlift Wing (MAW), the Reserve Associate wing of the 60th MAW, was dispatched from Travis AFB, Calif. The big transport flew to Norton AFB, Calif., and picked up needed fire-fighting equipment and US Forest Service fire fighters gathered from the southern California area.

The Galaxy carried three Bell 206 JetRanger helicopters that were specially equipped with tanks to air-drop water for fire fighting, three fuel tender trucks, three helicopter support trucks, and twenty-seven fire fighters direct to Mexico City, where it was met by US Ambassador to Mexico John Gavin and a representative of the President of Mexico. The helicopters were flying within an hour of being unloaded.

"Although the fires were all under control when we arrived and we did not air-drop water or another retardant as expected, we were actively using the helicopters to help with rescue and reconnaissance operations," said Dennis Pierce, assistant foreman at the Keenwild Ranger Station in the San Bernardino National Forest. The helicopters can carry tanks that hold up to 120 gallons of fire retardants.

"Our mission to Mexico City is a prime example of humanitarian airlift flown by the Military Airlift Command," said Maj. James M. Morgan, aircraft commander. "MAC's active-duty and reserve airlift forces frequently meet emergencies in relieving suffering caused by disasters."

A second 60th MAW C-5A later flew members of two US Forest Service "Hot Shot" fire-fighting teams and six vehicles to the Mexican capital. That transport returned the original fire-fighting team and three helicopters to Norton AFB. A third C-5A from the same wing later flew in supplies for disaster victims and returned the "Hot Shot" crews and their equipment to Norton.

The MAC C-5As, C-141Bs, and C-130s airlifted more than 300,000 pounds of rescue equipment, clothing, and medical supplies. Two dog teams to assist in locating survivors buried in the rubble, generators, water pumps, and cots were among the items delivered. Radio equipment was also flown in to open up the severed lines of communication to the stricken capital city from the outside.

Additionally, C-130s from Algeria, Argentina, Belgium, Spain, and Mexico itself were dispatched with relief equipment and people. The German government sent two German mobile hospitals on an L-100-30 transport, a civilian version of the C-130, flown under contract by an airline. Two Spanish C-130s each delivered ten tons of food and medicine for earthquake victims and workers and evacuated to Spain a number of Spanish people who had been living in Mexico and who were made homeless by the disaster. The Mexican government oil company, PEMEX, used its own L-100-30 to fly in twenty tons of rescue equipment picked up in Atlanta, Ga.

The first T-46A flies its maiden mission at Edwards AFB, Calif., with Republic test pilot James Martinez at the controls for the one-hour-and-twelve-minute flight. The aircraft will undergo a twenty-month test and development program and could enter operational service by the spring of 1988.

'The Military Balance' Coming in February

"The Military Balance," which AIR FORCE Magazine has traditionally published each December, does not appear this month because of delays in its completion by the International Institute for Strategic Studies in London. Our Military Balance theme issue has been rescheduled for February 1986.

This annual presentation is the standard international reference on military forces of the world and is published by this magazine under exclusive US magazine rights from the Institute.

A USAF C-5 aircraft pilot, Reserve Capt. Martin G. Palagi from the 301st Military Airlift Squadron (MAS) at Travis AFB, summed up the feelings of transport crewmen on the Mexican relief flights when he said, "I can't think of a more rewarding way to spend a day than to help people so desperately in need."

★ The T-46A, designed and developed by Fairchild Republic Co. as the next-generation US Air Force primary trainer, successfully completed its first flight on October 15 and now enters a twenty-month test and development program, the Air Force Flight Test Center at Edwards AFB, Calif., has announced. The aircraft was flown for an hour and twelve minutes by Republic test pilot James Martinez.

Main objectives during the flight were to evaluate the basic handling and flying qualities of the aircraft. "It's a very solid aircraft and flew quite well," Martinez said of the new two-seat, side-by-side trainer.

The T-46A was flown to 15,000 feet, where the pilot began checking all aircraft systems and evaluating stability and control. Airspeed was maintained between 100 and 175 knots. Included in the checks were the operation of the engines, speedbrakes, flaps, yaw damper, environmental control system, hydraulics, electrical system, flight controls, avionics, and fuel system. The test pilot flew a simulated landing approach at altitude before bringing the little prototype down for the actual landing.

The aircraft is being tested by the Air Force Flight Test Center's T-46A Combined Test Force (CTF), a unit made up of Air Force and contractor pilots and technicians working together. Test force director is Lt. Col. Michael Edmondson. In planned flights, the CTF will expand the test "envelope" out to the aircraft's design capabilities of more than 400 mph and a service ceiling of 45,000 feet.

Each of the aircraft's two Garrett F109 advanced turbofan engines produces 1,300 pounds of static thrust. They have been designed to provide improved efficiency, reliability, and durability, the Test Center said, while at the same time lowering maintenance and operational costs and increasing flight safety.

★ In nineteen live-fire launches during a test program at Nellis AFB, Nev., that ended in mid-October, Hughes imaging infrared (IIR) Maverick missiles scored eighteen direct hits on a variety of armored military trucks and tracked vehicles, AFSC's Aeronautical Systems Division announced. The tests were conducted to evaluate Maverick's improved effectiveness in combat and to verify the operational viability of changes made to enhance producibility of the missile.

The missiles were launched in two separate series. One series, conducted by the Air Force Tactical Fighter Weapons Center at Nellis, evaluated the operational effectiveness and suitability of the IIR Maverick. The missiles were launched from A-7, F-4E, F-4G, and A-10 aircraft and scored seven hits in seven launches. The other series at Nellis was conducted by the Air Force Operational Test and Evaluation Center, headquartered at Kirtland AFB, N. M. In that series, there were eleven successes out of twelve launches from A-10 Thunderbolt II ground-support aircraft.

"Results of the most recent tests

Russell A. Rourke is the new Secretary of the Air Force.

Welcome Aboard, Mr. Secretary

A dynamic, red-haired New Yorker from the Bronx who fibbed his way into the US Navy at the age of fifteen is about to become Secretary of the Air Force. Russell A. Rourke, age fifty-three, has a lot to recommend him. Starting out as an underage seaman recruit in 1947, he switched to the Marine Corps, got his commission, left active duty after serving a stint in Korea, and eventually retired as a full colonel from the Marine Corps Reserve.

After he left active duty, he obtained a law degree from Washington's Georgetown University, worked in a law firm in the nation's capital, and then settled in for a twenty-year career as administrative assistant to several Republican members of Congress. In between, he ran for Congress—seeking the seat of his retiring boss, a representative from upstate New York—but lost in the backlash of Watergate and President Nixon's resignation. For almost five years now, he has served as Assistant Secretary of Defense for Legislative Affairs. Congressional support of defense requirements during that period has been extraordinary, with the Air Force budget, for instance, more than doubling.

Working Congress, Secretary Rourke told AIR FORCE Magazine, will continue to be his "principal priority" in his new assignment. His key concerns, in Congress as well as in general, will be issues affecting Air Force people and maintaining the momentum of the President's strategic force modernization program. The new Air Force Secretary is not willing to accept the defeatist notion that President Reagan's drive to strengthen national security is running out of steam on Capitol Hill: "I don't see a diminution of support for a strong defense. I do see pressures from the deficit problem that [create] competing interests." His job, he feels, is to argue the case for all vital defense interests under Air Force purview.

Another goal Secretary Rourke has set for himself is to make sure that the vast majority of "good guys" in industry don't get tarred because of a few "bad guys." The military-industry team must be permitted to function as a partnership: "I don't agree at all with the theory that the [relationship between government and industry] should be an adversarial one." The rank and file of industry is not "some mysterious entity with a post office drop box in the Bahamas. The industrial world is the world of the American working public [who provide us] with the best weapons and materiel the world has ever known." There is, he avers, "nothing onerous about this partnership. We can be proud of it."

Maintaining a viable relationship with aerospace industry and meeting all the other "tremendous challenges" that go with his new office is something Secretary Rourke looks forward to with "great enthusiasm."

Welcome aboard, Mr. Secretary.

—E.E.U.

indicate the AGM-65D Maverick is a highly reliable and effective air-to-ground weapon," said Col. Robert Jennings, Maverick program director. "It will add a significant new dimension to the capability of our tactical air forces."

The air-to-surface IIR Maverick is the Air Force's most advanced "smart" tactical missile for destroying such point targets as tanks or in-ground fortifications. Its launch-and-leave capability enables a pilot to locate a target, lock the missile on to it electronically, fire, and leave the target area or attack other targets in the vicinity. Maverick guides itself to the target. An on-board computer continually monitors the target's movements and, if necessary, corrects the missile's flight path.

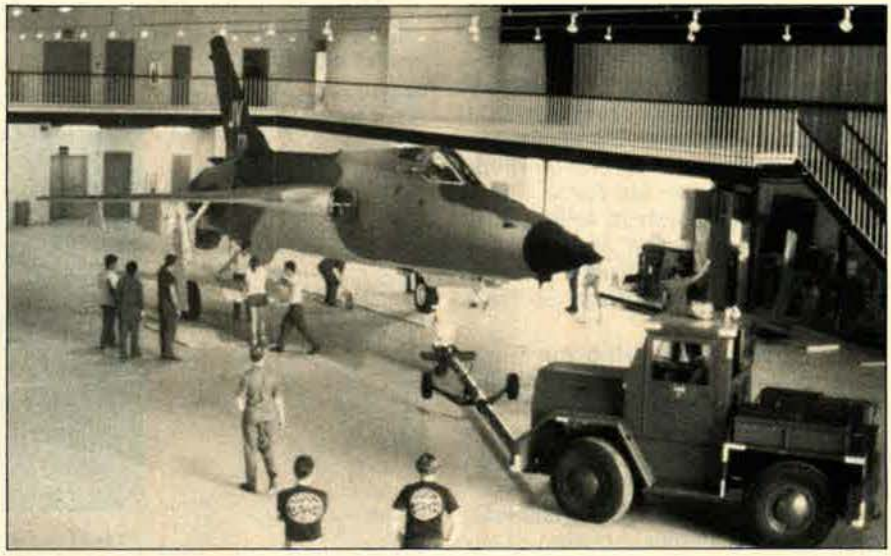
In employing the missile, the pilot first locates the target, viewing an electronically enhanced infrared image of it on a television-like, in-cockpit presentation. He then uses controls in the cockpit to move aiming crosshairs across the "TV screen," superimposing them on the target. He launches and, if he desires, leaves. The missile does the rest.

To date, more than 170 IIR Maverick missiles and spare guidance sections out of a planned buy of 60,644 have been delivered to the Air Force. The program office also procures AGM-65 variants for the Navy (AGM-65F) and the Marine Corps (AGM-65E). More than 30,000 AGM-65A and B television-guided Mavericks were produced by Hughes. These versions are now deployed worldwide with US and allied air forces. Second-source producer for the IIR Maverick is Raytheon Missile Systems Div.

★ In October, in their first deployment to Latin America since 1973, the US Air Force Thunderbirds air demonstration squadron visited four countries south of the border. The team visited and performed demonstrations at Quito, Ecuador; Lima, Peru; Natal and Brasilia, Brazil; and Caracas, Venezuela. A demonstration at Mexico City was canceled because of the earthquake devastation in the city.

The Thunderbirds team deployed with seven General Dynamics F-16 Fighting Falcon jet fighters and seventy pilots and support people from Nellis AFB, Nev. Military Airlift Command provided airlift for support team members and equipment. The Thunderbirds were refueled in flight by a Strategic Air Command KC-10, which also carried support equipment and the people who accompanied the Thunderbirds.

AEROSPACE WORLD



An F-105 Thunderchief, supersonic workhorse of the Vietnam War, is installed in the new USAF Armament Museum at Eglin AFB, Fla. The museum boasts more than 5,000 exhibits from World War I, World War II, the Korean conflict, and Vietnam.

★ The United States Air Force Museum has begun construction of a new structure that will double the size of the original building at Wright-Patterson AFB, Ohio, and an entirely new museum, the Air Force Armament Museum at Eglin AFB, Fla., has opened.

Secretary of the Air Force Verne Orr was the speaker during the groundbreaking for the new facility at Wright-Patterson. The huge hangar-like structure is expected to be finished in the fall of 1987. It will house nearly fifty aircraft and exhibits that are currently shown outdoors or in a remotely located building.

Funding for the building, approximately $10 million, will be shared equally by the federal government and the Air Force Museum Foundation, a private organization that assists the Museum.

The Air Force Museum traces its history back to its founding in 1923 in Dayton, Ohio. It is now the world's largest and oldest military aviation museum, attracting more than a million visitors each year. Its exhibits include thousands of photographs,

A Thunderbird crew chief adds a final touch of polish to one of the demonstration team's F-16s. In October, the Thunderbirds made their first deployment to Latin America since the early 1970s.

documents, aviation-related artifacts, and personal memorabilia, plus nearly 200 aircraft and major missiles. The Museum also owns more than 1,100 additional aircraft, which are on loan at exhibits in the United States and overseas.

The new Air Force Armament Museum is located just outside the west gate of Eglin AFB. It is owned by the US government and operated by a small staff from Eglin. The building was donated by the Air Force Armament Foundation and covers 20,000 square feet. Volunteers conduct tours, help to build exhibit cabinets, take care of administrative work, and maintain the library.

There is no admission charge to see the Museum's more than 5,000 air armament exhibits, which range from World War I bombs and machine guns to Vietnam-era missiles, guided bombs, and Gatling guns. The Museum is open every day except Thanksgiving, Christmas, and New Year's Day.

★ US Air Force F-15 Eagle fighters will soon be flying regular air defense missions from the NATO base at Keflavik, Iceland. The first two of eighteen F-15s assigned to the 57th Fighter Interceptor Squadron based there have arrived on station, soon to be followed by sixteen additional F-15s that will be deployed gradually, with all aircraft on station by next spring. They replace F-4 Phantoms.

The 57th pilots, known as the "Black Knights of Keflavik," regularly intercept Soviet Bear, Badger, and Bison aircraft penetrating near and in Icelandic airspace. Iceland, located strategically on NATO's northern flank in the Norwegian Sea, is on the route between Soviet far north bases and the Atlantic Ocean.

The new aircraft, sixteen C models and two D models of the F-15, will be equipped with conformal fuel tanks, which will add 9,750 pounds of fuel to the Eagle's internal fuel capacity of 13,455 pounds. This is particularly significant for aircraft based at Keflavik, for virtually all flying is over water and in weather that is often bad. The additional fuel provides a big safety margin. Conformal tanks do not significantly increase drag.

★ The Air Force has awarded two contracts worth $20.6 million for the production of a standard medium-accuracy inertial navigation unit system (INU) incorporating a ring laser gyroscope. The new INU is expected to be four times as reliable as present systems, according to Lt. Col. Bruce Walling, program manager in ASD's Deputy for Aeronautical Equipment, Subsystems, and Support Equipment Systems Office.

The new unit is designed for use in both fighters and transport aircraft, including the C-130, RF-4, F-4, and EF-111. The contracts also call for additional development of an F-15E ring laser gyro inertial navigation system.

Honeywell, Inc., Clearwater, Fla., was awarded $8.8 million, and Litton Systems, Woodland Hills, Calif., was awarded $11.8 million for production of the units. Each company will produce an initial lot of fifty-one systems, and both have contract options calling for as many as 1,000 additional units each.

The INU is a self-contained, all-attitude navigation set providing information on line and angle of acceleration, velocity, position, heading, attitude, and altitude. Automatically computed, this data is sent continuously to other aircraft subsystems, such as radar, automatic flight control, and weapon delivery systems. The standard medium-accuracy INU provides readings accurate to within eight-tenths of a nautical mile.

Key to the new INU is the inertial sensor assembly, which includes the ring laser gyroscopes and accelerometers. Ring laser gyroscopes use laser light to sense angular motion of the aircraft. The information coming from it is similar to that coming from a standard gyro containing a rotating mass, except that the ring laser gyro produces direct digital information.

Since there is no rotating mass in the ring laser gyro, it does not require gimbals or other moving mechanisms, which improves the reliability of the INU dramatically. Also, whereas conventional systems require heating

Among the winners of the Bendix Trophy honored recently at the National Air and Space Museum were (from left, standing): Carlos W. Talbott (1955), James H. Doolittle (1931), Robert MacDonald (1962), Leon W. Gray (1946–47), John T. Walton (1962), and Robert G. Sowers (1962). Seated, from left: F. Taylor Brown (1948), Vernon A. Ford (1949), Edward W. Kenny (1954), and Keith K. Compton (1951).

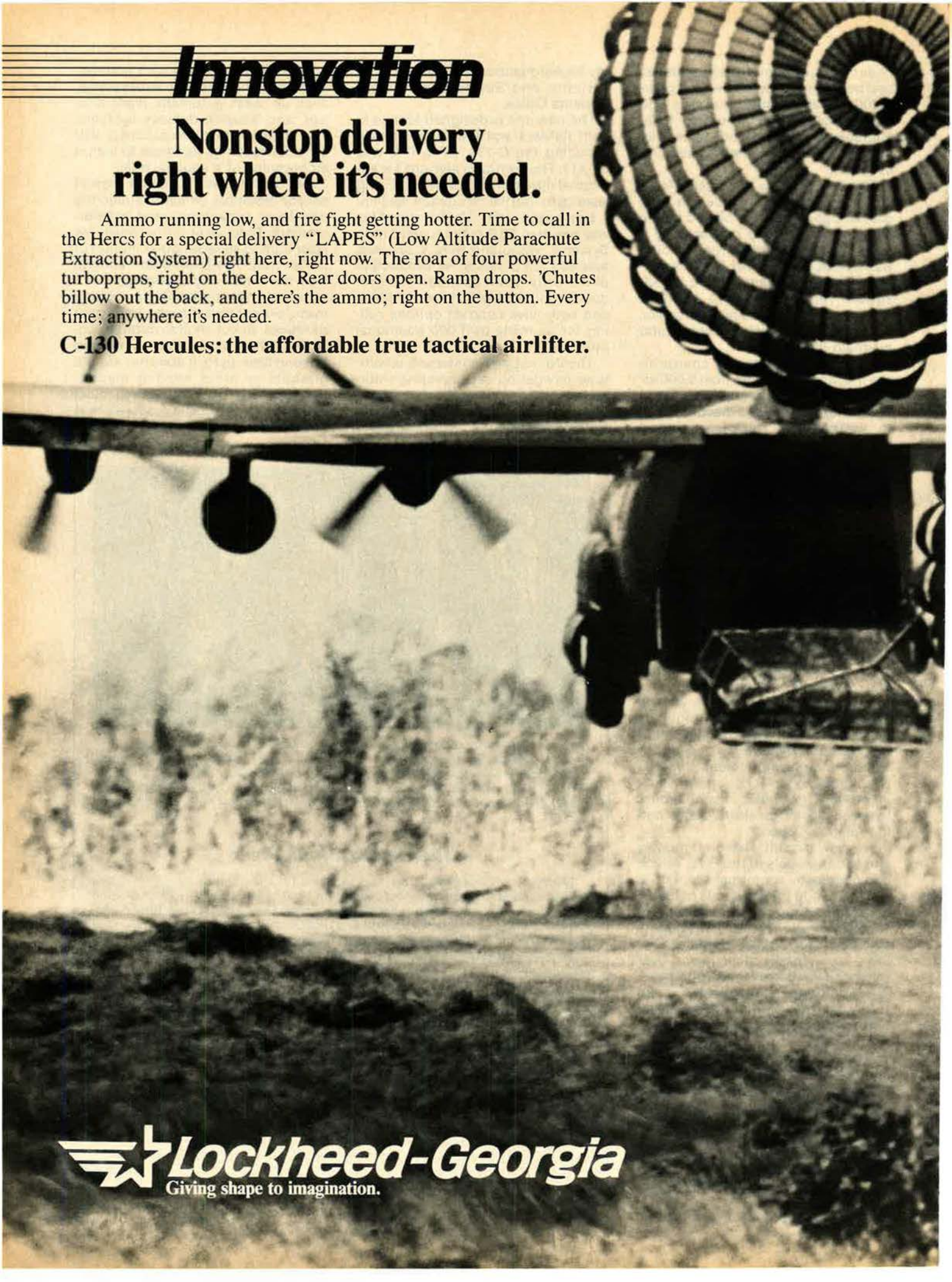
The Bendix Brotherhood

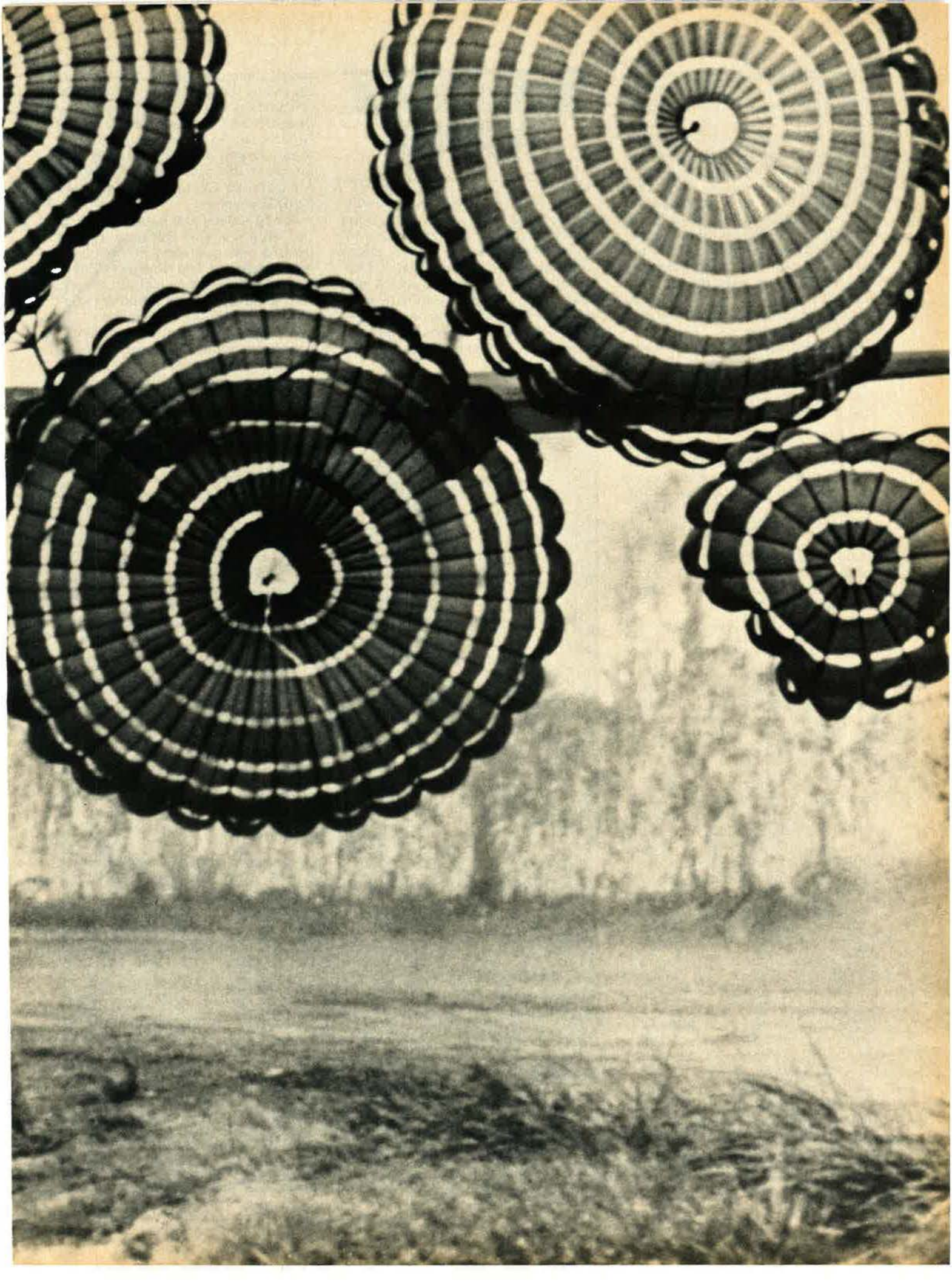
Twenty-one times between the years 1931 and 1962, the Bendix Transcontinental Air Race shone as one of the most eagerly anticipated and closely watched aviation events in the country. Such luminaries as Jimmy Doolittle, Roscoe Turner, Jacqueline Cochran, and later Paul Mantz and Dick Gordon all entered the event to race against the clock. On October 30, the elite group of past Bendix Trophy Race champions gathered as a group for the first time at a reception hosted by the National Air & Space Museum in Washington.

Twelve of the thirteen living recipients of the Trophy attended, including then-Major Doolittle, who, at a speed of 223 mph, flew the Laird *Super Solution* to victory in the first race, and Capts. Bob Sowers, Bob McDonald, and John Walton, who crewed the B-58 that won the last sprint with an average rate of 1,214 mph. Six other winners were represented by their wives or children.

The evening, which honored the pilots and crews as well as their contributions to the advancement of aviation, was highlighted by a multimedia presentation featuring film clips and interviews with the winners. Allied-Signal Inc., parent company to the reunion's sponsor, Bendix Aerospace, presented a $50,000 endowment to the Massachusetts Institute of Technology in the name of Gen. James H. Doolittle, USAF (Ret.). The endowment will support undergraduate students in the fields of aeronautics and astronautics. General Doolittle, AFA's first president, received both his master's (in 1924) and doctorate (1925) from the school at Cambridge, Mass.

—J.P.R.


Innovation
Nonstop delivery right where it's needed.
Ammo running low, and fire fight getting hotter. Time to call in the Hercs for a special delivery "LAPES" (Low Altitude Parachute Extraction System) right here, right now. The roar of four powerful turboprops, right on the deck. Rear doors open. Ramp drops. 'Chutes billow out the back, and there's the ammo; right on the button. Every time; anywhere it's needed.
C-130 Hercules: the affordable true tactical airlifter.
Lockheed-Georgia
Giving shape to imagination.



of the inertial sensor assembly to maintain the gyro at an operational temperature, the ring laser gyro does not.

Both firms, under the contracts, have guaranteed a mature system with a mean time between failure (MTBF) of 2,000 hours for fighter aircraft and 4,000 hours for cargo aircraft. Current systems have a MTBF ranging from 500 hours for fighter aircraft to 1,000 hours for transports. Initial production ring laser gyro systems that do not meet the contract goals for a mature system will be modified to do so by 1990, the end of the contract period.

Both contracts call for the companies to provide five years of depot maintenance on the INU systems following delivery and installation of the final production lot.

★ An Air Force Reserve outfit, the 419th Tactical Fighter Wing, Hill AFB, Utah, won the Gunsmoke '85 overall team title during the annual worldwide fighter gunnery meet held in October at Nellis AFB, Nev. Flying F-16s, the 419th scored 9,431.5 points, which edged out the Gunsmoke defending champions, the 50th TFW, Hahn AB, Germany, by two points. The 50th also flies F-16s.

The annual meet pits the world's finest fighter pilots and their ground crews against each other in a fast-paced competition that tests their combat skills. Seventeen teams competed for bombing and gunnery points, flying basic bombing and tactical bombing and strafing runs and concluding with a challenging navigation/attack profile.

In third place was the 23d TFW, England AFB, La., scoring 9,106.5 points in A-10s. The 23d was the top-scoring A-10 team. In eighth place was the top A-7 team, the Air National Guard's 192d Tactical Fighter Group, Byrd Field, Va. The top F-4 unit was the 37th TFW, George AFB, Calif. The 37th took fifteenth place overall.

The top gun—the pilot with the highest individual score—was Capt. Mark Fredenburgh, an F-16 pilot with the 50th TFW. F-16 aircrews captured the top eleven places, with second place going to Col. Bane Lyle, 419th TFW. Capt. Mitchell Dodd of the 50th took third, followed by the 419th's Maj. Tom King and Maj. Frank Wille of the 474th TFW at Nellis.

A-10 top gun was Capt. Robert Yates, 23d TFW. Maj. Allen Smith, 185th TFG (Air National Guard), Sioux City, Iowa, took A-7 top gun honors, and Capt. Corky Von Kessel, 4th TFW, Seymour Johnson AFB, N. C., won the F-4 top gun award.

AEROSPACE WORLD

The 44th TFW (AFRES), Richards-Gebaur AFB, Mo., swept the ground crew competition, winning both overall maintenance and loadeo events and honors as the top A-10 team. Capturing both F-16 maintenance and loadeo titles was the 419th TFW, while the 37th TFW did the same in the F-4 category. The A-7 winners were the 185th TFG in maintenance and the 192d for loadeo.

★ Hughes Aircraft Co. has been selected by NATO to supply eight long-range, three-dimensional, phased-array radars for air defense of its southern borders. The company will deliver three HR-3000 radars to Turkey, two to Greece, two to Italy, and one to Portugal. Turkey, Greece, and Italy will integrate the radars into the NATO Air Defense Ground Environment (NADGE) system.

The HR-3000 radar is a derivative of the Hughes Air Defense Radar (HADR) now operating in West Germany, Malaysia, and Norway. HADR is capable of detecting fighter aircraft with small radar cross sections at distances of more than 200 miles.

The new radars feature low-maintenance requirements and can be easily transported and assembled. They will operate on concrete platforms without supporting towers or radomes. The radar is blast-resistant and is

The late Richard D. Kisling, third Chief Master Sergeant of the Air Force, at one of his last public appearances.

A Man Who Listened

Richard D. Kisling—the third Chief Master Sergeant of the Air Force and the first chairman of AFA's Retiree Advisory Council—died November 3 at Malcolm Grow Medical Center, Andrews AFB, Md., after a lingering illness. He was sixty-one.

An Army infantryman in World War II, Dick Kisling became a charter member of the brand-new United States Air Force in 1947. He proceeded up the ladder in the personnel career field and, in 1959, was on the first list of selectees for the new grade of chief master sergeant. He wore the special stripes of the Chief Master Sergeant of the Air Force from October 1971 to September 1973.

When AFA's Enlisted Council honored the first eight Chief Master Sergeants of the Air Force in a publication called *The Chiefs* in 1984, the chapter on Dick Kisling was entitled "A Man Who Listens." He will be remembered for many outstanding qualities, but perhaps particularly so for his oft-expressed belief that communication—especially hearing what the troops had to say—was a vital element in leadership.

After his retirement, Chief Kisling continued to serve the Air Force as a civilian, working as Chief of Publications and Forms Management in USAF's Directorate of Administration.

One of his last public appearances was at a Roundtable on the Chiefs, sponsored by the Aerospace Education Foundation on March 18. He was a Life Member of AFA. Last spring, a new AFA chapter—the Richard D. Kisling Chapter—was formed in Sioux City, Iowa.

—J.T.C.

shielded against the electromagnetic pulse produced during nuclear detonations.

Improvements made to upgrade HADR to the HR-3000 include increased electronic counter-countermeasures capability, wider receiver bandwidth, improved clutter-rejection waveforms, and a faster antenna rotation speed to meet NATO's requirement for higher data rates. Contract negotiations for the new radar have begun, but a final price has not yet been determined.

★ Harris Corp., Government Systems Sector, Melbourne, Fla., has been selected by NASA as the prime contractor for a 200-foot deployable mast, the largest structure yet to be attached to the Space Shuttle to fly in space.

The program, called COFS I (control of flexible structures in space), will demonstrate the technology for active control of large structures in space. Harris will be responsible for the design, development, and integration of the system. Besides the mast, it will include control mechanisms, several on-board computers, and measurement systems. It will be delivered to NASA in thirty-six months.

This 200-foot deployable mast, shown here in an artist's concept, will be the biggest structure yet attached to the Space Shuttle. It will demonstrate the technology for active control of large structures in space.

★ The Alternate National Military Command Center (ANMCC) near Washington, D. C., at Fort Ritchie, Md., will be getting one of the world's most advanced, large-screen, full-color visualization systems next March.

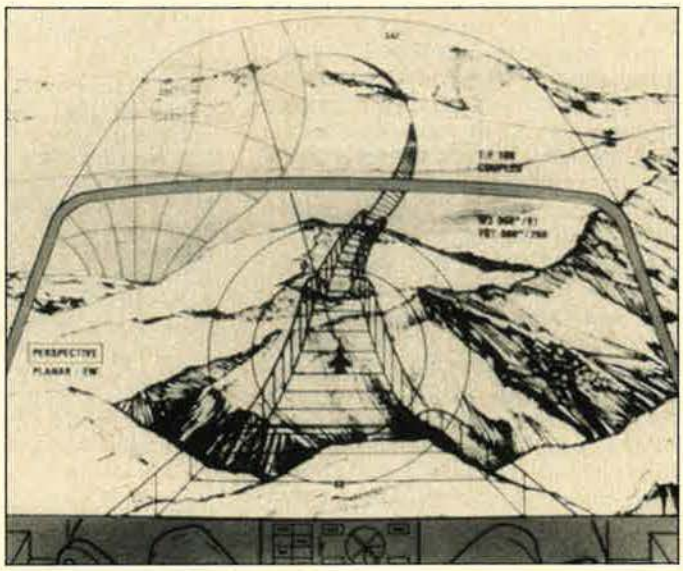
This French system, manufactured by SODERN near Limeil Brevannes, France, is a state-of-the-art projector that can project high-resolution images on a screen that is as large as 1,000 square feet. SODERN developed its new SVS 24 system in cooperation with the French Armament Agency and the US Air Force. It can display alphanumerics and symbols as well as standard television and other video images.

The Royal Danish Navy has purchased the SVS 24 for its Command Center, and the French Air Force is training Mirage pilots in the south of France with air combat simulations projected with the SVS 24.

The system uses a light-modulating electron tube in which a slice of solid-state crystal is scanned by an electron beam to modulate the projected light beam locally and emulate the video signal. The system has a high luminous output (2,500 lumens) and achieves a contrast ratio greater than 100. Its 1,000-by-1,000-pixel resolution is made possible by use of upgraded light valve tubes manufactured by HYPERELEC, another French firm.

★ McDonnell Aircraft Co., St. Louis, Mo., has been awarded a $1.5 million contract to start building a simulator for a twenty-first-century approach to a fighter aircraft cockpit. The simulator should be available by 1987. At the direction of the Avionics Laboratory of ASD's Air Force Wright Aeronautical Laboratories (AFWAL), the company will construct a large display screen with computer-generated graphics to replace the clutter of dials and gauges now found in fighter cockpits. It's called Panoramic Cockpit Control and Display System (PCCADS).

Such modern fighters as the F-15 and F-16 have small television-like



Pilots will be given a new "wraparound" display to help them recognize threats, flight paths, targets, and other key environmental factors with the Panoramic Cockpit Control and Display System (PCCADS).

displays now, but the new, single-screen display will enable the pilot to mix or enhance data and pictorial displays—something that can't be done with today's displays. The new display is also expected to save space because the cathode-ray tubes of today's smaller screens could be replaced by the new system's single, flat-screen, liquid-crystal display, which requires less depth behind the instrument panel.

In the simulator, the pilot will have a simple, full-color, "picture-book" assessment of his environment—from surrounding terrain and ground targets to advancing enemy aircraft and escape routes from hostile territory. Some images will be animated, moving as the plane moves, and the screen will update the display of detected threats or targets or of the ground track in real time.

The screen will be touch-sensitive. The pilot will touch a segment of the screen to change the display, call up more data, or provide more detail. Ultimately, a special computer interface will allow him to give voice commands to the aircraft and its systems. Another computer interface would allow his voice to interact with his touch of the screen for additional options.

PCCADS will be impressive in size compared to today's display screens—about 200 square inches. The contract calls for the company to build the screen for use only in a simulator. Actual flight testing of PCCADS is still years away.

★ Military Airlift Command (MAC) has awarded contracts for more than $251 million to seventeen commercial airlines for international airlift support during Fiscal Year 1986. Commercial airlines airlift about eighty-five percent of MAC's passengers worldwide, a majority of them on DC-10 or B-747 wide-body aircraft.

The total represents the fiscal year's international "fixed buy," which is a significant part of the total projected commercial airlift requirements for the year. MAC adjusts the total as additional airlift requirements develop.

In FY '85, the fixed buy for international airlift was approximately $220 million. MAC spokesmen said they expect the total buy this fiscal year to top $400 million. All the carriers selected are members of the Civil Reserve Air Fleet (CRAF), which supports Department of Defense airlift requirements when those requirements exceed the capability of military aircraft. Currently, the airlines have committed 393 aircraft to CRAF, including 346 long-range international planes.

AEROSPACE WORLD

Airlines awarded contracts for this fiscal year are Airlift International, $1,202,000; American Trans Air, $1,282,000; Arrow Air, Inc., $13,832,000; Continental Air Lines, Inc., $6,369,000; Evergreen International Airlines, $7,823,000; Federal Express Corp., $7,769,000; Flying Tiger Line,

A McDonnell Douglas technician makes an adjustment on the wind-tunnel model of the F-15 short-take-off-and-landing and maneuvering technology demonstrator during low-speed wind-tunnel tests. The aircraft itself will fly in 1988.

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Inc., $74,377,000; Jet 24 International Airways, $619,000; Northwest Orient, $42,710,000; Pan American World Airways, Inc., $16,306,000; Rich International Airways, Inc., $162,000; Tower Air, Inc., $989,000; Transamerica Airlines, Inc., $28,820,000; Trans World Airlines, Inc., $6,662,000; United Air Carriers, $10,687,000; United Air Lines, Inc., $162,000; and World Airways, Inc., $31,566,000.

★ McDonnell Douglas of St. Louis, Mo., has begun wind-tunnel testing of a seven-percent-scale model of a new, one-of-a-kind F-15 fighter aircraft equipped with short takeoff and landing technology. The full-size demonstrator will be modified with two-dimensional, thrust-directing engine nozzles. Canards (short, controllable wings on the forward fuselage) will also be added.

The specially built F-15 will be able to land or take off in 1,250 feet or less of runway in any weather and demonstrate in-flight maneuvering capabilities, at high and low speeds, exceeding those of F-15 aircraft now in production.

The current wind-tunnel work involves low-speed testing to determine how the airflow from the thrust-reversing engine nozzles affects the aerodynamics of the aircraft. William Brinks, McDonnell Douglas program manager, explained, "Wind-tunnel testing will determine whether the exhaust flowing to the front of the aircraft from reversal thrust will reenter the engine intakes. The exhaust must be controlled to avoid that."

Mr. Brinks also said the company will determine how to prevent ingestion of loose ground material that might be thrown into the air by thrust reversal on landing. Low-speed testing will give way to high-speed testing later this year. The F-15 demonstrator is scheduled to make its first flight in 1988.

★ **HONORS**—The prestigious Wright Brothers Memorial Trophy has been awarded to **Harry B. Combs,** the National Aeronautic Association has announced. Mr. Combs is President of Aviation Corp. and former vice chairman of the Gates Learjet Corp. and chairman of its Executive Committee. Under the leadership of Combs, Gates Learjet has become the world's foremost producer of business jet aircraft.

He was cited by NAA for his "more than a half century as a major force in the development and progress of aviation in the United States." His writings on the birth of powered flight were mentioned as important and lasting tributes to the genius of Orville and Wilbur Wright. In 1961, Combs was appointed by President Kennedy to serve with Project Beacon, a group tasked to restructure and modernize the nation's air traffic control system.

The trophy will be presented to him on December 6 at a banquet hosted by the Aero Club of Washington. Vice President George Bush will assist in making the presentation.

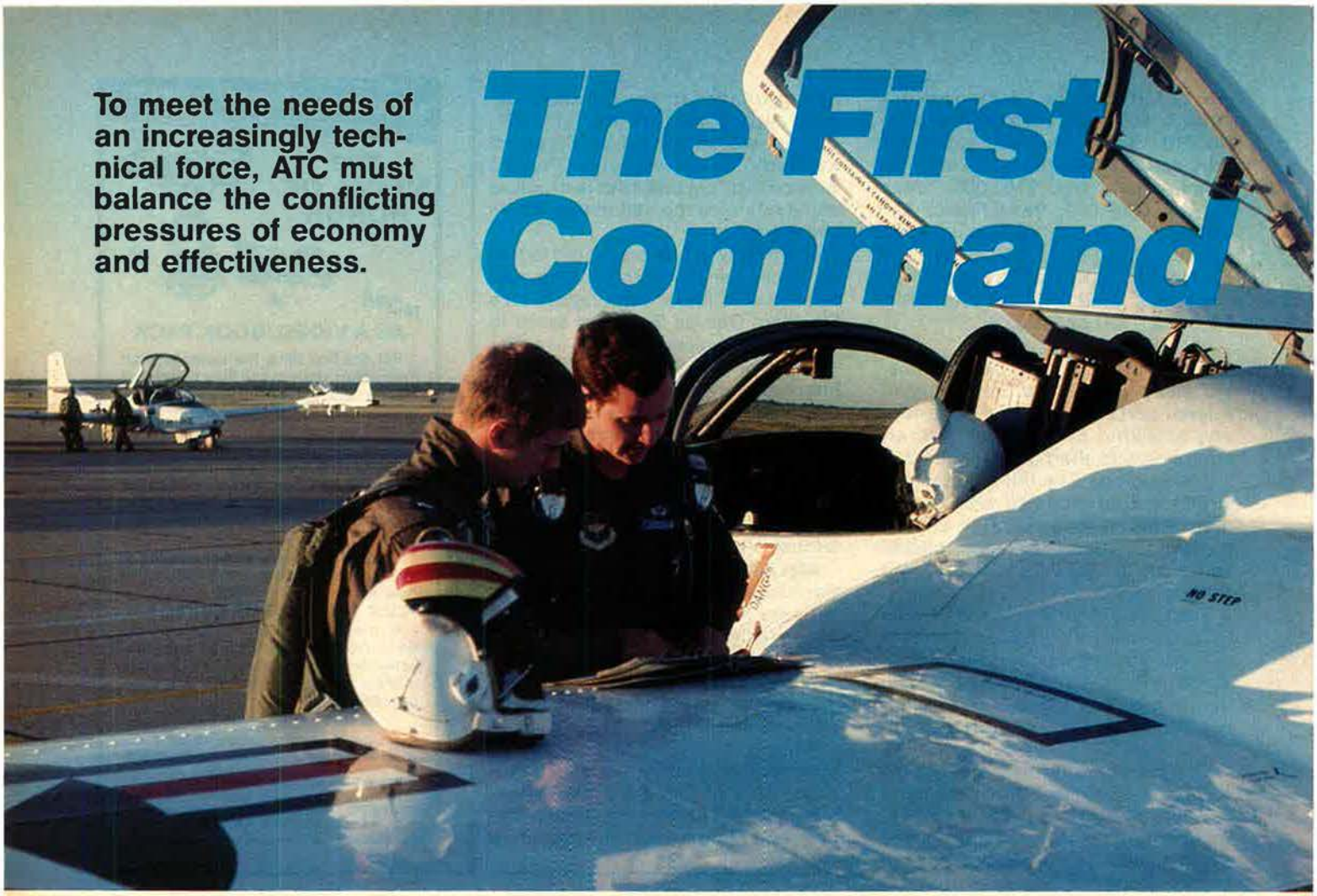
Last month in San Diego, Calif., the International Aerospace Hall of Fame inducted two aviation leaders of the World War II era. **Lord Hugh Dowding,** Air Chief Marshal during the Battle of Britain, was cited as an astute airpower strategist who was responsible for Britain's victory in the skies in September 1940.

Alexander Martin Lippisch was a German aeronautical engineer who, between World Wars I and II, developed the flying wing design. His work led to the revolutionary Messerschmitt Me-163, the stubby aircraft that became the world's first operational rocket fighter.

Among the eighty-three previous honorees of the International Aerospace Hall of Fame are the Wright brothers, Neil Armstrong, Amelia Earhart, and Manfred von Richthofen. ■

The First Command

To meet the needs of an increasingly technical force, ATC must balance the conflicting pressures of economy and effectiveness.



BY CAPT. RANDAL E. MORGER, USAF, CONTRIBUTING EDITOR

MANY Air Force workers in the year 2000 will be "generalized specialists," trained in a variety of related skills and singlehandedly doing the work of two, three, or even more of today's airmen. Obversely, other skill categories, particularly those for officers in technical and rated jobs, will become more specialized than ever before.

Two big forces are shaping this drive. One is high technology, with its problems and promises. The other is money. As weapon systems increase in complexity, so must the training for those who man and maintain them. Training budgets, however, do not always advance at the same rate that technology does. This basic fact of life constantly prods Air Training Command (ATC) to search for better ways and new concepts for training the force—and for doing it within budget constraints.

ATC's training effort is massive. The command last year touched a third of a million people from the Air Force, other services, and allied nations. Nearly 115,000 people spent anywhere from a few days to many months in resident training. Field training detachments (FTDs) at ninety-five sites worldwide taught 166,000. Additional thousands of ROTC cadets, student pilots, and student navigators came under ATC's aegis. The command's recruiters signed up 65,000 nonprior-service enlistees, plus doctors, nurses, Officer Training School candidates, and people in other categories. To the majority of those coming on active duty, ATC is not only the "First Command" but also the one to which many of them will return at key points in their careers.

Belying the command's size and scope, according to ATC Commander Gen. Andrew P. Iosue, is the command's mission: "Service." Other commands—the users—generate the requirements and set the priorities.

Meeting these needs and priorities isn't easy, especially when money is a complicating factor. Tight budgets take away resources from the classroom, and high-tech simulators are expensive. The budget constricts training time, but new high-technology systems often require more training time. Physical plants obsolesce while advances in the military state of the art penetrate to every corner of the Air Force mission and, as one briefer put it, "create new corners." High-tech training costs more, and seventy-two percent of Air Force career fields are now considered "high-tech" areas.

One answer to higher cost is greater efficiency, but that's not necessarily synonymous with effectiveness—especially if economy and efficiency are considered only in the short term.

An instructor pilot and student prepare for an early morning flight at Laughlin AFB, Tex. Sun-up to sundown operations are standard at UPT wings. (USAF photo by Walt Weible)

Changes in the Wheel

Maj. Gen. Larry N. Tibbetts, ATC's Deputy Chief of Staff for Technical Training, likens the formal training process to "a big wheel," inexorably turning out hundreds of thousands of graduates to fill Air Force jobs. Dramatic changes that might slow or stop the wheel, even temporarily, "would mean chaos" throughout the Air Force, he said.

Nevertheless, change is occurring. It stems from a variety of intertwined factors, most notably new operational concepts, new weapons and support systems, a new emphasis on reliability and maintainability, and a move away from labor-intensive operations, a shift that is driven by both the budget and technology.

But training itself is a labor-intensive business; more than 68,000 people are permanently assigned to ATC. However, efficiencies are always possible. They can be realized by such initiatives as contracting out, cutting back on requirements, consolidating and restructuring, substituting resources and simulating, trading off manpower with technology, and maximizing productive time. The command uses all these approaches and more to stretch the training dollar. Each cost-cutting method, though, has its strengths and its drawbacks.

Contract training is a small but significant slice of ATC's budget. Of the 7,900 technical courses offered in 1984, about thirty-eight percent were contracted out. Officials say that contracting has proven particularly appropriate for short-term or unique training and in developing experienced cadres who can then train others.

ATC has gone about as deeply into contracting out support services as any major command. Private companies handle functions from audiovisual to food services, flight-line maintenance to supply.

But the contracting well is beginning to dry up. "You have to remember that ATC has a combat mission, too," pointed out Col. Thomas D. Scanlon, the command's Comptroller. Training must have some surge capability in a crisis. Additionally, more than half of the command's security police and many of its medics, engineers, and maintenance and other support people are committed to immediate deployment in wartime.

Contract people, however, cannot be called up for combat, and there is always the potential for disruptive strikes or labor disputes. The short-term up-front expenses of contract training are only later offset by avoided costs.

Cutting training requirements saves money up front, but has its own hidden costs. About seven percent of basic training graduates now report directly to their operational units, bypassing tech school. While some training costs are eliminated, the training burden shifts to unit on-the-job training (OJT) monitors and supervisors. Better "transportable courseware" may help relieve the dilemma; a new software support activity at Keesler AFB, Miss., will develop formal training substitutes.

Any extra "nice to have" training also adds unnecessary costs. For example, teaching grid navigation is superfluous if the student goes to an airframe that doesn't use grid.

The biggest efficiencies accrue, say the trainers, when training is considered early in the acquisition process. Air Force Systems Command and ATC are working more closely together now to ensure that that happens.

ATC is also consolidating activities where possible to improve efficiency. Those actions continue a historical trend, such as consolidating all navigator training at Mather AFB, Calif., or concentrating T-41 flight screening at Hondo, Tex. Air Force intelligence training, now divided among four installations, is slated to consolidate at Goodfellow AFB, Tex., adding 860 student and support members to the San Angelo base. A proposal to site all survival training at one location, another ATC cost-cutting initiative, is currently being reviewed by the Air Staff.

The possibility of sharing water survival training resources with the Navy would add to the number of consolidations occurring across interservice lines. Already, Air Force helicopter pilots are trained by the Army at Fort Rucker, Ala.—just a small part of the joint training given to 4,000 blue-suiters in FY '84. ATC also provides training to 14,000 Army, Navy, and Marine Corps members annually. An Interservice Training Review Organization (ITRO), with representatives from each service's training command, proposes many of these consolidations. Since its formation in 1972, ITRO has consolidated fifty-two functions for a savings to DoD of $106 million.

Simulators and other aids have come a long way since the Link trainers of the 1940s. Simulation equipment is now prevalent in flight training and tech school classrooms. These trainers range in complexity from very low to very high tech. Though their utility rarely matches the "real thing" for a practicing trainee, the simulator cost/benefit ratio is pretty good and getting better. It might take longer for a T-38 student to get the hang of an instrument procedure in the sim, but the $200 or so expended is still far cheaper than the cost for an hour of flight time.

Sophistication is continuing to climb, too. Beginning in April 1986, B-1 maintenance trainers developed by Cubic Corp. will be delivered to Dyess AFB, Tex. These will be used to train bomber crew chiefs to the 3-c (fully proficient) level. General Tibbetts says the B-1 maintenance sim "will probably be the most sophisticated, complex, usable, and exciting piece of machinery" that ATC has fielded for technical training.

Time Is Money

The old concept of time-motion efficiency still yields money savings, too. ATC regularly measures, massages, and streamlines the training pipeline. A study of individual technical trainee processing time—that is, nonproductive training days—led to reductions averaging three days per student from 1983 to 1984.

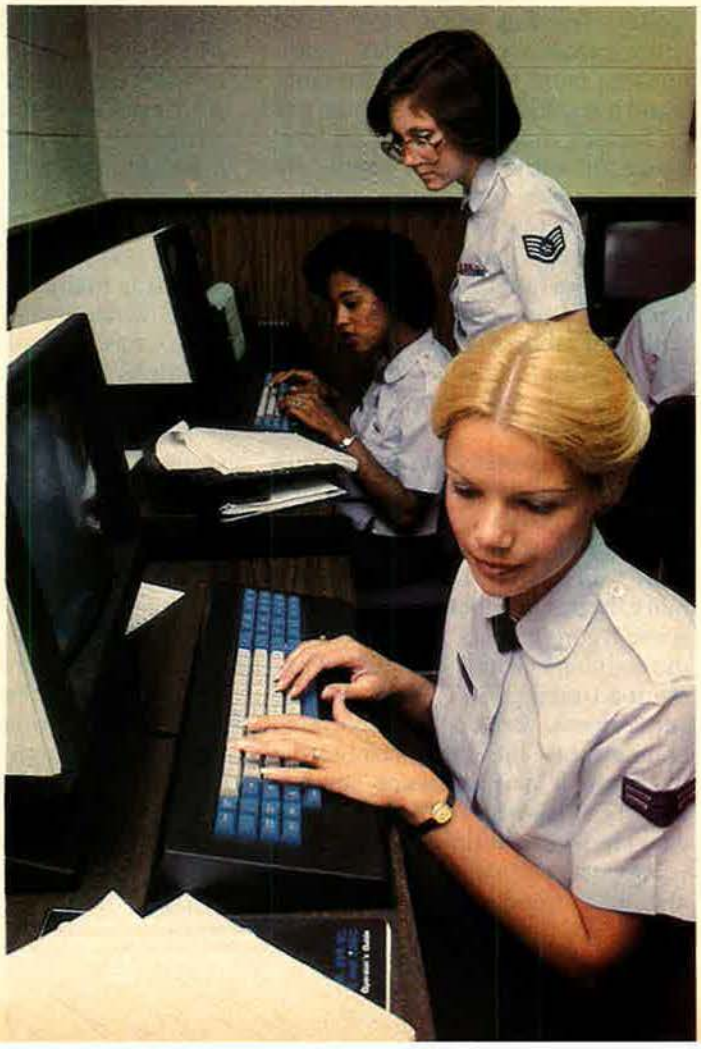
The command is also improving its flight screening of pilot candidates. Formerly limited to testing of Officer Training School (OTS) students and active-duty military who did not already have flight experience, the program this year tested ROTC students and "experienced" private pilots as well. The washout rate was high enough to justify, beginning in 1986, expanded screening of ROTC and OTS students bound for rated slots. Millions of dollars will be saved because of lower attrition rates in the much more expensive Undergraduate Pilot Training program. Full screening may sound the death knell for most ROTC Flight Instruction Programs across the country.

This kind of screening also extends to enlisted aircrews. Major commands, concerned by the elimination rate of aircrew members during formal training, asked ATC to conduct a qualification course to determine the students' physiological aptitude for flight. They even "loaned" ATC enough manpower spaces to implement the course a year ahead of schedule. The first aircrew members began their qualification testing at the altitude chamber at Sheppard AFB, Tex., in October.

Pressing technology into service, the UPT wing at Laughlin AFB, Tex., completed testing in July on a system called Time Related Instructional Management (TRIM). Part of the computerized system allows real-time processing of student records, improves data accuracy, and helps plan the daily flying schedule. The other part, interactive Computer Assisted Instruction (CAI), is touted as providing students with about forty percent of the instruction previously given in class. The students proceed at selective levels of self-paced study. If the Air Force approves buying the system, projected manpower savings would pay for TRIM. It could be installed at all UPT bases as early as mid-1987.

Automation can also save money in overhead and support areas. How about "bank teller cards" for basic trainees? Right now, new enlistees at Lackland AFB, Tex., get paid pretty much the same way as their fathers did on a World War II payday—they line up and sign for their money from a cashier. National Cash Register is now debugging a teller machine system to allow automatic withdrawals by the trainees. To be tested this spring, the new method could delete five manpower spaces.

Wide fluctuations in Trained Personnel Requirements (TPRs) within career fields also cause turbulence and inefficiency because of the constant shift of training resources and a glut/drought cycle of new graduates arriving annually at duty locations. A test program called "Smooth Flow" is designed to stabilize production of personnel in Air Force Specialty Codes (AFSC). The five-year test began in 1984, and it is expected to benefit both the tech trainers and functional users.



Herald of high tech, the computer terminal gets a workout from students learning financial services at Sheppard AFB, Tex. "Hands on" training boosts effectiveness and helps produce skilled graduates. (Photo by Sid Puder)

Toward More Effective Training

Only rarely, unfortunately, does a cost-cutting project benefit the other side of the training coin—effectiveness. Efficiency can be measured "in exquisite detail," General Tibbetts remarked. It deals with "the system." Effectiveness, on the other hand, is a quality measurement of the "output"—how well the trainee can do the job.

Feedback from the user line chiefs and immediate supervisors, says the General, is the essential first step to improving training effectiveness. And it has to be better than it is. "My phone's not ringing off the wall," he pointed out. With-

out feedback, ATC finds it difficult to decide how to boost training quality. The command hopes to institutionalize the responsibility for feedback within the offices of Air Force unit training monitors and to spur better return of training evaluation questionnaires.

Efficiency must sometimes be sacrificed to effectiveness. For instance, some tech schools tried computer-based/computer-assisted techniques several years ago in a self-pacing format. The results were poor; operational commanders quickly noted a lower quality of training among their new arrivals. Now, instead of attempting to reduce time in training, tech schools are using the computer to complement the students' classroom learning experience. Fast students will probably benefit the most, but even slower pupils should gain from the supplemental computer instruction.

Simulators can increase training efficiency, but they're only valuable up to a point. "Hands on" training is the big boost to effectiveness. However, "hands on" often means pulling equipment out of user inventories, so it involves difficult tradeoffs.

"In those areas where actual hardware can be reproduced out in our centers, we try at all cost to do that," General Tibbetts said, "because it's obvious that hands on training has a great payoff."

Among big-ticket items, ATC is short forty-six aircraft needed for ground training of technical trainees. A student crew chief at Sheppard AFB earmarked for an F-16 wing practices maintenance skills on F-101s and A-7s. An F-16 at Sheppard would mean "I could provide F-16 wings with a crew chief who's a lot better prepared to go to work," General Tibbetts said. He's hoping to get at least a crash-damaged jet in the near future.

"Real equipment" in the classrooms also gives instructors more flexibility to shape their courses. Jet engine mechanics at Chanute AFB, Ill., all train on the J57 engine, but relatively few of them actually go on to KC-135 outfits. The planned arrival of other engines, such as General Electric's F110 and Pratt & Whitney's F100-PW-220, will allow for a wider variety of trailer courses in a modular instruction format. A proposal to combine J57 and F100 training into one twelve-week course raises the possibility that graduates would receive a consolidated AFSC. If approved, such a move could provide for a wider range of follow-on assignment options.

Restructuring Training for Combat

Consolidating AFSCs gets to the heart of the "generalized specialist" issue. Lt. Gen. Leo Marquez, the Air Force's Deputy Chief of Staff for Logistics and Engineering, is promulgating a project called Rivet Workforce—and it has captured the very close attention of the personnel and training communities.

The main thrust of Rivet Workforce is selective restructuring of maintenance AFSCs to fit the realities of combat. Proponents point out that an A-10 squadron in Europe might, at the onset of war, scatter its twenty-four attack aircraft away from the main operating base to three or four bare base sites. The problem is there aren't enough specialists to support the A-10s fully at each location. However, if one person knew two or three related skills, the support tail would be reduced. Other examples, aimed at a number of operational concepts, all derive from the Rivet Workforce slogan, "Dare to Change."

AFSC restructuring is nothing new. More than 350 job specialty changes and additions took place between 1982 and 1985. What is new is the conscious attempt to shape the force, at least in maintenance, to Air Force 2000 long-range planning.

Inherent in Rivet Workforce, though not formally mentioned, are the advantages of a better reliability and maintainability posture in the future, contrasted against Five-Year Defense Plan (FYDP) provisions that virtually guarantee an increasingly manpower-shy Air Force. While manpower savings per se aren't driving Workforce, analysts are evaluating that aspect of the project.

Some restructuring has already occurred—combining electromechanical communication systems and teletype maintenance, unifying two different shreds of a helicopter AFSC, and moving wire communications from equipment to systems maintenance. More, and grander, ideas are in the works. There are even glimmers of its applicability to unrelated career fields, such as supply.

The impact on training could be far-reaching. Expanding an avionics specialist's job skills from one integrated suite to three calls for a much higher investment in individual training. Generalized specialists who are more experienced in a specific airframe or off-aircraft piece of equipment probably wouldn't be crosstrained as much into other career fields. Increased training could make a skilled technician even more attractive to civilian industry. Rivet Workforce planners are still ironing out these issues.

From the training perspective, General Tibbetts made this point to functional managers: "Don't let the training required be a constraint on your thought process." However Rivet Workforce shapes up, he said, ATC can provide the training needed, "given the resources. Always given the resources."

The Raw Material

Right now, ATC experts agree that the biggest single impact on training effectiveness is the quality of the raw material—the people being trained. They also agree that the Air Force is in the best shape ever for high-quality recruits. More than ninety-nine percent of the enlistees have high school diplomas. Many have college experience. Their scores on the Armed Services Vocational Aptitude Battery (ASVAB) tests are the best in history. New OTS and ROTC accessions have solid 3.0 college grade point averages based on a 4.0 scale.

"By any measure, by any standard, we're doing extremely well" in recruiting, General Iosue said. The Commander of Recruiting Service, Brig. Gen. William J. Porter, forecast an outstanding year for recruiting in 1986, though he's less certain about 1987 and beyond.

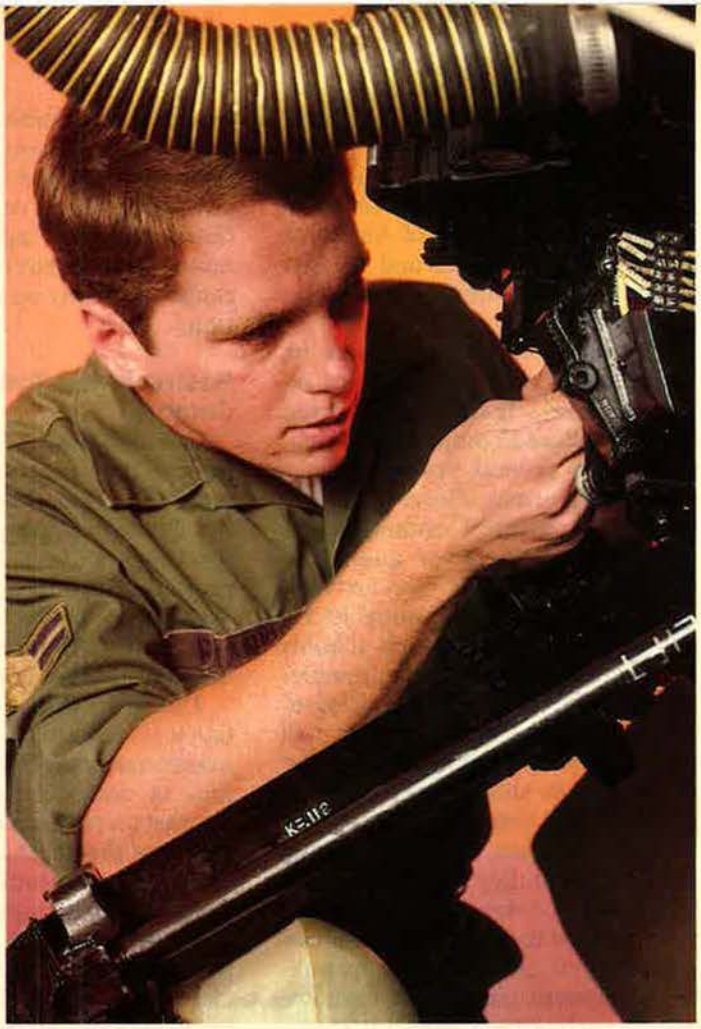
Every weekday, between 240 and 400 recruits arrive at Basic Military Training School at Lackland AFB, Tex. The six-week transition course they experience is the shortest in the four US military services. But time is money. It costs nearly $100 a day to support each basic trainee. Adding a day of basic training, mul-

tiplied by 65,000 recruits each year, must have benefits to equal its $6 million price tag.

ATC relies heavily on quality instructors to lick the problems imposed by time. Military Training Instructors are handpicked; General Iosue says they have "a tough, tough job." Instructor pilots are chosen from the best of the UPT graduates or have recent operational experience. Many tech training instructors also bring fresh field experience to the classrooms. The instructors are required to teach more than military and technical skills; ATC wants them to set an example and instill dedicated, fighting attitudes in their students. As the ATC motto proclaims, the instructors and ATC staff are expected to "Show the Way."

It takes serious training to nurture such intangible qualities as "service to country," "commitment," and "dedication" in an undisciplined nineteen-year-old. ATC is now stressing a "back to basics" theme in counterpoint to more permissive attitudes fostered during the mid- to late-1970s. "Inability to adjust to military life" now accounts for a large percentage of initial attrition among new recruits and OTS candidates.

Discipline, pride, and tradition are stressed at all ATC schools. "What we're really trying to produce out there are warriors," General Tibbetts commented, "who are productive, combat-ready airmen first and technicians second." Ideally, ATC graduates "report to their work centers ready to go to work—or to war." He admits that doesn't always happen, which makes user feedback doubly necessary.



A1C Jim Franklin practices antenna alignment at ATC's avionics school at Lowry AFB, Colo. Avionics maintenance is one career field being studied for possible restructuring under the aegis of Rivet Workforce, which is finding ways to reduce the logistics tail. (USAF photo by SMSgt. Buster Kellum)

The Flexibility Problem

On the other hand, ATC's Deputy Chief of Staff for Operations, Maj. Gen. Chris O. Divich, says he gets great feedback from flight school graduates and their major commands. But he faces another problem: flexibility.

Individual student pilot flying hours have declined in the jet age from 262 hours (from 1963 to 1977) to 210 hours for a couple of years and finally to a level in 1979 of about 175 hours. Crammed into a forty-nine-week syllabus, that's where it remains today. The drop, relieved partially by more simulator activities and ground training, was precipitated by increased fuel and flying costs. Less flying slowed the aging of the T-37 and T-38 training fleet, but UPT is rapidly approaching a point where the number of aircraft will simply be insufficient to train all the pilots needed.

Today, flying at ATC's five pilot training bases is routinely a sunup-to-sundown operation, augmented by night and weekend flying. Twelve-hour days and six-day weeks are necessary, one instructor pilot said, to squeeze a constant number of flying hours out of fewer and more maintenance-prone aircraft.

The 645 T-37s have an average age of twenty-three years, while the T-38 fleet is nineteen years old. The airplanes supported a pilot production of 1,863 USAF flyers last year, plus 330 Air National Guard, Air Force Reserve, and international students. ATC also trained about 600 new instructor pilots and participated in the Accelerated Copilot Enrichment program for Strategic Air Command. And while ATC pilots chalked up a nearly unprecedented safety record of 0.45 Class-A mishaps per 100,000 flying hours in 1984–85, accidents do happen. Aircraft losses spread even more requirements over the rest of the fleet.

Training officials meet annually with major commands, the Air Guard, and the Air Force Reserve at a Course Training Standards conference to discuss the quality of the new pilot graduates. One outcome of these meetings was the Air Force-approved addition of 14.3 more flying hours per student, to be phased in over the next three years. The 3.9 hours to be added to FY '86 classes and 5.2 hours to 1987 and 1988 would allow for more training in low-level, instrument, and formation flying. "If we had the time and money to do it, we'd like to add probably another fifteen on top of that," General Divich said.

With the fate of the next-generation trainer still undetermined, though, he worries about the effect those extra hours will have on the current fleet. The combination of old planes and new budget constraints could force ATC to delete the additional hours.

Without a new trainer, long-range alternatives are grim. Eventually, it could come down to cutting back flying time even further or reducing the number of pilots trained annually.

The uncertainty about a replacement for the T-37 primary trainer also affects plans to reimplement a Specialized Undergraduate Pilot Training (SUPT) program. The Air Force used SUPT until 1959, but discarded it in favor of training a "universal pilot." Now, with more complex and demanding cockpit missions, the era of specialization is back—almost.

Getting from UPT to SUPT is not a Point A to Point B process. Col. John R. Hullender, ATC Deputy Chief of Staff for Plans, emphasizes that the different phases of pilot training all tie together—what he calls a "total training program." Tinkering with one part of it affects the other parts.

Ideally, future pilot training would include:

- A T-37 replacement, pressurized and fuel efficient, to allow expanded flying time in the primary training phase at lower cost. Combined with the newer T-37s that will remain in service for a number of years, a new aircraft would allow more pilots to be trained annually and would allow the introduction of an intermediate phase just before dual-tracking students into either Fighter/Attack/Reconnaissance (FAR) training or to a Tanker/Transport/Bomber (TTB) track.
- Purchase, probably off the shelf, of a TTB trainer. Buying a multiengine business jet, such as a Lear or Citation, would be cheaper than the only other alternative—acquiring additional T-38s or a follow-on trainer, the T-XX. It would also take a lot of the aging pressure off the remaining Talons. TTB students would go directly to the business-type jet from the T-37 replacement aircraft.
- Extending the useful life of the T-38 even further through a modernization program called Pacer Classic. If the updated T-38s were then used to train only FAR-track pilots, then they could be in service until 2010.

All this taken together, ATC officials say, would be cheaper in the long run and would produce more effective pilots. The late-1970s goal called for implementing SUPT this year. Now, with the T-46 uncertain and the TTB trainer purchase continually slipping, specialized pilots may not fly until the early 1990s, if at all.

ATC is having better luck in upgrading its navigator training program. A brand-new Specialized Undergraduate Navigator Training (SUNT) program has gotten under way at Mather AFB, Calif., continuing a trend begun in 1978 toward navigator specialization. Specializing to specific systems and types means "a B-1 navigator is going to be a B-1 navigator for a long, long time," General Divich said. SUNT assigns extraneous topics applicable only to certain missions to more detailed, advanced follow-on courses.

The common core course has been pared from 120 to sixty-five training days, while specialized "tracks" have become much weightier. Navigators destined for FAR aircraft will receive ninety-five days of tactical navigation training instead of the twenty-five days offered in UNT. The advanced navigation course for TTB types increases by seventy-three days, while Electronic Warfare Training (EWT) adds fifteen days to the specialized syllabus. The point at which navigators pin on their wings is delayed until graduation from the specialized tracks.

All the user commands bought off on the SUNT concept, which stresses both a more efficient and effective way to train navs. ATC will be able to implement it with present manpower authorizations and current aircraft and at no additional cost.

Training for Space

Still another undergraduate course is looming for Air Force and some officers from other services. Called Undergraduate Space Training, it's roughly analogous to UPT and UNT.

The Air Force has been training space operators in the 20XX career field since the mid-1970s, but, said General Tibbetts, "there had not been a clear vision" of the exact role these officers would play. Elements of the space program switched from Air Defense Command to Strategic Air Command to Space Command in four years, and training requirements fluctuated between technical and nontechnical skills.

The field is growing rapidly. About 400 officers were trained for space operations last year. That's projected to grow to 1,500 officers a year by 1990.

Beginning in early 1985, ATC and Space Command planners, along with Systems Command representatives, worked to define space training roles and responsibilities precisely. Their product, completed in October, is a draft training plan that restructures space training.

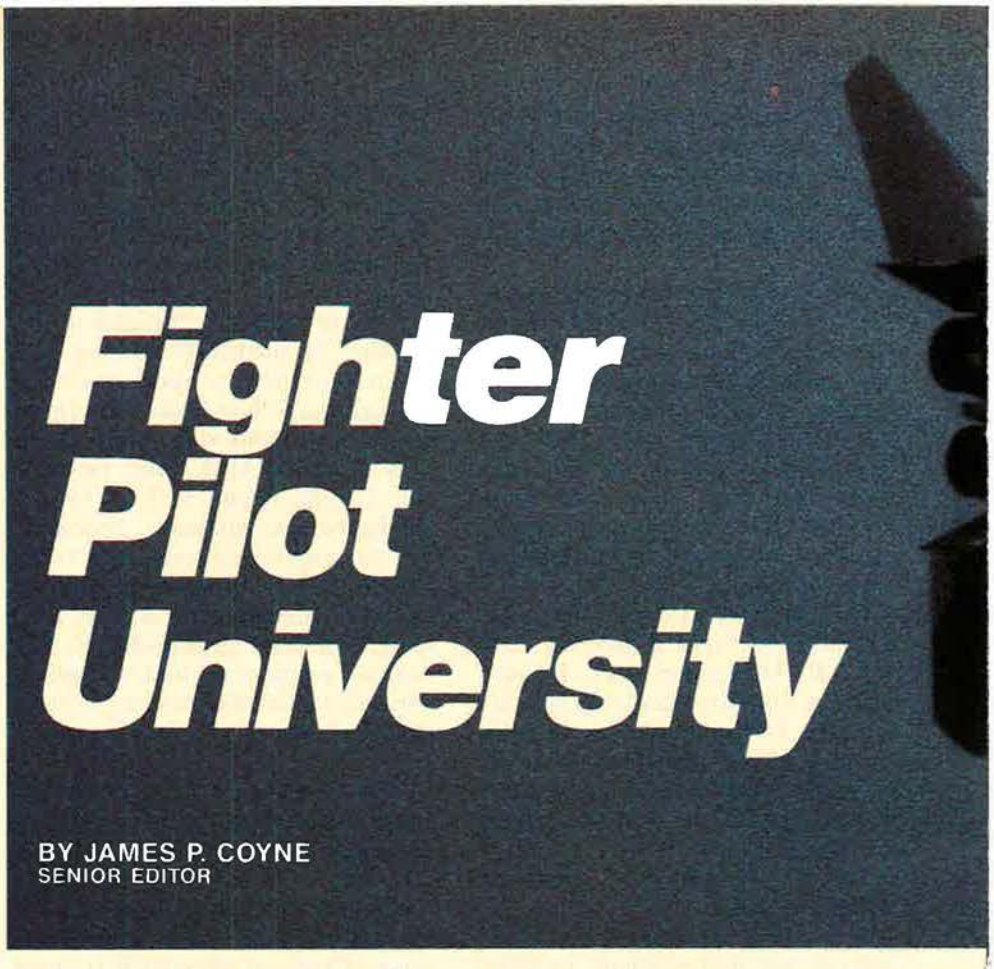
Like the "universal" pilots of UPT, officers assigned to space duties are to receive an ATC-sponsored "core course" concentrating on the fundamentals of the military use of space. Graduates will be awarded the Space Badge and assigned to such duties as satellite operations and surveillance and warning. About 150 Army, Navy, and Marine officers will probably participate annually in UST in order to meet the needs of the unified Space Command and the individual services. A separate course is being developed for enlisted operators. The first UST class could begin at Lowry AFB, Colo., as early as October 1986.

Hurdles must still be overcome, though. Developing all aspects of UST will be a "massive effort," one briefer stated, and may require contractor support. Performance simulators, key to the UST concept, still must be produced to duplicate many space systems. The complexity of the space mission might also drive training into specialized tracks, akin to SUNT and the proposed SUPT. At the bottom line, the Air Force still must come to grips with the role of space in the overall Air Force mission and decide how much of its limited resources can be diverted to space.

Just as questions about space training need to be answered in the broader context of the mission, Air Force training in general must measure up to equally stringent tests. There aren't any pat or lasting answers in the efficiency/effectiveness equation, but those tough questions are being vigorously addressed within the training community. ■

Luke keeps pace with technology and requirements as it prepares today's pilots to fight tomorrow's wars.

Fighter Pilot University



BY JAMES P. COYNE
SENIOR EDITOR

DRIVING westerly for twenty long miles out of Phoenix, Ariz., you don't see much except patches of desert alternating with irrigated cotton fields, some houses every now and then, and, up ahead, the majestic White Tank Mountains. With no warning except a REDUCE SPEED AHEAD sign, you pass through a military housing area discreetly walled off on both sides of the road and come to a halt at the entrance to Luke AFB—Fighter Pilot University.

In addition to almost 29,000 American students who have trained there, Luke has graduated nearly 2,000 foreign pilots, most of them from West Germany, but also many from Saudi Arabia, Japan, Israel, Italy, Pakistan, Venezuela, and Egypt. It is the largest fighter training base in the free world.

Overhead in the traffic pattern, splitting the brisk desert air with an unmistakable roar, are the aircraft used there for training—the McDonnell Douglas F-15 Eagle and the General Dynamics F-16 Fighting Falcon. In any year, about 500 student pilots, divided about evenly between the two aircraft, are "on campus" and going through the base's training courses.

Training in the F-15 is conducted with the ninety aircraft of the 405th Tactical Training Wing, commanded by Col. Thomas C. Skanchy. The 405th possesses the A and B models of the Eagle. F-16 training is conducted by the 58th Tactical Training Wing, commanded by Col. Ralph T. Browning. The 58th has the A, B, C, and D models of the Fighting Falcon, more than seventy in all.

Because Luke's huge parking ramps are just about at maximum capacity and because the training requirements for fighter pilots keep growing, the Air Force established another training wing for F-15s at Tyndall AFB and an F-16 training wing at MacDill AFB, both in Florida. Neither of these bases can match Luke, though, for a training environment, says Brig. Gen. John M. Davey, 832d Air Division Commander. "Luke's airspace, ranges, and weather are unmatched anywhere else in the world," he says. Luke itself covers 4,197 acres and also has 2,700,000 acres of flying ranges near Gila Bend, which is about sixty miles to the south. The Gila Bend range complex stretches almost all the way west to Yuma, on the Arizona-California border.

Sixty miles away, based at Williams AFB on the southeast side of Phoenix, is the 425th Tactical Fighter Training Squadron, which is part of Luke's 405th Wing. Williams is an Air Training Command base and uses the T-38 to teach basic flying training. The 425th is equipped with the F-5 Freedom Fighter. Both aircraft are manufactured by Northrop and have many areas of maintenance commonality, especially in engines, so it is more efficient to base the 425th at Williams instead of at Luke.

The squadron trains international students in a variety of courses varying from simple introductory training up through air-to-air and night attack courses. Now going through training are student pilots from Indonesia, Canada, Taiwan, Kenya, Kuwait, and Saudi Arabia. Also in training are US students who will either be assigned to Military Advisory Groups in nations flying the F-5 (such as Morocco, Sudan, and Tunisia) or else stay at Williams as instructor pilots. F-5 maintenance people are also trained at Williams.

Curiously, many international students trained by the 425th are from nations that don't have any F-5s, according to Col. E. Terry

A Luke AFB pilot learning to fly at the edges of the maximum performance envelope racks his F-15 Eagle into a hard right turn during a basic fighter maneuvers training mission.

—Photo by William B. Folsom

Boswell, 425th Commander. "They are learning the system we use and then applying it to their own air forces," he says. "They are interested in teaching techniques, tactics, threat analysis, ways of reinforcing flight discipline, and the fighter weapon program." Some countries that have recently sent students through the 425th courses are Zimbabwe, the United Arab Emirates, Lebanon, and Kuwait. These nations have such aircraft as the British Hawker Hunter, the American A-4 Skyhawk, and the French Mirage.

Fighter Pride

At Luke, there is no doubt what the base is there for. "Home of the Fighter Pilot" signs are posted conspicuously. On the flight line, the entire wall of the largest hangar has been turned into a huge "Fighter Country" sign. On top of that hangar, visible only from the air, is the friendly admonition "Check Six," the cardinal rule in fighter flying. "Check Six" means always check behind your aircraft, at the six o'clock position.

Both the F-15 and the F-16 wings offer two main courses, the basic "B" course for pilots who have not previously flown fighters and the transition "TX" course for those who have. In addition, the 405th Wing offers an F-15 surface attack familiarization course for students who are assigned to units with that mission.

The basic objective of both the B and the TX courses, explains Maj. James F. Burho, Chief of F-15 Operational Training Development, is "to train the pilot to find, fight, and kill enemy aircraft in front- or rear-attack engagements." When asked why the Air Force is still teaching rear-attack engagements when modern radar and heat-seeking missiles have a head-on kill capability, he replied, "Sometimes they just don't score a hit, sometimes because the pilot can't establish the parameters required—because of enemy defensive action, for example—to get a successful shot. But a big advantage of a rear attack is that your opponent's weapons, like yours, fire forward; if you're behind him, he can't shoot you!"

A student pilot taking the B course will have progressed through USAF primary and basic flying training and then through Fighter Lead-In Training (FLIT) at Holloman AFB, N. M. At Holloman, fighter pilot candidates fly the AT-38, which is slightly different from the T-38 they flew in basic training. It has a gunsight and carries dispensers for practice bombing. The student is taught Basic Fighter Maneuvers (BFM), formation flying, and combinations of basic aerobatics he will use later when he progresses to fighter training. A basic student coming to Luke, then, will have flown the Cessna T-41, which is a fixed-wing lightplane, the Cessna T-37 primary trainer, and the Northrop T-38 and AT-38 and will have accumulated about 300 hours of flying time.

There may be some pilots taking the B course who are more experienced—for example, Air Training Command instructors who went right into instructing out of basic pilot school, forward air controllers who have flown aircraft like the OV-10 Bronco turboprop, or perhaps a transport or bomber pilot who has decided to become a fighter pilot.

Pilots taking the TX course will be even more experienced, having flown the F-4, A-7, F-106, or some other fighter. Perhaps they once flew the F-15 and have been out of the cockpit for a long period of time. The B course in the F-15 is seventeen weeks long, during which time the student flies forty-three fighter sorties, gets forty-two hours in the simulator, and receives 212.5 hours of academics. The F-16 B course, with similar requirements, lasts about twenty weeks. The TX course in F-15s lasts ten weeks, during which time the student pilot flies twenty-five fighter sorties, gets 31.1 simulator hours, and attends 181.7 academic hours. Instructor courses in both aircraft last about eight weeks and include more than twenty sorties.

Courses of instruction at Luke use the building-block approach—the student sees nothing in the cockpit that he hasn't already seen in the simulator and nothing in the simulator that he hasn't seen or heard discussed in class. Simulators, Major Burho emphasized, help student pilots make the jump from basic (and old) training aircraft with their "round dial" cockpits to the "glass cockpit" systems of the F-15 and F-16. In the new aircraft, the pilot is confronted with video displays. In

the F-15, they're called Vertical Situation Displays, and in the F-16, they are Multifunctional Displays. The only round dials in these aircraft are basic or backup instruments, such as altimeter and airspeed indicator. Everything the pilot needs to know is available to him through displays he calls up on the video tubes on his instrument panel. One reason we need new primary and basic trainers with glass cockpits, Major Burho says, is that there is a negative learning transfer from the old trainers to the new fighters. But the new simulators and variations of them help to bridge the gap.

Part-Task Trainers

The newest concept in simulators is the "part-task trainer" approach. Part-task trainers are devices that realistically simulate the environment and physical movements required to perform certain tasks in the cockpit. One such trainer is used in the maintenance training section.

The instructor, SSgt. Jeffrey D. Dziedzic, was training two new crew chiefs to start, run up, and ground-check an F-16 engine just as they might be required to do on the flight line. The classroom trainer was a cutaway F-16 cockpit, an exact lookalike, even to the tilt-back seat, of those installed in F-16s. Only the throttle and the engine instruments and switches were real, however. Everything else was pictured.

As each crew chief followed his checklist and went through the procedures, the instruments duplicated exactly what would be happening on a real engine. Even the rising start sound, as it would be heard inside the cockpit, was duplicated. One crew chief successfully accomplished the procedure, did his checkout, and shut down the "engine." The second performed correctly, but in the emergency fuel pump check, he moved the throttle too quickly, causing the engine to overtemp. He had only to shut down the trainer and start the procedure again immediately. The second time, he got it right. But if he had been learning it the old-fashioned way—in a real F-16 on the flight line—he might have damaged the engine. Alternatively, this check could have been taught in a full-system simulator, but it would have been many times more expensive.

Part-task trainers, more economical than full-system simulators, are integral to both flying and ground training at Luke. This F-16 Engine Operating Procedures Trainer is used to teach crew chiefs to start, run, and check out the Fighting Falcon powerplant, with emphasis on switchology and interpretation of instrument readings.

The part-task trainer observed was built by General Dynamics. But Luke AFB has its own center for the manufacture of training aids, including simulators and part-task trainers. The job of the Training Systems Center of the 4444th Operations Squadron is to design and build low-cost, state-of-the-art equipment to train aircrews for preflight and follow-on operations.

Major Burho says the training people at Luke want to carry the reactive trainer concept a step further and take it into the classroom. "An instructor writing on the blackboard is an anachronism," he says. Ideally, students should have individual computer terminals as learning aids.

Computers are versatile and require the student to interact with the device—"punch up" information—to learn. The student performs motor skill operations, such as pressing different buttons and flipping switches, just as he has to in the new fighters. The Navy pioneered this new concept with the F/A-18, melding computer-based training systems into all their courses of instruction. "The Navy says they've never had pilots understand systems the way they do [after] having used the computer-based learning centers," Major Burho says. Part-task trainers are extremely useful for teaching the operation of a radar system or a weapon system or for programming an inertial navigation system.

These devices, however, cannot replace a human instructor when it comes to teaching about tactics or weapons employment. "For that," Major Burho says, "we need a real, live role model, preferably a pilot who has just returned from a flight, standing there in a slightly sweaty flying suit and with the oxygen-mask creases on his face, using hand and body language to tell the students what maneuvers will win a fight."

Such an instructor, Capt. Dan B. Martinez, was observed teaching a hydraulics class. About twenty student pilots, all going into the F-15, stolidly took notes and participated in discussion as Captain Martinez ran through his slides and commentary. The class perked up noticeably whenever he said something like, "This warning light means your PC-I reservoir is losing hydraulic fluid. That happened to me a couple of weeks ago, and here's what I did. . . ." Members of the class also hung on every word as he described how one of the instructors successfully performed a belly landing because the gear wouldn't extend, a very rare occurrence in the F-15. "He just slid in on the tanks, and the aircraft wasn't hurt at all."

Flying the Simulator

It had been some six years since I last flew the F-15, and to see the changes that had transpired in training since then, I was scheduled as the backseater for an F-15B mission over the range. First, though, came a flight in the F-15 simulator at the base.

The simulator at Luke is an excellent one and very good for developing or refreshing such procedural skills as flying instrument approaches, practicing radar operations, and running the fire-control system. This can be done with the cockpit canopy closed so that the occupant can't see anything except the instruments, switches, and displays inside. Fortunately, my instructor, Major Burho, kept the canopy open, leaning in the side of the cockpit to observe what I was doing.

I was rusty and wasn't doing much right except keeping the wings level and managing turns to specified headings. We ran through operation of the radar. Once it's turned on, everything is done with buttons and switches on the throttles and control stick. On the throttles, I counted eight buttons and switches for the radar, radio, weapon systems, and other functions—and some of them moved back and forth as well as in and out. On the stick, there were four more buttons, a trigger, and a switch for disengaging the autopilot system. There are even more of these in the cockpit of the F-16. Today's fighter pilot must have well-developed manual dexterity skills—he flies supersonic through the sky, moving his fingers like a concert pianist, but hardly under the same physical circumstances.

With the Major's help, I remembered how to designate a target, change the radar antenna elevation, select radar missiles, heat-seekers, or the gun, and lock on to a target at close range. It would take more practice than we had time for, however, to guarantee that I would get the right finger to actuate the right gadget in the air.

One of the things we practiced was programming the inertial navigation system (INS). Turned on as soon as the engines have been started, it has given itself a basic alignment (orientation) and will be usable for flight in about three minutes. For really accurate navigation, however, the INS needs about nine minutes of alignment (for F-15s on alert, the aircraft can be "cocked," and it can be ready to go in a shorter period of time, but it would be impractical to keep an entire fleet of F-15s "cocked" on the ramp).

We used the alignment time to program the INS, typing in coordinates (latitude, longitude, and elevation) of various checkpoints, destinations, offset aiming points, and targets along our simulated flight path. We then flew a short mission, which was a good refamiliarization with the F-15 cockpit, including the head-up display (HUD) and its plethora of symbols that repeat, in cryptic form, information from the flight instruments, the INS, and the weapon control system.

Of particular interest during practice attacks was the target designator (TD) box that appeared on the HUD whenever I locked on to a target. In actual flight, the box pinpoints on the windscreen where the target being attacked will appear visually. This is important, because the pilot who actually sees his opponent first is the most likely to win the fight—"First sight, win the fight." Pilots who visually observe what the target is doing react much quicker than they do when they have to interpret what the symbology of their systems is telling them.

Also interesting is the symbology on the radar screen (it's really a cathode-ray tube or video terminal) that told me all I needed to know about a designated target, including his speed, range, angle off my nose, aspect angle (direction his nose is pointing in relation to me), the number of Gs he is experiencing, his altitude, and our combined closure rate. HUD symbology also carried much of this information.

The key to success—and survival—in combat, Major Burho told me, is good radar discipline. Lead and his wingman must identify the individual members of the opposing flight, sort them out, make sure they are locked on to individual targets and not both on the same target, and then carry out coordinated tactics to defeat them. With today's beyond-visual-range (BVR) weapons, he said, radar is the vital key.

Radar Is the Primary Job

Of utmost importance is good radar coverage of the sky ahead. The F-15 radar sweeps from side to side in "slices" of the sky. It can search a sector in eight-bar scan or four-bar. The height of the bar, or slice, depends on how far ahead the radar is ranging. If you are scanning at thirty miles, for example, and searching between 12,000 and 22,000 feet, the radar will take about eight seconds to do a four-bar scan of that area. That sounds fast, but if you and an as-yet-undetected target are flying at near Mach 1, you and the target will be three miles closer to each other at the end of each four-bar scan.

Also, the height of the scan, since it is pie-shaped, is narrower closer in to you. In other words, the target could be in the 12,000- to 22,000-foot height band you are searching, but be only ten miles away and above or below your radar beam and therefore invisible to you. So you have to change scope settings frequently so that a target doesn't get through and turn into a killer. To someone being briefed on a radar attack, it becomes clear that flying the airplane had better be second nature, because running the radar is the primary job.

Leaving the simulator, we visited the F-16 side of the field. The F-16, since it is newer than the F-15, has more pushbuttons, switches, and videos. Maj. Linn E. Wilde showed off one gadget the F-15B doesn't have—a data transfer cartridge loader/reader. It loads a cartridge with all the data that heretofore had to be punched into the aircraft's computers manually. Input now takes twenty seconds.

Using computer programming, all planned destinations, altitudes, targets, headings, and other data for the F-16 mission are loaded into the cartridge loader/reader. When a mission is scheduled, the flight leader gets a printout of what is in the cartridge loader/reader software for that particular mission and checks it for accuracy. Even appropriate radio frequencies are included. He updates the data if necessary and inserts the information in the loader/reader.

Each pilot on that mission inserts his own cartridge into the loader/reader, which loads the data. The

pilot takes the cartridge with him to his F-16, and instead of having to enter all the data manually, he simply plugs it into the system. All aircraft systems are then automatically programmed for that mission. When he finishes flying, the pilot takes his cartridge back to the operations building, where it is ready to be programmed for the next mission. This only works on the F-16C at present, but will soon be in all F-16 models.

The F-16s had more part-task trainers than the F-15s. One cockpit procedure trainer enabled an instructor pilot to simulate up to fourteen emergencies that might confront a student. Another was a realistic radar procedures trainer, and still another was for weapons employment. These trainers were all built by General Dynamics.

Sunrise at Luke—a scene etched in the memory of every pilot who has trained there, with fighters ready on the flight line and the rays of the sun just starting to hit the barren flanks of the White Tank Mountains five miles across the desert. (USAF photo by Sgt. John G. King)

An F-16 instructor pilot, Capt. Jimmie R. Duncan, took me to Gila Bend, where we visited an air-to-ground range. The huge complex, with an auxiliary airfield on its northeast corner, contains eight separate ranges. Three tactical ranges are used for simulated attack of convoys, airstrips, tanks, and other vehicles. Four are for scored air-to-ground gunnery and bombing qualification, and one, the air-to-air range, is for simulated combat between aircraft, including those equipped with the Air Combat Maneuvering Instrumentation (ACMI) system. ACMI enables observers at Luke to score air-to-air encounters. An average of 175 sorties a day is flown over the complex.

We flew down to Gila Bend's Range Four on one of Luke's UH-1F helicopters. After we passed over Interstate 8, running west to Yuma, we suddenly found ourselves on the range complex and in some of the most desolate territory ever seen anywhere. No water. No trees. No vegetation except the scraggliest of mesquite and other desert plants. Nothing moved down there, not even jackrabbits.

We checked in by radio with Range Four and were told the range was "hot," with a flight of F-16s working. To save fuel, we set down in a small level area just outside the range traffic pattern. We were in a small crater-like depression surrounded by black boulders varying from football size right on up to the height and width of automobiles. We could have been on the moon. No wonder this land is available for ranges. It couldn't be used for anything else.

Students Score High

When the F-16s departed, we flew into the range and landed on a helipad near the control tower. On a scored range, targets for strafing are made of old drag chutes that are suspended upright beyond the tower. A foul line, marked by old tires painted white, runs out from either side of the tower. Fighters approach by flying perpendicular to the foul line and then pass above and to the side of the tower to strafe the targets. The foul line is 2,000 feet from the targets. If a pilot has not stopped firing by the time he reaches the line, a foul is called by the range control officer. If a pilot fouls twice, he must leave the range and forfeit his score.

Each pilot is scored on how many hits he gets, based on a total of 100 usable rounds carried. The scoring is done acoustically, with each round's supersonic shock wave being recorded as it passes through the target. The range control officer radios each pilot's score on each pass. Before aircraft had INS and computer systems like those in the F-16, F-15, and A-7, scores as high as forty-five were considered excellent. Today, even some beginning students score in the seventies, Captain Duncan said.

Farther out from the tower, in line with the foul line, is the dive-bombing target. Aircraft drop twenty-five-pound practice bombs on the range. Each bomb has a small white phosphorous marking charge that expels a small puff of white smoke when the bomb hits. Using a calibrated telescopic device, a technician in the range tower sights on each puff and calls out its azimuth. In another tower, at right angles to the foul line but in line with the range control tower, another technician also obtains an azimuth bearing. The two sightings are used to plot the exact position of the bomb impact point.

The dive-bombing target is a wooden pylon surrounded by concentric circles. To qualify, a pilot must put his bombs an average of 140 feet from the pylon. In older aircraft, scores of forty or fifty feet were considered quite good. In today's aircraft, most scores are in the teens.

In addition, there is another circle, quite far out from the tower and dive-bombing circles. This is the target for nuclear weapons training. Most aircraft coming to the range fly a low-level navigation mission ending in a nuclear delivery pass. Nukes, because of their wide destructive power, do not have to be delivered as accurately to get a "hit." In fact, in older aircraft, a bomb landing within 2,000 feet of the bull's-eye was considered ac-

ceptable. But today, bull's-eyes are not uncommon, even though the bombs are tossed from great distances away from the target.

We watched two flights of F-16s strafe and bomb on Range Four. Following prescribed safety procedures, each flight was cleared onto the range, and each aircraft was cleared for each individual pass.

Using the radio and binoculars from inside the glass-enclosed tower, the range officer bears responsiblity for safe flying at all times. He even uses lines drawn on the tower windows to verify that aircraft are not pulling out too low on any pass. The range officer also gives each strafer an estimated point at which he started firing and ceased firing.

There were no fouls that day, although pilots ceased firing on several passes at 2,100 feet, just 100 feet short of the foul line. Captain Duncan explained that if a pilot fires too far out, his rounds may slow down to subsonic before reaching the target. These shots would not register acoustically and would be scored as misses. So pilots try to fire as close in as possible without breaching the foul line. Every strafer that day scored more than fifty hits.

The F-16s practiced pop-ups for dive bombing. In this maneuver, students approach the target area at a low altitude (for safety reasons, at least 500 feet above the ground), pull up steeply, roll inverted, pull the nose down, roll out, put the aiming pipper (F-16 pilots call it the "death dot") on the pylon, push the bomb-release button on the control stick, and pull out. At the proper point in the pullout, the bomb releases automatically for its flight to the target. Out of five aircraft dropping two bombs on the dive-bomb target, each got at least one bull's-eye.

The Luke Air Combat Maneuvering Instrumentation system is one of several installed around the world by the Cubic Corp. of San Diego, Calif. So far, Cubic is the only company manufacturing this system, which is used by the A-4, F-14, F-15, F-16, and F/A-18 aircraft. It allows pilots to fight each other in the air and score "kills" without launching live ordnance. Instructors on the ground monitor each pilot's moves in real time on large computerized graphic displays. Missions are recorded on tape and are replayed later for the aircrews.

ACMI Tells the Story

The range is managed by a two-man team consisting of a system operator and a Range Training Officer (RTO) who monitor the high-altitude air battle by watching computerized displays in the control center at Luke. Centerpiece of this system is a wall-sized screen that shows where maneuvering aircraft are located in relation to each other. The RTO can view the battle from any angle—from above, from the side, or even from the viewpoint of the cockpit of one of the participating aircraft. If he desires, he can also display important flight data, such as airspeed, altitude, angle of attack, G-load, and closing velocities of aircraft.

All the data is recorded and can be replayed at any time. Students can review their performance by stopping the action, backing it up, or rotating the view to any angle. Since the simulated mission performance is based on actual data, the ACMI is the most valuable tool available at Luke to teach pilots the proper position and procedure for attacking and destroying enemy aircraft. And since pilots fly against actual aircraft, they learn how fast-paced the action can be and how important weapon systems management can be. They can also determine why they missed the target and, as a bonus, can learn evasive maneuvering to avoid being hit by enemy missiles. I watched a flight in progress on the Gila Bend range and was able to keep track of kills and misses as they occurred. Later, pilots from the flight I watched debriefed, using the record of their combat.

The next day, with Major Burho in the front seat, I was in an F-15 on an offensive air combat maneuver (OACM) mission on the ACMI range, high over the Growler Mountains on the Luke air-to-air range. On our wing was a student, 1st Lt. Gary J. Bauhan. Our flight of two was pitted against a flight of two Marine A-4s, flown by 1st Lts. Paul J. Smith and Thomas M. Richard, both from El Toro MCAS, Calif.

Despite an unusual Arizona rain, we were in good spirits as we briefed in one of the briefing rooms of the 461st Tactical Training Squadron (the Deadly Jesters). With Major Burho leading the briefing, it was quickly established that the Marines felt their best maneuvering altitude for the A-4 was below 20,000 feet. Since students in the air-to-air range can't fly below 10,000 feet, it was decided that the Marines would fly in an altitude block of 10,000 to 14,000 feet and we would fly at 15,000 to 19,000.

The rules are that fighters must stay in their own blocks during the intercept until each flight has sighted the other visually. When the battle is joined—"the merge"—only one maneuvering turn is permitted. We would then have to "knock it off" and regroup for another engagement. Purpose of the mission was to give Lieutenant Bauhan experience as a wingman in a two-vs.-two—2v2—encounter, especially learning how to operate his radar, sort out the bandits, and lock on to his assigned target.

We would have the assistance of an E-3 AWACS cruising somewhere far to the east of the range. The AWACS—call sign "Dragnet"—out of Tinker AFB, Okla., the biggest AWACS training base, would have student controllers. The briefing with the Marines starts at 0645 hours and lasts longer, it turns out, than the flight. Major Burho discusses safety rules with the Marines, including criteria for engaging and for knocking it off.

Interesting discussion takes place over the differences in our armament. Both flights had newer models of the AIM-9 Sidewinder, with a front-quarter attack capability. Ours had seeker heads that could be freed and allowed to lock on before launch, but theirs could not be freed before launch, meaning they would have to aim them by "boresight" before release. Ours could lock on even though we weren't pointing directly at the other aircraft.

The safety rules were specific: "There will be a 1,000-foot bubble around each aircraft for safety—so don't come any closer than that. There will be no front-quarter gun attacks at the merge for safety reasons. In a head-on pass, if you're on the right, pass on the right. If you're nose high, pass high. Don't cross nose positions to make the rules work for you. After the merge, if

you lose visual contact, maintain turn and maneuver; if a visual contact is not regained, advise the other flight through the AWACS controller or the Range Training Officer."

"Take Shots" Is Third

The Marines go off to a different briefing room to plot their strategy and tactics, and we discuss ours. First and most important is radar discipline. Lead, said Major Burho, would radar search from 20,000 feet on down; No. 2 would search 18,000 feet and higher until contact. When contact is made, we would sort side to side, each aircraft taking his opposite in the other formation. If blips merge on the radar, we will sort top to bottom as soon as we get a vertical split of the blips. At the merge, No. 2 stays on the outside of the turn, looking through lead to his own target.

"Finally," said Major Burho, "I expect you to be an active participant in this fight. I expect you to give me directive commentary when appropriate. If I don't see him and you do, tell me where he is. We will separate [after the merge] after 180 degrees of turn going downhill supersonic. Before the merge, after positive target identification, take whatever [missile] shots you want—after the merge, wait for me to clear you to fire. As wingman, your job is, first, to maintain visual contact with me and look for bandits, second, work the radar, and third, take shots. In that order."

Out on the ramp, the rain had stopped, but there were several layers of clouds above. To the southwest, toward Gila Bend, it looks much better. Jim Burho starts the engines, turns on the INS, and goes through his pre-taxi checks. He types needed data into the INS computer, and after nine minutes, it is aligned. We taxi out on time, stop in the arming area where ground crewmen look us over, and then wait twenty minutes, engines running, because Phoenix Control is working traffic out of another field south of us. Finally, cleared to 9,000 feet on one of the Luke standard departures, we make a formation takeoff—with Lieutenant Bauhan hanging in like an old pro—and pop into the clouds just after establishing a 180-degree turn to the south.

As we fly along, talking to various controllers on various frequencies, I suddenly realize how convenient the new F-16C cartridge loader/reader would be. I count six channel changes, and for each one, No. 2 has to fly his plane in close formation in the weather and fiddle with his radio. How much simpler it would be with the new system.

In the air-to-air range, we check in with Dragnet and go to a southern holding point to orbit and wait for the two Marines, who also had been held up back at Luke by weather. Major Burho uncages our Sidewinder missile heads and drops back to check the missiles' lock-on capability on Lieutenant Bauhan's aircraft. The urgent warbling tone in our headsets tells us the Lieutenant is a "dead duck." Lieutenant Bauhan makes the same check with his missile on us. We practice tactical formation turns as we wait. The Range Training Officer, on the same frequency as Dragnet, tells us the ACMI system is working perfectly.

The A-4s enter the area, and Dragnet gives us a vector to their position. Burho immediately spots a blip on radar and calls the contact. "Only one blip—where's the other guy?" he asks. He tells No. 2 to keep searching high. Dragnet says the bandits are at 13,000 and 12,700, respectively. We make a ninety-degree right turn to draw out the second bandit and whip back to the left. No. 2 loses visual contact with us in the turn. Major Burho gives him directions to us. No. 2 gets back in position, and, as the blip closes to fifteen miles, the other blip emerges from the first one—they must be in pretty close formation.

Closer in, Major Burho takes a lock on the lead bandit and tells No. 2 to take the other one. No. 2 has no joy—no blip on his radar. "Keep searching," Major Burho tells him. Burho fires his first simulated missile, a radar-guided AIM-7, and calls, "Fox One," and then, "Tally Ho!" meaning he has a visual sighting of the bandits. He then calls, "Fox Two," indicating that he has fired a heat-seeking Sidewinder. Now supersonic at Mach 1.3, we "blow on through" the bandit flight, and as one passes underneath us, we roll into a hard, five-G turn and head south to the original holding point to wait for the next setup.

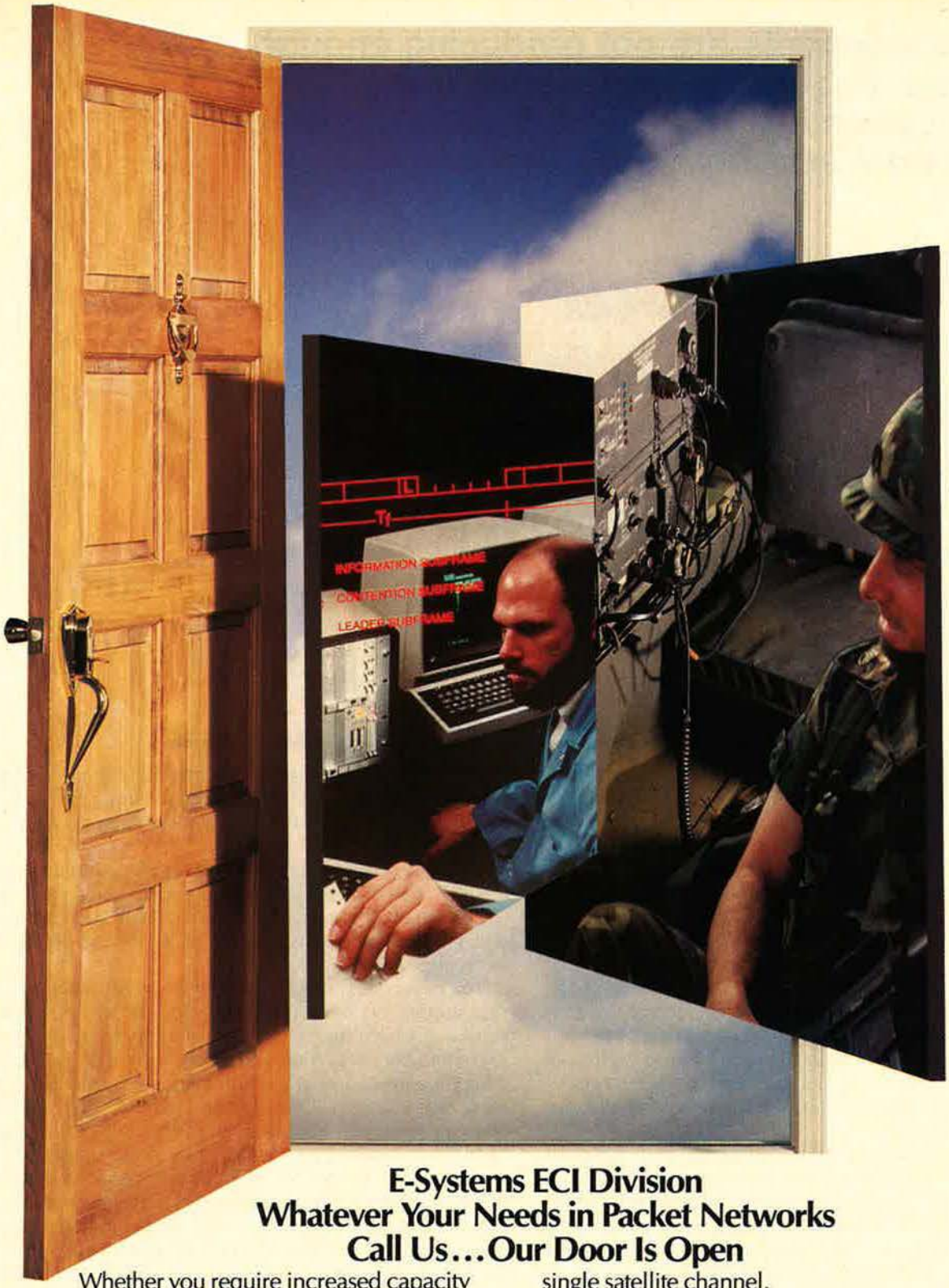
On the second encounter, Dragnet calls the bandits at thirty miles and 14,500 feet and then at twenty-three miles. Both Burho and Bauhan soon get a lock this time, and they both get Fox Ones. "Oh, boy," says Major Burho on intercom, "we killed everybody that time!" We turn hard again to the south for the next setup. It's a repeat of the second, except this time the Marines get off some shots that miss (we find out in the debriefing later). Now, low on fuel, we return to Luke, leaving the bright sunshine of the air-to-air range for the unusual weather at the "home drome."

We debrief briefly, then go over to the ACMI facility. The Marines say the reason we saw only one blip on the first encounter is because they were flying "shackled," or close together, hoping to confuse us. It worked pretty well. Major Burho says that if the Luke F-15s had a track-while-scan mode in the radar, like the F-16 does, we would have had a better chance of getting them both the first time.

The ACMI is fascinating to watch. The missiles come off the pictured aircraft and make trails of dots to the targets. We can hear the voice transmissions we made as we fired. It was a good mission.

Fighter Pilot University is pretty sophisticated nowadays—much more so than in F-84 days in the 1960s, and even since F-15 days in the late 1970s. When we first got the F-15—and it was far superior to everything else in the sky—mutual supporting tactics weren't thought to be too important. A flight of two would often split at the merge and pursue individual attacks. Often, this resulted in one of the F-15s getting a bandit on his tail. Today, the Luke syllabus doesn't even include a 1v2 mission—it's counterproductive, a spokesman says.

All the gadgetry in the airplanes has changed the course of things completely. Pilots have to deal with capabilities—and threats—that are new. And they are being taught to deal with them, using equipment that certain old heads used to call "Buck Rogers stuff—it'll never work." Well, it's here, and it's working. More important, the air combat trainers at Luke are keeping pace with requirements, teaching today's fighter pilots to fight tomorrow's wars. ■



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America's schools are not producing enough scientists, engineers, and technicians. Unless corrected, this problem will jeopardize our national security.

Our Dangerous Shortfall in Technical Education

BY GEN. ROBERT T. MARSH, USAF (RET.)
CHAIRMAN, AFA SCIENCE AND TECHNOLOGY COMMITTEE

IN THE years after World War II, the United States rejected the notion that national security and world stability required us to match the size of the Soviet military machine. Instead, we exploited our strengths—technical ingenuity, unprecedented scientific achievement, an unequaled industrial base, and a strong free-market economy—to build superior military capabilities. We chose to pit American quality against Soviet quantity.

Clearly, we chose well. The relative stability of the world in the last forty years and the strength of Western freedoms testify to the validity of our choice.

The launch of Sputnik and, later, the introduction of ballistic missiles were clear challenges to our strategy of qualitative superiority. America rose to those challenges and surged forward.

Today, we are facing similar challenges. Recent Soviet developments in military technologies, supported in great measure by the theft and appropriation of Western technology, are threatening the balance of world power. Also disquieting are the trends clearly indicating the erosion of our technological leadership. New Soviet offensive capabilities and their massive investment in defensive technologies are indicative of the ongoing Soviet drive to nullify America's qualitative superiority.

Meeting this major Soviet challenge requires a broad national effort on many fronts: in education, in basic research, in engineering, in development, and in industrial productivity.

Our educational system carries the burden of providing Americans the knowledge and skills to build and maintain our technological superiority. It is the fundamental area deserving major attention. People are, after all, the most important factor in the equation of technological superiority. Scientists, engineers, and technicians are the foundation of America's technological leadership.

Because we recognize that high-quality technical education is essential to a continued effective defense strategy based on qualitative superiority, AFA's new Science and Technology Committee chose American education as its first area for inquiry.

The basic questions for defense are whether or not the educational system today is meeting our future defense needs by providing (1) sufficient numbers of scientists and engineers, (2) enough technicians with sufficient education in science and mathematics, (3) enough young men and women with adequate mathematics, science, and computer science education to learn the skills necessary for increasingly sophisticated and technical Air Force career fields, (4) prospective defense industry employees with the mathematics and science backgrounds required to manufacture sophisticated weapon systems in the future, and (5) all Americans with the mathematics, science, and computer background needed to discharge a citizen's responsibilities effectively in the technologically oriented world of tomorrow.

Vision of the Future

Science and mathematics education is clearly important in any vision of the future. In defense, career fields have already changed to the extent that the Air Force now estimates that a math and science background is desirable in seventy-five percent of its career fields.

In the future, the Air Force will become even more technically oriented, impelling a corresponding increase

in the requirement for technically prepared personnel. Such career fields as munitions will change dramatically. As iron bombs are replaced by sophisticated, electronics-laden weapons, munitions technicians and munitions maintenance people will trade their wrenches for computer diagnostic equipment. Screwdrivers will give way to software revision.

In 1975, there were about 250,000 computers in use in the United States. Estimates for 1985 reach 6,000,000. And the Air Force is no exception to this trend. Battle management, for example, is becoming an increasingly automated process. Commanders and their staffs will need sound technical backgrounds to understand, interpret, and act on the massive amounts of data available. Discrimination between important and unimportant data, the reliability of the sensors involved, the accuracy and reliability of software, and—perhaps more difficult—the design and use of expert systems and artificial intelligence to manage the battle more effectively will require unprecedented levels of technical knowledge among Air Force people.

Such will be the case with all career fields. Security police will rely increasingly on sophisticated sensors and computers; aircraft maintenance technicians will utilize diagnostic computers in lieu of their tech manuals. Administrative people and personnel managers are already replacing typewriters and file cabinets with word processors and computers. As a result, the Air Force estimates an increase by one-third in its requirements for enlistees with high aptitudes in electronics by the year 2000.

In the civilian world, the story will be much the same. The Bureau of Labor Statistics estimates that between 1982 and 1995, as many as 4,000,000 new jobs will be created in high-technology fields. Among these will be approximately 100,000 new jobs in the manufacture of supercomputers by 1993 and between 100,000 and 250,000 in computer operations.

Manufacturing will change significantly with the trend toward increased use of robotics. In fact, the Robot Institute of America estimates a twelvefold increase in robot use. The Bureau of Labor Statistics says there may be 1,000,000 new robot manufacturing jobs by 1990. The Labor Department also projects an increased requirement of sixty percent for computer programmers, more than eighty percent for computer analysts, and 112 percent for computer service technicians.

The growth in demand for scientists and engineers will be equally great. The National Science Foundation predicts that defense and defense industry requirements for engineers will grow at a rate of between 6.1 percent per year and 8.5 percent per year (depending on defense expenditures and economic growth). While the demand for engineers increases rapidly, the supply does not. Historically, the proportion of college graduates who major in engineering has remained relatively constant.

In the recent past, this was generally adequate, because growing demand was being met by the increase in college enrollments—a function, at least in part, of the growing population of eighteen- to twenty-four-year-olds. However, the National Academy of Science's 1984 joint meeting of the Engineering and Scientific Manpower Commissions reported that this population will decrease by more than 3,000,000 between 1981 and 1988. The result will be a decrease in total engineering (and science) graduates, along with an overall decrease in college graduates through 1990. While the impact of this change may be mitigated somewhat by non-engineers transferring to engineering fields, demand for engineers will outstrip engineering accessions—especially in some fields critical to national defense. In fact, the NSF is predicting a forty percent decline in aerospace engineer production through 1990 during a period when the demand for aerospace engineers is expected to increase by seventy percent. Likewise, the shortage of electrical engineers may reach 30,000 by 1987.

The situation is much the same for technicians. Especially acute will be the shortage in computer specialists, which may reach 140,000 by 1987. And the shortage in aircraft mechanics may reach 40,000 by 1990, according to the General Aviation Manufacturing Association.

Technical background is already important in seventy-five percent of USAF's career fields, and the percentage is growing.

This is not meant to paint a bleak and irreversible picture of our technological future. Rather, it is to demonstrate the importance of preparing America's young people now for the technology-charged opportunities of tomorrow.

Are We Meeting the Challenge?

Unfortunately, the educational system of the United States does not appear to be meeting that challenge. The National Commission on Excellence in Education described the problem well: "The nation that dramatically and boldly led the world into the age of technology is failing to provide its own children with the intellectual tools needed for the twenty-first century."

Much has been made of lower Scholastic Aptitude and Achievement Test scores as indicators of reduced knowledge among today's high school students as compared to their predecessors. There has definitely been a dramatic decrease in scores, but an examination of school curricula gives rise to our most serious concerns about how well we are preparing today's youth for their technical futures.

American elementary students have twenty-five percent shorter school days and school weeks than their counterparts in other industrialized nations. Our students receive less than four hours of mathematics and less than two hours of science instruction each week. This is particularly disturbing, because it is in these early years that students form their attitudes toward math and science, which affect later course and career choices.

The problem shows up also at the high school level, where enrollment in science courses has been decreasing for twenty years. Half of America's students take no math beyond the tenth grade. Only sixteen percent take a year of chemistry, and only ten percent take a year of physics. Fully half of the nation's public high schools do not offer sufficient math courses to qualify their graduates for admission to an accredited engineering school. Only one-third of America's 21,000 schools offer calculus, and only half offer physics with qualified teachers.

Bottom-line proof of the lack of emphasis on science and mathematics is that one-third of the nation's 16,000 school districts surveyed in the early 1980s required only one year of math and one year of science for high school graduation.

That lack of preparation is reflected in high school graduates' plans for and performance at college. A survey of 1981 graduates revealed that only about one-fourth of them intended to major in engineering, computer science, biology, physical sciences, or mathematics.

In colleges and universities, the number of remedial math courses increased by seventy-two percent between 1975 and 1980, although total enrollments increased by only seven percent. One-fourth of the math courses taught at four-year institutions were remedial, and more than forty percent of math courses at two-year schools were remedial.

And even though higher education enrollment was increasing from 1960 to 1980, the share of engineering and science majors remained constant at about thirty percent. Included in that figure, however, are social science majors, who made up eight percent of all enrollees in 1960, rising to fifteen percent in 1974 and dropping to eleven percent in 1980. Engineering enrollments, on the other hand, dropped from ten percent in 1960 to four percent in 1974 and grew to only eleven percent in 1980.

High school students do not get enough math and science. The deficiency carries forward when they go to college.

At the graduate student level, the story is bleaker and is perhaps more important, since engineers and scientists with master's degrees and doctorates constitute the core of our research and development cadre as well as our university faculties.

The Scientific Manpower Commission reported that of the 2,780 engineers earning Ph.D. degrees at American universities in 1983, only forty-four percent were US citizens. Furthermore, only one-third of the Ph.D.s granted by US colleges and universities in 1979 were in engineering. Three-fifths of those graduates were in the sciences, but seventy percent of them were psychologists, social scientists, and life scientists.

The conclusion is inescapable: The supply of advanced-degree holders is low and is becoming dangerously low. Especially important for defense is the fact that the pool of Ph.D. engineers available to work on classified defense projects—whether in the government or in industry—is necessarily restricted to that forty-four percent who are American citizens.

The Shortage of Teachers

Surely the well-documented shortage of math and science teachers is one cause for the nation's poor showing in technical education.

In 1981, forty-three of forty-five states reported shortages of math teachers. Forty-two reported shortages of physics teachers. In addition, half of the new teachers hired for science and math courses were uncertified to teach those courses. These figures are not surprising, considering that the NSF also reported that, in 1980, only five percent of those receiving bachelor's degrees and ten percent of those receiving master's degrees in science and engineering went into teaching.

The shortage of science and math teachers continues to grow, partly because of the lucrative employment opportunities available in industry. Only half of the math and science student teachers between 1971 and 1981 actually went into teaching. And one-quarter of those who did teach said they would leave teaching in the near future.

Clearly, those who do study math and science in college are opting for the higher pay of industry. The same is true at the Ph.D. level. In 1968, recent Ph.D.s accounted for thirty-nine percent of all full-time science and engineering faculties. By 1980, that figure had dropped to twenty-one percent. The DoD-University Forum Working Group explained why Ph.D.s are not joining university faculties: "At least for the last eight to nine years, the demand for baccalaureate engineers has exceeded the supply, and salaries have been rising steadily. For a period in the early '70s, the salaries of engineering bachelors escalated more rapidly than the salaries of engineering Ph.D.s, particularly those on university faculties."

That same study also noted that "the shortage of graduate students and faculty members creates unusually heavy teaching loads, which make academic jobs less attractive to those interested in research." A survey found that while three-fifths of faculty Ph.D.s reported teaching as their primary activity in 1973, only half made the same report in 1979.

The Question of Quality

A number of studies indicate that outdated, excessively expensive, or nonexistent labs and equipment are contributing to the lack of quality in science and engineering education at all levels. In one survey, twenty-five percent of science teachers said that inadequate labs were hindering presentation of their courses.

The DoD-University Forum Working Group report summarized the problems facing universities today. These include "(1) increasingly obsolete research laboratories and equipment, (2) a serious shortage of faculty qualified to teach state-of-the-art technology, (3) smaller percentages of US citizens in graduate programs, (4) pay differentials that are enticing faculty and prospective graduate students out of our universities, (5) poorly prepared high school graduates, (6) an inescapable decline in the number of college-age youth, and (7) the cumulative effects of prolonged erosion in the general quality of education in science, engineering, and mathematics now provided to precollege, undergraduate, and graduate students."

Competition to attract technical talent is fierce. Our schools and our military must be able to compete.

There is no doubt that these are all serious problems. With the number of college- and military service-age students dropping, there is a very real need for the Air Force to be more competitive for those high school graduates—and college graduates—best prepared for the service's technically demanding jobs.

Toward that end, the service has initiated a number of programs designed to recruit and retain qualified people. Such initiatives as the engineering bonus, special incentive pay, and various precommissioning assistance programs are paying off.

However, as indicated above, that is not the whole solution to the problem. Successful pursuit of our defense strategy requires a work force that is technically oriented and well-prepared in science and mathematics. The military is not alone in its need to maintain the qualitative edge. We of AFA must concern ourselves with the talent base required by industry as well. And as citizens of a democracy, we must also be concerned with ensuring that our general population has sufficient technical background and understanding to participate effectively in the processes and decisions of our increasingly technically oriented democracy.

What Are the Solutions?

Our concern with the educational system is made all the more acute by the shift in the US-Soviet balance of forces through the 1970s. While the American educational system was turning away from the "hard sciences" and toward the pursuit of a more liberal education with emphasis on personal growth and development—as opposed to discipline and knowledge—the Soviets concentrated on science and technology. Their success in education has been the key to the tremendous progress of their effort to deny us technological superiority as a means of ensuring our security.

The indicators discussed in the preceding pages are alarming. But they are not the only indications of how our technological capability has slipped. Such other matters as the doubling of US patents granted to foreign nationals—fully fifty percent of all patents now—are indicative of a loss of technological innovativeness and creativity. There is a definite relationship, though perhaps not quantifiably proven, between Ph.D.s in engineering and the sciences and the quality of the research and development output of the United States. It follows that the quality of R&D must have an impact on the capabilities of the systems resulting from that work.

Some studies indicate that laboratory supervisors perceive only small reductions in the quality of laboratory personnel. However, the reality of the changed military balance and the increasing popularity of non-US high-technology products on the world's markets can only be viewed as indicative of a disturbing reduction in R&D quality.

As a part of the overall decline of America's prestige in research and development and in technology, this decline in R&D quality must be addressed as well.

There is widespread concern throughout industry and government with the plight of our science, engineering, and mathematics education system. Many industry groups have taken novel approaches to the problem and have developed a variety of outreach programs that are already improving local school systems' programs. Government agencies, including the Air Force, have done similar things—providing opportunities for their scientists and engineers to aid local school programs. The National Science Foundation, the government, and industry have undertaken a variety of important programs to increase funding for research facilities at our colleges and universities. These, too, will pay off in stonger science and technology programs.

This is a vital national defense problem. It must be understood as such. The technological advantage that underpins our security must be maintained. It can be maintained only by improving science and mathematics education at all levels of our educational system, by increasing the number of Ph.D.s available for R&D in defense areas, and by effectively supporting the training of science, mathematics, and engineering instructors at all levels of education. Special financial incentives and continuing education opportunities must not be overlooked or dismissed out of hand.

The time has come for concerted action to restore our nation's mathematics and science educational system to its rightful position of preeminence. Failure to do so means nothing less than jeopardizing national security. ■

Gen. Robert T. Marsh, USAF (Ret.), is former Commander of Air Force Systems Command, Andrews AFB, Md. A graduate of West Point, General Marsh served twenty-four years in various capacities with AFSC and a total of forty-one years in the Air Force before his retirement in 1984. He is currently an aerospace consultant and chairman of AFA's new Science and Technology Committee.

It's not easy to keep aircraft simulators abreast of the operations they simulate.

The Technology Of Training

BY JAMES W. CANAN
SENIOR EDITOR

IN THE Air Force, technology is fast becoming as important to weapons training as it is to the weapons themselves. USAF now thinks of training in terms of full-up systems embodying the latest technologies and is giving industry wider latitude in devising the hardware, the curricula, and the instructional programs for such systems.

The Advanced Tactical Fighter (ATF) program exemplifies USAF's new "systems" approach to training. In the early stages of ATF development, Air Force Systems Command (AFSC) has already begun planning what it calls "the total training system requirements for the ATF."

These requirements include an integrated system of simulators and other computerized devices to train ATF aircrews and support personnel. AFSC wants that system to be ready when the fighter comes into being in the early 1990s and to be capable of training aircrews not only how to fly the ATF but also, for example, how to wage air-to-air and air-to-ground combat, including recognition of targets and delivery of ordnance.

Next year, AFSC will pick an ATF development contractor to write performance-oriented specifications for an ATF training program. It plans to issue a request for proposals (RFP) for the program, based on those specifications, in 1988.

Simulators will play a major role in the ATF training system, and they are expected to be far more comprehensive than those now in use.

Flight simulators for the F-15 and F-16 fighters do a nice job of teaching aircrews how to fly the aircraft. However, they do not include visual systems to simulate combat environments and thus are of limited or no value in training crews to cope with combat situations.

"The Advanced Tactical Fighter," explains an AFSC document, "will be the first Air Force weapon system to address training in a total system concept, integrated with the weapon system design."

Training: The Vital Link

The thrust toward more comprehensive training through the increased use of technology is shared by all the services. Three years ago this month, the Defense Science Board issued a report that crystallized the services' growing misgivings about the sagging state of their training programs.

"Major improvements in training are necessary," the DSB reported. "Technology will contribute significantly to effecting these improvements, thereby enhancing force readiness and productivity."

The DSB document warned that training was falling dangerously far behind the operational requirements and capabilities of new high-tech weapons. The services, it said, "must place much more emphasis on training before the IOCs of future weapon systems if those systems are to perform as designed.

"There is a disconnect," the report continued, "between the skill-performance requirements for operation and maintenance of new weapon systems and the aptitude of the available or projected manpower to meet those requirements. Training provides whatever link there is, but that link is approaching its limits."

The DSB study panel also noted that "the training aspects of systems

development are too often sacrificed first when funds run short. Thus, gaps in readiness grow larger."

Secretary of Defense Caspar W. Weinberger implemented the DSB report with alacrity. He exhorted the services to allocate sharply increased funding for "the development of training technology and the use of this technology to address training problems." He also urged them to muster more four-star attention to the matter.

The Air Force quickly followed through. Its budgetary projections for training hardware are evidence enough.

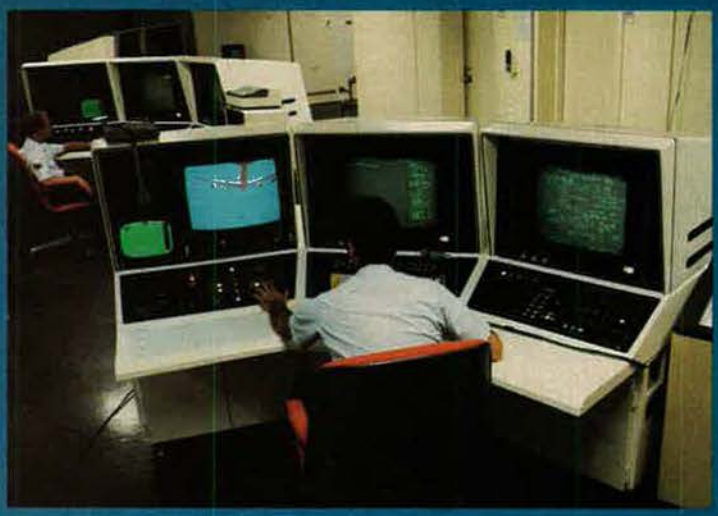
From the current fiscal year through FY '90, the Air Force plans to budget $2.4 billion for procurement of such hardware, mostly in the form of simulators, for aircrew training alone. Over the same period, it has earmarked $591 million for research and development of new aircrew training technologies and systems.

Hardware for maintenance training is expected to account for one-fourth again as much money in USAF's training procurement and R&D budget projections through FY '90. The big bucks tell only part of the story. Maybe even more important at the moment is the top-ranking attention USAF is paying to sprucing up its training technologies.

Early last year, AFSC launched a study of training that involved all USAF major commands. It culminated in a Four-Star BAR (Broad Area Review) at AFSC headquarters at Andrews AFB, Md., involving six four-star generals and twenty other general officers.

"The almost unheard-of scope of

RIGHT: F-16 flight simulator. BELOW: Simulated imagery of a fighter edging up to an aerial refueling boom. Designed and built by the Singer Co.'s Link Flight Simulation Division, both of these systems exemplify the rapidly advancing state of the art in simulator technologies. USAF is now moving toward full-up, technology-intensive training systems.



ABOVE: B-52 Weapon System Trainer instruction stations. BELOW: Simulation of aerial tanker trailing the refueling boom seen on the preceding page. The B-52 WST shows both the flight instructor, foreground, and the offensive systems instructor at separate stations. The B-52 WST virtually duplicates combat missions anticipated for SAC crews by means of its "integrated mission training approach."

that Four-Star BAR shows how important the Air Force considers training and simulation," declares Lt. Col. Eugene Clayton, chief of AFSC's Aircrew Training and Specialized Systems Division. "We all recognize we have to do a better job of training, and I think we've made tremendous strides over the past few years in the way we manage it.

"The biggest stride we've made is in concentrating on the whole training system for a weapon system early in the weapon system's development and [in relying] on industry to define and scope out the training system.

"Embedded in that are all the initiatives the Air Force has taken [on training], as briefed to and approved at the Four-Star BAR."

Getting Started Early

One such initiative is what AFSC

calls "front-end analysis" of training requirements and technologies in the use and support of weapon systems.

In this, as evinced by the ATF program, the Air Force will rely on industry—for example, such companies as Singer, Sperry, Boeing, American Airlines, United Airlines, McDonnell Douglas, General Electric, and many others expert in simulation—to define training systems in consultation with USAF's training, hardware, logistics, and user commands and training experts. Aeronautical Systems Division will serve as overseer.

After USAF chooses contractors to develop and build training systems, it will give them much freer rein than it has in the past. It now understands, officials say, that it has overburdened contractors in the past with military management practices, including excessive milspecs oriented more to engineering minutiae than to performance requirements.

This has been the big reason why simulators have been far too slow to come into play.

The Defense Science Board addressed this problem. "A chronic complaint from the training and user communities alike is that training packages/devices arrive too late for effective use, often months or even years after the weapon system has been fielded," the DSB said.

Consequently, the DSB recommended that the services ease their procurement specs and standards and set forth their training system requirements much earlier in the weapon system development cycle.

There is ample precedent in the Air Force for giving private industry wider latitude in setting up and supervising training systems. American Airlines devised and is running the KC-10A training program for SAC. United Airlines won MAC's C-5B training system contract and will operate the program. Republic Airlines, Western Air Lines, and KLM are also involved in training systems for other MAC aircraft.

Expanding on such precedent, the Air Force is now devising what it calls the "total contract approach" to procurement of training systems for combat aircraft. In this, it may even buy, as part of training packages, "crew members" from industry to instruct its student aircrews.

A trainee practices handling defensive avionics in the B-52 WST's "defensive station." The WST is used to train the bomber's EWO and gunner, who uses its aft-facing ASG tail-defense radar. USAF has big plans for making its fighter-training simulators more comprehensive to train aircrews not only to fly their aircraft but also to wage air-to-air and air-to-ground combat.

This raises a question, however, that Air Force officials concede will take some working out: How and at what levels will the Air Force use civilian instructors from commercial companies to train its aircrews in air-to-air fighters and in air-to-ground attack aircraft?

Tactical Air Command and Air Training Command could become pretty prickly about that.

Part-Task Training

Even as it takes the systems approach to training, the Air Force is being careful not to try to do too much in any one simulator.

"Simulating the whole real world—everything that the aircraft does and that the environment presents to the crew members—gets to be extremely complex," explains AFSC's Colonel Clayton.

This, he says, is a major reason why USAF is now emphasizing the development of "part-task trainers" that individually simulate such singular operations as aerial refueling, air-to-air combat, ILS landings, and air-to-ground weapons delivery.

Given the advanced state of microelectronics and sensor and data-processing technologies, part-task trainers can be sophisticated devices, like the C-5/C-141 aerial refueling trainer, or relatively simple ones, such as a desktop cathode-ray tube embodying video disk technology.

Simplicity will be the key in the Generic Infrared Training System (GIRTS) for which AFSC is now developing specifications.

The GIRTS program sprang from an in-depth USAF review of training requirements across the widening spectrum of infrared and electro-optical weapons and from its Four-Star BAR of training programs in general.

GIRTS tackles the highly complex problem of simulating combat-aircraft infrared imagery systems in an operational environment. It is being developed to train aircrews in target recognition for weapon systems employing IR guidance, including the IIR Maverick missile and the GBU-15 IR bomb variant. It also will come into play in training crews to use the Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) system.

As part of GIRTS, a GBU-15 part-task trainer is being planned as a desktop device that will simulate the delivery of the weapon from the moment of release until impact.

This device will support training of F-4 and F-111 aircrews in delivering the GBU-15. GBU-15 training for F-15E dual-role fighter crews will be incorporated in the existing F-15E simulator system, however. It already incorporates LANTIRN image-generation hardware that ties in with simulated F-15E delivery of the GBU-15.

The Air Force still has to get down to specifics on how best to allocate simulators and other de-

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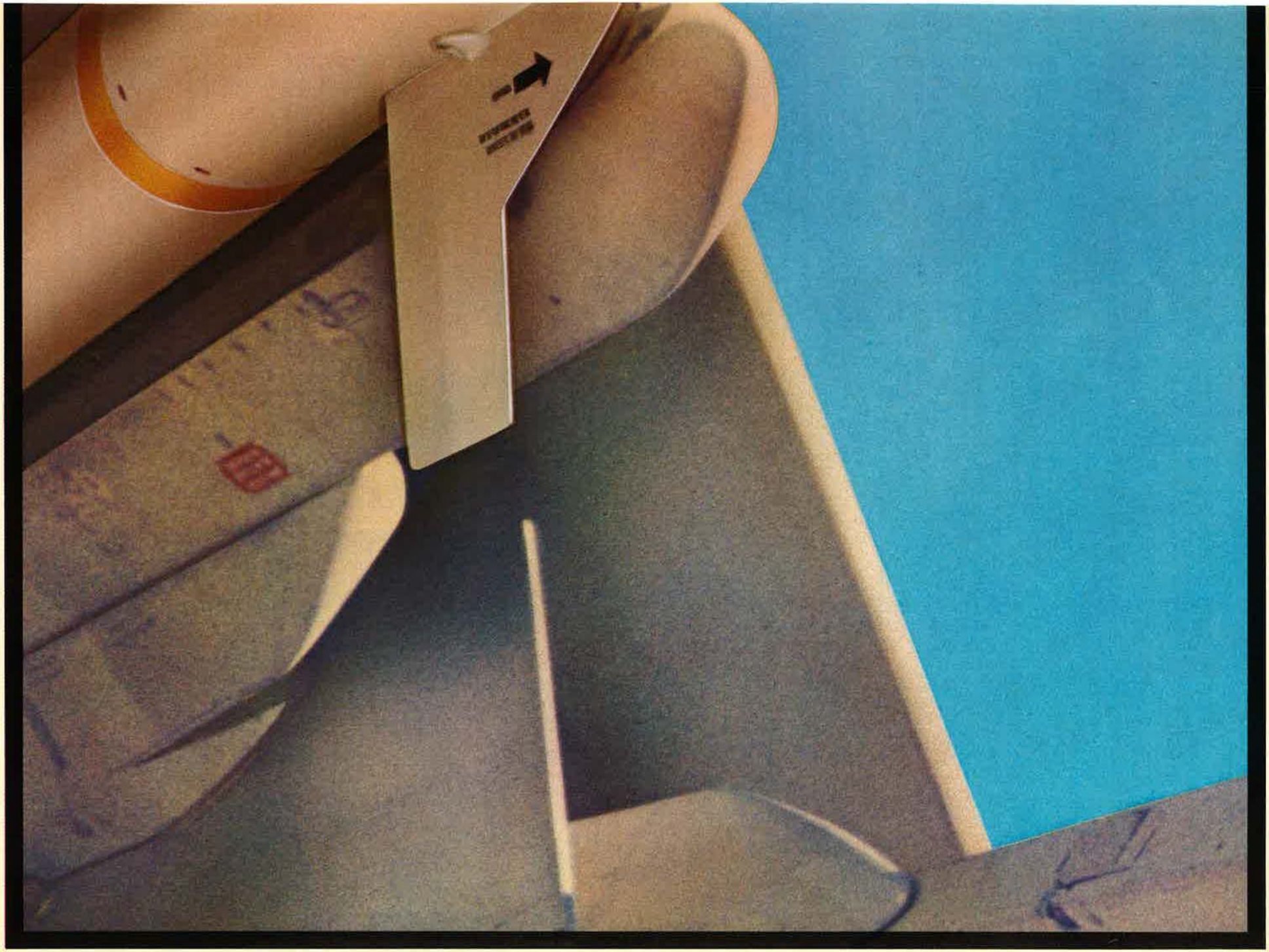

vices to particular training tasks. It is currently working up a formal "hierarchy of devices" as its basis for deciding "how to transfer training among various devices," Colonel Clayton explains.

It will be helped in this by the Training Effectiveness Plan that AFSC's Human Resources Laboratory recently prepared. That plan is aimed at "telling us what we really need in order to do the training, how effective that training is, and giving us some milestones," Colonel Clayton says.

Keeping Training Current

Assigning various training functions to part-task trainers within simulation systems is expected to go a long way toward solving the increasingly difficult problem of keeping aircraft simulators abreast of changes in the operational aircraft they simulate.

This problem is inevitable because of USAF's practice of getting the most out of existing fighters, for example, by updating their avionics in accordance with advances in the technologies of their sensors, computers, and cockpit displays.

Take the F-16. Its operational simulator, built by Singer, is a dandy. It consists of several very complex subsystems, such as a radar simulator by GE and an electronic warfare simulator by AAI. The government acted as the integrating contractor.

As the F-16 has evolved from A and B variants to C and D variants, the F-16 simulator, too, has required corresponding modernization.

The more complex and comprehensive a simulator, the harder it is to change its hardware and software to make it replicate the aircraft. This is why the Air Force is about a year behind in bringing the complex F-16 simulator up to speed with the latest variants of the F-16 and why fledgling F-16 crews are currently "flying" simulators of outdated configuration.

The problem would have been easier to handle had some of the F-16 simulator's functions been built into separate, part-task simulators, each more manageable in modernization than the whole, or if all of the subsystems had been designed under an integrated systems contract.

Air Force officials also claim that some aircraft simulators are more sophisticated (having nothing to do with the modernity of their technologies) than they need to be. For example, they embody many more "malfunctions" than pilots could possibly cope with in real-world flying and thus go beyond the utilitarian to the fanciful.

In this vein, the Air Force wants new technologies to do for its simulators exactly what it wants them to do for its operational aircraft—to provide superb, but not superfluous, performance and to keep the systems as simple as possible to manage and maintain.

A USAF air controller works with GTE's System Trainer & Exercise Module (STEM), which duplicates actual air traffic conditions, including a radar display of up to 200 aircraft, pilot communications, and weather and terrain information. Using real aircraft to duplicate STEM's simulated workouts for controllers would entail prohibitive flying hours and costs. STEM training has a real-life feel.

Replacing the Real Thing?

Meeting these standards will be difficult as simulators move into such technologically uncharted areas as imagery of multiple moving air and ground targets, weapons delivery and effects, damage assessment, and such environmental effects as smoke.

No one doubts, however, that the technologies are at hand for the simulator industry to pull it off.

That industry has made tremendous gains since military aircraft simulators really began coming into vogue in the mid-1970s. It was then that ASD created its simulator system program office (SPO) at Wright-Patterson AFB, Ohio, to oversee the work on a spate of new or emerging simulator programs for such aircraft as the B-52, the F-15, the F-16, the A-10, and the EF-111.

In keeping with USAF's activity, simulators took hold harder in the aerospace and electronics industries as well, and the spectrum of companies getting involved in simulators and in other high-tech training devices has been widening ever since.

Consequently, both the Air Force and industry now appear to have enough experience with simulators and their advancing technologies to make the next generation of simulators do the jobs that the Air Force is now demanding in its new training-systems approach.

Despite their high hopes for new training systems centered on simulators, Air Force leaders are careful to draw the line between the imagined and the real. They remain wary of taking simulation too far. In fact, USAF's leadership recently restated and reemphasized its position that simulators can complement flying time, but they can never replace it.

Protecting that position against the assaults of defense budget-cutters may take some doing if costs per flying hour continue to go up and simulator training systems of the sorts now envisioned really catch on. ■

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There is substantial progress on new armaments, ranging from AMRAAM to weapons for airfield attack.

The Steady Evolution In Armaments

BY EDGAR ULSAMER
SENIOR EDITOR (POLICY & TECHNOLOGY)

"OUR JOB is to give the Air Force more standoff, better accuracy, and broader options for the autonomous delivery of weapons against multiple targets." This is how Maj. Gen. Gordon E. Fornell, the dynamic new Commander of AFSC's Armament Division at Eglin AFB, Fla., encapsulates the task assigned to his command.

The Armament Division (AD) is Air Force Systems Command's newest "product division," founded six years ago and responsible for the development, test, and acquisition of the weapons, munitions, submunitions, sensors, and other devices known collectively as "armament." In short, the Division is in business to maximize the "bang" that the Air Force—and to some extent other services and US allies—can deliver under conventional warfare conditions against targets in the air, on the ground, and at sea.

AD's business is booming, and its product line is expanding. The Division's FY '86 budget is about $2.8 billion. Next year, General Fornell points out, that figure is slated to reach $3.5 billion. The Division's technology projects range from electromagnetic rail guns for future gunships and the Strategic Defense Initiative (SDI) program to autonomously guided weapons that, in concert with tomorrow's "stealthy" platforms, could bring a new dimension to conventional warfare.

The armament field has been in a state of steady evolution since the advent of the first "smart bombs" during the Vietnam War, and it is now transitioning to

This F-16 Fighting Falcon sports four AIM-120 AMRAAMs and two AIM-9 Sidewinders. AMRAAM features launch-and-leave capability, multiple targeting, and superior maneuverability.

what is called "brilliant" or, put less hyperbolically, "literate" weapons. Driving this evolution are several fundamental factors. Of overarching importance is the change in the threat—especially in the target base—in the form of greater hardness, more mobility, and more lethal defenses, both in the air and on the ground. Since it is the Air Force's task to carry the fight to the enemy, the central answer to this challenge is to enhance the productivity and survivability of the force through greater standoff, multiple kill capability, and "automation" of air warfare. The technological catalyst behind the change in the armament field is the cornucopia of new electronic sensors and devices that filter, process, and compute information on the spot, that are increasingly compact and robust, and that keep coming down in price and size while multiplying capability and capacity.

The operational payoffs are multiple kills per pass, the ability of one aircraft to engage a number of enemy fighters at the same time and possibly from a safe distance, and the knack of supersmart armament to function autonomously under night and adverse weather conditions. Also, some advanced technology armament can be launched or released before the weapon or its controller has selected any specific target because of the ability to recognize and home in on predetermined locations or types of targets. Ancillary benefits range from midcourse guidance, which can make up for intrinsic limits of sensors by coupling them to on-board computers, to increased resistance to electronic countermeasures. The latter results from the autonomy of these new weapons, which reduces or eliminates the need to communicate with them as they perform their mission.

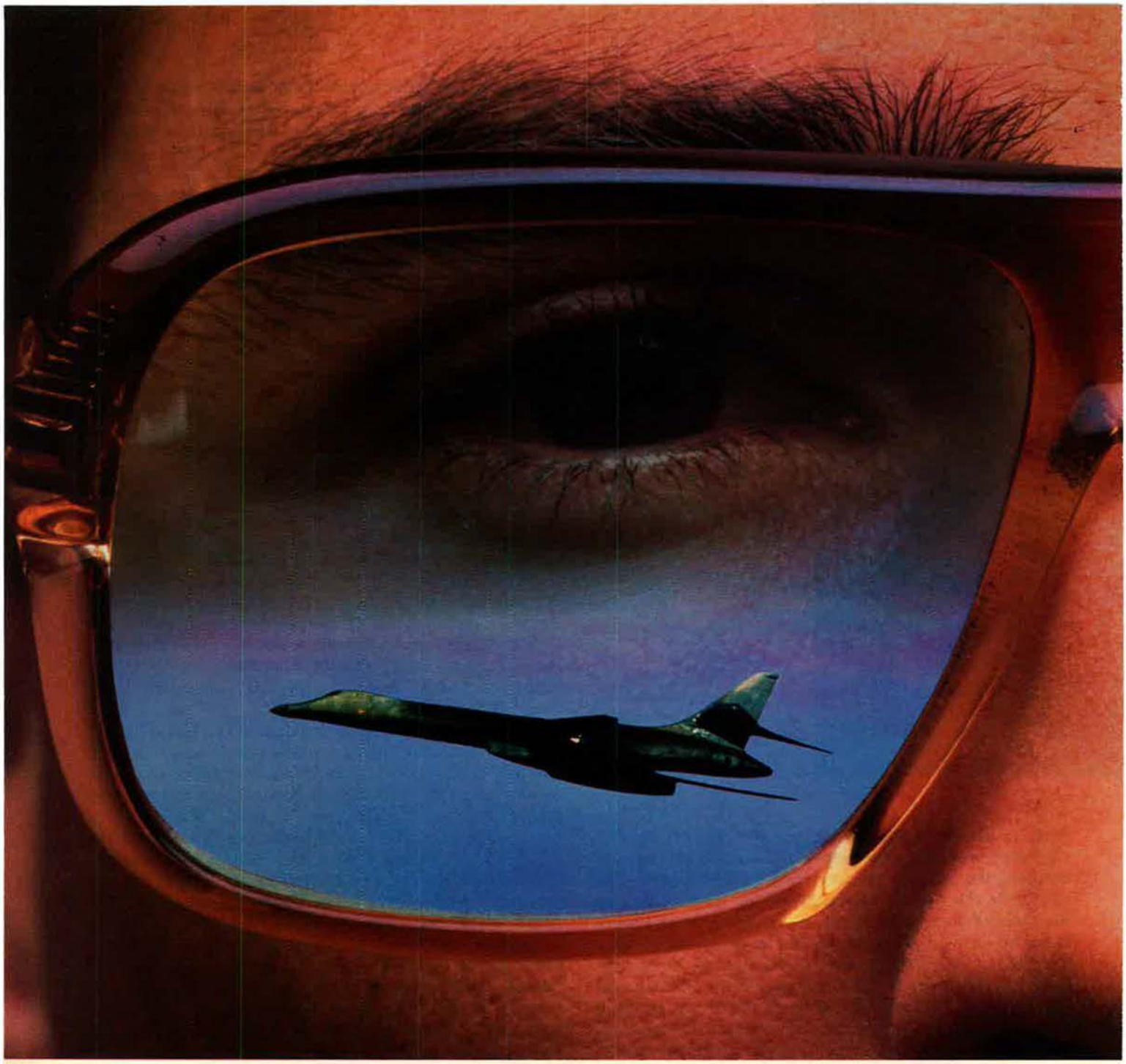
AMRAAM Off and Running

After a twenty-year hiatus, the Air Force is back in the air-to-air missile business. The Advanced Medium-Range Air-to-Air Missile (AMRAAM) is needed "beyond any doubt" by the US and major allies because of its potential as a "force multiplier" in the air-superiority arena, General Fornell points out.

While he concedes that contractor performance on the AMRAAM program initially "was mixed," General Fornell asserts emphatically that, in a hardware sense, the program is "back on track to the extent that the missile does what we said it would do—that is, provide our fighters with a launch-and-leave as well as a multiple kill capability" that they lack at this time. While the original cost and schedule estimates turned out to be "overextended," the Air Force's confidence in the program is now such that "we recommended to the Secretary of Defense that he place a cost cap on the program similar to the one we committed to in the case of the B-1B program," the AD Commander emphasizes. That proposal, presented to the Defense Systems Acquisition Review Council (DSARC) principals last August, caps the production costs of some 24,000 missiles (17,000 for the Air Force and 7,000 for the Navy) at $7 billion expressed in FY '84 dollars (or $10.5 billion in "then-year" dollars).

AMRAAM, officially designated AIM-120A, is an all-weather, all-environment, radar-guided, air-to-air missile that is being developed by the Air Force in a joint service program with the US Navy. It is a follow-on to and replacement for the AIM-7 Sparrow. AMRAAM is to be compatible with the Air Force's F-15 and F-16, the US Navy's F-14 and F/A-18, the German F-4, and the British Tornado and Sea Harrier aircraft. AMRAAM's program director, Brig. Gen. Thomas R. Ferguson, Jr., is confident that "we are out of the woods" on the program even though its cost is going to be about two times the level forecast by the Air Force at the 1979 DSARC and the weapon won't reach the operational inventory until 1989 rather than next year. But, as he points out, "we updated our forecasts in the initial Selected Acquisition Review (SAR) in 1982 and have never hidden [either cost growth or schedule slippage]. Congress appropriated [AMRAAM production] funding following these reported and announced increases in cost forecasts." Since this initial SAR, cost growth has been modest, about ten percent.

A recent comprehensive Pentagon review of the AMRAAM program concluded that there are no cost-effective substitutes for AMRAAM. Also, the government and the two contractors have already invested almost $1 billion in the program. The Air Force plans to award the advanced buy for Low Rate Initial Production (LRIP) next year. Continued congressional funding of the program is, however, in question. Yet, as General Ferguson points out, "to abandon the program at a time when the technical problems appear to be in hand and when the cost forecasts are running reasonably close to what we said in 1982 and 1983 would not seem to be wise." The program entered its "validation phase" in



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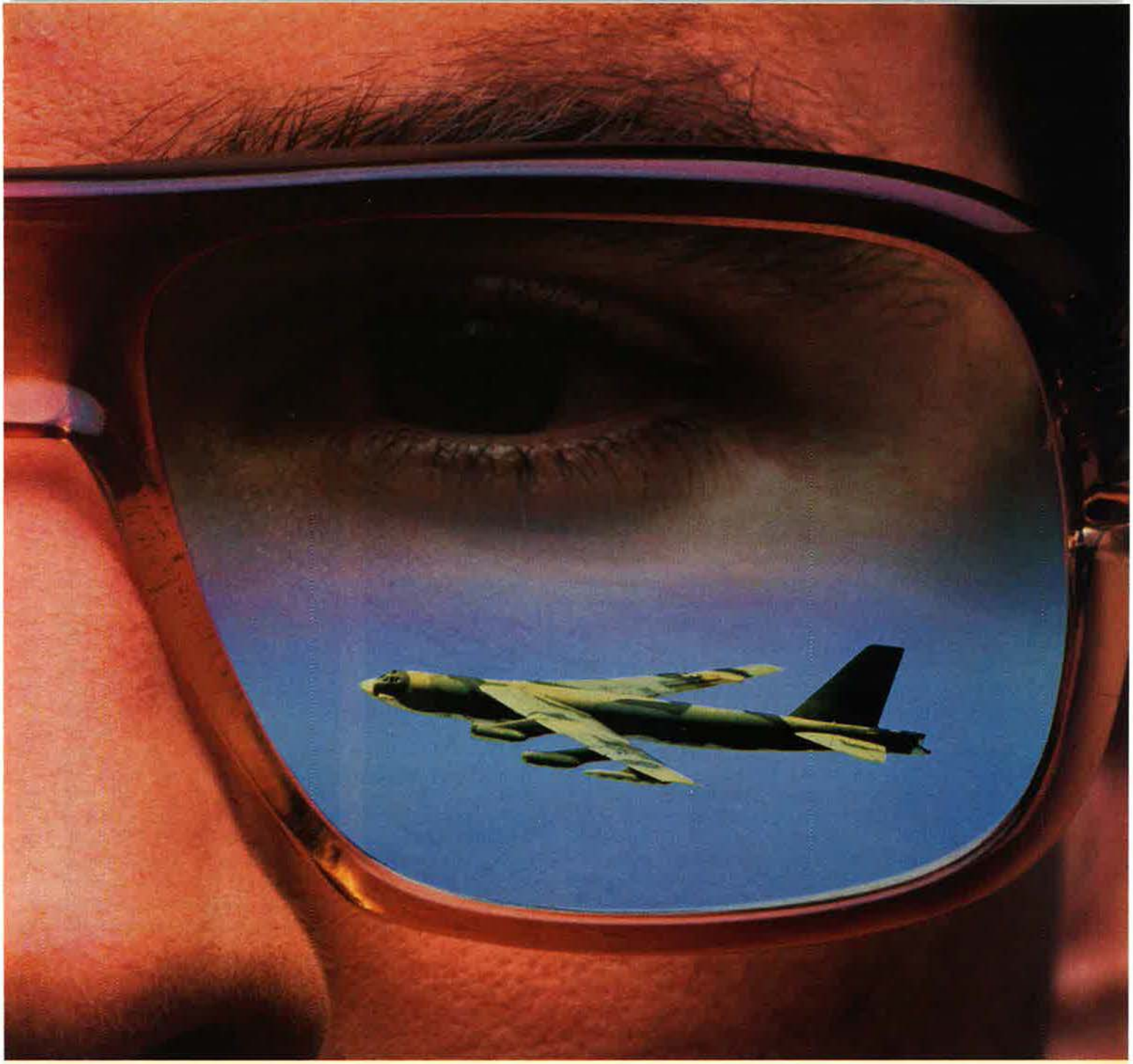

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February 1979 when the Air Force picked Hughes Aircraft Co. and Raytheon Co. to build prototypes of the missile on a competitive basis over a thirty-three-month period.

By December 1981, both contractors had demonstrated that their flight-test missiles could meet all joint service requirements, and the Air Force subsequently selected Hughes Aircraft's Missile Systems Group as the contractor to continue into the program's full-scale development phase. During that phase—currently scheduled to run for seventy-five months—Hughes Aircraft Co. is to complete missile development and to plan for a cost-effective, smooth transition into production. During this full-scale development phase, Hughes is to produce a total of 122 "development" missiles, the last of which is scheduled to be delivered by March 1988. Of these missiles, ninety-one are earmarked for guided flight testing at Eglin AFB, Fla., Holloman AFB, N. M., and the Pacific Missile Test Center at Point Mugu, Calif. The contract with Hughes contained prepriced options for 924 operational missiles and future options for developing second-source or follow-on missiles.

The Air Force, for a variety of reasons, decided in 1979 that the AMRAAM development and acquisition strategy should be based on an innovative "leader-follower" contractual arrangement. As a result, the Air Force awarded Raytheon a "follower" contractor in July 1982, seven months after signing a "leader" contract with Hughes. This leader-follower arrangement, General Ferguson emphasized, results in one uniform missile that can be procured from two contractors with possibly significantly different vendor bases, but not two "different missiles." The contractual stipulations, therefore, are for Raytheon only to "track" Hughes's engineering program during FSD but not to build any developmental missiles in parallel: "The idea is to let the leader develop the missile and then to bring the follower aboard." Hughes, he added, "deserves kudos" for making available to Raytheon its engineering data on the AMRAAM development missiles.

Five of the 122 development missiles will be turned over to Raytheon in accordance with the provisions of the leader-follower agreement, he said. Raytheon, he added, is now emerging from the state of a "paper engineering organization" with regard to AMRAAM and is about to start building actual missiles. The "follower" contractor will build an initial batch of fifteen missiles as part of his qualification phase. Following Raytheon's qualification, the two companies will split production during the LRIP phase, with Hughes slated to manufacture 599 and Raytheon 494 missiles during a two-year period.

The initial operational capability (IOC) of the missile is to be attained in the second quarter of 1989. While the first two lots bought during the low rate initial production phase involve "directed splits" between the leader and follower contractors, subsequent production contracts will be awarded on a competitive basis, according to General Ferguson. As recommended by the Pentagon's blue-ribbon panel that reviewed the AMRAAM program earlier this year, the Air Force plans to expand "producibility enhancement" efforts associated with the AMRAAM program in order to drive down future costs of the missile.

The current cost forecasts underlying the proposed $7 billion (1984 dollars) cap—predicated on the acquisition of 17,000 missiles by the Air Force and 7,000 by the Navy—show that the increases since the FY '85 budget submission amounted to about 10.4 percent in "then-year dollars," or a boost from $442,000 to $488,000 per missile. These costs are averages calculated on the basis of the program's total development and production cost; average missile production costs in terms of constant 1984 dollars showed a modest increase over the same period, from $274,000 to $288,000, General Ferguson pointed out.

The cost of the full-scale development phase of AMRAAM remains at $556 million, meaning that Hughes—not the government—will have to absorb cost and schedule "variances" amounting to about $200 million, according to Brig. Gen. Robert D. Eaglet, AD's Deputy Commander for Research, Development, and Acquisition. He suggested to this writer that quality-control problems encountered in the past by Hughes on such programs as Maverick, Phoenix, and TOW have not affected AMRAAM: "We are going to benefit from" the lessons learned on these earlier programs.

One contingency that could conceivably derail the Air Force's cost forecast and proposed AMRAAM cap, General Fornell conceded, would be a reduction in or cancellation of the US Navy's scheduled acquisition of 7,000 missiles. But he dismissed such a possibility as highly unlikely: "The Navy has made its commitment, and, with the early, formidable successes in our flight-test program, I think we are all back in harness now."

The AD Commander said that all factors surrounding contracts, manufacturing capability, and plant management have been looked at in "excruciating detail." He pointed out with visible exasperation that the number of official visitors inspecting the Hughes AMRAAM facilities has swelled to a high of 733 a month: "We have been looked at under a microscope, and I hope that all these inspections will be completed in good stead so that we can let the contractor perform in the way we expect him to."

AMRAAM's Bright Test Record

On September 17, 1985, an AMRAAM missile without a warhead scored a direct hit on a QF-100 drone over the White Sands Missile Range, N. M., after being fired from an F-16 that was flying at Mach 1.2 at 20,000 feet above sea level under the control of a member of the Armament Division's 3246th Test Wing. The drone was traveling at transonic speed (Mach 0.95) and closing in on a head-on approach to the launching aircraft. AMRAAM's bull's-eye was the third successful guided test launch in a row for the developmental missile. The first launch of the missile against an actual target also involved an F-16 and occurred in May of this year. The second launch involved an F-15 and took place in August 1985.

The most recent launch demonstrated the weapon's "command inertial feature" and its data link. The missile involved was of the "Stage II" type, the first to incorporate a data link. (AMRAAM's full-scale development program calls for a progression through five stages, following an order of ascending technological sophistication.) The second missile fired was a look-down/

shoot-down shot with the launch range at about eighty percent of AMRAAM's maximum range. The exact range capabilities of the missile are classified, but are known to be less than those of the US Navy's Phoenix missile system.

The next step in the development of AMRAAM, according to General Ferguson, involves the systematic addition and testing of various features, including electronic counter-countermeasures (ECCM). The culmination of these efforts will be an air-to-air weapon that, when linked to the launching aircraft's "track-while-scan" radar, can engage up to eight targets in near real time. The 335-pound missiles can be launched in salvos against clusters of targets, even when the launching aircraft's radar can't resolve individual targets. The missiles will selectively find their own targets. Individual missiles won't duplicate targets within a cluster because of a "smart logic" feature, according to General Ferguson. Also, the missile can be "command internal guided." The missile's guidance system uses target coordinates provided at launch by the avionics of the aircraft and can be updated by data links in the case of maneuvering targets. In the terminal phase of flight, the missile's active radar seeker takes over and guides the weapon against its target. When launched within the missile's radar range, the AIM-120's "launch-and-leave" feature permits the pilot to break away immediately after launch to go after additional targets.

AMRAAM packs significantly higher performance into an airframe that is only two-thirds the weight of the AIM-7 Sparrow and, at the same time, minimizes life-cycle costs through greater reliability and maintainability. As a goal, the first versions of AMRAAM can on average be kept in "ready storage" for 60,000 hours and in "captive carry" aboard aircraft for 600 hours before maintenance is required.

AMRAAM can handle any launch aspect, and its maneuverability exceeds that of any potential target. It thus differs markedly from the US Navy's longer-range Phoenix missile, which is meant to go over long distances after such targets as Soviet Backfire bombers without the need to engage in "dogfights." Another plus that accrues to AMRAAM when compared to older designs is that its low-smoke, high-impulse rocket motor makes it next to impossible for target aircraft to notice either its launch or approach. This virtually precludes evasive action. A potentially significant virtue of AMRAAM, or any active radar air-to-air missile, is its ability to ferret out cruise missiles or other "low observable targets." If other sensors were to make it possible to cue AMRAAM into the general target area and thus bring a low observable target into its field of view, then the missile would be likely to find such a target.

An F-4 Phantom II from Eglin AFB's Armament Division in flight tests with Gator munitions dispensers over Florida's Gulf coast. Gator is the first air-delivered scatterable mine system in the USAF inventory and can be released from a variety of aircraft.

From the outset of the AMRAAM program, there existed a mutual understanding that this system would be made available to other NATO nations. The European NATO members, in turn, allowed for US participation in their Advanced Short-Range Air-to-Air Missile (ASRAAM) program. Germany's Bodenseewerk Geraetetechnik GmbH and British Aerospace are the joint lead elements of a European industry consortium developing ASRAAM, a potential follow-on to the US Sidewinder air-to-air missile. In August 1980, the defense ministries of Germany and England and the US Defense Department signed a Memorandum of Understanding (MOU) for the development and production of air-to-air missiles in line with NATO's "family-of-weapons" policy. The bottom line of this joint approach is to provide improved air-to-air missiles and armaments within the European theater, enhance interoperability among aircraft of various member nations, and substantially reduce procurement costs on both sides of the Atlantic.

The nature of European industry participation in the AMRAAM program, General Ferguson pointed out, is not yet clear. A consortium of European companies is probing various forms of participation in the AMRAAM program. It does not appear likely that the consortium will come up with any specific recommendations before 1987. The European NATO members will start to acquire the missile in 1989 or 1990. It is likely, however, that NATO will start out by buying initial quantities of AMRAAM on a Foreign Military Sales (FMS) basis and eventually phase in missiles produced by a European

industry consortium. Tentative estimates suggest that the European NATO members might acquire up to 8,000 AMRAAMs. This quantity would be in addition to the 24,000-plus missiles required by the US.

Over the longer term, a number of AMRAAM applications beyond air superiority and CONUS air defense suggest themselves, even though none is being worked formally by the Air Force as yet. Included is self-defense of such aircraft as the B-1, the Advanced Technology, or "Stealth," Bomber (ATB), the E-3A AWACS, and the future Joint Surveillance and Target Attack Radar System (JSTARS). In addition, it is probable that the Navy will eventually deploy AMRAAM in a ship-to-air mode in the same way as it plans to use a tail-controlled version of Sparrow.

Lastly, as part of the Air Force's Advanced Tactical Fighter program, concepts for internal carriage of AMRAAM are being looked at. The focus here is on "compressed carriage." Some approaches to ATF rule out carriage of external stores that would "dirty up" the signature of the aircraft. AMRAAM program people are working with the ATF System Program Office to evolve an AMRAAM variant that could be "compressed" and carried internally in a weapons bay. A basic requirement for packing a maximum number of missiles into a volume-limited weapons bay is to modify the weapon's control surfaces. Also, ATF might require release of the missile at high dynamic pressures and under maneuver conditions involving high "G" loading. Candidate launch mechanisms include rotary launchers patterned after those developed for the B-1 as well as an extended ejector foot that goes out into the launching aircraft's slipstream.

The Soviets, so far, don't seem to have an AMRAAM equivalent in full-scale development. If they were to field an active radar air-to-air missile, the need for AMRAAM would "become even more pronounced than it already is," General Ferguson suggested.

The Current Crop of Munitions

Almost any NATO/Warsaw Pact scenario is dominated by two fundamental conditions: a "target-rich" environment—consisting mainly of the Pact's concentrated armor—and an unprecedented massing of air defenses designed to thwart NATO's airpower. A number of munitions and submunitions fielded or under development by the Armament Division capitalize on this set of conditions.

One of the most ingenious munitions for raising havoc in the Warsaw Pact's second echelon or for employment against massed hostile forces anywhere is the Combined Effects Munition (CBU-87/B, or CEM for short). The 950-pound free-fall cluster weapon consists of a tactical munitions dispenser—essentially a canister equipped with a tail that causes it to spin up on release—loaded with 202 BLU-97/B submunitions. Three kill mechanisms are built into these "bomblets": a shaped charge to kill armor, the incendiary chemical zirconium to start fires, and a fragmenting warhead that performs an antipersonnel role. The munition can be released by aircraft traveling at speeds ranging from 200 to 700 knots at altitudes between 200 and 40,000 feet.

The spinning canister is blown open by a shaped charge when a special fuze tells it to. Usually the preferred altitude for the release of the bomblets is around 200 feet above ground. The bomblets, oriented downward by a ballute (a cross between a balloon and a parachute) to increase their effectiveness against armor, then rain down on the battlefield. CEM can be set for various "seeding" patterns by regulating the dispenser spin and submunition dispersion. One weapon can seed an area the size of several football fields. Individual tactical aircraft can carry up to eight tactical munitions dispensers, each of which contains 202 submunitions.

Field delivery of the Combined Effects Munition is expected to start in February 1986 and continue well into the 1990s. More than 50,000 CEMs might be acquired over the life of the program. Acquisition of the weapon is based on firm fixed-price "leader-follower" contracts. Aerojet Ordnance Co. is the lead prime and Honeywell Inc. the second-source prime.

The Gator mine system (CBU-89/B) is the first air-delivered scatterable munition of this type in the Air Force inventory. This small, surface-emplaced antiarmor/antipersonnel munition is suitable for air support of ground forces in combat and for deployment by tactical air forces operating independently over enemy territory. Carried by the Air Force's standard tactical munitions dispenser (but without the spin feature used by CEM), seventy-two antiarmor and twenty-two antipersonnel Gator mines are intermixed to create instant minefields to disrupt, demoralize, and destroy enemy forces passing through them. The lethal Gator mine is triggered in a number of ways. It will go off if its magnetic field is disturbed by approaching vehicles, if it is shaken or picked up, or if its nearly invisible four trip wires are touched. Major contractors involved in the Gator program, which is about to enter its production phase, are Honeywell, Motorola, Aerojet, Lockheed, and RCA, among others.

Target vehicles and aircraft feel the brunt of a Combined Effects Munition (CEM). Each CBU-87/B carries 202 bomblets for incendiary, antiarmor, or antipersonnel use. Field delivery of CEMs is expected in early 1986.

Considerable high-tech wizardry goes into the Sensor Fuzed Weapon (SFW, or CBU-97/B), a cluster bomb unit that also uses the nonspinning tactical munitions dispenser. Each 1,000-pound unit consists of ten submunitions and can be released at speeds ranging from 200 to 700 knots at altitudes from 200 to 40,000 feet. The

weapon is compatible with all tactical combat aircraft in USAF's inventory and is under consideration for preliminary tests on B-52 bombers.

The weapon, which just completed an eighteen-month "risk-reduction" phase and is about to enter full-scale development, involves a complex but reliable employment sequence. Following release—usually from low-flying aircraft—the dispenser disperses the ten submunitions at a predetermined altitude. Each submunition deploys its pilot and main chutes in sequence to achieve a vertical attitude. The chutes are then jettisoned, and the BLU-108/B submunitions stretch out four arms with a "Skeet" warhead on each arm. On the edge of each Skeet is an infrared seeker that looks for targets within its range. When the submunition with four Skeet at the ready reaches its functional altitude as determined by its own altimeter, it actuates a small rocket motor that causes the device to spin at a high rate. The centrifugal force of the spin catapults the four Skeet

warheads in different directions over distances in excess of 300 feet. Each Skeet, in turn, "nutates," or spins in Frisbee-like fashion, and thereby maps out an oval ground track.

Once it detects an armored vehicle or other target within its lethal range, it drives a self-forging projectile at enormous velocity through the top of the target all the way into the ground. Self-forging fragments are in effect high-energy slugs that, unlike shaped charge penetrators, don't require physical contact with the target for detonation and that are effective over greater distances. This technology is a spinoff from the elaborate computer analyses required to probe the kinetic and other processes that occur inside a detonating nuclear warhead. An exploding self-forging warhead releases concentrated energy in a precise, precalculated manner. This process, in turn, causes the warhead's copper liner—a concave disk—to forge itself at great velocity into solid slugs. These slugs attain speeds faster than a rifle bullet. The combined speed and mass of these slugs is sufficient for them to tear through heavy armor. The lethal range of the individual Skeet is classified.

Current Air Force plans call for SFW to enter the operational inventory in limited quantity in June 1990, with full-scale production to begin in December 1990. More than 10,000 weapons are to be acquired by FY '93, according to General Eaglet. AVCO is the major contractor for the Sensor Fuzed Weapon. During the risk-reduction phase, SFW's fixed-price incentive fee (FPIF) contract was capped at a price ceiling that AVCO overran by a marginal amount. The contractor will have to cover this deficit of about $2 million, he pointed out.

From Thanh Hoa to Paveway III

After flying 871 sorties and losing eleven aircraft in a vain effort to take out the strategically important Thanh Hoa bridge during the Vietnam War, the Air Force came up with the Paveway I "smart" bomb that accomplished the job in four sorties and with no loss of aircraft. AD is working full tilt on Paveway III, alternatively known as GBU-24 or Low-Level Laser-Guided Bomb (LLLGB), a versatile third-generation smart bomb that can be delivered below and outside the range of most defenses. Paveway III is tailored to the high threat conditions typical of Central Europe and can be delivered in one of three modes: level, loft, and dive.

LLLGB adapts automatically to a specific release mode and requires only a limited designation time. Targets can be designated either by the launching aircraft or by an external designator aboard another aircraft or on the ground. The munition can be set to match individual designator codes. This trait makes it possible to attack a number of targets simultaneously.

While Paveway III is designed for use with either a 500-pound or a 2,000-pound warhead, only the latter version, designated the GBU-24, is scheduled for production. Paveway III has no electrical interface with the carrier. It can be deployed on any aircraft with standard general-purpose bomb racks. It is compatible with a number of designators, including Pave Tack, Pave Spike, the ground laser locator designator (GLLD), and LANTIRN, the Low-Altitude Navigation and Targeting Infrared for Night system.

The GBU-24's four-quadrant laser detector picks up reflected laser energy from illuminated targets, which is then converted by the bomb's guidance electronics into line-of-sight error information. In turn, these signals are used to direct the munition to the target by means of proportional guidance. As General Eaglet pointed out, proportional guidance is a giant step up from the so-called "bang-bang" guidance used in present-generation smart munitions. Bang-bang control systems are confined to hard-over right or hard-over left course corrections. Proportional control guidance is far more accurate than the bang-bang approach. The difference between the two systems, General Eaglet explained, is that with a Paveway II, "I can maybe hit a building, but with a Paveway III, I can hit a general's jeep." The range of Paveway III is classified, but is in excess of three miles, even in case of weapon release at very low altitudes.

The Air Force plans to acquire about 5,000 GBU-24s, starting next year. Texas Instruments is the GBU-24 program's prime contractor.

The GBU-15 Family of Weapons

Like Paveway, the genesis of the various variants of the GBU-15 guided glide bombs that fly to their targets

Maj. Gen. Gordon E. Fornell took over as Commander of AFSC's Armament Division in July 1985. The Division develops, tests, and acquires conventional armaments for the Air Force. A former test pilot, General Fornell has flown forty different types of aircraft during his twenty-seven-year career.

with the help of various guidance updates goes back to the Vietnam War. These munitions—built around the same Mk 84 2,000-pound bomb used by Paveway III—differ from the latter in that they don't home in on targets illuminated by a laser or other designator; rather, they have either a TV camera or an imaging infrared sensor at the front of the weapon and a data-link transmitter in the back. The cockpit display shows what the glide bomb's camera sees, and the F-111 or F-4 backseater can use his "controller" to "fly" the weapon with great accuracy. The TV-guided variant of the GBU-15 entered production in 1983, while the imaging infrared (IIR) version is scheduled for deployment in the field next year. The two guidance units are interchangeable.

The advantage of the IIR guidance module, which is patterned on that of the IIR Maverick, is that it works at night. Total R&D investment to date in both GBU-15 variants is less than $200 million. Average flyaway cost of the cruciform wing weapon with TV guidance is $128,000 in then-year dollars. The comparable figure for the IIR version is expected to be about $182,000. The GBU-15 can be released at supersonic speed at altitudes ranging from 2,000 to 30,000 feet. The range of the weapon is classified, but known to exceed the original performance specifications. The GBU-15 buy is pegged at more than 3,000 units. Rockwell is prime contractor; Hughes provides the IIR seeker and data link.

By hanging a rocket motor at the bottom of either a GBU-15 or a modified version of the 2,000-pound SUU-54 dispenser, the Armament Division created two new and highly efficient armament systems, the AGM-130A and AGM-130B. The powered, unitary (one Mk 84 bomb) version of the GBU-15 has roughly three times the range of the unpowered weapon when launched at low altitude. The "B" version's dispenser can be filled with such submunitions as boosted kinetic energy penetrators (BKEPs) and British-made HB-876 mines to provide a standoff runway attack capability. Each AGM-130B can carry fifteen BKEPs and sixty HB-876 mines. Use of these antipersonnel mines in combination with the runway-busting BKEPs deters runway repair in a major way. Rockwell is the prime contractor for both variants of this air-to-ground munition. The Air Force plans to acquire more than 2,000 of the "A" variant, but has not yet determined the numeric requirements for the AGM-130B.

Airfield Attack Weapons

Specialized munitions that can close down an enemy's airfields by cratering runways or damaging other essential facilities are one of the Armament Division's top priority jobs. In case of a NATO/Warsaw Pact conflict, some fifty major Pact airfields would have to be closed to suppress the Soviet bloc's counterair and air-to-ground forces. While findings from US analyses of the number of bombs required to close down hostile airfields are classified, there is no reticence on the part of the Pentagon in acknowledging that this country lacks the number of aircraft needed to do the job with only "dumb" bombs. This would be true under even ideal conditions, when both the weather and the absence of effective enemy air defenses would allow the friendly forces to come in high and dive on the target. If the attacks have to be flown in shallow patterns—a far more likely circumstance in the European theater—then, as General Eaglet put it, "the numbers go off the chart in terms of Mk 82 bomb drops."

Lacking an immediately available US munition tailored for runway closure, the Armament Division—under the Pentagon's foreign weapons evaluation program—started to look at the French Matra Durandal rocket-assisted runway-cratering munition. After painstaking evaluation and test, the Air Force decided two years ago to acquire some 5,000 of these munitions for use by F-111 aircraft in the European theater. The weapon is designed for low-altitude, high-speed direct attack. The impact speed of the weapon, which can crack runways up to a foot thick, is in excess of 750 feet per second, and it is effective at angles of attack down to the forty-degree range. Unit cost is slightly below $30,000.

Closely behind Durandal in a chronological sense is the Direct Airfield Attack Combined Munition

(DAACM). The weapon uses AD's standard tactical munitions dispenser loaded with eight BKEPs in the front section and twenty-four HB-876 aerial denial mines in the back section. DAACM's key component is BKEP (BLU-106/B). Although smaller and lighter than Durandal, BKEP's higher impact speed—up to 1,200 feet per second—and larger envelope give it greater effectiveness. BKEP is being developed by AVCO.

Designed for release in low-level horizontal flight by a variety of combat aircraft and, eventually, unmanned platforms, this submunition deploys fins to stabilize itself and then a parachute to retard its descent and to position itself sixty-five degrees off horizontal. At a preset moment, the BLU-107/B's rocket motor ignites to accelerate the weapon to an impact speed of up to 1,200 feet per second. The bomb detonates about six milliseconds after impact, and even though its warhead is significantly smaller than that of Durandal, the US design causes slightly more damage.

DAACM's area-denial mines, produced by Hunting Engineering Ltd. of England, stabilize and orient themselves with a drogue chute. Once on the ground, the submunition orientation system—consisting of spring-steel legs—causes the mine to stand on end. The mine's fuze is activated either by a preset timer or by sensors. On detonation, the mine fires off high-velocity slugs capable of penetrating mine-clearing vehicles and high-density fragments lethal to personnel. A special "influence," or target-sensing, capability is to be added to the design. Initial production of DAACM is to start in FY '89. Air Force calculations indicate that the number of sorties required to close enemy airfields with DAACM—involving low-level attack—drops to a mere fraction when compared to the number of sorties using Mk 82B bombs.

Hardened Target Weapons

The recent growth in the number of hardened targets in the Warsaw Pact countries and other likely theaters of operations has been tremendous, as has the increase in hardness levels. The only weapon in USAF's inventory suitable against hardened targets under conventional warfare conditions is the Mk 84 general-purpose bomb that was designed in the mid-1950s. This warhead has a thin, low-grade steel case that tends to fail against hardened targets. The Mk 84 also ricochets, even at relatively steep angles.

Within a year from the day that AD received a high-priority request to come up with a hardened target munition, the Division put I-2000 into production. Designated the BLU-109/B, this improved 2,000-pound warhead, mated to the GBU-10 laser guidance kit, can go through seven to ten feet of concrete or through ship steel plates four inches thick (twice the thickness of the plates on most naval vessels). The I-2000's warhead is encased in one-inch-thick high-grade steel. State-of-the-art forging technology had to be called into play to create the I-2000's single-piece case forgings. During 600-mph sled tests, inert I-2000 prototypes developed by AD's Armament Laboratory went through six-foot slabs of concrete with ease. Not only can the I-2000 penetrate concrete roughly twice as thick as can the Mk 84 without encountering case breakup, or what armament specialists call "deflagration," but the weapon's tendency to ricochet is also reduced markedly. The Air Force plans to acquire more than 20,000 I-2000s by 1991, according to General Eaglet. Major contractors involved in the program are Lockheed Missiles and Space Co. and Fairchild-Weston Systems Inc.

I-2000 applications being considered at this time include linkups with the Paveway II GBU-10, Paveway III, GBU-15, and AGM-130 and with a special booster to enhance its effectiveness against superhard targets. The Navy, General Eaglet said, wants the I-2000 badly because of its high effectiveness against ships.

The Hypervelocity Missile

AD, along with its US Army and US Marine Corps counterparts, is working on a triservice program called the Hypervelocity Missile (HVM) weapon system. A joint-service memorandum of agreement (MOA) drawn up in October 1984 gave birth to this program. HVM is a low-cost (by Air Staff fiat, not to exceed $8,500 per round) missile designed to achieve multiple kills per pass against various battlefield vehicles, including armor. The missile uses a high kinetic energy penetrator rod as its kill mechanism. The weapon is being developed by LTV's Vought Missiles and Advanced Programs Div.

Meant to be compatible with A-10, F-16, and future follow-on close air support aircraft, HVM can be carried in large quantities by the carrier aircraft. Its basic missions are battlefield interdiction and close air support. AD experts indicate that the weapon will be developed as a common "core" design that can serve as the matrix for several variants optimized for use by the individual services. Assuming Congress approves the required funding, HVM could enter production in 1991.

Among AD's promising long-term projects is the autonomous guided bomb (AGB). This program seeks to develop simple, generic, autonomous target acquisition and guidance algorithms linked with a low-cost imaging infrared seeker for the attack of high-value fixed targets in both day and night and in limited adverse weather. This seeker can be coupled to existing airframes, such as the GBU-15, GBU-24, and AGM-130, thus grafting onto these weapons a true launch-and-leave capability. Since the concept does not require any communication with the weapon in flight—such as a laser designator or man in the loop—multiple weapons can be launched at the same time and guided to various targets.

A fundamental step that is being undertaken by General Fornell to strengthen the Division's science and technology base is the formation of the Technical and Engineering Acquisition Support organization (TEAS). TEAS will support AD with the engineering functions that MITRE, Aerospace Corp., and other Federal Contract Research Centers (FCRCs) carry out for other AFSC product divisions. Located at Eglin AFB and governed by competitive contracts running perhaps up to five years, TEAS will provide AD with an organization of about 200 civilian experts whose skills extend across the spectrum of AD's technical interests. These experts will be made available to AD's various systems program offices as needed.

All told, the gung-ho spirit that is so evident at AD these days suggests that AFSC's youngest division is realizing its proclaimed goal of being "the business end of the Air Force." ■

The Europeans worry that forward defense and flexible response will be abandoned in favor of AirLand Battle and FOFA.

Europe's Edgy Approach to Strategy

BY JACQUELYN K. DAVIS

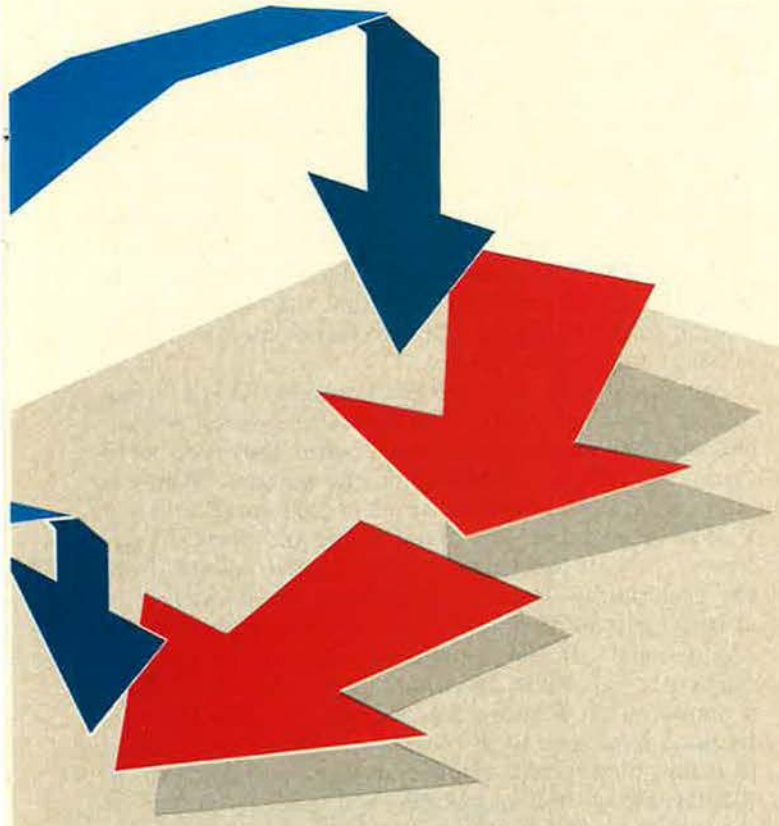
ONCE again, it has become fashionable in Western Europe to challenge openly the credibility of the US extended deterrence guarantee, which is the keystone of NATO's Flexible Response strategy. Even Europeans who usually disagree on most other issues perceive a changed global security environment in which Western Europe is seen as less a critical factor in US foreign and national security policy deliberations than was the case a generation ago. The Reagan Administration's emphasis on a global US strategy conflicts with Western Europe's more regional orientation, giving rise to transatlantic tensions.

Differences Between the US and Europe

Differences between the US and Europe on a range of issues, including East-West relations and trade, technology transfer, and protectionism on both sides of the Atlantic, reinforce an impression, widespread in Western Europe today, that the consensus has eroded that once served so well as the basis for collaboration in the Atlantic Alliance. This perception is giving rise to an increasing desire among Europeans to evolve closer links among themselves on a range of foreign policy and national security issues. However, as has been demonstrated in the past, the West European commitment to unity is tempered by national aspirations, cultural differences, and economic interests that reinforce the nation-state concept and the national identities of the European peoples. Thus, the desire for greater European unity is constrained by persistent conceptions of national identity that continue to influence West European conceptions of national interest. The result in Europe today is contending national conceptions of and prescriptions for the pressing issues that face Western societies.

Since the European concept of unity appears to be more or less unworkable in the contemporary European security environment, most West Europeans continue to value the NATO security connection with the United States. Even the political left of center in Europe largely recognizes the need to sustain at least a loose link with the United States in order to allow their conceptions for the evolution of Europe to come about without any of the anticipated negative consequences for West European security interests and political freedom of action.

The French, for example, even the center-left of the Socialist Party, recognize the importance of the US extended deterrence commitment to Western Europe. Without it, and without NATO, France would be expected to bear a greater burden of the security of Western Europe and ultimately might have to extend its own deterrence guarantee to the Federal Republic of Germany to anchor Bonn to the West. For the French, who



hold to a proportional deterrence concept for France, contemplation of the type of deterrence guarantee that the US extends to the FRG is, at this time, unthinkable. The same is true for Britain.

Premises of Strategy

Most Europeans who perceive their relationship with the United States in NATO as vital to West European security interests recognize that the unprecedented growth of Soviet/Warsaw Pact forces, together with the development of innovative tactical concepts by the Soviet Union, has made necessary a reassessment of the premises upon which NATO strategy has been based since 1967 and the formal adoption of the Flexible Response concept. Both in qualitative and quantitative terms, improvements in the Soviet/Warsaw Pact force structure are perceived to have undermined the credibility of a conventional-nuclear "firebreak," placing a premium on the early resort by NATO to a theater nuclear employment to halt an enemy offensive against Western Europe.

Even in the event of the Soviet Union conducting operations against Western Europe using, at least initially, only conventional arms and chemical weapons, the prospective response of NATO is widely perceived to be reduced to a nuclear employment, given the anticipated lack of warning time for mobilization of NATO forces as well as the need to deploy Alliance forces to their assigned wartime positions—a contingency that could take more than seventy-two hours, depending on when and with what degree of surprise enemy forces initiate their attack.

This unhappy state of affairs, together with the uncertainty surrounding a NATO nuclear-release decision or even the availability of an escalatory option given the extreme vulnerability of US-owned and Alliance theater nuclear assets, encouraged a reassessment of the basis of current Alliance planning, especially its reliance on the threatened use of US strategic nuclear forces in a European contingency. For many Europeans, notably the British and the French who developed their own respective national deterrent forces, the escalatory link to a US nuclear employment lacks credibility when it comes to the defense of European interests. A large number of Europeans share the view that, in an era of superpower nuclear parity, if not Soviet superiority, the United States would be unwilling to employ its central strategic forces on their behalf. Hence, many in Western Europe today believe that the United States would not risk its own destruction by invoking the escalatory options inherent in the Flexible Response strategy.

The ensuing dilemma in which the West Europeans find themselves as a result of the growth, modernization, and reorganization of Soviet/Warsaw Pact forces has occasioned discussion among Alliance members of a revitalized "conventional option for NATO" and support for the concept of the "no early first use" of nuclear weapons. Paradoxically, European members of the Alliance accept the need to revitalize Alliance tactics and perhaps even its strategic concepts, but they are generally hesitant about overemphasizing the development of a NATO conventional option for fear of inducing the strategic decoupling that they seek to avoid.

European Alliance members have long sought to maintain simultaneously a low nuclear and a high conventional threshold in the expectation that the threat of escalation to the central strategic level of warfare, based on a US nuclear employment, would sustain the putative deterrence relationship in Europe, including deterrence of a nonnuclear Soviet attack against Western Europe. Deterrence rather than defense remains the critical element in European conceptions of NATO strategy. This explains, in part, why many in Western Europe have been critical of proposed changes in US and NATO operational concepts, particularly with respect to the US Army's new operational doctrine called AirLand Battle and the Alliance's emphasis on Follow-on Forces Attack (FOFA), both of which (or so it seems to West Europeans) appear to require changes in NATO strategy and tactics—changes that would make more, rather than less, apparent the US strategic nuclear decoupling from Western Europe.

Anxiety About Commitment

Many Europeans view the Follow-on Forces Attack concept and AirLand Battle with great suspicion. These concepts are variously perceived either (in the case of FOFA) as an alternative to existing NATO strategy or (in the case of AirLand Battle) as a means of conducting a limited theater war in which American territory would

be preserved as a sanctuary. However valid or invalid such characterizations, European apprehension with regard to potential changes in US and NATO operational concepts reflects a deeply rooted anxiety about the future of the US defense commitment to NATO Europe. Periodic attempts in the US Congress to legislate reductions in the US ground force presence in the FRG—most recently the Nunn Amendment—have served to undermine American arguments about the importance of NATO to US global interests.

There is fear in Europe that AirLand Battle is more conducive to the light division concepts now being explored by the US Army for global contingencies outside of Europe than to the NATO-oriented heavy division structure. From a European perspective, NATO's existing corps structure necessitates the heavy division concept in light of the dense armor environment of the European theater. The tensions inherent in the logistical requirements of AirLand Battle and current NATO strategy only serve to heighten European anxieties about the future US role in the direct defense of Western Europe.

Beyond European apprehension relating to the strategic decoupling that new operational concepts like AirLand Battle and FOFA are perceived as likely to induce, many West European strategists and political decisionmakers are critical of what they perceive as these concepts' adverse implications for the forward defense concept, which, for the West Germans at least, remains an article of faith in NATO strategy. The maneuver emphasis of AirLand Battle doctrine provides for greater fluidity on the battlefield and includes the option of "falling back" to regroup and attain a more propitious basis for countering the offensive movement of enemy forces in NATO territory.

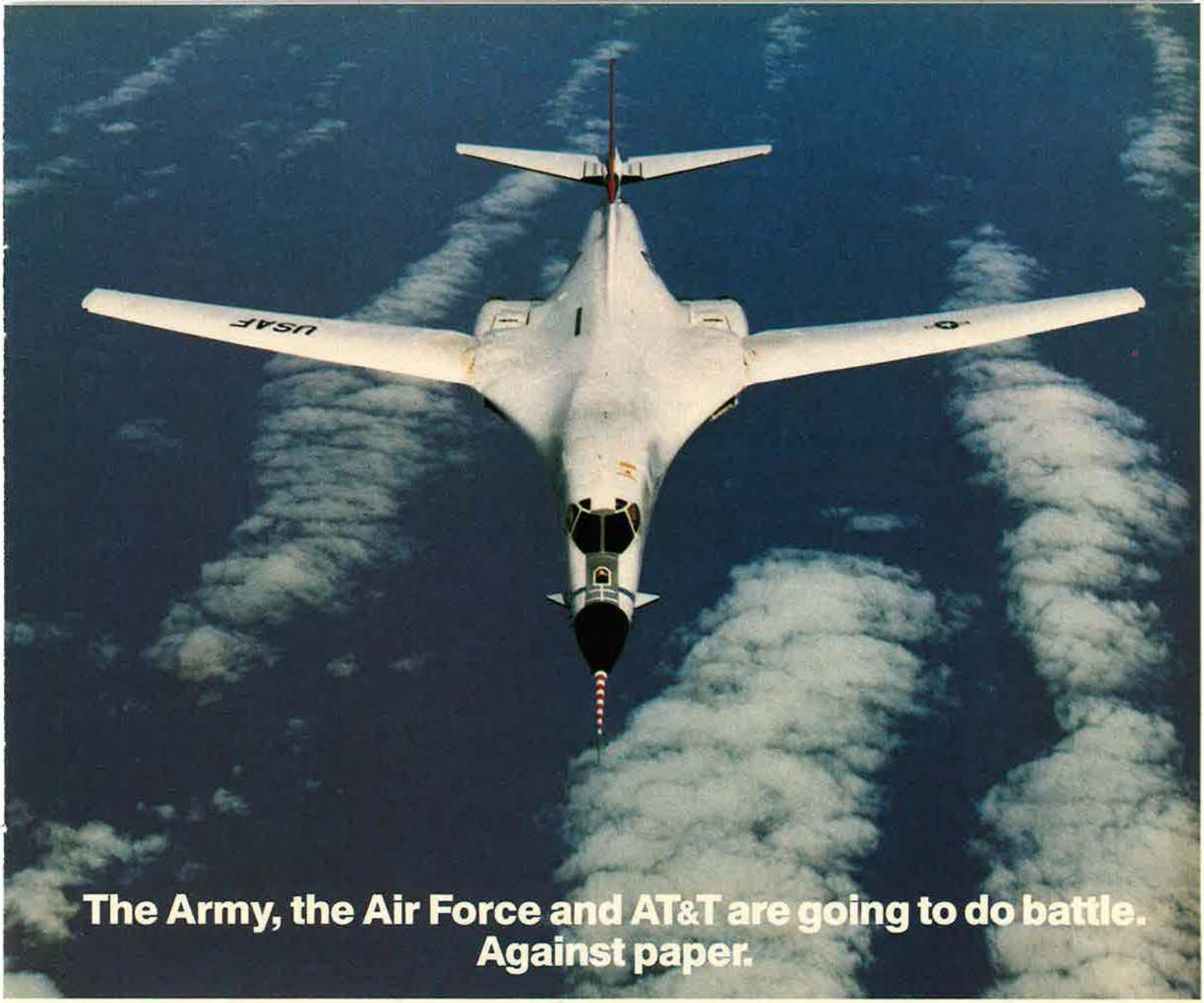
Rearward movement, even as a temporary expedient, is regarded as an anathema by the West Germans, who largely for political reasons remain committed to staging a defense as close to the inter-German border as possible. The lack of strategic depth of West German territory together with the uncertainty of an Alliance capability for a "defense-in-depth," given the ambiguity of France's role in a theater war in Europe, operate as very real constraints on the maneuver options of AirLand Battle. The Germans believe that the only feasible option for NATO is to strengthen the forward defense concept, based on the development of a more adequate "force-to-space" ratio and sufficient reserves. However, the adverse demographic trends that will affect, profoundly by the 1990s, the available manpower pools in major NATO countries, including the FRG, the United States, and the United Kingdom, are viewed elsewhere in Europe, especially in Britain, as necessitating the development of more flexible operational tactics to compensate for this reduced manpower availability. Yet, the perceived tendency of the United States to emphasize a technology/manpower tradeoff to compensate for reduced manpower resources is criticized in Europe on the basis that it places too much faith in untried systems and emerging technology (ET) weapons that are not yet even developed.

Priorities for Attack

Operationally, both the US Army's AirLand Battle and NATO's Follow-on Forces Attack concepts are designed specifically to offset the principles of mass and echeloning, which are fundamental to Soviet theater strategy. For many Europeans, the West Germans in particular, the United States tends to place too great an emphasis on the strategic concept of echeloning and not enough on its tactical operational variants. Thus, while most European NATO allies support (and have supported in the past) rear-area denial missions against fixed targets, they are concerned about the new emphasis on attacks against mobile forces located in areas beyond the FLOT and its immediate vicinity. For them, the capability to identify the main body and major points of an enemy attack is far more important than is the effort, central to the FOFA concept, to target enemy second-echelon and reserve forces.

Inherent in both AirLand Battle and FOFA is a "Deep Attack" concept whose purpose is to destroy Soviet/Warsaw Pact maneuver elements before they are able to "form up" for a breakthrough engagement. Whereas each of the deep attack concepts of AirLand Battle and FOFA emphasizes the importance of "forward defense," neither has yet been able to solve satisfactorily the contentious issue of prioritizing the allocation of scarce national resources to accomplish both tasks simultaneously. In the Federal Republic of Germany, in particular, sensitivity over any suggestion of the abandonment of the forward defense concept would be particularly explosive for the Atlantic Alliance. As viewed in Bonn, the forward defense concept is tantamount to the defense of the Federal Republic, and any perceived digression from that principle would be interpreted as a weakening of the US commitment to defend Western Europe. Thus, even though the maneuver emphasis of AirLand Battle may make sense militarily, from a political-psychological perspective it may encourage those elements in Europe that seek to undermine transatlantic security collaboration in NATO.

If a majority of Europeans fears the alleged potential consequences of the AirLand Battle concept for forward defense, others—particularly those who are hostile to NATO and would prefer to see the withdrawal of US forces from Europe—perceive in its maneuver option a danger to stability in Europe because of its emphasis on cross-border operations. Whereas AirLand Battle envisages deep attack operations out to eighty kilometers beyond the Forward Line of Own Troops (FLOT) in addition to cross-border operations to slow the rate of advance of attacking forces in order to mount tactical and operational counteroffensives on terrain and in circumstances most favorable to US and NATO forces, it is often confused by Europeans with the adoption of a counteroffensive strategy that aims at seizing and holding significant territory in Eastern Europe. Even though AirLand Battle does not incorporate this option, its most ardent critics, among them members of the Social Democratic Party in the Federal Republic of Germany, have characterized AirLand Battle doctrine as "offensive" in character and dangerous to stability (especially in times of crisis) in Europe. Understandably, therefore, the current West German government has been cautious in its support for AirLand Battle, not wishing to raise in the political arena a potentially divisive debate over its tenets.



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TEXAS INSTRUMENTS

27-3455

However, what worries the West German government is AirLand Battle's emphasis on "seizing the initiative" to "force an enemy to go where you want him to go" and "to fight on most favorable terms for friendly forces." Optimally, to be effective, AirLand Battle may require that US (and NATO) forces mount cross-border operations upon assessment of warning of an enemy attack. The thorny political issues raised by this contingency will not likely be resolved, given West German sensitivities relating to attacks against East German territory. As a result, US forces operating according to AirLand Battle concepts may find it necessary to develop alternative, less than optimal, employment options to satisfy the political-strategic requirement dictating that enemy forces must themselves first cross the East-West border demarcation before Alliance troops can react. Under these circumstances, AirLand Battle operations could perhaps be best effected through US (and NATO) employment of short-range, so-called tactical nuclear weapons. However, contemplation of the use of short-range nuclear weapons against enemy forces in either of the two Germanys has no support in Europe and in any case would not be pursued given the moral dilemma of opting for a nuclear first use and hence the difficulty inherent in coming to such a decision in timely fashion in Alliance decision-making circles.

If AirLand Battle is criticized in Europe for abandoning the notion of forward defense, FOFA—or the Alliance's Follow-on Forces Attack concept—is alleged by some of its European opponents to pose an alternative to NATO's Flexible Response strategy. Proponents of FOFA, among them the Supreme Allied Commander, US Gen. Bernard Rogers, contend that it is only an operational innovation to NATO's tactical planning guidelines and as such does not purport to be a new Alliance strategy. FOFA, it is said, is designed to enhance NATO's conventional defense/deterrence capabilities by raising the nuclear threshold in Alliance military planning. Unlike AirLand Battle, therefore, FOFA explicitly depends on nonnuclear employment options, although this is often lost upon European audiences who equate employment options for Alliance INF with the emerging technologies that are critical to FOFA's deep attack options.

The Issue of Cost

If, as with AirLand Battle, the purpose of FOFA is to defeat Soviet theater strategy, its dependence on emerging technologies in the areas of very-high-speed integrated circuits, Stealth technologies, advanced computer software and algorithms, new-generation electronics, and composites raises the issue of cost, which is a major concern in the European debates on FOFA. General Rogers has estimated that FOFA, which includes a deep attack option of from twenty-five kilometers to more than 400 kilometers beyond the FLOT, can be implemented with real annual increases of four percent of defense expenditures by all NATO members. This represents an increase by one percent of the three percent spending obligation to which Alliance members committed themselves in 1977 as part of the NATO Long-Term Defense Improvement Plan. Most Europeans are skeptical of this assessment, feeling that it falls far below the real costs that would be necessary to procure those systems needed to implement a Follow-on Forces Attack.

One European critic of the FOFA concept, Christoph Bertram, citing the escalating costs of maintaining NATO's current force posture and of reconstituting war reserve stocks of ammunition, spare parts, and combat consumables, has stated that NATO members must each contribute an increase of six percent (in real growth) just to sustain what it already has, to say nothing of procuring additional weapon systems. In this context, many Europeans view US support for new operational concepts like FOFA as the basis for forcing the Europeans to purchase expensive new weapon systems manufactured in the United States, thus contributing to the perpetuation of the transatlantic technology gap. European dependence on the United States for high technology defense systems has long been of concern among West Europeans who seek the emergence of an integrated European market and technological power center. Anxiety about Europe's technological inferiority has led France to promote the Eureka concept and is what underlies much of the European ambivalence about participation in the US SDI program.

While the FOFA concept was adopted officially by Alliance planners in November 1984, there is significant doubt about the willingness of Alliance members to allocate a four percent real increase in their respective national budgets for defense spending on an annual basis. In this regard, even the United States in its FY '86 defense budget will not meet its NATO commitment, increasing European doubts about the wisdom of the FOFA concept. From the European perspective, unless the resources are readily available, the defeat of Soviet first-echelon forces must remain the top NATO priority. Strikes against follow-on forces would be supported, but only if the resources exist to perform both missions simultaneously. If a choice must be made, the European priority is clear-cut: Forward defense remains the key to European security.

In this sense, differences have emerged between European Alliance members and the United States with regard to the mission orientation of NATO forces, particularly Alliance aircraft assets. To most European military analysts, the offensive counterair mission remains the priority of NATO air forces, with battlefield interdiction and rear-area denial the second and third mission priorities. For these same Europeans, adoption of the FOFA concept is seen as a reordering of those air force mission priorities, to the detriment of the battle for air superiority and close air support of forward-based Alliance assets. The tensions that exist between the US AirLand Battle air interdiction and battlefield interdiction concepts and those of FOFA further exacerbate the European debates over the adoption by NATO of the Follow-on Forces Attack concept. Moreover, the theater perspective that is inherent in FOFA contrasts sharply with the corps-orientation of AirLand Battle, raising the legitimate issue of how to reconcile changes in national operational doctrines with the compromises that are required by an alliance strategy.

Assumptions About the Future

Clearly, the essence of the European concerns over FOFA and AirLand Battle has less to do with cost issues

than with changes in NATO's defense/deterrence strategy. As with the European debates over the US strategic defense research program, European fears over reconceptualizing the basis of war deterrence stem from the fallacious assumption that what has worked in the past will remain effective in the future. This European view has evolved from an overwhelming belief in the assured destruction philosophy of deterrence, which emphasizes the putative threat of the offensive employment of nuclear weapons against selected demographic aimpoints in enemy territories. Yet, since the European defense debates are largely devoid of recognition of Soviet strategic defensive programs and deployments, the discussions in Western Europe about Alliance strategy fail to consider the implications for NATO planning of the changes that have taken place in the Euro-strategic environment.

Oftentimes Soviet force modernization programs are explained away as evolutionary improvements, and changes in operational tactics are regarded as responses to alterations in NATO tactics and force posture. Thus, for example, NATO's decision to deploy new-generation intermediate nuclear forces in Western Europe was cited by many Europeans as the basis of the Soviet decision to upgrade and station in forward areas the SS-21, SS-22, and SS-23 nuclear-capable surface-to-surface weapons. Rather than putting the INF deployments into their proper context—as a response to Soviet SS-20 IRBM deployments—many Europeans preferred to characterize the SS-20 as an evolutionary modernization of the older, single-warhead SS-4 and SS-5 IRBMs and not representative of a significant qualitative and quantitative change in the Soviet/Warsaw Pact theater posture.

Rarely, if ever, are so-called out-of-area contingencies discussed in European defense debates unless they are addressed in the context of US global strategy—in which case they are debated in abstract terms, with few Europeans coming to grips with the potentially profound consequences for Western Europe of events in the Persian Gulf region or even resource-rich Africa.

To the extent that NATO's Flexible Response strategy has always represented a political-strategic compromise that provides for a flexibility of force employment options, its potential applicability in Western Europe remains a viable basis for Alliance planning. However, insofar as Flexible Response strategy is perceived to be delineated ultimately by the US extended deterrence guarantee, its credibility as the operational basis of Alliance defensive planning has come into question as a result of the growing vulnerability of US strategic forces themselves. Whereas, paradoxically, the US strategic defense research program offers the potential for enhancing the survivability of US central strategic (land-based) deterrent forces and with it (at least theoretically) the credibility of the US extended deterrence guarantee, few Europeans appreciate the potential positive effect of SDI on the direct defense of NATO Europe.

Aside from its potential to strengthen "strategic coupling" between the United States and NATO Europe, the strategic defense research program may yield new technologies that could enhance NATO's force posture and even the flexibility of employment options available under a revised Flexible Response concept. Both in terms of AirLand Battle and FOFA, space-based surveillance and reconnaissance technologies could be adapted from the SDI program for use in a theater application. From research into laser and directed-energy technologies, new-concept weapons for use against the massive enemy armored threat are likely to emerge as a result of the strategic defense program. However, as with the current European debates over FOFA and AirLand Battle, consideration of the role and potential of strategic defense technologies for NATO strategy and the direct defense of Western Europe must be based on a clear understanding of what is involved, where we in NATO wish to go, and what our collective interests are.

In sum, there is little support in Western Europe for altering the deterrence potential of NATO nuclear forces. Whereas FOFA is designed to raise the nuclear threshold within the existing NATO strategy of deliberate escalation, AirLand Battle makes no assumption about the types of capabilities to be used. The designers of FOFA seek to make the direct defense of Western Europe feasible if deterrence fails. It is precisely this contingency that Europeans prefer not to consider and, for this reason, oppose any change that appears to depart from NATO's escalatory dependency. Thus, for most Europeans, innovative operational concepts like AirLand Battle and FOFA are applicable to the European theater only insofar as they support and enhance the broad outlines of NATO strategy. For them, there can be no question of revising the fundamental principles of NATO strategy. ■

Jacquelyn K. Davis is the Executive Vice President of the Institute for Foreign Policy Analysis in Cambridge, Mass. She holds graduate degrees in international relations from the University of Pennsylvania and, during her career, has written extensively on strategic security issues and has lectured at the Air War College. Dr. Davis is the coauthor of The Atlantic Alliance and U.S. Global Strategy. *She is the author for this magazine of the articles "Japan Wrestles With Its Defense Options" in the May '84 issue and "France Debates Its Defense Policy" in the September '84 issue. Dr. Davis, who was recently named to head the Defense Advisory Committee on Women in the Services (DACOWITS), is shown at left with General Sir Edward Burgess, Deputy Supreme Allied Commander for Europe, during a meeting in 1984.*

The military thinks that irresponsible reporting has undermined national security. The reporters think the military disregards the public's legitimate right to know.

The Military-Media Wars

BY JOHN T. CORRELL, EDITOR IN CHIEF

THE dislike that the military and the news media have for each other is deep, bitter, and mutual. Military people believe that a biased, muckraking press is systematically—and perhaps willfully—undercutting national security. For their part, reporters believe that they are routinely denied access to news by a military establishment that tends to regard the public's business as none of the public's business.

Consequently, nobody expected it to be a tea-sipping session when panelists representing the military and the media met in an Aerospace Education Foundation Roundtable debate on October 8 in Washington.

To illustrate the hostility that exists on the military side, Col. Michael P. McRaney, USAF Director of Public Affairs, quoted retired Army Gen. John Murray, who recently proclaimed that "engaging the press while engaging the enemy is taking on one adversary too many."

Col. David Shea, Director of Public Affairs for Air Force Systems Command, said that it has become increasingly difficult to persuade senior officers—many of whom have been unfairly burned by the media in the past—to so much as talk to a reporter.

William Beecher of the Boston *Globe*—and also a former Acting Assistant Secretary of Defense for Public Affairs—said that the big split developed during the Vietnam War, when newsmen felt they were misled by the nation's civilian and military leaders and when the military felt that some reporters consciously undermined the war effort with their reporting. "Both Vietnam and Watergate fed the notion that representatives of our government sometimes lie when it serves their purpose," Mr. Beecher said.

The prime topic of debate, however, was the role and behavior of a free press in a free society. Ike Pappas of CBS News said that he regards himself as a representative of the public when he covers a story. Bill Monroe, longtime moderator of *Meet the Press* and now with the *Today* show, found the idea that reporters represent the public "presumptuous" and declared: "I represent NBC News!"

John Keeley, a retired Army colonel, a military affairs commentator for the Cable News Network, and legislative aide to Sen. Carl Levin (D-Mich.), put it a different way: "The media are the only public audit of public activity. There is no independent audit of our government except by the media." Reporters, though, "are not public servants, and they should not forget that they work for private corporations that make money. They often hide irresponsibility under the First Amendment."

Bearing down on responsibility of the media, AFA Executive Director Russell E. Dougherty, moderator of the Roundtable, presented a question sent up from the audience: "Privately, many newsmen will acknowledge instances of incompetence or even blatant bias by other newsmen. Publicly, though, the media close ranks, circle the wagons, and wrap themselves in the First Amendment. If the media will not police themselves and do it publicly, why shouldn't someone else do the policing?"

The media people on the panel posed a counter-question: Who would sit in judgment? They rejected official government control of the media as unacceptable. Mr. Monroe said that the National News Council, which once tried to perform the function of criticism, "finally went out of business because the press refused to pay any attention to it." The real control, Mr. Monroe said, is the audience. "There's a boundary beyond which we cannot go. There are outrages we can't commit and maintain the mass audience that we need." Mr. Beecher said that incompetent reporters are gradually weeded out.

Irresponsibility by the media strengthens the already strong forces within government that are inclined to keep release of information to a minimum. Colonel McRaney said that he always argues for voluntary release of any material that could be obtained under the Freedom of Information Act and contends that if information is too sensitive to be let out, then it ought to be classified. He said he didn't expect the media to be cheerleaders, but he did expect "fairness, balance, perspective, accuracy, reason, and sensitivity." The most important of these, in Colonel Shea's view, is balance. He quoted the advice of Joseph Califano in his book *Governing America:* "Try to tell the difference between tides, waves, and ripples."

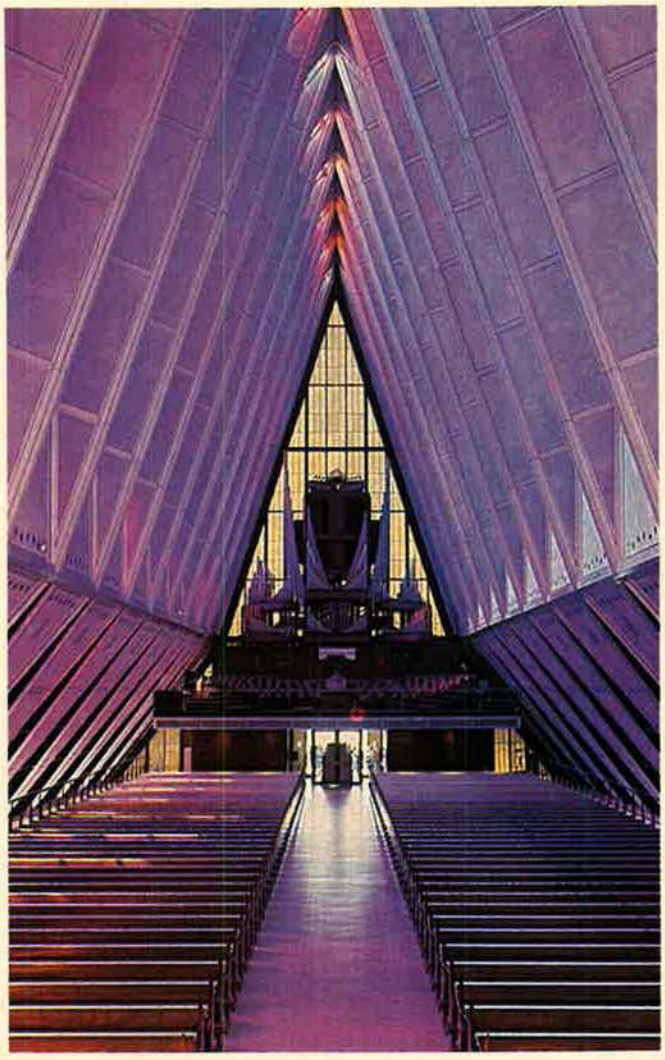
There was general agreement that the combatants in the military-media war should know more about each other. Mr. Pappas said that older military people may be too set in their opinions to change, but that younger ones should have formal training in media relations. He'd be willing to address Academy cadets, he said. The Air Force Academy public affairs officer, present in the audience, promptly served up an invitation for Mr. Pappas to speak to the cadets—and asked when the media planned to put on a course for reporters and invite the military to lecture.

The military-media wars are likely to go on for awhile, but it might do wonders for détente if every reporter honestly subscribed to the philosophy put forth by Mr. Monroe in his summation: "We cover the news that's there, and we do so in the faith that the facts, in the long run, are going to bring us clear." ■

The Academy chapel design was almost scrapped as an "insult to religion and Colorado."

The Chapel That Nearly Wasn't

BY JAMES R. PATTERSON



More than a million people a year visit the Air Force Academy chapel. This interior view shows the pews that accommodate 1,200 in the Protestant area, along with its 4,334-pipe organ in the background. (USAFA photo by Bill Madsen)

THE Air Force Academy is Colorado's number one man-made tourist attraction. More than a million visitors a year come to the 18,000-acre campus north of Colorado Springs, drawn especially by the Academy's spectacular cadet chapel.

It is a distinctive house of worship, with seventeen spires and an unconventional design. What few of the visitors know, however, is that when plans for the chapel were first revealed in the 1950s, the design was so controversial that it was almost scrapped.

After President Dwight D. Eisenhower signed the bill authorizing the Air Force Academy on April 1, 1954, the architectural firm of Skidmore, Owings and Merrill was commissioned to prepare building plans. A year later, shortly before the first class began training at the interim campus at Lowry AFB, Colo., a small-scale mockup of the complex was unveiled. The architects made their presentation in Colorado Springs before a high-level delegation from Congress and the Pentagon as well as to state and local officials.

The main buildings in the mockup won generally favorable, if not hearty, approval; the cadet chapel design got a rousing vote of opposi-

tion. Its appearance was denounced as "paganistic" in feeling and was ridiculed as resembling a hangar or an accordion.

"An insult to religion and Colorado," Edwin C. Johnson, then governor of the state, called the chapel's architectural treatment. Many agreed with him.

Walter A. Netsch, the architect whose creation caused such bitter comments, recalls how deeply he was stung by the criticism.

"I took it very hard," he remembers. "I went to a corner of the display room, because I was about to cry. Mr. Owings, one of the partners in the firm, came over to me and patted me on the shoulder. He said I mustn't lose my confidence. That I should try again.

"I told him I was so upset I wanted to get away for awhile. So I went to Europe. I felt I needed some fresh inspiration—to visit churches and cathedrals—to get a new start."

From Europe the young architect returned with a renewed enthusiasm for his project. He had been particularly influenced by the Cathedral of Notre Dame at Chartres, France, and by the Sainte-Chapelle Chapel in Paris.

Mr. Netsch's new concept was first shown to Air Force officials at a meeting on the Colorado Springs construction site on March 12, 1957. Secretary Donald A. Quarles liked "the inspirational quality" of the new chapel design, but agreement was reached to withhold any public announcement about the appearance of the structure until it had been shown to Congress for approval.

Interior Space Controversy

A decision was also made to withhold details of the proposed interior of the chapel. Preliminary plans called for the Protestant place of worship to occupy the upper level of the chapel, while the Catholic area would be smaller and below at the "terrace" level, with the Jewish meeting room on the same floor and having less space.

These area assignments were based on the percentages of members of the various faiths in the cadet wing. But this did not satisfy the many clergymen and chaplains who wanted extensive changes.

Such problems led to pressure for three separate houses of worship to satisfy the conflicting viewpoints. At one time, four separate chapels were proposed. The Air Force, however, insisted on a single chapel building, a position subsequently reinforced by congressional demands to hold down costs.

In May 1957, James H. Douglas, Jr., became Secretary of the Air Force. He had only a few months before the House military construction program for the next fiscal year went before a subcommittee of the House Appropriations Committee. The crucial test was at hand for the revised chapel concept.

Air Force representatives met with the subcommittee on July 18 in Washington. Rep. Errett P. Scrivner of Kansas, chairman of the subcommittee, asked about the design of the chapel and was told that a model of it had been endorsed by leading architects and clergymen. This did not satisfy the chairman, who said the committee members should see the model for themselves to "pass on its propriety."

Two weeks later, the chapel model was taken before the subcommittee, where it barely passed inspection by a vote of 6 to 5. Five days later, the committee's report went to the House as a whole. Scrivner offered an amendment to the appropriations bill to prohibit "any funds for the chapel as designed." The amendment passed by a vote of 101 to 53.

The Associated Press later quoted Scrivner's characterization of the chapel design as "a cathedral of polished aluminum with nineteen spires." Rep. Walt Horan of Washington suggested that the model should be shipped to Disneyland. Other House members called the design "a monstrosity" and a "rectangular accordion."

The next morning, Air Force officials were told to bring the chapel model to the Capitol for a private showing before the House convened and to be prepared to defend the design. Military advocates, strongly supported with speeches by Reps. Byron G. Rogers of Colorado and George Mahon of Texas, saw the Scrivner amendment defeated, 147 to 83.

Mahon, however, later warned Secretary Douglas in a letter that "I am of the opinion that at least two-thirds of them [House members who voted] were unfavorably impressed" by the chapel design.

The Senate's turn came when Secretary Douglas appeared at an appropriations hearing. He was first sharply questioned about why $3 million was needed for the chapel and then grilled about the planned internal arrangements.

"Insult to God Almighty"

But not until a night session of the Senate did the issue explode. Sen. John Stennis of Mississippi led off with a scathing attack on the design of the structure, followed by Sens. Gordon Allott of Colorado, A. Willis Robertson of Virginia, and Ralph E. Flanders of Vermont. Of all of the blasts at the chapel, Senator Flanders's denunciation probably ranked as the most vitriolic: "The proposed structure is a deliberate insult to God Almighty."

The barrage of criticism in the House and Senate aroused some articulate defenders. Schools of architecture, prominent architects and their professional societies, and architectural publications began to speak up in staunch support of the chapel's modern design concepts.

In September, the last day of the congressional session, Senator Stennis introduced a bill to elimi-

nate all funds for the chapel. No action was taken on the measure before adjournment.

The scare, however, jolted the Air Force into a public relations campaign. The effort included sending Mr. Netsch, the chapel architect, on a national tour to address architectural and religious organizations. Meanwhile, Congress found its mail from constituents running heavily against the project.

A further source of continuing controversy was the allotment of space for the three main religious groups. Just when the question seemed settled, the archbishop of the Greek Orthodox Church of North and South America wrote Secretary Douglas that "we are distressed to note that no provision has been made for our Eastern Orthodox faith. . . ." The Secretary replied diplomatically, adding that, at the time, only one cadet was a member of that faith.

Air Force planners were also under pressure from Congress to hold down rising costs and to eliminate unnecessary features. A proposal for a bell tower was scrapped, the nineteen spires were reduced to seventeen, the provision for public toilets was dropped, and other economies were adopted.

The chapel was eventually saved, but the project was delayed by slow authorization of funds and by the many design changes to cut costs. The cadet wing moved to the Colorado Springs campus in August 1958. Not until five years later, though, was the chapel opened for services.

The dedication took place on September 22, 1963, with a host of dignitaries participating, including Francis Cardinal Spellman, Roman Catholic archbishop of New York and military vicar of the Catholic Church, and Eugene M. Zuckert, Secretary of the Air Force. Eight years had passed since the first outraged cries against the "paganistic" design of the chapel. Now there was only high praise from the speakers.

As finally completed, the chapel seated 1,200 in the Protestant area, 500 in the Catholic section, and 100 in the Jewish section. In addition, an all-faiths room accommodating twenty-five persons was set aside.

The total cost of the project to the government came to $3.5 million, but this did not include the liturgical furnishing and adornments, all of which were provided by individuals or private organizations. As part of a campaign for contributions, the Air Force conducted an Easter Sunday solicitation at its bases worldwide. Two of the most important items given by the public were the 4,334-pipe concert organ in the Protestant area and a similar but smaller organ in the Catholic section.

Attitudes Change

Architect Netsch says he could not have been more astonished or delighted at the "remarkable" change in the public's attitude toward the chapel.

"I never once thought that my work might become a tourist attraction," he says. "What I tried to do was design a great church with a Gothic feeling in a contemporary medium."

Now sixty-five, Mr. Netsch looks back to the turbulent controversy in the late '50s with wry humor.

"I received a lot of hate mail in those days. I was even called a Communist." He says, however, that "in recent years my heart has been warmed by many fine letters from parents of cadets who have told me of having been spiritually uplifted in visiting the chapel."

Col. Meredith J. Thomas, cadet chaplain at the Academy, can vouch for the enthusiastic reaction of present-day visitors to the chapel, who sometimes number 5,000 to 6,000 a day in the summer months. But sightseers are drawn to the showplace in even the most severe weather.

"I remember the worst snowstorm we had one winter," the chaplain related, "when the Academy was closed for the weekend. I put on my boots and struggled through the drifts to check on the chapel. When I got to the steps, there was a young man with a camera slung around his neck.

" 'How did you get here?' I asked, amazed that a tourist could get through in such weather.

" 'Four-wheel drive,' he said. 'Mind if I take some pictures?' "

Ms. Peggy Kelley, supervisor of the six chapel guides who escort the tourists, reports an overwhelmingly favorable public response.

"Many who come here have an Air Force connection," she said, "either having served themselves or because of a relative or friend. For them, a visit to the chapel is especially gratifying. But even those who come primarily out of curiosity are also moved by the experience."

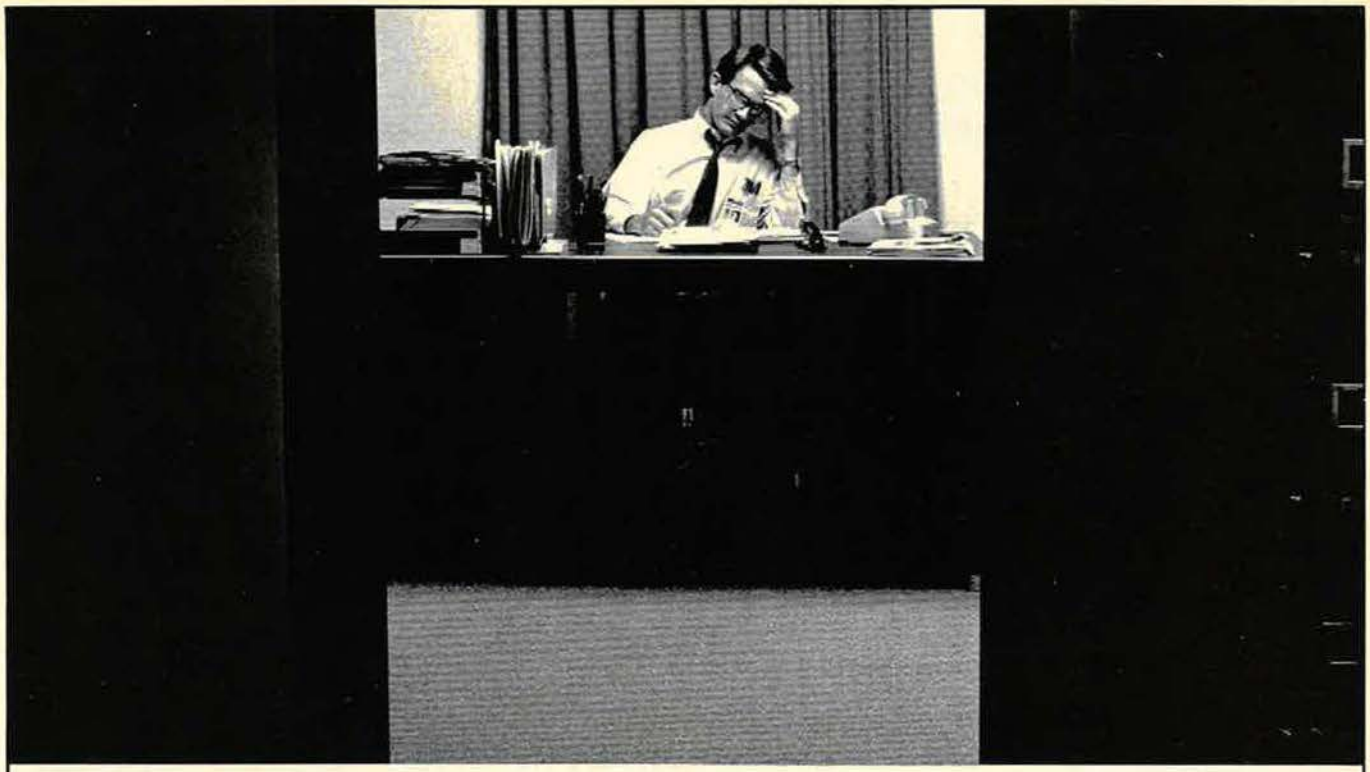
Ms. Kelley pointed out that the chapel boasts excellent acoustics as well as beauty. Occasionally, to the delight of other tourists, a visiting church group will sing a hymn in the chapel in response to the magnificent setting.

In June 1985, the Air Force Academy Foundation announced that it would raise $4 million in private funds to build a visitors center. Gen. James E. Hill, USAF (Ret.), executive vice president of the Foundation, said the project should be completed by June 1986. The center will include a theater, restaurant, gift shop, and conference rooms and be located within walking distance of the student area. The new facility will replace the present center, which is located near the south entrance to the Academy eight miles by road from the campus area.

Lt. Gen. Winfield W. Scott, Jr., Superintendent of the Academy, has seen the number of visitors increase steadily during his administration.

"We are proud of our cadet chapel and pleased that it has attracted so much popular interest and admiration," he says. "For our cadets, it has stood as a symbol of the lofty ideals of the service, a dedication to God and country. The chapel also shines as a spiritual beacon to light the way for our graduates throughout their lives." ■

James R. Patterson is a free-lance author now living in Colorado Springs, Colo. Mr. Patterson worked eighteen years as a reporter for the Kansas City Star. During World War II, he flew C-46s and C-47s in the China-Burma-India theater, and during the Korean conflict, he was recalled for what he terms "hardship" duty in London. He subsequently took a job with United Aircraft International (later United Technologies Corp.), working in the company's London and Washington offices for eighteen years. He is a retired Air Force Reserve lieutenant colonel.



"Ideas Won't Keep..."

***"Something must be done about them."* Alfred North Whitehead, Philosopher and Mathematician**

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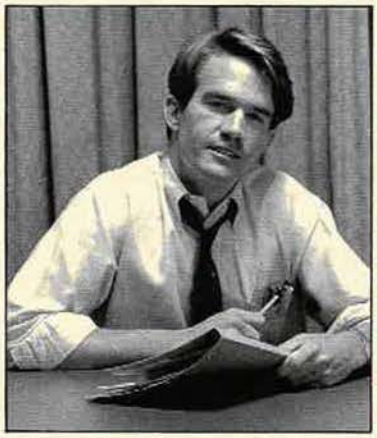

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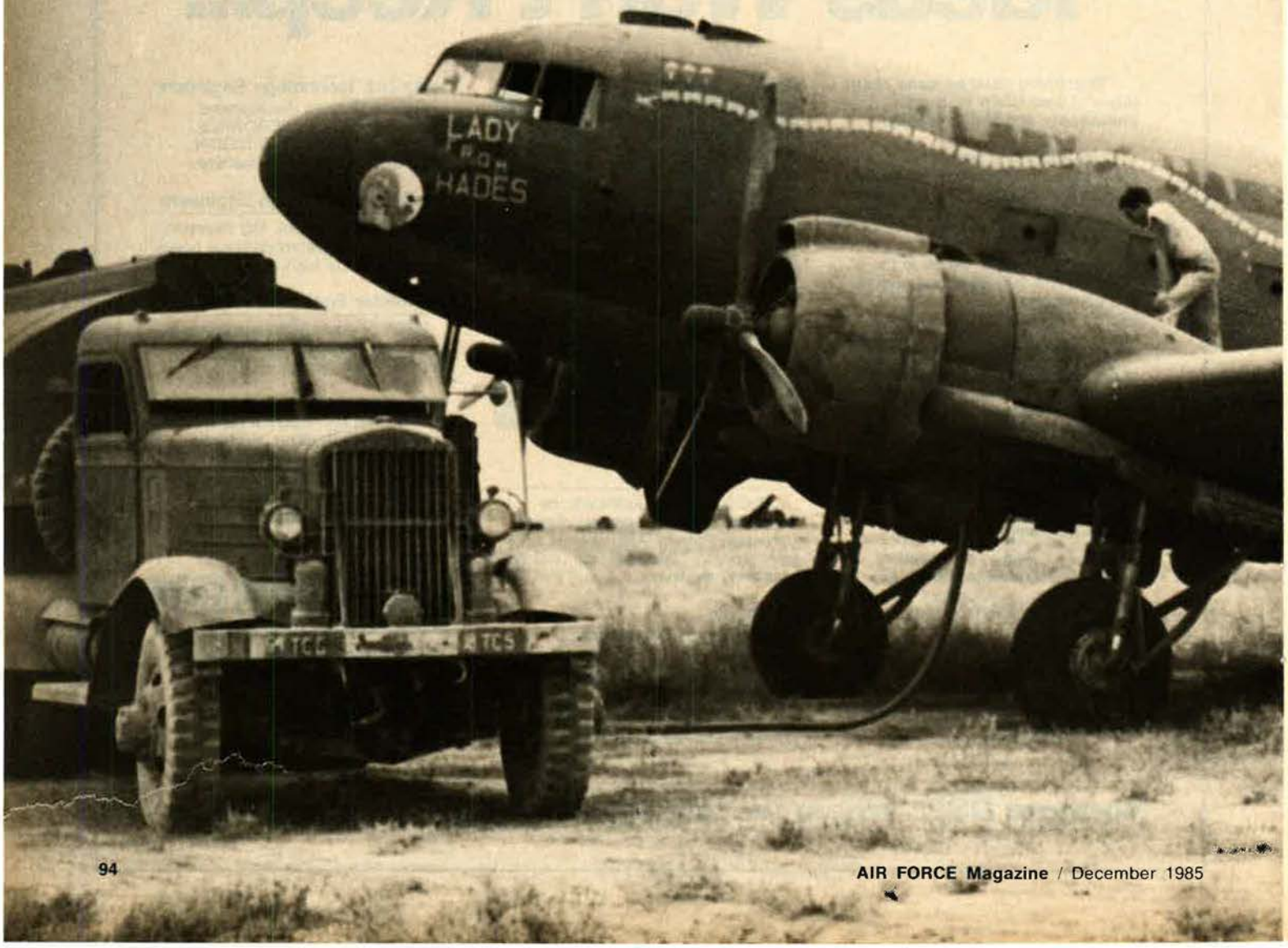
The DC-3 is fifty years old this month and still flying. It may be immortal.

The Grand Old Gooney Bird

BY C. V. GLINES

TRIVIA QUESTION: What transport aircraft designed to carry twenty-one passengers has hauled more than 100 and has been transformed into a fighter, bomber, amphibian, glider, tow plane, laundry, classroom, crop duster, flying loudspeaker, hospital, wire layer, command post, mobile home, chicken coop, restaurant, fire fighter, and chapel?

ANSWER: The Douglas DC-3, also known in the Air Force as the C-47 (plus other designations) or Skytrain and in the Navy as the R4D. The British called it the Dakota. The airlines referred to it simply as the Three; their pilots called it Old Methuselah, Placid Plodder, Dowager Duchess, Doug, or the Dizzy Three. But the name most commonly applied to this Grand Old Lady of the Skies is Gooney Bird, named after the albatross, a seabird known for its endurance and ability to fly great distances.



Most readers of AIR FORCE Magazine will not need an introduction to the Gooney. It received its baptism of fire during World War II, proved its durability during the Korean War, and demonstrated its unusual versatility during the Vietnam War. And while it is not in the military inventory anymore, it is still plying the world's airways and doing its duty in other countries in peace and war as it has always done.

Golden Anniversary

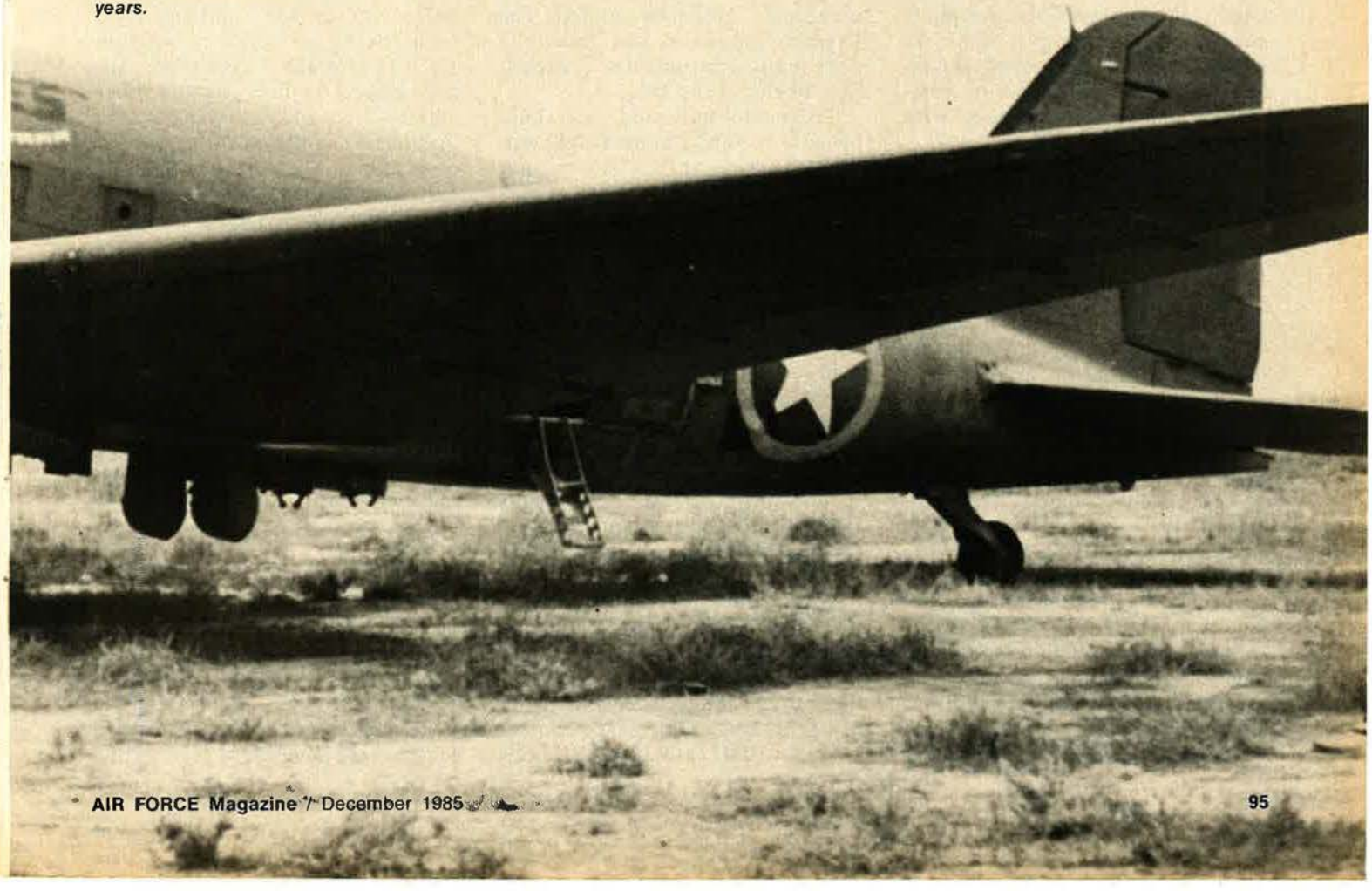
It may surprise you that the DC-3/C-47/R4D celebrates its fiftieth birthday this month. It was on December 17, 1935, the thirty-second anniversary of the Wright brothers' famous first flights, that the first DC-3 took to the air to begin a saga of accomplishment unmatched by any other aircraft design in the world. It has not only filled the roles mentioned above but has also served in every country on every continent in the world, once broke the coast-to-coast speed record, and set nineteen other national and international speed records. It was the first aircraft to land at both poles and, according to C. R. Smith, former president of American Airlines, was "the first airplane that could make money just by hauling passengers."

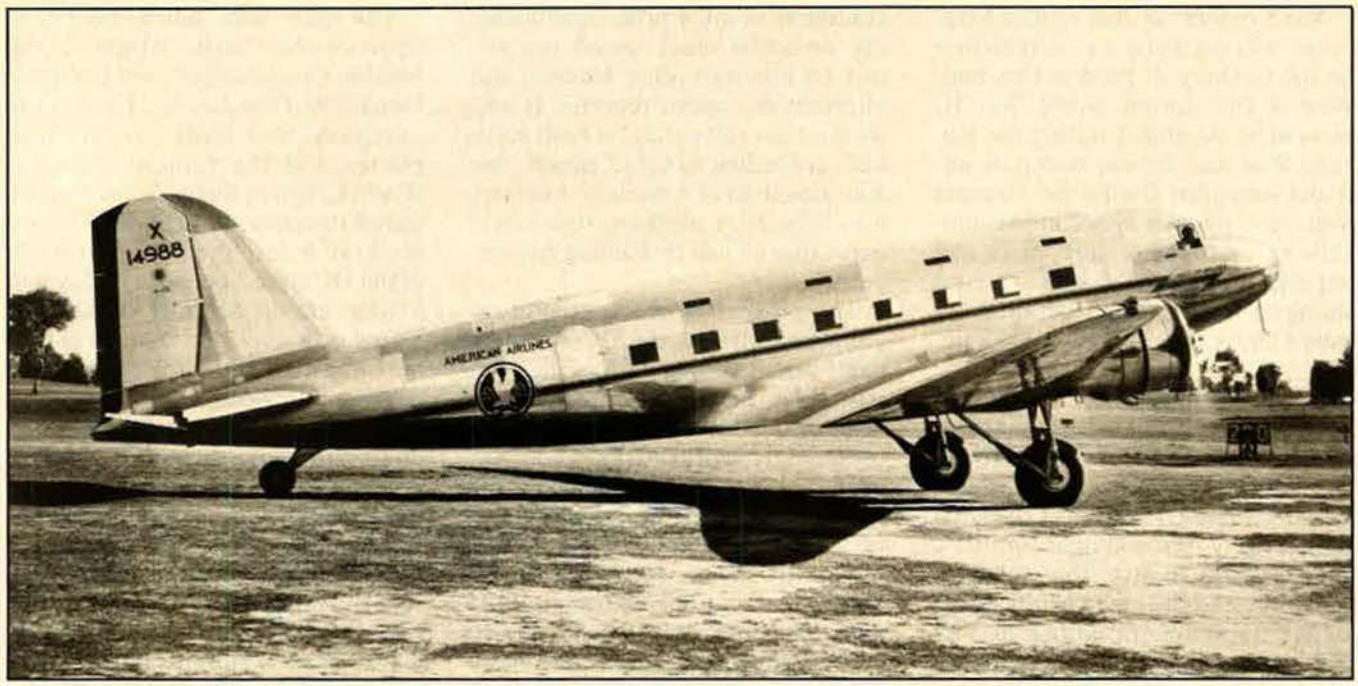
The progenitor of the ubiquitous Gooney Bird was the DC-1, which came about through a specification issued by Jack Frye, president of Transcontinental and Western Air (now Trans World Airlines) on August 2, 1932. The letter asked for bids for an all-metal monoplane to be manned by a crew of two, with a maximum gross weight of 14,200 pounds, a range of 1,080 miles at 145 miles per hour, and the capacity to carry twelve passengers. The lucky bidder would receive an order for "ten or more trimotor transport planes."

The letter was sent to the presidents of the Curtiss-Wright, Ford, Martin, Consolidated, and Douglas. Donald W. Douglas, Sr., head of the company that built several mail planes and the famous Douglas World Cruisers that had circumnavigated the globe in 1924, later called the Frye letter "the birth certificate of the DC ships" because it spawned a new era in aircraft design for Douglas that took advantage of new aeronautical developments then coming into being.

Instead of three engines, Douglas engineers came up with a twin-engine design. It would be a low-wing monoplane with semimonocoque fuselage and wings with a then-new "honeycomb" construction. The wheels would retract into the engine nacelles for better streamlining. Three-bladed Hamilton propellers whose pitch could be controlled by the pilot inside the cockpit would be attached to 710-horsepower Wright

Whether in civilian livery or warpaint, the Gooney Bird has done yeoman-like work on every continent over the last fifty years.





On December 17,1935, this first of more than 10,000 other Gooney Birds took to the air for an hour-and-forty-minute flight around the Santa Monica, Calif., airport. A DST (Douglas Sleeper Transport) version of the DC-3, this aircraft was later "drafted" and designated as a C-49E. The plane crashed in October 1942.

Cyclone air-cooled radial engines. The cabin would seat passengers in two rows of six passengers each. There would be a small galley and a lavatory, the latter a "first" for airline passenger comfort. The cabin would be heated and noise-insulated. In the cockpit, the two pilots would have the new gyroscopic instruments and Sperry automatic pilot, making the DC-1 the first commercial plane to be equipped with such devices.

When the Douglas design was submitted to TWA, Frye asked Charles A. Lindbergh, then a consultant, what he thought about it. Lindbergh liked it, but recommended that TWA specify that the aircraft had to prove it could take off with a full load from any point on the TWA system *on one engine!*

The DC-1 Appears

Douglas engineers thought they could meet this latest requirement, so a contract was signed on September 20, 1932. On June 22, 1933, a sleek, shiny craft sixty feet long with a wingspread of eighty-five feet was rolled out into the bright sunlight. On July 1, 1933, the DC-1 (for Douglas Commercial, first model) made its initial flight and began a series of tests that culminated in a successful single-engine takeoff from Winslow, Ariz., on September 4, 1933. When it was obvious that the Douglas design was meeting all the specifications, TWA placed orders for twenty-five more with slightly altered structural changes. The fuselage was to be longer and wingspread wider so that fourteen passengers could be carried. The Douglas engineers saw that they were really designing a new aircraft and labeled it the DC-2.

There was only one DC-1 built because the DC-2 immediately outdated it. The first DC-2 was accepted by TWA on May 22, 1934. Others followed, and one of them was purchased by KLM Royal Dutch Airlines. Christened *Uiver,* it was entered in the 1934 MacRobertson Trophy Race, better known as the London-to-Melbourne Derby. To everyone's surprise, the DC-2 finished second in the 11,000-mile competition to a souped-up British fighter plane. The result was a sudden interest by the world's airlines in this transport, which had not only raced the distance without difficulty but had nonchalantly carried mail and three passengers.

While orders for DC-2s poured into the Douglas factory at Santa Monica, Calif., American Airlines prepared a new set of specifications that called for a passenger capacity of twenty-one. This meant another stretch to the fuselage and a new designation—the DC-3. When the 185th DC-2 or a military variant was pushed out of the hangar, the first DC-3 was rolled out beside it. Three models of the new version were offered: a twenty-one-passenger day plane, a fourteen-passenger luxury DST "Skysleeper," and the fourteen-passenger "club-car-of-the-air" "Skylounge." American Airlines placed the first quantity order and, on June 25, 1936, became the first airline in the world to put the new plane into service. Shortly thereafter, Donald W. Douglas received the coveted Collier Trophy from President Roosevelt for having developed "the most outstanding twin-engined transport plane." This plane, the President said, "by reason of its high speed, economy, and quiet passenger comfort, has been generally adopted by transport lines throughout the United States. Its merit has been further recognized by its adoption abroad, and its influence on foreign design is already apparent."

Air Corps Interest

While the airlines found they could make money with the DC-3, the war clouds gathering in Europe prompted the US Army Air Corps to study all types of aircraft. Experts pored over the DC designs and made exhaustive flight tests of the

DC-2 and -3. The DC-1 was borrowed from TWA briefly to test the Sperry autopilot; 1,600-gallon fuel tanks were installed, which tripled its range.

Eighteen DC-2s, modified to Air Corps specifications, were ordered by the Air Corps and designated C-33s. New specifications were ordered, resulting in new designations: XC-32, C-32A, and C-34. While these were being tested and the DC-3s were being produced to airline specifications, the Air Corps asked for changes, and one DC-2 with a DC-3 tail was constructed and called the C-38. Subsequent tests proved successful, and an order was placed for thirty-five C-39s, which were DC-2s with DC-3 tails and modifications inside to carry cargo.

As was often the case before Pearl Harbor, aircraft procurement decisions were made too often by men who had never flown and were not acquainted with the capabilities and limitations of aircraft. Army officers with no knowledge of flight characteristics insisted that the loading door on the new C-39 be made wider to accommodate a 75-mm field piece. One insisted that the aircraft's floor be rebuilt so that it would remain level while on the ground. Another wanted the floorboards covered with a sandpaper-like material so that paratroopers wouldn't slip as they went out the door (a good idea that was adopted). Others wanted modifications to carry litter patients or urged that it be outfitted as an airborne office or that it drop paratroopers and supplies. Someone asked for the installation of hooks on the outside of the fuselage to carry spare propellers and wing panels. (During World War II in the Pacific, P-40 wings were attached underneath the fuselage of C-47s for transport to front-line fields.)

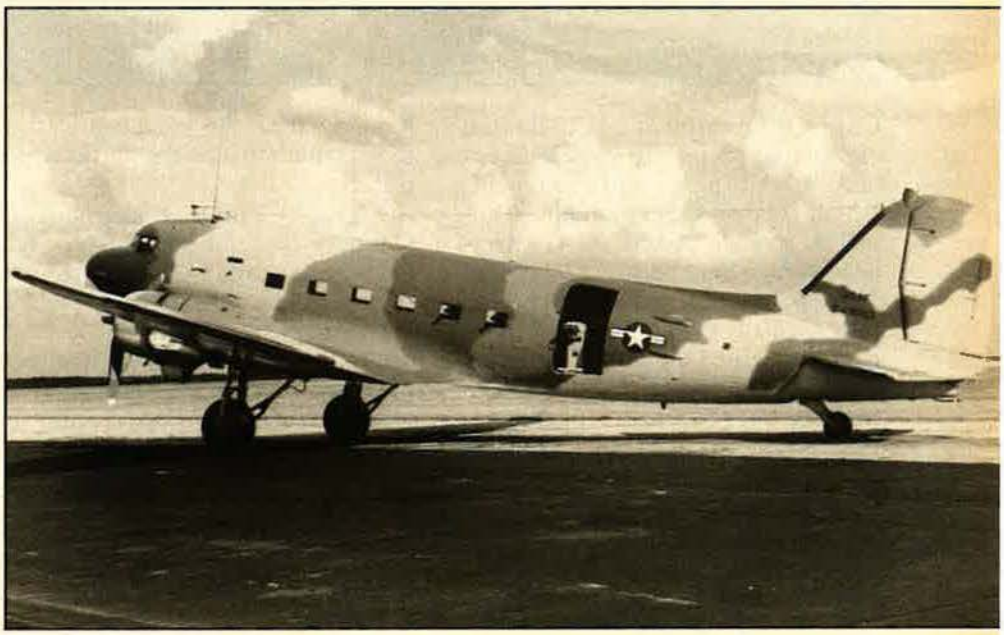
In an attempt to satisfy some of these separate requirements, single purchases were made of a C-41, C-41A, and C-42. The engine horsepower was boosted by the installation of 900-hp Wright Cyclone engines to accommodate the increased weight. Later, the power was again increased by the installation of 1,150-hp Pratt & Whitney engines.

During this prewar period, so many changes were made inside and out that the Air Corps designated the major model as the C-47. However, more changes were made, resulting in a few more variants with more designations: C-48, C-49, C-50, C-51, C-52, C-53, and C-68. Of these, only the C-49 and the C-53 were produced in quantity. The only difference between the C-47 and these two was that the C-49 was the "Skysleeper" version of the DC-3 and the C-53 had a wide door for use as the paratroop model. After the war, a plushed-up version of the C-47 became the C-117, and one Super DC-3, with squared-off wingtips and tail surfaces, designated the YC-129, was converted from a C-47 and purchased by the Air Force. The Navy bought 101 of this converted model. Three more were sold to Capital Airlines.

Stories of the Goon

As could be expected, any plane that has survived a half century of the toughest kind of flying has spawned many stories, most of them seemingly unbelievable but true. Here are some that have been documented.

- A Chinese airline DC-3 that was strafed by a Japanese fighter had to make a forced landing. One wing was completely destroyed. The only available spare wing panel—ten feet shorter—belonged to a DC-2, but had the same wing attaching points. It was put on the DC-3, which, although a little wing heavy, was flown away. Naturally, it was called the DC-2½.
- Another badly shot-up Chinese DC-3 with more than 1,000 bullet holes was patched up with canvas cut from a missionary's awning. Capt. Harold Sweet flew it with sixty-one refugees from Chungking to a military base in India. In flight, many of the patches came off. Sweet recalled, "We could hear an eerie whistle even over the roar of the engines." Fifteen minutes from his destination, Sweet radioed his estimated time of arrival. When he arrived, the base commander asked, "Why did you bother to call us? We could hear you coming fifty miles out!" That Gooney, of course, was named *Whistling Willie*.
- Several Gooneys were used as bombers during World War II. Maj. Archie C. Burdette led two planes of the 317th Troop Carrier Squadron that dropped twenty-eight barrels of napalm on Caribou Island at the entrance to Manila Harbor to burn out the last of the Japanese resisters. In Burma, Maj. Richard L. Benjamin of the 1st Air Commando Group in India piloted a "B-47" that dropped 500-pound bombs and several boxes of fragmentation bombs on an enemy truck convoy driving along the Burma Road.
- Col. Charles D. Farr and Capt. John A. McCann of the 443d Troop Carrier Group in Burma installed



In Vietnam, the venerable Gooney Bird took on a new role and a new designation. The AC-47 Spooky mounted three side-firing 7.62-mm Gatling guns, each with a capacity of 18,000 rounds per minute, for counterinsurgency missions.

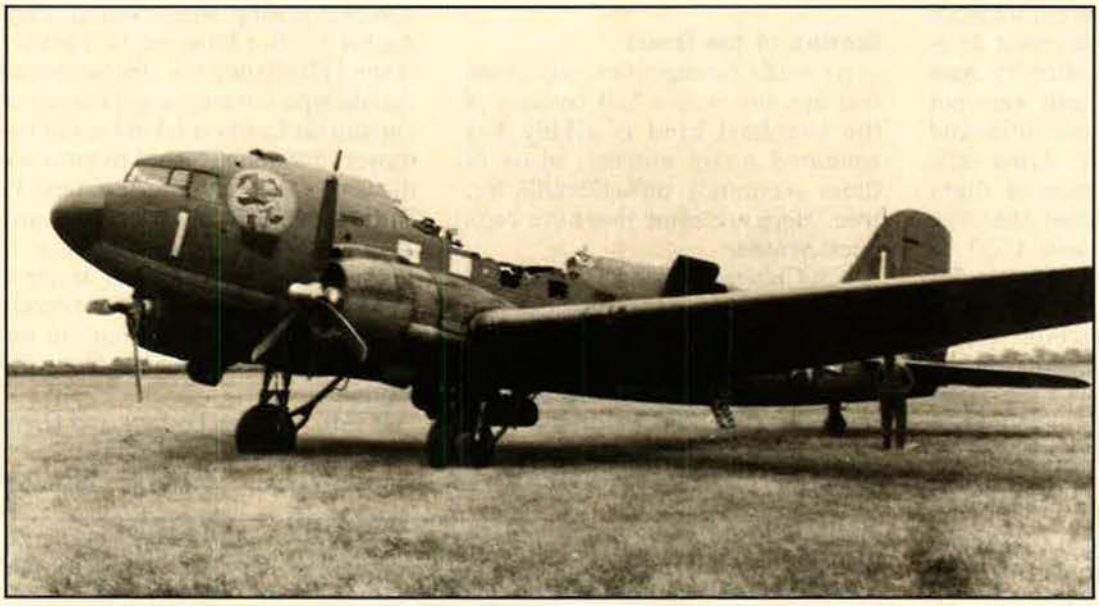
two .50-caliber machine guns in the aft section of two Gooneys. "The guns had a radius of action of about 160 degrees, about eighty degrees of elevation and a like amount of declination, minus, of course, the contour of the tail and wing assembly, about which there was a lot of head-shaking among the pilots," according to McCann. Both planes were used successfully during low-altitude drop missions. Side-firing, pilot-aimed 7.62-mm Gatling guns were installed on Gooneys in Vietnam to give them a new sobriquet—"Puff the Magic Dragon" or "Spooky," and a new designation, AC-47.

• Although designed to carry about 5,000 pounds of freight, Gooneys have carried much more. Capt. John Mowat once hauled eighty live sheep and sixteen shepherds with baggage and equipment, which totaled 11,000 pounds. During the Berlin Airlift, C-47s averaged somewhere between 6,000 and 7,000 pounds of varied cargo. One pilot, whose manifest said he was hauling pierced aluminum planking from Wiesbaden, actually hauled a load of pierced *steel* planking. Hardly able to get above the treetops along the corridor to Berlin, he flew the distance at full throttle and crunched down his Gooney at Tempelhof to discover that he had just delivered about 13,500 pounds!

• The Gooney has often carried many more passengers than the twenty-one the designers originally intended. Jimmy Doolittle, called back to the States after the Tokyo Raid in 1942, was flown out of China on a China National Airways Corp. (CNAC) DC-3. "There were more than seventy-five people on that plane," Doolittle recalled. "Twenty-one women, twenty-one children, ten Indians, twenty-one soldiers, and one exhausted lieutenant colonel named Doolittle. When we got on the ground, I told the pilot that if I'd known he was going to take off with that many people aboard, I would have walked home." This wasn't a record, however. More than ninety refugees were flown out of Peruvian flood areas in an Air Force Gooney in 1947. During the Vietnam War, a DC-3 with three crew members evacuated ninety-eight refugee orphans and five attendants from the village at Da Lat to set what must be the all-time record.

• The damage sustained by Gooneys that continued to fly has become legendary. In addition to several midair collisions in which the Gooneys survived, battle damage to many was so severe that they never flew again after being safely landed. Capt. Jack Farris, pilot of *Geronimo,* which was carrying paratroopers, had a six-foot hole blasted in the fuselage, lost a portion of the rudder, and managed to nurse the aircraft across the Mediterranean after a mission to southern France. Another Gooney collided with a German fighter that plowed through the center of the fuselage, causing severe structural damage but not enough to prevent the crew from bringing it home.

• Any collection of stories about the Gooney Bird would not be complete without the tale of the time one of them was officially credited with bringing down a Japanese Zero. This C-47, piloted by Capt. Hal M. Scrugham, was flying a routine cargo mission in Burma when his plane was attacked by a pair of enemy fighters. He pushed the Gooney into a dive to the treetops. The Zeros followed. The first one broke off the attack as the Gooney leveled off. The second one tried to ram the helpless transport as Scrugham pushed the throttles full forward. The Zero knocked the rudder off the Gooney, but did not bring it down. The Zero kept right on going and exploded against the mountain. The other enemy fighter fled.



The Gooney had a reputation for being a tough old bird. Despite major structural damage to its center section after a midair collision, this C-47 made it back to its base.

Animal and Amateur Aviators

Although the tales above have been verified, there are some that cannot. Yet they persist in aviation lore. For instance, there's the story of the C-47 that ran out of fuel over Missouri. The crew parachuted and watched as the Gooney gently circled and then landed gracefully wheels-up in a pasture. Another crew bailed out of a Gooney when both engines malfunctioned en route to Tempelhof during the Berlin Airlift, leaving the crew chief's dog aboard. The plane's engines, acting erratically, kept the Gooney airborne far into East Germany, where it landed in a farmer's

field with only minor damage. The dog was unhurt. It is said that to this day the Russians cannot figure out how the Americans taught a dog to fly.

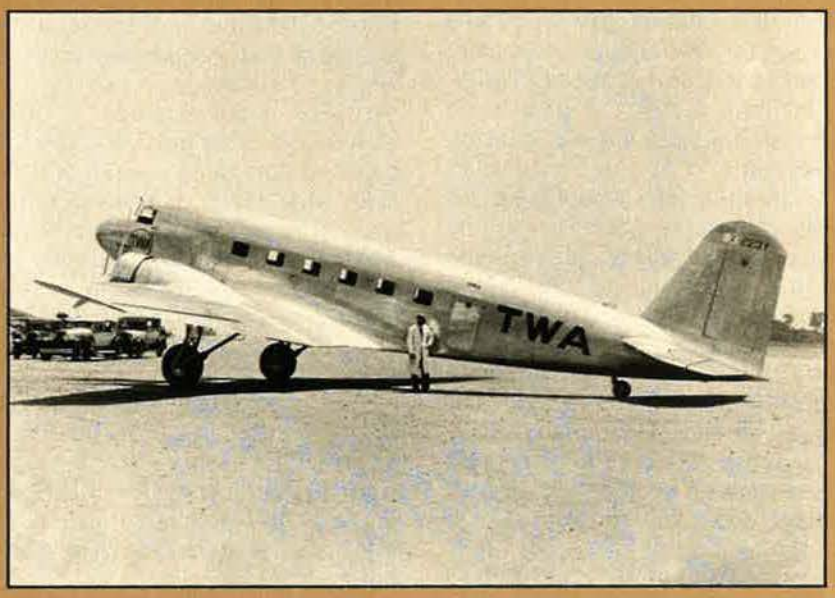
Flying the Gooney was not difficult for a qualified pilot, but transition training was necessary. Or was it? A nineteen-year-old mechanic at Naha AB on Okinawa didn't believe he needed any instruction for his flight in May 1962. The airman, assigned to the 51st Field Maintenance Squadron, for reasons only he and his psychiatrist know, decided he wanted to fly one of the base's Gooneys. Although he had only seven hours of instruction in a light, single-engine plane, he was apparently convinced that the C-47 was so easy to fly that he could do it alone.

When no one was looking on a late afternoon, he boarded a Gooney, started engines, and taxied out without radio contact with the tower. The base was alerted, and when it was established who was aboard, Capt. Dallas H. Pope and Lt. Col. Robert E. Woody took off in another Gooney to try to talk the airman down. As they flew formation and began to talk with him, they found that the cover to the airspeed pitot tube had not been removed, but had been partially torn by the wind. His airspeed reading was about twenty percent less than the actual speed.

Colonel Woody, flying copilot, began instructing the airman in a calm voice how to reduce the power and prepare for a landing.

The first pass at the field was too high, apparently because the airman could not bring himself to pull the throttles back. Colonel Woody instructed him to go around and then set him up for a long, straight-in approach. This time the errant Gooney got down to fifty feet and had to go around again. A report of the incident tells what happened next:

"By now the sun had dropped below the horizon, and dusk was beginning to fall. A thin layer of scud clouds had begun to form at about 800 feet, and concern was mounting. Captain Pope decided that he could best judge [the airman's] approach by positioning the nose of his plane underneath the tail of [the airman's] craft. Another long,



The grandfather of all Gooney Birds is the lone DC-1. The plane was used as a flying laboratory and set many speed records. After crashing in Spain in 1940, parts of the plane were salvaged and are still used on religious holidays there.

Whatever Happened to the DC-1?

After TWA took delivery on the DC-1, it was used for a number of flight tests—so many that the press dubbed it "the laboratory plane." In February 1934, Jack Frye and Eddie Rickenbacker set a nonstop coast-to-coast record from Burbank to Newark, taking the last load of mail east before President Roosevelt canceled all air mail contracts in February 1934.

Later that year, the Department of Commerce and the Army Air Corps used the DC-1 to test the new Sperry automatic pilot, which was linked to a radio compass and used for navigational purposes. Additional gas tanks were installed to boost the fuel capacity from 500 to 1,600 gallons.

In 1935, two years after its maiden flight, the DC-1 was loaned to the National Aeronautic Association for an attempt to set new records for speed, distance, and load. Within a three-day period, it smashed nineteen marks. Following this, Howard Hughes, largest TWA stockholder, planned a record-breaking round-the-world flight. He decided that the DC-1 was the airplane for the job and bought it from TWA for this purpose in the summer of 1936. He modified it further by installing larger engines and increasing the fuel capacity to get a 6,000-mile range. After exhaustive tests, however, Hughes chose the faster Lockheed 14, in which he later circled the globe in ninety-one hours.

Hughes sold the DC-1 to Viscount Forbes, the Earl of Granard, in May 1937. By that time, the DC-1 had accumulated 1,370 flying hours.

The DC-1's new owner kept the plane for about three months and then sold it to a French company. Shortly afterward, it turned up in Spain just as the civil war was drawing to a close. By September 1938, the Spanish government bought it for L.A.P.E. (*Lineas Aeros Postales Espanoles.*) It was painted a dull brown and put into service between Paris, Barcelona, and Albacete. It was reportedly ordered on reconnaissance missions for the Spanish Republican Army.

When Barcelona fell in March 1939, government officials fled in the DC-1 to Toulouse, France. When the war was over, Nationalist Spanish forces flew it back to Madrid, where it was handed over to the *Sociedad Anonima de Transportes Aeros,* later named Iberia Airlines. The camouflage paint was removed, and the DC-1 was christened *Negron* after a famous Nationalist pilot who had been killed in action. It flew on regular schedules connecting cities in Spain.

On a morning in December 1940, *Negron* arrived at Malaga from Tetuan with Capt. Rudolfo Bay in command. On takeoff from Malaga, the left engine failed, and the aircraft crashed off the end of the runway. No one was injured, but the aircraft was wrecked beyond repair.

However, the DC-1 is still making a contribution. Monks from the nearby Malaga cathedral salvaged metal spars and skin from the wreckage to make *andas,* or portable platforms that are used during religious holidays to carry the image of the Blessed Virgin through the streets. Thus, the Granddaddy of all Gooney Birds is still doing a job that requires strength and dependability. Somehow, it seems right that the DC-1 was destined to live on in this fashion.

straight-in approach was established. The landing gear and flaps were set for the landing miles from the runway. Colonel Woody established [the airman's] approach speed at slightly above landing speed and told him to concentrate on maintaining his wings level for lineup with the runway. He told the airman to disregard his instruments and to look only at the runway and follow precisely his instructions on use of the throttles. By this method, [the airman] was talked down to within one foot of the runway surface, at which time Colonel Woody instructed him to cut the power and concentrate on keeping the aircraft straight down the runway until it coasted to a stop. When the plane was landed and under control, [the airman] taxied to base operations and shut down the engines."

Flying on Forever?

Will the Gooney last forever? Although no one is certain, it is estimated that there are about 500 DC-3/C-47s still flying somewhere in the world—and maybe a few not flying that will be resurrected to fly again. One disabled Gooney that had been hoisted atop a restaurant in South Africa for several years after World War II was restored to airline service. A Gooney carcass used as a chicken coop in Alabama was put back into flying shape as an executive transport in the 1960s. Another that had landed on a frozen Canadian lake fell through the ice and sank. A salvager lifted it off the bottom, drained it, and when the lake was frozen again, flew it away. And there are several Gooneys abandoned by the Navy at the base at McMurdo Sound in Antarctica that are frozen in the ice there. Someday they may be deiced to fly again.

A ski-equipped Air Force search-and-rescue C-47 was dispatched to pick up the crew of a downed Icelandic Airlines DC-4 on top of Vatna Jokull Glacier in Iceland in the early 1950s. It landed safely, but despite repeated attempts to take off with JATO bottles, the Gooney wouldn't budge. Bad weather set in, and the C-47 was abandoned, but not forgotten. Two Icelanders—Kris Oleson and Alfred Eliasson, owners of the crashed DC-4 and nearly bankrupt—wanted that C-47 to continue flying. They offered the Air Force $700 for it, and the offer was accepted. After digging through the snow and bulldozing a takeoff strip, they flew it out at a cost of about $5,000. The Gooney was flown to England for modification, but before work began, a Spanish airline executive offered the plucky pair $80,000, which they promptly accepted. The $74,300 profit enabled them to make a down payment on a DC-6 and keep their airline in business.

H. L. "Smokey" Roland of Cardiff-by-the-Sea, Calif., knew what to do with a Gooney he purchased from an airline boneyard in Arizona in the 1970s. He made it into a mobile home. And the airport at Whitehorse, Canada, uses an abandoned Gooney as a wind tee.

Those of us who have piloted the lovable Gooney Bird feel forever privileged. We agree with the words that are often used to describe it—"irreplaceable," "indomitable," "fabulous," "jack-of-all-trades." And we agree with the tribute paid to it by Braniff Airlines Capt. Len Morgan, who said, "I came to admire this machine, which could lift virtually any load strapped to its back and carry it anywhere in any weather, safely and dependably. The C-47 groaned, it protested, it rattled, it leaked oil, it ran hot, it ran cold, it ran rough, it staggered along on hot days and scared you half to death, its wings flexed and twisted in a horrifying manner, it sank back to earth with a great sigh of relief—but it flew and it flew and it flew."

It was an old friend who brought us through thousands of hours safely and fairly comfortably. (No one ever solved the leaky windshield problem.) And we will still stop and look skyward when we hear those faithful engines purring in unison. That sound is rarer now, but we shouldn't despair. The 1986 World Exposition at Vancouver, Canada, will feature an air show next August 6–10 in which as many as fifty DC-3/C-47s from all over the world, led by a DC-2, will make a "flypast" to honor the Gooney's golden anniversary. There will be many of us there who will view that sight through a few tears. The Grand Old Lady of the Skies will forever have a warm place in our affections and memories.

A Gooney on Ice

How long will there be a Gooney flying?

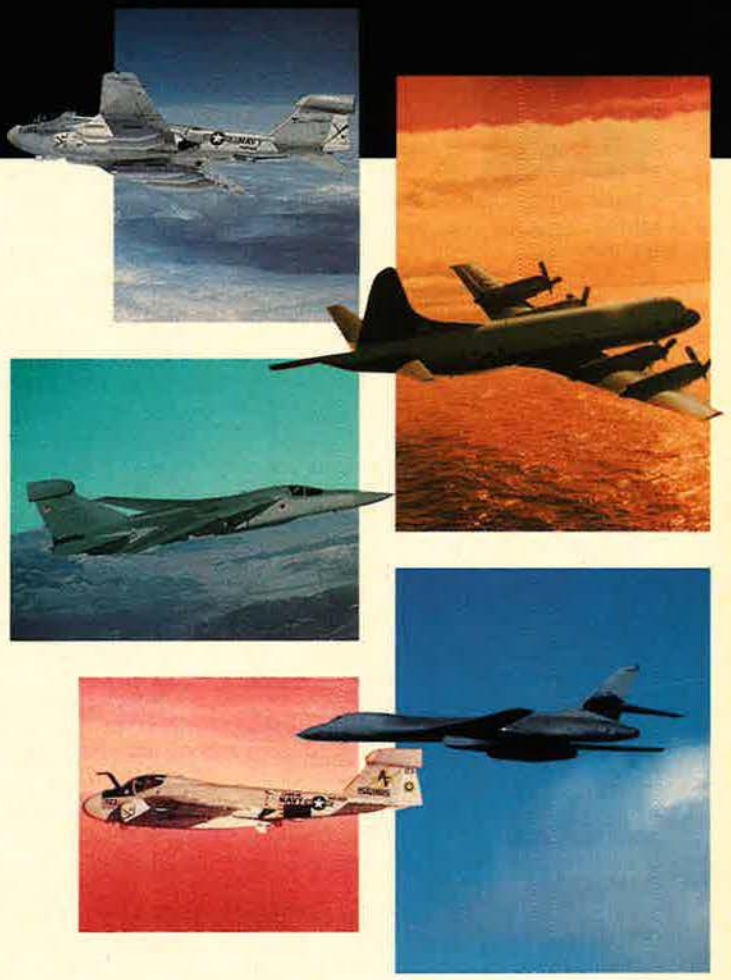
No one knows, but it's possible that at least one will be in the air 600 years from now. That's because Maj. Ralph H. Tate, while on instruments, flew one onto a glacier high in the Alps in 1946 with twelve souls aboard. The Gooney was undamaged as it plowed into soft snow. All aboard were rescued by Swiss mountaineers after extensive search and rescue attempts that captured the world's attention for more than two weeks. The plane was quickly covered over with snow, and no trace of it could later be seen from the air.

The world's press soon forgot the incident, but not the Swiss. They collected the photos, magazines, and newspapers featuring the crash and rescue and placed them in their museum at Bern. The next spring, those who had participated in the rescue climbed back up to the plateau, located the plane, dug down to it, and placed a capsule inside. The capsule contained copies of the articles, photos, and news items. The site was quickly covered up again.

This gesture had meaning to the Swiss. It was the first time that a transport plane had crashed in the Alps without killing everyone on board. The rescue had been a classic from beginning to end, with literally hundreds of people of many nationalities pitching in to save lives. But the reason for locating the plane and placing the capsule inside was because Swiss glaciologists believe that Tate's Gooney will sink slowly through the ice until it slides downhill and emerges at the bottom sometime in the year 2500—completely intact. ■

Col. C. V. Glines, USAF (Ret.), is the coauthor (with retired Lt. Col. Wendell F. Moseley) of three books about the DC-3: Grand Old Lady, The DC-3: The Story of a Fabulous Airplane, *and* The Legendary DC-3. *Both authors have more than 1,000 hours of pilot time in the Gooney Bird. Colonel Glines's most recent article for* Air Force *Magazine was "Jimmy Doolittle's Greatest Contributions" in the September 1985 issue.*

The Threats Are There



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EATON

VIEWPOINT

A New High Ground

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

Spaatz said it long before man moved into space: "Whoever can go highest over the earth's surface can eventually control it if he has a sufficient number of vehicles."

The future of the Air Force may be at stake in what's happening a few miles east of Colorado Springs, Colo., where, at the beginning of the Great Plains, the Consolidated Space Operations Center is taking shape. This Center, or CSOC, to use its inevitable acronym, will serve as the functional headquarters for the newly formed Unified Space Command.

The Air Force has had its eyes on space since the days of Gen. Tommy White's tenure as Chief of Staff, but there have been a lot of frustrations in between. White's great dream of a Manned Orbiting Laboratory fell out of the budgets long ago, a victim, as much as anything, of a national predilection for civilian management of space exploration.

The explorers could be military officers, as they have mainly been, but NASA gave the early American space effort a reassuring nonmilitary facade. That the Soviet competition was plainly military didn't really matter in the early years. Space activity was on the low end of the learning curve, and national prestige, rather than strategic advantage, was what was mostly at stake.

As usually happens, however, one thing leads to another. The first warplanes began innocently enough, widely viewed as of little military use beyond serving as observation posts and deliverers of messages. Then someone put a machine gun aboard, and the light dawned. The air above the battlefield had become the new high ground. The outcome of World War II hinged on control of the air every bit as much as did Wellington's victory at Waterloo on control of that ridge near Mont St. Jean.

Now a new high ground is beginning to emerge. When the Space Operations Center becomes operational next year, its initial responsibilities will include management of the Global Positioning System, a constellation of eighteen satellites designed to make navigation truly precise. Civilian ships and aircraft will use slightly degraded information, while the ultimate capability will be reserved, in coded form, for our forces. Foot soldiers in the middle of a jungle on a dark night will be able to know exactly, within a few yards, where they are, and any bare airstrip will be instantly equipped with navigation and landing aids.

Then there is the Milstar, the worldwide military communications satellite, jam-resistant and hardened, which will also be controlled by the CSOC.

Space, in short, has long since become a military asset. Even in the unlikely event that the search for a missile defense is negotiated away, the vast regions above the atmosphere may still hold the key to our future security.

They almost certainly hold the key to the future of the Air Force. The battle for an independent air force in the years before and after World War II centered initially on the indivisibility of airpower. As we know, that fight ended with four air forces instead of one. The clinching argument for a separate US Air Force was the role of strategic airpower and the intercontinental bomber.

Now a new era is beginning. The modern-day Wright brothers have landed on the moon, and Shuttle missions have become routine, even though their spectacular launchings will one day be historic curiosities to a generation whose transatmospheric vehicles take off and land on their own.

The new Space Command is still feeling its way, its initial activities essentially peaceful. But the day is coming when space is going to be militarily contested, despite the fervent wishes of those who would like to put it off limits.

Militarization of space is just as inevitable as was the militarization of the atmosphere and—long before that—the militarization of the oceans. The Royal Navy gave the world unprecedented years of relative peace and stability by its domination of the seas. The United States Air Force performed a similar service during the years of our nuclear delivery dominance. With the emergence of space as the new key to military supremacy, there will surely be zealots who see the need for a new service, the real-life version of Star Fleet in the Hollywood fantasy.

Juggling the priorities between earthly essentials like SAC, TAC, and MAC and the reach for the heavens will be a tricky job for Air Force leaders in the years to come. Nonetheless, the future role of the Air Force is very much at stake. If Hitler's priorities had not been so addled, the Me-262, in quantity and earlier, could have changed the whole complexion of World War II. The Luftwaffe would have held the high ground. Someone is always going to hold it once he has figured out a way to get there.

A long time ago, Gen. Carl Spaatz, a man not given to idle chatter, made an observation about the then-distant future:

"Whoever can go highest over the earth's surface," he said, "can eventually control it if he has a sufficient number of vehicles."

A simple enough statement, but an awful lot to think about. ■

JANE'S

ALL THE WORLD'S AIRCRAFT SUPPLEMENT

DECEMBER 1985

McDonnell Douglas/British Aerospace AV-8B of VMA-331, first US Marine Corps combat unit to operate this V/STOL close support aircraft

McDONNELL DOUGLAS/BAe

McDONNELL DOUGLAS CORPORATION: Box 516, St Louis, Missouri 63166, USA
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McDONNELL DOUGLAS/BRITISH AEROSPACE HARRIER II

US Marine Corps designations: AV-8B and TAV-8B
RAF designation: Harrier GR. Mk 5
Spanish Navy designation: EAV-8B

Initial enthusiasm of the US Marine Corps for an advanced version of the AV-8A Harrier resulted in Anglo-American studies as long ago as 1973. After these foundered in 1975, McDonnell Douglas and Hawker Siddeley/British Aerospace at first pursued their own separate lines of development, both aimed broadly at doubling the payload/radius capability of the Harrier/AV-8A without departing too radically (or expensively) from the existing airframe/engine combination. The two companies subsequently joined forces in the current Harrier II programme, initially for the US Marine Corps (**AV-8B** and **TAV-8B**) and the Royal Air Force (**Harrier GR. Mk 5**).

As a first step, McDonnell Douglas and the USMC modified two AV-8As as prototype YAV-8Bs, these flying for the first time on 9 November 1978 and 19 February 1979. Four full scale development (FSD) AV-8Bs were ordered on 12 April 1979, and the first of these made its initial flight on 5 November 1981. The remaining three first flew on 17 April, 9 April, and 4 June 1982 respectively. Two airframes were built for structural and fatigue testing.

The decision to commit the AV-8B to production was announced on 24 August 1981, at which time the British Ministry of Defence and the main industrial partners in the programme indicated initial requirements of 257 for the USMC and 60 for the

AV-8B of VMA-331 preparing for take-off

RAF. The total current USMC requirement is for 328 production aircraft (300 AV-8Bs and 28 two-seat TAV-8Bs), of which the first 12 ('pilot production') AV-8Bs were ordered in FY 1982. The first of these made its initial flight on 29 August 1983. Subsequent orders were placed in FYs 1983 (21 aircraft), 1984 (27, including one TAV-8B) and 1985 (32, including two TAV-8Bs); funding for a further 46 AV-8Bs was requested in FY 1986, and production is planned to continue into the early 1990s. The AV-8B is intended to re-equip three fleet operational AV-8A/C squadrons (VMA-331, VMA-542, and VMA-513), one training squadron (VMAT-203), and five A-4 Skyhawk squadrons by 1989. The first pilot production AV-8B was delivered to the USMC in October 1983. The first operational AV-8B squadron, VMA-331, was commissioned at MCAS Cherry Point, North Carolina, on 30 January 1985. Initial operational capability (IOC) was scheduled for late 1985, and full operational readiness with 20 AV-8Bs by mid-1986.

First flight of the two-seat TAV-8B is scheduled for 1986. This version will have a longer forward fuselage and taller vertical tail than the AV-8B, with two cockpits in tandem. For weapons training it will be able to carry Mk 76 practice bombs, LAU-68 rocket launchers, or 1,135 litre (300 US gallon) external fuel tanks. BAe will be the major subcontractor for the TAV-8B.

Deliveries of the GR. Mk 5 to the Royal Air Force, scheduled to begin in late 1986, are being preceded by two development aircraft for weapons system certification flying, plus—since most GR. Mk 5s are expected to be based in RAF Germany—a fatigue test airframe to clear the aircraft for the rigorous central European low-level operating environment. First flight by a GR. Mk 5 (ZD318) was made on 30 April 1985.

First export customer for the Harrier II is the government of Spain, which is acquiring 12 **EAV-8Bs**, assembled by McDonnell Douglas, to supplement its carrier-based AV-8A Matadors. Deliveries are due to begin in late 1987.

A programme to develop a night attack version of the Harrier II was announced by McDonnell Douglas in November 1984, and was to be followed by a memorandum of understanding with BAe, subject to British Ministry of Defence approval. A USMC prototype of this version should fly in May 1987, with production deliveries starting in September 1989; any RAF night attack version would be undertaken as a retrofit programme. Changes being considered for the American version include the addition of a FLIR system, use of night vision goggles and changes in cockpit lighting, and a Smiths Industries display computer and modified HUD.

Aim of the AV-8B is to achieve the improved performance capability required by aerodynamic means, while retaining the same basic F402 (Pegasus 11) engine, thus saving the cost of developing the Pegasus 15 originally considered necessary for the advanced version. Several growth versions of the current Pegasus 11-21, such as the Pegasus 11-61, are being considered for future developments of the Harrier II.

Features of the design are the use of graphite epoxy (carbonfibre) composite materials for the wings, and parts of the fuselage and tail unit; adoption of a supercritical section wing; addition of lift improvement devices (LIDs) comprising fuselage mounted or under-gun-pod strakes and a retractable fence panel forward of the pods, to augment lift for vertical take-off; larger wing trailing-edge flaps and drooped ailerons; redesigned forward fuselage and cockpit; redesigned engine air intakes to provide more VTO/STO thrust and more efficient cruise; and the Hughes Angle Rate Bombing Set. The leading-edge root extensions (LERX) developed originally by British Aerospace for the UK designed Big Wing Harrier (see 1980–81 *Jane's*) have also been adopted as standard, although they are now only 64 per cent of the size originally proposed. This feature adds considerably to the AV-8B's instantaneous turn rate, enhancing still further its air combat capability. The landing gear is strengthened to cater for the higher operating weights and greater external stores loads made possible by these changes.

Work split on the airframe for the AV-8B is 60 per cent to McDonnell Douglas and 40 per cent to British Aerospace; the GR. Mk 5 work split is 50 per cent to each manufacturer. On any future third party orders McDonnell Douglas would make 75 per cent of the aircraft deliveries and British Aerospace 25 per cent. Each manufacturer is responsible for the systems in those parts of the airframe which are its concern, and for their installation. British Aerospace provides the complete reaction control system for all aircraft in the programme, and undertakes final assembly of aircraft for the RAF. McDonnell Douglas assembles the aircraft for the USMC and Spain. Total programme value is estimated at $9,100 million for US production and $1,400 million for UK manufacture; planned peak production rates are four and a half and two aircraft per month respectively.

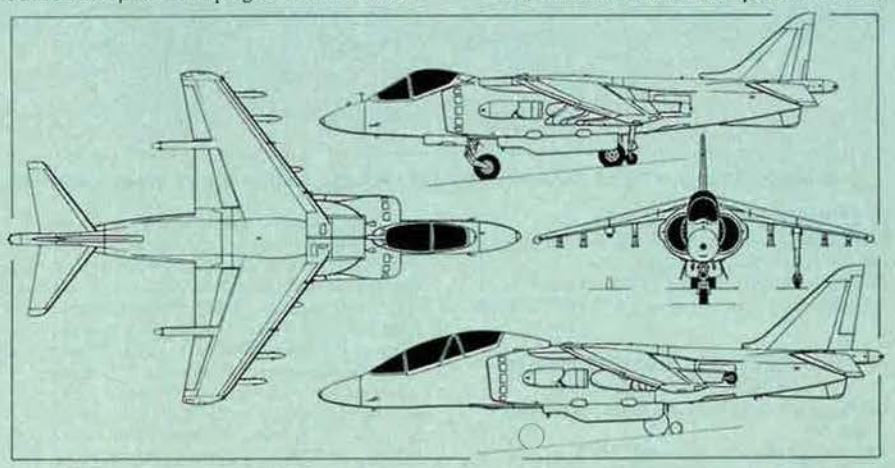
Pratt & Whitney manufactures up to 25 per cent by value of the engines for the USMC aircraft; Rolls-Royce builds the remainder. The production engine is the F402-RR-406 (Pegasus Mk 105), an improved version of the Pegasus 11 with new features designed to offer substantially increased engine life and reduced peacetime operating costs. Beyond the current production engine, growth engines may offer some 13.3 kN (3,000 lb) more thrust. Growth engines will also form the basis of a supersonic engine using plenum chamber burning (PCB), and all four major airframe/engine partners are engaged in jointly funded R&D for the eventual development of a supersonic V/STOL combat aircraft. A digital engine control system (DECS) for the F402 is under development by Dowty and Smiths Industries, and flight testing on an AV-8B began in 1984.

The following description applies to the production AV-8B and the Harrier GR. Mk 5:

TYPE: Single-seat V/STOL close support and (RAF only) reconnaissance aircraft.

WINGS: Cantilever shoulder-wing monoplane. Low aspect ratio sweptback wings, with non-swept inboard trailing-edges and curved leading-edge root extensions (LERX). Span and area increased by approx 20 per cent and 14.5 per cent respectively compared with Harrier/AV-8A. Supercritical aerofoil section, with thickness/chord ratio of 11.5% at root, 7.5% at tip. Leading-edge sweep 10° less than that of Harrier/AV-8A. Marked anhedral. One-piece structure, of mixed construction, with extensive use of graphite epoxy (carbonfibre) and other composite materials in the main multi-spar torsion box, ribs, skins, flaps, ailerons, LERX, and outrigger pods and fairings. Leading-edges (reinforced against bird strikes) and wingtips of aluminium alloy. Wide chord single-slotted trailing-edge flaps, with flap slot closure doors. Drooping ailerons, actuated by Fairey hydraulic jacks. Jet reaction control valve at each wingtip. LERX for RAF aircraft manufactured by BAe; all other wing manufacture and assembly by McDonnell Douglas.

FUSELAGE: Conventional semi-monocoque safe-life structure of frames and stringers, generally similar to that of AV-8A, but longer, due to provision of a new forward fuselage built largely of graphite epoxy composite material. Centre and rear fuselage mainly of aluminium alloy, except for forward and rear underfuselage heatshields, and small area immediately forward of the windscreen, which are of titanium. Lift augmenting underfuselage devices consist of a fixed strake on each of the two ventral gun packs, plus a retractable fence between forward edges of gun packs, just aft of forward main landing gear unit. During VTOL modes the 'box' formed by these surfaces, which are made of composite materials,



McDonnell Douglas/British Aerospace AV-8B Harrier II, with added side view (bottom) of two-seat TAV-8B *(Pilot Press)*

traps the cushion of air bounced off the ground by the engine exhaust, providing sufficient additional lift to enable the AV-8B to take off vertically at a gross weight equal to its maximum hovering gross weight. Access to engine through top of fuselage, immediately ahead of wing. Large forward hinged airbrake beneath fuselage, aft of rear main landing gear bay. Jet reaction control valves in nose and tailcone. McDonnell Douglas is responsible for manufacture of all forward and forward centre-fuselages, including nosecones, air intakes, heatshields, engine access doors, and forward fuel tanks; and for the underfuselage fences and strakes. British Aerospace builds, for all aircraft, the rear centre and rear fuselages, including blast and heatshields, centre and rear fuel tanks, dorsal air intakes, and tail bullets. Fuselage assembly is by McDonnell Douglas for USMC and by BAe for RAF aircraft.

TAIL UNIT: One-piece variable incidence tailplane, with marked anhedral, differing in planform from that of AV-8A in having constant sweep on leading-edges and reduced sweep on trailing-edges. Tailplane is built mainly of graphite epoxy, with aluminium alloy tips and leading-edges, and is operated by Fairey tandem irreversible hydraulic jacks. Aluminium alloy fin, with dielectric tip; manually operated graphite epoxy composite rudder, with inset trim tab. Dorsal airscoop, at base of fin, for equipment bay cooling system. Ventral fin under rear fuselage. Fins and rudders for all aircraft, and tailplanes for RAF aircraft, built by BAe; tailplanes for USMC aircraft built by McDonnell Douglas.

LANDING GEAR: Retractable bicycle type of Dowty Rotol design, permitting operation from rough unprepared surfaces of very low CBR (California Bearing Ratio). Hydraulic actuation, with nitrogen bottle for emergency extension. Single steerable nosewheel retracts forward, twin coupled mainwheels rearward, into fuselage. Small outrigger units, at approx mid span between flaps and ailerons, retract rearward into streamline pods. Telescopic oleo-pneumatic main and outrigger gear; levered suspension nosewheel leg. Dunlop wheels, tyres, multi-disc carbon brakes and anti-skid system. Mainwheel tyres (size 26.0 × 7.75-13.00) and nosewheel tyre (size 26.0 × 8.75-11) all have pressure of 8.62 bars (125 lb/sq in). Outrigger tyres are size 13.5 × 6.00-4.00, pressure 10.34 bars (150 lb/sq in). McDonnell Douglas responsible for entire landing gear system.

POWER PLANT: One 95.86 kN (21,550 lb st) Rolls-Royce F402-RR-406 (Pegasus 11-21) vectored-thrust turbofan engine in production AV-8B; one 96.75 kN (21,750 lb st) Pegasus Mk 105 in Harrier GR. Mk 5. Zero-scarf front nozzles. Air intakes have an elliptical lip shape, leading-edges reinforced against bird strikes, and a single row of auxiliary intake doors. Integral fuel tanks in wings; total internal fuel capacity (fuselage and wing tanks) 4,163 litres (1,100 US gallons; 915 Imp gallons). Retractable in-flight refuelling probe. Each of the four inner underwing stations capable of carrying a 1,135 litre (300 US gallon; 250 Imp gallon) auxiliary fuel tank.

ACCOMMODATION: Pilot only, on zero/zero ejection seat (Stencel for USMC, Martin-Baker for RAF), in pressurised, heated, and air-conditioned cockpit. AV-8B cockpit raised approx 30.5 cm (12 in) by comparison with AV-8A/YAV-8B, with redesigned one-piece wraparound windscreen (thicker on RAF aircraft than on those for USMC) and rearward sliding bubble canopy, to improve all-round field of view. Windscreen deicing and windscreen wiper. Windscreens and canopies for all aircraft manufactured by McDonnell Douglas.

SYSTEMS: Full details not yet announced, but generally similar to those of Harrier/Sea Harrier. Announced systems include Westinghouse variable speed constant frequency (VSCF) solid state electrical system, Lucas Mk 4 gas turbine starter/APU, Clifton Precision onboard oxygen generating system (OBOGS), and Graviner Firewire fire detection system.

AVIONICS AND EQUIPMENT: Include dual Collins RT-1250A/ARC UHF/VHF com, R-1379B/ARA-63 all-weather landing receiver, RT-1159A/ARN-118 Tacan, RT-1015A/APN-194(V) radar altimeter, Sperry CV-3736/A com/nav/identification data converter, Bendix RT-1157/APX-100 IFF, Litton AN/ASN-130A inertial navigation system, AiResearch CP-1471/A digital air data computer, Smiths Industries SU-128/A dual combining glass head-up display and CP-1450/A display computer, IP-1318/A CRT Kaiser digital display indicator, and (RAF aircraft only) Ferranti moving map display. AN/ALR-67(V)2 fore/aft looking radar warning receiver, and Goodyear flare/chaff dispenser (in lower rear fuselage). Primary weapon delivery sensor system for AV-8B and GR. Mk 5 is the Hughes Aircraft AN/ASB-19(V)2 Angle Rate Bombing Set, mounted in the nose and comprising a dual-mode (TV and laser) target seeker/tracker. This system functions in conjunction with the CP-1429/AYK-14(V) mission computer, the Lear Siegler AN/AYQ-13 stores management system, the display computer and its associated cockpit displays, the head-up display, and the digital display indicator. Flight controls that interface with the reaction control system are provided by the Sperry AN/ASW-46(V)2 stability augmentation and attitude hold system currently being updated to the high AOA capable configuration. RAF aircraft will have an accident data recorder. Backup standby mechanical instrumentation includes airspeed indicator, altimeter, angle of attack indicator, attitude indicator, cabin pressure altitude indicator, clock, flap position indicator, horizontal situation indicator, standby compass, turn and slip indicator, and vertical speed indicator. Other equipment includes anti-collision, approach, formation, in-flight refuelling, landing gear position, auxiliary exterior lights, and console, instrument panel, and other internal lighting.

ARMAMENT AND OPERATIONAL EQUIPMENT: Two underfuselage gun/ammunition packs, mounting a five-barrel 25 mm cannon based on the General Electric GAU-12/U, with 300 rounds, in the AV-8B; or two 25 mm Royal Ordnance Factories cannon with 200 rds (derived from the 30 mm Aden) in the GR. Mk 5. Single 258 kg (570 lb) stores mount on fuselage centreline, between gun packs. Three stores stations under each wing on AV-8B, the inner one capable of carrying a 907 kg (2,000 lb) store, the centre one 454 kg (1,000 lb), and the outer one 286 kg (630 lb). The four inner wing stations are 'wet', permitting the carriage of auxiliary fuel tanks. Including fuel, stores, weapons and ammunition, and water injection for the engine, the maximum useful load for vertical take-off is approximately 3,062 kg (6,750 lb), and for short take-off nearly 7,710 kg (17,000 lb). Typical weapons include two or four AIM-9L Sidewinder, Magic, or AGM-65E Maverick missiles; up to sixteen 500 lb general purpose bombs, 12 cluster bombs, ten Paveway laser guided bombs, eight fire bombs, ten rocket pods, six chaff or flare pods, or (in addition to the underfuselage gun packs) two underwing gun pods. ML Aviation BRU-36/A bomb release units standard on all versions. Provision for AN/ALQ-164 defensive ECM pod on centreline pylon (AV-8B). RAF aircraft will have two additional underwing weapon stations, for Sidewinder air-to-air missiles, ahead of the outrigger wheel fairings; a nose-mounted infra-red reconnaissance sensor; and a Marconi Defence Systems Zeus internal ECM system comprising an advanced radar warning receiver, and a multi-mode jammer with a Northrop RF transmitter.

This view of an RAF Harrier GR. Mk 5 illustrates well the pilot's wide field of view

Three or four stores stations under each wing reflect the doubled payload/range of the Harrier II compared with earlier versions

DIMENSIONS, EXTERNAL:

Wing span	9.25 m (30 ft 4 in)
Wing aspect ratio	4.0
Length overall (flying attitude)	14.12 m (46 ft 4 in)
Height overall	3.55 m (11 ft 7¼ in)
Tailplane span	4.24 m (13 ft 11 in)
Outrigger wheel track	5.18 m (17 ft 0 in)

AREAS:

Wings, excl LERX, gross	21.37 m² (230 sq ft)
LERX (total)	0.81 m² (8.7 sq ft)
Ailerons (total)	1.15 m² (12.4 sq ft)
Trailing-edge flaps (total)	2.88 m² (31.0 sq ft)
Ventral fixed strakes (total)	0.51 m² (5.5 sq ft)
Ventral retractable fence (LIDs)	0.24 m² (2.6 sq ft)
Ventral airbrake	0.42 m² (4.5 sq ft)

Fin	2.47 m² (26.6 sq ft)
Rudder, excl tab	0.49 m² (5.3 sq ft)
Tailplane	4.51 m² (48.5 sq ft)

WEIGHTS:

Basic operating weight empty:	
AV-8B	5,936 kg (13,086 lb)
GR. Mk 5	6,258 kg (13,798 lb)
Max fuel: internal only	3,519 kg (7,759 lb)
internal and external	7,180 kg (15,829 lb)
Max external stores	4,173 kg (9,200 lb)
Basic flight design gross weight for 7g operation	10,410 kg (22,950 lb)
Max T-O weight:	
500 m (1,640 ft) STO	14,061 kg (31,000 lb)
S/L VTO, ISA	8,595 kg (18,950 lb)
S/L VTO, 32°C	8,142 kg (17,950 lb)
Design max landing weight	11,340 kg (25,000 lb)
Max vertical landing weight	8,391 kg (18,500 lb)

PERFORMANCE:

Max Mach number in level flight:	
at S/L	0.85 (562 knots; 1,041 km/h; 647 mph)
at altitude	0.91
STOL T-O run at max T-O weight	500 m (1,640 ft)
Operational radius with external loads shown:	
short T-O (366 m; 1,200 ft), twelve Mk 82 Snakeye bombs, internal fuel, 1 h loiter	90 nm (167 km; 103 miles)
hi-lo-hi, short T-O (366 m; 1,200 ft), seven Mk 82 Snakeye bombs, external fuel tanks, no loiter (payload of 1,814 kg; 4,000 lb)	480 nm (889 km; 553 miles)
Combat air patrol endurance at 100 nm (185 km; 115 miles) from base	3 h
Unrefuelled ferry range, with four 300 US gallon external tanks	2,120 nm (3,929 km; 2,441 miles)
g limits	+7/−3

PZL MIELEC

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PZL MIELEC M-26 ISKIERKA (LITTLE SPARK)

The Iskierka (see accompanying three-view drawing) is a single-piston-engined aircraft, designed to FAR Pt 23 and intended for civil pilot training and pilot selection for military training. Selected parts and assemblies of the M-20 Mewa were used in the design of the wings, tail unit, landing gear, power plant, and electrical and power systems. Chief designer is Mr Krzysztof Piwek.

First flight of the Iskierka was scheduled for late 1985.

TYPE: Tandem two-seat training aircraft.

WINGS: Cantilever low-wing monoplane. NACA 65_3-415 section constant chord wings, with 7° dihedral from roots and 2° incidence. Sweptforward leading-edges at root. Safe-life semi-monocoque structure of aluminium alloy, including the Frise ailerons and single-slotted trailing-edge flaps. No spoilers, airbrakes, or tabs.

FUSELAGE: Semi-monocoque safe-life structure of aluminium alloy.

TAIL UNIT: Conventional cantilever type, of similar construction to wings, with sweptback vertical and non-swept horizontal surfaces. Fixed incidence tailplane. Trim tab in starboard elevator.

LANDING GEAR: Retractable tricycle type, actuated hydraulically, with single wheel and oleo strut on each unit. Mainwheels retract inward into wings, nosewheel rearward. Cleveland 6.00-6 wheels and Goodrich 445 × 160 mm tyres on all three units; tyre pressures 3.43 bars (50 lb/sq in) on main units, 2.16 bars (31 lb/sq in) on nose unit. Cleveland aircooled disc brakes.

POWER PLANT: One 153 kW (205 hp) PZL F 6A-350C1 flat-six engine, driving a PZL Warszawa-Okecie US 142 three-blade variable-pitch propeller with pointed spinner. One 93 litre (20.5 Imp gallon) fuel tank in each wing leading-edge, plus a 10 litre (2.2 Imp gallon) fuselage tank, to give total capacity of 196 litres (43 Imp gallons). Gravity fuelling point in top of each tank. Oil capacity 10 litres (2.2 Imp gallons).

ACCOMMODATION: Tandem seats for pupil (in front) and instructor, under framed canopy which opens sideways to starboard. Rear seat is elevated. Baggage compartment aft of rear seat. Both cockpits heated and ventilated.

SYSTEMS: Two independent hydraulic systems, one operating at 154 bars (2,233 lb/sq in) for landing gear extension/retraction and the other at 103 bars (1,494 lb/sq in) for wheel braking. DC electrical power supplied by a 24V 50A alternator and 28Ah SAM-28 battery. No pneumatic or oxygen systems or de-icing provisions.

AVIONICS AND EQUIPMENT: Polish made ARL 1601 radio compass and CG 121 gyro compass standard; RS 6102 radio optional. No blind-flying instrumentation. Landing light in port wing leading-edge.

DIMENSIONS, EXTERNAL:

Wing span	8.60 m (28 ft 2½ in)
Wing chord: at root	1.88 m (6 ft 2 in)
at tip	1.60 m (5 ft 3 in)
Wing aspect ratio	5.28
Length overall	8.295 m (27 ft 2½ in)
Length of fuselage	7.685 m (25 ft 2½ in)
Height overall	2.96 m (9 ft 8½ in)
Tailplane span	3.80 m (12 ft 5½ in)
Wheel track	2.93 m (9 ft 7¼ in)
Wheelbase	1.925 m (6 ft 3¼ in)
Propeller diameter	1.90 m (6 ft 2¼ in)
Propeller ground clearance	9 cm (3½ in)

DIMENSIONS, INTERNAL:

Cockpits: Length (total)	2.91 m (9 ft 6½ in)
Max width	0.88 m (2 ft 10½ in)
Max height	1.30 m (4 ft 3¼ in)
Floor area	2.30 m² (24.76 sq ft)
Volume	2.30 m³ (81.22 cu ft)
Baggage compartment volume	0.20 m³ (7.06 cu ft)

AREAS:

Wings, gross	14.00 m² (150.7 sq ft)
Ailerons (total)	1.172 m² (12.62 sq ft)
Trailing-edge flaps (total)	1.06 m² (11.41 sq ft)
Fin	1.965 m² (21.15 sq ft)
Rudder	0.89 m² (9.58 sq ft)
Tailplane	3.30 m² (35.52 sq ft)
Elevators (total, incl tab)	1.15 m² (12.38 sq ft)

WEIGHTS AND LOADINGS:

Basic operating weight empty	780 kg (1,719 lb)
Max fuel weight	140 kg (308 lb)
Max T-O and landing weight	1,100 kg (2,425 lb)
Max wing loading	78.6 kg/m² (16.10 lb/sq ft)
Max power loading	7.19 kg/kW (11.83 lb/hp)

PERFORMANCE (estimated at max T-O weight):

Never-exceed speed	215 knots (400 km/h; 248 mph)
Max level speed at S/L	143 knots (265 km/h; 165 mph)
Max cruising speed at 1,500 m (4,920 ft)	135 knots (250 km/h; 155 mph)
Stalling speed, flaps down	53 knots (98 km/h; 61 mph)
Max rate of climb at S/L	318 m (1,045 ft)/min
Service ceiling	4,000 m (13,125 ft)
T-O to 15 m (50 ft)	360 m (1,180 ft)
Landing from 15 m (50 ft)	445 m (1,460 ft)
Range with max fuel, 30 min reserves	442 nm (820 km; 509 miles)

LET

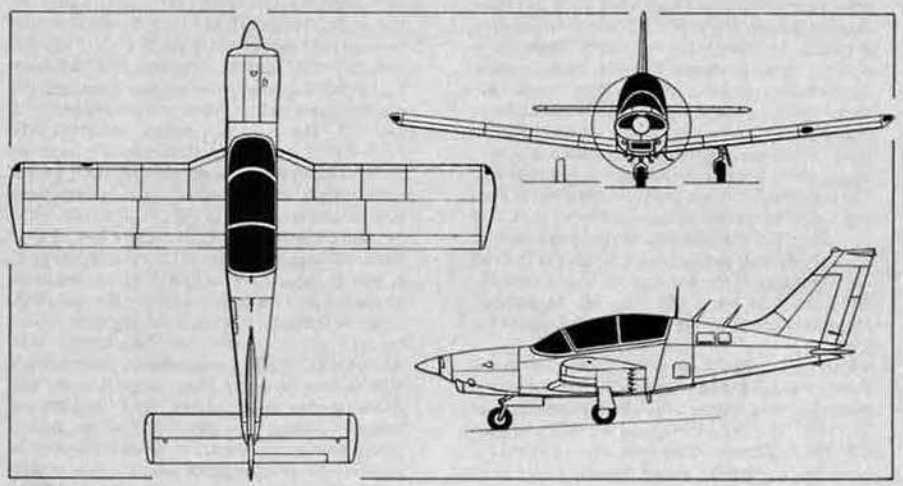
LET NÁRODNÍ PODNIK (Let National Corporation): Uherské Hradiste-Kunovice, Czechoslovakia

The original Canadian-engined prototype of the Let L-410 Turbolet flew for the first time on 16 April 1969. Several versions have appeared subsequently, mostly with Czech M 601 series turboprop engines, and more than 600 L-410s of all types have now been built, including over 500 for the USSR. Standard production version since early 1979 has been the L-410UVP, a detailed description of which appeared in the October 1979 *Jane's Supplement*. Let has introduced a further variant for 1985, known as the L-410UVP-E, with new engines, five-blade propellers, and increased payload/range capability. The factory is also developing a new, larger commuter transport in the 35/40-seat category, known as the L-610.

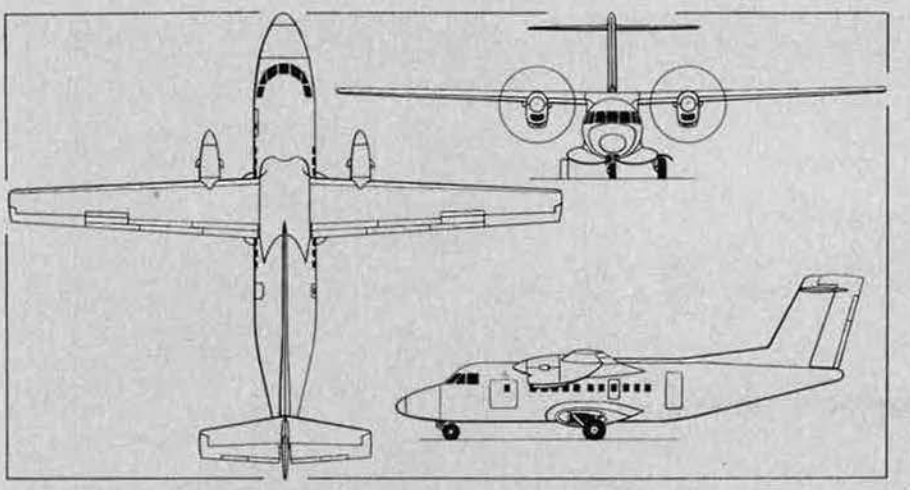
LET L-410UVP-E TURBOLET

Without increasing overall length, the rear fuselage of the L-410 has been modified in the UVP-E version by moving the baggage and toilet compartments further aft, so creating space for an additional four passenger seats, increasing the total to 19. The wings have been reinforced to carry two streamlined wingtip tanks, each containing 200 kg (441 lb) of fuel, enabling the range to be increased by more than 40 per cent. Maximum flap deflection has been increased (to 41°) compared with the UVP, and the spoilers have two fixed deflection angles: 25° (for use in flight) and 72°. The tail unit remains unchanged. Increased empty and max T-O weights have required reinforcement of the landing gear struts, wheels, tyres, and brakes, with an increase of mainwheel tyre pressure to 4.5 bars (65 lb/sq in).

Power plant of the UVP-E comprises a pair of 559 kW (750 shp) Motorlet M 601 E turboprop engines, each driving a V 510 five-blade propeller with manual and automatic feathering and electric (AC) blade de-icing. Associated changes include a vacuum sintered oil cooler of new design, an oil-to-fuel heat exchanger on each engine firewall to avoid the need for fuel additives at low ambient temperatures; relocation of the engine fire extinguishing bottles under the port rear wing/fuselage fairing; and, on the instrument panel, separate speed indicators for each engine and propeller.



PZL Mielec M-26 Iskierka training aircraft *(Pilot Press)*



Let L-610 regional transport for 35 to 40 passengers *(Pilot Press)*

Cabin improvements include installation of portable oxygen equipment and an improved PA system; a fire extinguishing system is installed in the nose baggage compartment. The original DC electrical system is augmented by two AC power sources for windscreen heating and propeller deicing, one DC rotary inverter being deleted and the necessary AC for gyros and radios being supplied by static inverters only. Improved avionics and instrumentation include new LUN 1205 horizon gyros and LUN 1215 turn and bank indicator, ARK-22 ADF, A-037 radio altimeter, SO-69 SSR transponder with encoding altimeter, ILS/SP-50 instrument landing system, and a new analog flight data recorder. Weather radar and a new VZLU autopilot are optional.

The prototype L-410UVP-E (OK-120) flew for the first time in late 1984.

DIMENSIONS, EXTERNAL:

Wing span: over tip tanks	19.88 m (65 ft 2¼ in)
without tip tanks	19.49 m (63 ft 11½ in)
Length overall	14.48 m (47 ft 6 in)
Height overall (static)	5.83 m (19 ft 1½ in)
Propeller diameter	2.30 m (7 ft 6½ in)

WEIGHTS:

Weight empty	3,950 kg (8,708 lb)
Max payload (cargo)	1,710 kg (3,770 lb)
Max T-O weight	6,400 kg (14,110 lb)
Max landing weight	6,200 kg (13,668 lb)

PERFORMANCE (at max T-O weight):

Max level speed at 4,200 m (13,780 ft)
205 knots (380 km/h; 236 mph)
Max operating altitude with passengers
4,200 m (13,780 ft)
Range with max payload, 45 min reserves
286 nm (530 km; 329 miles)
Range with max fuel
863 nm (1,600 km; 994 miles)

LET L-610

This new 35/40-passenger regional transport aircraft is under development for a planned first flight in late 1987/early 1988, with service entry expected in 1990. Designed primarily to meet a Soviet requirement for a 216–324 nm (400–600 km; 248–373 mile) stage length operation, it will be powered by two 1,358 kW (1,822 shp) Motorlet M 602 turboprop engines with Avia V 518 five-blade propellers. Although resembling an enlarged L-410, it will be an entirely new design, with weather radar and a pressurised cabin as standard, and a seat pitch of 75–85 cm (29.5–33.5 in) depending on the number of passengers carried. The L-610 will have a rough-field tricycle landing gear, and an APU to make it independent of ground facilities.

DIMENSIONS, EXTERNAL:

Wing span	25.60 m (84 ft 0 in)
Length overall	21.40 m (70 ft 2½ in)
Fuselage: Max diameter	2.70 m (8 ft 10¼ in)
Distance between propeller centres	7.00 m (22 ft 11½ in)
Height overall	7.60 m (24 ft 11¼ in)
Tailplane span	7.908 m (25 ft 11⅓ in)
Wheel track	4.60 m (15 ft 1 in)
Wheelbase	6.60 m (21 ft 7¾ in)
Propeller diameter	3.50 m (11 ft 5¾ in)

DIMENSIONS, INTERNAL:

Cabin:	
Width at floor	2.02 m (6 ft 7½ in)
Max height	1.825 m (5 ft 11¼ in)

WEIGHTS:

Operating weight empty	9,000 kg (19,841 lb)
Max fuel	2,650 kg (5,842 lb)
Max payload	3,600–3,800 kg (7,936–8,377 lb)
Max T-O weight	14,000 kg (30,865 lb)
Max landing weight	13,500 kg (29,762 lb)
Max zero-fuel weight	12,800 kg (28,219 lb)

New wingtip fuel tanks distinguish the L-410UVP-E version of the Let Turbolet light transport

In its new L-410UVP-E form, the Let Turbolet carries 19 passengers

PERFORMANCE (estimated):

Max cruising speed
264 knots (490 km/h; 304 mph)
Econ cruising speed
216 knots (400 km/h; 248 mph)
Max operating altitude 7,000 m (22,975 ft)
Balanced field length 875 m (2,870 ft)
Range with 40 passengers, 45 min reserves
469 nm (870 km; 540 miles)

KAWASAKI

KAWASAKI JUKOGYO KABUSHIKI KAISHA (Kawasaki Heavy Industries Ltd): 1-18 Nakamachi-Dori, 2-chome, Chuo-ku, Kobe, Japan

Kawasaki's Aircraft Division, which has a workforce of some 3,700 people, is developing under Japan Defence Agency contract its new XT-4 intermediate jet trainer, which flew for the first time earlier this year. The production version is intended to succeed both the Lockheed T-33A (of which Kawasaki built 210 under licence in 1956–59) and the Fuji T-1 in service with the Japan Air Self Defence Force.

KAWASAKI XT-4

Kawasaki was named by the Japan Defence

Rollout of the prototype Kawasaki XT-4 jet trainer in April 1985 *(Kensuke Ebata)*

Agency on 4 September 1981 as the prime contractor to develop a new intermediate trainer to replace Lockheed T-33As and Fuji T-1A/Bs in service with the JASDF. The designation XT-4 has since been allocated officially to the type during its development.

Current plans call for procurement of about 200 production T-4s, for pilot training, liaison, and other duties. Funding was approved in the FY 1983 defence budget to procure three flying prototypes and a static test aircraft. A fourth prototype and a fatigue test aircraft were approved for FY 1984. The first 45 production aircraft are included in current five-year (1983–87) defence planning.

The XT-4 is based on Kawasaki's KA-850 design, by an engineering team led by Mr Kohki Isozaki. Mitsubishi (centre fuselage and engine air intakes) and Fuji (rear fuselage, wings, and tail unit) will each have a 30 per cent share in the production programme. Kawasaki, as prime contractor, will build the forward fuselage, and will be responsible for final assembly and flight test.

The T-4 will have high subsonic combat manoeuvrability, and will be able to carry external loads under the wings and fuselage. Basic design studies were completed in October 1982, and detail design by the Spring of 1984. Subassembly of the first prototype began in April 1984, followed by that for the second, third, and fourth in July, August, and December 1984. The first of these (56-5601) was rolled out on 17 April 1985 and made its first flight on 29 July; the prototypes are scheduled to be delivered in December 1985, and February, April, and June 1986. The static test aircraft is due for delivery in February 1986 and the fatigue test aircraft in the following October. Flight testing will continue until the Autumn of 1986; operational evaluation will start at the end of that year and continue until March 1988. Production, which is expected to begin during FY 1986, is planned to be at the rate of approximately 40 per year for five years.

TYPE: Tandem two-seat intermediate jet trainer and liaison aircraft.

WINGS: Cantilever mid-wing monoplane, of supercritical section, with anhedral from roots. Sweepback 27° 36′ at quarter-chord. Extended chord on outer panels, giving leading-edge 'dog-tooth'. Flaps of advanced design. Teijin aileron servo-actuators.

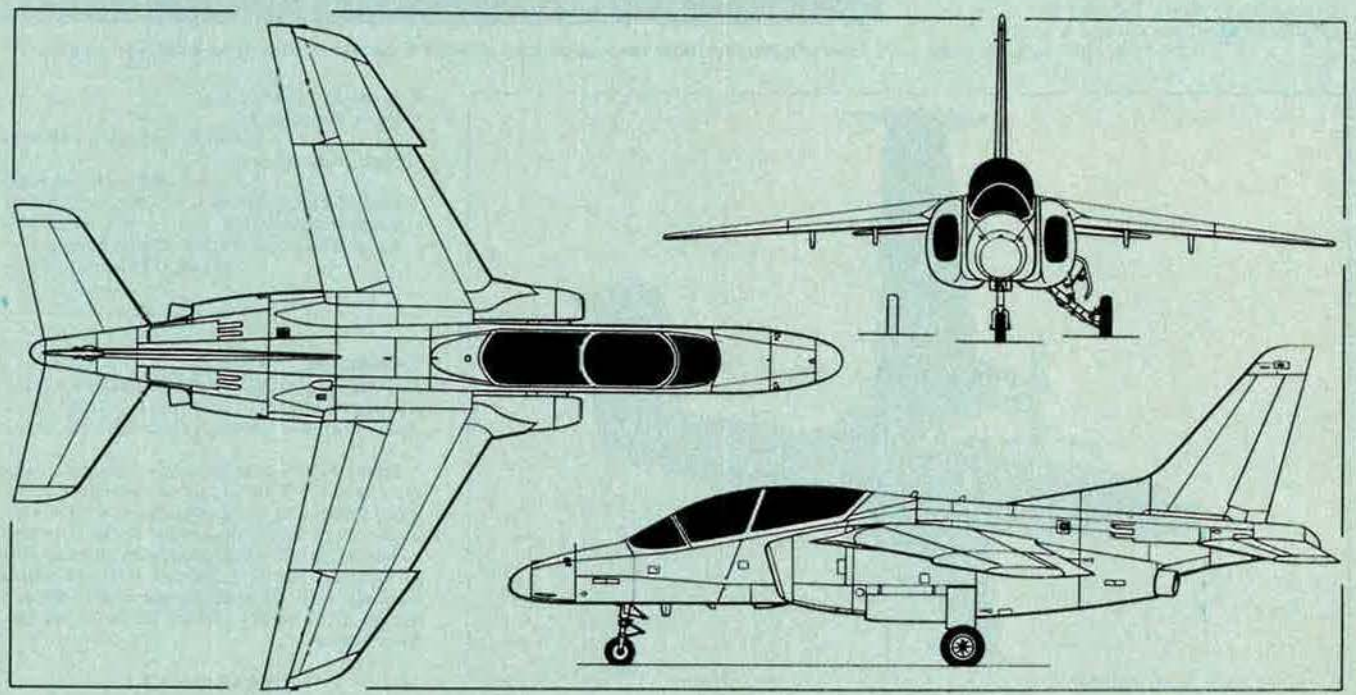
FUSELAGE: Conventional semi-monocoque fail-safe structure, mainly of aluminium alloy, with minimal use of titanium in critical areas.

TAIL UNIT: Cantilever structure, with sweepback on all surfaces. All-moving anhedral tailplane, mid-mounted on rear fuselage, has aluminium alloy spars, ribs, and skins (except for trailing-edge skins of CFRP) and a Nomex honeycomb core. Rudder and fin are of CFRP construction. Rudder and tailplane servo-actuators by Mitsubishi.

LANDING GEAR: Sumitomo hydraulically retractable tricycle type, with oleo-pneumatic shock absorber in each unit. Single wheel and low pressure tyre on each unit. Main units have Bendix (Kayaba) wheels and brakes, and Hydro-Aire (Sumitomo) anti-skid units, and retract inward. Steerable Kayaba nose unit retracts forward.

POWER PLANT: Two 16.28 kN (3,660 lb st) Ishikawajima-Harima XF3-30 turbofan engines, mounted side by side in centre-fuselage. Fuel (2,271 litres; 600 US gallons) in wing tanks and three tanks in fuselage. Provision to carry one 454 litre (120 US gallon) Shin Meiwa drop tank on each underwing pylon.

ACCOMMODATION: Crew of two in tandem in pressurised and air-conditioned cockpit with wrap-round windscreen and one-piece sideways opening canopy. Dual controls standard; rear (instruc-



Kawasaki XT-4 tandem two-seat intermediate jet trainer *(Pilot Press)*

Model of the new UTVA Lasta primary trainer and light attack aircraft, under development for the Yugoslav Air Force *(Brian M. Service)*

tor's) seat elevated. Stencel SIIIS-3ER ejection seats and Teledyne Micronetics canopy jettison system, licence built by Daicel Chemical Industries. Baggage compartment in centre of fuselage, with external access via door on port side.

SYSTEMS: Shimadzu air-conditioning system; cockpit pressurisation system; fly by wire flight control system with Lucas (Sumitomo) Q-feel; hydraulic system; Aro Corporation (Tokyo Aircraft Instruments) onboard oxygen generating system.

AVIONICS: Kaiser head-up display, Sperry air data computer, Honeywell AHRS, Collins UHF/DF, Teledyne Electronics SIF, all built under licence in Japan. Domestic avionics include Mitsubishi Electric UHF com, Nippon Electric Tacan, and Nagano intercom.

ARMAMENT: No built-in armament. Two Nippi pylons under wings, and one under fuselage, for carriage of drop tanks, target towing equipment, or ECM/chaff dispenser/air sampling pods. In weapons training role, can carry gun pods, three or four 500 lb practice bombs, or infra-red homing air-to-air missiles.

DIMENSIONS, EXTERNAL (approx):

Wing span	10.00 m (32 ft 9¼ in)
Length overall	13.00 m (42 ft 8 in)
Height overall	5.00 m (16 ft 5 in)

AREA (approx):

Wings, gross	21.6 m² (232.5 sq ft)

WEIGHTS:

Weight empty	3,700 kg (8,157 lb)
T-O weight 'clean'	5,500 kg (12,125 lb)
Max design T-O weight	7,500 kg (16,535 lb)

PERFORMANCE (estimated, in 'clean' configuration. A: at T-O weight of 4,700 kg; 10,361 lb with 50% fuel; B: at T-O weight of 5,500 kg; 12,125 lb):

Max level speed at 7,620 m (25,000 ft):
A
Mach 0.9 (540 knots; 1,000 km/h; 622 mph)

Max level speed at S/L:
A 500 knots (927 km/h; 576 mph)

Cruising speed: B Mach 0.75

Stalling speed:
A 90 knots (167 km/h; 104 mph)

Max rate of climb at S/L:
B 3,050 m (10,000 ft)/min

Service ceiling: B 13,715 m (45,000 ft)

T-O to 15 m (50 ft), 35°C: B 750 m (2,460 ft)

Landing run: B 620 m (2,035 ft)

Range at Mach 0.75 cruising speed:
B, internal fuel only
750 nm (1,390 km; 863 miles)
B, with two 120 US gallon drop tanks
900 nm (1,668 km; 1,036 miles)

UTVA

UTVA—SOUR METALNE INDUSTRIJE, RO FABRIKA AVIONA: Utve Zlatokrile br 9, 26 000 Pancevo, Yugoslavia

UTVA LASTA (SWALLOW)

First shown publicly in model form at the 1985 Paris Air Show, the Lasta was designed by the Vazduhoplovno Tehnicki Institut at Zarkovo, near Belgrade, as a primary trainer for the Yugoslav Air Force. Although similar in configuration and purpose to the French Epsilon, and with the same power plant, it is a larger and heavier aircraft. Pupil pilots are intended to progress from the Lasta directly to the Soko G-4 Super Galeb jet basic trainer, and the cockpits of the two aircraft are fundamentally similar.

Manufacture of the Lasta is being undertaken by Fabrika Aviona UTVA at Pancevo. The first of two prototypes was expected to fly for the first time at the end of June 1985. Tooling was being prepared at that time for a pre-series of ten production Lastas.

TYPE: Tandem two-seat primary trainer and light attack aircraft.

WINGS: Cantilever low-wing monoplane of conventional light alloy construction. Dihedral from roots. Ailerons and flaps over full span. Trim tab in inboard trailing-edge of each aileron.

FUSELAGE: Conventional light alloy semi-monocoque structure.

TAIL UNIT: Cantilever light alloy structure. Fixed incidence tailplane. Horn balanced rudder. Long dorsal fin and shallow ventral fin. Trim tab in rudder and starboard elevator.

LANDING GEAR: Hydraulically retractable tricycle type of Prva Petoletka-Trstenik design and manufacture, with single wheel on each unit. Nosewheel retracts rearward, main units inward. Oleo-pneumatic shock absorbers. Nosewheel steerable to 30° each way, via rudder pedals. Dunlop tyres: size 6.00-6 (8PR), pressure 3.8 bars (55 lb/sq in), on mainwheels; size 5.00-5 (8PR), pressure 4.2 bars (61 lb/sq in), on nosewheel. Hydraulic disc brakes.

POWER PLANT: One 224 kW (300 hp) Avco Lycoming AEIO-540-L1B5D flat-six engine, driving a Hoffmann HO-V-123K-V three-blade constant-speed metal propeller with spinner.

ACCOMMODATION: Two seats in tandem, with raised rear seat. Separate canopy over each seat, sideways hinged to starboard.

SYSTEMS: Hydraulic, electrical, and oxygen systems standard. Full night lighting.

AVIONICS: Standard equipment will include VHF, VOR, ILS, and DME.

ARMAMENT: Two underwing hardpoints for bombs, rocket packs, and pods containing twin machine-guns, with total external load of up to 240 kg (530 lb).

DIMENSIONS, EXTERNAL:

Wing span	8.34 m (27 ft 4½ in)
Wing aspect ratio	6.32
Length overall	8.04 m (26 ft 4½ in)
Height overall	4.45 m (14 ft 7¼ in)

AREA:

Wings, gross	11.0 m² (118.4 sq ft)

WEIGHTS:

Weight empty, equipped	1,060 kg (2,337 lb)
Max T-O weight	1,630 kg (3,593 lb)

PERFORMANCE (estimated, at max T-O weight):

Never-exceed speed
302 knots (560 km/h; 348 mph)

Max level speed at S/L
186 knots (345 km/h; 214 mph)

Max rate of climb at S/L	540 m (1,770 ft)/min
T-O run	320 m (1,050 ft)
Landing run	310 m (1,017 ft)

AIRMASTER

AIRMASTER INC: 840 West Perimeter Road, Renton, Washington 98055, USA

Airmaster Inc was formed in 1980 to develop and market the Avalon 680 and Twin Star 800 turboprop amphibian aircraft. The Avalon 680 is a single-engined aircraft, now being flight tested; the Twin Star 800 is a proposed twin-engined variant of the same airframe, of which prototype construction was scheduled to begin in 1985. The A-750 Guardian is a proposed maritime patrol variant of the Avalon 680.

AIRMASTER AVALON 680

The Avalon 680 prototype (N767LB) made its first flight on 1 October 1983, and used the wings, strengthened tailbooms, and the tailplane from a Cessna Model 337 Skymaster (military designation O-2). Production versions will have new cantilever wings of increased area and parallel chord, larger fins and rudders, a 0.35 m (1 ft 2 in) fuselage stretch in the cabin area to provide seating for seven people, additional cabin windows, increased capacity in the main fuel tanks between the outrigger sponsons and the fuselage, a 189 litre (50 US gallon) auxiliary fuel tank in each wing, larger mainwheels, engine mounts and cowlings interchangeable with the Twin Star 800, and side-mounted engine and oil cooler intakes. Orders totalled 26 by April 1985; first deliveries are expected in early 1986.

TYPE: Single-engined seven-seat amphibian.

WINGS: Prototype uses wings from Cessna Model 337 Skymaster. Production aircraft will have larger cantilever constant chord wings of conventional all-aluminium construction. Wing section NACA 23015 (modified). Dihedral 2°. Incidence 4°. Frise type ailerons. Fowler single-slotted trailing-edge flaps. Electrically actuated trim tabs. Pneumatic boot de-icing of leading-edges optional.

FUSELAGE: Conventional 2024T-3 fail-safe aluminium structure, with hull section comprising 14 watertight compartments.

TAIL UNIT: Prototype uses Cessna Skymaster tailbooms with structural strengthening, tailplane and fins/rudders, with additional dorsal and ventral fins to increase area. Trim tab on elevator and starboard rudder, actuated mechanically. Pneumatic boot de-icing of tailplane leading-edge optional.

LANDING GEAR: Tricycle type, with oleo shock absorption. Hydraulic retraction, nosewheel forward into hull, single mainwheels rearward into outrigger sponsons. Mainwheel tyre size 7.00-6;

Airmaster Avalon 680 prototype (Pratt & Whitney Canada PT6A-34 turboprop engine)

steerable nosewheel, tyre size 6.00-6. Cleveland brakes. Steerable, hydraulically actuated retractable water rudder.

POWER PLANT: One 559 kW (750 shp) Pratt & Whitney Canada PT6A-34 turboprop engine, driving a Hartzell three-blade constant-speed reversible-pitch pusher propeller. Total fuel capacity 946 litres (250 US gallons); main tank in fuselage area between sponsons, capacity 568 litres (150 US gallons), with filler point above sponson; 189 litre (50 US gallon) auxiliary tank in each wing, each with single flush refuelling point in top of wing. Oil capacity 11.4 litres (3 US gallons). Engine air intake has heated lip for anti-icing.

ACCOMMODATION: Enclosed cabin, with seating for seven including pilot. Forward and middle row of two seats each, with rear row of three seats. Dual controls standard. Single forward-hinged door on each side of forward cabin, incorporating boarding step in lower hinge-down section. Doors open 180°; starboard door serves as emergency exit. Accommodation is heated and ventilated, with freon air-conditioning optional.

SYSTEMS: Cabin pressurisation system with max differential of 0.27 bars (4.0 lb/sq in) optional; freon air-conditioning system optional. Single hydraulic system, with emergency handpump, pressurised at 83 bars (1,200 lb/sq in). 24V electrical system. Oxygen system, wing and tail surface de-icing boots, and windscreen wipers/alcohol de-icing system optional.

AVIONICS AND EQUIPMENT: To customer's choice, including autopilot, fuel management computer, weather radar, and 3M/Ryan Stormscope. Blind-flying instrumentation standard.

DIMENSIONS, EXTERNAL (production version):

Wing span	13.41 m (44 ft 0 in)
Wing aspect ratio	7.3
Length overall	10.36 m (34 ft 0 in)
Length of fuselage	8.08 m (26 ft 6 in)
Height overall (ground operation)	3.81 m (12 ft 6 in)
Tailplane span	3.53 m (11 ft 7 in)
Wheel track	3.35 m (11 ft 0 in)
Wheelbase	4.09 m (13 ft 5 in)
Propeller diameter	2.59 m (8 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin:	
Max length	3.05 m (10 ft 0 in)
Max width	1.27 m (4 ft 2 in)
Max height	1.57 m (5 ft 2 in)
Passenger doors:	
Height: port	1.22 m (4 ft 0 in)
starboard	0.89 m (2 ft 11 in)
Width: port	0.84 m (2 ft 9 in)
starboard	0.81 m (2 ft 8 in)

AREAS:

Wings, gross	24.53 m² (264.0 sq ft)
Fins (total)	2.90 m² (31.2 sq ft)
Rudders (total, incl tab)	1.45 m² (15.6 sq ft)
Tailplane	4.92 m² (53.0 sq ft)

WEIGHTS AND LOADING:

Weight empty	1,587 kg (3,500 lb)
Max fuel weight	680 kg (1,500 lb)
Max T-O weight	2,631 kg (5,800 lb)
Max landing weight	2,540 kg (5,600 lb)
Max zero-fuel weight	1,497 kg (3,300 lb)
Max wing loading	107.3 kg/m² (21.97 lb/sq ft)

PERFORMANCE (estimated at max T-O weight):

Never-exceed speed	217 knots (402 km/h; 250 mph)
Max level speed and max cruising speed at 4,875 m (16,000 ft)	199 knots (370 km/h; 230 mph)
Econ cruising speed	174 knots (322 km/h; 200 mph)
Stalling speed, flaps down, power on	56 knots (105 km/h; 65 mph)
Max rate of climb at S/L	670 m (2,200 ft)/min
Service ceiling	7,925 m (26,000 ft)
T-O run: on land	244 m (800 ft)
on water	366 m (1,200 ft)
T-O to 15 m (50 ft) on land	305 m (1,000 ft)
Landing from 15 m (50 ft) on land	290 m (950 ft)
Landing run: on land	198 m (650 ft)
on water	213 m (700 ft)
Range with max fuel:	
at econ cruising power	955 nm (1,770 km; 1,100 miles)
at max cruising power	781 nm (1,448 km; 900 miles)
Min depth of water for operation	0.56 m (1 ft 10 in)

AIRMASTER A-750 GUARDIAN

The A-750 Guardian is a proposed military/maritime patrol version of the Avalon 680 for multimission roles, including fishery protection, pollution monitoring, oil and gas rig patrol, SAR, and drug enforcement. It will have provision for the carriage of a range of lightweight rocket and grenade launchers, 7.62 mm machine-gun pods, or mini torpedoes, on standard NATO stores racks under the wings or on mounts above the aircraft's outrigger sponsons. Search radar can be installed above the cabin section. The A-750 Guardian's dimensions, weights, and estimated performance are as for the Avalon 680, with the exception of an empty weight of 1,451 kg (3,200 lb) and a maximum loiter range of 1,216 nm (2,253 km; 1,400 miles). Power plant is a 559 kW (750 shp) PT6A-135 turboprop; fuel capacities are 757 litres (200 US gallons) standard, or 1,325 litres (350 US gallons) for long-range patrol.

AIRMASTER AVALON TWIN STAR 800

The description of the Avalon 680 applies also to the Twin Star 800 except:

POWER PLANT: Two 313 kW (420 shp) Allison 250-C20B turboprop engines, driving a single Hartzell three-blade constant-speed reversible-pitch pusher propeller.

PERFORMANCE (estimated at max T-O weight):

Max cruising speed at 4,875 m (16,000 ft)	207 knots (383 km/h; 238 mph)
Normal cruising speed	180 knots (333 km/h; 207 mph)
Cruising speed, one engine out, at 1,830 m (6,000 ft)	113 knots (209 km/h; 130 mph)
Stalling speed, flaps down, power on	59 knots (108 km/h; 67 mph)
Max rate of climb at S/L	701 m (2,300 ft)/min
Service ceiling, one engine out	3,350 m (11,000 ft)
T-O run: on land	229 m (750 ft)
on water	335 m (1,100 ft)
Range with max fuel:	
at econ cruising power	1,042 nm (1,931 km; 1,200 miles)
at cruising power	738 nm (1,368 km; 850 miles)

Artist's impression of the twin-turboprop Airmaster Avalon Twin Star 800 seven-seat amphibian

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Beech Aircraft Corp.
BEI Defense Systems Co., Inc.
Bell Aerospace Textron
Bell Helicopter Textron
Boeing Aerospace Co.
Boeing Co., The
Boeing Military Airplane Co.
British Aerospace Dynamics Group
British Aerospace, Inc.
Brunswick Corp., Defense Div.
Budd Co., The
Burdeshaw Associates, Ltd.
California Microwave, Inc., Communication Systems Operation
Calspan Corp., Advanced Technology Center
Canadair
Canadian Marconi Co.
Cessna Aircraft Co.
Chamberlain Manufacturing Corp.
Clearprint Paper Co., Inc.
Clifton Precision, Instruments & Life Support Div.
Colt Industries, Inc.
Computer Sciences Corp.
Comtech Microwave Corp.
Contel Page Systems, Inc.
Contraves Goerz Corp.
Control Data Corp.
Cryomec, Inc.
Cubic Corp.
Cypress International, Inc.
Data General Corp.
Datatape, Inc.
Douglas Aircraft Co., McDonnell Douglas Corp.
Dowty
Dynalectron Corp.
Eastman Kodak Co.
Eaton Associates, Inc.
Eaton Corp., AIL Div.
ECI Div., E-Systems, Inc.
EDO Corp., Government Systems Div.
Educational Computer Corp.
Educational Testing Service
E. I. du Pont de Nemours & Co.
Elbit/Inframetrics
Electronic Data Systems Corp.
Emerson Electric Co.
E-Systems, Inc.
Euromissile
Evans & Sutherland
Ex-Cell-O Corp., Aerospace Div.
Fairchild Communications & Electronics Co.
Fairchild Control Systems Co.
Fairchild Republic Co.
Fairchild Weston Systems, Inc.
Falcon Jet Corp.
Ferranti plc
Fluids Control Div. of LFE Corp.
Ford Aerospace & Communications Corp.
GA Technologies, Inc.
Garrett Corp., The
Gates Learjet Corp.
GEC Avionics, Inc.
General Defense Corp., Ordnance Div.
General Dynamics Corp.
General Dynamics, Electronics Div.
General Dynamics, Fort Worth Div.
General Electric Co.
General Electric Co., AEBG
GMC, Allison Gas Turbine Div.
GMC, Delco Systems Operations
Goodyear Aerospace Corp.
Gould Inc., Computer Systems Div.
Gould Inc., Defense Systems Group
Grumman Corp.
Grumman Data Systems Corp.
GTE Government Systems Corp.
GTE Government Systems Corp., Communications Systems Div.
GTE Government Systems Corp., Strategic Systems Div.
Gulfstream Aerospace Corp.
Harris Government Communications Group
Harris Government Support Systems Div.
Harris Government Systems Sector
Hayes International Corp.
Hazeltine Corp.
H. B. Maynard & Co.
Hercules Aerospace Div.
Honeycomb Co. of America, Inc.
Honeywell, Inc., Aerospace & Defense Group
Howell Instruments, Inc.
HR Textron, Inc.
Hughes Aircraft Co.
IBM Corp., Federal Systems Div.
IBM Corp., National Accounts Div.
Information Systems & Networks Corp.
Ingersoll-Rand Co.
Intermetrics, Inc.
Interstate Electronics Corp.
ISC Group, Inc.
Israel Aircraft Industries Int'l, Inc.
Itek Optical Systems, A Division of Litton Industries
ITT Defense Communications Div.
ITT Defense-Space Group
ITT Federal Electric Corp.
Jane's
John Deere Technologies Int'l, Inc.
Kaiser Electronics
Kelsey-Hayes Co.
King Radio Corp.
Kollsman Instrument Co.
Lear Siegler, Inc.
Lear Siegler, Inc., Avionic Systems Div.
Lewis Engineering Co., Inc.
Litton-Amecom
Litton Applied Technology
Litton Data Systems
Litton Guidance & Control Systems
Litton Industries
Lockheed Aircraft Service Co.
Lockheed-California Co.
Lockheed Corp.
Lockheed Electronics Co.
Lockheed Engineering & Management Services Co., Inc.
Lockheed-Georgia Co.
Lockheed Missiles & Space Co.
Lockheed Space Operations Co.
Logicon, Inc.
Loral Corp.
LTV Aerospace & Defense Co.
LTV Aerospace & Defense Co., Sierra Research Div.
Lucas Industries Inc.
Magnavox Advanced Products & Systems Co.
M.A.N. Truck & Bus Corp.
Marotta Scientific Controls, Inc.
Marquardt Co., The
Martin Marietta Aerospace
Martin Marietta Denver Aerospace
Martin Marietta Orlando Aerospace
MBB
McDonnell Aircraft Co.
McDonnell Douglas Astronautics Co.
McDonnell Douglas Corp.
Midland-Ross Corp./Grimes Div.
MITRE Corp., The
Morton Thiokol, Inc.
Motorola Government Electronics
NORDAM
Northrop Corp.
Northrop Corp., Aircraft Div.
Northrop Corp., Electronics Div.
Odetics, Inc.
OEA, Inc.
Olympus Corp., Industrial Fiberoptics Dept.
O. Miller Associates
Orbital Sciences Corp.
ORI, Inc.
Oshkosh Truck Corp.
Pacific Car and Foundry Co.
Pan Am World Services, Inc., Aerospace Services Div.
Perkin-Elmer Corp.
Planning Research Corp.
Products Research & Chemical Corp.
Rand Corp.
Raytheon Co.
RBI, Inc.
RCA, Government Systems Div.
RECON/OPTICAL, Inc., CAI Div.
Rediffusion Simulation, Inc.
Republic Electronics, Inc.
Rockwell Int'l Collins Government Avionics Div.
Rockwell Int'l Corp.
Rockwell Int'l Defense Electronics Operations
Rockwell Int'l North American Aircraft Operations
Rockwell Int'l North American Space Operations
Rohr Industries, Inc.
Rolls-Royce, Inc.
ROLM Mil-Spec Computers Div.
Rosemount Inc.
Sabreliner Corp.
Sanders Associates, Inc.
Schneider Services International
Science Applications Int'l Corp.
SENTEC
Short Brothers USA, Inc.
Singer Co., The
Singer Co., The Link Flight Simulation Div.
Smiths Industries, Aerospace & Defence Systems Co.
SofTech
Sonicraft, Inc.
Space Applications Corp.
Space Communications Co.
Space Ordnance Systems
Sperry Corp.
Standard Manufacturing Co., Inc.
Stencel Aero Engineering Corp.
Sundstrand Corp.
Sverdrup Corp.
Syscon Co.
System Development Corp., A Burroughs Co.
Systems Control Technology, Inc.
Systron Donner, Safety Systems Div.
Talley Defense Systems
Teledyne CAE
Teledyne, Inc.
Teledyne Ryan Aeronautical
Texas Instruments, Defense Systems & Electronics Group
Thomson-CSF, Inc.
Time & Space Processing, Inc.
Tracor, Inc.
Trident Data Systems
TRW Electronics & Defense Sector
TRW Space & Technology Group
Turbomach Div. of Sundstrand Corp.
United Airlines Aircrew Training, Inc.
United Technologies Corp.
UTC, Chemical Systems
UTC, Hamilton Standard
UTC, Norden Systems, Inc.
UTC, Pratt & Whitney
UTC, Research Center
UTC, Sikorsky Aircraft
VAC-HYD/Interturbine Companies
Varo, Inc.
Vega Precision Laboratories
V. Garber Int'l Associates, Inc.
Vitro Corp.
Western Gear Corp.
Western Union Telegraph Co., Government Systems Div.
Westinghouse Electric Corp.
Westinghouse Electric Corp., Baltimore Div.
Westland Technologies, Ltd.
Wild Heerbrugg Instruments, Inc.
Williams International
Wyman-Gordon Co.
Xerox Corp.

THE BULLETIN BOARD

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

Recruiting Good—For Now

While recruiting could be a big problem in a few years, as pointed out in AFA's 1985 policy statement on Defense Manpower Issues *(see November 1985* AIR FORCE *Magazine, p. 108),* things look good right now.

In the active force, the Air Force enlisted 100 percent of its objective in the fiscal year just ended. Not only that, but ninety-nine percent of these new recruits were high school graduates, far and away the highest such percentage among all the services. Next in this category was the Marine Corps with ninety-five percent, followed by the Navy with ninety-three percent and the Army with ninety-one percent.

Meanwhile, the Air Force Reserve topped its end-of-the-year strength goal for the eighth consecutive year. It had 75,228 members on its rolls against a target strength of 74,829. Reserve officials attribute this success to good recruiting and high retention.

"Only through very hard work, very smart work, and the support of everyone in the command were we able for the eighth year in a row to attain and exceed the manning level set by Congress," said AFRES Director of Reserve Recruiting Col. Charles R. Ramsdale.

In 1985, Reserve recruiters brought nearly 14,000 new Reservists into the program to help meet the required 5,000-plus gain, and Reserve units also retained more than sixty percent of their members eligible for reenlistment.

And, rounding out the picture, the Air National Guard reached its manning goal of 108,000 for the 1985 time frame more than a month ahead of schedule *(see photo).* Thus, all recruiting systems for 1985 were "go." The year 1986 might tell a different story, however.

New CHAMPUS Form Required

If you are a CHAMPUS-eligible person and if you were in an auto accident—or were injured in some other way—CHAMPUS has a new form you must send in along with your regular claim for cost-sharing of the civilian medical care.

It's the CHAMPUS Form 691 (Statement of Personal Injury—Possible Third Party Liability). CHAMPUS processors are now requiring the form if an injury was the result of an accident. The new form will allow CHAMPUS to evaluate the circumstances of an accident and the possibility that the government may recover the costs of the medical care from the person who injured you.

So any time from now on that you submit a claim that looks as if a third party may have liability, expect CHAMPUS to bounce back the claim and ask for the completed Form 691. If the 691 doesn't appear in the CHAMPUS office within thirty-five days, your claim is likely to be denied.

Also, CHAMPUS reminds you that if you have other health coverage (such as Blue Cross, personal injury protection, or another insurance policy) that pays before CHAMPUS, your bills must be submitted to the other policy first. CHAMPUS is "second-pay" to all coverage except CHAMPUS Supplemental policies (such as AFA's CHAMPlus) and Medicaid and won't pay until your other insurance has processed your claim. A copy of the Explanation of Benefits from your other insurance company must be sent in with your CHAMPUS claim.

If you have any questions about any aspect of CHAMPUS, contact the Health Benefits Advisor at the nearest military hospital.

Lt. Gen. Emmett Walker, Jr. (front row center), Chief of the National Guard Bureau, and Maj. Gen. John B. Conaway (front row right), ANG Director, celebrated with ANG personnel and recruiting staffers when ANG reached its FY '85 manning goal of 108,000 a month early. (ANG photo by Gwilym Hughes)

New Air Force Chaplain

Brig. Gen. Stuart E. Barstad has been named new Chief of Chaplains of the Air Force and will pin on his second star *(see photo).* The new Deputy Chief of Chaplains is Col. John P. McDonough. Chaplain Barstad replaces retiring Maj. Gen. John A. Collins.

The US Air Force Chaplain Service, headquartered at Bolling AFB, D. C., directs about 850 active-duty chaplains representing more than sixty denominational groups. It also supervises 732 chapel managers, 459 Air Force Reserve and Air National Guard chaplains, and 400 auxiliary chaplains and civilian employees of the Chaplain Service.

The mission of the Chaplain Service is to provide opportunities for the religious expression and moral growth of Air Force people and their families. This includes conducting religious services, promoting religious

Brig. Gen. Stuart E. Barstad will pin on a second star and become USAF's next Chief of Chaplains.

education, and providing pastoral care, to include personal and family counseling. It also embraces visiting, creating spiritual renewal opportunities, encouraging stewardship and humanitarian projects, implementing social-concern activities, and developing public relations.

Chaplains are unique among Air Force officers in that, regardless of what the Bible says, they do serve two masters—both the Air Force and their faith. They are not, however, required to act contrary to their beliefs or practices.

Chaplain Barstad has been in the Air Force since 1955. He's a native of Wisconsin and received his advanced degrees at St. Olaf College, Northfield, Minn., and his theological degree from Luther Theological Seminary, St. Paul, Minn. He has been serving as Deputy Chief of Chaplains since July 1982.

Chaplain McDonough, born in Boston, Mass., was ordained a Roman Catholic priest in 1952 and entered the Air Force in 1963. Prior to his appointment as Deputy Chief of Chaplains, he was the Command Chaplain at TAC.

Civil Air Patrol Moves Overseas

Young men and women in the Bitburg AB, West Germany, area now have another option if they want to learn about the military and flight—in the Civil Air Patrol.

The Bitburg Cadet Squadron of the CAP received its organizational charter recently and is gearing up for an active program of academics and training. The squadron is composed of young people aged thirteen to eighteen as well as adult (senior) members from Bitburg and Spangdahlem ABs.

The squadron is part of the national CAP structure, which is best known, of course, for its search and rescue activities in the US.

Air Force Concerned About No-Show Rate

USAF's overseas passenger no-show rate has been increasing steadily despite efforts to reduce those numbers, according to Pentagon air transportation officials. It's now at an unprecedented twelve percent, which translates into 3,000 Air Force passengers over the past year who failed to show up as scheduled.

If these figures don't nose-dive in the immediate future, the Air Force plans to start charging a portion of processing costs to the losing units. It is hoped that charges will get local commanders concerned about the problem. Since MAC works with all services, the problem is not USAF's alone. However, and surprisingly, blue-suiters appear to be the worst offenders.

MAC reminds all concerned that if you can't make a flight for whatever reason, you have an obligation, just as in civilian life, to call and cancel reservations. Travelers may call either the port or whomever made the reservations in the first place, usually the losing unit. Officials believe that this unnecessary expense can be reduced with a little diligent attention.

Reserve Crew Airlifts Donor Organs

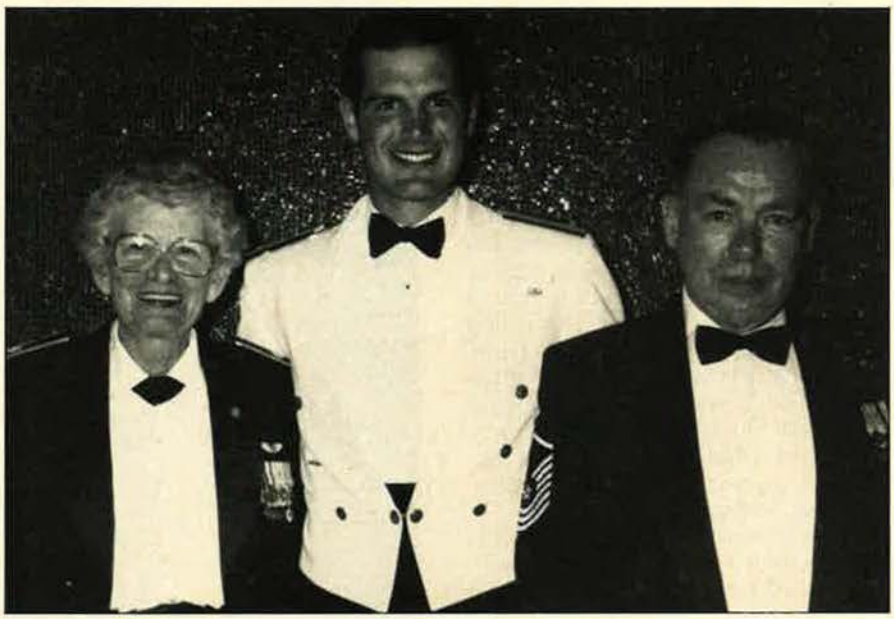
An Air Force Reserve C-5 crew from Dover AFB, Del., recently played a key role in an international kidney transplant saga.

The story began with the death of the thirteen-year-old daughter of a US Army couple at the Army hospital at Landstuhl, Germany. Her parents asked that her kidneys be donated for transplant.

Walter Reed Army Medical Center in Washington, D. C., determined that they could use the kidneys, and a Hamburg Surgical University Hospital surgical team was formed for the removal.

Meanwhile, the 2d General Hospital officials contacted the 322d Air Division at Ramstein AB, requesting airlift for the kidneys, which must be transplanted within thirty-six hours. A Dover AFB C-5, with a Reserve crew headed by Maj. Jack E. Gray II, was at Ramstein and was alerted for the mission. They flew the organs to Dover immediately after the surgical removal.

From Dover, the kidneys were taken by a waiting Army helicopter to Walter Reed, where they were transplanted into two male recipients. Major Gray found nothing new in this "first" procedure—an Eastern Air Lines pilot in civilian life, he has transported fifty corneas and ten kidneys on Eastern.



2d Lt. Peter R. Straight, center, recently swore his commissioning oath as administered by his great aunt, Lt. Col. Yvonne C. Pateman, USAF (Ret.), as his father, SMSgt. Thomas Straight, USAFR, looked on. Colonel Pateman, who served as a WASP during World War II, believes she is the first woman to swear in an Air Force Academy graduate. Lieutenant Straight is now undergoing flight training at Laughlin AFB, Tex.

THE BULLETIN BOARD

VA to Promote Hiring of Disabled Vets

The Veterans Administration will offer special incentives to employers hiring certain disabled veterans in an effort to "bridge the gap" that has prevented some disabled from being employed.

VA Administrator Harry N. Walters said that despite intensive placement efforts, some disabled veterans who are well-trained and otherwise qualified for employment may not be hired because of a lack of work experience, special training requirements on the part of employers, or the nature of the disability.

The VA, as allowed by current law, is making a special effort to identify problem placements and make payments to employers to encourage the hiring of well-trained veterans. The payments can cover up to nine months of work experience or on-the-job training to enable the veteran to adjust to and maintain employment. Under a written agreement with the employer, the VA will pay for direct expenses that result from hiring the veteran and that do not exceed one-half of the wage paid to other employees in the same or in similar jobs.

Collaterally, the Labor Department has announced that it will be giving special emphasis to this program. "We think this is one of those situations in which everybody wins," says Secretary of Labor William E. Brock. "Employers can gain dedicated employees, trained for a job that employers need to have filled."

Employers wishing to participate in the program may obtain additional information from any local office of their state's Job Service or from any VA office.

Britain's Prince of Wales recently visited USAF units at RAF Lakenheath, England, where he received a briefing on the GBU-15 weapon system. Shown here with Prince Charles are, from left, Capt. Jay Lindell, SSgt. Tod Coombs, and Capt. Jim Welton.

PARS Program Remembered

The History of the Public Affairs Reserve Squadron (PARS) Program is hot off the press, and the booklet is now available from the USAF Historical Research Center, Maxwell AFB, Ala. 36112.

For those who might wonder what the PARS program was, it was a highly successful Reserve program that, for twenty-seven years, provided a pool of talented civilian professionals to fill Reserve slots in public relations, communications, advertising, and the like.

The PARS Reserve squadrons frequently worked closely with neighboring AFA units and, when PARS phased out, its activities were sometimes continued solely by local AFA chapters. It's estimated that more than 200 former PARS members are now active in AFA chapters around the country.

Short Bursts

One of the nation's longest running—since 1958—**studies on aging** is the one being conducted by the **National Institute on Aging.** It involves ongoing physical, medical, and psychological monitoring of more than 900 men and women, aged twenty to ninety-three. VA's **Dr. James Fozard**—an acknowledged expert on aging—has been selected as associate scientific director for the research effort.

Maj. Robert P. Bongiovi, assigned to the office of the Deputy Chief of Staff for Research, Development, and Acquisition in the Pentagon, has been **named "action officer of the year"** *(see photo).* Action officers have been called the "linchpin, the cornerstone, of Air Force research and development staff work in the Pentagon."

CHAMPUS users in South Carolina have a new processsor—it's **Wisconsin Physicians Service,** P. O. Box 8965, Madison, Wis. 53708. Call toll-free (800) 356-5954. They recommend against calling on Mondays and Fridays, when the lines are busiest.

VA has replied to a veteran's query that anyone purchasing a home using the **GI guaranteed loan benefit** is obligated to live in the home as a "principal residence."

SSgt. Michael Michel, Vice Commandant of AFSC's NCO Academy at Kirtland AFB, N. M., is not only **the**

Maj. Robert P. Bongiovi, center, recently received the Lt. Gen. Kelly H. Burke Award for his outstanding staff work while assigned to the office of the Deputy Chief of Staff for Research, Development, and Acquisition at the Pentagon. Congratulating Major Bongiovi are the award's namesake, retired General Burke, left, and Lt. Gen. Bernard P. Randolph, DCS/RD&A.

first Air Force Senior NCO to attend the Navy's NCO Academy at Newport, R. I., but was also the class honor graduate.

The VA has announced plans to open a **new national cemetery** at Pruntytown, W. Va., in late 1986. The 3,000-gravesite location will become the nation's 110th national cemetery.

C. Craig Cumbey has retired from his post as Air Force **Director of Civilian Personnel.** He has held the top position since 1977, believed to be the longest tenure in the job. **Pat L. Schittulli,** current deputy, will move up.

Students at DoD's Dependents Schools overseas have, for the tenth consecutive year, scored higher than the national average on the **Scholastic Aptitude Test.** The overseas dependents averaged 442 in verbal skills, eleven points above the national average, and 480 in math, exceeding the norm by five points.

The Air Force has **more military installations** and properties in the US (401) than any of the other services. Closest is Navy with 241, followed by the Army with 107. The Marine Corps has twenty-five.

The Chosin Few, a veterans organization of those with Korean service, has elicited from DoD the information that 389 men are still missing and unaccounted for from that conflict. The group wants to **reunite the survivors** of the 1950 battle of the Chosin Reservoir, which *Time* magazine called "an epic of great suffering and great valor."

Col. Ronald W. Carl has been named Conductor of the US Air Force Academy Band. Colonel Carl has served as a USAF band commander for more than two decades.

Senior Staff Changes

RETIREMENTS: M/G John A. **Brashear;** B/G Wilfred L. **Goodson;** M/G Walter C. **Schrupp.**

CHANGES: M/G Clarence R. Autery, from Vice Cmdr., 8th AF, SAC, Barksdale AFB, La., to Dir., Prgms. & Eval., DCS/P&R, & Chairman, Air Safety Board, Hq. USAF, Washington, D. C., replacing M/G Hansford T. Johnson . . . **M/G Robert D. Beckel,** from DCS/Ops., Hq. SAC, & Dep. Dir., Ops., SAC Combat Ops. Staff, Hq. SAC, Offutt AFB, Neb., to C/S, Hq. SAC, Offutt AFB, Neb., replacing retired M/G John A. Brashear . . . **B/G Richard E. Carr,** from Cmdr., 831st AD, TAC, George AFB, Calif., to Ass't C/S for Studies & Analyses, Hq. USAF, Washington, D. C., replacing retired B/G Wilfred L. Goodson.

M/G Hansford T. Johnson, from Dir., Prgms. & Eval., DCS/P&R, & Chairman, Air Safety Board, Hq. USAF, Washington, D. C., to DCS/Ops., Hq. SAC, & Dep. Dir., Ops., SAC Combat Ops. Staff, Hq. SAC, Offutt AFB, Neb., replacing M/G Robert D. Beckel . . . **B/G John P. Schoeppner, Jr.,** from Vice Cmdr., Armament Div., AFSC, Eglin AFB, Fla., to Dep. Dir., OT&E, OSD, Washington, D. C., replacing B/G Michael D. Hall . . . **M/G Samuel H. Swart, Jr.,** from Cmdr., 57th AD, SAC, Minot AFB, N. D., to Vice Cmdr., 8th AF, SAC, Barksdale AFB, La., replacing M/G Clarence R. Autery. ■

AIRMAN'S BOOKSHELF

The Faithful Phantom

Phantom in Combat, by Col. Walter J. Boyne, USAF (Ret.). Smithsonian Institution Press, Washington, D. C., 1985. 176 pages with photographs and appendices. $22.50.

There is a plethora of F-4 Phantom reference material on the market these days, and unfortunately, most of it is garbage. Walt Boyne, a notable aircraft historian and the worthy director of the Smithsonian's National Air and Space Museum, has produced a rarity with his *Phantom in Combat*—a fresh, historically accurate, and very readable approach to an otherwise well-worn subject.

Rather than dwell on the by now well-known technical descriptions of the nuts and bolts and sheet metal that constitute actual Phantom hardware, Boyne documents, primarily through first-person accounts, the use of this ubiquitous warplane in the skies over Vietnam, the Middle East, and elsewhere.

The F-4 is ideal fodder for Boyne's literary cannon. Vietnam, various Israeli wars, and miscellaneous other conflicts of lesser intensity have seen it blooded in combat. Accordingly, there are many stories of the Phantom's successes and failures in real-war scenarios.

Author Boyne has chosen to present many of these exploits by relying on firsthand narratives by the pilots and WSOs who were wrestling with the hardware while the actual history was being made. Such documentation adds substantially to the credibility of the text—and immeasurably to its impact.

The photo coverage, much of which is fresh and previously unpublished, is exceptional and appropriate. Though there are no color photos, their absence in a book in which the meat lies in the text is not critical.

There are numerous tables in the appendices that cover such items as Phantom variants, the highly successful "Bolo" MiG-sweep mission of January 2, 1967, Navy Phantom aces in Vietnam, Air Force Phantom aces in Vietnam, and aircraft and weapon combinations used in USAF Vietnam MiG victories.

All told, this is an excellent and exciting history about fighter crews playing for keeps in an airplane that has now written an indelible chapter in the relatively short history of aerial warfare. No reservations here—this volume would be a fine addition to any airman's bookshelf.

—Reviewed by Jay N. Miller. Mr. Miller is Editor/Publisher for Aerofax, Inc.

American Martial History

For the Common Defense: A Military History of the United States of America, by Allan R. Millett and Peter Maslowski. Free Press, New York, N. Y., 1984. 621 pages with notes, bibliography, photographs, and charts. $24.95.

Uniformed professionals judge military histories primarily by the lessons they teach for the future. This is rightly so, and by this standard, *For the Common Defense* belongs on the airman's bookshelf. It is a first-rate book that is well written, solidly researched, and full of sound analysis—a comprehensive American military history that sets a high standard.

Authors Millett and Maslowski found the book on the constant themes of our martial history and give proper weight to all of the crucial elements: politics (domestic and international), strategy, tactics, logistics, mobilization, and what Clausewitz would call moral forces. The authors are notably objective about the contributions and shortcomings of all the armed services. Soldiers, sailors, Marines, and airmen alike will find value here.

Six major themes frame the book.

- "Rational military considerations alone have rarely shaped military policies and programs." Anyone who considers just the wars that the US has waged in the twentieth century—especially the two since 1950—will discover the truth of this notion.
- "American defense policy has traditionally been built upon pluralistic military institutions, most noticeably a mixed force of professional soldiers, citizen-soldiers, and antimilitary and pacifistic citizens." This is difficult to dispute, especially given the makeup of the bulk of US combat forces in American wars in the eighteenth, nineteenth, and twentieth centuries. The authors also demonstrate conclusively that "antimilitary and pacifistic citizens" were abundantly vocal in all of America's wars and were not a unique phenomenon of the Vietnam War.
- "Policymakers have done remarkably well in preserving the nation's security. For most of American history, they wisely realized that geographic distance from dangerous adversaries, the European balance of power, and growing material and manpower mobilization potential were powerful assets. . . . However, mobilizing simultaneously with war's outbreak has extracted high costs in terms of speed and ease with each new mobilization." Here the past speaks clearly, but the future bodes ominously.
- "The nation's firm commitment to civilian control of military policy requires careful attention to civil-military relations. The commitment to civilian control makes military policy a paramount function of the federal government, [and] the executive branch and Congress vie to shape policy." The frequent contests within our own memory between Congress and Presidents bear this out.
- "The armed forces have become progressively more nationalized and professionalized. . . . Although civilians ultimately control military policy, the professionalization of officership has had important consequences for the conduct of military affairs, since career officers in the national service . . . have progressively monopolized high command positions." No argument here, given the massive contributions of the graduates of such institutions as the Military Academy, the Naval Academy, etc.
- "Industrialization has shaped the

way the nation has fought. In particular, the United States has used increasingly sophisticated technology to overcome logistical limitations . . . and to match enemy numbers with firepower. This dependence upon industry and technology in executing military policy has placed enormous burdens on career military officers and the defense industry complex." The victories of America in both world wars bear out both parts of this final theme.

Beyond providing us these unifying themes, the authors are to be commended for their admirable balance. They look at all facets of a problem facing uniformed or civilian decisionmakers and are never shrill in their criticism.

Useful lessons for us, furthermore, abound throughout the book. For example, in describing the English strategic failure during the American Revolution, the authors suggest the US experience in Vietnam: "Perhaps England's fundamental error was its inability to implement an unambiguous strategy early in the war. . . . England wavered between coercion and conciliation, vacillating between punitive war to impose peace and an attempt to negotiate a settlement through appeasement. Unclear about its objectives, Britain inspired neither fear nor affection in the colonies."

Millet and Maslowski, moreover, write with gripping incisiveness of the Vietnam War and its consequences. "The United States failed to win its political objectives in Vietnam, and it paid such a high cost that it mortgaged its will and ability to use military force anywhere else in the world." The authors highlight the "multiple wounds the war inflicted on American defense policy," citing especially fiscal and moral losses. They discuss how and why the "Vietnam War made a major contribution to reducing the United States' ability to protect itself and its allies." They believe that we live in more perilous times today than in 1961, and the Vietnam defeat is the primary cause of our present predicament.

The authors spare no one in their criticism. Politicians, the media, vocal antiwar militants, and, most significantly for the military, professional military officers are all faulted. The authors' treatment, while balanced, is painful nonetheless.

The book's final chapter recalls James Madison in highlighting the argument that "moral suasion alone" cannot guard the Republic. We live in dangerous times, the authors argue. They note that only "another history can answer whether the people of the United States in the late twentieth century understood that constant vigilance is the price of liberty."

—Reviewed by Col. Alan L. Gropman, USAF. Colonel Gropman is the Deputy Director of Air Force Plans for Planning Integration.

Recipe for Disaster?

Revising U.S. Military Strategy: Tailoring Means to Ends, by Jeffrey Record. Pergamon-Brassey's International Defense Publishers, McLean, Va., 1984. 113 pages with appendices, bibliography, and index. $16.95.

At the close of World War II, the United States emerged as the only democracy possessing both the economic and military capability to oppose further Communist aggression in Europe, Southeast Asia, or elsewhere in the Third World. Following President Harry Truman's announcement of V-J Day on August 15, 1945, the US had little choice but to accept the leadership role as protector of the free world.

Since that time, reformers inside and outside the Pentagon have debated how the US could best meet its global military responsibilities at the least cost in dollars. But seldom have voices for reform been so loud as in recent years, when massive and growing federal deficits have fueled calls for cuts in defense spending.

Author Jeffrey Record is one such reformer, and in this book, he strikes at the heart of the dilemma of limited resources and global military responsibilities. He warns that current US military strategy posits goals far exceeding the resources not only necessary but available to realize them. He views present military strategy as a recipe for potential disaster.

According to Mr. Record, "Strategy is the calculated relationship of purpose and power. It involves choices within a framework of finite resources and an ability to distinguish between the desirable and the possible, the essential and expendable." Noting the gap between US military goals and actual capabilities, the author states that, since 1945, America has never possessed sufficient military power to make good on all its defense commitments abroad. Coupled with the fact that US military power has declined in relation to that of the Soviet Union, this gap between commitments and capabilities has widened perilously over the years.

The author cites two efforts in the 1950s to determine the level of conventional forces needed to defend Western Europe against a Soviet invasion. During North Atlantic Treaty Organization meetings in Lisbon in 1952, NATO members determined what was thought, at that time, to be the minimum combat ground force required to defend Western Europe—ninety-six divisions. By 1957, lacking the resolve to achieve that level, the goal was reduced to thirty divisions. Author Record notes that the Alliance today deploys only twenty-six active full-strength divisions on the Central Front.

Such failed attempts to reach recommended conventional force levels helped to promote the military strategy of massive retaliation. Based on the threat of a massive nuclear response to a conventional attack, this strategy allowed the US and its allies to maintain a perception of security in the face of the huge Soviet conventional military presence in Eastern Europe. Once the Russians acquired their own significant nuclear capability, however, this perception quickly changed.

From massive retaliation, author Record documents such approaches as flexible response, the Nixon Doctrine, the Carter Doctrine, and the present worldwide war strategy. Of the latter, he writes, "Indeed, a central premise of the Reagan Administration's military strategy is that any shooting war with the Soviet Union, in whatever region of the world it might start, is likely to spread quickly to other theaters of operations." In examining each strategy, the author underlines the fact that the resources required to implement any given US military strategy were—and are—insufficient.

Although the author makes an impressive case for the need to tailor resources to goals, he comes up short on recommending workable solutions for closing the gap between the two.

Among other suggestions to enable America to meet its global defense commitments effectively, Mr. Record proposes "a new transatlantic division of military labor." This would require our European allies to reach a level of defense spending commensurate with their overall economic power. The Europeans would be expected to shoulder the total responsibility for Europe's initial forward defense. Though not without merit, this recommendation has little if any chance of acceptance by West European nations struggling with economic woes and leery of any attempt by the US to reduce its ground-force presence.

Author Record also proposes that the US move toward a closer strategic engagement of China. This suggestion, too, appears to fly in the face of present realities. While it is true that China has begun to open its doors to the West and has undertaken economic reform, it would be a mistake to assume that Chinese and American interests are wholly compatible. Too many major obstacles, among them the future of Taiwan, stand in the way of a close military relationship between Washington and Beijing.

The author does not strike out with all his recommendations for matching means to ends. He does hit home with proposals for greater reliance on reserve forces and for enhancing US strategic mobility—especially airlift.

However, in the most critical oversight in the book, the author fails to address the issue of nuclear forces. He does not suggest how nuclear forces should be maintained, deployed, modernized, or weighed in the overall military balance. Too many questions are left unanswered.

In sum, however, *Revising U.S. Military Strategy* is a thought-provoking book that poses serious, honest questions about American military strategy. It is well worth reading.

—Reviewed by Capt. Napoleon B. Byars, USAF. Captain Byars is assigned to the Civil Affairs Branch, Community Relations Division, Secretary of the Air Force Office of Public Affairs.

The Prime Contractor

Brotherhood of Arms: General Dynamics and the Business of Defending America, by Jacob Goodwin. Times Books, New York, N. Y., 1985. 420 pages with glossary, notes, and index. $18.95.

Despite its title, this book is neither an exposé nor a puff piece about General Dynamics Corp. It's about the business of selling arms to the government. In telling the story, it focuses on General Dynamics, the only defense contractor selling major weapon systems to all three military departments.

Author Jacob Goodwin, a freelance journalist who has worked for *Defense Week* and *Military Logistics Forum,* has compiled a highly readable and well-researched primer on the acquisition of weapon systems—how they're conceived, how they're sold by and to the services and Congress, how the planning and negotiating are managed within Pentagon committees and industry planning staffs, and how such players as generals, admirals, civilian officials, congressmen, competitors, consultants, engineers, lawyers, foreign governments, and financiers figure in the process.

General Dynamics, the third largest defense contractor (next to Rockwell International Corp. and McDonnell Douglas Corp.), builds F-16 fighters and cruise missiles for the Air Force, M1 tanks for the Army, and the nuclear-powered Trident and attack submarines as well as sea-launched cruise missiles for the Navy.

Goodwin tells, step by step, how General Dynamics got each of these major contracts. In winning the competition between GD's YF-16 and Northrop's YF-17 in 1975, General Dynamics landed what turned out to be the most lucrative fighter program of all time. In this "deal of the century," General Dynamics expects to sell more than 4,000 F-16s to the United States and at least eleven foreign countries.

Goodwin keeps his story moving with revealing glimpses of the principal characters. Among them is David S. Lewis, Jr., chairman of General Dynamics. The former president of McDonnell Douglas Corp. had built his reputation on McDonnell's F-4 Phantom before coming to GD in 1970. He ran General Dynamics with overall success until 1977, when the Navy identified irregularities in GD's contract claims and the Justice Department began investigating allegations of fraud. On May 21, 1985, the Navy suspended all new contracts with two of GD's largest divisions. The next day, Lewis announced his intention to retire by the end of the year.

Least known nationally of those who plan and supervise GD's strategy is Henry Crown, the Chicago industrialist who controls more General Dynamics stock than anyone. Goodwin writes: "At 89, Crown still dominates General Dynamics. Far from an absentee landlord in Chicago, Crown is on the phone with David Lewis almost daily. While Lewis is clearly in charge of the company's day-to-day operation and deserves most of the credit for fashioning GD into the nation's premier defense contractor, no one doubts the ultimate authority at GD is still Henry Crown."

If there are any villains in *Brotherhood of Arms,* they are former GD vice president P. Takis ("Taki") Veliotes and Adm. Hyman G. Rickover, the "father" and longtime chief proponent of the Navy's nuclear submarine program.

Panagiotis Takis Veliotes, former general manager of GD's Electric Boat Division, was executive vice president of General Dynamics in 1982 when he suddenly resigned to return to his native Greece. The next year he was indicted in a US District Court in New York for allegedly splitting $2.7 million with another GD executive in kickbacks from a subcontractor supplying insulation for liquefied natural gas tankers.

From Greece, where he's a citizen, Veliotes has been conducting a campaign against General Dynamics and its chairman. He has been interviewed by most leading US news agencies, making allegations based on secretly taped conversations with David Lewis, Admiral Rickover, and others. He accuses the General Dynamics hierarchy of unethical conduct and questionable billing practices in building nuclear submarines for the Navy.

General Dynamics officials saw Admiral Rickover as a chronic meddler in nuclear submarine matters. Many believed that his suspicions had passed the point of rationality. They resented his belief that the nation's shipyards could not be trusted to build naval vessels under cost-plus rather than fixed-price contracts. And they contested his accusations that they had bid too low on new submarine contracts, submitted unreasonable claims, and built shoddy vessels. GD officials attempted to placate the irascible Admiral with gifts and perquisites that might have been reserved for a potentate.

Secretary of the Navy John Lehman reprimanded Admiral Rickover earlier this year for accepting such largess over the years and fined General Dynamics $676,283—calculated at ten times the value of GD's gifts to the Admiral.

Goodwin ends his story of General Dynamics' rocky road to the pinnacle with a five-page epilogue aimed at "the myth of the conception of a venal military-industrial complex." With all its faults, he contends, "the defense industry isn't the inept or malevolent institution that some suggest."

—Reviewed by Frank W. Jennings. Mr. Jennings retired recently after a thirty-six-year career as a writer for military leadership communication programs.

Battle Over Bougainville

Jay Zeamer and his crew had to get back to New Guinea with intelligence essential to the invasion of Bougainville.

BY JOHN L. FRISBEE
CONTRIBUTING EDITOR

WHEN Capt. Jay Zeamer, a member of the 43d Bomb Group, lifted his B-17 off the runway at Port Moresby, New Guinea, on June 16, 1943, he knew, as did every member of his crew, that this was a vitally important mission. The lone, unescorted bomber was headed for Buka, a small island just north of Bougainville, some 600 miles to the northeast of New Guinea. They were to photograph Japanese installations and then map the west coast of Bougainville as far south as Empress Augusta Bay in preparation for the Allied landings that were scheduled for late October or early November. There might not again be a clear day over the area in time to fly another mapping mission and prepare detailed charts for the invasion force. It was now, or perhaps never.

In the course of his forty-seven previous missions, Captain Zeamer had flown over Bougainville before and encountered only light opposition. But, unknown to Zeamer if not to higher headquarters, the Japanese had moved about 400 fighters into Rabaul and the Solomon Islands during the night of June 15. Zeamer was flying into a hornet's nest, as he was soon to find out. But Jay Zeamer would have volunteered for the mission anyway, and so would have most of his crew. After months of frustrating shortages and overwhelmingly adverse odds, the war in the Pacific was turning around. Slowly, the Japanese were being pushed back in the Southwest Pacific, and Bougainville was a key to taking, or bypassing, the great Japanese base at Rabaul.

In the nose of the B-17 was 2d Lt. Joseph Sarnoski, who had received an unorthodox introduction to the craft of bombing. In the late 1930s, he and another raw recruit at Langley Field, Va., were put through an informal course on the Norden bombsight to demonstrate its simplicity and to prove that bombardiers could be turned out *en masse* if the US became involved in a major war.

The photo recce part of the Buka mission went off without incident, though twenty-two enemy fighters were seen taking off from the island's airfield. A few minutes later, Zeamer started a mapping run along Bougainville's west coast. Forty-five seconds from completion of the run, his B-17 was attacked head-on by five Japanese fighters. Though wounded in the attack, Lieutenant Sarnoski continued to fire his nose gun, shooting down two enemy aircraft. Had it not been for him, says retired Lt. Col. Jay Zeamer, the B-17 would have been destroyed by that initial attack. For his part, Zeamer shot down one of the attackers with a nose gun fired by a button on the control column—a rare, perhaps unique, achievement for the pilot of a heavy bomber.

Then a 20-mm shell exploded in the nose of the bomber, hurling Sarnoski into the catwalk under the cockpit and riddling Zeamer's arms and legs with shell fragments. With a supreme act of will, the mortally wounded Sarnoski dragged himself back to the nose and continued to fire until he fell dead over his guns.

Left, Lt. Joseph R. Sarnoski; right, Lt. Col. Jay Zeamer—decorated for valor in the Pacific in World War II.

The head-on attack knocked out the B-17's oxygen and hydraulic systems and all flight instruments. Captain Zeamer, with a broken leg and multiple deep lacerations, put the bomber into an almost vertical dive from 25,000 feet to about 10,000 feet. He could judge his altitude only by the increase in engine manifold pressure. As he leveled off, an estimated seventeen enemy fighters resumed the attack from all quarters, staying with the B-17 for forty-five minutes until they ran low on fuel. During the running battle in which Zeamer saved the B-17 by taking violent evasive action, his crew shot down two fighters and probably downed another two.

Although weak from pain and loss of blood, Captain Zeamer refused medical aid and remained at the controls until the enemy fighters had left. Then, during moments of consciousness, he assessed the condition of the bomber, decided it could not make it over New Guinea's Owen Stanley Mountains, and directed his copilot to land at Dobodura on the east coast. With no brakes or flaps, the B-17 ground-looped to a stop with one dead and six wounded aboard. Only the copilot and two gunners had escaped injury.

For their heroic roles in that incredible mission, both Captain Zeamer and Lieutenant Sarnoski were awarded the Medal of Honor, the only instance of World War II when two members of a crew were so honored for separate and independent acts of heroism in combat. All other members of the crew were awarded Distinguished Service Crosses.

A year later, Jay Zeamer was released from the hospital. In January 1945, he was retired for disability resulting from his combat wounds. He now lives in Boothbay Harbor, Me. ■

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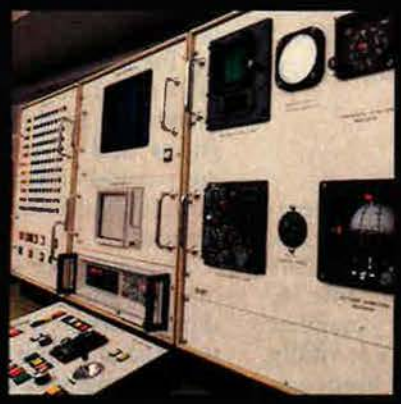

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By Robin L. Whittle, AFA DIRECTOR OF COMMUNICATIONS

Fresno Chapter Sponsors "Gathering of Warbirds"

The skies above the Madera Municipal Airport, which serves the small farming community of Madera about halfway between Los Angeles and San Francisco, were a bit crowded on Friday, August 16, as British-, Canadian-, German-, and Italian-built aircraft joined American-manufactured fighters, bombers, transports, trainers, and miscellaneous types representing forty years of aerospace progress for the opening day of the Fresno Chapter's fifteenth annual "Gathering of Warbirds."

California Gov. George Deukmejian was among the throngs who turned out during a ninety-degree "cold spell" to witness the arriving warbirds—a B-17, two C-47s, a C-46 Commando, an A-26 Invader, a C-7A Caribou, and a formation flight of B-25 Mitchells, P-51 Mustangs, F4U/FG-1 Corsairs, Sea Furies, and large formations of trainers.

"One of the greatest surprises and a rare treat for the warbird enthusiasts on Friday was the unannounced arrival of two P-47 Thunderbolts, a Curtiss-built P-47G Razorback and a Republic P-47M with the traditional bubble canopy," said Sam Boghosian, Fresno Chapter leader. Both of the "Jugs" were from the California-based Planes of Fame Air Museum.

The event officially got under way late on Saturday because of unexpected rain. Troops from the California State Military Reserve's "Cavalcade of Colors," attired in uniforms from the Civil War to Vietnam, posted the colors. After the National Anthem, a firing salute from a 1918 British-built cannon jolted the crowd, signaling that things were now officially on schedule. A missing-man formation was flown both Saturday and Sunday in honor of American servicemen who had lost their lives to international terrorism. Two P-47s and two P-51s flew the formation, with the M-model Thunderbolt doing the pull-up.

In a scene reminiscent of World War II, six Mustangs escorted the B-17 Flying Fortress during flybys that prompted one Army Air Forces veteran to comment: "I never thought I'd live to see that again. The last time was in Europe in 1944."

Ramp space was at a premium during the Fresno Chapter's "Gathering of Warbirds" at Madera Municipal Airport. Here, three Hawker Sea Furies, with folded wings, nestle tightly among a P-51 Mustang and F4U Corsair. (Photo by Ron Miller)

"Nostalgia plays an increasingly important role each year during the 'Gathering,'" Mr. Boghosian reported. This year, "Big Band" music from the 1940s was played throughout the day, and many participants donned WW II uniforms for the 1985 event. Meticulously restored vintage military vehicles, armor, and armored vehicles added to the nostalgic theme.

Part of the program was devoted to crowd-pleasing aerobatics by P-51s, F4Us, Sea Furies, T-28 Trojans, and T-6 Texans. Five B-25 Mitchell bombers conducted a "Thirty Seconds Over Madera" display that recalled the 1942 Doolittle raid over Tokyo. According to Mr. Boghosian, the B-25 flyover took the crowd by surprise when the lead bombers opened their bomb bays and dropped "dark objects" that turned out to be watermelons!

"California had just suffered significant losses because of the pesticide-tainted watermelon scare, which caused one of our attendees to remark, 'Well, at least they make darn good bombs!'" Mr. Boghosian recalled.

Another sight to remember was the graphic example of aerospace technological change presented by the giant C-5, which completely dwarfed the C-45 Expeditor, C-46 Commando, and C-47 parked together on the Madera ramp.

Also participating in the Gathering were five British Hawker Sea Furies, making up the largest contingent of foreign-manufactured aircraft. The five-bladed carrier-borne fighters saw service during the Korean conflict. Four of the the Hawker fighters served formerly with the Royal Australian Navy, while the fifth saw service with the Iraqi Air Force. Two Supermarine Spitfires scheduled to participate with the British contingent suffered mechanical problems and were unable to attend.

Canadian manufacturers were represented by a California Army National Guard de Havilland C-7A Caribou that served in Southeast Asia, a de Havilland Chipmunk, and Can-Car Harvard trainers. Ross Grady of Edmonton, Alberta, flew in with his

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P-51D Mustang, which had been in the Salvadoran Air Force and still had that air force's camouflage paint scheme.

Two SIAI-Marchetti SF.260 ground attack and ground support aircraft represented Italian manufacturers. One formerly served with the Zaire Air Force and still had that nation's camouflage paint scheme. Owned and flown by "Team America," the Marchettis demonstrated precision flying during an aerobatic sequence.

Harold Kindsvater brought in his "Fresno Luftwaffe"—an expertly restored and authentically repainted Fieseler Fi-156D Storch. It was equipped with a WW II German flare gun and a rear machine gun. The "Stork" is believed to be the only ambulance version flying today. Mr. Kindsvater has also done an accurate job of restoring his Me-108 Taifun. He participated in the flying portion of the show with both aircraft and demonstrated the Storch's STOL capabilities with slow flights of fifteen mph into a gentle breeze.

The concluding act of the "Gathering of Warbirds" was the Condor Squadron's "good-guy" vs. "bad-guy" routine. Five T-6s painted in Luftwaffe markings succeeded in destroying the "officers' club" before they were "shot down" by the "good guys" flying five T-6s in the markings of the 31st Fighter Group. A Hollywood special effects technician provided the simulated bomb burst, flak, and ground strafing.

The air show's chairman, Arnie Schweer, said that all goals but one had been fulfilled. Planners had hoped to celebrate the fortieth anniversary of the end of WW II with a B-29, "but the fuel costs of bringing in the 'heavy iron'—the B-17, B-25s, the A-26, the C-46, the C-47s, the TBM Avenger, and the fighters—to Madera precluded getting the Superfortress," Mr. Schweer said. "But we fulfilled three of our goals—to celebrate the fiftieth anniversaries of the B-17 and C-47, to carry out the international airshow theme, and to include aircraft representing WW II, Korea, and Vietnam." He noted that Chapter officials believe that this year's "Gathering of Warbirds" featured the greatest variety of current and former military aircraft ever assembled at any airfield.

Fresno Chapter President Ron Markarian and Chapter member Chris DeGuitaut, who have been involved with the program since the first one in 1972, said the event was one of the Chapter's best. Funds generated by the event support the Chapter's myriad AFROTC and Civil Air Patrol scholarship programs, the base museums at Castle and McClellan AFBs, and the Fresno Metropolitan Aviation Center.

"We will reconvene for the 1986 event the weekend of August 15–17 and hope to have as large a foreign press contingent as we did this year. We had press from Australia, Britain, France, Italy, and Switzerland," Mr. Markarian said.

TAC Commander Addresses Langley Chapter

Gen. Robert D. Russ, Commander, Tactical Air Command, told a Langley Chapter luncheon meeting in September that if the aircraft industry could provide the equivalent of a 60,000-mile spark plug for combat planes, DoD would realize vast savings and US forces would be more combat-ready, reports Virginia Biggins, who covered the event for the Newport News *Daily Press*.

"You may have heard we [TAC] have a spare parts problem and a manpower problem. Well, we don't, but we do have a problem in reliability and maintainability of our equipment. If new systems are designed to break less often and are easier to repair when they do break, fewer people are required and fewer spare parts are required," he said. The TAC Commander thinks maintenance time at air bases would be greatly reduced if the Air Force had more reliable planes that required less time and fewer parts to repair.

TAC Commander Gen. Robert D. Russ recently spoke before the Langley Chapter in Virginia. (Photo courtesy Kenneth Silver of the Newport News Daily Press)

"If the auto industry can give us a five-year battery and a 60,000-mile spark plug, and if we can buy a television that's trouble-free for years, I'm convinced we can do the same thing with aircraft parts," said General Russ, who has commanded TAC since May.

Regarding the Advanced Tactical Fighter (ATF), General Russ said the Air Force hopes to have it by 1995. It would be the first major weapon system designed from the ground up to maximize reliability and maintainability. ATF will be a reliable "pilot's airplane," in which man and machine will function as an integrated weapon system, he said.

Although the Air Force will need a new combat aircraft by the mid-1990s, when the F-15 fighters of today will be twenty years old, General Russ said his command is better prepared than ever before to go to war and win. "TAC aviation is in the best shape ever," he told the AFA crowd.

A surprise visitor to the "Gathering of Warbirds" this year was a meticulously restored Republic P-47M Thunderbolt. The Jug belongs to California's Planes of Fame Air Museum. (Photo by Donald Cook)

Vinson Chapter Donates $20,000 to Museum

"It was a big check representing a lot of dollars—and a lot of hard work—that was given to the Robins AFB Museum of Aviation by AFA's Carl Vinson Memorial Chapter," reported Michael Pannell in the Warner Robins, Ga., *Sun*. Moreover, it was fitting testament to the skilled leadership of retiring Chapter President Joe Sherrill Stafford, who had led the Chapter to national prominence and who had helped win recognition for the Chapter as the outstanding AFA unit in communications for 1985 from among the more than 300 chapters worldwide.

Two goals had been set by the Chapter for the year: to improve communications and to make it the "Year of the Museum" by supporting the museum with visits and donations. Contributions were raised from every new, transfer, and renewal member during the community and base membership drives. A donation of $20 was gleaned from every Community Partner, and finally, two successful fund-raisers—an auction and a golf tournament—helped the Chapter reach a figure that amounted to the largest single donation given the museum by any organization.

"I'm real pleased to see the AFA year end with this particular donation," Mr. Stafford said. "It represents an entire year of work and interest by a lot of people. I've certainly appreciated the support of the community and base officials for AFA during the year.

"Of course, a new AFA year began in October, and that means a new beginning for a lot of folks doing a lot of good things," he said.

On hand to receive the donation in behalf of the museum was Maj. Gen. Cornelius Nugteren, Commander of the Warner Robins Air Logistics Center at Robins AFB. General Nugteren said he appreciated not only the $20,000 donation to the museum but also the AFA chapter's spirit and the pulling together that the gift represented. He commended Mr. Stafford and the Chapter for its accomplishments, which showed that everyone is working together, military and civilian.

Vinson Chapter members made it the "Year of the Museum" by raising $20,000 for the Robins AFB Museum of Aviation. Then-Chapter President Joe Sherrill Stafford, center, presented the donation to Warner Robins ALC Commander Maj. Gen. Cornelius Nugteren, left, and Museum Foundation Chairman Walter Whiting.

AFA's Active Grass Roots

Eugene Chapter officials in Oregon are planning to give broad exposure to the National Security Briefing Team from the Air War College, Maxwell AFB, Ala., during its scheduled appearance in the area on December 3. A luncheon for the media is on the agenda, and a dinner cosponsored by the Eugene Chapter, the Navy League, the Defense Education Committee, and the Pearl Harbor Survivors Chapter will bring in the community. Former Eugene Chapter President **Harry Hance** made arrangements for the Team's appearance. Mr. Hance is also founder of the Defense Education Committee of Eugene, which seeks "to educate the public about the necessity for an adequate national defense strong enough to deter our enemies from attacking and to protect us if we are attacked." The Committee sponsors programs aimed at the community, including a speakers bureau, monthly programs, and a well-written and widely distributed newsletter. Members regularly respond to inaccurate and misinformed newspaper articles and editorials via the letters to the editor columns. A sister Defense Education Committee has also been established in Portland by AFA leaders . . . In related news, **Robin Steussy,** former professor of Russian history at the University of Oregon and Portland State, discussed "The Differences Between the Russian People and Their Government" at a recent meeting of the Defense Education Committee at the Eugene Elks Lodge. Steussy served with the American foreign service behind the Iron Curtain in Hungary during the postwar years (1947–49).

Vincent O'Connor, longtime AFA leader from New York and AFA's Suffolk County Chapter, fashioned an outstanding speech on strategic deterrence and presented it to the "First Monday Club" of the St. John's Episcopal Church. The Club meets the first Monday of every month and is

South Dakota AFA recently presented commemorative plaques to its native sons at the Air Force Academy. Pictured are, from left, Cadet R. Ed Johnson, Cadet Perry J. Johnson, South Dakota AFA President Col. John E. Kittelson, Cadet Dennis M. Armstrong, and Cadet Scott R. Gregory. (Photo by A1C Daryl Pagel)

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open to the general public. "I believe in remaining active, and wherever I can, I try to explain why we need a strong deterrent capability and how, rather than being provocative, military strength is the great stabilizing force for world peace," Mr. O'Connor said. He also serves as an advisor to the World Affairs Council in the area and is president of the local American Association of Retired Persons.

South Dakota AFA recently honored its native sons graduating from the Air Force Academy. South Dakota President **John Kittelson** journeyed to Colorado Springs to present commemorative plaques, which were designed and constructed in the state and which bore the American and South Dakota flags, to four cadets: **R. Ed Johnson, Perry J. Johnson, Dennis M. Armstrong,** and **Scott R. Gregory** . . . AFA National Director **Jack B. Gross,** who is treasurer of AFA's Aerospace Education Foundation, spotted an item in the "Air Force Policy Letter for Commanders" that he thought deserved broader reading. Using the item as a basis, he wrote a letter to the editor that appeared in its entirety in the Harrisburg, Pa., *Patriot News* in July. The item was on President Reagan's address to a special session of the European Parliament on steps the superpowers could take to reduce East-West tensions . . . **CMSgt. James M. "Willie" Williamson** was named by Texas AFA in July as Texas Air Reservist of the Year in Tenth Air Force. He is maintenance manager for the 924th Tactical Fighter Group at Bergstrom AFB and, as a civilian, heads up the 924th's component repair branch. "I appreciate this honor," Chief Williamson said, "but I never expected recognition for performing my duty to my country and for working to enrich my community. You can be certain there are other Air Force Reserve men and women who are just as dedicated and active as I am," he said.

AFA's **Chicagoland-O'Hare Chapter** joined forces with the Armed Forces Communications and Electronics Association (AFCEA) and the Old Crows to hear **Brig. Gen. Donald L. Moore,** Vice Commander, Air Force Communications Command, discuss digital communications, reports Civil Air Patrol **Lt. Col. Ben Minardi,** Chicagoland-O'Hare Chapter member . . . **Carrol Buford** hit the membership nail on the head when, in the August issue of the California AFA newsletter, he said: "It is important to have the regular member, the relatively stable member of the community, as our core membership in order to maintain continuity and to remove ourselves somewhat from the 'choir' " . . . California AFA member and retired Air Force **Col. Jose Holguin** of Los Angeles spent a good deal of his time and more than $12,000 of his own money to locate the remains of five fellow crew members who were killed when their B-17 was shot down over Rabaul on the island of New Britain during WW II. Extensive research and trips to the South Pacific and Hawaii finally established what had actually happened. Colonel Holguin's work, reports California AFA President **Gerry Chapman,** eased the minds of relatives of the airmen.

Elsewhere in California, the Monterey Bay Chapter has been drawing quite an audience from the community, thanks to the efforts of **Paul Rush** to host outstanding speakers. **Dr. E. J. Kennedy,** a senior medical flight examiner, discussed developments in aerospace medicine; **Tom Scanlon,** former foreign service aide, outlined Soviet interference in US Embassy affairs; and **Gene Kozack,** a Canadian businessman, spoke on US-Canadian relations in the post-Trudeau period . . . **Charles O. Kilpatrick,** editor and publisher of the San Antonio *Express-News,* received the 1985 Walter W. McAllister, Sr., Patriotism Award—named for the late Mayor Emeritus of San Antonio—from AFA's Alamo Chapter on October 10. He was honored "for effectively working to promote a better understanding of national defense issues and to strengthen ties between the local military and civilian communities," reports Alamo Chapter leader **E. F. "Sandy" Faust.**

"Fund Drive Tops $400,000 Goal!" read the banner headline in the Virginia Aeronautical Historical Society newsletter. Active Virginia AFA leader **Neil November,** fund drive chairman, says the drive to raise funds to build the Virginia Aviation Museum has topped its $400,000 goal by some $25,000. Ground-breaking for the facility was scheduled for November on a five-acre site at the Richmond Airport. The opening is planned for May 1986. Another active Virginia AFA leader, **Ken Rowe,** director of the Virginia Department of Aviation, joined Keysville **Mayor Reggie Pettus** in presenting the first "Living History Series" program for the Virginia Aeronautical Historical Society on September 28. The program was devoted to their World War II flying experiences. Pettus and Rowe were aviation cadets who went on to fly the B-17 and B-24. By coincidence, both were shot down on wartime bombing missions and spent time in German prisoner-of-war camps.

JCS Chairman Adm. William J. Crowe, Jr., center, recently addressed a luncheon sponsored by AFA's Hawaii Chapter. Pictured with Admiral Crowe are Chapter President Don J. Daley, left, and retired Army Chief of Staff Gen. Fred C. Weyand.

Dan Hogan III, publisher of the Oklahoma City *Journal Record* and chairman of the *Journal Record* Publishing Co., was honored by **Maj. Gen. Richard Burpee,** Commander, Oklahoma City Air Logistics Center, Tinker AFB, and the local AFA during a meeting of the directors of the Oklahoma City Chamber of Commerce. Mr. Hogan was given a medallion struck at Tinker AFB for his "outstanding work as a civic leader and a friend of the Air Force." The medallion was sponsored by the local AFA . . . AFA's **Hawaii Chapter** sponsored and coordinated a luncheon for key business,

professional, and military leaders in Hawaii to hear the new Chairman of the Joint Chiefs of Staff, **Adm. William J. Crowe, Jr.,** who emphasized the importance of the Pacific and outlined the challenges facing America and its friends and allies in the area. Also attending were members of the Navy League, the Association of the US Army, the Pacific and Asian Affairs Council, and the Japan-America Society of Honolulu.

AFA's award-winning Charles A. Lindbergh Chapter in Westport, Conn., which has won thirteen major AFA national awards in the five years since its chartering in 1980, has begun a new Chapter award of its own. Named in honor of its founder and first president, **Alton G. Hudson,** the award is for superior dedication and performance in support of the Air Force and the Chapter, reports Chapter President **John Henry Griffin** . . . AFA's Fort Worth Chapter, named the outstanding extra-large-size chapter for 1985, sponsored "An Evening With the Thunderbirds" for the civilian and military communities that attracted some 400 for a Texas barbecue in honor of the Thunderbird pilots and maintenance personnel. **Lt. Col. Larry Stellmon,** commander and leader of the Thunderbirds, introduced the team and showed a new film. Colonel Stellmon received an AFA Citation from Fort Worth Chapter President **Dan Heth** and a Fort Worth Honorary Citizen certificate from **Mayor Bob Bolen.** Also attending the barbecue were retired **Lt. Gen. John Flynn, USAF,** a former Vietnam POW; retired **Lt. Gen. Gene Tighe, USAF;** retired Navy **Capt. Red McDaniel,** a former POW; and **Rep. Bill Hendon** (R-N. C.). On September 28, Fort Worth Chapter officials and Carswell AFB cohosted the Eighth Air Force Band for "An Evening of Entertainment" and the Band's "Sounds of Our Military Heritage." The program includes many of Glenn Miller's famous songs. Glenn Miller was Director of the Army Air Forces Band during World War II and was stationed with Eighth Air Force in England at the time of his death.

Greater Seattle Chapter members and guests heard **Bruce Allesina,** chief engineer of the Strategic Defense Initiative (SDI) for Boeing Aerospace, discuss the Strategic Defense Initiative at a meeting on September 25. "This highly technical subject has been bantered about in the press to such a degree that few lay people truly understand, in basic terms, what SDI is," the Chapter's promotional flier noted. The dinner event was held at the Holiday Inn at the Seattle-Tacoma Airport. In other Seattle AFA news, Chapter newsletter editor **Maurice E. Marler** does an outstanding job of mixing news affecting AFA policy positions with local AFA chapter news. Articles on the ABM system, NATO, and political meddling during the Vietnam War were run in the August issue along with highlights from the state convention, new officer rosters, and a profile of Medal of Honor recipient **Joe Jackson,** a Greater Seattle Chapter officer who addressed a recent meeting. *(For more on Joe Jackson, see "Deliverance at Kham Duc," p. 136, November '85 issue.)*

AFA's Greater Los Angeles Airpower Chapter held its tenth annual "Salute to Space Division" with Johnson Space Center Director **Gerald D. Griffin** as speaker. He told the nearly 700 attendees that the first West Coast liftoff of the Space Shuttle will be the most important program milestone since the reusable spaceship's first flight in 1981, according to **Bill Ormsby,** Chapter communications director. The March 1986 launch of the Shuttle from Vandenberg AFB, Calif., will involve a new launchpad

(Continued on p. 129)

The Greater Los Angeles Airpower Chapter recently held its tenth annual "Salute to Space Division." The almost 700 Salute attendees heard Johnson Space Center Director Gerald D. Griffin speak on Space Shuttle operations. The Chapter also presented thirteen awards to Space Division members during the Salute. See item above. (USAF photo)

The Fort Worth Chapter held a Texas-style barbecue during "An Evening With the Thunderbirds" that attracted nearly 400 military and civilian guests. Lt. Col. Larry Stellmon, commander and leader of the precision flying group, screened a new Thunderbirds film for the audience. Colonel Stellmon also presented an autographed photo of the Thunderbirds to the Chapter. Chapter President Dan Heth, left, accepted the photo.

Rocky Mountain Region—Lean and Effective

AFA's Rocky Mountain Region is best described as wide open spaces with few, but enthusiastic, people. It is composed of Colorado, Utah, and Wyoming. We have fifteen AFA chapters in this region, and while some are near US Air Force bases (Lowry, Hill, and F. E. Warren) and others are near large colleges with Air Force ROTC units (Boulder, Colorado University; Greeley, University of Northern Colorado; and Fort Collins, Colorado State University), there are chapters situated in small, isolated towns that nonetheless have commendable AFA programs (Pueblo and Grand Junction, for example).

In the recent past, two chapters from this region have been named by national AFA as outstanding chapters. Flatirons in Boulder received the outstanding small-size chapter award, and Colorado Springs/Lance Sijan was named Chapter of the Year for AFA. This year, the Colorado Springs Chapter was honored with AFA's national Exceptional Service Award for the best single program for 1985, which was the annual July Fourth celebration. The Chapter helped to plan and also spearheaded the celebration fund drive, which raised $30,000 for the dramatic fireworks display. Thousands turn out for the festivities each year, and the Chapter receives extensive and positive publicity.

State conventions in the region have featured some unique activities, including a train ride for convention-goers from the gathering point to the convention site and an exciting trip by gondola up the side of a mountain to a ski lodge. Conventions have been held in conjunction with large art festivals and Air Force Academy tours. Several regional activities have become long-standing traditions, including our "Irish Hanukkah" and the Oktoberfest. These complement our family picnics and, as one might expect, Western-style barbecues and chili cook-offs. Fund-raising activities are varied and range from the usual raffles and dinners to sponsoring the only beer concession at a Thunderbirds airshow attended by 250,000 thirsty people on a hot August afternoon!

While chapters in this region enjoy getting together and socializing, they never forget their commitment to the Air Force Association mission, especially in the area of education. One chapter, Blue Barons in Littleton, specializes in aerospace education. It conducts an annual scholarship contest for Civil Air Patrol cadets, AFROTC cadets, and students of flying and aircraft maintenance. It also sponsors a highly acclaimed workshop for aerospace educators every year that has received national recognition. The Utah AFA golf tournament raised more than $15,000 for scholarships and charitable organizations this year. Many activities in the region center on the Air Force Academy.

Karen M. Kyritz served as the AFA National Vice President for the Rocky Mountain Region during 1984–85.

In addition to its emphasis on education, the Rocky Mountain Region demonstrates its commitment to AFA's mission of supporting adequate armed strength to ensure the security and peace of the free world by its successful symposia on key defense issues. The planned 1986 deployment of MX Peacekeeper missiles in the region has afforded AFA leaders the opportunity of explaining to the public the need for MX. A highlight this year was AFA's "Welcome Home" dinner held in honor of Sen. Jake Garn (R-Utah) when he returned from his journey aboard the Space Shuttle *Discovery*.

We are proud of the accomplishments of our members and chapters in the Rocky Mountain Region. And we are dedicated to increasing our membership and further promoting the goals of the Air Force Association.

—Karen Kyritz, Immediate Past National Vice President/Rocky Mountain Region.

Colorado

A golf tournament, reception, business session, and addresses by Lt. Gen. Winfield W. Scott, Jr., US Air Force Academy Superintendent, and retired Lt. Gen. George Miller were some of the Colorado state convention activities in July. The convention was hosted by the **Front Range Chapter.** Colorado AFA was led by Thomas W. Ratterree in 1985.

AFA's **Blue Barons Chapter** in Littleton sponsored an aerospace field trip for high school students in conjunction with the Pueblo Historical Society, sponsored several aerospace education workshops in Colorado and neighboring states, participated in a military appreciation day at Lowry AFB, and held a meeting with members of the Colorado Historical Aviation Society. Blue Barons Chapter was led by Roger M. Hayes.

Colorado Springs/Lance Sijan Chapter, led by Glenn A. Griffith, sponsored many activities, one of which earned the Chapter national recognition as winner of the Exceptional Service Award for Single Best Program. For the fourth consecutive year, the Chapter spearheaded a drive to raise funds in the community for the dramatic fireworks display for the Fourth of July celebration and organized community-wide activities in concert with media outlets and local business and civic groups. Other recent activities included support of the annual Armed Forces Day Luncheon, sponsorship of a booth at the Armed Forces Day observance at Peterson AFB, and sponsorship of the Outstanding Squadron dinner. The Chapter also holds

The Colorado Springs/Lance Sijan Chapter received AFA's Exceptional Service Award for its drive to raise funds to finance a July 4 fireworks display. Chapter President Glenn Griffith here presents a photo of the display to Gen. Robert T. Herres.

Wasatch Chapter President Glenn Lusk recently presented an AFA bronze medal to Clearfield High School AFJROTC Cadet 1st Lt. Quinn Monsen.

monthly luncheon meetings, and Brig. Gen. Marcus A. Anderson, Commandant of Cadets at the Academy, and Colorado State Sen. Joel Hefley were among featured speakers.

Flatirons Chapter, led by John Thaxton, sponsored several interesting events in recent months, including a dinner that featured an address by an active-duty Israeli Tank Corps officer on the history of the Middle East and his participation in the last two wars, a talk by Maj. David Bateman on flying the U-2, and a presentation on flying the RF-4C by Chapter member Jerry Owen, who flies with the Nebraska Air Guard.

Front Range Chapter officials sponsored the state convention and held a joint meeting with the Silver & Gold Chapter. The **General Robert Huyser Chapter,** led by Ten Sparn, met with the local Retired Officers Association, and the Chapter was recognized for its support of Air Force recruiting. AFA's **Long's Peak Chapter** held a meeting with the **Weld County Chapter** that featured Rep. Ken Kramer (R-Colo.) as speaker. Located in Fort Collins, the Long's Peak Chapter was led by John Ulvang.

The **Pueblo Chapter,** led by Warren Barter, held three executive committee meetings. Led by Jack Powell, AFA's Silver & Gold Chapter held several meetings, including one featuring Pat Schittulli, deputy director of civilian personnel at Hq. USAF, and another with National President Marty Harris. Weld County Chapter officials, led by Loyal Kelsey, helped fund the transportation expenses of two Arnold Air Society cadets from the University of Northern Colorado to the National Conclave. The Chapter met its membership goal for the year.

Utah

The **Ute Chapter** hosted the state convention in August. Activities included a golf tournament, business sessions, and various speakers. Utah AFA was led by Harry Cleveland.

Officials of the **Gold Card Chapter,** which was led by Lee Mohler, helped in overall programming for the state convention, supported the Industrial Associates Luncheon at Hill AFB, and hosted a farewell luncheon for retiring state leader Jack Certain. **Ogden Chapter** hosted its annual AFROTC dining-out for four Utah universities. Col. (Brig. Gen. selectee) James Record was the honored guest at the event. **Rocky Mountain Chapter** officials, led by Carol Matteson, raised funds for the Hill AFB Heritage Foundation and the Ogden YWCA Crisis Center, presented an AFA Bronze Medal to the outstanding Clearfield High AFJROTC cadet, and sponsored a Western-style barbecue at a meeting.

Salt Lake Chapter joined with several local organizations and the **Ute Chapter** to sponsor a dinner that honored Sen. Jake Garn (R-Utah). The dinner celebrated the Senator's return from the Space Shuttle *Discovery* mission. Chapter President LeRoy Gibson presented an AFA silver medal to the outstanding cadet from the University of Utah ROTC detachment and copies of the book *Wings* to a cadet from each class. Led by President Peggy Mohler, the Ute Chapter donated funcs to the Air Force Museum Foundation at Wright-Patterson AFB, Ohio, cosponsored the "Welcome Home" dinner for Senator Garn, and helped plan the Charity Golf Tournament held during the state convention.

Wasatch Chapter President Glenn Lusk presented an AFA bronze medal to the best cadet in the Clearfield High School AFJROTC detachment and presented plaques sponsored by the Chapter to the best flight sergeant, flight commander, staff NCOIC, and staff officer in the detachment.

Wyoming

AFA has one chapter in Wyoming. Led by William Helms, it is the **Cheyenne Chapter.** Chapter officials sponsored a booth at Frontier Mall on Armed Forces Day and helped in planning the Armed Forces Day banquet.

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(Continued from p. 125)

and ground systems and the first use of lighter-weight solid rocket boosters, Mr. Griffin noted. He also stated concern that budget problems are delaying Air Force completion of a military Shuttle mission planning and flight control center at Colorado Springs, Colo. During the Salute, the Chapter presented thirteen awards to Space Division members, with the "Aerospace Unit of the Year" going to the Upper Stages Program Office. "For his work in building a manned spaceport at Vandenberg AFB and overseeing a string of successful space booster launches from both coasts, **Maj. Gen. Donald Henderson,** Commander of the Space and Missile Test Organization at Vandenberg AFB, was honored with the tenth annual Gen. Bernard A. Schriever Award," Mr. Ormsby reported. Other award winners at the Salute were **Col. William H. Crabtree,** Officer of the Year, O-5 and O-4; **Capt. Norman Payne,** Company Grade Officer of the Year, over four years; **Lt. Leo K. Anderson, Jr.,** Company Grade Officer of the Year, under four years; **MSgt. Robert E. Jordan, Jr.,** Senior NCO of the Year; **TSgt. Mel P. Turner,** NCO of the Year; **A1C Theresa A. Pondek,** Airman of the Year; **Jo Ann White,** Civilian of the Year; **Capt. Mark D. Borchardt,** Award of Excellence; **Col. Ralph G. Tourino,** Exceptional Service Award; and **James E. Collins,** Award of Merit. "This [Salute] just might have been one of our best yet," Mr. Ormsby said. Media representatives included *Newsweek, Aviation Week & Space Technology,* and the Los Angeles *Times.* General Chairman of the Salute was **Pete Beardsley,** newly elected Greater Los Angeles Airpower Chapter President. Program Chairman was **Ron Wilkinson.**

Cincinnati Chapter President **Joe Warth** presented solo wings to Civil Air Patrol Cadet **Rich Embry** at an AFA-CAP meeting at Lunken Airport recently. A former Eighth Air Force bomber pilot, Mr. Warth first soloed at Lunken some forty-four years ago . . . **Andy Kelly,** then president of the Spokane Chapter in Washington, presented an AWACS poster and model to the Fairchild Base Museum recently. The items were donated by the Boeing Co. . . . AFA National Director **Jim McCoy,** whilom Chief Master Sergeant of the Air Force, presented the National Security Affairs/Force Employment Award to **SMSgt. David H. Palmer,** 7th Weather Squadron, Ausbach, Germany, during the Class 85-D Senior NCO Academy graduation banquet.

SMSgt. David H. Palmer, left, received the National Security Affairs/Force Employment Award during the graduation banquet for Class 85-D of the Senior NCO Academy. Making the presentation was former Chief Master Sergeant of the Air Force James McCoy, an AFA National Director.

TSgt. Douglas L. Medcalf, Keesler AFB, Miss., received the Air Training Commander's Trophy sponsored by the Alamo Chapter from **CMSgt. Robert W. Carter** and the John Levitow Honor Graduate Plaque from Alamo Chapter President **E. F. "Sandy" Faust** during the graduation ceremonies for ATC NCO Academy Class 85-7 in August . . . "A Weekend in Dayton at the Air Force Museum" was on the itinerary for AFA's **Cleveland Chapter** in late October . . . A celebration party for Florida Highlands Chapter members at the home of President **Roy Whitton** was held in October in recognition of the Chapter's selection as AFA's outstanding small-size chapter for 1985 . . . AFA's **Rheinpfalz Chapter** in Germany sponsored the first annual "Chili Cookoff" at the Ramstein bowling

Mailing Lists

AFA occasionally makes its list of member names and addresses available to carefully screened companies and organizations whose products, activities, or services might be of interest to you. If you prefer **not** to receive such mailings, please copy your mailing label **exactly** and send it to:

Air Force Association
Mail Preference Service
1501 Lee Highway
Arlington, Va. 22209-1198

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center on September 2. A chili contest and "Chili Queen," plus prizes, square dancing, a country-western band, and flea market, transformed the base into a "mini-Texas." Entry fees benefited the AFA Welfare and Scholarship Fund.

Tucson Chapter officials sponsored their seventh annual awards banquet to honor outstanding performance and selfless service by personnel from Davis-Monthan AFB in improving the quality of military life and contributing to the community. **Darrow "Duke" Tully,** executive vice president and publisher of the Arizona *Republic/Gazette* and a combat pilot in Korea and Vietnam, was guest speaker. Chapter President **Bob Munn** acted as master of ceremonies. Honored were **SrA. Dwayne D. Graves; MSgt. Henry B. Hutton; Maj. Catherine G. Ozolins; Michael S. Nolan,** civilian of the year; **Marion J. Mitchell,** aerospace manager of the year; **Capt. Larry G. Sills,** pilot of the year; **SSgt. Custer J. Saul,** top recruiter; **MSgt. Carlos A. Lopez,** Air National Guard member of the year; and **TSgt. Edward E. Monroe,** AFROTC award. The President's Award for out-

The Paul Revere Chapter sponsored a symposium on the Strategic Defense Initiative last October. The symposium audience of more than 250 people heard speakers from the military, government, and industry. Among those attending the event were, from left, Chapter Vice President Leo O'Hallahan, speaker Col. Jim McDonough, and Chapter President Bill Lewis.

Eagle Watch

Watch this space each month for updates on the activities planned for AFA's exciting Gathering of Eagles. The Gathering of Eagles, to be held from April 27–May 1, 1986, in Las Vegas, Nev., promises to be the aerospace event of the decade!

In addition tc those organizations listed on p. 222 of the September issue and p. 140 of the October issue of AIR FORCE Magazine, the following groups will attend the Gathering.

Reserve Officer Association
Air Section
Col. David G. Palmer, USAF (Ret.)
Reserve Officers Association
1 Constitution Ave., N. E.
Washingtcn, D. C. 20002
Phone: (202) 479-2225

1st Air Commando Association
Dr. Cortez Enloe
P. O. Box 1820
Annapolis, Md. 21404

If your group has been listed in this space but you have not yet signed up, notify the contact listed. If you or your alumni group has not considered attending the Gathering of Eagles, we recommend that you take action today. Remember, eagles don't flock—they gather. We encourage all interested individuals and affinity groups that want to gather with us to *sign up now!*

If you are interested in how this might be worked out, call Rick Harris, AFA Headquarters, (703) 247-5800, and get all the details.

Last September, the Cleveland Chapter heard a presentation by Frederick C. Crawford, former TRW executive, at brunch prior to the Cleveland Air Races. With Mr. Crawford are AFA leaders Leo Johnson, left, and Chester Richardson, right.

standing community leadership and strong support of the Air Force and AFA was presented to **Jack Sherlock.**

Frederick C. Crawford, the former chairman of the executive committee of TRW and the past president and board chairman of TRW's predecessor, Thompson Products, addressed a Cleveland Chapter brunch prior to the Cleveland Air Races in September. In his introduction of Mr. Crawford, who is ninety-four, Cleveland AFA leader **John Boeman,** who is now Ohio State President, said in part: "From the beginning of aerospace technology with the Wright brothers over eighty years ago, for every person with the vision to see the impact of that technology on our society, there seems to have been more who, lacking the vision or the will and energy to make it reality, could only belittle the efforts of those who had it and were working to transform vision into reality. This man, from the beginning, recognized the impact and has shown the way in fulfilling the responsibilities imposed by the impact of aerospace technology on society." ■

UNIT REUNIONS

Valiant Air Command
The Valiant Air Command (VAC) will hold its annual air show on March 7–9, 1986, at the Space Center Executive Airport (formerly Tico Airport) in Titusville, Fla. **Contact:** Kevin L. Quinlan, Valiant Air Command, 6600 Tico Rd., Titusville, Fla. 32780. Phone: (305) 268-1941.

5th Combat Cargo Squadron Ass'n
Members of the 5th Combat Cargo Squadron will hold a reunion on April 17–20, 1986, in Long Beach, Calif. **Contact:** Robert D. Beard, 10679 Quivas St., Northglenn, Colo. 80234. Phone: (303) 457-1451.

Class 41-C
Members of Class 41-C (Barksdale,

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Roundtable videotapes are shown across the nation on public television and local cable stations, and they are regularly featured overseas on the Armed Forces network. The tapes are also used to brief AFA members and officials at the highest levels of industry, government, and the military.

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FOR INFORMATION ON ATTENDING THE ROUNDTABLES OR ORDERING TRANSCRIPTS OR VIDEOTAPES (VHS, BETA, OR ¾"), CALL THE AEROSPACE EDUCATION CENTER, (703) 247-5852.

Tentative Schedule of Upcoming Roundtables

January 21, 1986—***Focus On: "Satisfying U.S. Military/Civilian Space Requirements"***

March 4, 1986—***Focus On: "Educational Partnerships For A Changing World of Work"***

April 15, 1986—***Focus On: "Advanced Technology Munitions"***

April 30, 1986—***AEF Educator Workshop: "Educating For Leadership In Space" (Las Vegas, NV)***

May 1, 1986—***Focus On: "Designing Tomorrow's Air Force" (Las Vegas, NV)***

June 5, 1986—***Focus On: "Implementing Total Force Policy"***

Floater—***Focus On: "Pride in the Past—Faith in the Future"***

July 15, 1986—***Focus On: "Maintaining Our Technology Base—America's Trump Card"***

November 5, 1986—***Focus On: "Officer/Enlisted Relationships"***

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(home) _____

Brooks, and Kelly) will hold their forty-fifth anniversary reunion on April 24–27, 1986, in San Antonio, Tex. **Contact:** William A. Jensen, 15703 Fern Ridge, San Antonio, Tex. 78232. Phone: (512) 496-1320.

49th Fighter Interceptor Squadron
The 49th Fighter Interceptor Squadron, the last active-duty squadron to fly the F-106 Delta Dart, will be converting to the F-15 Eagle this spring. To celebrate the conversion, the 49th FIS will host a reunion on July 11–13, 1986, at Griffiss AFB, N. Y. **Contact:** Capt. Bill Silvestri, USAF, 49th FIS/DO, Griffiss AFB, N. Y. 13441-5000. Phone: (315) 330-3185. AUTOVON: 587-3185.

53d Weather Recce Squadron
The 53d Weather Reconnaissance Squadron will hold a reunion on June 12–15, 1986, in Colorado Springs, Colo. **Contact:** David B. Rundle, Unit 25, 425 Dorset St., South Burlington, Vt. 05401.

60th Troop Carrier Group
Members of the 60th Troop Carrier Group will hold a reunion on July 2–5, 1986, in Albuquerque, N. M. **Contact:** John Diamantakos, 7216 Pine Tree Lane, Fairfield, Ala. 35064. Phone: (205) 923-2323.

F-86 Pilots
A reunion will be held for F-86 pilots on April 27–May 1, 1986, in conjunction with the "Gathering of Eagles" in Las Vegas, Nev. **Contact:** Warren E. Thompson, 7201 Stamford Cove, Germantown, Tenn. 38138. Phone: (901) 754-1852.

307th Air Refueling Squadron
The 307th Air Refueling Squadron will hold a reunion on February 21–23, 1986, at the Holiday Inn Hotel and Casino in Las Vegas, Nev. **Contact:** Don Campbell, 6175 E. Owens, Las Vegas, Nev. 89110. Phone: (702) 459-0751.

307th Bomb Group
Members of the 307th Bomb Group "Long Rangers" will hold their reunion on May 16–18, 1986, at the Red Carpet Inn in Milwaukee, Wis. **Contact:** Cena Marsh, 1923 Atkin Ave., Salt Lake City, Utah 84106. Phone: (801) 539-6300 (office) or (801) 466-5805 (home).

320th Air Refueling Squadron
The 320th Air Refueling Squadron (1952–62) will hold a reunion on May 21–25, 1986, at March AFB, Calif. **Contact:** Herman G. Benton, 6252 Hamilton Ct., Chino, Calif. 91710. Phone: (714) 628-8681.

451st Bomb Group
The 451st Bomb Group will hold a reunion on May 29–June 1, 1986, in San Antonio, Tex. **Contact:** Bob Karstensen, 1032 S. State St., Marengo, Ill. 60152.

452d/17th Bomb Groups
Members of the 452d/17th Bomb Groups will hold a reunion on June 24–26, 1986, in Washington, D. C. **Contact:** Walter H. Myers, 53 Howard Ave., Columbus, Ohio 43085. Phone: (614) 885-6010.

INTERCOM

475th Fighter Group
The 475th Fighter Group "Satan's Angels" will hold a reunion on July 17–20, 1986, at the Inn-at-the-Park in Spokane, Wash. **Contact:** H. N. "Pete" Madison, 150 N. Myers St., Los Angeles, Calif. 90033. Phone: (213) 261-7171. Dale Thisted, N3128 Ash Pl., Spokane, Wash. 99205.

674th AC&W/Radar Squadron
The 674th Aircraft Control and Warning/Radar Squadron will hold a reunion on June 19–22, 1986, at Eagle Park in Osceola, Wis. **Contact:** Rick Kao, 3777 S. 15th Pl., Milwaukee, Wis. 53221.

2d Troop Carrier Squadron
I would like to hear from anyone from the 2d Troop Carrier Squadron, 443d Troop Carrier Group, who would be interested in holding a reunion.
Please contact the address below.
John E. Scott, Jr.
1409 Parkway Dr.
Griffin, Ga. 30223

8th AF Composite Wing
The Eighth Air Force Composite Wing would like to hear from members who would be interested in attending a reunion to be held in England in 1986.
Please contact the address below.
Lt. Col. Paul Chryst, USAF (Ret.)
1494 N. Adams St.
Pottstown, Pa. 19464

556th Strategic Missile Squadron
I would like to hear from members of the 556th Strategic Missile Squadron for the purpose of holding a reunion.
Please contact the address below.
Bruce W. Raleigh
12441 Longtin
Southgate, Mich. 48195

781st Bomb Squadron
Former members of the 781st Bomb Squadron, 465th Bomb Group, from World War II who would like to attend a reunion or make contact with fellow members should contact one of the addresses listed below.
James C. Althoff
2 Mt. Vernon Lane
Atherton, Calif. 94025
or
James M. Snyder
1226 Royal Oak Dr.
Winter Springs, Fla. 32708
Phone: (415) 325-8356 (Althoff)
Phone: (305) 365-7938 (Snyder)

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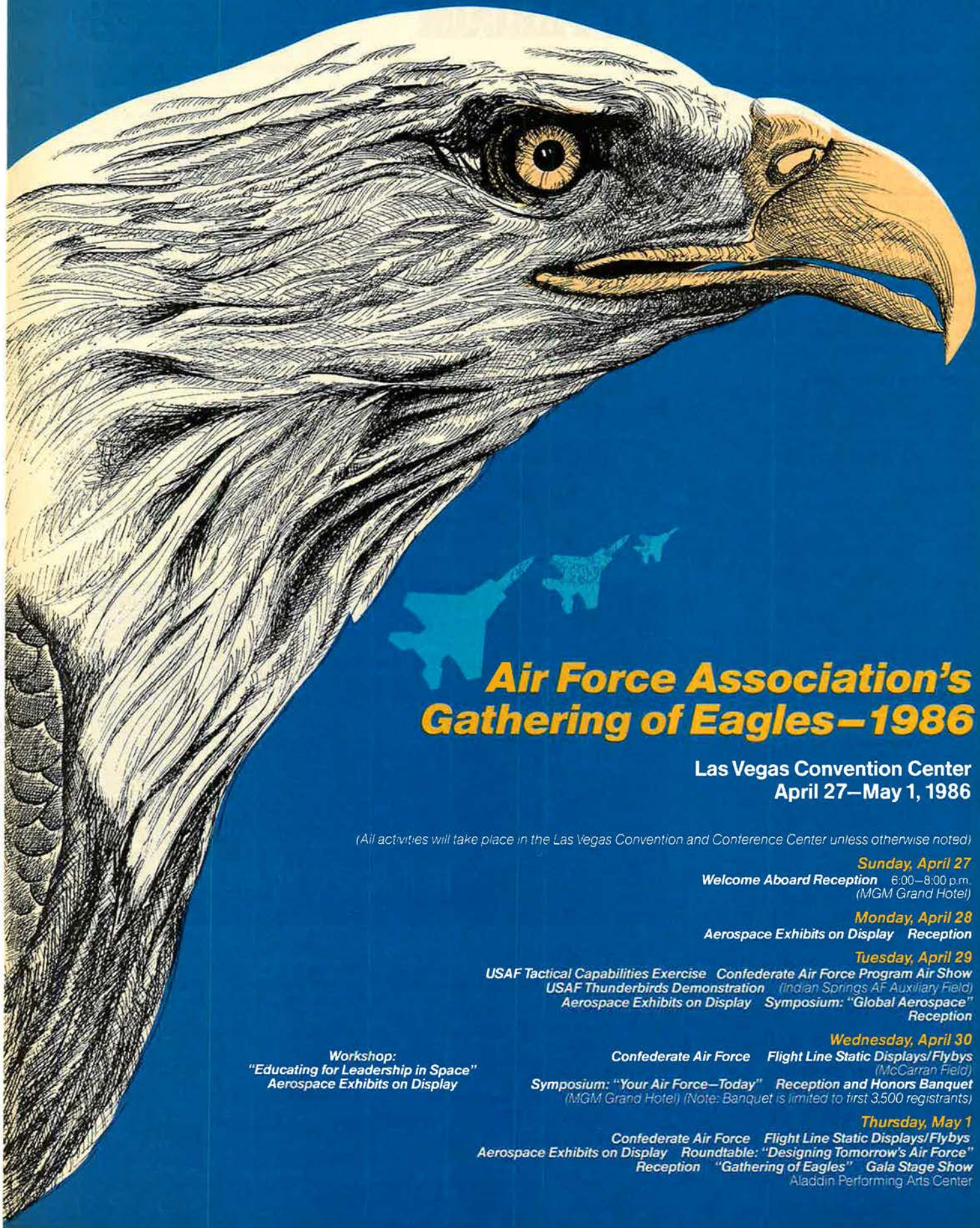


Air Force Association's Gathering of Eagles—1986

Las Vegas Convention Center
April 27—May 1, 1986

(All activities will take place in the Las Vegas Convention and Conference Center unless otherwise noted)

Sunday, April 27
Welcome Aboard Reception 6:00–8:00 p.m. *(MGM Grand Hotel)*

Monday, April 28
Aerospace Exhibits on Display Reception

Tuesday, April 29
USAF Tactical Capabilities Exercise Confederate Air Force Program Air Show
USAF Thunderbirds Demonstration *(Indian Springs AF Auxiliary Field)*
Aerospace Exhibits on Display Symposium: "Global Aerospace"
Reception

Wednesday, April 30
Workshop:
"Educating for Leadership in Space"
Aerospace Exhibits on Display

Confederate Air Force Flight Line Static Displays/Flybys *(McCarran Field)*
Symposium: "Your Air Force—Today" Reception and Honors Banquet
(MGM Grand Hotel) (Note: Banquet is limited to first 3,500 registrants)

Thursday, May 1
Confederate Air Force Flight Line Static Displays/Flybys
Aerospace Exhibits on Display Roundtable: "Designing Tomorrow's Air Force"
Reception "Gathering of Eagles" Gala Stage Show
Aladdin Performing Arts Center

WHEN SHOULD I REGISTER?

It is important that you register as soon as you can—TODAY, if possible. Las Vegas hotels are normally booked to capacity during the April/May time period each year. Consequently, to ensure you are able to reserve the hotel of your choice—AT the very special AFA rate—you must make your reservations immediately. Seating at Wednesday's Honors Banquet and Thursday's Gala Stage Show is limited, so sign up *now* to guarantee that you will be able to participate fully in all events.

See you in Las Vegas!

	Postmark Date Prior to February 28, 1986		Postmark Date On and After March 1, 1986 (and on site)	
Package #1 *(All activities including Honors Banquet—limited to first 3,500 registrants)*				
AFA Member/Patron	☐ $205		☐ $250	
AFA Spouse/	☐		☐	
	☐		☐	
Dependent Non-Member	☐ $235		☐	
	☐		☐	
Package #2: *(All activities except Honors Banquet, Wed., April 30)*				
AFA Member/Patron	☐ $155		☐ $200	
AFA Spouse/	☐		☐	
	☐		☐	
Dependent Non-Member	☐ $185		☐	
	☐		☐	

(Please print or type)

Application for Hotel Reservations

Please list three choices of hotels:

1st _____

2nd _____

3rd _____

Room will be occupied by:

_____
Name

_____
Affiliation

_____
Street

_____
City State Zip

Type of Accommodation

___ Single Rate ___

___ Double Rate ___

___ 1 B/R Suite Rate ___

___ 2 B/R Suite Rate ___

Date of Arrival: _____

_____ Hour _____ AM-PM

Date of Departure: _____

_____ Hour _____ AM-PM

Fill out this form completely and mail to:

"AFA Housing Bureau"
Las Vegas Convention & Visitors Authority
3150 Paradise Road
Las Vegas, Nevada 89109-9096

Note:

1. The AFA Housing Bureau will handle all reservations. Do not contact hotels. If changes need to be made after receiving confirmation, contact hotel directly.
2. A deposit of one night's lodging must be sent directly to the hotel once you receive confirmation.
3. Room assignments will be made on a first-come, first-served basis.
4. If a block of rooms is required, attach a list of individuals needing rooms to this form with arrival and departure dates and times.

Hotels and Rates

HOTELS	Single	Double	1-Bedroom Suite	2-Bedroom Suite
MGM Grand	$77	$77	$178-up	$260-up
Caesar's Palace	70	70	200	300
Flamingo Hilton	60	60	150-up	240-up
Dunes	58	58	180	250
Imperial Palace	60	60	150	210
Maxim	38	38	–	–
Continental	45	45	–	–
Alexis Park (All Suites)	70/90	70/90	–	–
Tropicana	42	42	125	250
Hacienda	55	55	100	165
Marina	42	42	100	150
Sands	55	55	125-up	225-up
Desert Inn	75	75	150-up	225-up
Frontier	54	54	185	225
Riviera	55	55	150	200
Sahara	55	55	90-up	180-up
Landmark	52	52	95-125	–
Las Vegas Hilton	64	64	–	–
Mardi-Gras (All Suites)	33	33	–	–

REGISTRATION FORMS MUST BE ACCOMPANIED BY U.S. DOLLAR CHECK, MONEY ORDER PAYABLE TO "AFA," OR CREDIT CARD AUTHORIZATION.

What Name/Title on your Registration Badge(s):

Your Name: _____

Other Registrants: _____

_____

_____

_____

_____

_____

Your Address: _____
Street Address

_____
City State Zip

_____
Country

Phone Number: (____)_____

Send this form and your payment to:

"Gathering of Eagles"
Air Force Association
1501 Lee Highway
Arlington, VA 22209-1198

☐ I enclose $_____ U.S. Dollars (in check or money order only) for _____ Registration Packages

or:

☐ Charge $_____ U.S. Dollars to my credit card, as indicated:

☐ AM EX
☐ VISA
☐ MasterCard

Account number: _____

Expiration date: _____

Cardholder's signature:

_____

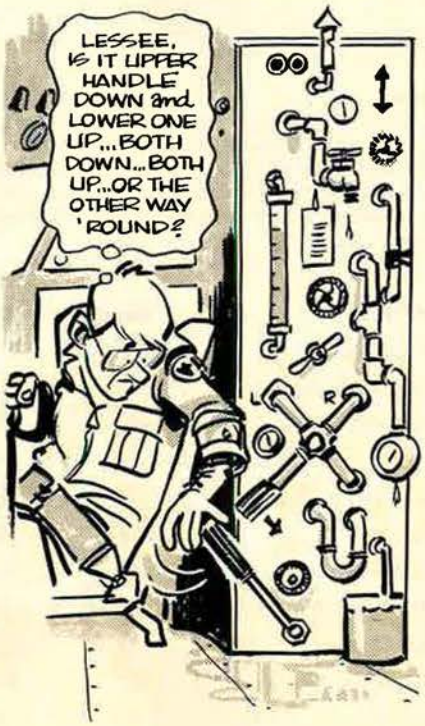
Bob Stevens'

"There I was..."

GOONEY BIRD, DAKOTA, SKY TRAIN, DIZZY THREE, PLACID PLODDER, DOUGLAS RACER, C-47, R4D, PUFF THE MAGIC DRAGON, OR SIMPLY- "THE THREE". THAT GRAND OLD LADY OF THE SKIES, THE DOUGLAS DC-3, IS **50** YEARS OLD THIS MONTH. AT LEAST 2 GENERATIONS OF ARMY/AIR FORCE CREWMEN - and PASSENGERS - SALUTE YOU, OL' GAL!

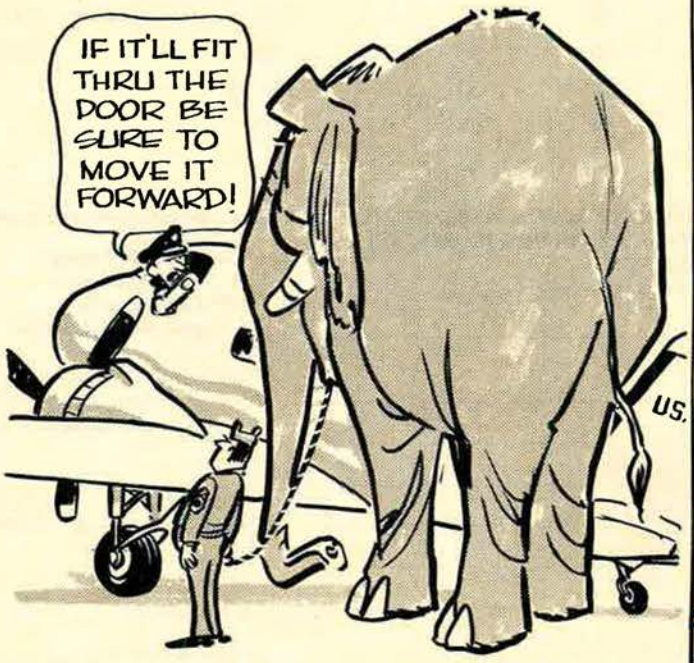
THE GOON'S COCKPIT IS CRAMPED and LEAKY...

...HER HYDRAULIC SYSTEM IS, AH, UM... ANTIQUATED...

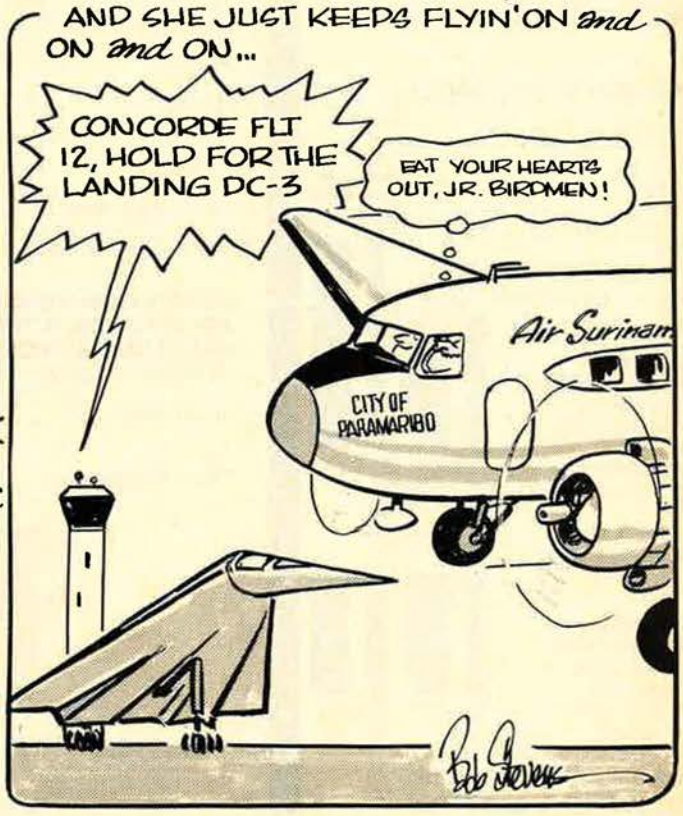


...THE HEATING SYSTEM HAS 2 POSITIONS - 'AMBIENT' and 'FREEZING'.

BUT HER LOAD HAULING CAPABILITIES ARE LEGENDARY-



AND SHE JUST KEEPS FLYIN' ON and ON and ON...



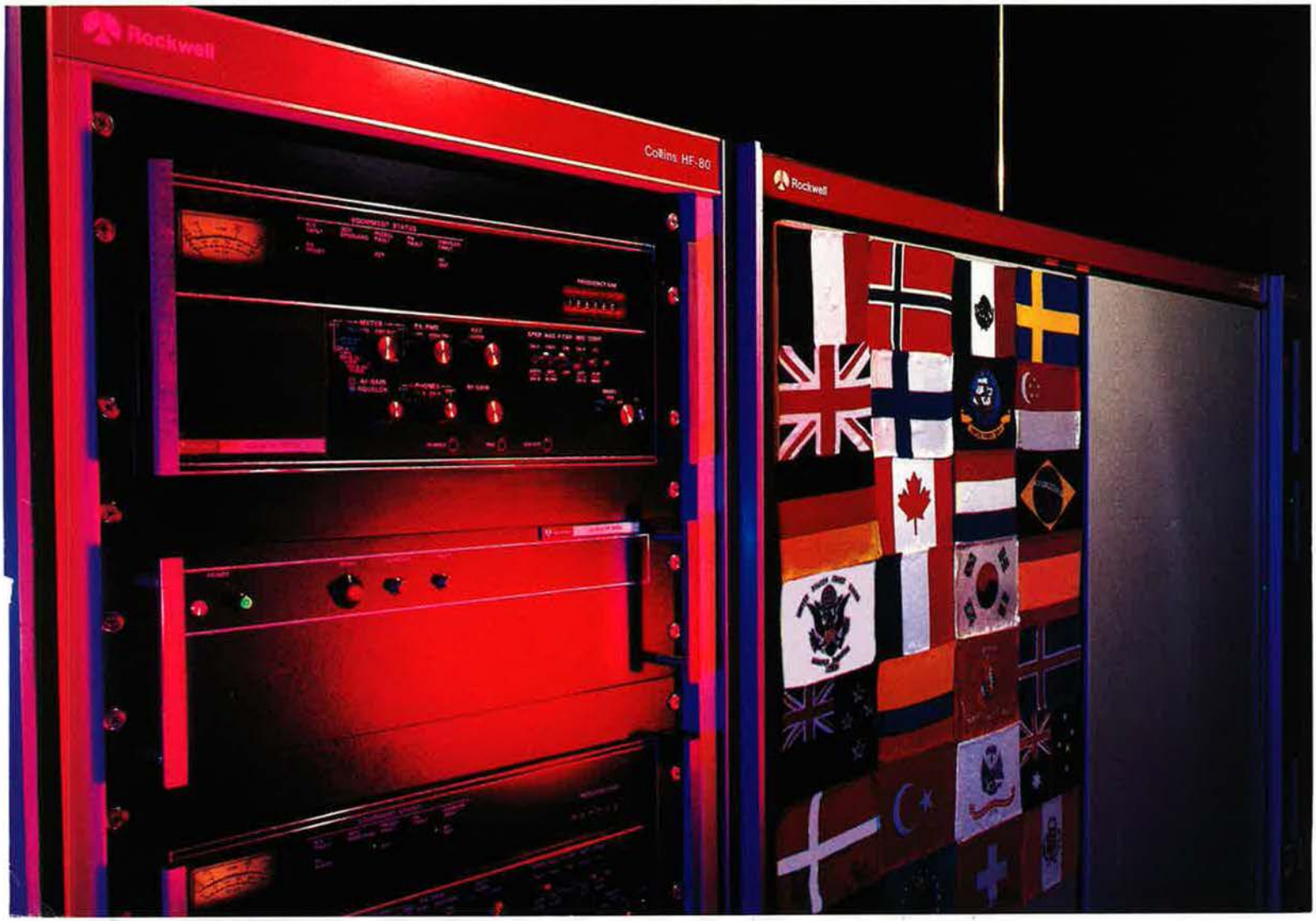
COLLINS HF: More than fifty countries are using the famous HF-80 family to provide reliable HF communication around the world. The HF-80 family's building block concept allows adding only the components necessary to build a communications system perfectly suited to your needs. ■ With transmit power levels of 1, 3, or 10 kW, the flexibility of the Collins HF-80 family offers the widest range of applications. From simple operator attended receivers and transmitters to fully automated and remote controlled fixed stations. ■ The high degree of commonality, and solid state design help reduce user costs and make field service quick and easy. Equipment is field proven and mil-qualified by the USAF and the U.S. Army. ■ The HF-80 family includes receivers, transmitters, transceivers, microprocessor remote control units and the Collins SELSCAN™ processor that automatically scans and selects the best HF channels at the touch of a button. For special purposes, optional configurations include four-channel multiplex, SIMOP and ECCM. ■ Over 50 years of technological expertise has made the Collins HF-80 family one of the most versatile, cost effective HF product lines in the world today. ■ For information contact: Collins Defense Communications, Rockwell International, Cedar Rapids, Iowa 52498, U.S.A. (319) 395-2690, Telex 464-435. ■ **COLLINS HF says it all.**

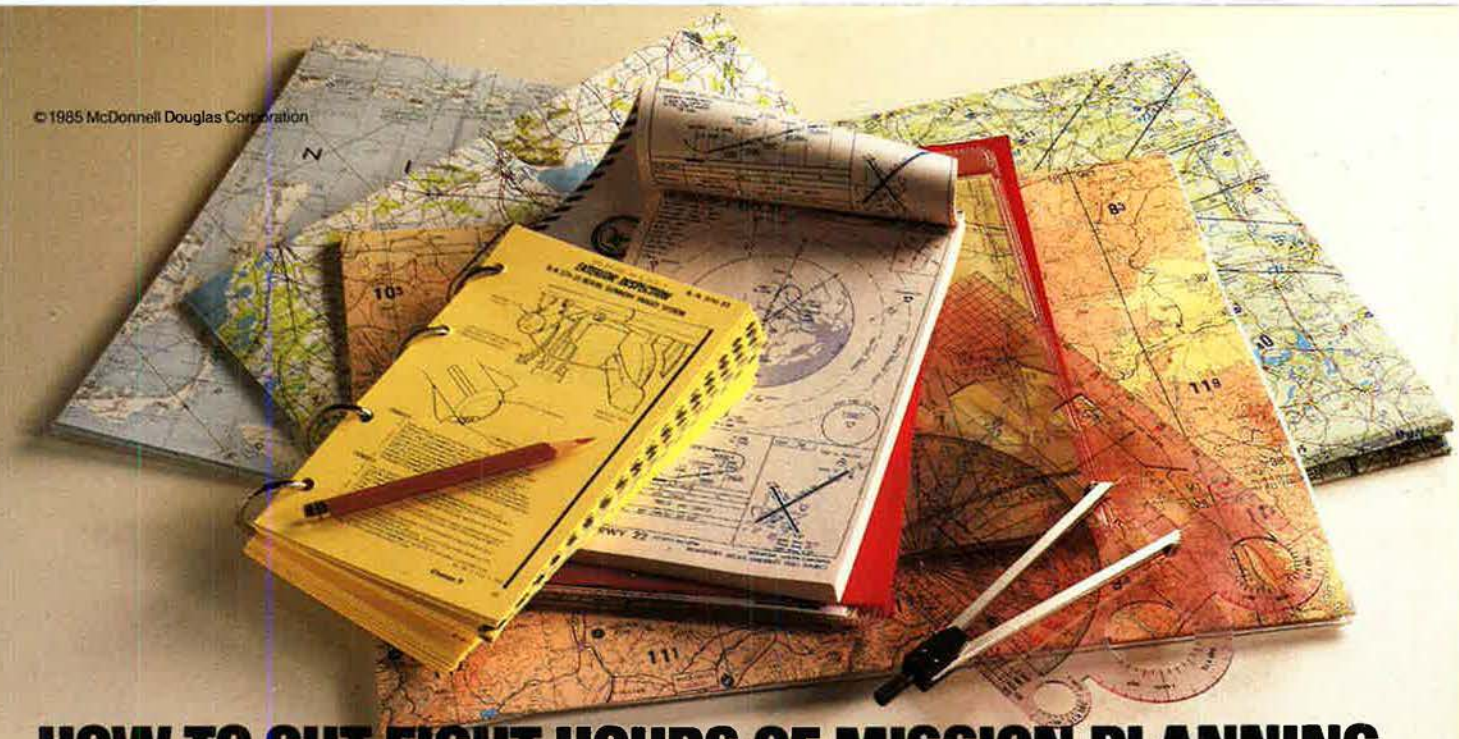
Rockwell International

...where science gets down to business

Aerospace / Electronics / Automotive
General Industries / A-B Industrial Automation

THE HF RADIO HEARD 'ROUND THE WORLD.





HOW TO CUT EIGHT HOURS OF MISSION PLANNING DOWN TO 30 MINUTES.

Every military pilot knows the drill: The charts, checkpoints, weather, fuel calculations, defensive system analysis. And especially the hours it takes.

Now there's a better way. Our computer-based Military Aircraft Planning System lets aircrews plan every aspect of a combat or training mission anywhere in the world in a fraction of the time previously required.

The reference data needed is in the computer. Interactive color graphics show basic geography with contours and population centers; navigation aids, corridors and checkpoints; even hostile defenses with radar terrain masks. As the mission planner develops the route, he gets a comprehensive analysis of his aircraft's performance, necessary navigation information, and an evaluation of the plane's ability to penetrate. Within minutes he can revise the route to minimize exposure to hostile defenses.

The system not only cuts hours off planning time, it can cut attrition rates as well. Operational simulations in Europe predict a 31% increase in mission success with the system.

The Military Aircraft Planning System. We've needed it for a long time, and now it's here. It's ready to improve our training and our ability to fight and win.

MCDONNELL DOUGLAS