DECEMBER 1986/$2

AIR FORCE MAGAZINE

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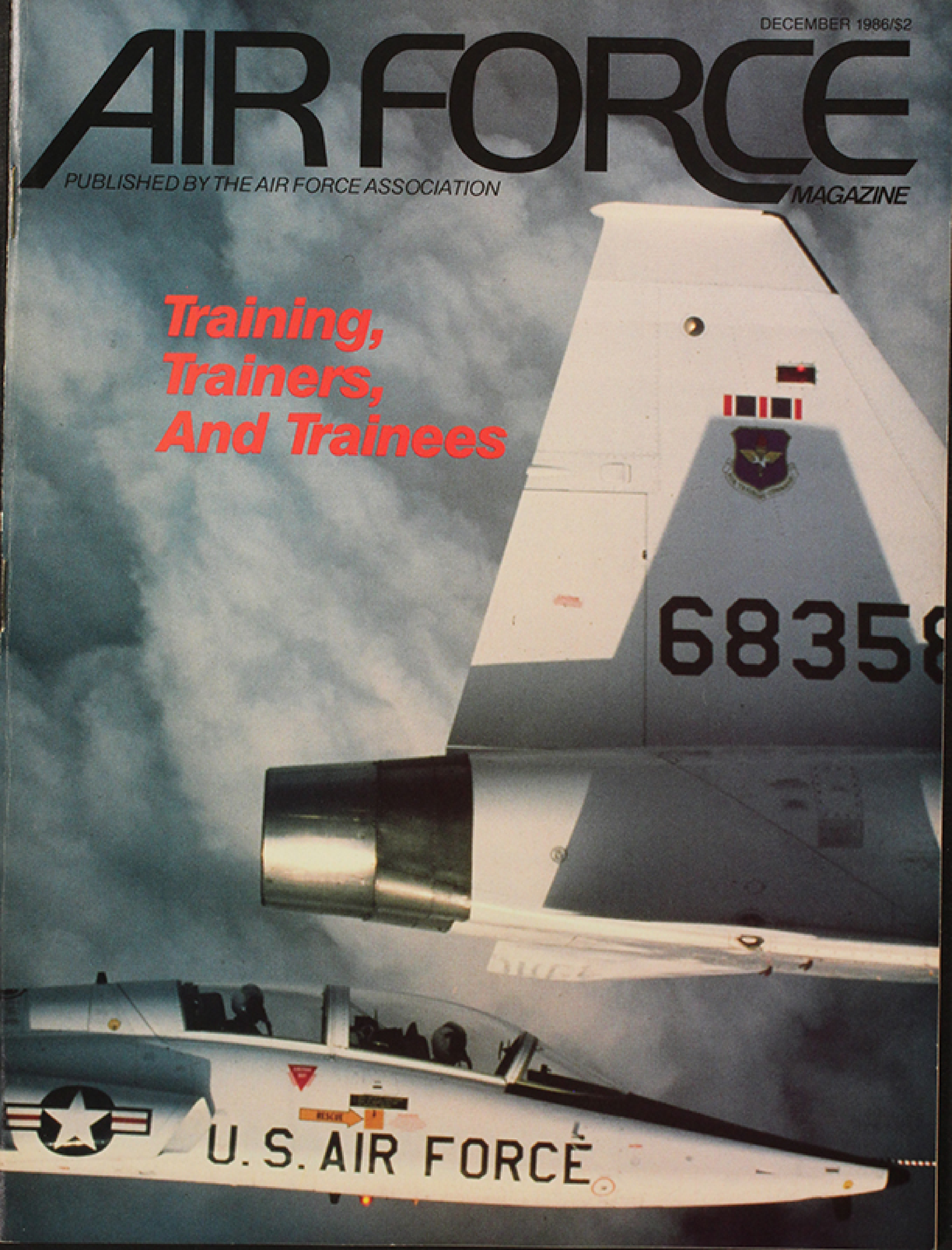
Training, Trainers, And Trainees



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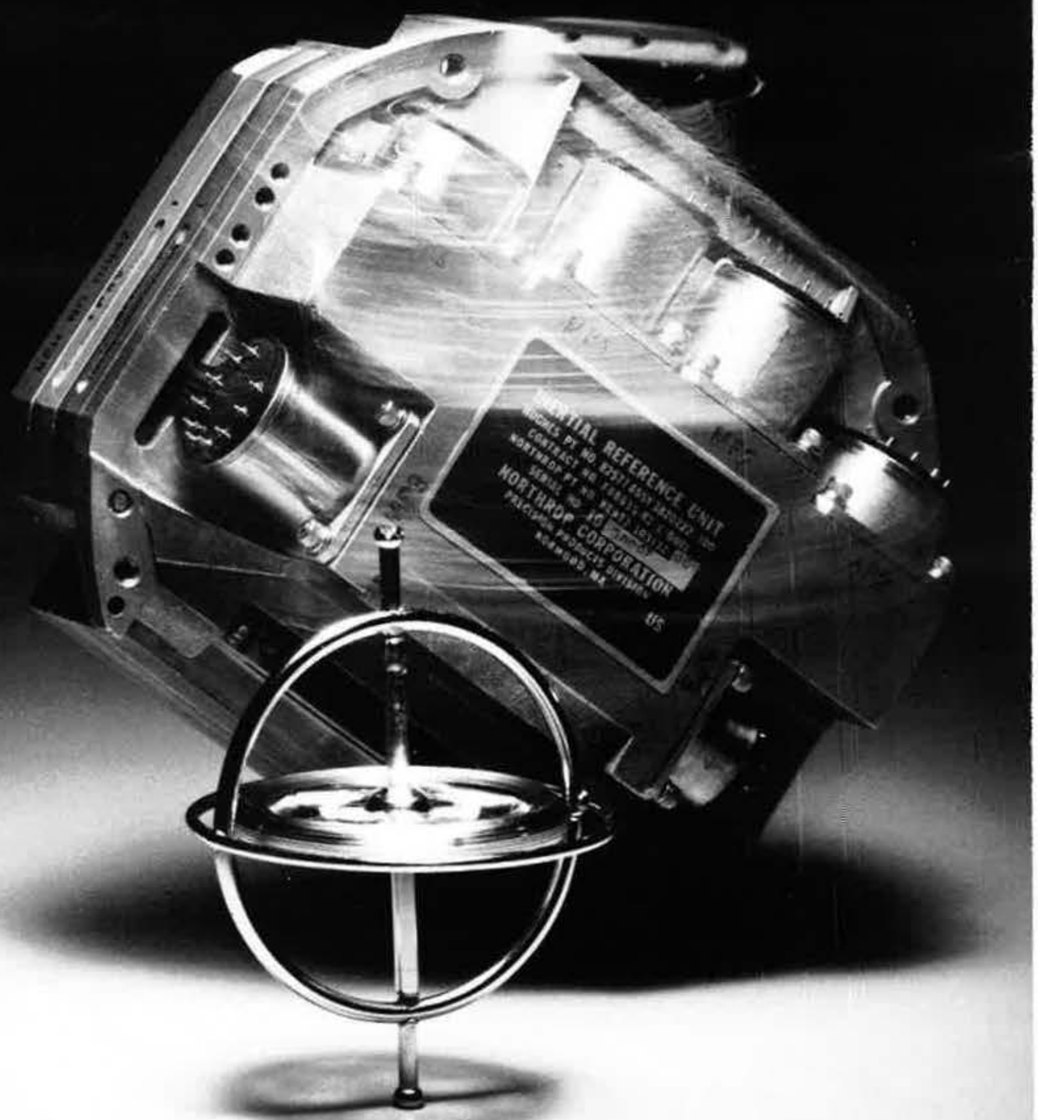

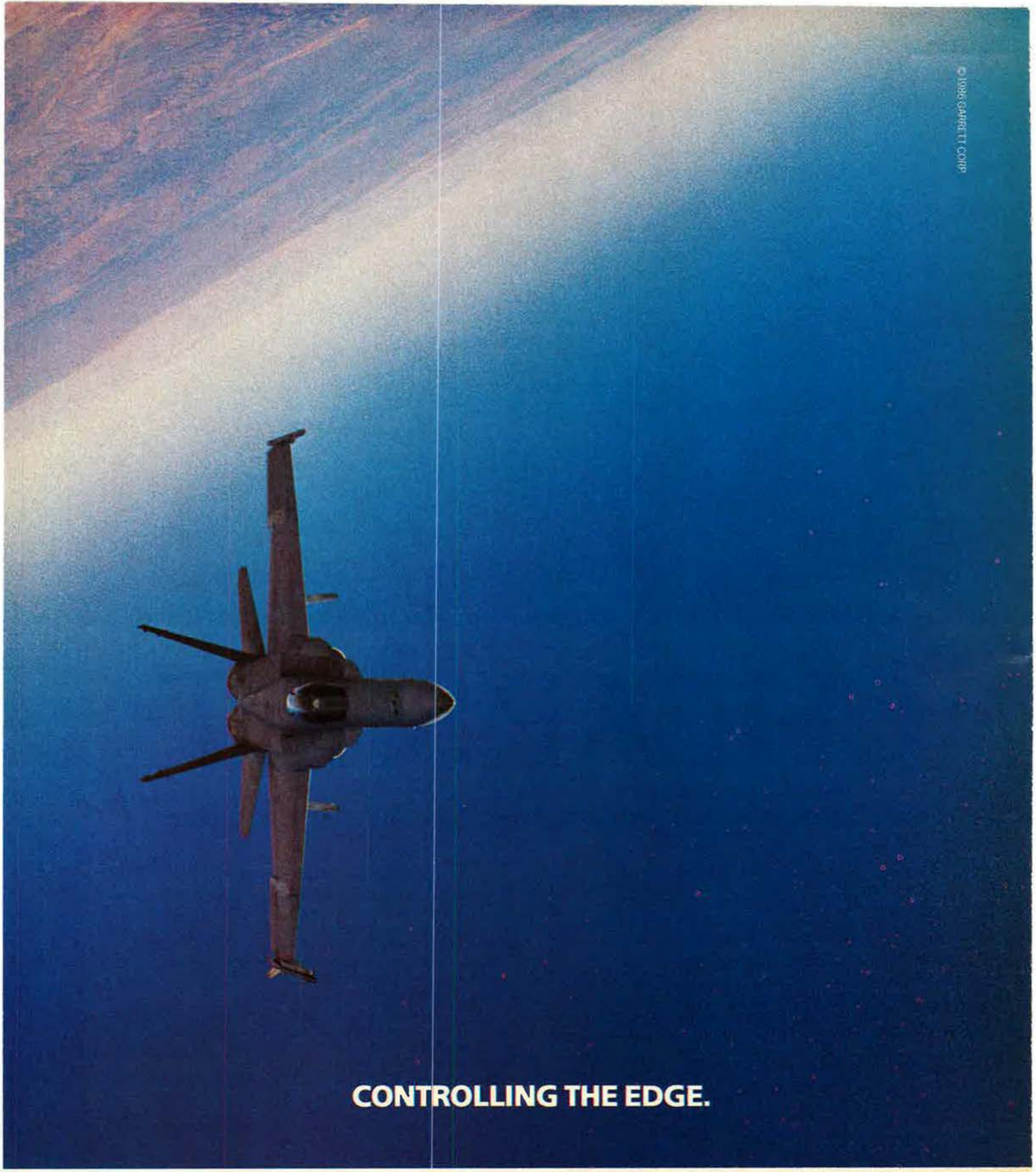

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GARRETT

DECEMBER 1986
VOLUME 69, NUMBER 12

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

Page 84

Page 106

About the cover: A pair of T-38s from Sheppard AFB, Tex., banks hard into a tight turn. A special section on "Training" begins on page 44 of this issue.

Special Section: Training

Features

Departments

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AN EDITORIAL

It's Science—Not Magic

By John T. Correll, EDITOR IN CHIEF

Among the spectators in the stands for the tactical capabilities exercise during AFA's Gathering of Eagles last spring was Gen. Robert T. Marsh, USAF (Ret.). He, along with thousands of others watching from the bleachers, saw the A-10s and F-16s roll in across some low hills to bombard trucks and bunkers with live ordnance. It was precision delivery all the way. An impressive number of the gravity bombs centered their targets, and most of the others were near bull's-eyes, clearly within lethal range.

When a few rounds missed, though, the crowd was noticeably disappointed. General Marsh, who is Chairman of AFA's Science and Technology Committee, had a different reaction. The staple of firepower demonstrations of the past, he says, was area bombing by intervalometer. In those days, the accuracy wasn't good enough for show-quality sharpshooting. Tactical precision has come a long way.

A similar assessment comes from Secretary of the Air Force Edward C. Aldridge, Jr., who, in his remarks to the AFA National Convention in September, said that tactical weapons accuracy has increased by a third since 1980. Modern precision-guided weapons, of course, take long-range accuracy far beyond anything seen in the Gathering of Eagles demonstration. The Air Force, General Marsh says, has entered a new era of precision, an achievement that he rates among the most significant developments in military airpower over the past forty years.

Tactical precision is just one illustration—although a spectacular one—of how technology is reshaping the art of war. Anyone who has been in or around the Air Force for long can think of numerous other examples.

The general trend in technological progress is indisputable. Yet there is a fairly broad apprehension about trusting too much in technology for future military effectiveness. The antitechnologists put up a variety of arguments. Technology costs too much. It's too complex for us to assimilate. The gadgets don't work the way they're supposed to. Scientific innovation is dangerous and destabilizing. It leads to change for change's sake and forces on us capabilities that we don't really need.

In each of these arguments there is a sliver of truth, but not much more than that. While technology is expensive, it's often the least costly way—and sometimes the only way—to solve a problem. Over time, technical devices tend to work, and we learn to use them to our advantage. Scientific change can pose new dangers, but in a military sense, failure to innovate and improve one's capabilities can be even more dangerous. The Gyro Gearloose school of interpretation might accuse basic research of finding answers for which no questions exist; the evidence of history, however, says that once a technology is developed, plenty of worthwhile applications ensue. Technical complexity is not a virtue in itself—but neither is old-fashioned simplicity. On the whole, systems that incorporate mature modern technologies work better and are easier to use than their less-technical predecessors.

A great many people find technology bewildering. They don't understand it, and they're unsure what to expect from it. The National Science Foundation reports that the US public is very interested in science, but knows little about scientific matters. A majority believes that technology will eventually solve most of the world's problems—if technology doesn't destroy the world first. Research by Dr. Jon D. Miller of Northern Illinois University finds that only seven percent of American adults meet minimum standards of scientific literacy, that forty-three percent of them think earth has been visited by extraterrestrial creatures, and that forty percent of them believe in lucky numbers. More than half worry that technologists have cornered the market on scientific information and might use this power in dangerous ways.

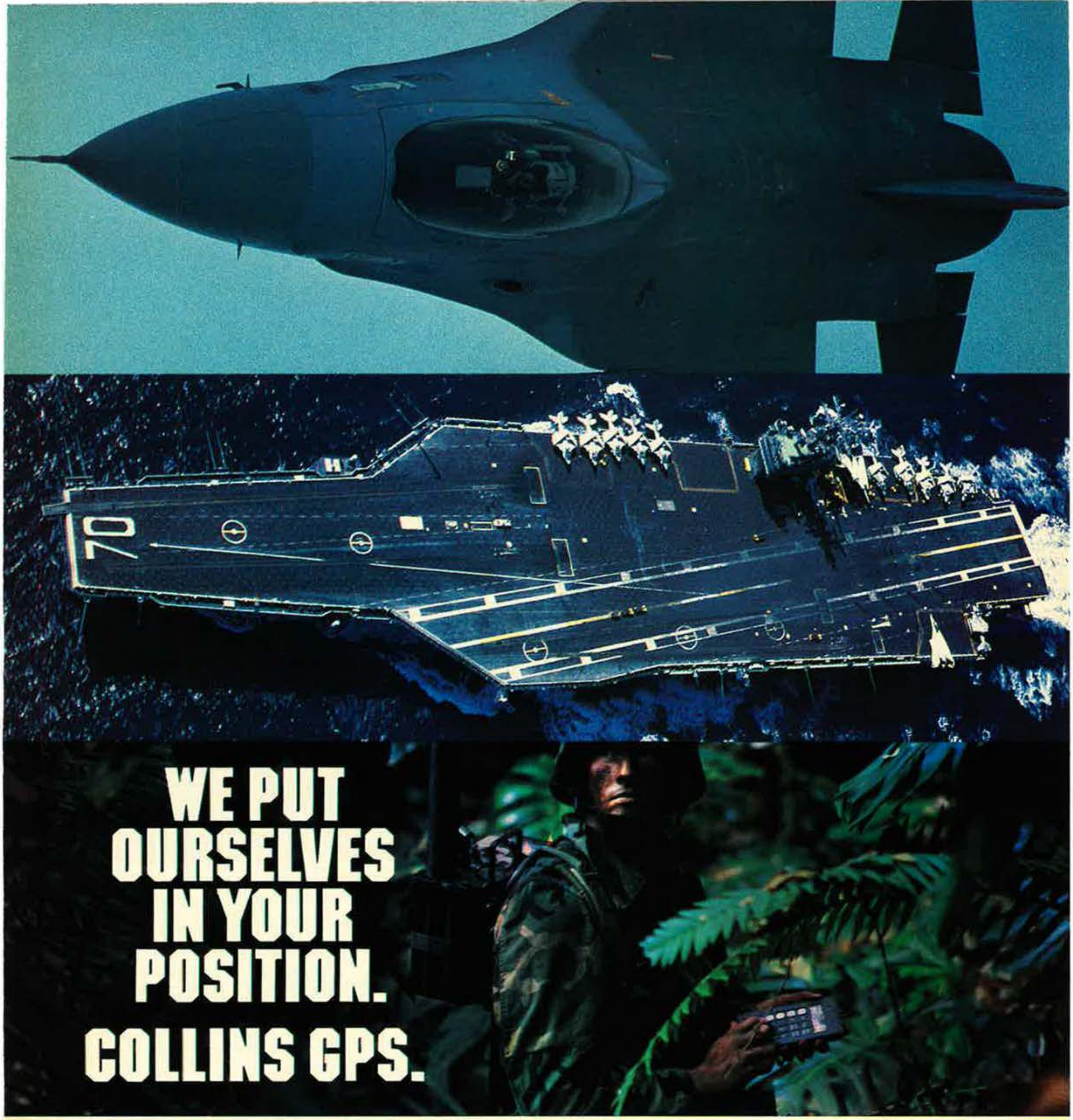
In their ambivalence, people often seem inclined to swing back and forth between extreme positions. At one extreme, they have an excessive faith in technology, expect perfection every time, and are harshly intolerant of shortcomings. At the other extreme is fundamental distrust of technology and a disinclination toward new technological ventures. Neither of these positions recognizes technology for what it is: a tool kit for improvement. Most of the time, the tool kit works well, but it's science, not magic. There will be some failures along with the successes, because technological development inherently involves reaching and risk-taking.

In military developments, particularly, it is important to set the right level of technical risk. The probability of failure is great when a new system pushes too far beyond state-of-the-art technology. But if the risk level is too timid, the system may be obsolete by the time it's fielded, or the limited gains may not be worth the effort. "The combat capability of the Army, Navy, and Air Force today did not result from marginal improvements," says Gen. Lawrence A. Skantze, Commander of Air Force Systems Command. "No risk means no payoff."

The history of the last half century encourages optimism about technology as the engine of progress. Technology, as a general proposition over time, takes several steps forward for every step it falls back.

There's no getting away from the fact that technology will be a major determinant of the future, so it is important for all of us to understand it as well as we can. Seven percent scientific literacy in the adult population, for example, is insufficient.

Attitudes toward science and technology are important, too. The most sensible view is that technology is neither omnipotent nor malevolent, but rather a set of tools that work well when we use them wisely and have a realistic notion of what to expect. ■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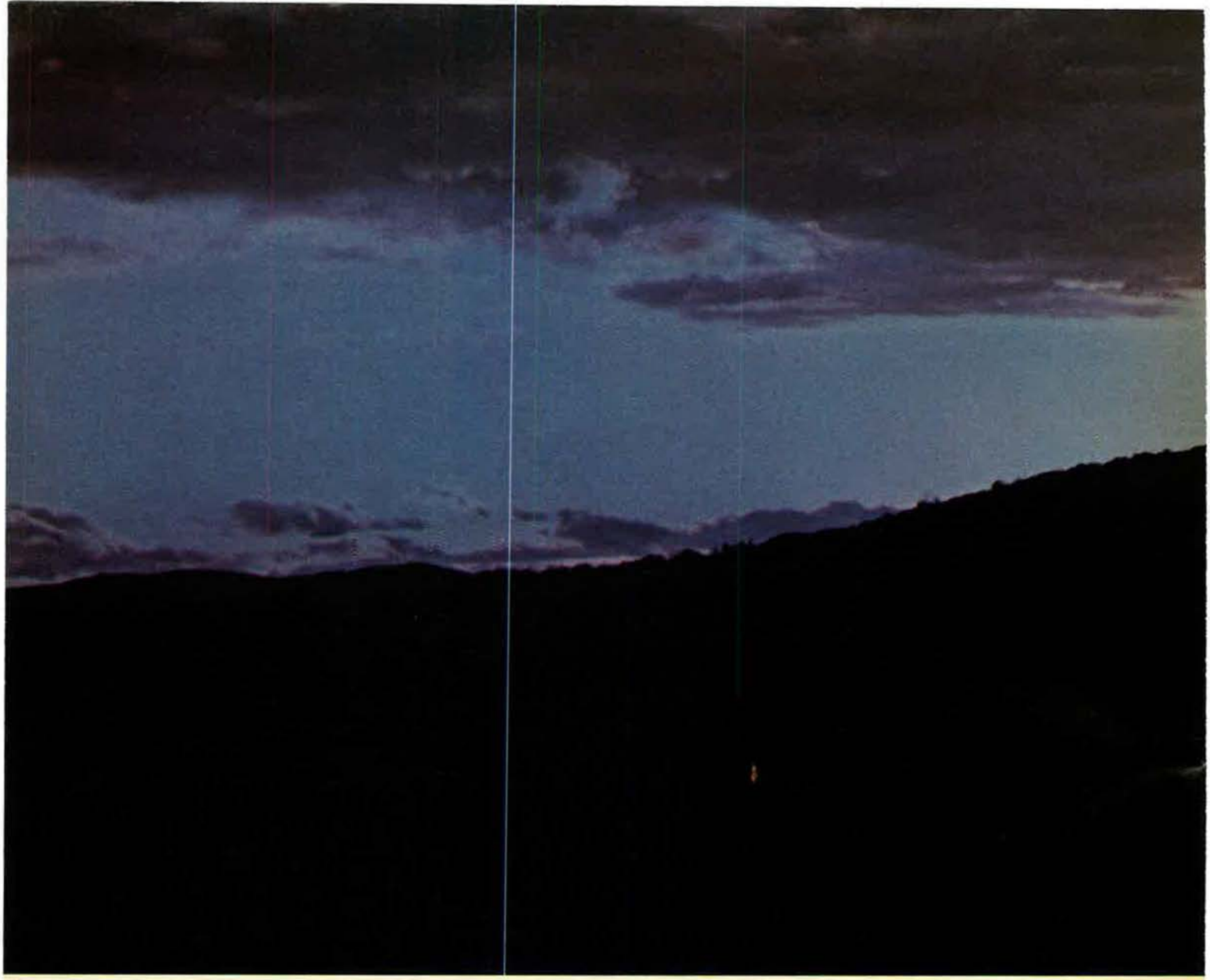

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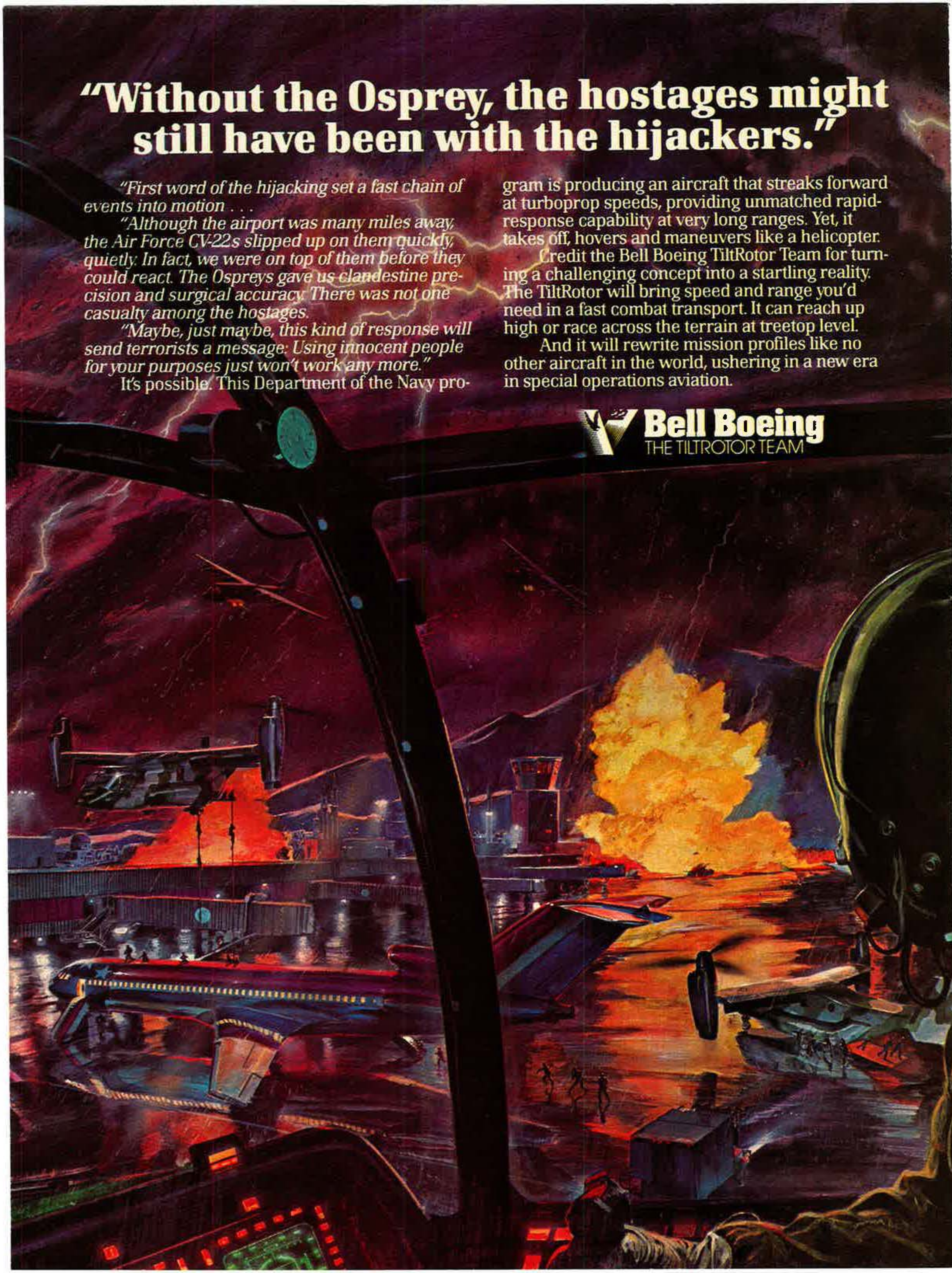
IR Maverick is the latest in a long list of airborne and surface-launched missiles from Raytheon, a list that includes the Sparrow, Sidewinder, and AMRAAM air-to-air missiles and the Patriot and Hawk ground defense missiles. Each reflects our uncompromising application of the fundamentals required to design, test, and produce a reliable, high-performance system. IR Maverick


"Without the Osprey, the hostages might still have been with the hijackers."
"First word of the hijacking set a fast chain of events into motion . . .
"Although the airport was many miles away, the Air Force CV-22s slipped up on them quickly, quietly. In fact, we were on top of them before they could react. The Ospreys gave us clandestine precision and surgical accuracy. There was not one casualty among the hostages.
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And it will rewrite mission profiles like no other aircraft in the world, ushering in a new era in special operations aviation.
Bell Boeing
THE TILTROTOR TEAM

AIRMAIL

The Speedy Tornado

Despite the difference between US and British pronunciation ("You say Tor-nah-do, I say Tor-nay-do") and the difference between knots and miles per hour, I'm sure that even the most ardent Tornado supporter would agree that 800 knots equals Mach 1.2, not Mach 2.2 *(see "Those Bombing Champs From Britain," November '86 issue, p. 58).*

I enjoyed Wing Commander John Grogan's article as well as the rest of your very fine publication.

Patricia Trenner
Falls Church, Va.

• *According to the authoritative* Jane's All the World's Aircraft, *the Tornado's maximum level speed is above 800 knots, but its maximum Mach number in level flight at altitude is Mach 2.2. Because of an editing error, we did not make clear that the Mach 2.2 figure cited was for flight at altitude.*—THE EDITORS

Philpott's Fans

This past week, I was given the October 1986 issue of AIR FORCE Magazine, and on reading through it, I came upon the article "Philpott Has the Last Word" by Maj. Gen. Dale O. Smith, USAF (Ret.). This was quite startling, since there could be only *one* Jim Philpott as described by General Smith. I am certain that only that Jim Philpott would or could have done the things that General Smith describes and attributes to him.

I first became acquainted with Jim in the 1940s when I was working at the Pomona, Calif., airport. We were frequently the target of buzzings by A-17s piloted by Jim. He also owned (or had access to) a Waco Taperwing hangared at the airport that he would frequently wring out in the late afternoon.

My next encounter with Jim was in 1948 or 1949 when he flew into Brackett Field in Pomona in a highly modified AT-6—Ranger V-12 engine, faired-in rear cockpit, clipped wings, etc. At the time, women's air races in T-6s were prevalent, and his had flown in several. At the time, although I cannot recall for sure, he was flying for TWA out of Los Angeles International and would work on the T-6 occasionally. One time, a drunk drove through the parking area at night and clipped the aircraft. Being the only licensed mechanic on the airport, I repaired the wingtip damage.

This was my last encounter with the proverbial Jim Philpott, because I left the immediate area for other fields shortly after. . . .

I concur with General Smith's story—only Jim Philpott could or would have done the things attributed to him!

Fred N. Knox
Tempe, Ariz.

Maj. Gen. Dale O. Smith's "Philpott Has the Last Word" was a real nostalgia trip. The exploits of those two took over most of the flight-line conversation at the old Luke Field.

Lt. Dale Smith had a few legends of his own. One involved the way he would get into the cockpit of a P-26. He was able to turn that starter fast enough to vault over the wing and into the cockpit before the starter ran down. He could fly better than Wheeler Field pilots. That reputation alone was more than Lieutenant Philpott could take without a challenge.

In October 1940, 1st Lt. James A. Philpott started flying at Sherman Field in Kansas, piloting A-17s for more than a year in low-level practice. His idea of low level was to fly under the telephone lines and pull up to go over the fences. I rode the backseat a few times.

I lost track of Lieutenant Philpott when he was recalled to active duty in 1941.

Maj. John D. Riley,
USAFR (Ret.)
Topeka, Kan.

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.

Maj. Gen. Dale O. Smith's story about Cadet James Philpott was most enjoyable (I wonder why I do not remember him?). In any case, I was in the 9th Bomb Squadron at March Field and moved with the 7th Bomb Group under Colonel Tinker when we opened Hamilton Field in December 1934. General Smith's mention of the Norden bombsight caused some feelings of real nostalgia, plus a feeling of being very lucky in winning the bombing competition in Hawaii in 1936 with Fred Johnson as bombardier.

I would like to take exception to Dale Smith's claim that parachute jumpers were carnival daredevils. It was not uncommon for pilots to make practice parachute jumps while we were still at March Field under the command of "Hap" Arnold, who not only permitted but encouraged it. As I write this, I am looking at a series of pictures on my wall showing Bill Capp, Hal Ecklund, and myself bailing out over March. The resultant certificate on my wall is suspended by the ripcord that I used and coiled up to place in my pocket as I descended.

I still do not think of it as very daring. It was good preparation for those jumps that we thought would surely occur in the future.

Brig. Gen. C. Richmond Bullock,
USAF (Ret.)
San Antonio, Tex.

Jack Broughton

I have just read with great interest John L. Frisbee's "Valor" column in the October 1986 issue of AIR FORCE Magazine. As a longtime fan of *Thud Ridge* and Col. Jack Broughton—I've read the book several times—I was pleased to see again some mention of Colonel Broughton in print. If I had to go fight a war, I'd want a leader like him in command.

I'd really like to know what Colonel Broughton is doing now. He intimated in *Thud Ridge* that he might do an-

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Charles E. Cruze, Richard M. Skinner

Editor in Chief
John T. Correll

Senior Editor (Policy & Technology)
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Advertising Director
Charles E. Cruze
1501 Lee Highway
Arlington, Va. 22209-1198
Tel: 703/247-5800

Director of Marketing Services
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Dr. Vittorio F. Negrone, Ediconsult
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Tel: (010) 543659

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AIRMAIL

other book someday. Based on his first one, I'd stand in line at Minot AFB, N. D., in January to get a copy!

Thank you again for a great magazine. I look forward to each issue. Keep up the good work.

Maj. Earl F. Phippen, USAF
Coral Gables, Fla.

Re: The article about Col. Jack Broughton, "Thud Ridge: A Legacy and a Legend," by John L. Frisbee in the October 1986 issue of AIR FORCE Magazine. It appears that much of the story was left unprinted.

The mark of a true professional includes being able to accept and follow orders and respect the procedures of chain of command. While good flying ability is necessary to be a great fighter pilot, so is the ability to follow orders from headquarters.

Is it possible that the "wrist slapping" referred to as a result of the court-martial could have been the kind offer of a chance to resign rather than to "go down in flames"? Perhaps the Air Force did itself a disservice, especially if we are going to make heroes out of former members whose reputations might be questionable.

Mrs. Paul P. Douglas, Jr.
Bertram, Tex.

Air Defense Fighter

Capt. Larry Austin shouldn't be concerned about the ANG getting the short end of the stick with the "old" F-4C/D aircraft *(see "Airmail," p. 10, October '86 issue).*

The F-4 can carry more farther, faster, and for longer than either of the new aircraft of which he is so envious. The F-16 and F-20 can't carry the missile load or mix, don't have the range, can't fly near Mach 2.2, and can't loiter on CAP station like the F-4 can. The F-16 doesn't even carry Sparrow, the most capable, medium-range, all-aspect air-to-air missile in the world (excepting the Navy Phoenix).

An air defense interceptor should have all these capabilities if it is to deal with an incoming long-range bomber before it launches its cruise missiles. Even after they're launched, neither the F-16 nor the F-20 is quick or agile enough to catch them individually with guns and Sidewinders. Consider also the solace of a partner in the other cockpit and that second engine turning on those long night intercepts over the North Atlantic or the Alaskan tundra.

No, Captain Austin—you're way ahead with the F-4 until a real ATF comes along.

To Mr. Jeffrey Canclini, who commented on the same subject in the same issue, I would say that I agree with the General Accounting Office on the unsuitability of either the F-16 or F-20 for the air defense fighter.

One point, though: The F-4 conformal fuel tanks are not needed and were never planned for combat. When mounted, they deny maintenance access. Their purpose was to extend unrefueled ferry range.

Lt. Cmdr. R. N. McDowell, USN (Ret.)
Garden Grove, Calif.

Bitburg Baa

In the October 1986 issue of AIR FORCE Magazine, there was a picture of a shepherd tending his flock at Bitburg AB, Germany *(see "Aerospace World," p. 35, October '86 issue).*

I was a member of the 53d Fighter-Bomber Squadron, part of the 36th Fighter-Bomber Wing. In the summer of 1952, we were the first squadron to move to Bitburg. We came from Fürstenfeldbruck, and what a shock! All we had was a runway, taxi ramp, clover-leaf revetments, and *mud.* We lived in tents and did all maintenance outdoors. But after two years of hard work by airmen and German construction workers, we had a modern base.

In the fall of 1954, our squadron was due for maneuvers. Our CO said that a few of us short-timers could stay behind and take care of the squadron area. For a carton of cigarettes, we got the shepherd to bring in his flock for two days.

The sheep did a very good job, but most of the grass planted that spring came up by the roots, and they left remains all over the concrete ramps!

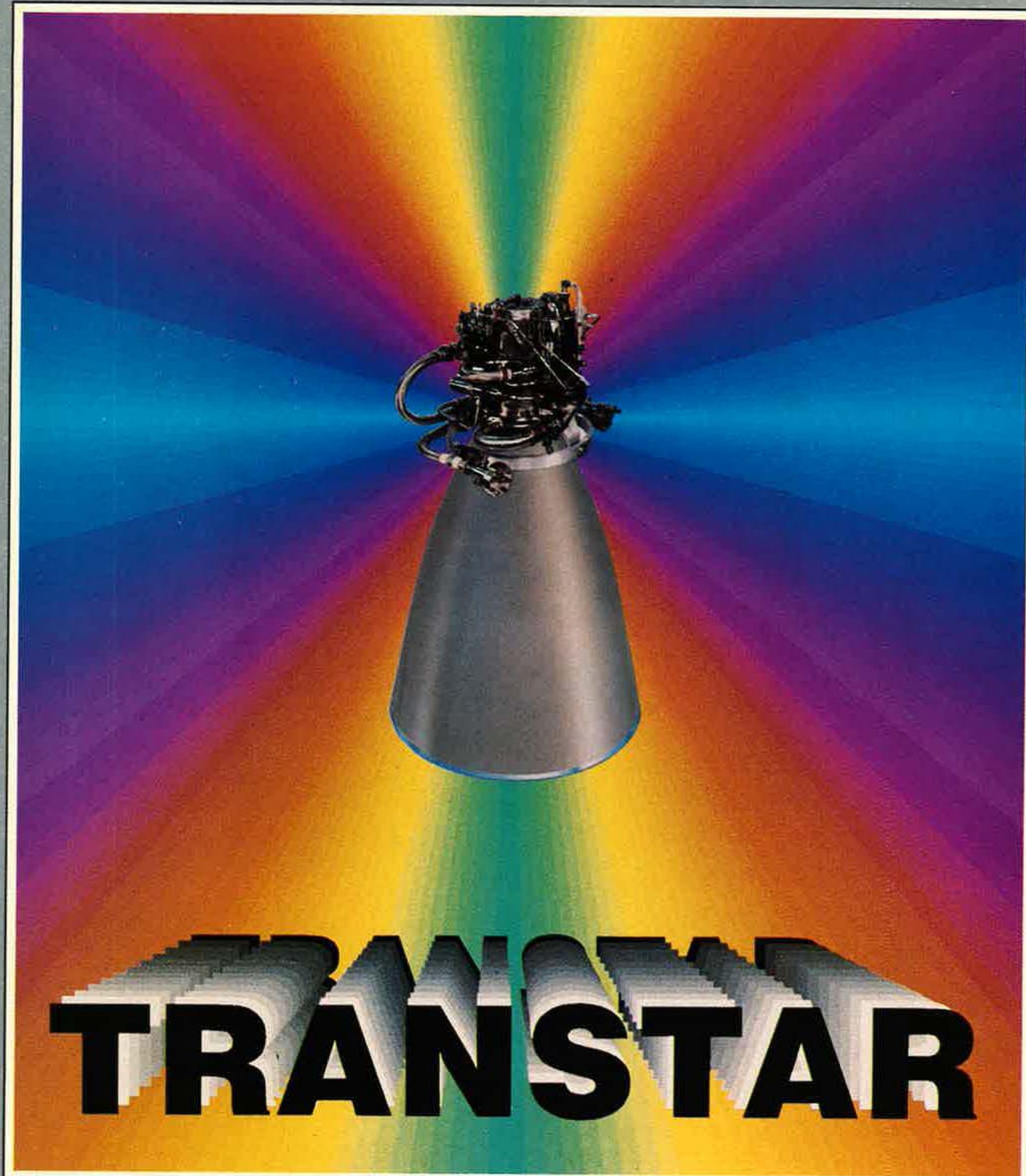
When the CO got back, we were called in his office and got a chewing out of the worst kind. He said it was a good thing we were going home!

The shepherd was there before we got there, so I figure sheep have been grazing at Bitburg for more than thirty-four years.

D. E. Butz
Caledonia, Ohio

SOF Reorganization

At last! From the recent legislation on the reorganization of our special operations forces (SOFs), one could conclude that Congress has finally assigned some priority to establishing a workable joint arrangement to manage and employ these forces *(see*



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"*Dealing With Ambiguous Warfare," p. 26, September '86 issue).* The new reorganization will be hailed at some echelons as the panacea to our nation's problems in the arena now labeled "low-intensity conflict" (LIC). But I fear that euphoria will soon fade when we discover that our new suit of armor contains the same chink as the old one.

That chink is a long-standing problem. The US military establishment is not prepared to deviate from the conventional model of warfare that yielded US victories in World Wars I and II. This is not a criticism of the strategy that won those wars, for it worked well in those scenarios. However, the advent of nuclear warfare has changed the face of war. The Soviets quickly discovered that the best way to extend their influence throughout the world without incurring risk of US military retaliation was through the more insidious method of unconventional warfare. But, to date, US foreign policymakers have been unable to formulate a coherent strategy to cope with this threat over the long term.

Certainly, we have kept pace with the Soviets in the conventional and nuclear race, as well we should. To fall behind in strategic strength would be a suicidal gesture, leaving the West to succumb to Soviet aims. We should make no mistake that our strategic strength is our first priority. Our ability to deter the Soviets in the high- and medium-intensity conflict regions has been the prime reason the world has avoided a major war since World War II.

But we have been satisfied with that accomplishment, while the Soviets have been end-running our military might at the low-intensity end of the conflict spectrum. We have assumed that to cover the worst threat is to cover all threats. And that has proved to be a costly axiom. Because of this, the Soviets continue to prevail in the shadowy warfare that has brought chaos and unrest to much of the free world. And all the tanks, B-1s, and aircraft carriers have not deterred them.

That's why we have no cause yet to celebrate the breakthrough in the reorganization of SOFs. This is only the beginning of fixing the SOFs. What remains to be done will be infinitely more painful and slow. It may be impossible, for it involves a renaissance of military thought and a sweeping indoctrination of our forces. That is the only hope we have of making them winners instead of losers in the next Vietnam. . . .

Our SOFs lack coherent and practical joint doctrine for conducting operations in the LIC arena. In order to develop such doctrine, the leadership of this nation must first formulate a cogent strategy to deter and counter Soviet unconventional warfare activities. Once this strategy has been articulated, the SOF hierarchy can develop the relevant doctrine.

This development of sound doctrine for special operations forces is probably the most important facet of the renewal of the SOFs, but we will also need the cadre of experts in the schools to teach it and the recent reorganization of the forces to implement it. When all this has been done, it will be time to celebrate, for we will have established, for the first time ever, a credible response to the war in which we've been floundering for more than thirty years.

Capt. Willard L. Elledge, Jr., USAF
Fort Walton Beach, Fla.

AIRMAIL

Reserve Enlisted

After reading Bruce Callander's article "The Evolution of the Air Force NCO" in the September 1986 issue of Air Force Magazine, I would like to offer a few comments.

While WAPS and TOPCAP appear to be the best solution at the moment for the active-duty forces, the reserve forces still suffer from the problems that caused these programs to come about in the first place.

As a member of the reserve forces who transferred from active duty, I have had numerous conversations with fellow members with similar backgrounds on the very subject of promotions. Those of us who have been under WAPS sadly see the need for it here in the Reserve and Air Guard. Why? Because the problems of unit quotas, commanders' prerogatives, and politics still exist.

It is very odd indeed to have peers and senior NCOs who, in outranking you, took their upgrades and PME by correspondence and still on an objective scale hardly meet apprentice-level competence. One postulate of how this happens is that many times stripes are given as a monetary incentive, not as an expression of confidence in skill, leadership ability, and potential.

On the other hand, I recognize that many of our full-time technicians and qualified aircrews do indeed approximate, and at time surpass, our active-duty peers.

SSgt. W. P. Jones, ANG
RAF Upper Heyford, UK

• *We would like to take this opportunity to apologize to Bruce Callander for misspelling his name in the by-line and the author note as well as on the "Contents" page in the September 1986 issue.*—THE EDITORS

Single-Engine Demon

Peter Mersky's article "Carriers Jubilee" in the September 1986 issue of Air Force Magazine, while most interesting, does contain an error. He states that the F3H Demon was a twin-engine fleet fighter. Having served in a Demon squadron, I can say that the F3H Demon was definitely a single-engine fighter.

Although I am ex-naval aviation, I am a member of the Air Force Association. Keep up the good work on a great magazine.

J. R. "Bill" Bailey
Slidell, La.

• *The McDonnell F3H Demon was powered by a single Allison J71-A-2E turbojet.*—THE EDITORS

Wrong Wing

While reading the September 1986 issue, I noticed a small but very significant error in the "Milestones" section of the "Aerospace World" column. You reported that four C-5Bs had been delivered to the 433d MAW at Altus AFB, Okla.

The 433d MAW (AFRES) is located at Kelly AFB, Tex. We are the first unassociated Reserve wing to receive the C-5A. The unit you had in mind is the 443d MAW, an active-duty unit.

I enjoy your magazine very much and have just recently subscribed to it. Please keep up the good work.

SSgt. Scott A. Howard, USAFR
Kelly AFB, Tex.

• *Sergeant Howard is correct. We should have reported that the C-5Bs are being delivered to the 443d MAW.*—THE EDITORS

Blue Flight Uniform

In response to MSgt. Edwin O. Learnard's letter "Blue Trees?" in the "Airmail" section of the August 1986 issue that addressed my previous letter in the June 1986 issue, I would like to make several clarifications.

I developed the blue Nomex flight uniform solely to improve the flight safety of 1st Helicopter Squadron aircrews. Prior to the adoption of the blue Nomex flight uniform, the 1st Helicopter Squadron aircrews flew approximately seventy percent of their flights, including all VIP flights, wearing the Air Force light blue short sleeve shirt with epaulets, Air Force dark blue trousers, standard issue green Nomex flight gloves, white flight helmet, and black flight boots. This uniform was a very serious flight safety hazard, since it provided no fire protection for the aircrews. Polyester melts and sticks to the skin during a fire.

The standard green Nomex flight uniform was deemed unsuitable for VIP flights because it didn't look professional. (Interestingly, the aircrews of the Army helicopter VIP transport unit at Fort Belvoir wear the standard issue green Nomex flight uniform, green flight helmet, and survival vest on all flights.) With the blue Nomex flight uniform, 1st Helicopter Squadron aircrews can now fly 100 percent of their flights in a uniform that provides the necessary fire protection and that also looks distinctive.

The blue Nomex flight uniform may be unsuitable for combat aircrews because of their need to escape and evade if shot down. (I would like to see the blue Nomex flight uniform tested in an escape and evasion situation to determine if the blue color is actually a problem.) However, for all noncombat aircrews who fly C-12s, C-21s, etc., and who don't wear the green Nomex flight uniform for whatever reason, the blue Nomex flight uniform is far safer than the uniform they are presently wearing. . . .

Capt. David C. Delisio, USAF
Indian Springs, Nev.

507th TFG

In an effort to foster pride in our past and also to upgrade a part of our headquarters, we are planning a historical display for the 507th Tactical Fighter Group's headquarters building. However, in researching our on-hand archives, we find that we lack much of the memorabilia that would enhance this project.

We would sincerely appreciate hearing from readers who are former members of the 507th TFG or the 507th Fighter Group from World War II and who have photographs or historical documents that they could briefly share with us. We especially need photos or documents about the 507th's operations from Okinawa with P-47 aircraft, photos of the 507th's F-89 and F-102 aircraft when the unit had an air defense mission, and photos of 507th operations from Petersen Field, Colo., Bruning AAF, Neb., and Dalhart AAF, Tex. Aircraft operated by the unit since 1944 include the P-47N, F-89, F-102, F-106, F-105, and F-4D.

AIRMAIL

If you have any material we could use, please send it to the address below. It will receive the proper TLC and will be quickly returned.

Lt. Col. James L. Turner, USAFR
507th TFG/PA
Tinker AFB, Okla.
73145-5000

71st TMS

I have recently been appointed the unit historian for the 71st Tactical Missile Squadron. As the unit historian, I would like to contact any readers who were formerly associated with or who have any information about the 71st Bombardment Squadron, 38th Bombardment Group, 71st TMS, 585th Tactical Missile Group, or 38th Tactical Missile Wing. I am interested also in any information about B-25 Mitchell operations in the Southwest Pacific from 1942 to 1945 and Mace and Matador missile operations in Europe from 1958 to 1970.

I am looking for photographs, notes, memorabilia, histories, and accounts of personal experiences from anyone who served in any of these units or who has any information about the operations mentioned above. This request applies especially to anyone who may have served with the 71st TMS in Belgium.

Any loaned items will be returned. Your help will be greatly appreciated.

2d Lt. Thomas C. Imburgio, USAF
71st TMS/DO
APO New York 09188-5000

B-36 Peacemakers

The B-36 Peacemakers Association, a national association of former SAC air and ground crews interested in preserving the memory of that stalwart bomber of the 1950s, is now being formed.

Who will ever forget the magnificent, symphonic sound of the B-36 on takeoff or the throbbing, droning, never to be duplicated sound of a B-36 flyby? During its reign, the B-36 was never called upon for battle—a credit to this gallant aircraft, which made up the main part of our deterrent force during the 1950s.

Let's keep its memory alive. We want to hear from you. If there is enough interest from former crew members and aviation buffs, the B-36 Peacemakers Association will be taking off shortly. Interested readers should contact the address below.

Joe Weber
23221 Via Guadix
Mission Viejo, Calif. 92691

Westover AFB Museum

The Westover AFB, Mass., Museum and Memorial has been established. We are appealing to anyone who has material to donate to the Museum. We are looking for such items as uniforms and patches and badges of any unit ever stationed at the base. Any pictures of either the base itself or aircraft stationed at the base would also be appreciated. Please include a brief description of the time and circumstances, if possible.

If you cannot donate material, we would like to borrow it to copy it. We will return any borrowed items to the owner.

Westover AFB has a long and proud history. We need your help to make the Museum a success.

Albert J. DiCarlo
4 Campbell Dr.
Easthampton, Mass. 01027

Hollywood Air Force

I am a veteran aviation writer who is seeking copies of private photographs and correspondence with military personnel who were witness to or participated in the production of any one of a number of Hollywood films during the 1940s and 1950s that dealt with the Air Force.

Features of particular interest include "Sabre Jet," "The McConnell Story," "Strategic Air Command," "Bombers B-52," and "The Hunters."

This material is being gathered for use in a forthcoming book on the subject. Anyone who may be able to contribute to this project is asked to contact me at the address below.

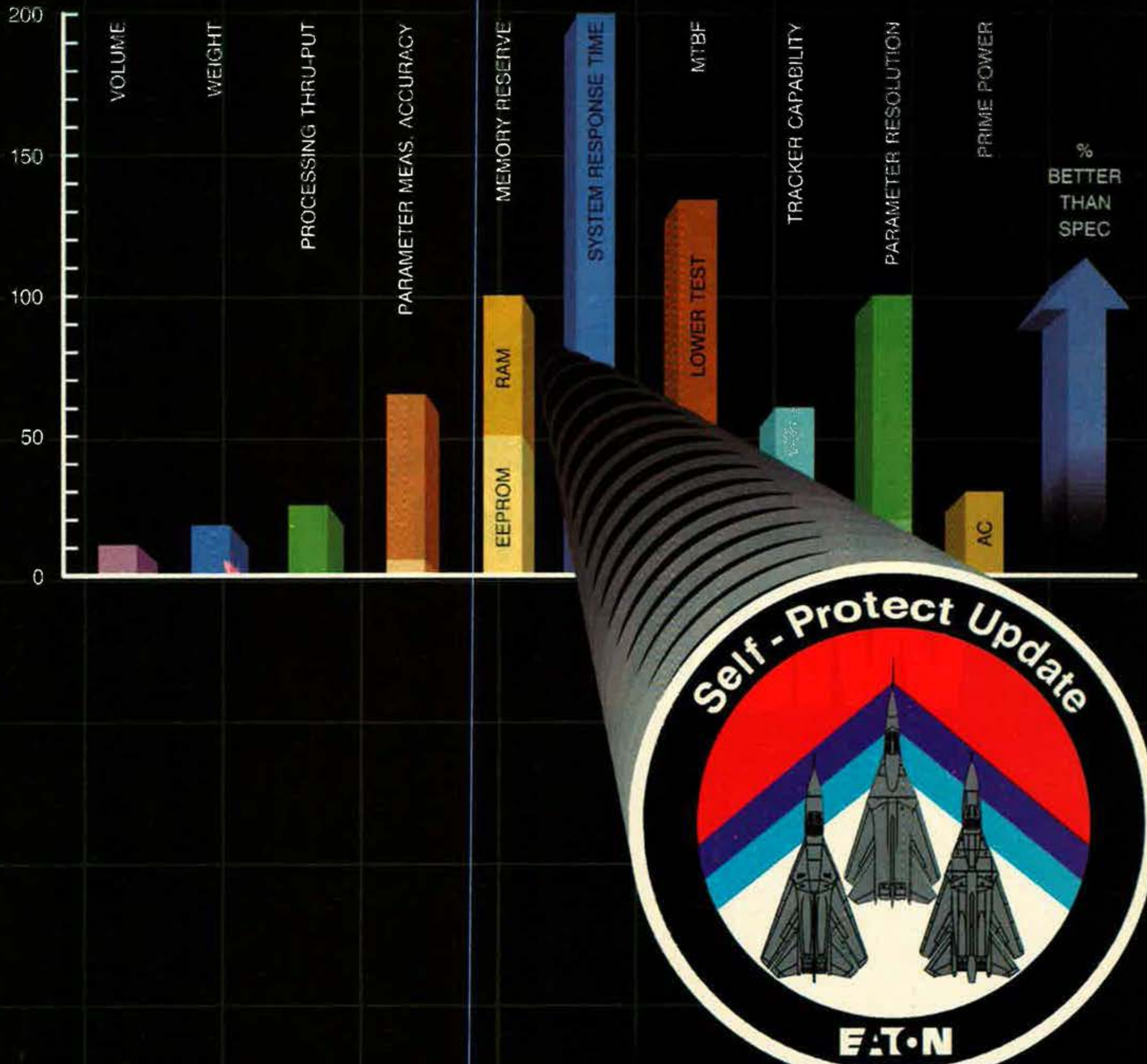
James H. Farmer
2132 E. Kenoma St.
Glendora, Calif. 91740

Yeager's F-100 Squadron

The Air Command and Staff College Class of 1987 is hosting the sixth "Gathering of Eagles" in May 1987. Included among our recognized airpower pioneers will be Brig. Gen. Chuck Yeager, USAF (Ret.).

We are focusing on General Yeager and his contributions to our aerospace heritage while he was an F-100 squadron commander at George AFB, Calif., from April 1957 to the winter of 1959. We are looking specifically for photos, squadron patches, and any data on General Yeager or the squadron during this period.

All material will be copied and re-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TRACKER CAPABILITY
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PRIME POWER
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% BETTER THAN SPEC
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EATON

turned. Please contact the address below.

Maj. Keith Fennell, USAF
ACSC Foundation
Maxwell AFB, Ala. 36112-5542

Roll Call

Does anyone out there have any information regarding Lt. John J. Armato, an Army Air Forces officer who served with the 69th Bomb Squadron, 42d Bomb Group, on Palawan Island in the Philippines?

Lieutenant Armato was the pilot of a B-25 Mitchell bomber called *The Plastered Bastard*. The aircraft was reported missing and presumed lost on or about June 1, 1945.

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

MSgt. Paul Orlando,
USAF (Ret.)
19 Empire Court
Commack, N. Y. 11725

I am trying to locate Col. Arthur A. McCartan, who was attached to the 2d Weather Reconnaissance Squadron in Natal in 1944–45.

"Mac" was one of the finest officers whom I have ever known. I wrote to him at his last known address with the 3d Weather Group at Ent AFB, Colo., in June 1953, but never received a reply.

I would appreciate hearing from anyone who has any information about Colonel McCartan. Please contact me at the address below.

Bob Pease
7211 Wheaton Lane
Fox Lake, Ill. 60020

I am searching for my World War II bomber crew. We were members of the 717th Bomb Squadron, 449th Bomb Group, flying B-24s out of Grottaglie, Italy, in 1944 and 1945.

The crew included James Pierman, Lenard Deusch, James Carr, Everett Odam, Natally Rueben, Bill Nicely, Murray Levites, and Ralph Lapinsky.

I would appreciate hearing from anyone who could put me in touch with any of these men.

Richard T. Asbury
415 Bond Place
Cincinnati, Ohio 45206
Phone: (800) 622-5690

I am attempting to locate some of my fellow crew chiefs on the F-101 Voodoo who served with me in the 75th Fighter-Interceptor Squadron at Dow AFB, Me., from 1960 to 1963.

They are David E. Clark, Max M. Martin, Thomas G. Nelson, Gerald A. Nicholson, Gary C. Prosser, and Victor R. Willoughby.

Anyone knowing the whereabouts of these former crew chiefs should contact me at the address below.

Rick Riggio
7500 W. University
Rte. 4, Box 1500
Odessa, Tex. 79763

I am trying to locate members of my B-24 crew. I haven't seen them or heard from them since war's end.

We served in Italy with the 449th Bomb Group, 717th Bomb Squadron. The crew included Sherwood Avery, Edward West, Maurice Perreault, Ralph Beard, Frank Mariani, and K. L. Wetzel.

Anyone having any information about these people is asked to contact me at the address below.

Roger R. Trumbull
10 Wildy Dr.
Roswell, N. M. 88201

The Lance P. Sijan Squadron of the Arnold Air Society at AFROTC Detachment 355, Boston University, is searching for all alumni.

If you are a Boston University AFROTC alumni and former member of AAS, we would like to hear from you. We are not only updating alumni files but also planning an alumni dinner banquet to honor all AFROTC/AAS graduates.

Any pertinent information from grads would be most appreciated. We are anxious to hear from you! Please contact the address below.

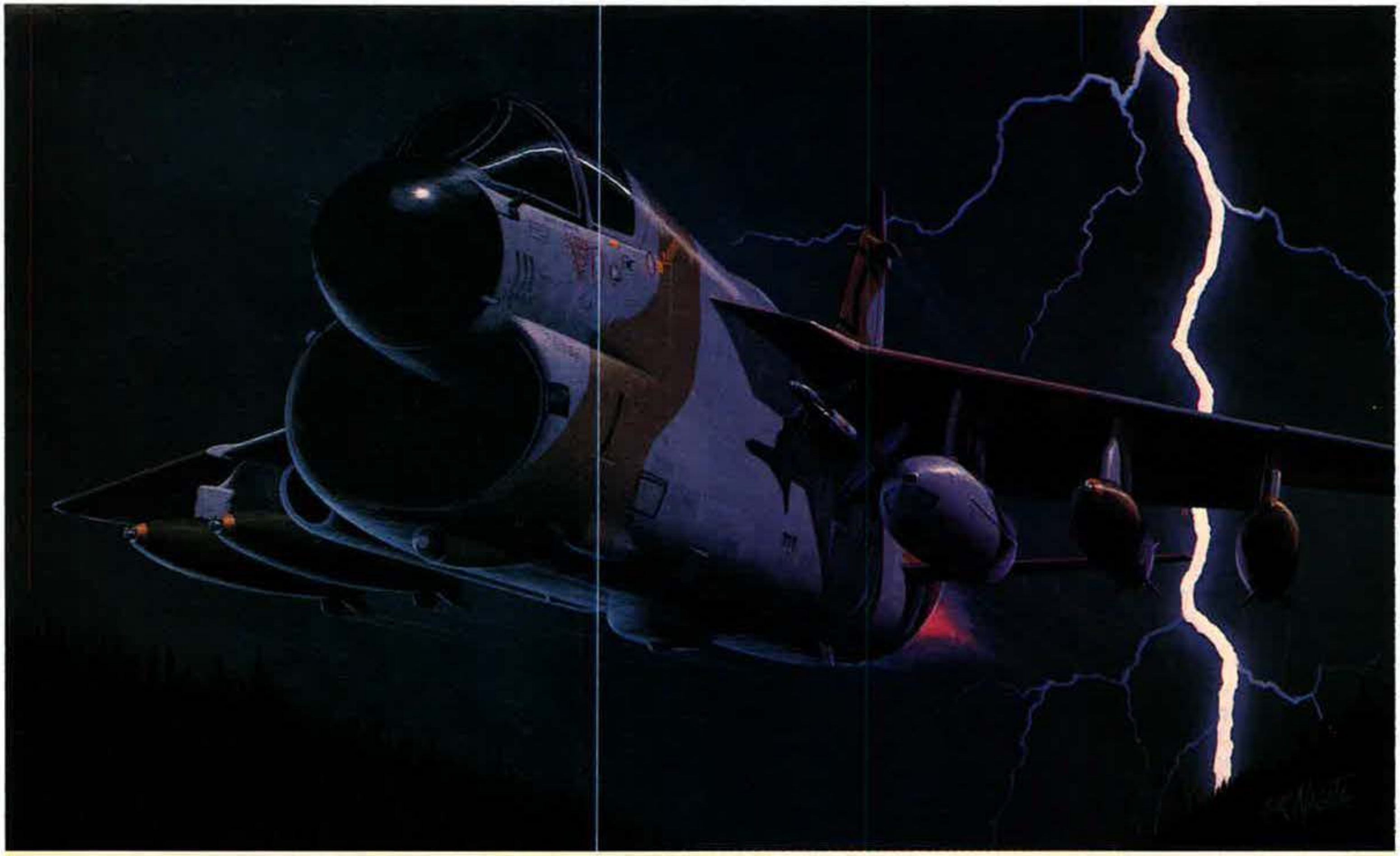
AFROTC Det. 355
AAS Alumni Files
156 Bay State Rd.
Boston University
Boston, Mass. 02215

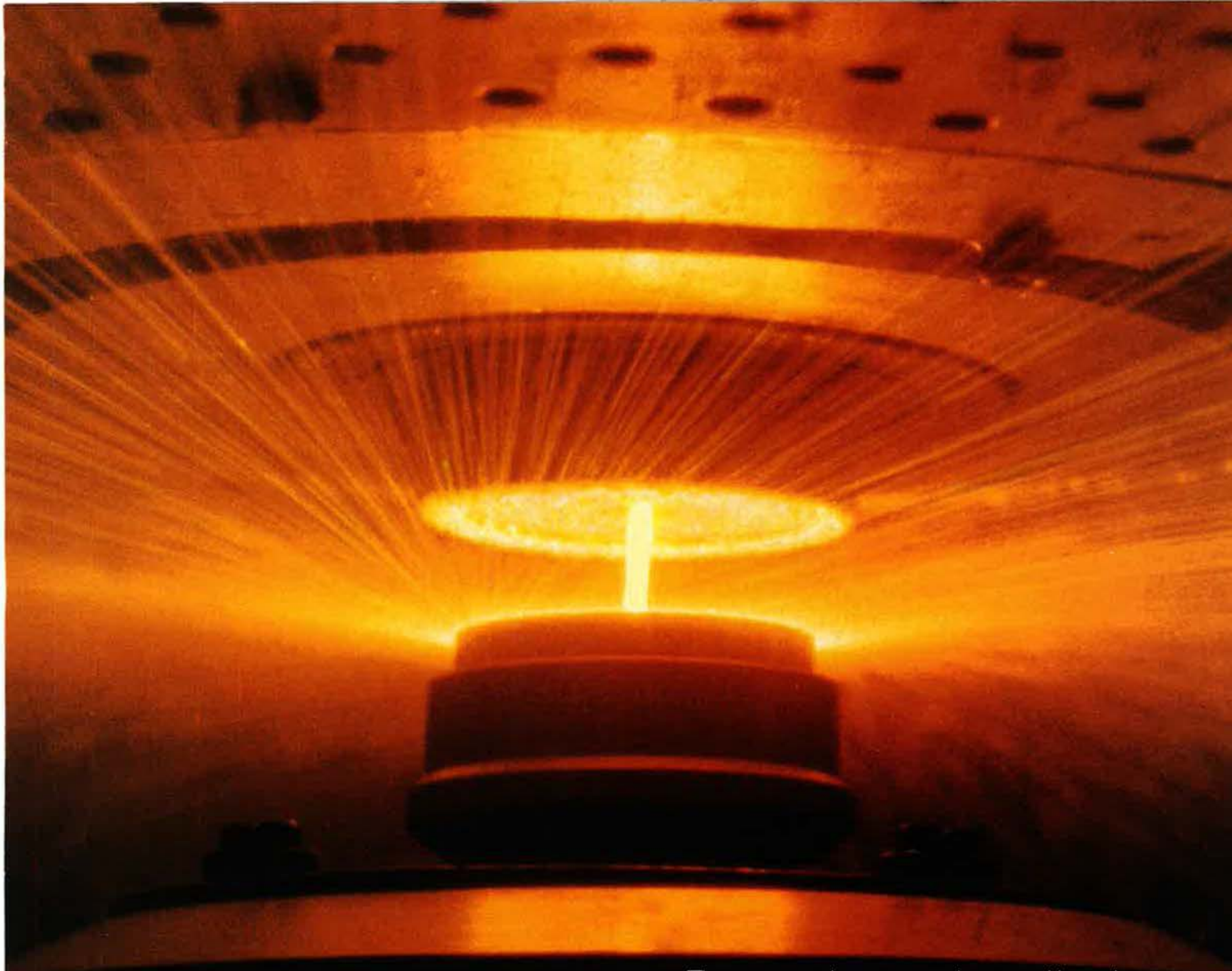
Collector's Corner

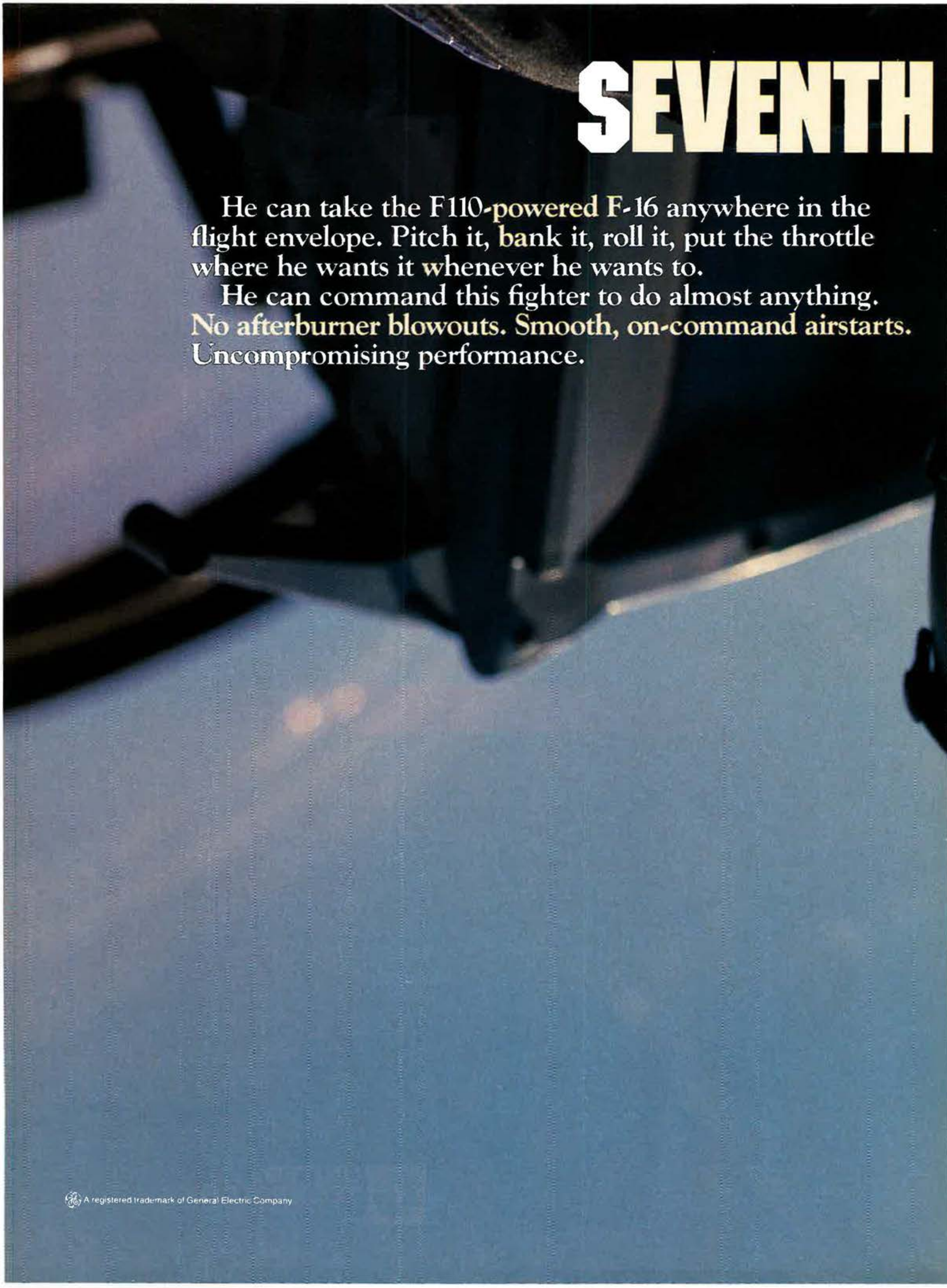
I am now collecting military payment certificates (MPC), which were issued in overseas areas, such as Vietnam, for use in military facilities only by authorized personnel. It was used to prevent speculation in US currency when the official exchange rate was artificially low.

MPC is now useless, except to collectors. I would appreciate any donations of MPC, but I am willing to purchase certificates that are in reasonable shape. The first year of issue was 1946, and denominations ranged from five cents to $20.

Lt. Col. Nick Schrier, USAFR
4121 Exa Court
Sacramento, Calif. 95860






SEVENTH
He can take the F110-powered F-16 anywhere in the flight envelope. Pitch it, bank it, roll it, put the throttle where he wants it whenever he wants to.
He can command this fighter to do almost anything. No afterburner blowouts. Smooth, on-command airstarts. Uncompromising performance.
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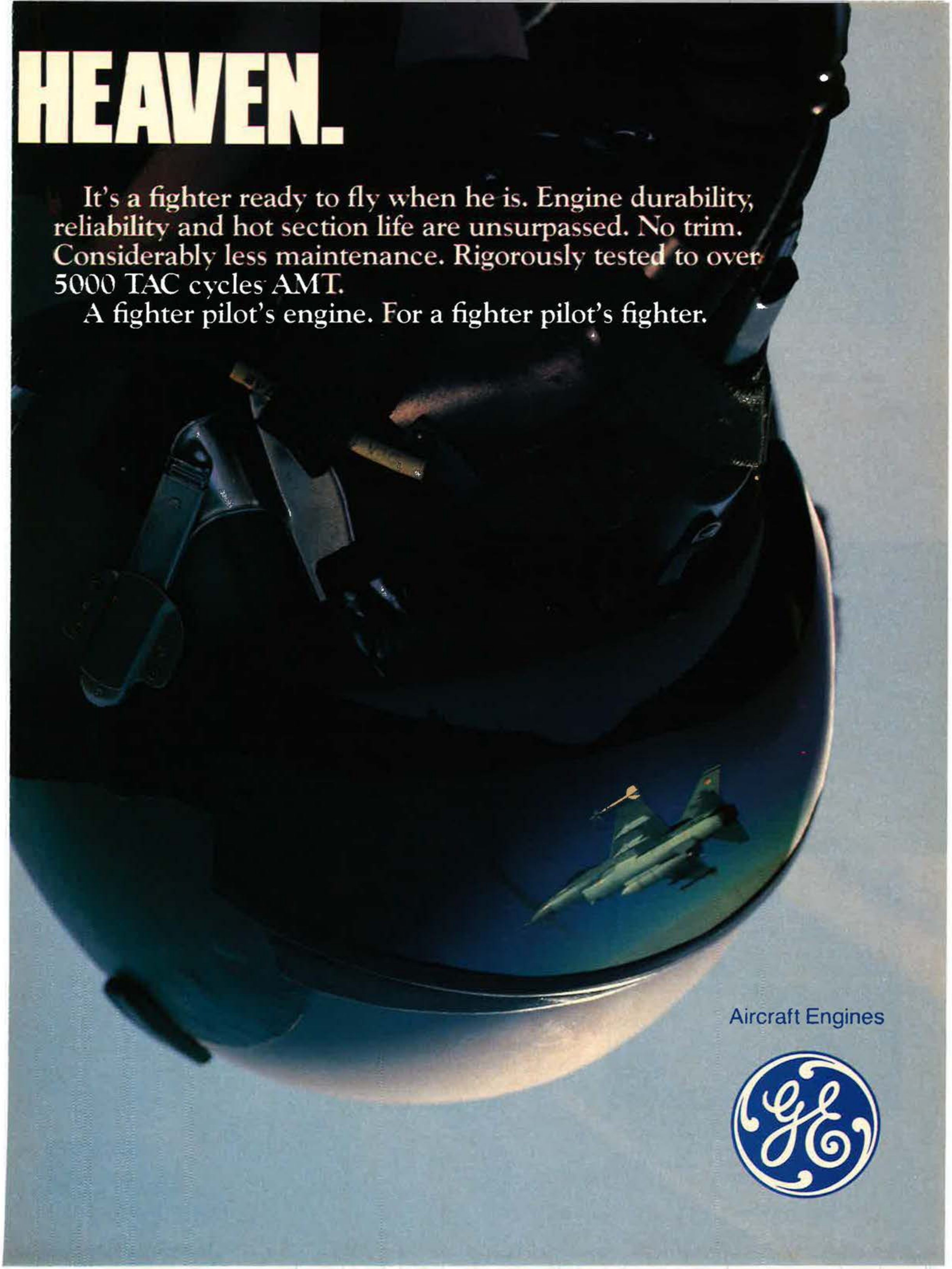
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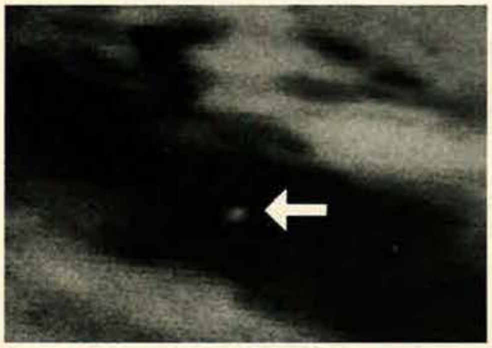
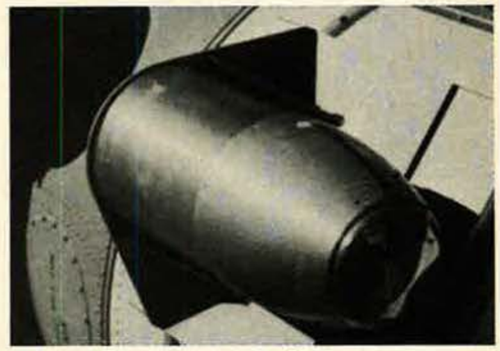


From a distance of 200 miles, a Hughes MAVERICK infrared sensor in space spots an Aries Missile (arrow) upon lift-off from White Sands Missile Range, New Mexico.

In a vital Strategic Defense Initiative (SDI) experiment—the most complex command and control mission in our nation's history—scientists successfully tested in space the ability to track a spacecraft within its own exhaust plume. Critical to the mission was the determination of what rocket plumes in space would look like to a variety of sensors—something that had never been done before. Also tested was the ability to spot from space a missile immediately after launch, as well as to achieve an intercept in space.

"Delta 180 was a textbook mission," according to Delta 180 Project Manager U.S.A.F. Lt. Col. Michael Rendine, "one that will make our job in the next stage of research a lot easier than we thought."

A key to the mission's success was the use of two sensors, an infrared sensor from a MAVERICK air-to-ground missile and a radar sensor



A key to the success of the SDI experiment was the MAVERICK infrared sensor, shown here attached to the Delta 180 second stage space vehicle. The device measures approximately one foot in diameter and more than two feet in length.

"The hardware worked beyond the point we dared hope in this storybook mission."

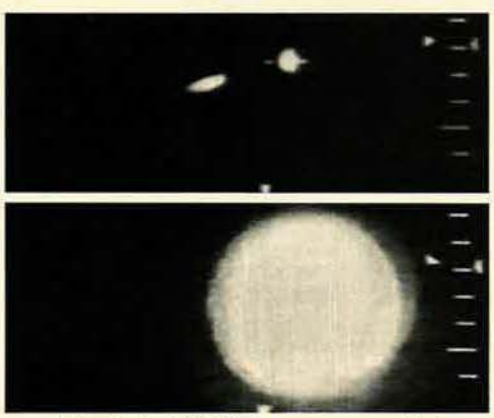
—U.S.A.F. Lt. Col. Michael Rendine

from a PHOENIX air-to-air missile, adapted for space use. Both performed with stunning accuracy. Both were from Hughes Aircraft Company.

The success of this vital mission is shared by the dedicated employees of Hughes' Missile Systems Group in Canoga Park, California and Tucson, Arizona.

Also shared is a simple idea: the gathering of this information in space can help secure peace here on earth.

MISSILE SYSTEMS GROUP



The Delta 180 third stage space vehicle, (upper) guided by its onboard Hughes PHOENIX radar, homes in on its target, then successfully intercepts at a closing rate of 6,500 mph (lower).

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IN FOCUS...

SDI in Increments

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

As a counter to skidding support for SDI, advocates in Congress want independent deployment of battlefield defenses and other elements of the program that are technologically mature.

Washington, D. C., Oct. 31

What Mikhail Gorbachev's gambits at the "presummit" in Iceland failed to net him, the lengthy gestation period of an all-or-nothing US strategic defense may do for him gratis. The reason: Congress and the American electorate are apt to run out of patience and budgetary largess long before such a leakproof defense umbrella can be erected over the US several decades hence. As a result, influential supporters of the Strategic Defense Initiative (SDI) on Capitol Hill worry just as much about the long-term political and fiscal sustainability of the program as about Soviet arms-control maneuvers aimed at confining SDI to sterile laboratory research for at least the next ten years.

In response, Sen. Dan Quayle (R-Ind.), a member of the Senate Armed Services Committee, helped spearhead legislation that seeks to deploy—on an accelerated, "incremental" basis—those elements of SDI that are technologically mature and that can stand alone in an operational sense. Toward this end, the Senate Armed Services Committee requested the Defense Department to report to Congress next spring "what Strategic Defense Initiative technologies can be developed or deployed within the next five to ten years to defend against significant military threats and help accomplish critical military missions." The Pentagon specifically should report by March 15, 1987, on SDI-derived systems capable of "defending our troops and allies abroad against tactical ballistic missiles, particularly new and highly accurate Soviet shorter-range ballistic missiles armed with conventional, chemical, or nuclear warheads."

Other objectives to be pursued within the SDI program on an incremental basis include defense against limited but gravely consequential Soviet attacks that seek to decapitate the National Command Authorities and rapidly available warning and tracking capabilities that will defend against or evade Soviet attacks on US military satellites, especially critically important spacecraft in high orbits. Lastly, the Defense Department is to examine SDI-derived capabilities that could be deployed within a few years to provide early warning and attack assessment information—and the associated survivable command control and communications net—to defend against Soviet conventional or strategic attacks.

The Pentagon's assessment of SDI-derived hardware and capabilities that could be fielded relatively quickly is to include schedule and cost estimates, with emphasis on analyses of "the survivability and cost-effectiveness at the margin of these systems against current and projected Soviet threats."

Asserting that the Administration has "got a big problem on SDI" in terms of congressional support, Senator Quayle told this writer that, to a predominant degree, the problem stems "from the policy and direction of SDI [and what it] actually is to entail. I believe [the Administration] will have to rethink what SDI is all about." SDI's problem in Congress, Senator Quayle suggested, is exacerbated by contradictory perceptions about the program's nature that range from a "near-perfect defense that protects the entire population" to a research program confined to the laboratory.

These divergent viewpoints put SDI's congressional support on a downward skid. Supporters of SDI in Congress, therefore, are urging the White House and the Pentagon to "redefine" the program, on the one hand, and on the other to look for SDI technologies that can be deployed "over the near term on an incremental basis" rather than to wait for "a perfect solution to an all-out [Soviet] attack," he said.

Congress reduced the Administration's SDI funding request for FY '87 of $5.3 billion to $3.5 billion. The Senate Armed Services Committee asserted in its authorization report that "while the committee believes that the potential ability of ballistic missile defenses to provide comprehensive, nationwide population protection should continue to be explored, the major emphasis within SDI should be dedicated to developing survivable and cost-effective defensive options for enhancing the survivability of US retaliatory forces and command control and communications systems."

The committee also criticized the Strategic Defense Initiative Organization (SDIO) for "paying inadequate attention" to research involving the program's near-term deployment options that could serve as a hedge against Soviet "breakout" from the ABM Treaty. Further, the Senate Armed Services Committee noted that "if SDI research were successful in rendering nuclear weapons 'impotent and obsolete,' the US would still require a second research-and-development effort to negate bomber-delivered and cruise-missile-carried weapons. In the committee's judgment, the advent of low-observable technology may well make this effort quite as challenging as the President's vision of SDI."

Even if it were technologically possible to eliminate both the ballistic-missile and air-breathing threat, the committee warned that, "unfortunately, the world's citizens may still not be freed from the threat of mass destruction, whether from clandestinely delivered nuclear weapons or from other forms of warfare. Moreover, our European allies would surely have reason to pause at the prospect of the elimination of nuclear weapons in light of the enormous disparity in conventional weapons between NATO and the Warsaw Pact."

These stipulations by the Senate Armed Services Committee were incorporated verbatim into the FY '87 defense authorization bill. That legislation, in addition, charged that the Administration was funding SDI at the expense of the defense technology base. As a result, Congress decided to "expand the role of technology and innovative weapons concepts while reducing the growth rate of the SDI research program." Congress's tool for redirecting a portion of SDI funding is the "balanced technology initiative," or BTI, which is meant to augment the Conventional Defense Initiative that is supported by both the Administration and Congress.

The defense authorization bill earmarked some $450 million in FY '87 money for BTI, with the goal of stimulating advanced conventional warfare technologies—including spinoffs from SDI—that "leapfrog" present-generation weapons. Congress, in subsequent appropriations action, embargoed a portion of these funds "until SDI spin-off technologies and their applications have been defined and reported to Congress, but in any event not prior to July 1, 1987." The handwriting on the walls of Congress seems clear: Funding requests for SDI in the future will encounter rough going unless technologies derived from the program can be applied sooner and more broadly than first envisioned by the Administration.

The fielding of SDI-derived defensive systems over the near term should be centered on weapons and capabilities that "are compliant with the [1972 ABM] Treaty," in Senator Quayle's view. Two ballistic missile defense activities are permitted by the ABM Treaty. They, therefore, ought to be developed—and possibly fielded in preference to other SDI products—according to Senator Quayle.

The treaty explicitly allows deployment of up to 100 ABM launchers. The US, therefore, should consider deploying the permitted number of launchers—which might be derived from SDI's ERIS, which stands for Exoatmospheric Reentry-vehicle Intercept Subsystem—around the National Command Authorities or a specific ICBM complex, Senator Quayle suggested. If such a system can be deployed over the near term, it would have "some effectiveness" in the case of a limited or accidental attack.

It is conceivable, he theorized, that the Soviets might launch a number of SLBMs from positions off the US shores and detonate their nuclear warheads at high altitudes to "temporarily make us deaf, dumb, and blind militarily." A limited number of ERIS interceptors, in concert with terminal imaging radars and airborne optical sensor systems, "could counter [the] small number of strategic missiles [involved] and do so in midcourse rather than in the terminal phase." He argued that "if we cannot perfect defenses against such a limited attack, there is little reason to believe that we can devise defenses against threats that are larger."

One of the most obvious—and probably most rapidly attainable—ballistic missile defense capabilities is antitactical ballistic missile defense (ATBM). Congress recently spun off $50 million from the SDI program to promote NATO cooperation on ATBM systems research. The USSR's SS-21, SS-22, and SS-23 medium-range ballistic missiles are expected soon to become so accurate that "the Soviets will be able to use conventionally and chemically armed versions to take out virtually all of NATO's key military assets without ever having to resort to nuclear weapons themselves," Senator Quayle said. He added that "this threat is not distant or remote. In the case of NATO, it will arrive within the next five years."

While the characteristics of an ATBM "would differ from defenses designed to cope with strategic ballistic missiles, the similarities in interceptor, sensor, radar, and battle-management technologies are significant. An ATBM could not take down an ICBM, but it could help us to learn how to design an interceptor that could."

The same is true for airborne optical sensors and warning radars whose development could also be approached incrementally, first for ATBM and then for ABM missions. "Certainly, if we cannot devise defenses against Soviet tactical ballistic missiles, there is little reason to believe that we can do much against strategic ones," Senator Quayle contended. ATBM systems, called enhanced air defense by the West Germans, would serve both the European NATO members and the US and, therefore, "should be developed jointly," he emphasized.

Some R&D carried out under SDI's aegis has important, near-term applicability to missions other than ballistic missile defense. Spin-offs of SDI technology into these mission areas would fall outside the scope of the ABM Treaty and, hence, are permitted, according to Senator Quayle.

Of central interest among the spinoffs are those that might help boost the survivability of US military spacecraft in the face of the growing Soviet ASAT threat. Congressional "hawks" as well as "doves" are becoming increasingly worried about range extensions of Soviet ASAT weapons that will put at risk critically important US military satellites orbiting at high altitudes, he pointed out. Timely warning of impending attacks by Soviet ASATs is indispensable for evasive or other defensive action by US satellites in high orbit. The only two US R&D programs potentially capable of providing warning against ASAT attacks in deep space are SDI's Space Surveillance and Tracking System (SSTS) and Boost Surveillance and Tracking System (BSTS) projects, he suggested.

While Senator Quayle acknowledged that the performance levels required for SSTS and BSTS to detect and track Soviet space mines or advanced ASATs at high altitudes were significantly below what would be needed for comprehensive ballistic missile defense, he warned that waiting until all requirements could be met means "we will face a strategic ASAT threat that will jeopardize any space-basing of any military assets, including SDI." As a result, Congress leans strongly toward mandating the incremental development and deployment of BSTS and SSTS.

Yet another component of the SDI program that should be accelerated, Senator Quayle suggested, involves advanced sensor and battle-management technology. Massive Soviet programs are directed at disabling or spoofing critically important US command control and communications systems that support both strategic and theater warfare capabilities, especially in Eurasia.

A key Soviet objective underlying these efforts is to develop counters to this country's so-called emerging technologies that might lead to dramatic gains in deep-strike automated standoff weapons. Highly survivable and jam-resistant advanced sensors and corresponding battle-management systems would go a long way toward curbing these Soviet threats.

Here, too, there is strong congressional sentiment in favor of incrementally developing and deploying these capabilities rather than waiting until a comprehensive leakproof ballistic missile defense system can be fielded twenty or thirty years from now, Senator Quayle emphasized. Phased-array radar satellites as well as BSTS's infrared focal-plane technology that

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in combination could revolutionize target detection and tracking, on the one hand, and standoff attack by means of guided submunitions, on the other, are other prime candidates for spin-off from SDI, he pointed out.

Washington Observations

★ The continuing resolution on defense appropriations just passed by Congress—in effect, the FY '87 defense appropriations bill—allocates $110 million next year to the National Aerospace Plane (NASP) program, but restricts the obligation of half of that amount "until the Secretary of Defense certifies that NASA has agreed to assume a significantly larger portion of the NASP RDT&E costs than the current twenty percent and that industry investment out of private capital has been incorporated into the acquisition plan." The Defense Advanced Research Projects Agency (DARPA) is to contribute $100 million and SDIO $10 million to fund the NASP program in FY '87. This amount represents an increase of 144 percent over the amount provided for the program in FY '86.

Because of schedule pressures, Congress refrained from dealing with a "late request from the Department of Defense to consolidate all NASP

IN FOCUS...

funding in the Air Force," according to the Joint Conference Report by the Appropriations Committees of the two chambers. Congress did agree, however, "to reconsider such a change during the next budget cycle, if necessary."

★ The Soviet Union's inventory of strategic nuclear delivery vehicles (SNDVs), which include ballistic missiles and strategic bombers, is well above the limits set by SALT II and continues to grow, Sen. James A. McClure (R-Idaho) charged recently on the floor of the Senate. Quoting unclassified US intelligence reports that acknowledge Soviet breakouts from the SNDV ceilings, Senator McClure bemoaned the Administration's refusal to divulge the extent to which the Soviets have exceeded these limits. He acknowledged, however, the difficulty associated with determining the precise numbers involved because of "several Soviet actions that deliberately impede US SALT verification by national technical means." This action, by itself, constitutes another violation of that treaty. He suggested that the Soviets "are at least seventy-five to 225 [ICBMs and strategic bombers] above" the SALT limits.

Senator McClure charged that the Soviets, starting this summer, have stopped dismantling SS-11 ICBM silos and Bison tankers, which is required to compensate for new systems entering the Soviet inventory. "This . . . cessation could add, in the near term, twenty to thirty or more SALT II-accountable SNDVs" because the Soviets continue the deployment of such new weapons as Typhoon and Delta-IV SSBNs, SS-24 and SS-25 ICBMs, and Bear-H and Blackjack bombers. He added that five of these new strategic bombers have been deployed and that as many as 200 mobile SS-16 ICBM launchers—outlawed by SALT II—have "simply disappeared, [meaning that they probably are] covertly deployed."

★ On the occasion of the first B-1B assuming a "constant alert" role as part of the single integrated operational plan (SIOP) forces, AFSC Commander Gen. Lawrence A. Skantze reported on October 1, 1986, that initial fuel leakage problems encountered by some of the first production aircraft are "largely behind us."

The B-1B is a "wet-wing" design, meaning that the fuel tanks are integral elements of the airframe. That, in turn, makes it the "most stressed wet-wing aircraft" in the Air Force's inventory because of its high-speed, low-level flight profile. Because of this, General Skantze told Pentagon correspondents, there was a "seep and weep" problem. He added, however, that the leaks that caused the temporary standdown of several aircraft last summer have been corrected to the extent that, at the present, there are no nonflyable B-1Bs.

The AFSC Commander predicted that the B-1B would reach full operational status in April 1988, when the 100th and last aircraft is expected to be delivered to SAC. The program remains within the $20.5 billion baseline specified as the not-to-exceed cost established at the program's outset, he added.

★ The Pentagon's investments in command control communications and intelligence (C^3I) have doubled over the past five years, growing from $12.3 billion in FY '82 to $24.4 billion in FY '87, according to Donald C. Latham, Assistant Secretary of Defense for C^3I.

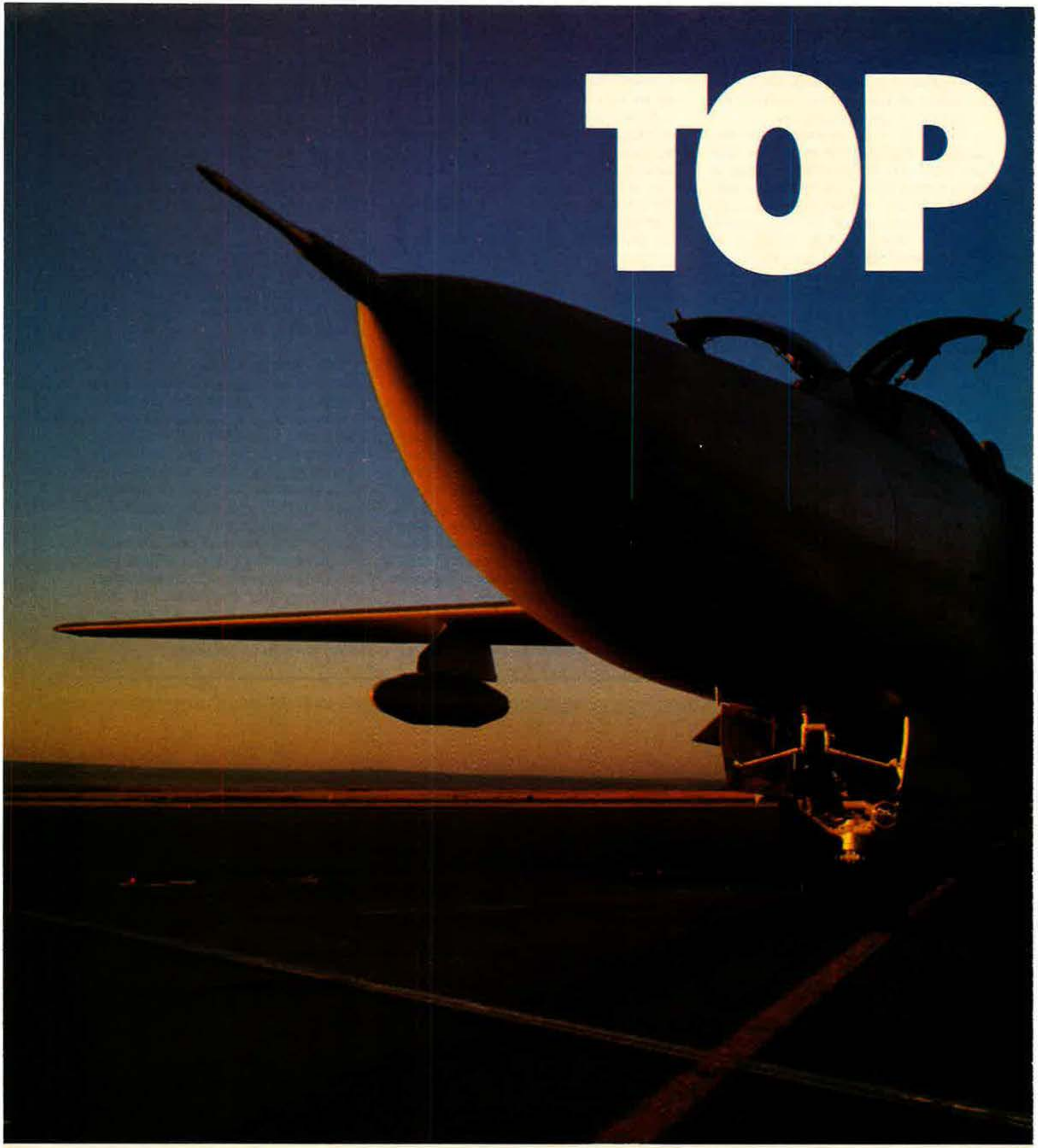
Strategic C^3I systems, including strategic information systems, recorded growth levels ahead of the overall values, jumping from $3.9 billion in FY '82 to $8 billion in FY '87. In the air warfare sector of C^3I, Secretary Latham reported that by the end of the current budget cycle, the US inventory will consist of thirty-four E-3 AWACS, 121 E-2Cs, ninety EA-6Bs, forty-two EF-111s, and sixteen Compass Call C^3CM aircraft.

Three major C^3 improvements in support of the ballistic missile submarine fleet (SSBNs) are under way. Next year, the extremely low frequency (ELF) system will achieve operational status. Orders are also on the books for fifteen E-6A TACAMO aircraft that act as airborne communications relay platforms to the SSBNs. Lastly, R&D involving a specialized space-based communications system for submerged submarines operating at speed—the so-called blue laser system—is progressing well, with full-scale engineering likely to start within a year or two.

In support of the B-1B's C^3 requirements, "miniature receive terminals" are being installed on the new bombers as well as on tanker aircraft, he said. This type of terminal "operates at low frequencies and very low frequencies to allow us to communicate [with] the bombers no matter where they are on the globe and through any kind of jamming or nuclear effects."

In the case of the Ground Wave Emergency Network (GWEN), fifty-seven out of a planned total of 127 individual "nodes" (relay towers) will be in place by the end of next year. In addition to tying the NCA to SAC command centers, GWEN can also serve as a link with air defense and SSBN forces, he said.

★ The Defense Department, in line with the recommendations of the President's Blue Ribbon (Packard) Commission on Defense Management, has expanded the role of the Defense Advanced Research Projects Agency (DARPA) to include prototyping and proof-of-concept demonstrations. DARPA will have overall program management responsibility through "Milestone I" and will retain prototype project responsibility until the completion of initial developmental testing and evaluation. At Milestone I (program go-ahead), program management is passed on to the using service or services. ■



The EF-111A Operational Flight Trainer (OFT) provides invaluable experience for the EF-111A crew. It trains the EW officer for high-density hostile environments and helps develop a coordination between him and the pilot that cannot wait for combat conditions. Designed by AAI in a special way to meet special training needs, this simulator does its job with maximum cost efficiency.

The EF-111A simulator typifies AAI's philosophy in developing high-technology electronic and mechanical systems. Whatever the system, AAI


FLIGHT.

CAPITOL HILL

By Brian Green, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., Oct. 24

Congress Staggers Home

The Ninety-ninth Congress approved a defense authorization bill and an omnibus continuing resolution (CR) that include $291.9 billion and $289.6 billion in budget authority (BA) respectively. Outlays approved were $281.6 billion and $278.5 billion respectively. House and Senate differences on the defense bills were resolved after a series of tough conference fights. The Administration requested $320.3 billion and estimated outlays at $297 billion.

The CR defense budget figure represents a real inflation-adjusted decrease of about two percent from the final FY '86 figure of $286.1 billion. This year's funding legislation, however, cancels about $5 billion in FY '85 and FY '86 BA. When those recisions are figured in, the real decline is about four percent.

The Air Force share of the defense budget is $93.2 billion in BA, compared to an FY '87 request of $105.2 billion and total FY '86 BA of $98.3 billion. Compared to FY '86, Air Force R&D is up about six percent, operations and maintenance down about seven percent, missile procurement down about thirteen percent, and aircraft procurement down roughly twenty-eight percent.

Arms-Control Fights

The authorization conference was dominated by arms-control issues. A compromise worked out on the eve of the Reykjavik summit meeting deleted the most demanding House provisions.

A House-approved ban on underground nuclear tests larger than one kiloton (contingent on reciprocal Soviet restraint) was dropped. A sense-of-Congress resolution was adopted advocating negotiations for a comprehensive test ban. President Reagan also agreed to submit for Senate approval the Peaceful Nuclear Explosions Treaty and the 1974 Threshold Test Ban Treaty (TTBT), which limits underground nuclear tests to 150 kilotons. The Administration in the past has argued that the Soviets have probably violated the treaty limit.

A House measure that denied funding to any program that would exceed SALT II numerical limits was also dropped. Congress urged continued compliance with the unratified, expired agreement.

Congress supported the production of a new binary chemical artillery shell and approved $15 million of the $28.4 million Air Force request for the Bigeye chemical bomb (not to be spent until FY '88), in spite of strong efforts to ban production of new chemical weapons.

The ban on tests of the F-15-launched antisatellite weapon (ASAT) against an object in space (in effect unless the Soviets resume such tests with their own deployed system) was upheld for another year. The Air Force is now reconsidering the future of the program.

Program Actions

• *T-46.* The toughest fight of the year was over this trainer, which the Air Force canceled. A total of $151 million was added to the appropriations bill by the Senate Appropriations Committee (SAC) and the full House. The funding was deleted by the full Senate, and the House finally acceded to the Senate position. A competitive flyoff was ordered among the T-37 trainer, the T-46, and any other candidate planes.

• *C-17.* The Air Force requested $217 million for C-17 procurement and $612 million for R&D, of which $180 million and $547 million were approved respectively in the authorization bill. The appropriations measure included only $50 million for procurement, but $650 million for R&D. Some of the costs covered in the authorization procurement funding will apparently be covered by the additional appropriations R&D money.

• *Tactical air.* Of the forty-eight F-15s requested, forty-two were approved; 180 of 216 F-16s were funded. Of the 260 Advanced Medium-Range Air-to-Air Missiles (AMRAAM) requested, 180 were funded. The Advanced Tactical Fighter was authorized for $275 million of the $294 million requested. The Air Defense Competition, to select a fighter to use for continental air defense, was fully funded at $411 million.

• *Strategic programs.* Twelve of twenty-one MX ICBMs were funded, but R&D on new, more survivable basing modes was cut from $389 million to $120 million—probably not enough to continue all the promising alternatives under investigation. The Advanced Technology Bomber (ATB) and Advanced Cruise Missile were both fully funded. The B-1 contingency fund, which would have kept open B-1 production lines as a hedge against problems with the ATB, was not approved. The Small ICBM was pegged at $1.2 billion (out of $1.4 billion), thus making possible full-scale development in FY '87. The congressionally mandated 30,000-pound weight limit, criticized by many as excessively restrictive, was dropped.

• *Strategic Defense Initiative.* SDI was funded at $3.5 billion out of $5.3 billion requested. *(See also p. 23.)*

• *Space programs.* The fourth Space Shuttle Orbiter, for which money was included in the defense budget by the SAC, was funded in the NASA budget instead.

Acquisition Reform and SOFs

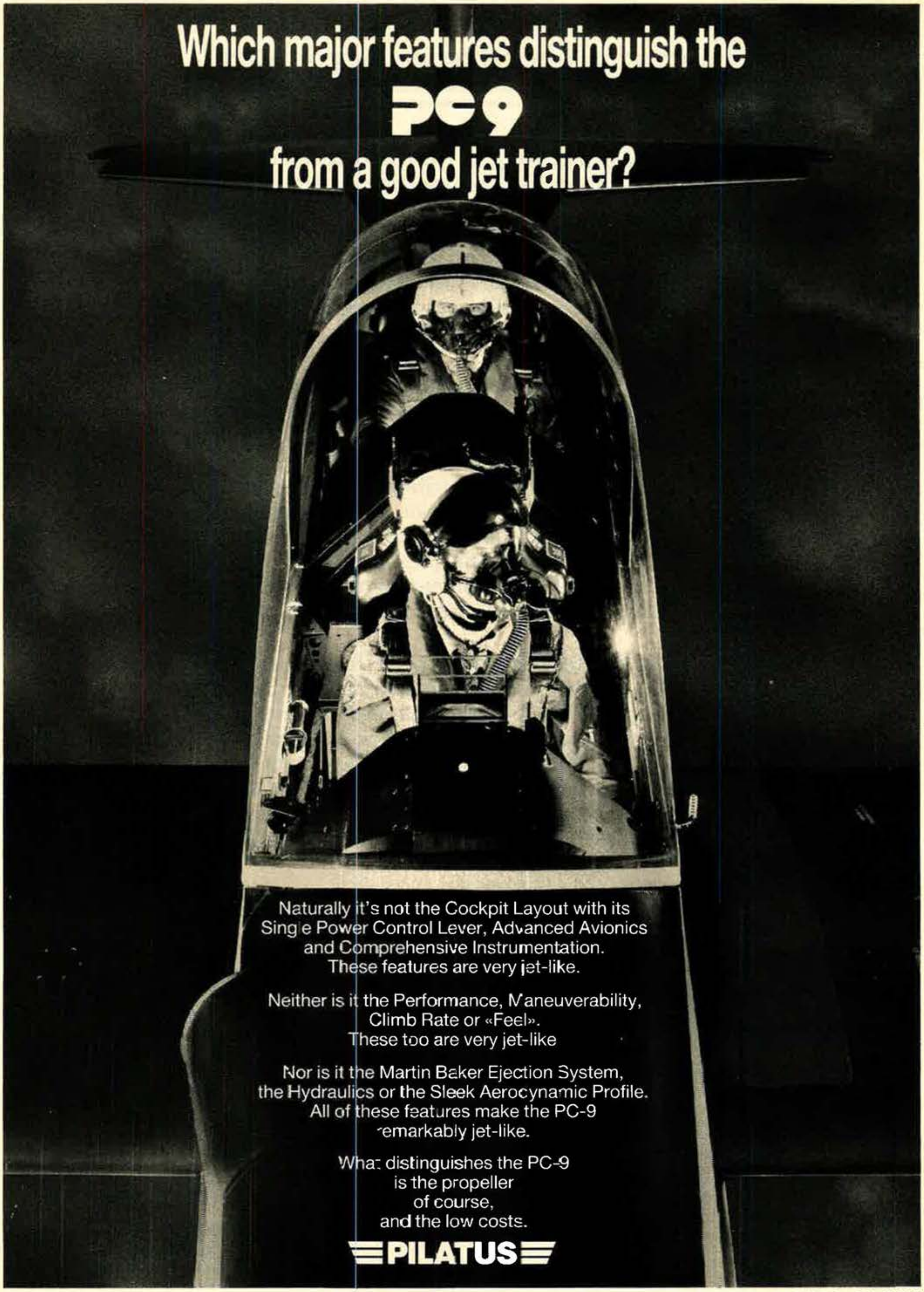
Extensive acquisition reforms were also appended to the authorization bill, including establishment of:

• The post of Under Secretary of Defense for Acquisition.

• Defense enterprise programs, with shortened lines of command and special authority for program managers.

• Controls on future inflation "dividends" that the Pentagon may reap because of lower-than-expected inflation.

Another authorization provision creates a new Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict, charged with oversight of special operations and low-intensity conflict activities, policy, and resources. The measure also establishes a unified special operations command, headed by a four-star officer. ■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from a good jet trainer?
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These features are very jet-like.
Neither is it the Performance, Maneuverability, Climb Rate or «Feel».
These too are very jet-like
Nor is it the Martin Baker Ejection System, the Hydraulics or the Sleek Aerodynamic Profile.
All of these features make the PC-9 remarkably jet-like.
What distinguishes the PC-9 is the propeller of course, and the low costs.
PILATUS

AEROSPACE WORLD

. . . PEOPLE . . . PLACES . . . EVENTS . . .

By Jeffrey P. Rhodes, DEFENSE EDITOR

Washington, D. C., Oct. 29

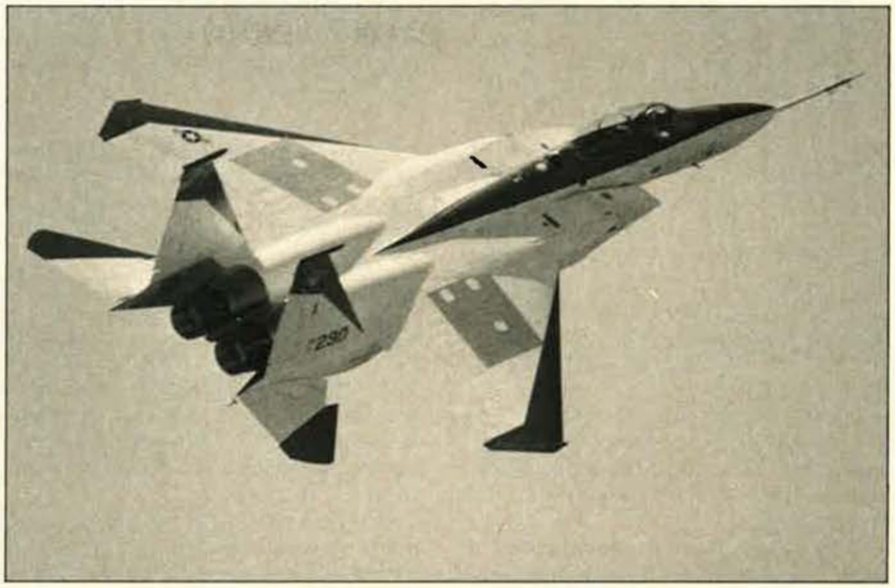
★ When the klaxon horn goes off in the alert shack at Dyess AFB, Tex., the crews of the 96th Bomb Wing will now run to their Rockwell International B-1B bombers. Initial operational capability (IOC) with the new bomber was reached October 1.

Only twelve of the fifteen bombers were capable of going on alert, though, since three B-1Bs did not have all of the line-replaceable units (LRUs) needed for the ALQ-161 electronic countermeasures equipment. AIL Division of Eaton Corp., maker of the ALQ-161, had been behind in delivery of the equipment, but has now almost completely caught up. AIL is expected to meet Rockwell's production rate of four aircraft per month by December. The three B-1Bs at Dyess will not go on alert until the equipment has been installed.

All of the aircraft are experiencing fuel leaks, partly as a result of the plane's wet-wing design. Most of the leaks are minor, however. The stresses put on the airplane's movable wings during low-level training flights loosen sealed fuel container joints and fasteners. At one time, forty percent of the leaks were serious enough to keep the B-1Bs grounded, but the Air Force and Rockwell have since reduced the leaks to minor seepage. The repairs are being done in the field.

Dyess AFB, which received the first operational B-1B in June 1985, will be assigned an additional fourteen aircraft. The 28th Bomb Wing at Ellsworth AFB, S. D., will begin receiving its complement of thirty-five aircraft in January 1987. Grand Forks AFB, N. D., and McConnell AFB, Kan., will be the other bases to transition to the B-1. Delivery of the 100th and final B-1B is expected in 1988.

★ The nation's inactive Space Shuttle program began to show the first visible signs of renewed life on October 9 when the Shuttle *Atlantis* was rolled out to Pad 39-B at the Kennedy Space Center in Florida. The purpose of the rollout was to test the pad's new weather protection modifications, perform a simulated countdown, and conduct several equipment and procedure checks.



A McDonnell Douglas F-15 recently flew for the first time with wing panels made from a new aluminum-lithium alloy. The panels made of the new alloy are five percent stronger and nine percent lighter than the all-aluminum parts they replace.

The test program is scheduled to last six to seven weeks. After tests are completed, *Atlantis* will be rolled back to the Vehicle Assembly Building. On the way to and from the pad, strain gauges will be fitted to the right-hand solid-rocket booster (SRB) to confirm that there are no unusual stresses placed on the SRB field joints during transport. Failure of the joints was the cause of the January *Challenger* accident.

The weather protection system consists of sliding and folding metal doors that will cover portions of the Orbiter that had been exposed to rain and occasional hail. The doors also feature inflatable seals that will bridge the gaps between the doors and the spaceship.

After the simulated countdown, a complete evaluation of crew egress and rescue procedures will be conducted.

Other tests include obtaining wind data from the pad's flame trench to determine if free hydrogen could be accumulating, analyzing payload bay cleanliness after long-term storage, taking optical measurements of the payload bay, and discovering if the payload bay doors can be opened while tests of the SRB's ground hydraulics are being conducted. In the past, the payload bay doors have had to remain closed during these tests, thus affecting the launch schedule.

Also in early October, NASA Administrator James Fletcher announced the schedule for Shuttle flights once operations are resumed in 1988. Five flights are planned for the year, with *Discovery* being the first to lift off on February 18. Through 1990, no more than twelve flights per year are planned with three Orbiters, and no more than sixteen flights per year are scheduled even after *Challenger's* replacement joins the Orbiter fleet. Orbiter 105, which is as yet unnamed, is slated to lift off on its maiden voyage in March 1991.

In related Shuttle news, Space Launch Complex-6 (SLC-6) at Vandenberg AFB, Calif., will be put into "caretaker" status late this fall rather than in May 1987 as previously announced. The shutdown is a result of budgetary constraints. Because of the shutdown, planned captive tests with Shuttle *Columbia* will not take place. By shutting down sooner, the Air Force expects to save more than $60 million. Shuttle operations are now scheduled to begin at SLC-6 in the second quarter of 1992.

★ With another successful launch on September 18, the LGM-118A Peacekeeper intercontinental ballistic missile program has now completed seventy percent of its scheduled test firings. This fourteenth test out of twenty went as planned, except that the missile's radar decoy system was not correctly released and failed to operate. The cause of the malfunction is under investigation.

The four-stage, seventy-foot-tall missile was launched from a modified Minuteman III silo at Vandenberg AFB, Calif., and flew to the target area in the Kwajalein Missile Test Range in the Pacific. The approximately 4,200-mile flight took thirty minutes. Although the Peacekeeper is capable of carrying ten reentry vehicles, only six unarmed RVs were carried on this flight. All six vehicles impacted in the target area.

This latest launch represented a considerable reduction in the time between tests. The normal schedule had been two months or longer between tests, but this launch came only twenty-six days after the thirteenth trial on August 23.

F. E. Warren AFB, Wyo., is expected to reach initial operational capability with ten Peacekeeper missiles in December.

★ With three successes in four attempts during September and early October, the AIM-120A Advanced Medium-Range Air-to-Air Missile (AMRAAM) is now batting .833 (fifteen of eighteen) in its full-scale development program.

There were a number of "firsts" recorded in the September 12 test at the White Sands Missile Range in New Mexico. This shot was the first time an unarmed AIM-120A was fired in a dogfight, or "visual," mode, it was the first ejector launch from an F-15, and it was the first time a production F-15C was used as the carrier aircraft.

The pilot of the F-15 aimed his aircraft at the target, a QF-100 drone, and without lock-on from the airplane's radar, fired the missile at short range. The AMRAAM locked on with its on-board radar and passed within lethal range of the target, which was performing an evasive three-G maneuver.

On September 30, an F-16 carrying both an unarmed AMRAAM and a flight-test vehicle flew against two QF-100s in a midrange, head-on, look-down/shoot-down engagement at White Sands. The flight-test vehicle is an unpowered missile used to collect test data.

Using the track-while-scan mode, which means the aircraft's radar continues to seek additional targets while sending target location updates to the missile after launch, the pilot of the F-16 simulated the firing of the flight-test vehicle against the first target while firing the AMRAAM against the second QF-100. The second drone, which was flying 500 feet below the first and 1,000 feet above the ground, executed a six-G evasive maneuver, but the missile, after receiving updates, passed within lethal distance of the drone.

On the same day, an AMRAAM was ejector-launched from an F/A-18 at the Naval Weapons Center at China Lake, Calif., at very close range against a maneuvering target in a high-clutter environment. The missile locked on to the target, a QF-86 drone, but a minor fabrication error prevented the missile's fins from unlocking, and the AIM-120 missed.

In a repeat of that failed test on October 15, the AMRAAM scored a direct hit on a QF-86. The F/A-18, which was traveling at Mach 0.89 at 5,000 feet above ground level, fired on the target, which was flying at Mach 0.75 at about 2,750 feet over the desert. Both aircraft were maneuvering at the time—the Hornet was in a three-G turn, and the drone was performing evasive 5.5-G maneuvers. The missile locked on after launch and destroyed the target.

★ The sun never sets on Air Force Systems Command's Electronic Systems Division. At least it won't now that the final link in ESD's Solar Electro-Optical Network (SEON) opened in San Vito, Italy, in mid-October. The site in southern Italy is one of six such stations that watch the sun around the clock for disturbances that could affect military operations.

ESD watches the sun because solar flares, or eruptions on the surface of the sun, can interfere with radar and communications equipment. Particles from the flares can heat and expand the earth's atmosphere, thus creating increased drag on satellites and slowing them down.

The station at San Vito is one of three SEON stations with both optical and radio telescopes. Observers there watch the sun through a ten-

Things don't really change as much as they appear to sometimes. R. Richard Heppe, President of Lockheed-California Co., is holding a model of the CL-133, a Lockheed design proposed to the Army Air Corps in 1940. Although the design was rejected at the time as being too radical, it incorporates many advanced design features, such as canards. Mr. Heppe is standing in front of an artist's concept of how Lockheed's design for the Advanced Tactical Fighter might look.

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Information gathered through the SEON network is transmitted to the Military Airlift Command Air Weather Service's Global Weather Center at Offutt AFB, Neb. Personnel at the Center take the data and create space environment assessments for the military and issue warnings when necessary. The Space Environment Services Center of the National Oceanic and Atmospheric Administration (NOAA) at Boulder, Colo., analyzes the data for civilian use.

At Holloman AFB, N. M., a technician polishes a ten-inch-diameter telescope that is part of Electronic Systems Division's solar electro-optical network (SEON). The recent opening of an observatory at San Vito, Italy, completed the network.

The other SEON stations are located at Palehua, Hawaii, Holloman AFB, N. M., Sagamore Hill in Ipswich, Mass., Learmonth, Australia, and Ramey, Puerto Rico.

★ To paraphrase the famous quotation, "Old C-124s never die, they just shake away." That saying was certainly true on October 9 when a Douglas C-124C Globemaster was flown from Willow Run Airport, Mich., to McChord AFB, Wash., in what was billed as the last flight ever for the type of plane that pilots dubbed "Old Shaky."

The C-124, serial number 52-0994, was obtained from the Detroit Institute of Aeronautics, an aviation trade school, and was restored and flown to McChord by volunteers. The Globemaster will become part of a museum on base along with a C-47, a B-18, a B-23, a CF-101F, and an F-106.

The 62d Military Airlift Wing at McChord had a proud history flying C-124s. The 62d used the planes to fly in troops to reinforce the French garrison at Dien Bien Phu in Indochina and to fly UN peacekeeping forces to the Congo in 1960. In addition, the 62d MAW flew C-124s to support research on ice islands in the Arctic and to resupply remote radar sites in Alaska.

The engines on McChord's C-124 got there in somewhat of a roundabout fashion. The four Pratt & Whitney R-4360s were shipped in August from Travis AFB, Calif., to Florence, S. C., where another C-124 was being readied for a last flight. After navigating via "iron compass" (railroad tracks) to Charleston AFB, S. C., where that C-124 is also going to be part of a museum, the engines were then shipped to Willow Run. They were then put on the Old Shaky heading to Washington state.

★ A Patriot surface-to-air missile traveling at more than three times the speed of sound successfully intercepted a US Army Lance target missile at New Mexico's White Sands Missile Range in early September. This is the first time the US Army has used its Patriot air defense missile system to intercept a tactical ballistic missile.

According to DoD, the Soviet Union is deploying a new generation of more accurate short-range missiles capable of delivering not only nuclear and chemical but also conventional payloads deep into West European territory. In response to this growing Soviet capability, the flight test served as part of a broader DoD examination of potential near-term defensive options available to the US and its allies.

DoD said that the flight test demonstrated that the Patriot system, with modifications, could serve as a defense against tactical ballistic missiles as well as advanced aircraft. The Patriot system will undergo further tests of its capabilities in subsequent flight tests.

★ With the possible exception of the KC-135, the venerable Lockheed C-130 has probably undergone more modification and technology demonstration programs than any other air-

On October 9, this Douglas C-124 Globemaster II made the last flight ever for the type as it lumbered nonstop from Willow Run Airport, Mich., to McChord AFB, Wash. This "Old Shaky" will become part of a museum at the 62d MAW's home base.

plane in history. In early October, the Hercules was once again tapped for a test program, this time for a study aimed at enhancing the big plane's movement on the ground.

Under a $248,689 contract from Air Force Systems Command's Aeronautical Systems Division at Wright-Patterson AFB, Ohio, the Boeing Military Airplane Co. will examine designs for a "strap-on" ground mobility system that can easily be attached or removed.

The aim of the program is to allow a C-130 to operate over such obstacles as rocks up to a foot high or ditches up to a foot deep on battle-damaged or unprepared runways in all types of weather.

Air cushions, skis and skids, "multibogied" wheels, and wheel tracks like those on tanks are some of the technologies to be considered. Boeing will take the four most prom-

SENIOR STAFF CHANGES

PROMOTIONS: To be **General:** Thomas C. **Richards.**

To be **Lieutenant General:** Aloysius G. **Casey**; Thomas G. **McInerney**; Robert C. **Oaks**; Claudius E. **Watts** III.

To be **Major General:** William K. **James.**

To be **Brigadier General:** James G. **Andrus.**

To be **CAP Brigadier General:** Eugene E. **Harwell.**

RETIREMENTS: L/G Carl H. **Cathey**; L/G Robert E. **Kelley**; M/G Ralph H. **Jacobson**; Gen. Richard L. **Lawson**; B/G Donald L. **Moore.**

CHANGES: Col. (B/G selectee) James G. Andrus, from DCS/Ops., Hq. AAC, Elmendorf AFB, Alaska, to Command Dir., NORAD, Combat Ops. Staff, Cheyenne Mountain Complex, Colo., replacing B/G Donald L. Kaufman . . . **B/G Joseph W. Ashy,** from IG, Hq. TAC, Langley AFB, Va., to C/S, Hq. TAC, Langley AFB, Va., replacing B/G John E. Jaquish . . . **B/G Edward P. Barry, Jr.,** from Vice Cmdr., BMO, and Prgm. Dir. for SICBM, AFSC, Norton AFB, Calif., to Cmdr., BMO, and Prgm. Dir. for SICBM, AFSC, Norton AFB, Calif., replacing M/G (L/G selectee) Aloysius G. Casey . . . **B/G Charles W. Bartholomew,** from Vice Dir., NORAD, Combat Ops. Staff, Cheyenne Mountain Complex, Colo., to Vice Cmdr., Hq. AFCC, Scott AFB, Ill., replacing retired B/G Donald L. Moore . . . **B/G Robert C. Beyer, Jr.,** from Dir., Ops. (J-3), Hq. USCENTCOM, MacDill AFB, Fla., to Spec. Ass't to CINC, Hq. USCENTCOM, MacDill AFB, Fla.

L/G James R. Brown, from Cmdr., AAFSE, and Dep. CINCUSAFE for the Southern Area, Naples, Italy, to Vice Cmdr., Hq. TAC, Langley AFB, Va., replacing retired L/G Robert E. Kelley . . . **M/G Anthony J. Burshnick,** from DCS/Plans, Hq. MAC, Scott AFB, Ill., to Dir., Pers. Prgms., DCS/Pers., Hq. USAF, Washington, D. C., replacing M/G Winfield S. Harpe . . . **M/G James T. Callaghan,** from Cmdr., 314th AD, PACAF, Osan AB, Korea, to C/S, Combined Forces Command, Yongsan, Korea . . . **M/G (L/G selectee) Aloysius G. Casey,** from Cmdr., BMO, and Prgm. Dir., Peacekeeper, Norton AFB, Calif., to Cmdr., SD, AFSC, Los Angeles AFS, Calif., replacing L/G Forrest S. McCartney . . . **B/G Larry D. Fortner,** from Cmdr., 42d AD, SAC, Blytheville AFB, Ark., to Dep. IG, Hq. USAF, Washington D. C., replacing M/G Michael A. Nelson.

B/G William J. Grove, Jr., from Cmdr., Chanute TTC, ATC, Chanute AFB, Ill., to DCS/Tech. Training, Hq. ATC, Randolph AFB, Tex., replacing M/G Larry N. Tibbetts . . . **M/G Winfield S. Harpe,** from Dir., Pers. Prgms., DCS/Pers., Hq. USAF, Washington, D. C., to Ass't DCS/Pers., Hq. USAF, Washington, D. C., replacing M/G (L/G selectee) Robert C. Oaks . . . **B/G Paul A. Harvey,** from C/S, Hq. MAC, Scott AFB, Ill., to Cmdr., 322d Airlift Div., MAC, and DCS/Airlift, Hq. USAFE, Ramstein AB, Germany, replacing M/G Richard J. Trzaskoma . . . **CAP Col. (B/G selectee) Eugene E. Harwell,** from Nat'l Vice Cmdr., Hq. CAP, Maxwell AFB, Ala., to Nat'l Cmdr., Hq. CAP, Maxwell AFB, Ala., replacing B/G William B. Cass.

B/G Richard E. Hawley, from Spec. Ass't to CINC, PACAF, Osan AB, Korea, to Vice Cmdr., 7th AF, PACAF, Osan AB, Korea . . . **B/G (M/G selectee) William K. James,** from Cmdr., 28th AD, TAC, Tinker AFB, Okla., to Cmdr., 3d AF, USAFE, RAF Mildenhall, UK, replacing M/G (L/G selectee) Thomas G. McInerney . . . **B/G John E. Jaquish,** from C/S, Hq. TAC, Langley AFB, Va., to Cmdr., TAWC, TAC, Eglin AFB, Fla., replacing M/G Thomas S. Swalm . . . **B/G Donald L. Kaufman,** from Command Dir., NORAD, Combat Ops. Staff, Cheyenne Mountain Complex, Colo., to Vice Dir., NORAD, Combat Ops. Staff, Cheyenne Mountain Complex, Colo., replacing B/G Charles W. Bartholomew . . . **M/G Buford D. Lary,** from Cmdr., 1st AF, Hq. TAC, Langley AFB, Va., to Cmdr., 1st AF, and Cmdr., CONUS NORAD Region, Langley AFB, Va.

M/G Donald A. Logeais, from DCS/Log., Hq. MAC, Scott AFB, Ill., to DCS/Ops., Hq. MAC, Scott AFB, Ill., replacing M/G William E. Overacker . . . **B/G John D. Logeman, Jr.,** from Vice Cmdr., 12th AF, TAC, Bergstrom AFB, Tex., to Cmdr., 28th AD, TAC, Tinker AFB, Okla., replacing B/G (M/G selectee) William K. James . . . **M/G (L/G selectee) Thomas G. McInerney,** from Cmdr., 3d AF, USAFE, RAF Mildenhall, UK, to Vice CINC, Hq. USAFE, Ramstein AB, Germany, replacing retired L/G Carl H. Cathey . . . **B/G Joel M. McKean,** from Dep. Dir., Force Development and Strategic Plans, J-5, OJCS, Washington, D. C., to Cmdr., Chanute TTC, ATC, Chanute AFB, Ill., replacing B/G William J. Grove, Jr. . . . **B/G Gary H. Mears,** from Vice Cmdr., Warner Robins ALC, AFLC, Robins AFB, Ga., to DCS/Log., Hq. MAC, Scott AFB, Ill., replacing M/G Donald A. Logeais.

B/G Richard C. Milnes II, from Spec. Ass't to CINCMAC for Mil. Effectiveness, Hq. MAC, Scott AFB, Ill., to Vice Cmdr., Warner Robins ALC, AFLC, Robins AFB, Ga., replacing B/G Gary H. Mears . . . **M/G (L/G selectee) Robert C. Oaks,** from Ass't DCS/Pers., Hq. USAF, Washington, D. C., to Cmdr., AAFSE, and Dep. CINCUSAFE for the Southern Area, Naples, Italy, replacing L/G James R. Brown . . . **M/G William E. Overacker,** from DCS/Ops., Hq. MAC, Scott AFB, Ill., to C/S, Hq. MAC, Scott AFB, Ill., replacing B/G Paul A. Harvey . . . **M/G Maurice C. Padden,** from Vice Cmdr., Hq. AFSPACECOM, Peterson AFB, Colo., to Cmdr., Hq. AFSPACECOM, Peterson AFB, Colo. . . . **L/G (Gen. selectee) Thomas C. Richards,** from Cmdr., Hq. AU, Maxwell AFB, Ala., to Dep. CINC, Hq. USEUCOM, Vaihingen, Germany, replacing retired Gen. Richard L. Lawson.

AFRES M/G Roger P. Scheer, from Cmdr., AFRES 10th AF, Bergstrom AFB, Tex., to Cmdr., AFRES, Hq. USAF, Washington, D. C., replacing AFRES M/G Sloan R. Gill . . . **B/G Donald Snyder,** from Spec. Ass't to Cmdr., 12th AF, TAC, Bergstrom AFB, Tex., to Vice Cmdr., 12th AF, TAC, Bergstrom AFB, Tex., replacing B/G John D. Logeman, Jr. . . . **L/G Truman Spangrud,** from Comptroller, Hq. USAF, Washington, D. C., to Cmdr., Hq. AU, Maxwell AFB, Ala., replacing L/G (Gen. selectee) Thomas C. Richards . . . **M/G Ralph E. Spraker,** from C/S, Hq. AFSPACECOM, Peterson AFB, Colo., to Vice Cmdr., Hq. AFSPACECOM, Peterson AFB, Colo., replacing M/G Maurice C. Padden . . . **M/G Samuel H. Swart, Jr.,** from Vice Cmdr., 8th AF, SAC, Barksdale AFB, La., to Dir., Ops. (J-3), Hq. USCENTCOM, MacDill AFB, Fla., replacing B/G Robert C. Beyer, Jr.

M/G Larry N. Tibbetts, from DCS/Tech. Training, Hq. ATC, Randolph AFB, Tex., to Cmdr., Lowry TTC, ATC, Lowry AFB, Colo., replacing retired M/G Joseph D. Moore . . . **M/G Richard J. Trzaskoma,** from Cmdr., 322d Airlift Div., MAC, and DCS/Airlift, Hq. USAFE, Ramstein AB, Germany, to DCS/Plans, Hq. MAC, Scott AFB, Ill., replacing M/G Anthony J. Burshnick . . . **M/G (L/G selectee) Claudius E. Watts III,** from Senior Mil. Ass't to Dep. Sec. of Defense, Washington, D. C., to Comptroller, Hq. USAF, Washington, D. C., replacing L/G Truman Spangrud . . . **B/G C. Norman Wood,** from Dep. Ass't C/S for Intelligence, Hq. USAF, Washington, D. C., to Dir., Intelligence (J-2), Hq. USEUCOM, Vaihingen, Germany, replacing L/G Edward J. Heinz.

SENIOR ENLISTED ADVISOR CHANGES: CMSgt. Bobby Renfro, to SEA, Hq. ATC, Randolph AFB, Tex., replacing retired CMSgt. J. C. Riley . . . **CMSgt. John W. Wright,** to SEA, Hq. AFSPACECOM, Peterson AFB, Colo., replacing retired CMSgt. Thomas J. Echols. ■

ising designs and compare the weight and performance tradeoffs of each system with the corresponding increases in ground mobility. Boeing will then prepare a preliminary design of the final concept. The study is to be completed in February 1988.

★ On the last day of the fiscal year, the Air Force opted to buy outright eighty Gates Learjet C-21As and forty Beech C-12F operational airlift support aircraft that had previously been leased.

The C-21As, which are the military counterpart of the Learjet 35A, were purchased for $180 million, while the C-12Fs, the uniformed version of the Super King Air 200C, were picked up for $52 million.

The leases on the aircraft would have expired in 1989, at which time the Air Force would have had the option to buy the aircraft or continue the lease. Maintenance on the two types, which was included under the terms of the lease, will continue to be provided by the contractors under a new agreement. The money for the purchase came from a reprogramming of FY '84 funds that would have expired at the end of FY '86.

Both the C-21s and C-12s are used for personnel transport and high-priority cargo. Both can also be converted to an aeromedical evacuation configuration. The C-21s, which are assigned to sixteen bases worldwide, are also used for pilot training. The C-12Fs are stationed at eleven bases around the world.

★ The Air Force's eyes in the sky got a little sharper recently when the CAI Division of Recon/Optical, Inc., delivered the first KS-127B camera for RF-4 aircraft. The camera is designed for long-range oblique photography (LOROP) and can take very sharp images from relatively high altitudes and distances greater than twenty miles. The nose of the RF-4 does not have to be modified to accept this camera.

KS-127B can be used as either a film camera or as an electro-optical real-time camera. The camera features a sixty-six-inch focal length optical system and has an autofocus as well as an active and passive stabilization system. It is also thermal-stabilized.

The plane's backseater has sights to point the KS-127B for multiple shots of selected targets. The camera can be pointed left or right while in flight.

Because the camera can get high-quality imagery at standoff distances, it can lessen the danger to the RF-4 and its crew because the plane does not have to fly directly over the target.

As part of a program to replace the Dragon portable antitank system, Ford Aerospace & Communications Corp. has been awarded a $30 million contract from US Army Missile Command to develop and flight-test an Advanced Antitank Weapon System-Medium (AAWS-M). The system works on laser-beam-rider technology.

A KS-127 Long-Range Oblique Photography Camera took this photo of the Tennessee ANG ramp, shown in 12X enlargement. This photo was taken from an altitude of 35,500 feet and from a distance of twenty-two nautical miles.

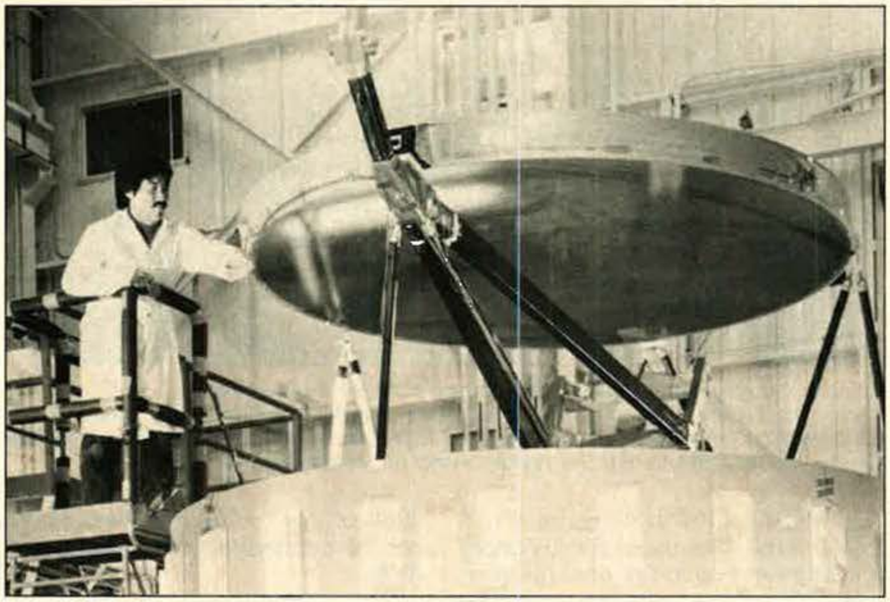
★ Smoke billowing from an airplane is usually a good indication that something is wrong. But when smoke flows off of an F-104 at NASA's Hugh L. Dryden Flight Research Facility at Edwards AFB, Calif., that is exactly what engineers want to see.

In preparation for the upcoming NASA High Alpha Flight Research Program, prototype smoke generators are mounted on one of the F-104's wing pylons. The generators, which look roughly similar to the waterbottles used by football teams, are being tested to ensure their ability to ignite reliably and to produce smoke of proper density at flight speeds. The generators have been tested at altitudes up to 45,700 feet and at temperatures as low as twenty-three degrees below zero.

The High Alpha program is designed to build a data base that aircraft designers can use to engineer future airplanes that perform better in high angle of attack (or alpha) attitudes. In order to verify wind tunnel and fluid dynamics computer data of aircraft flying at a high angle of attack, the smoke generators will be installed in the nose of one of NASA's F/A-18 Hornets. Once at high alpha, the F/A-18 pilot will start the generators to describe airflow around the airplane visually.

★ In a recent Air Force Policy Letter for Commanders, Lt. Gen. James A. Abrahamson, Director of the Strategic Defense Initiative Organization (SDIO), says that "the assault on SDI funding is perplexing in light of our tremendous technical progress in just three years."

He went on to cite such examples as smaller, more powerful high-speed digital computers being developed at lower cost, invention and development of a wide range of strong composite materials that drastically reduce weight, and free-electron laser research that is moving ahead rapidly with numerous potential applications in industry and medicine.



Nuclear Metals Inc. of Concord, Mass., has developed ultralight extruded beryllium tubing for use as structural components in communications satellites. The tubing, of high strength and stiffness at only two-thirds the weight of aluminum, can be made in various shapes and comes with aluminum end fittings.

★ One of the most promising new technologies on the horizon is laser communications. In order to fill a need for test equipment in this new field, a C-135E belonging to Aeronautical Systems Division's 4950th Test Wing will be permanently modified to become a Laser Communications Airborne Test-bed.

Under a $1.5 million contract, McDonnell Douglas Astronautics Co. will develop and fabricate the laser test-bed equipment. The company will also support the aircraft modification effort by the 4950th.

The C-135E will have a large window installed in the cargo door, an optical dome will be fitted to the top of the aircraft, and a vibration-isolated mounting system for the optical hardware will be built inside the airplane. A microprocessor computing capability for automated data collection and in-flight analysis of the data will also be a part of the modification.

The laser system will consist of a transmitter, receiver, acquisition and tracking subsystems, and a video camera for real-time analysis of the acquisition sequence.

In the past, the Air Force has had to spend up to a quarter of a million dollars to modify two aircraft temporarily each time a set of laser communications tests was to be conducted. The permanently modified aircraft will thus result in significant cost savings in the long run.

★ Since before the turn of the century, one very popular pastime has been looking at stereo, or three-dimensional, pictures through a stereopticon or a View-Master. By using the same basic technique of taking two slightly overlapping pictures of the same thing, engineers at the Arnold Engineering Development Center at Arnold AFS, Tenn., and NASA's Lewis Research Center in Cleveland, Ohio, are studying the formation of ice on the wings of commuter aircraft.

The test aircraft is a de Havilland-Canada DHC-6 Twin Otter fitted with a pair of 70-mm cameras (one mounted on the nose and one attached near the cockpit) pointed at the leading edge of the wing. The cameras are enclosed in boxes lined with heating

The Navy's newest Tomcat took to the air for the first time in late September as the first Grumman F-14A Plus aircraft lifted off from the company's Calverton, N. Y., test facility. It features two General Electric F110-GE-400 engines and improved avionics. Fleet deliveries of the new Tomcat will begin in late 1987.

pads and have hot air blown across the lenses to prevent fogging.

The plane is flown through cloudy skies to build up ice on the wings, and then the cameras snap the stereo picture pairs. Any one of three types of ice—rime, glaze, or mixed—can be formed. All three varieties are being investigated.

Once back on the ground, the pictures are fed into the Analytical Stereo Compiler at Arnold where the characteristic shapes of the ice types are determined. The dimensions of the ice shapes are then plotted on a graph. Because the wings have calibration marks painted on them, the depth and surface texture of the ice formations can also be measured.

There is also a test program just under way to study ice accumulation on the tail surfaces of the airplane.

The results of these icing missions provide data on how ice actually accumulates and help to verify ice accumulation data gathered during wind-tunnel tests.

★ **ANNIVERSARY**—The **US Readiness Command** (USREDCOM) celebrated its **twenty-fifth anniversary** on October 9. First established in 1961 as US Strike Command, this unified command headquartered at MacDill AFB, Fla., provides a general reserve of combat-ready forces to reinforce regional commanders in overseas theaters. The command also develops tactics, techniques, and procedures for the conduct of joint warfare, conducts joint training of assigned forces, and plans for the land defense of Alaska, the combined land defense of Canada and the US, as well as the land defense of the continental US alone. The Commander in Chief of USREDCOM, Army Gen. James J. Lindsay, exercises command over more than 234,000 personnel drawn from the Army Forces Command and from Tactical Air Command.

★ **MILESTONES**—The **Egyptian Air Force accepted the first of forty General Dynamics F-16C and D aircraft** in ceremonies at the GD plant in Fort Worth, Tex., in early September. The first two-seat F-16D was delivered to Egypt in early October. The $1.2 billion Foreign Military Sales program deal is being managed by Aeronautical Systems Division at Wright-Patterson AFB, Ohio. The last of the new F-16s is expected to arrive in the Middle East next June.

The **86th Tactical Fighter Wing** at Ramstein AB, Germany, became in early October the first wing in the Air Force **to receive F-16C aircraft powered by the General Electric F110-**

GE-100 engine. The engine has a 27,000-pound-thrust capability and features an engine monitoring system that can be hooked to a computer to alert maintenance personnel to any problems. Other bases to receive F-16C and D aircraft with the higher performance engines include Spangdahlem AB, Germany, and Torrejon AB, Spain, in Europe and Misawa AB, Japan, and Kunsan AB, Korea, in the Pacific.

Speaking of F110 engines, the first **Grumman F-14A Plus Super Tomcat** aircraft powered by a pair of F110-GE-400 engines with 27,300 pounds of thrust each **made its first flight** on September 29. Grumman test pilot Joe Burke took the plane, which also features improved avionics and radar, to a top speed of 762 miles per hour and a maximum altitude of 35,000 feet during the fifty-four-minute flight at the company's Calverton, N. Y., test facility. The F-14A Plus will enter the Navy's fleet air arm in late 1987 and will serve until 1990, when deliveries of the F-14D, which will have the new engines as well as digital avionics and advanced radar, begin. The original F-14As were powered by Pratt & Whitney TF30-P-412A engines, which are from the same family as the TF30-P-3 engines that power the F-111.

The **last of the 1,739 AGM-86B Air-Launched Cruise Missiles was delivered** to the Air Force on October 7. Final delivery of the Boeing-built ALCMs was ahead of schedule and $90 million under budget. Development work on the missile began in 1973, and Boeing was given a contract to build the missiles in 1980. In 1982, the 416th Bomb Wing at Griffiss AFB, N. Y., became the first unit to reach operational capability with the missiles.

Following a change in Air Force hospital regulations and a reorganization of the **Wilford Hall Medical Center** at Lackland AFB, Tex., the hospital began a new counting system for admitted patients on January 1, 1954. In September of this year, the hospital **admitted its 1,000,000th patient,** nineteen-year-old Charles A. Hagelin, who came in for a heart valve replacement. Wilford Hall, a 1,000-bed medical center, offers treatment in 136 medical specialties and subspecialties and provides advanced medical education for most Air Force doctors. It is also the only bone-marrow-transplant center in the military.

★ **NEWS NOTES**—In late September, **Aeronautical Systems Division** announced that it **intends to renegotiate the option price of the final twenty-one C-5B aircraft.** After a "should

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cost" review of the FY '87 buy of the Lockheed-built planes, Gen. Lawrence A. Skantze, Commander of Air Force Systems Command at Andrews AFB, Md., decided to renegotiate the option price of $2.4 billion for the airlifters. These twenty-one C-5Bs will complete the fifty-plane contract awarded to Lockheed in 1982.

Camouflaged **Military Airlift Command C-5 and C-141B aircraft will now bear a gloss American flag decal** on the vertical tail because of a recent change in MAC policy. The 31.4-inch-by-sixty-inch decals are to be positioned in the same location as now required on the aircraft that are painted gray and white. All planes are to get the decals within a year.

In a similar vein, **all Air Force Reserve F-4 aircraft are to be repainted in a gray-on-gray paint scheme** by 1990. This change will make them less visible at high altitudes. The aircraft will be repainted while undergoing scheduled maintenance at the Ogden Air Logistics Center at Hill AFB, Utah. ■

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The instructor pilot must be an aviator, a teacher, a counselor, and sometimes a psychologist.

The Faculty

The venerable (twenty-five-year-old) T-38, currently undergoing a modification program, will be used by the PIT program well into the next century. To make the aircraft more visible, Air Training Command is evaluating these different paint schemes.

# of Flight

BY JEFFREY P. RHODES, DEFENSE EDITOR

FLYING an airplane is one thing. Teaching someone else to fly is quite another. It involves not only a mastery of aviation skills on the part of the instructor pilot (IP) but also an understanding of how people learn and what brings out the best in them.

Teaching rated pilots how to be teachers is the charge of the 12th Flying Training Wing at Randolph AFB, Tex.

"How well we do our job is the cornerstone of what the pilots of the Air Force will look like," stated Col. Ralph R. (Bob) Rohatsch, Jr., Commander of the 12th FTW. "The quality of the UPT [Undergraduate Pilot Training] students is a direct result of the IPs we produce to train them. If we do a poor job, the pilots produced are not as high quality as the Air Force has to have. On the other hand, if we do a good job, the pilot base is in good shape."

When Randolph Field was established in 1931 as the Army Air Corps's Primary Flying School, the base was known as the "West Point of the Air." Over time, the mission changed to training UPT instructor pilots, and the base is one of two in the Air Force today that performs that duty on a large scale. Because of the "graduate-school" nature of the Pilot Instructor Training (PIT) program conducted there, Randolph AFB could now be called the "Oxford of the Air."

It Takes All Kinds

A great deal of time and money are spent in selecting pilot candidates, and the pace of learning to fly the Air Force's two jet training airplanes is unrelenting. The IP in the right seat of a Cessna T-37B or the backseat of a Northrop T-38A Talon is the key to success.

"Rather than just being a school for teaching people how to check out in the instructor's seat, we needed to spend more time on what the Air Training Command philosophy is. And that's been the biggest change I've seen since I've been here," noted Colonel Rohatsch, who assumed command of the wing in early 1985. "We needed to spend more time on what being an instructor pilot means. Obviously, that is the father image, the counselor, the teacher image. A source of emotional stability to the student. To some degree, it is being a psychologist—one who has to get inside the student's mind. That's the line of reasoning we took."

"We're not looking for a worship-type image from the students," added Maj. William A. Dalson, one of the PIT instructors with the 12th FTW's 560th Flying Training Squadron, which trains T-38 IPs. "The student's initiation into the Air Force is from his IP, and they pick up little cues. So we, as instructors, have to do the right things."

The "instructor instructor pilots" of the three squadrons involved with the PIT program—the 559th and the 560th FTS and the 12th Student Squadron—are, for the most part, captains. The IPs come from a variety of backgrounds—some have experience in major weapon systems, such as fighters or bombers, while others have served tours as instructors in ATC. There is even an exchange program with the air forces of other countries.

One allied pilot, Flt. Lt. Nick Willey of the Royal Air Force, is at Randolph as part of such an instructor swap. "The idea behind it is an exchange. I've picked up some good ideas. It is a good deal to see how another air force operates. The major differences are in the end product. In the UK, most of the training is aimed at training fast jet fighter pilots, whereas the USAF has a variety of different cockpit vacancies to fill."

Another of the not-so-common IPs with the 560th FTS is Capt. Kimberly D. Olson, who has been a pilot for the past seven years and who is one of three women instructors in the PIT program. "Some people are a little prejudiced and question my being here, but you just have to prove yourself. Once you do that, you get their respect, and you are viewed simply as another PIT instructor.

"You get a lot of immediate job satisfaction from being an instructor pilot," continued Captain Olson, who will be leaving the cockpit for an Air Staff Training (ASTRA) assignment at the Pentagon next May. "You can see you are really doing something. In six weeks, you can see concrete results in your students."

Most Are First-Assignment IPs

A majority of the pilots being trained at Randolph are first-assignment IPs, or FAIPs. These flyers are usually in the top twenty percent of their UPT class, are identified as fighter/attack/reconnaissance (FAR) aircraft pilot candidates, and are specially selected by their instructors to enter the PIT program. The FAIPs form the backbone of Air Training Command's instructor pilot force. In fact, command-wide, sixty percent of the instructors at UPT bases are in their first permanent assignment with the Air Force. At the individual flight level, though, close to eighty percent of the instructors are FAIPs.

"It is a real challenge to them," said Col. Ronnie K. Morrow, the wing's Deputy Commander for Operations. "Here is an individual who has just gotten his wings, has just over a year's worth of rank, and who turns around and is now instructing those of equal or sometimes greater rank. It's a lot of responsibility. We pick some sharp guys—those with good flying and teaching skills. They respond very well."

One advantage to using FAIPs in the undergraduate training process is the energy and motivation they bring to teaching. "We have done very well by the first-assignment IPs," declared Lt. Col. Thomas M. Pratt, Commander of the 559th FTS, which trains the T-37 IPs. "Because they have just graduated from UPT, the FAIPs can maybe identify a little better with their students, and they can use that to their advantage. They can see ways to help a student progress and succeed. We are getting the best of the UPT classes. By their nature, FAIPs can be very successful, and they have been."

The other pilots going through PIT training are the ones who have major weapon system experience and who are coming back into ATC. These pilots bring the added benefit of firsthand knowledge of fighters, bombers, and transports that the FAIPs don't have. They also bring the air judgment and insight that come only with accumulated time in flying an aircraft.

"The FAIP only knows the ATC way," said Capt. Daniel O. Beaudoin, a check pilot with the "Billygoats," as the 559th FTS is known. "All of one kind of instructor or the other would probably hurt us. The major weapon systems types bring a lot of good experience."

It is with this balance of enthusiasm and experience that ATC trains the Air Force's new flyers.

In addition to the primary mission of training instructor pilots, the 12th FTW also carries out several smaller-scale training programs. With the recent retirement of the Cessna O-2, several forward air control (FAC) units are converting to the T-37, and the 559th FTS has been requalifying those pilots in that airplane. The Resident Aerospace Medicine (RAM) program, in which flight surgeons become acquainted with the day-to-day operations of a wing, and the fixed-wing qualification program, in which Air Force helicopter pilots return to jets, are handled in phases by all three squadrons.

One important training program that the 560th FTS had carried out before it was phased out was the requalification of pilots who had been prisoners of war in Southeast Asia. The pictures of all 163 pilots who requalified hang in the Freedom Hall of the 560th's hangar.

A Semester's Worth of Class

The PIT program takes in a class of eight to ten pilots every two weeks. The entire syllabus takes about thirteen weeks to complete. "What this program does is teach pilots how to instruct from the right seat or backseat," said Col. Wallis D. Cone, Jr., the Assistant Deputy Commander for Wing Operations. "They are not learning to fly—they are looking to improve their skills."

The PIT trainees, who have already been designated as either a future T-37 or T-38 instructor (they don't have a choice in most cases), begin their training by taking four academic training courses in the classrooms of the 12th Student Squadron.

"We give them about two weeks of solid academics before they fly," said Capt. Tommy C. (Tom) Gray, an instructor with the 12th STUS. "We gear toward what the instructor needs—when to teach, when not to teach and let the student make his own mistakes. We also teach all of the systems [in the airplane] in great detail. Students ask incredible questions, and you have to have a super answer."

Each of the classrooms has what Captain Gray jokingly calls "play toys"—landing gear actuators, different panels from an aircraft, and giant models of altimeters, instruments, and other piloting aids.

"If the IP has an idea of how things are happening and has a good understanding of basic aerodynamics, he can better articulate it to the students," noted Captain Gray.

The roughly fifty hours of pilot classes involve a lot of give and take and open discussion. The FAIPs and the major weapon system pilots exchange real-life experiences, and

A crew chief signals "thumbs-up" to a T-38 pilot for a dawn takeoff. Maximum use of daylight hours is critical to the trainers and trainees at Randolph because night flying is made impossible by an enormous colony of bats nearby that forages nocturnally in groups large enough to be seen on radar.

the instructors pose hypothetical situations and ask the students to respond and to account for their responses.

The Air Force Instrument Flight Center, which is in the same building as the classrooms, is another resource that helps students to solve problems that come up in the discussions. It is very convenient having the people who write the regs right next door.

Once finished with their academic work, the PIT trainees head to their assigned flying squadrons, where, on average, two trainees will be paired up with each instructor. Because of the design of Randolph AFB, the two squadrons are separated by more than just philosophical differences and two distinct airplanes—the hangars and offices of the 559th FTS are on one runway, and the physical plant of the 560th is on a separate runway on the other side of the 2,901-acre base.

The flying portion of the PIT program progresses through four phases—contact (or basic maneuvers), instrument, formation (two- and four-ship), and navigation. There are programmed differences in the amount of time spent in each category for the T-37 and T-38 (the T-37 has less total time), but the average is about sixty flying hours. Along with the actual flying time, PIT trainees spend about thirty hours in one of the eight simulators (four each for T-37s and T-38s) on base, in which emergency procedures and weather flying can be practiced.

"It's a building-block approach," said Lt. Col. Scott P. McCabe, Commander of the "Chargin' Cheetahs," as the 560th FTS is called. "A pilot goes through a proficiency block, which is six or seven flights in each phase, and an instruction block, where you put the words and music together. The trainee learns how to teach and analyze a student in each of the phases."

In the instruction block of each phase, there is a minimum, an average, and a maximum number of sorties. "If any individual goes ten hours over that in any phase of the program, because of the concentrated effort [required], you ought to start wondering if that person should go out the back door [graduate]."

After completion of the PIT course, the newly minted instructor pilot goes to one of five UPT wings, which are based at Columbus AFB, Miss., Laughlin and Reese AFBs, Tex., Vance AFB, Okla., and Williams AFB, Ariz. An FAIP will often go back to the base where he or she learned to fly.

The training does not stop at Randolph, though. Once out in the field, a new instructor pilot enters what is called the Buddy IP program. "For the first few months, a new instructor is put with an experienced IP at his base," said Brig. Gen. John R. Hullender, Deputy Chief of Staff for Operations at ATC headquarters, which is also located at Randolph.

"The Buddy IP will take the new IP along with him. He will fly with the new IP's students and evaluate how well he is teaching," General Hullender said.

At the Heart of the Matter

While it is important for an instructor pilot to have good flying skills, it is even more important that

Capt. Kent D. Olson and Capt. Kimberly D. Olson, a rare husband and wife pilot combination, preflight a T-38 together. Such careful attention to detail has helped the 559th and the 560th Flying Training Squadrons compile enviable safety records.

the IP be able to teach and fly at the same time. And that is the cornerstone of the PIT program.

"[Developing] the ability to explain why you are doing something while you are doing it [requires] a lot of work," said 2d Lt. Wayne R. Olson, an FAIP going through T-38 IP training. "It's a lot of work, and there are a lot of things to get used to, but I think I'll be a better pilot going back. I feel like they [PIT instructors] want you to be the best."

The main method of teaching future IPs how to teach involves role reversal. The PIT instructor will "play" student and see how the trainee reacts. The instructor will then shift roles and explain to the trainee what should have been done and why. "We shift in and out of the roles," noted Colonel McCabe.

"We act like a UPT student, and when the instructor [the PIT trainee in the role of the instructor] does something wrong, we can say right then, 'Time out. Here's what you did wrong.' And we can correct the error and go on."

"We must teach our trainees when to talk and when to just observe," noted the 559th's Captain Beaudoin. "In trying to impart judgment from my experiences and knowledge, the trainee has to develop a sense of when or when not to take control of the airplane."

"We try to push them [trainees] to the limits," added Capt. John A. Salvador, the 560th's D Flight Commander. "We will not go to the point of being unsafe or allowing the situation to get out of hand. We do want to give the trainee every skill to prepare for whatever a student may do."

Part of this skill transference comes with what could be called "personality" flights. Not only does the PIT instructor act like a student, he will act like a certain type of student. On one flight, the instructor will be the brash, arrogant student, while on another trip, he will be the shy, introverted student who has to be prodded into action.

"Each trainee's grades are tracked on a computer," said Captain Salvador. "By looking at the area where he may be lacking a flight or is not quite as proficient, we can tailor a particular mission to that area."

Major Dalson added, "Students do a lot of predictable things. We just give the trainees a set of choices in the likeliest decision spots."

The role reversal goes on through all activities of the flying program. Trainees give morning formal briefings, individual flight briefings, and postflight evaluations to the PIT instructors, just as they would in the field. And in every area, the trainees are graded on presentation, execution, and how well they evaluate what the instructors as students did.

The differences in the T-38 and T-37 also necessitate some changes in teaching philosophy. "Training in a T-37 is almost a tougher job in a way," noted Colonel Pratt.

"It is hot and uncomfortable in the T-37. And the student you will be instructing has very little background in flying. By the time a student gets to a T-38, he is halfway to earning his wings. A lot of people can be screened out of the UPT program in the T-37. We are taking people basically off the street and teaching them to fly."

General Hullender agreed. "With the T-37, the IP is the first to say, 'My student can't fly.' Of course, there is a whole process that goes along with 'washing out' a pilot candidate, but the instructor pilot has to be able to make that decision."

Not only do the IPs have to fly and teach flying, they also have to teach students to fly safely. Air Training Command, the one command for which a high mishap rate would seem to be inevitable, has consistently maintained a low accident rate. Last year, for instance, ATC had one major (or Class A) mishap per every 200,000 flight hours. The two flying squadrons at Randolph both have enviable safety records. The 560th has not had a Class A mishap in fifty-nine months, while the 559th has had 222 accident-free months.

"As [ATC Commander Lt. Gen. John Shaud] says, there are three key characteristics to flying safely," said Lt. Col. Warren C. "Doc" Blanchard, Chief of ATC Flight Safety. "First, you have to have the knowledge to do the mission correctly. Second, you have to have the discipline to apply that knowledge. And third, you have to use common sense. You have to use common sense to recognize and avoid risks that are counterproductive to the mission. We eliminate those risks where we can and closely manage the others. If we can instill those attributes, we can get a safe pilot."

"Overall, we are training IPs better than we were just two years ago," said Colonel Rohatsch during a recent wing safety meeting. "But quality is the only game in town. If you can't put your signature on your trainee, don't send him out the door."

What Lies Ahead

Most of the instructors will be assigned to the Randolph program for either two or three years. Because of the specialized and intense nature of this program, the pilots are treated pretty well, both during their tenure at the base and when they go to other assignments.

There are two benefits for pilots in the PIT program. The first is the way the unit operates. The pilots fly with other rated people, and that makes for a much more pleasant environment.

The PIT trainees and instructors also do not do any night flying. "Interestingly enough, the reason for a lack of night flying is an unusual phenomenon that exists here," noted Colonel Rohatsch. "There is a large cave near Randolph that is home to some 20,000,000 bats, and they come out at night in numbers large enough to be seen on radar. The pilots get their night training back at their base when they complete their course."

Historically, once the pilots leave the PIT program, they usually get the assignment they request. Of the thirteen pilots recently up for reassignment, ten of the thirteen got one of their top three choices. Seven of the eight pilots wanting fighters got their top choice. A key to getting the choice assignments, though, lies in the individual pilot's performance while he or she is in the PIT program.

The PIT program itself receives as good treatment as do the pilots. The equipment is being upgraded, and the program is undergoing some evolutionary changes that will allow the 12th FTW to continue to do its job.

The T-38, despite hitting the twenty-five-year-old mark in 1986, is still the only supersonic trainer in the world. Lear Siegler, Inc., which

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performs all of the depot-level maintenance on the Air Force T-38 fleet right at Randolph, is currently well along on the contract to rewing the Talon. This modification will allow the T-38 to fly well into the next century. In addition, PPG Industries is currently testing a new windshield that will provide better birdstrike protection for the aircraft.

"The T-38 is a well-designed, classic trainer," noted Colonel Blanchard. "It was intended to give pilots a boost into the 'Century Series' [F-100 through F-106] fighters, but most of those airplanes are now out of the inventory. The T-38 lands at speeds higher than most of the front-line fighters do. If you can handle the T-38 successfully, you can usually handle any airplane thrown at you."

A major change for the PIT program will be the addition of dual-track pilot training, in which pilots are separated into FAR and TTB (tanker/transport/bomber) categories. "Dual-track is a funded program in the FYDP [five-year defense plan] for FY '89," General Hullender said. "IOC [initial operational capability] should be reached in 1991. We have already started looking for a TTB aircraft—such as the Lear 35, the Beechjet, the Falcon, or the Citation—that we can buy off the shelf. An initial cadre of IPs will be trained here at Randolph, and they will become the foundation of the PIT program for the TTB track."

The addition of a fleet of TTB trainers will also ease the wear and tear on the T-38 fleet, thus extending its life even further.

Whatever happens with plans for a new basic trainer, the venerable T-37, despite being hot, cramped, and noisy (the pilots refer to the nearly thirty-year-old airplane as the "World's Largest Dog Whistle"), is still a capable platform for teaching others how to fly.

The T-37 had an original design life of 8,000 hours. This was later extended to 15,000 hours, a mark that approximately nine aircraft in the Air Force fleet have hit. Those few aircraft were inspected and were cleared to go on to 18,000 hours. According to Maj. Mary Hamlin, Commander of the 12th FTW's Organizational Maintenance Squadron, the sixty T-37s at Randolph are showing signs of minor metal fatigue, but almost no corrosion.

"If we go beyond 18,000 hours with the fleet, we will have to do a service life extension program, or SLEP," said General Hullender. "With that program, the T-37 could last another 15,000 hours."

The simulators at the 12th FTW are undergoing modifications, too. Instead of the terrain model board—a three-dimensional representation of the ground that includes runways, buildings, and terrain features and that is viewed through the simulator cockpit—a computer-generated image system, due to be installed this fall, will be used. This improvement will give the pilots a much better simulation of the outside world.

Described by PIT students and instructors as hot, cramped, and noisy, the T-37 nonetheless plays a vital role in helping IPs screen out unsatisfactory UPT students, while its side-by-side seating benefits the IPs, who take people "basically off the street" and teach them how to fly.

"The work we have left lies in finishing what we have started," concluded Colonel Rohatsch. "We have to ensure that the people we have coming into this program are really special. We are trying to get really good people into PIT so that they can teach their talents to the people who will be going into the field. We have to keep on insisting we get high-quality folks to continue on."

The Pilot Instructor Training program at Randolph is in top shape, and it is striving to get even better. Morale and professionalism are high at every level. The plaque in the front corridor of the Taj Mahal (the nickname of the 170-foot-tall wing headquarters building) says it all: "Our mission is to train and graduate the best instructor pilots in the world while providing the best base support in the Air Force. All we do must be oriented toward this goal."

And as Colonel Rohatsch, with a smile, told his pilots in the wing safety meeting, "You will have fun in this wing. That is a standing order." ■

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Computers and simulators are playing an increasingly important role in training. These airmen are learning the basics of air traffic control through the use of this computer-generated scene of an air base tarmac. (USAF photo by MSgt. Buster Kellum)

TRAINING is unglamorous. It doesn't inspire the spirited debates we're accustomed to on weapon systems acquisition. Nor does it engender the emotions we felt, for example, when we read in years past of military families on food stamps. Training receives little attention from the budgeteers in Congress. Funds for it are usually buried in the Operations and Maintenance accounts and are among the last to be added when the budget is being prepared and among the first to be cut when money, as at present, gets tight.

This back-of-the-hand approach toward training by so many outside the military community—and by too many inside it—is most unfortunate. Training is the glue that bonds the superior weapons we buy to the superior people we recruit to form the superlative fighting machine the US Air Force is today.

• Half or more of the cost of a new weapon system is spent to acquire the last twenty percent (or less) increment of performance. But the value of that investment is rarely realized because few operators have all the training they require to squeeze the utmost ounce of performance from the weapons.

• Survey after survey makes it clear that proper training in a worthwhile and marketable skill is a prime recruiting incentive for intelligent young men and women and that job satisfaction—which is largely a function of proper training—is one of the most important of all retention incentives.

Proper training makes good weapons better, it attracts good people to the Air Force, and it keeps them happier longer.

Attitudes, Techniques, and Tools

The first thing we need to understand about training is that it's something we do every day. It isn't restricted to the classroom. The men and women of the Air Force are constantly honing the skills they would require in the event of war. Training never stops, and it is never complete.

The time to start thinking about training is when a weapon system is first designed. As we decide what capabilities we want to build into a system, we should be planning how we're going to teach our people to fly, fuel, and fix the thing and what special materials, if any, will be required for that purpose.

The importance of "user friendliness" is often raised in the context of enabling less capable people to work on systems. Our thinking should not be so limited. Air Force people today are the brightest, best educated, and most motivated in our history. But smart people as well as not-so-smart people prefer instructions that are simple and clear to those that are unnecessarily complicated or opaque and tasks that are easy to those that require more work than is necessary. The simpler and easier a task is, the more quickly it can be done and the fewer mistakes will be made.

Training must be realistic, as much like the real thing as possible. Only if our people practice the tasks they will have to perform under something approaching the conditions under which we expect they will have to perform them can we—and they—be sure that they'll be able to do what's necessary if the crunch comes. Furthermore, realistic training sparks interest. It

Training requirements are up, but training resources are not. Consequently, the Air Force is exploring new methods and advanced technologies to get the job done.

New Ways to Train

BY TIDAL W. McCOY
ASSISTANT SECRETARY OF THE AIR FORCE (MANPOWER, RESERVE AFFAIRS AND INSTALLATIONS)

holds the attention of the trainee for longer. It's generally recognized that realism is important for fighter pilots in Red Flag exercises, but realistic training is just as important for motor vehicle mechanics or administrative personnel.

Training must be challenging. It should push the trainee to expand his or her capabilities to the fullest, without pushing so hard that the trainee becomes discouraged and believes the task ahead insurmountable.

The computer and the microchip have brought about a revolution in training technology that makes it possible for training to be more realistic and more active than ever before, at less cost, and at less risk to people and machines. The progress in simulators is astonishing. While a simulator can never be the same as the "real thing," what can be accomplished with computer-generated simulation comes breathtakingly close.

The computer has also made self-paced instruction a practical possibility in many specialties. This puts the student in an active learning mode, which helps our best people progress further and faster. One learns best by seeing and doing, not by passive listening and watching.

In times of tight budgets, there is a tendency to cut back on simulators and other training aids. The technology exists for a revolution in training techniques, technology that can make training vastly more productive, effective, and fun. A few more dollars invested up front in training technology can pay enormous dividends in the very near future.

The Air Force has taken the lead in putting new ideas about training together with new technologies to produce better trained men and women than ever before while at the same time holding down training costs.

Quality in the Cockpit

Air Training Command (ATC) Undergraduate Flying Training (UFT) courses graduated approximately 2,400 active-duty students in FY '86. The courses were diverse, ranging from Euro-NATO Joint Jet Pilot Training (ENJJPT) at Sheppard AFB, Tex., to the Advanced Navigation Program at Mather AFB, Calif., to an Air Force-specific helicopter track at Fort Rucker, Ala.

The quality of ATC flying courses is judged in two separate yet complementary ways. One is ATC's "inhouse" evaluation and covers both the training process and graduate performance. The other evaluation is by the major commands (MAJCOMs) to which the graduates are assigned.

The office of ATC's Deputy Chief of Staff for Operations currently tracks several quality indicators, ranging from average flying time per graduate to student holdover rates (students retained for remedial training). ATC also conducts an extensive graduate evaluation program, which includes field visits to MAJCOM Combat Crew Training Squadrons (CCTSs) and Replacement Training Units (RTUs) for first-person observation of post-graduate performance and training environment. Recent graduates and MAJCOM first-line supervisors fill out questionnaires to complete the feedback loop. Follow-up graduate attrition in CCTSs and RTUs indicates a direct link to quality training. The average attrition rate for all UFT graduates in the recent past has been 0.5 percent or less of the total graduate population.

Annual Course Training Standards (CTS) conferences provide an open forum for MAJCOM users to update ATC on identified student strengths and weaknesses. For example, these conferences have continually surfaced a need for more formation and instrument training sorties.

Some recent changes demonstrate that improving the training system is a continuing process.

It's a fact that up-front flight screening of pilot training candidates is cost-effective. All UPT students must possess a Federal Aviation Agency private pilot's license or go through one of the three USAF-approved flight-screening programs. Air Force Academy graduates complete the Pilot Indoctrination Program (PIP). Those commissioned through Officer Training School complete the Flight Screening Program (FSP), and AFROTC cadets are screened through the Flight Instruction Program (FIP).

AFROTC has decided to adopt a three-pronged screening program, replacing its 100-plus FIP locations and increasing standardization and quality control. All AFROTC pilot candidates requiring flight screening will complete FIP through one of three pipelines. Approximately 250 cadets will undergo an on-campus path at one of thirteen university locations, 360 cadets will be screened at the AFROTC/FSP site at Hondo, Tex., after completing the required field training encampment, and another 300 cadets will complete training at Embry-Riddle Aeronautical University at Daytona Beach, Fla.

Improved testing devices to augment UPT flight screening have also been integrated into the selection process. One particular evaluation that offers promise is psychomotor testing. The test, basically a hand-eye coordination battery, was developed by the Air Force Human Resources Laboratory (AFHRL) a number of years ago and was first administered to UPT candidate test groups in 1978. The test design and administration have varied with improvements over the years, and the test has demonstrated significant success in predicting graduation vs. elimination from UPT. The test has also been employed to differentiate between better and weaker graduated students.

AFHRL is also working on an experimental selection test known as the Basic Navigation Battery (BNB) that is designed to improve selection for Undergraduate Navigator Training (UNT). The test measures mathematical and perceptual reasoning, ability to follow procedures, and plotting the location of an aircraft during a simulated navigation mission. The BNB was tested as a stand-alone and combinational factor to determine success in UNT. The results of the study, released in May 1986, indicate that BNB is a useful screening tool when used in conjunction with other proven predictors.

Specialized Flight Training

Better screening for UFT student entries is only one facet of the model to improve the quality of training.

UFT, until recently, employed a "universally assignable" concept. All graduates were prepared equally to fill any available cockpit on course completion.

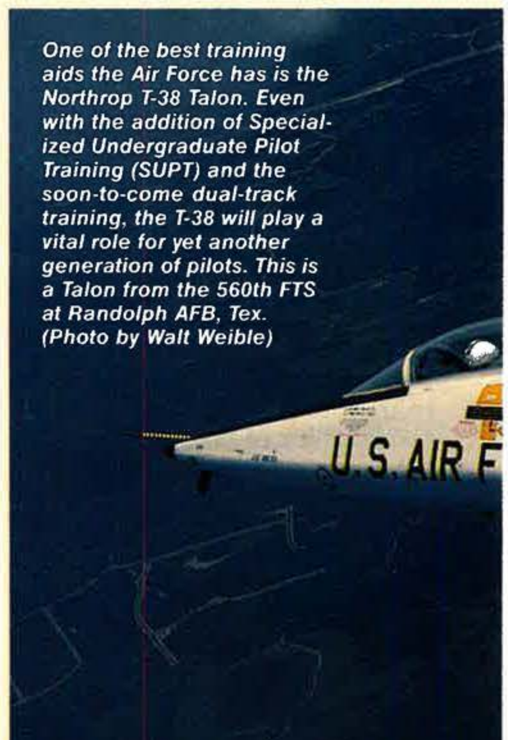
Specialized Undergraduate Pilot Training (SUPT) was conceptually approved by the Air Force in 1980. That same year, the UPT syllabus was enhanced, with students being selected for specialized minitrack training during the last month of the T-38 phase. Students assigned to Tanker, Transport, and Bomber (TTB) tracks received additional instrument sorties, while students bound for Fighter, Attack, and Reconnaissance (FAR) duties flew four-ship formations.

To realize the SUPT initiative fully, ATC needs to acquire approximately 215 multiengine business-type jet aircraft to train those pilots selected for TTB assignments. TTB will emphasize crew coordination, low-level instrument approaches, low-level navigation, and aerial rendezvous. TTB system acquisition is targeted for the 1991 time frame. FAR pilots will complete tailored training in the T-38 aircraft.

SUPT is a proven concept, used by USAF prior to 1960 and currently by the Navy and several allied countries. It is more sensitive to MAJCOM training needs, more flexible in meeting future training requirements, and more capable of expanding pilot production—all the while increasing graduate proficiency. It will also resolve a looming T-38 aircraft shortage.

To bridge the gap between today's partial SUPT execution and full implementation, ATC has programmed incremental flying hour additions in both T-37s and T-38s to better address student weaknesses in formation and instrument flying (5.2 additional T-37 hours and 5.2 T-38 hours are planned between now and FY '88).

UPT's training plant would also be enhanced by replacing the aging, 1950s-vintage T-37 primary trainer. The replacement aircraft will need to overcome the T-37's operational deficiencies, which include outdated avionics and ejection seat; inadequate performance, range, and weather capability; unpressurized cockpit; high fuel consumption; and increasingly expensive maintenance costs.



One of the best training aids the Air Force has is the Northrop T-38 Talon. Even with the addition of Specialized Undergraduate Pilot Training (SUPT) and the soon-to-come dual-track training, the T-38 will play a vital role for yet another generation of pilots. This is a Talon from the 560th FTS at Randolph AFB, Tex. (Photo by Walt Weible)

Tailored instruction is already in place for navigator students at Mather. A Specialized Undergraduate Navigator Training (SUNT) program, unanimously endorsed by the MAJCOMs, was implemented in July 1986. The result is a navigator better prepared for his or her first operational assignment and a program that can be flexible with future navigator requirements.

A sixty-five-day common course (entitled CORE) tests the student on universal navigation concepts and provides up-front, two-seat (T-37) jet screening, which factors significantly into the follow-on track selection process. After CORE, a board determines student assignment based on performance in the T-37, simulator and academic performance, Air Force needs, and individual student desires. Each CORE graduate will then enter one of three tailored tracks, which vary in length from ninety-five to 107 days.

Navigator students destined for TTB assignments will undergo advanced procedures for their specific multiplace crew member assignment. Training is further specialized in this track into SAC- or MAC-specific instruction. FAR students will enter a course emphasizing low-level operations and tactical skills. Deficiencies identified by the tactical air forces will be addressed in this tailored course. Officers selected for the Electronic Warfare Training (EWT) track will receive SAC-, MAC-, or TAC-specific instruction. Approximately thirty students per year destined for F-4G and EF-111 billets will complete EWT and a portion of the FAR track to increase their preparation for follow-on assignments.

The key SUNT concepts are a shortened yet intensive CORE syllabus prior to tracking students; sixty-five days in SUNT vs. the 120-day Undergraduate Navigator (UNT) program; elimination of redundant, unnecessary training (*e.g.,* celestial navigation for fighter navigators); increased flexibility for future changes to navigator training; and a later winging point (approximately 160 days in SUNT vs. 120 days in UNT), which eliminates the Flying Evaluation Board procedures now required for students currently eliminated in the Advanced ATC Navigator Courses.

Computers and Automation

The Air Force is increasingly using computers to accomplish its training mission. In this area, definitions have caused confusion for some.

Computer-Based Instruction (CBI) is a general term that covers the use of computers in the delivery or management of instruction. Computer-Assisted Instruction (CAI), which refers to the use of computers to present instructional materials, and Computer-Managed Instruction (CMI), which refers to the use of computers to manage the training process, are encompassed by CBI. Another term sometimes heard, Computer-Based Instruction System (CBIS), refers to the computer hardware and associated operating systems required to deliver or manage instructional programs.

In development of CBI systems, hardware and software need to be designed and procured concurrently, with the final training requirements as the driving factor in the decision process.

CBI can tailor instructional content, pace, and style to increase student progress toward instructional objectives. CBI also allows the scheduling of instructional resources for the best allocation, considering the constraints of time, availability, instructional objectives, and student progress. Computers make it easier to obtain accurate and timely information on individual and aggregate student progress, and they will allow the Air Force to deliver coordinated, standardized, and accountable instruction across the full range of training environments—from military schools to duty stations and job sites. CBI can provide training by simulating the appearance of functions of complex equip-

ment, especially for hazardous situations. Instructors using CBI have increased flexibility and availability because of a reduced administrative burden.

We are looking ahead to the possibility of a large-scale, automated, integrated system to deliver training across the Air Force. Air Force Systems Command (AFSC) is working two instructional projects—the Advanced Training System and the Advanced On-the-Job Training System—that could be the basis for this integrated system. The Advanced Training System (ATS) is being developed for use by ATC, which trains more than 300,000 students yearly in more than 2,800 courses.

Present training methods tax the instructor heavily. The intensity of instructor duty has significantly increased with longer classroom hours, more complex equipment, and greater student instructional needs. However, as the instructor's job has increased, the availability of instructors has decreased progressively. Retention of experienced second-term and career airmen has declined across the Air Force, while the demand for these people as instructors has grown with expanding technical training production (thirty percent since 1979). The increased allocation of inexperienced personnel to instructor positions will reduce the availability of experienced instructors to supervise the accomplishment of training. Additionally, the lengthy lead time for the acquisition and training of instructors limits the capability to accommodate rapid student production surges.

The solution lies in the application of technology to training. The Advanced Training System will apply current technology in order to help the instructor develop, deliver, and manage the course of instruction and evaluate instructional materials and tests.

Although training aids are of enormous benefit, the best training still comes from hands-on experience. These technicians are learning firsthand how to fix a radar set at the technical training school at Keesler AFB, Miss. (USAF photo by Carlos Baker)

Pressure on OJT

Air Force On-the-Job Training (OJT) capability is also pressed to its limits. New and complex weapon systems, along with functional community restructurings to improve manpower utilization, drive increased training requirements. Finite resident training resources shift some of this burden to OJT in the operational unit. OJT must then compete with mission requirements for limited manpower, time, and equipment.

The Advanced On-the-Job Training System (AOTS) prototype development at Bergstrom AFB, Tex., is being designed to provide some relief. With specialty-specific data determined by functional managers, AOTS will give supervisors a training plan tailored to each member assigned to their work sections. The system will compare position task requirements with trainee qualifications to produce a prioritized OJT schedule. Depending on task difficulty, task criticality, and available resources, a wide variety of options may be selected to support OJT. AOTS may identify and schedule by task, qualified and available trainers, technical references, study guides, supplies, equipment, weapon systems, and facilities necessary to support training. The supervisor may adjust this schedule as the mission demands. Several trainees requiring the same training may be scheduled together, or a trainee may complete a training module through CBI prior to receiving over-the-shoulder OJT as a means to increase the efficiency of hands-on training.

Evaluation criteria will be established for each task, with a similar array of scheduling and measurement options available. Machine-conducted and -scored tests may supplement over-the-shoulder evaluation, with third-party, random-sampling, quality-control, and certification procedures included as needed.

Management may review the training status of their organization, determine unit capability, or identify qualified individuals to support contingencies on a real-time basis as required. Cost data will be available to assist the manager in determining what combination of formal training and OJT is most effective in training for specific tasks.

AOTS prototype development will incorporate user feedback to ensure that program capability is developed and applied as a time-saving methodology for reliably producing certified warriors.

AFHRL Initiatives

The Air Force Human Resources Laboratory (AFHRL) is currently working on two other programs that hold great promise. The Training Decision System will bring together important cost, personnel utilization, and training considerations for improved decision-making. It will use information about job tasks (percentage of airmen in a career

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As the systems and machinery of the Air Force grow more complex and the size of the recruiting pool grows ever smaller, the need for competent and fully trained people grows larger. These trainees are practicing teletype procedures. (USAF photo by MSgt. Buster Kellum)

field performing a task, difficulty, and skill knowledge groupings), information about assignment and utilization of airmen (assignment patterns, geographic distribution of tasks performed, and CONUS/overseas imbalance), information about the capability of various training settings (resident school, OJT, etc.), to support training and Air Force training policies. The integration of this information within the automated system allows managers to assess the impacts of alternative assignments of job content to various training settings.

AFHRL is also doing research in the area of Cognitive Job Skills. The technical aptitude and abilities of Air Force recruits may decrease in the near future because of the reduced size of the recruiting pool. At the same time, aerospace systems and related equipment are increasingly complex, and entry-level jobs are more demanding. These human resource fluctuations and technical demands are making knowledge about exact job skills increasingly important. Identifying fundamental cognitive components of technical competence in demanding jobs will allow the Air Force to develop highly talented personnel and to use them more effectively. Similarly, creating focused instruction in cognitive jobs skills would accelerate the development of specific job skills in less experienced technicians.

The AFHRL research will result in training devices that accelerate the job performance improvement of less experienced technicians, particularly in workplaces heavily influenced by technologically advanced systems and equipment. It is believed that the unobservable mental acts required for skillful information processing constitute important elements of technical competence across many Air Force specialties. Once identified, these skills can become targets of these proposed training devices.

Training Technology

There have been significant advances in the development of instructional technology during the past ten years, and even greater strides are anticipated. The Air Force has taken steps to enhance training through the effective use of this modern training technology.

The basic objective of the Training Technology Application Program (TTAP) is to identify training technology innovations developed by government, business, and education agencies and to transition the applicable technologies to Air Force classrooms. TTAP concentrates its efforts in ATC, although lessons learned are disseminated Air Force-wide.

Currently, there are several TTAP projects in progress that are bringing new technologies into the Air Force classroom. At Keesler AFB, Miss., TTAP is applying Computer-Based Instruction to Air Traffic Control Operator Training. This will provide a more efficient and cost-effective method of training a large number of students. It will also provide a surge capability for handling increased flows during times of emergencies, improve retention, and decrease training time.

At Sheppard AFB, Tex., there is a project to teach instructors to design CBI. Currently, ninety percent of all courseware and software is contracted out. The remaining ten percent is authored by military members who either learned outside the service or during their years in service. The Air Force will save money and get a better product once in-house members are taught to author CBI.

A third example of a current TTAP project is the application of Interactive Videodisc Technology in an air traffic control radar maintenance course. This type of realistic simulated training is needed to provide enough practice without incurring safety hazards or inducing wear and tear on actual equipment.

The bottom line is that the Air Force training system now faces its toughest challenge. Here's the paradox: On one hand, new, complex technologies seem to demand more training time and money; on the other hand, competition for scarce budget dollars is fiercer than ever. Hanging in this delicate balance is the quality of training for our people—ultimately the key ingredient in how well we fly and fight. The challenge is to find new methods and to make advanced technology work for us. ■

Tidal W. McCoy is the Assistant Secretary of the Air Force for Manpower, Reserve Affairs and Installations. A West Point graduate, he earned a master's degree in business finance from George Washington University. Before assuming his present position, Mr. McCoy served as the Deputy Assistant to the Secretary of Defense, the Director of Policy Research in the Office of the Under Secretary of Defense for Policy, and Assistant for National Security Affairs to Sen. Jake Garn. His by-line last appeared in this magazine in the September '84 issue with the article "Total Force in a Global Context."

One reason that new airmen do well in technical training is that they're an elite group. The Air Force accepts only thirty-two out of every 100 serious applicants who want to join.

Technology and the Troops

BY JOHN T. CORRELL
EDITOR IN CHIEF

SOME people worry that technology is getting to be too much for the troops. The systems and operations of the armed forces—particularly the Air Force—become progressively more complex with each passing year. How can young Americans, fresh from civilian life, hope to absorb the necessary training and cope with their duties?

An answer for the worriers is readily available. Tens of thousands of new airmen pass through Air Training Command's tech schools annually. The operating commands are well pleased with the trained technicians they receive from ATC. And there is no indication that the troops are overwhelmed by the technical complexity of their jobs. To the contrary, they're ready for the challenging work and seem to thrive on it.

By its very nature, training doesn't leave the big questions hanging long. The results show up quickly. "We aren't *preparing* to do our mission," says Lt. Gen. John A. Shaud, ATC's new Commander. "We're *doing* it." He described ATC's time-tested approach to providing technical manpower for a technical force.

It begins with the quality of the trainee. Out of every 100 serious applicants who want to join the Air Force, only thirty-two are accepted. The other sixty-eight flunk their physicals or their mental tests, or something turns up in the background investigation that disqualifies them. Still more of the original 100 will wash out before they complete basic military training at Lackland AFB, Tex. For ninety-three percent of those who make it through basic, the next assignment will be further schooling at one of ATC's six technical training centers. These trainees aren't stumped easily by the difficult material that they will encounter in the course work.

Just before General Shaud left his previous post as USAF Deputy Chief of Staff for Personnel, a newspaper reporter asked him if the Air Force has to look for already developed technical skills in the airmen it recruits for technical jobs.

"Not really," General Shaud said, elaborating on the point in a recent interview with AIR FORCE Magazine. "From a technical training view, you take in young people with two fundamental characteristics.

The Microprocessor Application of Graphics with Interactive Communications (MAGIC) simulator (here operated by Capt. Keith Beachy) is an example of the high technology that is making the pilot's job simpler, not more complex. It will enable command of certain aircraft by voice alone.

THE DIPLOMA PERCENTAGE

High school graduates as a percentage of total active-duty nonprior-service accessions.

	FY '82	FY '83	FY '84	FY '85
Air Force	94	98	99	99
Army	86	88	91	91
Navy	79	91	93	89
Marine Corps	85	92	95	97
DoD Average	86	91	93	93

We recruit people with the capacity and energy to learn and with the right attitude for high-tech training. The capacity to learn is displayed through the test battery [the Armed Services Vocational Aptitude Battery (ASVAB)], and, by being high school graduates, they demonstrate that they have the persistence. We are high on both of those scales, especially compared with the other services." *(See the accompanying box.)*

"The real question we have to answer is if they are teachable. If they are instructable, we can take those basic skills and mold them." Beyond that, ATC's recruiters watch for young people motivated to be part of a high-tech team. It is that desire, General Shaud said, that attracts the best potential airmen to the Air Force to begin with and that leads them to reenlist later on. It comes as a surprise to some—often including parents—that such young people welcome the discipline of military life. "Taking discipline well is natural with people who want to be part of a team," General Shaud said.

The Training Process

General Shaud watches two indicators of how well ATC is doing its job. "One is the quality of the training process itself," he said. "That's where you make sure you're doing it smart and that you're up to speed on training technology. The other is the quality of our output. The using commands give us continuing feedback so we can know if our state-of-the-art training process is turning out the kind of graduate it's supposed to."

ATC is currently getting good signals on both of those indicators and is constantly tailoring and reshaping its program to keep up with the times.

In its FY '87 report to Congress, the Air Force said that it had "reduced the average initial skill course length from 16.8 weeks in early 1970 to 11.7 weeks in 1985, while there have been quantum leaps in the material being taught." That statistic, General Shaud said, does not reflect a flat reduction in course lengths across the board. Instead, ATC was able to shorten the time on some, but actually extended the length of others.

"First," General Shaud said, "those people we can send to the field without technical training, we are sending directly. Maybe there will be some ways in the future, with advanced training software, etc., that we can send more young people right out of Lackland to the field—to be trained by ATC, but at their bases.

"Second, because of advances in the ways that we train and because we have young people who are increasingly computer literate, some courses just don't need to be as long as they used to be. That speaks to the quality of the recruit.

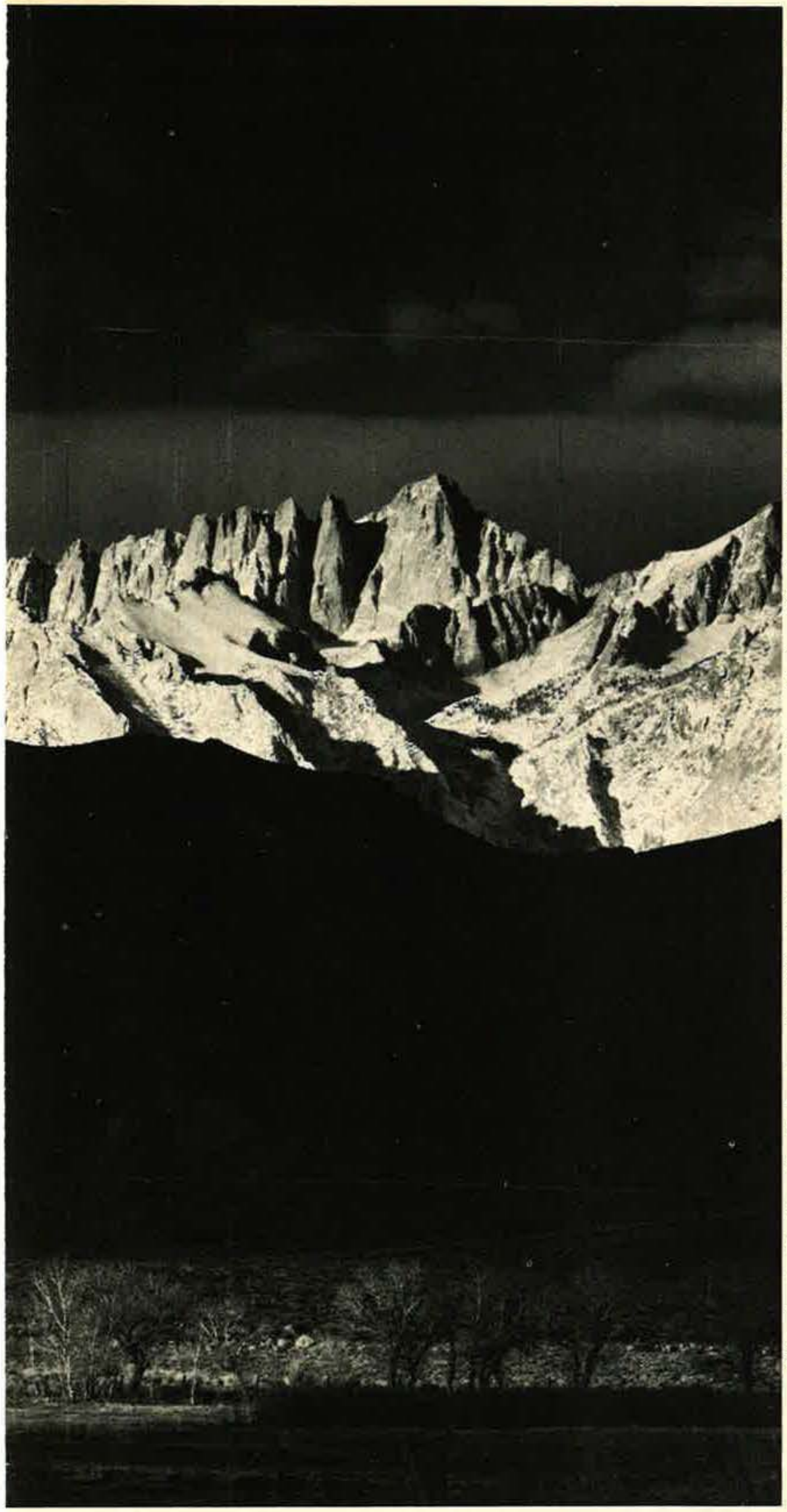
"We've taken advantage of economies in the time line where they presented themselves to teach the skill directly in the unit or to shorten the tech training course. And we've used some of that time to increase the course length in sortie-producing skills and put the focus on the training that we need." Among the courses lengthened are those for maintenance on aircraft and aircraft systems, avionics, jet engines, munitions, and weapon systems.

As military systems become more complex, it does not automatically follow that the tasks for humans will be more difficult—or even more complex. Use of modern test and diagnostic equipment, for example, has taken much of the guesswork out of field maintenance.

"One of the things that a computer does very well is handling and resolving complexity," General Shaud said. "A person working on the flight line today can make a judgment about the fitness of an airplane rapidly. Compare this with the old days when, if you had a reciprocating engine with a mag drop, you had to tinker with it forever."

Where the Sorties Are

Although technical training is the biggest item by far in ATC's operat-



Winter Sunrise, The Sierra Nevada, From Lone Pine, California. Photograph by Ansel Adams. Courtesy of The Trustees of The Ansel Adams Publishing Rights Trust. All Rights Reserved.

Like the Sierra Nevada, the U.S. Air Force B-1B Long-Range Combat Aircraft is a national resource.

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ing budget, the command annually trains 344,000 people in more than 4,300 courses covering some 300 specialties. This includes basic military training, Officer Training School, AFROTC, technical training, flying training, survival training, and instruction of foreign nationals. A significant share of this work load is carried by ATC's field training detachments and mobile training teams.

ATC aircraft fly the heaviest sortie rates of any major command in the Air Force and account for almost a fifth of all USAF flying. When General Shaud said that "there's great energy and vigor in this command," it's easy to understand what he means.

The ATC fleet of T-38s and T-37s is aging, but is still up to the vigorous daily workout it gets. The T-38s are being refurbished and modified under a program called "Pacer Classic," and that should keep them flying through the year 2010. The major aircraft modernization needs are a replacement for the T-37 primary trainer and the addition of a business-type jet for specialized undergraduate training of tanker, transport, and bomber pilots. *(See "What's Ahead for the Primary Fleet?" on p. 77.)*

Undergraduate pilot training (UPT) must take a student—whose acquaintance with aviation consists typically of a three-week screening program in light aircraft—and have him ready, forty-nine weeks later, to move on toward the cockpits of the late-model machines in the operating commands. ATC's trainer-aircraft needs, therefore, are based not only on the point at which the student begins learning but also on the kind of flying he will do within the year.

"That first step, when a young person first puts on a flight suit and is introduced to the world of flying airplanes, is an important one," General Shaud said. "It can't be so sophisticated or so much like advanced aircraft that it makes the step too difficult. I have a hunch that as we design airplanes to introduce young people into flying, they'll look very much like the T-37. I like the idea of side-by-side seating at first because of the decisions our instructors must make early on, such as whether an individual has flying skills that are worth pursuing or if it's in everybody's best interests for him to go do something else for a living.

"When you get to the second phase, and as we look to a trainer for the future, I like the idea of tandem seating. It's important, particularly for the student on a fighter training track, to feel—in as much as it's possible—that he's flying the airplane individually, that he's responsible. I don't think that an advanced trainer will look a whole lot different from a T-38.

"We have to make sure, of course, that the presentation of the avionics and instruments is reasonably similar to whatever the presentations in new aircraft, including the ATF [Advanced Tactical Fighter] and the ATB [Advanced Technology Bomber], will be. We can't make the UPT cockpit too different from most of the cockpits that our students will be flying later. The UPT trainer will probably not be at the leading edge of instrumentation change, but we will be best advised to have it reflect the majority of aircraft that the students are intended for." ■

THE COST OF TRAINING

Undergraduate Pilot Training	$368,941
Undergraduate Navigator Training	97,137
Missile Launch Officer	40,722
Weapons Controller	27,222
Air Force ROTC	26,920
Ground Radio Communications Repairman	21,908
Air Traffic Controller	14,315
Weather Specialist	11,965
General-Purpose Vehicle Mechanic	9,974
Jet Engine Mechanic	8,780
Administrative Officer	7,700
Computer Operator	6,111
Basic Military Training	3,499

These are average costs per graduate in sample training programs and reflect initial or entry-level training only. Specialized training often follows in the operating commands. The Air Force's investment in a seasoned, fully upgraded airman or officer is formidable.

Two mechanics work on a T-37 as part of the Air Force's On-the-Job Training (OJT) program. General Shaud hopes someday to send "more young people right out of Lackland to the field—to be trained by ATC, but at their own bases."

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MCDONNELL DOUGLAS

For all sorts of training—from LAPES drops to aerial engagements—the Air Force is relying more and more on simulators and is increasingly satisfied with the results.

Wild Blue Simulators

BY JAMES W. CANAN
SENIOR EDITOR

Fledgling F-15E aircrews will train in such simulated surroundings of cockpit, sky, and terrain as the one shown here. USAF is adopting a widening variety of sophisticated simulators for aircrew training. New visual systems in such simulators make it possible for trainees to prepare for actual flight with unprecedented thoroughness and a real-life feel for what their aircraft can do.

LOW-ALTITUDE parachute extraction of combat cargo is a difficult and dangerous maneuver for C-130 aircrews.

The aircraft must be flown over the drop zone only five to ten feet off the ground, often under fire. Parachutes must be deployed on the money to pull the pallets from cargo bays and deposit them where the ground troops can get at them in a hurry. The aircraft must then be racked out of harm's way.

The odds have always been heavily against C-130 aircrews getting all this down pat the first time—or even the first several times—they tried it in the air while in training. Now, thanks to simulators, those odds are dramatically improving.

Not long ago, the Military Airlift Command put one of its greatly upgraded C-130 simulators at Little Rock AFB, Ark., to an acid test.

Ten C-130 pilots from Pope AFB, N. C., used the simulator to practice the Low-Altitude Parachute Extraction System (LAPES) combat tactic. None had ever practiced it in the air. Each "flew" the simulator five or six times.

When the ten pilots took to the air for their LAPES check rides, eight passed with flying colors. One failed because he flew two feet too high. The other failure had nothing to do with lack of operational proficiency, merely with checklist omissions.

C-130 simulators have come a long way in just the past few years. Their new visual subsystems, featuring computer-generated images in living colors, make it possible for C-130 crews to get a hands-on feel for tactics that they could formerly experience only in flight, with much wasteful and sometimes risky trial and error.

Such procedures include low-level navigation, assault landings, formation flying, and airdrops and are similar to tactics used by the MC-130H Combat Talon II special operations forces (SOF) aircraft for which SOF simulation systems are now being planned.

Aircrews still have to go aloft a lot in order to get it all done with confidence, of course. But their preflight training in simulators rids them of rawness and turns their subsequent flying hours into higher-quality time.

An Air Force B-52 simulator duplicates maneuvers anticipated for the bomber's crews on combat missions. B-52 "weapon system trainers" are being upgraded to correspond with modifications of B-52 avionics, in keeping with USAF's drive to make its simulators as modern as its aircraft.

More and Better Simulators

Across the spectrum of Air Force training, the story's the same. Simulators of wider and increasingly sophisticated varieties are improving the quality of instruction by enabling students to practice—safely and repetitively—most flying maneuvers that aircraft can perform. Simulators also prepare trainees to cope with some exigencies, such as engine failures, that they cannot safely be subjected to in the air.

USAF is developing and implementing new simulator systems and is upgrading older ones to train the crews of all its aircraft in almost every task—from routine navigation to air-to-air combat and delivery of air-to-ground weapons.

For example, contracts have been awarded this year to Honeywell for a GBU-15 glide-bomb delivery simulator (called a part-task trainer) and to Singer for a Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) simulator. USAF has notified the simulator industry that it is in the market for a simulator that combines the attributes of its generic infrared training system (GIRTS) and radar warning receiver (RWR) system.

This year has also marked the passage through critical design review of a simulator for the F-15E dual-role fighter, the contract award to Boeing Military Airplane Co. for a KC-135 operational flight trainer simulator, and the completion of testing of a new visual subsystem for the C-5/C-141 aerial refueling simulator.

Much progress has been made this year, too, in EF-111A, B-52, F-16, and B-1B simulators as well. Moreover, United Airlines is well along in developing a full-up aircrew training system for the C-5. Such a system is in the works for the C-130, and another is being planned for the C-17 well in advance of the aircraft's production.

Plans for an Advanced Tactical Fighter (ATF) simulator are also beginning to jell just as the ATF enters its demonstration/validation phase.

"All of our work on simulators and training systems in the past five years is crystallizing," declares Lt. Col. Eugene Clayton, Chief of Air Force Systems Command's Aircrew Training and Specialized System Division. "There is a lot of momentum in our programs."

This is happening in the nick of time. The technology of Air Force training systems and of the simulators that make them go had become badly outdated. Funding to create new systems and to update old ones had been relatively skimpy. USAF had imposed too many nitpicking and often counterproductive engineering demands on its training system contractors.

New weapon systems were outpacing their training systems to the extent that aircrews, for example, were sorely disadvantaged. The F-16 simulator was a case in point. It was satisfactory in the beginning, but it did not keep up with the F-16 itself as the aircraft evolved into C and D variants. It also lacked adequate weapons-delivery imagery for trainees to eyeball as if in combat.

Aircraft simulators in general were deficient in visual systems that were needed to give trainees a pilot's view of airborne surroundings and a perception of what the world looked like when they made the aircraft and its weapons do this or that.

The situation began turning around a few years ago after the Office of the Secretary of Defense and the military services studied it and concluded that it had indeed become a sorry one. USAF's four-star community agreed that there should be much more funding for training systems, that expert contractors should be given freer rein in developing and operating such systems, and that simulators should be brought on line ahead of, or concurrently with, the operational systems they were designed to replicate.

Front-end Analysis

In keeping with all this, the Air Force adopted a procedure called front-end analysis for planning new training systems. This means that simulators are now being planned and designed right along with operational systems, the better to synchronize their development and production and to dovetail their technology and performance.

For a while, it looked as though the F-15E simulator would not be ready when the F-15E came on line. Everyone involved in the program sprang into action.

For two months, the F-15E program manager and the F-15E simulator program manager at AFSC's Aeronautical Systems Division, Wright-Patterson AFB, Ohio, worked intensely with Tactical Air Command and with Goodyear Aerospace and McDonnell Douglas, the prime contractors on the F-15E simulator and the F-15E respectively, to bring the simulator program up to speed.

The result, says AFSC's Colonel Clayton, is that "we are now on schedule, and we expect to have the F-15E training capability concurrent with the airplane."

It's a good thing. The F-15E crews will have their hands full, operating the aircraft as both an air-superiority fighter and a go-it-alone, air-to-ground machine with a rich variety of weapons for use against prime targets deep behind enemy lines. Everything the crews can learn in simulators before they climb into the dual-role fighters will be money in the bank.

Fighter simulators have to be fancy. Nowadays, so do airlifter simulators.

"Upgrading the C-130 training system was one of our higher priorities," Colonel Clayton declares. "It lacked a visual subsystem, and without one, there were just too many tasks for which C-130 crews could not be trained effectively—low-level drops, low-level navigation, and the like."

General Electric, the C-130 visual-system contractor, gets credit for having invested much company money in continuing to develop visual systems at a time, early in this decade, when technical problems caused USAF to draw down its own funding for them. GE solved the problems, and Air Force funding picked up.

Computer-generated visual systems have vastly broadened the scope and utility of USAF's simulators. This Singer-Link digital image generation (DIG) system depicts a final approach.

Now, four visual systems have been integrated with C-130 operational flight trainers—two at Little Rock AFB, Ark., one at Pope AFB, N. C., and one at Kirtland AFB, N. M.—and six more are on order.

The C-130 simulators also feature a cockpit procedures trainer (CPT) for training pilots, copilots, and flight engineers in cockpit and instrument familiarization and for training maintenance crews in preflight mechanical checks, engine starts and runups, and system functional checks.

A Digital Radar Landmass Simulation (DRLMS) system in the C-130 operational flight/weapon system trainer emulates the aircraft's radar subsystems. It is more realistic and easily reprogrammed than the older analog system.

Enthusiasm Is Spreading

Enthusiasm for new simulators seems to have spread throughout USAF's user commands. MAC, however, is leading the way in promoting the concept of contractor development and operation of full-up training systems for particular aircraft.

The C-5 is a prime example. United Airlines is designing a complete C-5 aircrew training system, including all simulation devices, courseware, computer management—the whole nine yards. In a year or so, United will pick up the training of all C-5 pilots, loadmasters, and flight engineers.

"We're gravitating toward a whole new approach—complete aircrew training systems," explains Col. Clifford P. Frey, ASD's assistant deputy commander for simulators. "The product will no longer be merely hardware and software, but aircrews who come out of the course fully qualified to fly C-5s after one check ride. If they don't pass the check ride, they'll go back into the course to get retrained on their weak points at no additional cost to the government."

Contractors in the training world will also be called on more and more to maintain the devices that they build and operate for the Air Force. USAF has decided to delete simulator maintenance as a career field, because it needs those maintenance manpower slots for warfighting tasks.

"This will begin affecting all our user commands as early as next year," says Colonel Frey. "So we are requiring the contractors to be responsible for the maintenance and the logistics of their devices under firm, fixed-price contracts with annual fixed-price options. The contractors will be paid on the basis of the availability of the devices. If they fail to meet availability requirements, they'll be penalized."

Development and implementation of the C-5 aircrew training system will likely help the Air Force to prepare its C-17 aircrew training system now being defined.

It will provide MAC with a contractor-developed, contractor-operated system for training pilots, copilots, and loadmasters, including advanced training in combat environments that cannot be duplicated in aircraft during peacetime.

The system is expected to train 1,000 three-man crews on active duty and in the Reserve at various locations in the United States.

The whole affair has to be in place prior to the C-17's initial operational capability (IOC), now planned for 1992.

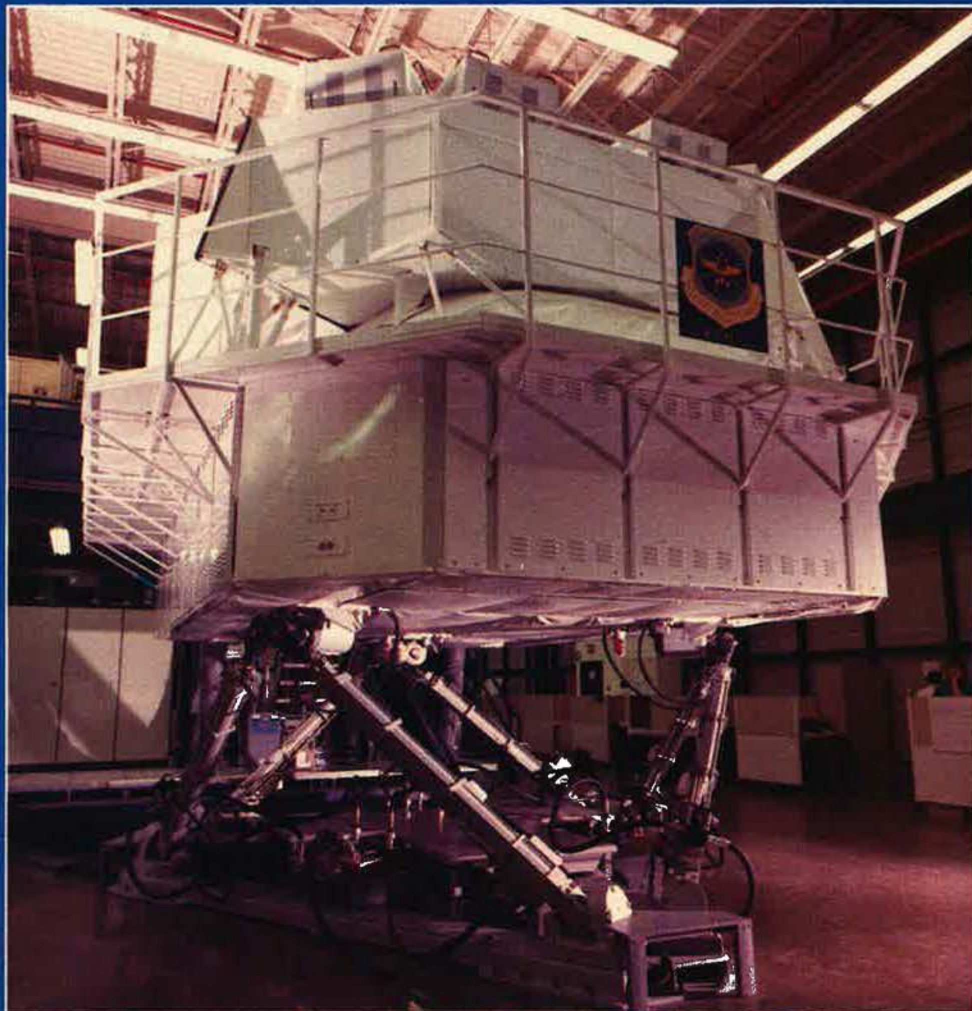
"The C-17 program is our first opportunity to field a training system at the same time the airplane is fielded, and maybe even some months earlier," Colonel Frey asserts.

Around that same time, the Advanced Tactical Fighter should also be just about ready to come into play, with its training system also in operational shape.

Total System Concept

The ATF will be the first Air Force weapon system to be mated with its companion training system in a "total system concept," meaning that the designs and performance characteristics of both will be fully integrated from scratch.

"We're into our front-end analysis of the ATF training system now," says AFSC's Colonel Clayton. In this, the Air Force is studying the training industry's potential role

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and the prospects of borrowing concepts and technologies from existing fighter-simulation systems.

There is some question as to how much can be borrowed. The ATF simulators will have to be the most sophisticated ever built, given the superlative performance being planned for the fighter itself.

In any case, USAF plans to issue a request for proposals (RFPs) to industry for the ATF simulation program in 1988, having previously chosen an ATF development contractor to write performance-oriented specifications—rather than engineering-oriented specifications—for that program.

As it begins to forge the ATF training system, the Air Force can take satisfaction, and can draw on valuable experience, from its struggles with the F-16 simulator.

Embodying such complex subsystems as GE's radar simulator and AAI's electronic warfare simulator, Singer's F-16 simulator got good marks from the Air Force at the outset. It was highly successful in providing "safety of flight" training and was effective in training aircrews in normal and emergency procedures.

It was not so successful in the warfighting training area, however. The reason: It lacked a wide-field-of-view visual system for training crews in air-to-air and air-to-ground combat. This drawback became more troublesome as the F-16 evolved into a fighter more capable in both those modes. Because the F-16 simulator was so complex from the start, the job of updating it was correspondingly complex.

"It's been one of the toughest programs we've had," Colonel Clayton declares. "But Singer has done a good job with it, and it is progressing extremely well. It has taught us a lot."

Now Singer, under an ASD contract awarded last June, is developing a LANTIRN simulator that will be integrated with the F-16 operational flight trainer. Scheduled for operation at Luke AFB, Ariz., by October 1989, the first LANTIRN simulator will be followed by four more currently in the planning stage.

"It will give pilots practice in flying low-level navigation and target-identification missions," explains Ms. Sandi Simmons, ASD's LANTIRN simulator program manager. "They will also use the simulator to enhance their skills in flying specific LANTIRN missions."

The F-15E is scheduled to be the first fighter to carry the LANTIRN system. Thus, LANTIRN simulation is also being incorporated in the F-15E weapon system trainer.

Upgrading the B-52 Trainers

On yet another front, Singer is modifying its nine B-52 weapon system trainers (WST) to correspond with avionics upgrades in the bombers themselves. Containing fourteen computers capable of more than 5,000,000 operations each, the B-52 WSTs duplicate all aircraft movements anticipated for combat missions. The first modified trainer is scheduled for delivery to Strategic Air Command's 379th Bomb Wing at Wurtsmith AFB, Mich., next September.

Meanwhile, Boeing is training E-3A AWACS crew members at Tinker AFB, Okla., aboard its new E-3A simulator. The system includes visual simulation of a KC-135 tanker, allowing the crews to practice refueling operations as if for real.

Another contractor, Rediffusion Simulation Inc., of Arlington, Tex., updated an AWACS trainer and recently returned it to service.

Rediffusion is a major subcontractor to Boeing in transforming KC-135A cockpit procedures trainers into KC-135R operational flight trainers for SAC. Enhancements include a computer-generated visual image system, a new computer system, and improved electronics systems.

Having throttled up its simulator programs for aircraft and their weapons, USAF is now intent on developing others for such diversified arenas as maintenance and space.

Air Force pilots practice aerial refueling while "flying" a B-52 simulator that shows a KC-135 tanker, as if for real, in one of their out-of-the-window scenes. Such computer-generated images are the stuff of modern simulators.

Cubic Corp.'s Defense Systems Division, for example, has devised the B-1B Simulated Maintenance Training System to train ground crews in readiness testing and in procedures for power control, engine start, hydraulic servicing and landing-gear servicing, operational checkouts, and fault isolation.

Simulation of space operations is catching on fast. Working with Space Command, Air Training Command is intent on establishing a graduate space training program in such arenas as space launching, satellite control, satellite surveillance, and Space Shuttle operations.

Infotec Development Inc. is under contract to AFSC's Space Division for computer-based training systems to school about 500 officers a year in simulated space operations at Colorado Springs, Colo. ■

Air Force officials get a look at the bird on which the Navy's new trainer, the Anglo-American T-45, is based.

McDonnell Douglas and British Aerospace (BAe) are teaming up to build the US Navy's new jet trainer, the T-45A Goshawk, which is based on the highly successful BAe Hawk trainer/light attack aircraft. In late September and early October, the two companies brought a demonstrator aircraft, Hawk ZA101, to the US to acquaint Air Force officials with the capabilities of the Hawk and with the T-45 program.

The Hawk on Tour

BY JEFFREY P. RHODES
DEFENSE EDITOR

In between officials, I had my turn in the Hawk, flying out of Andrews AFB, Md., with McDonnell Douglas test pilot Mike Norman showing what the aircraft could do.

The Hawk was first flown in 1976, and more than 300 aircraft have been built for five countries and the Royal Air Force. In fact, the RAF's air demonstration team, the Red Arrows, flies the Hawk. While the Navy's T-45A will look almost identical to the Hawk, there will be a number of significant structural and equipment changes to the aircraft.

One major change will be in the landing gear. Unlike previous versions of the Hawk, the T-45 will have to be capable of handling the high stresses of carrier operations. Consequently, the main gear of the Goshawk will be lengthened and will have a greater-diameter barrel to absorb shocks. In addition, a redundant brake system and a dual nosewheel with a launch bar for catapult shots will be fitted.

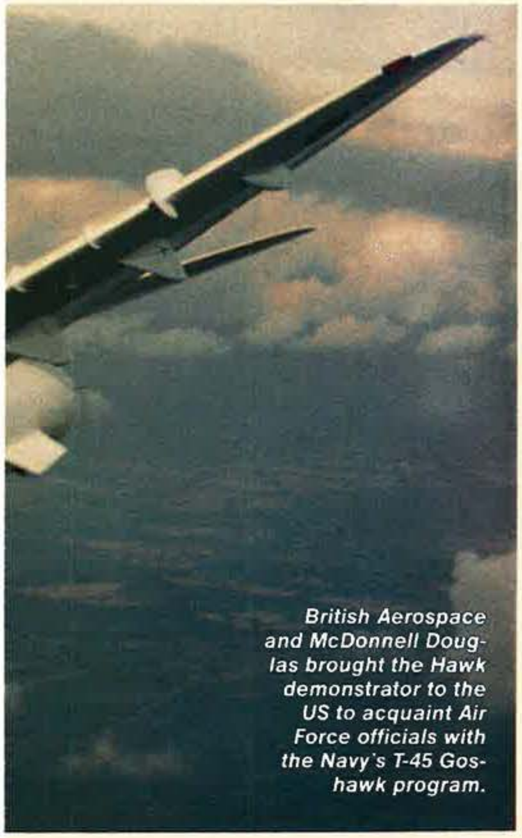
While the T-45 will have a steerable nosewheel, Hawk ZA101 was steered by means of differential braking. Mike Norman demonstrated this technique of tapping on one brake or the other to keep the plane in line.

In order for the beefed-up landing gear of the T-45 to retract properly, both the wings and the forward fuselage of the Goshawk had to be redesigned. The wings were also reengineered to better accommodate the strain of a carrier environment. The T-45 will replace both the North American T-2C Buckeye and the Douglas TA-4J Skyhawk for Navy flight training. The expected useful life of the T-45A airframe is 14,400 hours, more than twice the expected longevity of the Hawk.

As a result of the need for an arresting hook on the T-45, several other modifications have had to be made to the design. The two ventral fins of the Hawk will be replaced by a fairing covering the hook's mechanical linkages. The single under-side speed brake of the Hawk will be replaced by a pair of slotted, side-mounted speed brakes. The weight of the hook and nosegear adds approximately 800 pounds to the T-45.

A Look Inside

Internally, the T-45 will have the Martin-Baker Navy Aircrew Common Ejection Seat (NACES) and an On-Board Oxygen Generating System (OBOGS) that produces breathable air so long as the engine is running. Sortie generation, or the ability to fly repeated missions in the same day, will be enhanced by the OBOGS, since high-pressure oxygen bottles will not have to be refilled as they were on this particular Hawk. The T-45, like the Hawk, will have an internal stair, and easy access to all major systems is ensured because of the aircraft's relatively low height (eight feet, ten inches at the top of the rear cockpit). These features will further eliminate the need for ground-support equipment.



British Aerospace and McDonnell Douglas brought the Hawk demonstrator to the US to acquaint Air Force officials with the Navy's T-45 Goshawk program.

The layout of the T-45's instrument panel was designed by the Navy's Aircrew Systems Advisory Panel (ASAP). Some of the instruments (all of which will be analog) will be in a different location, and others will have different faceplates from the ones in the Hawk. The location and accessibility of the Hawk's wiring harnesses made this custom-designed layout a relatively simple operation to carry out early in the Goshawk's development. The T-45 will also have a different center-mounted stick from the one in the Hawk.

While the T-45 differs in many ways from its progenitor, several important features are retained. Foremost among these is the great visibility afforded both the student and instructor by the side-hinged, single-piece, upturned, horseshoe-shaped canopy. Several times during the flight, pilot Norman was able to peer around the front seat to verify that I had performed an operation, such as retracting and lowering the gear or changing the radio frequency after takeoff and before landing. Because Norman could see the indicator light on my panel, he could also tell when I had accidentally flipped off the antiskid switch.

In addition to the tandem seating, the T-45 will also have a single engine, as did the venerable Lockheed T-33. The same Rolls-Royce Adour engine that powers the Hawk will be used in the T-45. Designated F405-RR-400, the 5,450-pound-thrust engine runs very quietly, performs well, and is very reliable. There have only been four engine failures in the Hawk in the more than 335,000 hours flown by the type.

Originally designed as a supersonic, afterburning engine for the Anglo-French Jaguar, the Adour has accumulated more than 2,500,000 hours in the Hawk, Jaguar, and Mitsubishi F-1 and T-2 aircraft.

Fuel consumption by the engine is also very low. For instance, Hawk ZA101 burned about 1,500 pounds of fuel in roughly an hour's worth of flight time and returned with the tanks half full. During the plane's week-long stay at Andrews AFB, forty sorties were flown, and the engine needed only a pint and a half of oil. The only other maintenance the aircraft required was a tire change.

Over the Bay

Over Chesapeake Bay, Mike Norman executed a barrel roll with a constant one-G force, then performed a loop to 22,500 feet with minimal stick action. He put the aircraft into a tight left-hand spiral for a simulated ground-attack mission. While the Hawk/T-45 is capable of pulling up to eight Gs, the G-meter only got up to about four on this flight.

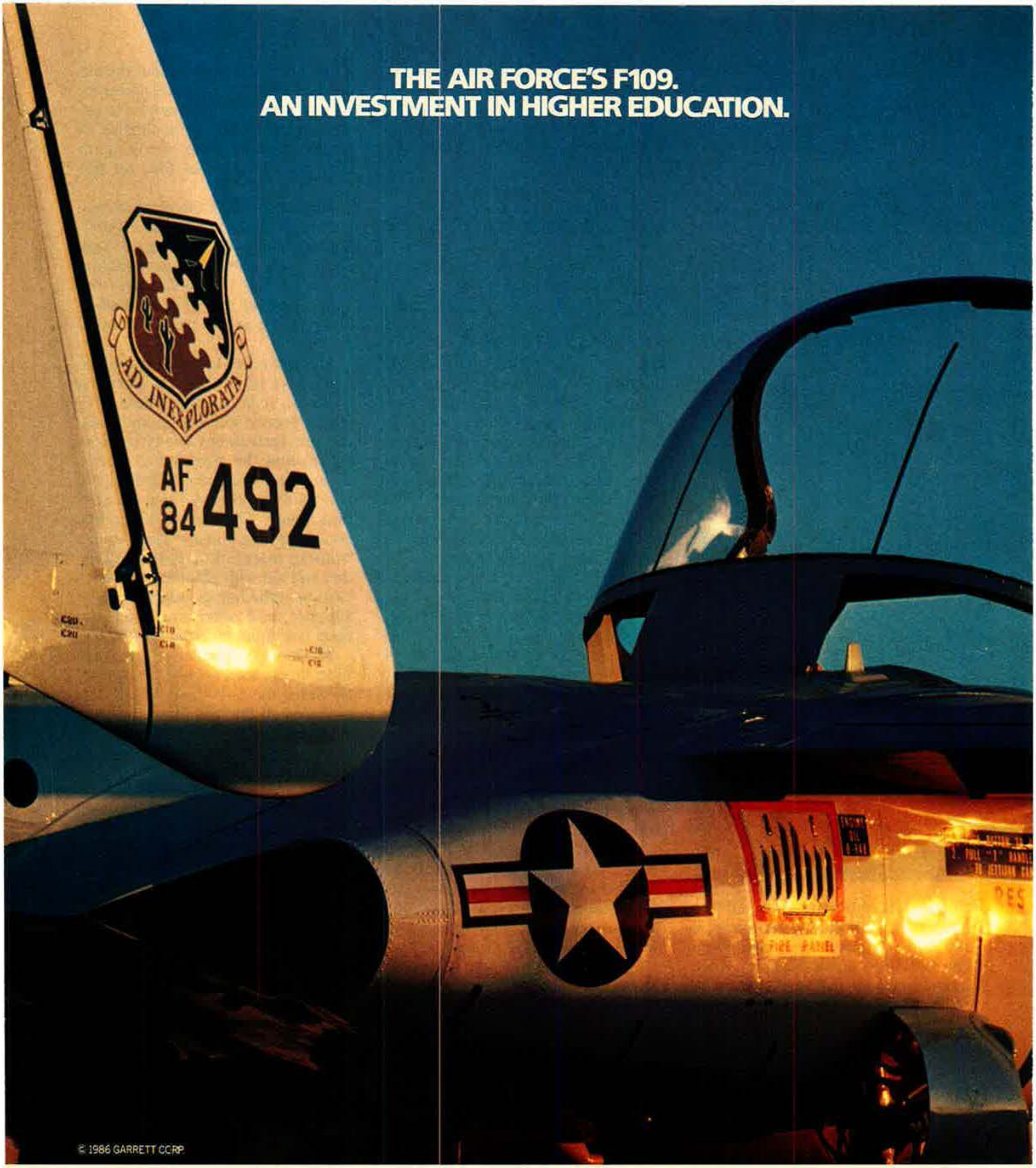
Norman brought the plane in for a landing at about 116 knots in a gusting crosswind. The landing roll took about 3,000 feet. A design program is under way that will lower the T-45's landing speed even further, allowing the jet to come in at 110 knots.

Although the Goshawk is the primary part of the T45TS (Training System), it is not the whole program. Sperry will design and build the ten instrument flight trainers (IFTs) and the twenty-two operational flight trainers (OFTs) for the Navy's four primary flight instruction bases. Students will receive computer-based instruction, and a training integration system (TIS) that will aid with planning and forecasting, scheduling, administrative support, and other training functions is also included in the T45TS.

McDonnell Douglas will also provide integrated logistics support (ILS) for the T-45 fleet. The ILS is designed so that the Navy, without losing control of the system, can later open up the logistics function to competition, or the service itself can take it over.

The total T45TS is geared to train 600 aviators a year, or 100 more aviators than the present system. This totally integrated approach to training is also expected to cut annual costs by close to fifty percent—the roughly $478 million spent under the current T-2C/TA-4J system is expected to be reduced to approximately $248 million with the T-45.

The first flight of the T-45A is scheduled for December 1987, and after flight evaluations at NAS Yuma, Ariz., and at the Naval Air Test Center at NAS Patuxent River, Md., where the Goshawk will undergo a full spin test program, the first squadron, which will be formed at NAS Kingsville, Tex., should be ready to start training in late 1990 with twelve aircraft. Production will accelerate to forty-eight aircraft a year from 1993 to 1997, when the last of the 302 Goshawks currently called for in the contract is delivered. ■



It's a 1,500 lb. class trainer engine. And it has already accumulated over 8,000 lab testing hours and over 600 operating hours in the flight test program. With the best SFC in its class and a projected 8 maintenance minutes per engine flight hour.

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GARRETT

Program difficulties and then budget priorities took the T-46A into stormy weather. But extending the service life of the T-37 is a temporary solution only.

What's Ahead for the Primary Fleet?

BY JOHN T. CORRELL
EDITOR IN CHIEF

WHEN the Air Force set out to replace its aging T-37 primary trainer aircraft, the acquisition promised to be as noncontroversial as such things ever get.

The "Next-Generation Trainer" would not push the state of the art in technology. The program had widespread support. It appeared to be the perfect answer to improving flight-training operations while reducing fuel use substantially. In 1982, Fairchild Republic was selected from a field of six bidders and awarded a fixed-price contract to build the aircraft. The new trainer was subsequently designated the T-46A.

As it turned out, the acquisition was anything but smooth and easy. First, Fairchild ran into development trouble, and the schedule slipped badly. Then, before the recovery effort was completed, the T-46A lost its funding for production.

Congress, attempting to get under the ceilings of the Gramm-Rud-

When it was rolled out in early 1985, the Fairchild T-46A was scheduled to be the Air Force's first new primary trainer in thirty years. The airplane features side-by-side seating in a pressurized cockpit and two engines.

Although it is cramped, hot, noisy, and getting long of tooth, the Cessna T-37B is still a very capable platform for teaching pilots how to fly. Cessna has proposed a New Technology T-37 that will have new engines and a redesigned tail.

man-Hollings balanced budget law, stripped billions of dollars from defense. Programs had to be reduced, and the Air Force chose the T-46A as one to cut. The service life of the T-37 fleet could be extended for at least an additional 3,000 flying hours per airframe, the Air Force determined. For the time being, funding priority would go to requirements more immediate than a new trainer.

That "budgetary decision," as USAF calls it, effectively terminated the T-46A program, although the contract option to proceed with production will not expire until March 1987. That left open the possibility, however, that Congress might reverse the Air Force's decision. The issue became highly politicized.

In October—after extended and heated argument that overshot the budget deadline and closed down much of the federal government for an afternoon—Congress ordered that a new trainer competition take place. A flyoff, to be conducted by January 1, 1988, is to be part of the competition, and contenders identified by Congress were the T-46A, the existing T-37, an upgraded T-37, and "any other aircraft capable of meeting Air Force training requirements."

Today, six months after the first operational T-46A was to have been delivered, the future of the primary trainer program remains uncertain.

The Trainer Requirement

The subsonic T-37 has been a rugged performer for Air Training Command since the 1950s. Its maneuverability is comparable to that of most fighter aircraft of World War II. Student pilots fly seventy-five hours in the T-37 before moving on to the supersonic T-38.

The Air Force's desire for a modern primary trainer is predicated on the T-37's deficiencies as well as its age. Since the aircraft is not pressurized, training flights are restricted to crowded lower airspace. The engine gulps fuel. The range is relatively short. Scheduled training sorties often have to be canceled because the T-37's capability is limited in bad weather.

At the time the Next-Generation Trainer requirement was established, the service life limit of the T-37 was assumed to be 15,000 flying hours. Last year, however, the Air Force began pulling inspections on aircraft reaching 15,000 hours and determined that they could go on safely to 18,000 with minor modifications. The T-37 fleet today averages 12,000 hours, and if most of the aircraft can be certified to 18,000, that makes the primary trainer problem about six years less urgent than it was thought to be.

It is difficult to see extending the service life of the T-37 as anything more than a temporary measure. It does buy some time, though, for the Air Force to find a more lasting solution that it can afford. Sooner or later, USAF will have to acquire a modern primary trainer.

Trials of the T-46A

The T-46A is the trainer that the Air Force wanted originally, and it may yet turn out to be the final selection. Overall, it is reported to be doing well in flight tests. It retains the twin engine and side-by-side seating features of the T-37 and adds pressurization, range, fuel efficiency, and capability in bad weather. It is powered by two Garrett F109-GA-100 turbofan engines.

When it rolled out at Fairchild's Farmingdale plant on Long Island, N. Y., in February 1985, the company expressed confidence that it would exceed all of the Air Force's design specifications. Shortly thereafter, the problems began coming to light.

The Air Force was considerably upset to find that the T-46A had been rolled out with parts missing and work still to be done. In April, the airplane was unable to make its first scheduled flight. In June, the Farmingdale plant failed a Contractor Operations Review conducted by the Air Force Contract Management Division. More scheduled milestones were missed, and the program is still behind.

By the time Fairchild began to get the main problems under control, the budget squeeze was upon the Pentagon. The combination of program and budget difficulties may have been fatal to the T-46A, at least in its previous incarnation.

Deliveries are running late on the first production lot of ten aircraft, and the Air Force does not plan to use its option for production of the second lot.

Lt. Gen. Bernard P. Randolph, Deputy Chief of Staff for Research, Development and Acquisition, said

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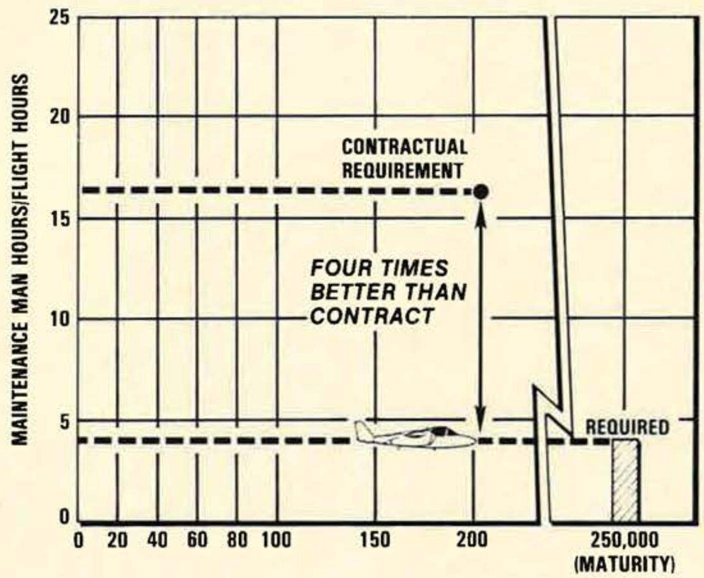
Since flight testing began October 15, 1985, Fairchild Republic Company's T-46A has achieved a notable record in reliability and maintainability. The T-46A is proving to be **four times better** than the contractual requirement (see chart at right). The T-46A was required to achieve 16 Maintenance Man Hours per Flight Hour (MMH/FH) after 200 hours. In fact, it achieved 3.7 MMH/FH and is projected to be in the 2.7 to 1.2 range when it has reached 250,000 hours of maturity.



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Britain's Royal Air Force selected the Shorts Tucano last year to replace their Jet Provost trainers. This tandem-seat advanced turboprop with its 1100shp Garrett TPE-331 powerplant uses half the fuel and one-third of the maintenance manpower, climbs faster and has over twice the range and endurance of the jet. A 12,000 hour fatigue life, ejection seats, weapons capability, superb aerobatic clearance including inverted spinning – combine to make the Shorts Tucano the cost-effective and efficient solution to today's primary trainer needs.

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that USAF owns the data—which it continues to develop—and the tooling for the T-46A. "We have told Congress that, at this time, we don't want to buy the T-46, but at some point in the future, with the drawings, we may put it out for recompetition."

Other Choices Possible

Cessna calls its proposed T-37 upgrade "the New Technology NTT-37." It says it will accept a fixed-price incentive fee contract to produce this trainer in its plant at Wichita, Kan.

The NTT-37 would use the T-37 airframe and the well-regarded Garrett F109 engine developed for the T-46. It would feature modern avionics, lower gross weight, a new instrument panel, cockpit pressurization, better fuel efficiency, and significantly increased range. There would be a new vertical tail to improve crosswind control. Noise levels—which the present T-37 has in abundance—would be well below the Air Force's specifications for the Next-Generation Trainer. "The NTT-37 meets the performance and schedule requirements while reducing the program acquisition costs by more than $1 billion for 650 aircraft," Cessna says.

Still other options are possible, because, as General Randolph observed, "there are a lot of trainers out there." If the price is right, the Air Force might decide that some existing trainer would meet its needs. One frequently mentioned possibility is that the Air Force could piggyback on the US Navy's purchase of the T-45A Goshawk and achieve some economy by the scope of the joint procurement. *(See "The Hawk on Tour" on p. 74.)*

"That's certainly an option that's being talked about," General Randolph said. "There are some in Congress who think that's what we should do. We've had a round of flying with the Hawk. The problem I see is that it remains a pretty expensive airplane, and we really can't afford it. The Air Force doesn't have a formal position on the Hawk. We haven't had sufficient time to evaluate it."

The Hawk would be at some disadvantage in the competition because it has neither twin engines nor side-by-side seating, which are called for as "mission essential" in the Next-Generation Trainer specifications.

There have also been suggestions that the Air Force consider going with a modern turboprop trainer, such as the Pilatus PC-7/9, the Beech T-34C, the Embraer Tucano, or the SIAI Marchetti SF-260TP. A turboprop would be inexpensive to buy and operate.

"I'd be very surprised if we bought a turboprop," General Randolph said. "The Air Force is primarily a turbojet operation. I'm not sure why you'd want to train on turboprops and then go fly turbojets."

begin in the T-37 or its replacement. Then those headed for fighter, attack, or reconnaissance (FAR) cockpits will train in the T-38, and those on the TTB track will move to the new aircraft to be procured.

The Mission Element Needs Statement (MENS) laid down in 1981 prescribes a speed of 300 knots at sea level, positions for an instructor and two students, and range for a three-hour mission with a 300-nautical-mile divert capability. The acquisition package includes twenty-six simulators. Initial Operational Capability (IOC) is projected for FY '91.

McDonnell Douglas and British Aerospace are teaming up to build the Navy's new trainer, the T-45A Goshawk. Removing the T-45's arresting hook and replacing its dual nosewheel, neither of which the Air Force needs, would save roughly 800 pounds of weight.

On Track for TTB

Ironically, a replacement for the T-37 may not be the next trainer the Air Force buys. In FY '89, acquisition will begin on 215 off-the-shelf business jets for the instruction of Tanker-Transport-Bomber (TTB) students in Specialized Undergraduate Pilot Training.

For the past twenty-five years, the Air Force has conducted identical training programs for all student pilots, no matter what sort of aircraft they would be flying after graduation. This generalized approach to training was a function of the aircraft USAF had available, not a conviction that it was the best way to prepare pilots. A decision was made some time ago to return to specialized tracks. All trainees will

In addition to providing better training, the TTB aircraft will take some of the work load off the T-38 fleet, thus extending its service life. Because of increased reliability and maintainability and lower operating and maintenance costs, the TTB trainer is expected to reduce training expense by $37,700 per student.

Potential TTB candidates would probably include the British Aerospace HS 125, the Gates Learjet 35A, the Cessna Citation II, the Beech Jet, the Israeli Westwind II, and the Dassault Falcon 100.

"When we're able to afford a new trainer, we're going with the lowest-cost airplane we can find that will meet our needs," General Randolph said. "We will probably rely on contractor logistics support." ■

VIEWPOINT

Operating in the Shadows

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

Clandestine operations tend to be raunchy in both look and discipline. They seldom measure up to professional military standards. Deeper questions aside, the Hasenfus affair has been amateurish.

Whoever first said that confession is good for the soul was doubtless speaking in theological terms. Confession, in that sense, is most certainly good for the soul. From personal experience, I can also attest to the fact that the prospect of going to confession cast an inhibiting pall over the sinful temptations of my salad days. That, too, was good for the soul.

On the temporal side of life as it is today, however, confessions more often have to do with saving skins than saving souls. The criminal with his plea-bargaining confession has become a necessary adjunct to the criminal justice system. Thus, despicable creatures escape severe punishment by implicating their even more despicable partners in crime.

Refusing to confess when captured is one of the treasured military virtues. It is perhaps the most difficult test of all, for it requires calculated and enduring courage as opposed to the adrenaline-assisted bravery of the moment. The saga of our Hanoi prisoners reflects the ultimate in human courage. And since those men were randomly selected by an antiaircraft lottery, their behavior was a testimonial to the high standards of the military pilots involved in the Vietnam War.

That brings us to the recent case of Mr. Eugene Hasenfus, who appears to have hit the ground confessing. Without passing judgment on him, it is fair to say that his performance differs strikingly from that of our Navy and Air Force aviators who ended up as guests in the Hanoi Hilton. Whoever may have been behind that C-123 flight is none of our business. It is enough to know that the crew was engaged in a clandestine supply mission and, according to the voluble Mr. Hasenfus, was operating out of San Salvador's Ilopango Airport.

For possibly obvious reasons, clandestine operations tend to take on a sort of raunchy look. Back in the 1960s, Air America pilots in Laos sometimes appeared as though they had just left Skid Row. It was all part of the mystique. The trouble with that is that discipline also tends to become a bit raunchy. Certainly, there were documents aboard the C-123 that should have been left at home, suggesting a certain kick-the-tire aspect to the preparations for the mission.

With the world in its present state of confusion, the United States is going to face continuing situations that call for low-key, which is to say clandestine, responses. Central America is decidedly one such situation, and anyone who thinks we should leave matters there alone is, to put it charitably, blind to a grave danger. The question seems—in light of Mr. Hasenfus and the C-123 crash—to be how best to serve our national interest in this shadowy business.

Congressional and public attitudes being what they are, there is no easy answer. Still, we are engaged in a contest in which the rules are nonexistent and the other side is playing to win. Short of caving in or declaring war, we are forced to play the game of surrogate support—our surrogates against theirs. The players representing us in the game should be motivated by more than money, or so it seems to me.

Where can we find such players? Perhaps an answer lies in some promised return to the fold for military people who volunteer for these operations. If that is too hard to handle, perhaps a stiff screening in how to behave when captured would suffice.

Even taking into consideration the ambiguous results of the Reykjavik summit—or perhaps because of them—the prospect of World War III seems comfortably dim. The contest between the two opposing ideologies of democracy and Marxism-Leninism will thus take place in the bush leagues, so to speak: Africa, Central America, and wherever opportunity presents itself to the architects of revolution. So far, our record in these contests hasn't been all that bad.

Beginning with Berlin, and then the bloody Communist attempt to take over Greece, the United States has done a fair job of halting Marxist expansion. Vietnam, of course, goes down as a great failure, but even there the rest of Southeast Asia remains out of the Soviet orbit, thanks to our long Vietnam stand.

We have done creditably in El Salvador, despite misguided opposition in Congress, academia, and the press. It is worth noting that our best efforts—Berlin, Greece, and, for that matter, Vietnam—were overt and were carried out by our professional military.

The C-123 episode in Nicaragua was disturbing in its resemblance to amateur night. The choice of the airplane itself gives cause for wonder. The C-123 has always been a marginal performer, noisy and all too visible. Without trying to ferret out who was paying Mr. Hasenfus's salary, he was obviously working for our side.

That being the case, we deserve better equipment and, on the evidence, more professional people. ■

SCIENCE/SCOPE®

An automated inspection machine will speed one procedure tenfold when full production starts on a new missile program. Producibility specialists at Hughes Aircraft Company are developing robots to handle the task formerly done manually on the production line. About 75,000 particle impact noise detection (PIND) tests will be required each month for the AMRAAM missile. These tests will involve nondestructive acoustic sensing on undesirable particles inside selected electronic devices. Manual operations require about five hours to perform all the tests for one missile. The automated equipment will cut test time to half an hour. The new system can be adapted to test electronic components on other missile programs. Hughes is producing AMRAAM for the U.S. Air Force and Navy.

Malaysia is one of the first nations in Asia to operate an advanced three-dimensional radar as part of its new automated air defense system. The Malaysian Air Defense Ground Environment (MADGE), developed by Hughes, uses the Hughes Air Defense Radar (HADR). This system detects and tracks fighter aircraft at extreme distances under adverse conditions. West Germany, with four radars in 1984, was the first nation to operate HADR. The new MADGE allows Malaysia to detect and identify all military and civilian aircraft approaching its airspace. Should aircraft be identified as threats, commanders can order fighter interceptors to take immediate action.

U.S. Army Cobra helicopter pilots will be able to fly round-the-clock combat missions, thanks to an advanced night targeting system. The new COBRA-NITE system, called C-NITE, augments the existing Airborne TOW anti-tank missile system. It includes a forward-looking infrared sensor which permits gunners to see through darkness, smoke, haze, and bad weather to fire TOW missiles. The sight also is equipped with a laser rangefinder which directs cannon and rocket fire with increased accuracy. C-NITE fires and guides the TOW 2 missile which features improved IR guidance and a more lethal warhead. Hughes will deliver the first C-NITE systems under a preproduction contract to the U.S. Army.

Brazil has expanded its telecommunications service now that the new Brazilsat 2 satellite has gone into operation. The spacecraft joins Brazilsat 1 in uniting the wilderness along the Amazon Basin with the more populated regions in the south. The two satellites carry telephone, TV, and data services. Spar Aerospace Ltd. of Canada built the Brazilsats under license from Hughes for EMBRATEL, Brazil's state-owned telecommunications agency. Hughes supplied antenna reflectors, solar cell arrays, propulsion systems and other electronic components and subsystems.

The Laser Maverick missile has earned high marks in a series of ground and flight tests at the U.S. Naval Air Station, Patuxent River, Maryland. The tests were part of a program to certify the laser-guided air-to-surface missile for fleet use on the U.S. Marine Corps' AV-8B Harrier 2 aircraft. Laser Maverick, currently carried on Marine A-4M aircraft, is in production at Hughes. In addition, both the AV-8B and A-4M are equipped with the Hughes Angle Rate Bombing Set (ARBS), a weapons delivery system that uses a dual-mode tracker in the aircraft's nose.

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Weather is a big player in military operations. The Air Force goes to considerable lengths to understand it better, predict it, take advantage of it, or succeed in spite of it.

Up Against The Elements

BY CAPT. NAPOLEON B. BYARS, USAF

FROM thunderstorms that whip across the Southeast to freezing temperatures at Eielson AFB, Alaska, that sometimes drop as low as sixty degrees below freezing to typhoons that occasionally threaten Clark AB, the Philippines, to pea-soup fog at RAF Mildenhall, United Kingdom—when you talk about bad weather, aircrews have seen it all.

And because the effectiveness of military operations depends on the weather, it is more than merely a topic of passing conversation. "Weather is a limiting factor for the Air Force," one pilot said. "It always has been, and I don't see that changing."

Still, the Air Force, which in the last forty years has largely conquered the obstacles of distance and speed by fielding air-refuelable aircraft capable of supersonic flight, is

Undaunted by such extreme forms of weather as this Arizona thunderstorm, the AWS works daily to lessen the limiting impact of weather. (Photo by 2d Lt. Andrew J. Terzakis, Jr., USAF)

not giving up in the battle against bad weather.

Leading the fight is Air Weather Service (AWS), a technical service of the Military Airlift Command. From its headquarters at Scott AFB, Ill., AWS provides global weather and environmental services to the Air Force and the Army. Additionally, it provides operational weather support to DoD.

With more than 4,800 personnel stationed at 270 locations worldwide, AWS observes and forecasts environmental conditions to help military commanders incorporate weather information into operational plans.

Perhaps the most notable military forecast ever issued was during World War II for Operation Overlord, the June 6, 1944, D-Day invasion of Normandy.

A joint meteorological staff was given the job of forecasting the weather for the invasion. Allied commanders knew all too well that a cross-Channel invasion during bad weather could end in disaster.

On June 5, weathermen advised Gen. Dwight D. Eisenhower that a thirty-six-hour period of good weather would begin the next morning. German meteorologists had predicted exactly the opposite the day before. Consequently, believing an invasion was not imminent, the Germans were caught off guard on June 6 when the Allies hit the Normandy beaches.

How Weather Works

Since its establishment almost fifty years ago, AWS, a direct descendant of the Army Air Forces Weather Service, has observed and collected weather information to improve forecasting.

Before you can forecast the weather, you have to understand it.

Weather results from the uneven heating of the earth's atmosphere by the sun. This causes variable winds, pressures, and rates of evaporation. The movement of cold and warm air masses, in combination with the earth's rotation, geography, and differences in surface temperature, forces air currents into complex and irregular paths. Consequently, weather patterns are always in motion.

Gilles Sommeria, a scientist at the European Center for Medium-Range Forecasts, put it quite simply: Weather is energy in and energy out.

A crucial step in weather forecasting is observing it. AWS observational data comes from a number of sources—direct observations by ground-based personnel and equipment, airborne weather reconnaissance, and meteorological satellites.

Even though computers and modern instruments play an important role in the collection of weather data, the oldest and most accurate observer is still man. "I don't think it demeans our forecasting service one iota to say that observing is the best thing we do," said Brig. Gen. George E. Chapman, AWS Commander.

Collecting Data

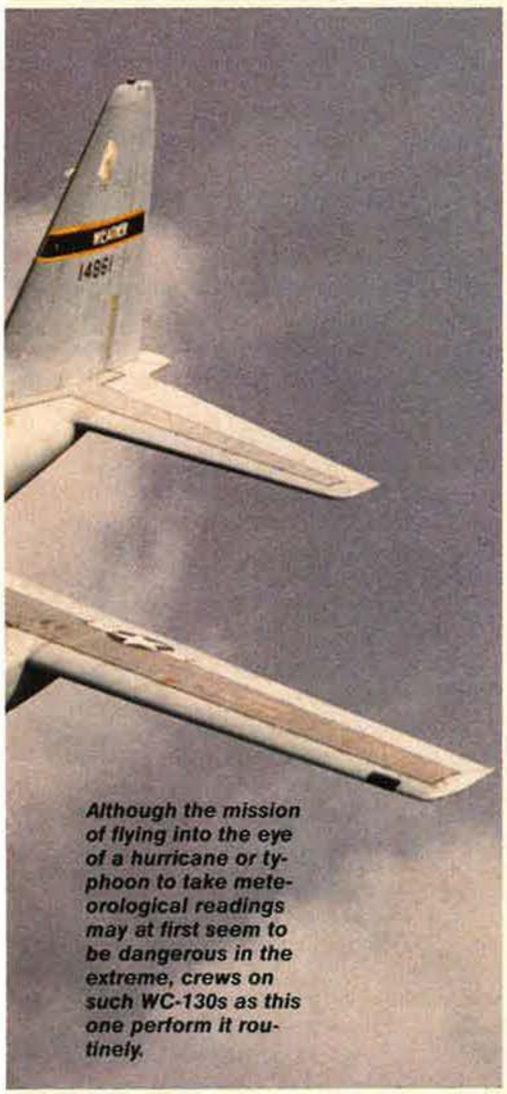
Observations by AWS personnel on the ground, in combination with other data, become part of an environmental data base at the Air Force Global Weather Central (AFGWC) located at Offutt AFB, Neb. AFGWC operates the largest military meteorological computer facility in the world and serves as manager for the collection and dissemination of aerospace environmental data for AWS. Daily, more than 140,000 weather reports are gathered from sources throughout the world and relayed by the Automated Weather Network. This network is a real-time, high-speed, digital communications system connecting AFGWC with military weather units in fifteen allied countries.

Airborne weather reconnaissance is perhaps the most daring way to gather observational data. Each year during the hurricane and typhoon seasons, WC-130s from Keesler AFB, Miss., and Andersen AFB, Guam, fly into storms to take meteorological readings. Using

storm-avoidance radar, they enter a storm at approximately 10,000 feet and penetrate the eye, taking readings at various points along the route.

Technically, a tropical depression becomes a tropical storm when its winds exceed thirty-eight mph. Once its winds reach or exceed seventy-three mph, it then becomes a full-fledged hurricane or typhoon. Aircrew observations allow the National Hurricane Center in Miami and the Joint Typhoon Warning Center in Guam to predict the movement, speed, and intensity of storms more accurately. This information is the basis for weather alerts that have significantly reduced the number of deaths and the amount of property damage caused by these storms.

Another key source of environmental data are meteorological satellites, which cover large and remote expanses of the earth's surface. Conventional data-collection methods would, at best, be difficult to apply for such areas.


Although the mission of flying into the eye of a hurricane or typhoon to take meteorological readings may at first seem to be dangerous in the extreme, crews on such WC-130s as this one perform it routinely.

Meteorological satellite imagery is a powerful forecasting tool and, when combined with conventional data, can alert forecasters to subtleties of a situation they might not otherwise be aware of.

The NEXRAD System

In fact, the impact of adverse weather on commercial transportation and military operations is so pervasive that the Department of Commerce, Department of Transportation, and DoD have launched a joint effort to build the Next-Generation Weather Radar (NEXRAD) System.

The NEXRAD system uses an S-band Doppler weather radar to collect high-accuracy meteorological data. NEXRAD is much more sensitive than conventional radar and will be able to detect and analyze storms in real time. Unlike conventional weather radar, Doppler can look inside a storm and detect the movement of precipitation particles.

NEXRAD collects data for multiple altitudes from a range of up to 290 miles. It also makes use of advanced signal processing to eliminate data contamination caused by ground clutter returns. NEXRAD will automatically alert forecasters of such severe weather as hail, thunderstorms, microbursts, and tornadoes.

Once the NEXRAD network is completed, it will provide overlapping coverage of the continental United States and allow for comprehensive storm tracking with great accuracy.

Provided the program remains on schedule, the first delivery of NEXRADs will begin in 1989. Both Raytheon and Sperry are competing for the NEXRAD contract.

Two other advanced systems high on the AWS priority list are the Automated Weather Distribution System (AWDS) and the Battlefield Weather Observation and Forecast System (BWOFS).

"Along with NEXRAD, it's essential that we develop and exploit improved methods and equipment to support Air Force weapon systems of the future," General Chapman said.

With AWDS, weather service personnel will be able to reduce significantly the amount of time required to make forecasts by using high-speed computer and communications technology. AWS hopes to have 160 sites operational by 1992.

Future Look

An advance look at what the system might eventually resemble is currently operational at the Cape Canaveral Forecast Facility (CCFF). At Cape Canaveral, the Meteorological Interactive Data Display System enables weather forecasters to perform rapid data integration, display, and analysis and to provide highly accurate forecasts to the Eastern Space and Missile Complex.

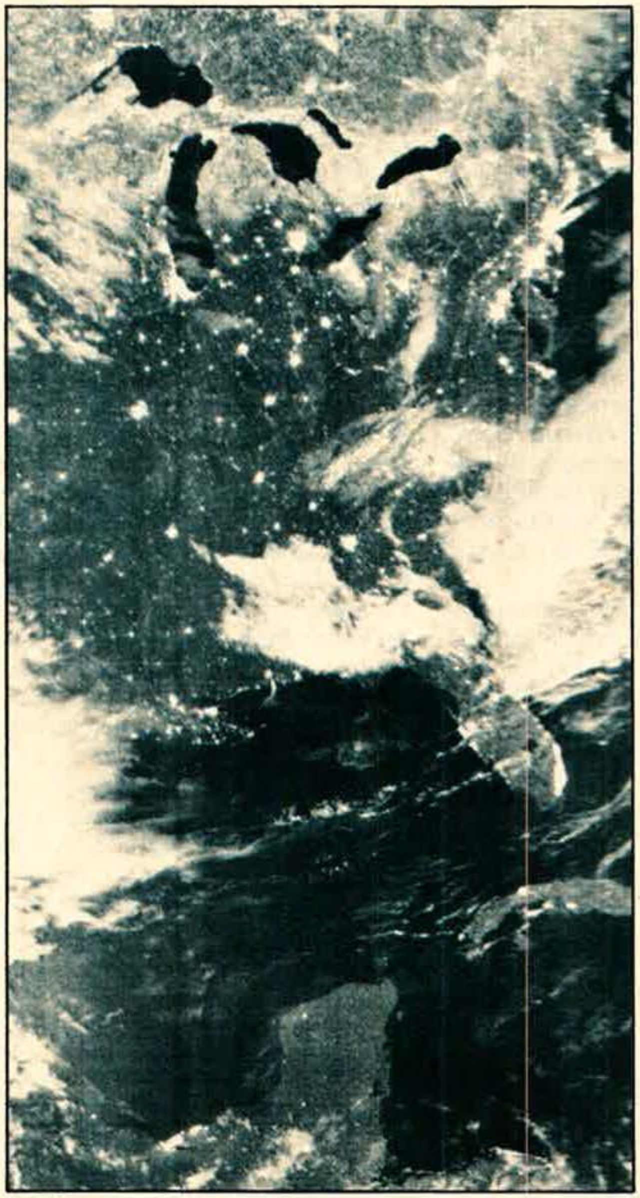
On the battlefields of tomorrow, military commanders may use the BWOFS to exploit weather to their advantage or lessen its adverse impact on operations.

Military weathermen point out that the most important aspect of the battlefield weather system is that it will allow them to observe and collect weather information from areas not under friendly control. It will also allow for the processing and dissemination of weather data in real time to support tactical battlefield decisions.

Of the great natural sanctuaries—among them darkness, terrain, and weather—that have historically hampered air operations, one is about gone. Today, with inertial navigation aids, night-vision goggles, and the advent of the Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) system, aircrews can expect to fly at night with near daylight-equivalent vision. When it comes to flying in any kind of bad weather, though, Mother Nature continues to hold her own.

"You can fly in weather, but your safety margin decreases," said Capt. Curtis Ross, an MC-130 pilot assigned to Hurlburt Field, Fla. "And while it may be technically possible to fly, it's tactically inadvisable."

With such newer systems as the C-17, the Advanced Tactical Fighter (ATF), and the Advanced Technology Bomber (ATB), the Air Force hopes to field an all-weather force by the year 2000. However, Air



This two-nautical-mile visual sensor view is an example of the satellite images that have become an integral part of weather forecasting. Valuable in analyzing US weather patterns, these images will be indispensable in wartime because they will allow collection of weather information for areas not under friendly control. (USAF photo)

Force officials caution that all-weather aircraft will have limits.

"Your weapon must find the target before it can hit it," as one weatherman said. "The fundamental axiom of tactical weapons delivery has not changed."

In Vietnam, the limits that weather can put on air operations were painfully apparent. Monsoons, tropical storms, heat, humidity, and fog combined to create miserable conditions for aircrews as well as for troops on the ground.

According to AWS historical documents, dense water concentrations in monsoon rain clouds caused compressor stalls in jet engines in Vietnam. Heat and humidity caused canopy fogging in F-5s flying at low altitudes. F-4s had to be grounded for a period when a potting compound used to insulate electrical connections melted.

Decreased Effectiveness

Additionally, bad weather took its toll on mission effectiveness. More than 31,000 sorties (twenty percent of the total number of missions) scheduled against targets in Laos and North and South Vietnam either had to be canceled or diverted because of the weather. Heavy cloud cover often obscured North Vietnamese surface-to-air-missile (SAM) sites and enemy resupply movements along the Ho Chi Minh trail.

During one five-year period, the US sought to use weather against the enemy by modifying the monsoon season to make North Vietnamese resupply trails impassable. Silver iodide dropped by Air Force pilots during the rainy season increased the amount of precipitation by thirty percent in some areas.

And though attempts to control weather were inconclusive overall, military commanders, as in previous conflicts, emerged from Vietnam with a growing appreciation of the military implications of weather.

Today, Army weather support includes developing weather support procedures that complement tactical combat doctrine. AWS people support Army assets, such as gunnery ranges and helipads, and deploy with Army units.

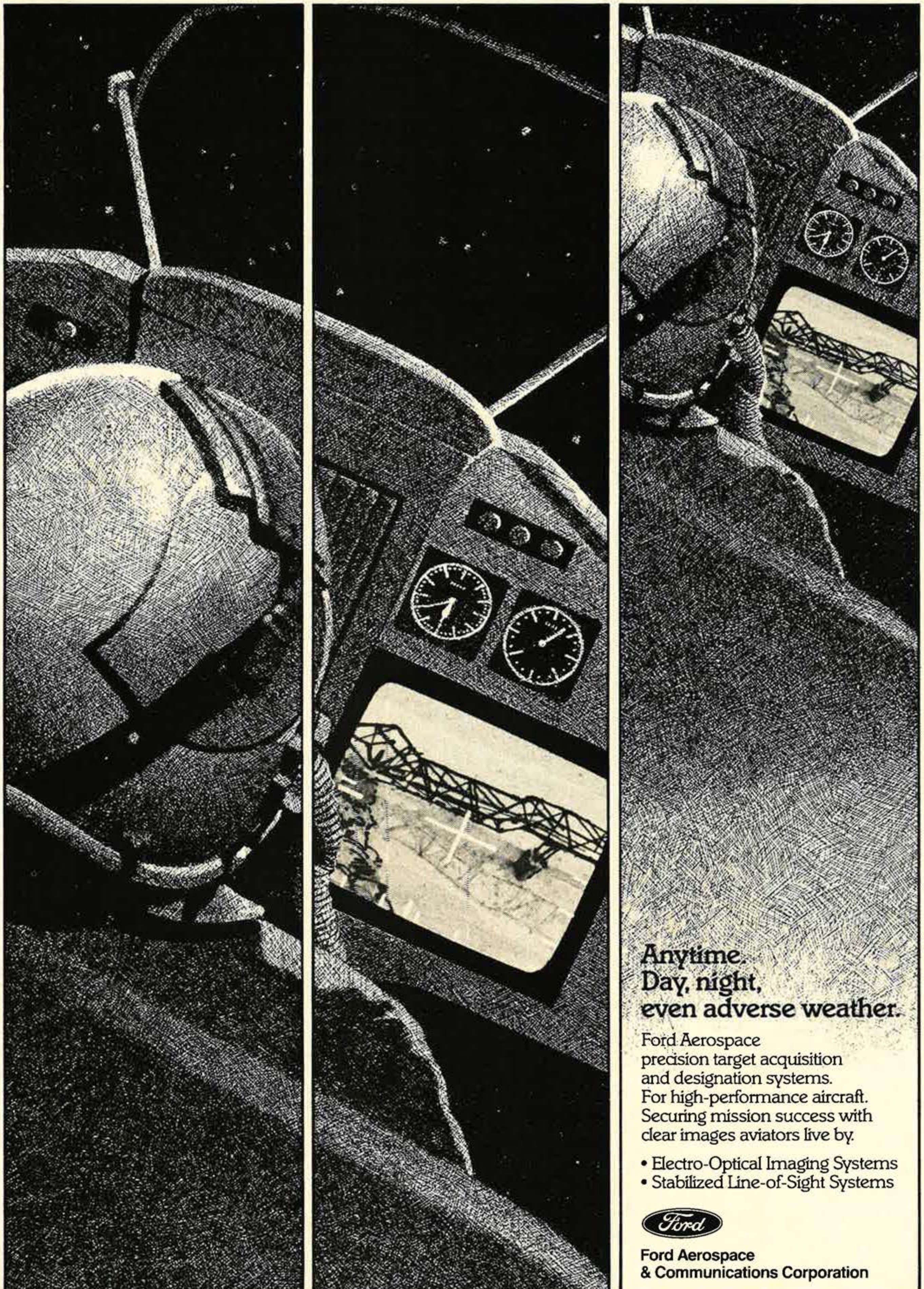
Also, AWS uses a network of radio and optical observatories to monitor the solar atmosphere. Even though the sun is 93,000,000 miles from earth, solar activity can adversely affect surveillance and warning systems, satellite tracking systems, high-frequency communications, and manned spaceflight.

Weather officers also train on board EC-135 airborne command post aircraft. During training scenarios, they advise SAC generals of environmental conditions that include possible radiation fallout considerations.

In the research and development arena, scientists and engineers look to weathermen to predict how future weapon systems might perform in adverse weather. And as DoD research on the Strategic Defense Initiative (SDI) proceeds, military weathermen will offer advice concerning environmental impacts on proposed systems.

Almost everywhere one looks, the Air Force is integrating the weather factor into military operations—a sound tactic when you're up against the elements. ■

Capt. Napoleon B. Byars, USAF, is currently assigned to the Secretary of the Air Force Office of Public Affairs. He holds a bachelor's degree in journalism from the University of North Carolina and a master's in communication from the University of Northern Colorado. He was a Contributing Editor of AIR FORCE *Magazine in 1984–85 under the Air Force's Education With Industry program and continues to write regularly for this magazine. His most recent offerings include the article "Manpower, Missions, and Muscle" in the September '86 issue and a book review last month.*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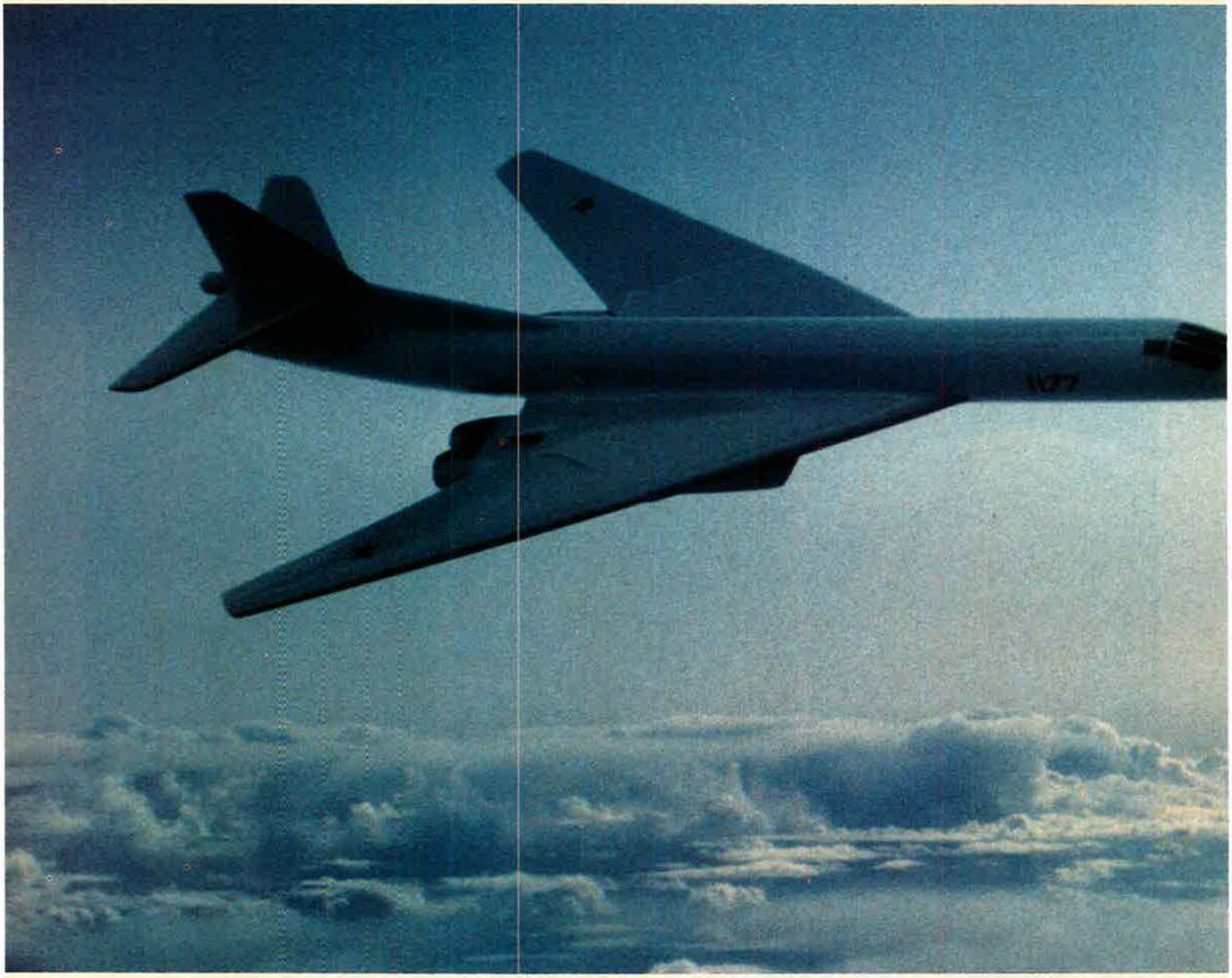


The new Soviet supersonic bomber, the Blackjack, is now undergoing flight test and will probably enter the operational inventory in two or three years. US intelligence analysts expect the aircraft to be equipped with AS-15 cruise missiles. (Photo-illustration by Erik Simonsen)

WESTERN defense analysts tend to become mesmerized by specific advances in Soviet military technology, but often fail to grasp that "we are witnessing a modernization and upgrading of their forces" that spans the spectrum from strategic to conventional conflict, according to the latest Defense Intelligence Agency (DIA) assessment. Moreover, DIA Deputy Director for External Affairs A. Denis Clift told AFA's National Convention on September 17, this stem-to-stern overhaul of the Soviet Armed Forces has transformed them from garrison forces to global forces that routinely test and probe this nation's defense perimeters. In the first two weeks of September alone, the DIA official reported, US F-15s had to scramble twice to shadow Soviet strategic bombers operating along the US East Coast and near Alaska.

Rejuvenated Air-breathing Forces

Calling special attention to massive and comprehensive Soviet efforts to rejuvenate their strategic air-

Deployment of fourth-generation ICBMs is not yet complete, and the fielding of the mobile fifth generation is barely under way—but the USSR is already testing the next generation of missiles.

INTELLIGENCE UPDATE ON SOVIET POWER

BY EDGAR ULSAMER
SENIOR EDITOR (POLICY & TECHNOLOGY)

breathing forces, Mr. Clift predicted that, as a result, the Soviets will be able to boost their inventory of offensive strategic warheads from about 9,000 at present to some 12,000 within three years and possibly to 16,000 by the mid-1990s. After a period of relative quiescence, Soviet offensive strategic air-breathing weapons are coming into their own, he reported, with three different bomber types in production or under development and five new nuclear-armed cruise missile programs in progress. Rather than wait until its state-of-the-art supersonic Blackjack achieves full operational capability, the Soviets decided to capitalize on their inventory of new air-launched cruise missiles by building and deploying a comprehensively updated version of an older strategic bomber, the Tupolev Tu-95 Bear. Some forty H versions of the Bear are known to have been brought into the Soviet inventory and equipped with AS-15 3,000-kilometer-range, nuclear-armed cruise missiles.

Within two or three years, a highly advanced, large strategic bomber, the Blackjack, can be expected to enter the USSR's operational inventory. Now undergoing flight testing, the supersonic Blackjack is both larger and faster than the B-1B, according to the DIA official. In the view of US intelligence analysts, the new Soviet bomber's primary mission is to carry nuclear-tipped cruise missiles. Among the cruise missiles that the Blackjack might carry is the AS-15.

Backstopping the Bear-Hs and Blackjacks is Backfire, a supersonic swingwing design that started entering the Soviet operational inventory about a decade ago. Some 270 of these versatile aircraft have been deployed so far. The Backfire is capable of high-altitude subsonic nuclear attack missions against this country, but also seems well qualified for conventional warfare, antishipping, and reconnaissance missions. The range of the Blackjack makes it well suited for low-altitude, supersonic missions anywhere over the Eurasian landmass, according to the DIA official.

Both the Blackjack and the Backfire are Mach 2 aircraft and thus considerably faster than the transonic

Mach 1.25 B-1B or the subsonic Tu-95 Bear-H and B-52G/H. In terms of range, however, the Bear-H bests all other US and Soviet strategic bombers.

New Cruise Missiles and SLBMs

Another growing dimension of offensive strategic nuclear capabilities, the DIA official told AFA's 1986 National Convention, is represented by a new crop of cruise missiles that can be launched from the air, from submarines standing off US shores, or from the ground. Two different types of GLCMs (ground-launched cruise missiles), Mr. Clift reported, are under full-scale development. The SSC-X-4, he said, probably won't reach operational status until next year and is comparable in size to USAF's GLCMs now being deployed in NATO Europe. There is no US counterpart to a large cruise missile designed for ground-launch, according to Mr. Clift.

The Soviets are also developing two new SLCMs (sea-launched cruise missiles). One of them, the SS-NX-21, appears to be a derivative of the AS-15 ALCM and is expected to reach operational status late this year or early next year. This weapon, the DIA official reported, "can be launched from any standard Soviet torpedo tube." Potential launch platforms of this new SLCM—apparently a nuclear-armed standoff weapon suitable for use against counterforce and countervalue targets in this country—include the Victor III-class of SSNs (nuclear-powered attack submarines) as well as an entirely new generation of cruise missile attack submarines comprising Akula-, Mike-, and Sierra-class SSNs.

Another new Soviet SLCM, the SS-NX-24, is of the same large size as the new Soviet GLCM. The SS-NX-24, he reported, is being flight-tested from converted Yankee-class SSBNs. Rather than decommissioning these SSBNs that butt up against the numerical limits of SALT, the Soviets are converting these boats to a "wide-hipped" configuration in order to accommodate the launch tubes for these new large SLCMs.

One of the most impressive aspects of the Soviet military modernization efforts is centered on the ballistic missile launching submarines, according to the DIA briefing. Of the more than 360 submarines in the Soviet inventory, sixty-two are SSBNs that in the aggregate carry about 944 SLBMs.

The transmutation since the 1970s of the ballistic missiles carried by the Soviet SSBNs has been dramatic, progressing from single-warhead missiles with a range of about 3,000 kilometers to MIRVed weapons with an initial range of 6,000 kilometers that is now being expanded to between 8,000 and 9,000 kilometers. The consequence of this growth, he explained, "is not only [many more] warheads aboard their SLBMs but also the fact that with the increase in range, the Soviet [SSBNs] can now almost stay at pier-side, close to the home waters under cover of their own defenses, and still launch and attack targets in the US."

The performance boost in SLBMs went hand in glove with comprehensive upgrading of the SSBNs themselves. As the Yankee-class boats were taken out of the SSBN fleet, three types of Delta SSBNs—the Is, IIs, and IIIs—took their place.

Even more modern and more capable SSBNs are now joining the Soviet SSBN fleet. Three Typhoon-class submarines are operational, with a fourth nearing operational status, according to Mr. Clift. This 25,000-ton

The Soviets are converting older Yankee-class SSBNs to launch their new large cruise missile, the SS-NX-24. The hulls of these SSBNs are being widened to accommodate the SS-NX-24s.

SSBN—the world's largest submarine—is about a third larger than the new US Trident (Ohio-class) SSBN and carries twenty SS-N-20 SLBMs with a range of more than 8,000 kilometers. The Typhoon's conning tower and rudder posts are heavily reinforced to permit this SSBN to operate under the Arctic ice cap. The result is increased survivability.

The Soviets have also launched two new SSBNs of the Delta IV-class, according to the DIA official. These boats are larger than the Delta IIIs, have a larger missile bay, and carry a still newer SLBM, the SS-NX-23, which is completing flight test. This new SLBM, he said, carries ten warheads over a range of more than 8,000 kilometers, compared to the six to nine warheads of the SS-N-20. The SS-NX-23 is a liquid-propelled weapon, whereas the SS-N-20 uses solid propellants.

Rapid ICBM Modernization

The Soviet strategic triad reflects a strong bias toward the ICBM force, which accounts for about seventy-five percent of the total number of the USSR's strategic warheads, according to the DIA official. The Soviet SLBMs, by contrast, account for only about nineteen percent of that total, while the strategic bombers make up the balance. Six different types of ICBMs are operational, involving in the aggregate some 1,400 silo and mobile launchers that are dispersed across the USSR. Three modern ICBM types, the SS-17 Mod 3, the SS-18 Mod 4, and the SS-19 Mod 3—members of the so-called fourth generation—as well as more than seventy SS-25s—the first fifth-generation type—constitute the bulk of the currently deployed Soviet ICBM force.

The most formidable component of the fourth generation of Soviet ICBMs, according to the DIA briefing, is the SS-18 Mod 4 type involving some 308 missiles deployed in six complexes spread across the south-central region of the USSR. Each missile carries "at least ten warheads, [with] each warhead packing at least twenty times the explosive power" of a World War II A-bomb. This weapon, he said, was designed expressly for attack against US ICBM silos and other hardened targets through a combination of high accuracy and high yield.

The SS-18 force is credited by US intelligence with the capability of destroying between sixty-five and eighty percent of all US ICBM silos by cross-targeting two warheads against each. Even after such an attack, the Soviets would have left and available for restrikes more than 1,000 warheads carried by SS-18s kept in reserve. In addition, there are two other fourth-generation ICBM types in the Soviet operational inventory—some 360 SS-19 Mod 3 and about 150 SS-17 Mod 3 weapons.

Emphasis on Survivability

In synchrony with its drive to boost the accuracy—and hence the lethality—of its ICBM force, the Soviet Union is increasing the survivability of its silo-based forces. Since 1972, Mr. Clift told the AFA meeting, the Soviets have either rebuilt old or built new hardened silos "to withstand attack by our currently operational ICBMs." Even though the deployment of the fourth generation of Soviet ICBMs is not yet complete and the fielding of the fifth-generation weapons—to wit, the SS-25 and the SS-24—has barely gotten under way, the Soviet Strategic Rocket Forces "are already testing future generations of ICBMs." These include a follow-on to the SS-18 Mod 4 as well as a replacement for the SS-24, even though the latter is not expected to achieve operational status until its flight-test program nears completion later this year. Both of these nascent designs, the DIA official said, seem to be tailored toward accuracies and payload-range capabilities in excess of those exhibited by the Soviet fifth-generation ICBMs.

The Soviet SS-18 ICBM force is credited with the ability to destroy a large portion of US ICBM silos in a first strike. Even after such a strike, US intelligence analysts believe that enough of the ten-warhead, heavy Soviet missiles would remain in reserve to loft another 1,000 warheads in a follow-on strike.

Mobility, and hence survivability, is the central trait of the fifth-generation ICBMs. The Soviets, he explained, started development of mobile ICBMs about twenty years ago, involving such systems as the SS-X-15, which was never deployed. But the technology embodied in these early designs germinated the SS-16 ICBM and the SS-20 IRBM (intermediate-range ballistic missile), both of which are mobile. The technology lessons learned, in turn, from these weapons were then applied to the SS-25 and SS-24. The former is approximately the same size as the US Minuteman. It carries a single reentry vehicle over a distance of up to 10,500 kilometers and is being deployed in a roadmobile configuration similar to that of the SS-20.

The SS-24, a railmobile weapon comparable in size to the MX Peacekeeper, carries ten warheads over a range of up to 10,000 kilometers. The Soviet penchant for mobile ICBMs, Mr. Clift suggested, ensues from geographic factors: "The Soviet commanders know that [the USSR] occupies approximately one-sixth of the earth's land surface and that one way of taking advantage [of this circumstance] is mobility." In the case of the

SS-24, he added, the Soviets will be able to take this weapon "out of garrison and deploy it at points along the rail systems, making it far more difficult [for this country] to monitor, track, and target these weapons."

The SS-25, on the other hand, is deployed in a wheeled transporter/erector/launcher that can move cross country to complicate tracking and targeting by US strategic forces. While garrisoned under benign conditions, the SS-25 and its cannister are housed in sliding-roof garages and thus can be launched rapidly, according to the DIA official.

Soviet Strategic Defense Capabilities

The Soviets devote as much effort to strategic defense as to strategic offense, according to the DIA official. Strategic defense efforts are enormous and comprehensive, extending from such passive measures as networks of hardened bunkers and underground shelters for party and state leaders as well as other elements of the Soviet infrastructure to advanced defenses against ballistic missiles. Work on ABM systems has been under way for more than twenty-five years, giving Moscow about a ten-year lead over corresponding US efforts, Mr. Clift pointed out. The original ABM system around Moscow of the 1950s has undergone steady modernization and expansion. Pacing the growth of deployed ABM systems is an ambitious and expanding research and development program that, beginning in the 1970s, concentrated on space- and ground-based directed-energy weapons.

The USSR's operational ABM system comprises a network of defenses. Key here is a launch-detection satellite network, which provides Moscow with some thirty minutes of warning of an impending ballistic missile launch against targets in the USSR as well as information about the general direction of the attack and its targets. Corroboration of such warning information is obtained by the Soviet over-the-horizon radar network that provides the ballistic missile defense with roughly the same lead time as do the launch detection satellites. In the early 1970s, the Soviets put in place eleven early-warning and tracking radars that operate at six locations spread across the USSR. These so-called Henhouse radars, he explained, confirm that an attack has been launched and, at the same time, help the ABM forces identify the size of the attack as well as provide target-tracking data to the interceptor missiles.

Working in concert with the Henhouse radars is a network of large phased-array radars (LPARs) at six sites. These LPARs can track more targets with greater accuracy than can the Henhouse system. Five of these LPARs are located on the periphery of the USSR and are oriented outward. Their primary function appears to be early warning, even though they possess an intrinsic "definite target-tracking capability," according to the DIA official. The sixth LPAR is at Krasnoyarsk, deep inside Soviet territory and hence, in the US view, a clear-cut violation of the 1972 ABM treaty. The Krasnoyarsk LPAR can provide substantial target-tracking information to the Soviet ABM forces.

The ABM defenses ringing Moscow are undergoing extensive modernization. The above-ground Galosh launchers are being replaced by two entirely new ABM interceptor types involving silo-based launchers. The DIA official reported that one of these new interceptor types is designed to intercept warheads beyond the atmosphere (exoatmospheric), while the other, called the Gazelle system, is a high-acceleration weapon that can intercept targets during their descent through the atmosphere (endoatmospheric). This two-tiered system of upgraded Galosh and Gazelle interceptors is expected to achieve full operational status next year.

Battle management for the upgraded Moscow defenses will be provided by "an enormous battle management radar at Pechora, just outside [of the Soviet capital], that is nearing completion." The Pechora radar has transmitters and receivers on each of its four faces and provides 360-degree coverage in terms of managing ABM interceptors. The LPARs, working in conjunction with the Pechora facility, the DIA official explained, give the USSR "the capability to deploy a nationwide ABM system" by using transportable ABM interceptors. He added that while the Soviets as yet have not deployed transportable interceptors, this country has expressed concern over such an eventuality.

Of major concern over the longer term is the fact that the USSR has assigned more than 10,000 scientists and engineers to six R&D and test complexes to work on advanced technology projects centered on ground- and space-based laser weapons as well as particle-beam prototypes. At the Sari Shagan Missile Test Center, for instance, the Soviets are operating a ground-based laser "already capable of interfering with some US satellites." The DIA official added that the Soviets "are working on space-based lasers with ASAT potential and, within the next decade, could have [space-based lasers] with an ABM capability as well."

The Soviet Union is rapidly closing the technology gap with the West in the arena of tactical aircraft as well. The MiG-29 Fulcrum fighter is a high-performance aircraft with look-down/shoot-down capability and may deploy with the 65,000-ton Soviet aircraft carrier now under construction. (Photo courtesy of Jane's All the World's Aircraft)

Soviet strategic defenses, he pointed out, "cover an incredible spectrum of capabilities involving thousands of radar sites across the USSR and thousands of air defense interceptors." These capabilities are being upgraded on a continual basis. The SS-X-12 that is expected to achieve operational status next year, for instance, is a uniquely versatile interceptor that is effective "against all aircraft, cruise missiles, tactical ballistic missiles, and some strategic ballistic missiles—a truly incredible system," the intelligence expert told the AFA meeting.

Space and Theater Forces

"Dramatic advances" characterize the Soviet space program, with two entirely new spacelaunch vehicles under development and eight types of launch vehicles already in service. A new medium-lift vehicle—roughly comparable in size to the US Titan—that can lift fifteen tons of payload into orbit as well as two variants of a Saturn V-class heavy-lift vehicle that can lift more than 100 tons into orbit are under development. The significance of the new medium-lift vehicle, Mr. Clift suggested, is its ability to lift the Soviet ASAT space weapon to altitudes significantly higher than the 5,000-kilometer level that this interceptor can reach at present. The new medium-lift launcher will probably also serve the Soviet spaceplane that US intelligence believes is meant for ASAT, space station defense, and reconnaissance missions as well as for cosmonaut training.

The heavy-lift launchers, in part, support the Soviet space shuttle program. The Soviet space shuttle differs from its US counterpart in that its lift comes solely from a separate launcher rather than a combination of rocket engines and boosters. The new heavy-lift launcher is expected to enter service next year in association with Soviet plans for large manned space stations, according to the DIA analyst. Support of military missions appears to be the primary purpose of these large space stations, which are likely to be deployed by the end of this decade.

The some 441 5,000-kilometer-range, MIRVed SS-20 IRBM launchers, each equipped with a refire missile, carry in the aggregate some 1,200 nuclear warheads and cover the entire Eurasian landmass, according to the DIA official. The number of deployed SS-20s almost doubled during the last five years. In addition to these long-range theater missiles, the Soviets are building up and modernizing their inventory of shorter-range, new nuclear-armed theater missiles as well as their nuclear artillery. The DIA official pegged the number of SS-21, SS-23, and similar ballistic missiles at "more than 1,600."

There is evidence of similar trends in the Soviet ground forces, with the number of Soviet divisions having gone up from about 180 in 1981 to more than 200 at present. This numerical expansion reflects Moscow's emphasis on airborne, armored, and motorized rifle divisions. Accompanying this equipment upgrading are better training and streamlined doctrines. The some 52,000 main battle tanks in the Soviet inventory are mostly modern T-64s, T-72s, and T-80s with improved armor, laser rangefinders, and the largest tank gun in the world. These guns can fire guided antitank missiles, Mr. Clift reported.

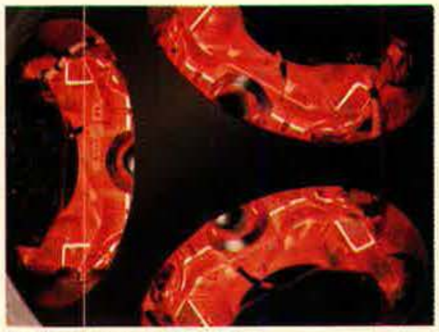
In the arena of tactical air, the Soviets are rapidly closing the technology gap with the US with the wholesale deployment of such advanced high-performance aircraft as the MiG-29 and Su-27 supersonic fighters equipped with look-down/shoot-down capability as well as various types of modern air-to-air missiles. Equally startling has been the rapid transformation of the Soviet Navy from a defensive force to a truly global "blue-water" fleet that will soon include a full-size 65,000-ton aircraft carrier. There is some indication that this carrier will accommodate such high-performance fighters as the MiG-29 Fulcrum, according to the DIA official. ■

Litton 2nd generation inertial "initializes" SRAM

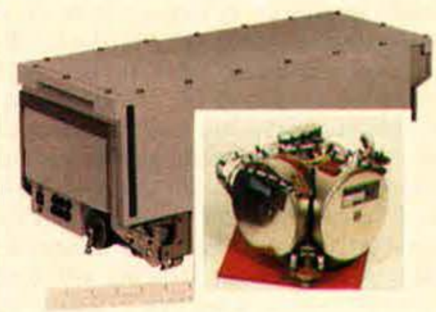
Litton 3rd generation guides ALCMs

Litton 4th generation inertial guides SRAM II

High-volume RLG production for USAF



High accuracy rate-bias RLGs



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Guidance & Control Systems

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DECEMBER 1986

Dassault-Breguet Rafale A taking off on first test flight, 4 July 1986

DASSAULT-BREGUET

AVIONS MARCEL DASSAULT-BREGUET AVIATION, 27 rue du Professeur Victor Pauchet, 92420 Vaucresson, France

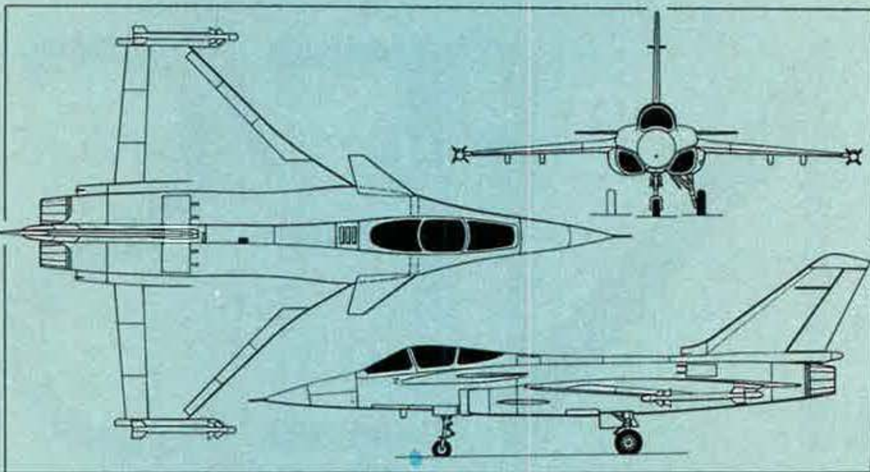
DASSAULT-BREGUET RAFALE A (SQUALL)

Known initially as the ACX (advanced combat experimental), the **Rafale** A is an experimental prototype that was built to demonstrate technologies applicable to the tactical combat aircraft (ACT) needed to replace French Air Force Jaguars in the 1990s, and to the ship-based combat aircraft (ACM: avion de combat marine) proposed for deployment on the French Navy's nuclear powered aircraft carrier. The production version will be known as **Rafale B** and is described separately.

Essential characteristics of the Rafale A were revealed in the early weeks of 1983, at the time of Dassault-Breguet's decision to build it. On the basis of an airframe with overall dimensions little greater than those of the Mirage 2000, the company set out to produce a multi-role aircraft able to destroy everything from supersonic fighters to a helicopter in an air-to-air role, and able to deliver at least 3,500 kg (7,715 lb) of modern weapons on targets up to 350 nm (650 km; 400 miles) from its base. The ability to carry, and fire in rapid succession, at least six air-to-air missiles was considered essential, together with the ability to launch electro-optically guided and advanced 'fire and forget' standoff air-to-surface weapons.

High manoeuvrability, high angle-of-attack flying capability under combat conditions, and optimum low-speed performance for short take-off and landing were basic design aims. This led to choice of a compound-sweep delta wing, a large active canard foreplane mounted higher than the mainplane, twin engines, air intakes of new design in a semi-ventral position, and a single fin. To ensure a thrust-to-weight ratio far superior to one, it was decided to make extensive use of composites, such as carbon and aramid fibres, and aluminium-lithium alloys throughout the airframe, as well as the latest manufacturing techniques, such as superplastic forming/diffusion bonding of titanium components.

Ergonomic cockpit studies suggested that the pilot's seat should be reclined at an angle of 30° to 40° during flight testing, and that equipment should include a sidestick controller, a wide angle holographic head-up display, an eye-level display collimated to infinity (avoiding the need to refocus from the HUD to the instrument panel), and lateral multi-function colour displays.



Dassault-Breguet Rafale A (two General Electric F404-GE-400 augmented turbofans) *(Pilot Press)*

The digital fly by wire control system embodies automatic self-protection functions to prevent the aircraft from exceeding its limits at all times. Functional reconfiguration of the system in case of failure, and anti-turbulence functions, are embodied. Provisions are made for the introduction of fibre optics to enhance nuclear hardening, and of voice-activated controls and voice warning systems.

A full-scale mockup of the original ACX design was exhibited at the 1983 Paris Air Show, and construction of the Rafale A began in March 1984. Compared with the mockup, it embodies a number of significant refinements. In particular Dassault-Breguet was able to achieve improved flow into the engine air intakes, and greater efficiency at high angles of attack, by modifying the lower fuselage cross-section to a V shape, enabling it to dispense with centrebodies and other moving parts. The size of the fin was also greatly reduced.

Rafale A was rolled out of the Saint-Cloud assembly plant on 14 December 1985, and exceeded Mach 1.3 during its first test flight on 4 July 1986. Mach 1.8 was achieved during the sixth flight, by which time the aircraft had been subjected to load factors of $+6g$ in supersonic flight and $+8g$ in subsonic flight, and angles of attack up to 23°.

TYPE: Single-seat twin-engined experimental combat aircraft.

WINGS: Cantilever multi-spar mid-wing monoplane of compound delta planform. Most of wing components made from carbonfibre, including three-segment full-span elevons on each trailing-edge. Wing spar/fuselage attachment fittings of aluminium-lithium alloy. Elevons can be deflected identically or differentially. Full-span three-segment leading-edge slats on each wing operate automatically with the elevons to alter wing camber and provide high lift. Slats made from titanium. Wingroot tip fairings of aramid fibre. All movable surfaces actuated by fly by wire control system, via hydraulic actuators.

FUSELAGE: Conventional semi-monocoque structure; 50 per cent carbonfibre, including entire front fuselage and dorsal spine fairing. Aramid fibre nosecone and jetpipe fairings. Most centre and rear fuselage skin panels of aluminium-lithium alloy. Wheel doors and engine doors of carbonfibre. Dorsal spine fairing from rear of canopy to jet nozzles. Forward hinged door type airbrake above engine duct on each side of fin leading-edge.

FOREPLANES: Shoulder-mounted active foreplanes of sweptback planform, actuated hydraulically by fly by wire control system. Made primarily of carbonfibre with honeycomb core and aramid fibre tips.

TAIL UNIT: Fin and inset rudder only, of sweptback form, made primarily of carbonfibre, with honeycomb core in rudder. Aramid fibre fin tip. Air intake in base of fin leading-edge. Rudder actuated hydraulically by fly by wire control system. No tabs.

LANDING GEAR: Hydraulically retractable tricycle type supplied by Messier-Hispano-Bugatti, with single wheel on each unit. Hydraulically steerable nosewheel. All wheels retract forward. Designed for impact at vertical speed of 4 m (13 ft)/s, without flare-out. Michelin radial tyres. Mainwheel tyres size 810 × 275-15, pressure 16.0 bars (232 lb/sq in). Carbon brakes on all three wheels, controlled by fly by wire system. Brake-chute for emergency use in cylindrical container at base of rudder.

POWER PLANT: Two General Electric F404-GE-400 augmented turbofan engines, in 71.2 kN (16,000 lb st) class, mounted side by side in rear fuselage. Kidney shape plain air intakes, with splitter plates, mounted low on centre-fuselage. Integral tanks in fuselage and wings for more than 4,250 kg (9,370 lb) of fuel. Inboard underwing pylons able to carry two 2,000 litre (440 Imp gallon; 528 US gallon) drop tanks. Provision for flight refuelling.

ACCOMMODATION: Pilot only, on Martin-Baker Mk 10 zero/zero ejection seat, reclined at angle of 30° to 40°. One-piece blister windscreen/canopy, hinged to open sideways, to starboard. HOTAS (hands on throttle and stick) controls, with sidestick controller on starboard console and small-travel throttle lever.

SYSTEMS: Bootstrap cockpit air-conditioning system. Dual hydraulic circuits, pressure 280 bars (4,000 lb/sq in), each with two Messier-Hispano-Bugatti pumps. Variable frequency electrical system, with two 30/40kVA Auxilec alternators. Triplex digital plus one dual analog fly by wire control system, integrated with engine controls and linked with weapons system. Eros oxygen system.

AVIONICS AND EQUIPMENT: Provision for more than 780 kg (1,720 lb) of avionics equipment and racks, including Thomson-CSF RDX lookdown/shootdown radar with acquisition range in 50 nm (92 km; 57 mile) class, able to track up to eight targets simultaneously, with automatic threat assessment and allocation of priority. (Radar and some other advanced equipment are not installed initially.) Sagem Uliss 52X INS. Digital CRT display of fuel, engine, hydraulic, electrical, oxygen, and other systems information. Wide-angle diffractive optics HUD, collimated eye-level display and lateral multi-function colour displays by Thomson-CSF/SFENA. TRT com. SOCRAT VOR/ILS. Crouzet voice activated radio controls and voice alarm warning system. LMT IFF. Internal ECM suite.

ARMAMENT: One 30 mm DEFA 554 gun in side of port engine duct. Twelve external stores attachments: four under fuselage, four under wings, two at wingtips, and two below engine air intakes for sensors. Basic armament of four fuselage mounted Matra Mica medium-range air-to-air missiles and two wingtip mounted Matra Magic close-range air-to-air missiles for air defence role, with provision for four additional Micas under wings.

DIMENSIONS, EXTERNAL:
- Wing span — 11.2 m (36 ft 9 in)
- Length overall — 15.8 m (51 ft 10 in)

AREA:
- Wings, gross — 47.0 m² (506 sq ft)

WEIGHTS:
- Weight empty — 9,400–9,500 kg (20,725–20,945 lb)
- Combat weight, with 4 Mica and 2 Magic missiles — 14,000 kg (30,865 lb)

PERFORMANCE (estimated):
- Max level speed — Mach 2 (800 knots; 1,480 km/h; 920 mph IAS)
- Approach speed — under 120 knots (223 km/h; 138 mph)
- T-O run: at 14,000 kg (30,865 lb) AUW — 400 m (1,313 ft)

The Rafale A is a little larger than the Mirage 2000

The Rafale A, like BAe's EAP, is intended primarily as a technology demonstrator for the planned production Rafale B

at 20,000 kg (44,100 lb) AUW	under 700 m (2,300 ft)
g limit	+9

DASSAULT-BREGUET RAFALE B

Rafale B is the planned production version of Rafale A, to replace French Air Force Mirage III-Es and Jaguars, and French Navy Crusaders and Étendard IV-Ps, in the mid-1990s. It is intended to be slightly smaller overall than the Rafale A, although the general configuration will be identical except for deletion of the air intake at the base of the tail fin. Differences in the naval version (ACM) compared with the Air Force version (ACT) will include a reinforced main landing gear able to cope with rates of sink up to 6 m (19.7 ft)/s, a modified nose gear for nose gear catapult launch and possible use of a mini ski-jump T-O technique, and added arrester hook.

The proposed development programme for Rafale B envisages design freeze by early 1987, followed by construction of four ACT prototypes and two ACM prototypes, with flight testing to start in 1990. Other features of Rafale B announced in Summer 1986 are as follows:

Power Plant: Two SNECMA M88 turbofan engines, each rated at approx 50 kN (11,240 lb st) dry and 75 kN (16,860 lb st) with afterburning. Internal fuel capacity more than 4,000 kg (8,818 lb).

Avionics: Thomson-CSF RDX multi-function radar to permit terrain following/terrain avoidance/threat avoidance flight at low altitude, with simultaneous air-to-air search/track of multiple targets; and fire control of Mica and AMRAAM air-to-air missiles. Self protection ECM. Communications via SINTAC/JTIDS. Autonomous navigation, supplemented by use of GPS/Navstar satellite systems.

Dimensions, external (calculated):	
Wing span over missiles	10.75 m (35 ft 3¼ in)
Length overall	14.20 m (46 ft 7 in)
Area:	
Wings, gross	44.0 m² (474 sq ft)
Weights:	
Avionics	more than 780 kg (1,720 lb)
Target operational weight, empty	8,500 kg (18,740 lb)

ENAER CHILE

EMPRESA NACIONAL DE AERONAUTICA, Gran Avenida José Miguel Carrera 11087, Par. 36½, El Bosque, Santiago, Chile

ENAER T-35TX AUCÁN

A description of ENAER's piston engined T-35 Pillán trainer appeared in the April 1985 *Jane's Supplement*. This aircraft is now in service with the Chilean Air Force as the T-35A and T-35B, and 40 similar T-35Cs are being assembled from ENAER kits by CASA for the Spanish Air Force, by whom they are known as the E.26 Tamiz.

Design studies for a turboprop version of the Pillán were completed in 1985. Originally known as the Turbo Pillán, the trainer has since been redesignated T-35TX Aucán and is powered by a 313 kW (420 shp) Allison 250-B17D engine instead of the 239 kW (320 shp) Allison 250-B17C intended previously. The prototype Aucán (CC-PZC) was shown at the FIDA exhibition in Chile in March 1986, following its first flight on 14 February. Production is planned to start in 1988.

Dimensions, external:	
Wing span	8.81 m (28 ft 11 in)
Wing aspect ratio	5.69
Length overall	8.29 m (27 ft 2½ in)
Height overall	2.34 m (7 ft 8¼ in)
Wheel track	3.02 m (9 ft 11 in)
Wheelbase	2.09 m (6 ft 10¼ in)
Area:	
Wings, gross	13.64 m² (146.8 sq ft)
Weights:	
Basic weight empty	1,048 kg (2,310 lb)
Max T-O weight	1,364 kg (3,007 lb)
Performance:	
Max level speed at S/L	198 knots (367 km/h; 228 mph)
Max cruising speed at 3,050 m (10,000 ft)	186 knots (345 km/h; 214 mph)
Stalling speed at S/L, flaps down	59 knots (109 km/h; 68 mph)
Max rate of climb at S/L	588 m (1,930 ft)/min
Service ceiling	8,535 m (28,000 ft)
T-O run at S/L	178 m (583 ft)
Range	620 nm (1,150 km; 715 miles)

SHENYANG

SHENYANG AIRCRAFT COMPANY, Shenyang, Liaoning Province, People's Republic of China

SHENYANG J-8

Chinese name: Jianjiji-8 (Fighter aircraft 8) or Jian-8
Export designation: F-8
NATO reporting name: Finback

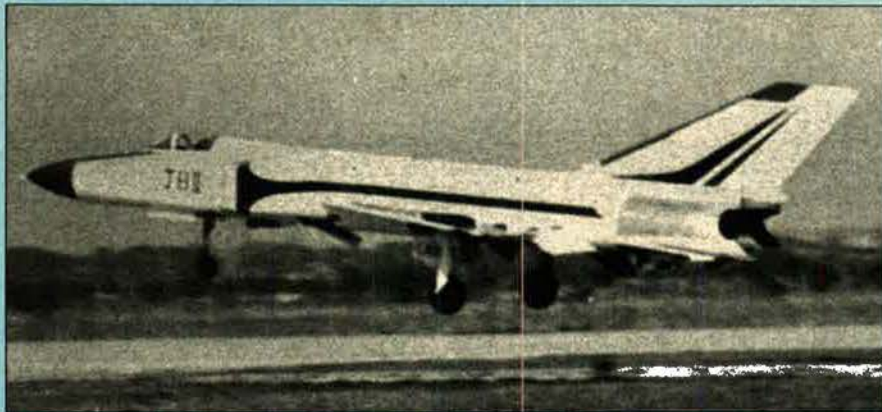
Development of the J-8 began in the mid-1960s, the first example being completed in about 1969. Initially, it appeared to follow closely the same design philosophy as the Soviet Mikoyan Ye-152A 'Flipper', and a description of it in this form (now called the **J-8 I**) appeared in the April and August 1985 *Jane's Supplements* and the 1985–86 *Jane's All the World's Aircraft*.

According to Chinese official sources, only limited production of the J-8 I (about 50 aircraft) was undertaken. An improved version was expected, however, and the possible existence of a J-8 with twin lateral air intakes was reported as long ago as 1979. Confirmation that such a version had been developed came in January 1985, when the Xinhua news agency announced that a J-8 with wingroot intakes had made a successful first flight in early May 1984. Initial flight testing was said to have been very successful, showing a considerable improvement in performance compared with the earlier model. The test programme was continuing in 1986. The new version is designated **J-8 II** in China, or **F-8 II** when offered for export.

The main purpose of the configuration change was twofold, the first being to provide a 'solid' nose with adequate accommodation for a modern AI radar, and the second to provide increased airflow for a more powerful engine installation, it being generally conceded that, with its original 59.82 kN (13,448 lb st) WP-7B engines, the J-8 I was underpowered. The power plant problem seems to have been overcome, at least for the time being, by fitting the J-8 II with twin engines designated WP-13A II, almost certainly a Chinese derivative of the Tumansky R-13-300.

In early 1986, US government approval was given for American avionics companies to bid for the avionics upgrade under FMS (foreign military sales) regulations. The requirement was reported to be for 50 shipsets, plus five spare kits, of an avionics suite comprising an AI radar, inertial navigation system, HUD, mission and air data computers, and

ENAER T-35TX Aucán turboprop powered basic trainer



China's new twin-jet fighter, the Shenyang J-8 II (NATO 'Finback')

a data bus. Other details in the Washington report indicated that the improved version of the J-8 was intended for production in the early 1990s, and for service in Manchuria and along China's northern border with the USSR. Most US avionics, however, would be approved only for J-8 IIs for use within China, and other Western alternatives are being sought to enable the aircraft to be exported.

Official details provided during the 1986 Farnborough International air show now make it possible to give the following description of the J-8 II:

TYPE: Single-seat twin-engined air superiority fighter, with secondary ground attack capability.

WINGS: Cantilever mid-wing monoplane. Thin-section delta wings, with slight anhedral and 60° sweepback on leading-edges. Small fence on each upper surface near tip. Two-segment single-slotted trailing-edge flaps on each wing inboard of aileron. Main wing structure is of aluminium alloy and high tensile steel. Control surfaces, which have hydraulically boosted actuation, are of aluminium honeycomb with skins of sheet aluminium.

FUSELAGE: Conventional semi-monocoque structure, 'waisted' between air intakes and tail section in accordance with area rule. Construction is mainly of aluminium alloy, with high tensile steel for main load-bearing members and titanium in high-temperature areas. Dielectric nosecone. Four door-type underfuselage airbrakes, one under each engine air intake trunk and one immediately aft of each mainwheel well. Spine fairing along top of fuselage from cockpit to fin, with small airscoop at foot of fin leading-edge. Additional airscoop at top of rear fuselage on each side, above tailplane.

TAIL UNIT: Cantilever sweptback all-metal surfaces, comprising broad chord fin and rudder and low-set all-moving tailplane; 60° sweepback on tailplane leading-edges. (Tailplane anti-flutter weights of J-8 I deleted.) Ventral fin similar to that of MiG-23, main portion of which folds sideways to starboard during take-off and landing, to provide additional directional stability. Rudder and tailplane are of aluminium honeycomb, with sheet aluminium skins; actuation is hydraulically boosted. Dielectric panels at tip of main fin and on non-folding portion of ventral fin leading-edge.

LANDING GEAR: Hydraulically retractable tricycle type, with single wheel and oleo-pneumatic shock absorber on each unit. Nose unit retracts forward, main units inward into centre-fuselage; mainwheels turn to stow vertically inside fuselage, resulting in a slight overwing bulge. Brake-chute in bullet fairing at base of rudder.

POWER PLANT: Two Wopen-13A II turbojet engines (Chinese development of Tumansky R-13-300), each rated at 64.72 kN (14,550 lb st) with afterburning, mounted side by side in rear fuselage with 'pen nib' fairing above and between exhaust nozzles. Lateral, non-swept air intakes, with large splitter plates similar in shape to those of MiG-23. Internal fuel capacity (wing and fuselage tanks) estimated at approx 5,500 litres (1,210 Imp gallons; 1,453 US gallons). Provision for auxiliary fuel tanks on fuselage centreline and each outboard underwing pylon.

ACCOMMODATION: Pilot only, on ejection seat under one-piece canopy hinged at rear and opening upward. Cockpit pressurised, heated, and air-conditioned.

SYSTEMS: Two simple air-cycle environmental control systems, one for cockpit heating and air-conditioning and one for radar cooling; cooling air bled from engine compressor. Two independent hydraulic systems (main utility system plus one for flight control surfaces boost), powered by engine driven pumps. DC primary electrical system, with alternators for AC power.

AVIONICS AND OPERATIONAL EQUIPMENT: VHF/UHF and HF/SSB com radio, Tacan, radio compass, radar altimeter, marker beacon receiver, 'Odd Rods' type IFF, radar warning receiver, and ECM. Autopilot for attitude and heading hold, altitude hold, and stability augmentation. Existing fire control system comprises a monopulse radar, optical gyro gunsight, and gun camera. Enlarged avionics bays in nose and fuselage provide room for modernised fire control system.

ARMAMENT: One 23 mm Type 23-3 twin barrel cannon, with 200 rds, in underfuselage pack immediately aft of nosewheel doors. Seven external stations (one under fuselage and three under each wing) for a variety of stores which can include PL-2B infra-red air-to-air missiles, PL-7 medium-range semi-active radar homing air-to-air missiles, 18-round pods of 57 mm Type 57-2 unguided air-to-air rockets, launchers for 90 mm air-to-surface rockets, bombs, or (centreline and outboard underwing stations only) auxiliary fuel tanks.

DIMENSIONS, EXTERNAL:

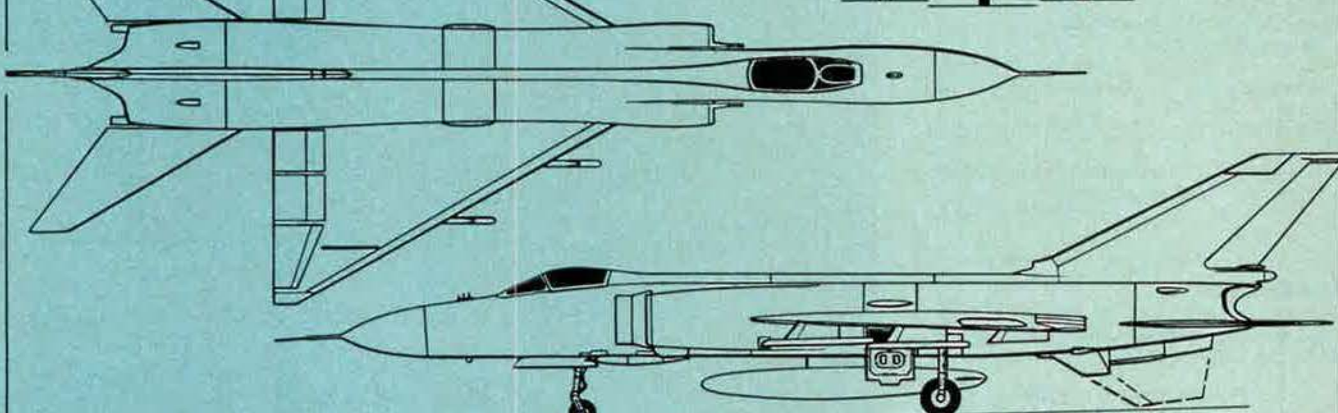
Wing span	9.344 m (30 ft 7⅞ in)
Wing aspect ratio	2.07
Length overall, incl nose-probe	21.59 m (70 ft 10 in)
Height overall	5.41 m (17 ft 9 in)
Wheel track	approx 3.80 m (12 ft 7 in)
Wheelbase	approx 7.25 m (23 ft 9½ in)

AREA:

Wings, gross	42.2 m² (454.2 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	9,820 kg (21,649 lb)



Shenyang J-8 II twin-engined air superiority fighter *(Pilot Press)*

Normal T-O weight	14,300 kg (31,526 lb)
Max T-O weight	17,800 kg (39,242 lb)
Wing loading:	
at normal T-O weight	338.9 kg/m² (69.4 lb/sq ft)
at max T-O weight	421.8 kg/m² (86.4 lb/sq ft)
Power loading:	
at normal T-O weight	110.5 kg/kN (1.08 lb/lb st)
at max T-O weight	137.5 kg/kN (1.35 lb/lb st)
PERFORMANCE:	
Design max operating Mach number	2.2
Design max level speed	701 knots (1,300 km/h; 808 mph) IAS
Unstick speed	175 knots (325 km/h; 202 mph)
Landing speed	156 knots (290 km/h; 180 mph)
Max rate of climb at S/L	12,000 m (39,370 ft)/min
Acceleration from Mach 0.6 to 1.25 at 5,000 m (16,400 ft)	54 s
Service ceiling	20,000 m (65,620 ft)
T-O run, with afterburning	670 m (2,198 ft)
Landing run, brake-chute deployed	1,000 m (3,280 ft)
Combat radius	432 nm (800 km; 497 miles)
Max range	1,187 nm (2,200 km; 1,367 miles)
g limit in sustained turn at Mach 0.9 at 5,000 m (16,400 ft)	+4.83

The Cheetah has many design features in common with the Israeli Kfir, but retains an Atar engine

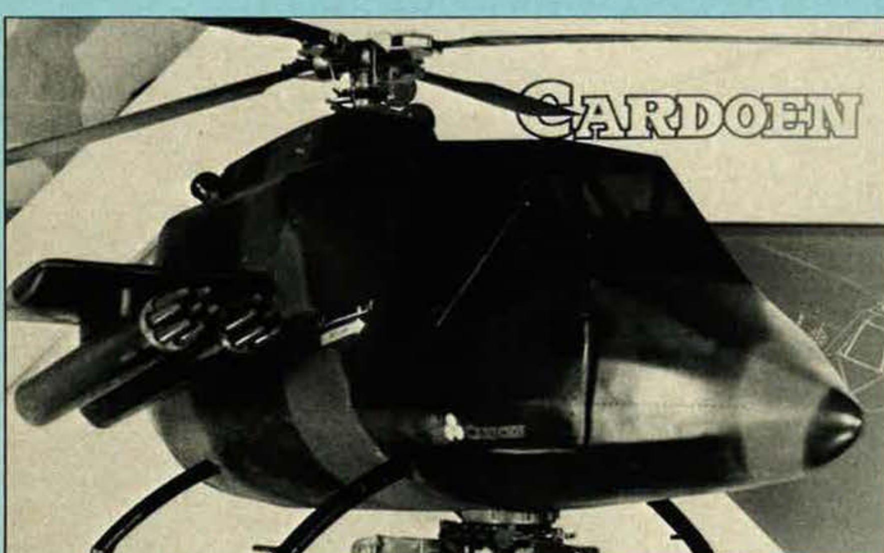
CARDOEN

INDUSTRIAS CARDOEN SA, Avenida Providencia 2237, 6° Piso, Santiago, Chile

CARDOEN ATTACK HELICOPTER

Reports that Chile was developing an armed helicopter began to circulate in 1984, and at the FIDA air show in El Bosque in March 1986 Cardoen displayed a mockup of such an aircraft. It represented a twin-turbine helicopter apparently based on the MBB BO 105, which is currently being assembled locally by ENAER Chile, although neither MBB nor ENAER is understood to be involved in the Cardoen project.

The modifications are generally similar to those by which the French Alouette III has been adapted for a similar role by ICA in Romania and Atlas in South Africa (see the *Jane's Supplements* for October 1985 and August 1986 respectively), mainly involving redesign of the forward fuselage and the endplate tail-fins. Initial reports from FIDA suggested that both single- and two-seat versions are proposed, with a first flight likely in late 1986 or early 1987. One or both seats would be provided with armour protection, fuel capacity increased, and the smaller profile would probably permit a higher maximum speed than that of the standard BO 105. An underfuselage Lucas turret mount is provided for a 12.7 mm (0.50 in) ventral gun, aimed by helmet sight, and there are stub-wings in line with the rotor mast, each with two attachments for the carriage of 70 mm rocket pods, bombs, or anti-tank missiles such as Hot or TOW. Other features are believed to include a head-up display, night vision system, and digital avionics.



Mockup of Cardoen attack helicopter displayed at FIDA air show in Chile *(Jorge F. Núñez Padín)*

ATLAS

ATLAS AIRCRAFT CORPORATION OF SOUTH AFRICA (PTY) LIMITED, PO BOX 11, Atlas Road, Kempton Park 1620, Transvaal, South Africa

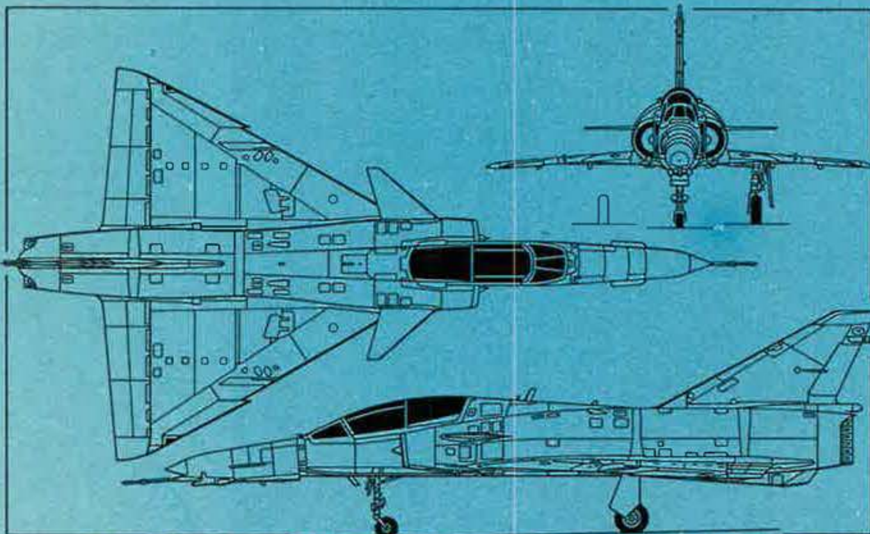
ATLAS CHEETAH

The South African Air Force has given the name Cheetah to a redesigned and upgraded version of the Mirage III which is now undergoing modification by Atlas Aircraft Corporation. The new name, justified by the extensive changes, commemorates the fact that South Africa's first Mirage IIIs entered service, in March 1963, with the SAAF's No. 2 'Cheetah' Squadron.

Unveiled by Prime Minister P. W. Botha in Pretoria on 16 July 1986, the Cheetah's configuration invites immediate comparison with the Israel Aircraft Industries Kfir, although official South African statements imply that no outside assistance was given in its design. According to the SAAF, the modification is a mid-life update aimed at increasing the aircraft's operational life, made necessary by the continuing escalation of hostile forces on South Africa's borders (notably between northern Namibia and southern Angola) and the country's inability to procure modern front-line aircraft from elsewhere since the United Nations embargo on the sale of arms to South Africa in November 1977. Since then, and increasingly since the ending of Impala Mk 2 production, Atlas has been charged with maintaining and updating the existing aircraft of the SAAF.

South Africa received some 74 Mirage IIIs from France between 1963 and the mid-1970s, and the majority of these remain in service. No. 2 Squadron at Hoedspruit in the Eastern Transvaal operates a mixture of the single-seat Mirage III-CZ, two-seat III-BZ trainer, and reconnaissance III-RZ/-R2Z models, while No. 85 Combat Flying School at Pietersburg flies mainly the III-EZ single-seater and III-DZ/-D2Z two-seat combat trainer versions. Most of these are powered by 60.8 kN (13,670 lb st) SNECMA Atar 9C afterburning turbojet engines, but the later D2Z and R2Z have the higher rated (70.6 kN; 15,873 lb st) Atar 9K-50. In the mid-1970s Atlas acquired a licence to manufacture the latter engine, which also powers the SAAF's Mirage F1s, and refit with the 9K-50 may be an ingredient of the Cheetah modification.

According to the SAAF, the Cheetah programme includes new performance levels, and the replacement of many structural components and upgrading of flight systems, about 50 per cent of the existing airframe being reconstructed and equipped with the latest navigation and weapon systems. The Cheetah chosen for the July 1986 rollout was a two-seat III-D2Z (SAAF serial number 845), and exhibited many outward similarities to the TC2/TC7 two-seat versions of the Kfir, including the sweptback, intake mounted fixed foreplanes, small nose side-strakes, curved lower-fuselage side-strakes, and



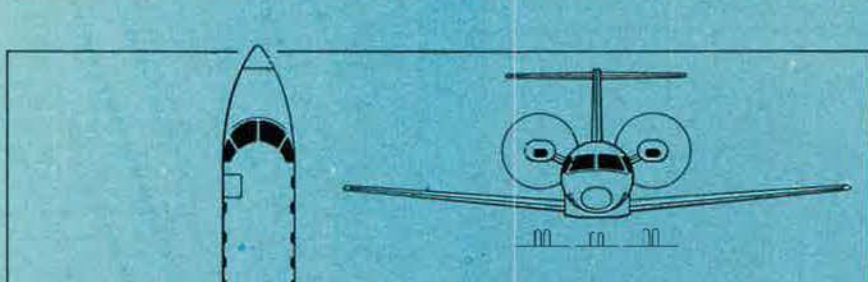
Atlas Cheetah tandem two-seat multi-role combat aircraft *(Jane's/Mike Keep)*

'dog-tooth' wing leading-edges. The nose extension appears to be shorter than that of the Kfir TC, and has rather more droop, but is large enough to accommodate a multi-mode radar. Beneath the nose mounted pitot probe are box and blister shaped fairings which suggest the presence of such equipment as a Doppler or terrain following radar and an infra-red seeker. Retention of the Atar engine is confirmed by absence of the Kfir's large dorsal airscoop (for its bigger, heavier J79 engine) and also of the smaller, rearmost pair of overfuselage airscoops of the Israeli aircraft. The Cheetah also retains the upward opening framed canopy of the two-seat Mirage.

Sum total of the changes may be expected to confer upon the Cheetah the same kind of performance benefits as those claimed for the Kfir, namely improvements in dogfighting agility, especially in instantaneous and sustained turn rates (19°/s and 9.5°/s respectively in the case of the Kfir); handling and control at higher angles of attack; gust response, especially at low level; and take-off and landing distances. Other general performance figures are likely to remain similar to those of the Mirage III.

In addition to the pair of built-in 30 mm DEFA cannon, recent armament of SAAF Mirage IIIs has consisted primarily of Matra R550 Magic or AIM-9 Sidewinder air-to-air missiles, medium-range Matra R530 missiles, Matra JL-100 combined fuel/missile pods, and Nord AS 30 air-to-surface missiles. The Magic has already begun to be replaced by the domestic Armscor V3B infra-red homing missile, and it has been stated officially that all weaponry for the Cheetah is totally of South African origin.

Artist's impression of the EMBRAER EMB-123 nineteen-seat transport, due to enter service in 1990



EMBRAER EMB-123 twin-turboprop regional and corporate transport *(Jane's/Mike Keep)*

EMBRAER

EMPRESA BRASILEIRA DE AERONÁUTICA SA, Av Brig Faria Lima 2170, Caixa Postal 343, 12200 São José dos Campos, SP, Brazil

EMBRAER EMB-123

Following a co-operation agreement with the Fabricá Militar de Aviones (FMA) of Argentina, signed in January 1986, EMBRAER revealed in April provisional details of a proposed new commuter transport aircraft to be known as the EMB-123. At that time it was planned to use a lengthened version of the EMB-121 Xingu fuselage, fitted with foreplanes, but by the time that a more detailed description was released at the Farnborough International air show in September 1986 it had been decided to delete the canard surfaces and to adopt a shortened version of the larger diameter EMB-120 Brasilia fuselage. Orders and options for the Brasilia totalled 218 at that time, and the EMB-123 will now share with that aircraft approximately 60 per cent commonality of components, including almost the same flight deck, as well as common maintenance and cabin and crew procedures. Combined with a new supercritical wing, a T tail, and two rear mounted 'pusher' turboprop engines with scimitar propeller blades, the EMB-123 in this configuration is expected to offer an optimum combination of fuel efficiency and speed, as well as an extremely smooth and quiet ride. Certification will be to FAR/JAR Pt 25 (Transport Category), with noise certification to FAR Pt 36 (ICAO Annex 16).

The EMB-123 is expected to enter service in 1990, replacing the EMB-110 Bandeirante, and the Brazilian and Argentine governments have announced their intention to support its launch with the purchase of 36 aircraft each, for military and executive transport or corporate use. The agreement includes purchase by Argentina of an undisclosed number of EMB-312 Tucano turboprop trainers, and collaboration in the EMB-123 programme was being discussed also with Chile and Peru in the Autumn of 1986. Under present arrangements, one-third of the work-split between Brazil and Argentina is allocated to FMA, which will produce the wings, fins, and rudders.

TYPE: Twin-turboprop regional and corporate transport aircraft.

WINGS: Cantilever low-wing monoplane. High aspect ratio wings with supercritical section and 8° sweepback, taper being increased on inboard portions by extending chord and sweeping trailing-edges forward. Two-segment flaps and single aileron on each trailing-edge.

FUSELAGE: Pressurised semi-monocoque structure of circular cross-section; generally as for EMB-120, but of reduced length.

TAIL UNIT: Broad chord sweptback fin and rudder, with shallow dorsal fin. Sweptback variable incidence tailplane with balanced elevators.

LANDING GEAR: Retractable tricycle type, with twin wheels on each unit. Mainwheels retract inward into wing/underfuselage fairing; nose unit retracts rearward.

POWER PLANT: Two 895 kW (1,200 shp) class Pratt & Whitney Canada or Garrett turboprop engines, each driving a slow-turning 'pusher' propeller with reversible pitch, autofeathering, synchrophasing, and six scimitar blades. Engines mounted at rear of fuselage, on pylons set at dihedral angle of approx 30°, and having a cruise/climb rating of 746 kW (1,000 shp). Fuel in two integral wing tanks with combined capacity of 1,211 litres (266.5 Imp gallons; 320 US gallons). Single-point pressure fuelling/defuelling, and overwing gravity refuelling.

ACCOMMODATION: Crew of two on flight deck, with optional seat to rear for observer. Standard commuter cabin layout for 19 passengers, in five rows of three and a final four-seat row, at 79 cm (31 in) pitch. Wardrobe, toilet, galley, and seat for cabin attendant at front of cabin. Underseat and overhead bin stowage for carry-on baggage; main baggage/cargo compartment aft of rear row of seats. Executive interiors, to customer's requirements, available optionally. Passenger door and baggage/cargo door on port side, at front and rear of cabin respectively. Passenger emergency exit above wing on each side; flight deck side windows serve as emergency exits for crew. Entire accommodation pressurised and air-conditioned. Max pressure differential 0.56 bars (8.2 lb/sq in), giving a S/L cabin atmosphere up to 6,400 m (21,000 ft), and a 2,440 m (8,000 ft) environment at altitudes up to 12,200 m (40,000 ft).

AVIONICS: Generally similar to those for EMB-120 Brasilia. Standard fit will include electronic flight instrumentation system (EFIS), electronic engine and instrument caution advisory system (EICAS), autopilot/flight director, flight data recorder, cockpit voice recorder, and weather radar.

DIMENSIONS, EXTERNAL:	
Wing span	16.46 m (54 ft 0 in)
Wing aspect ratio	12.32
Wing taper ratio	0.5
Length overall	17.19 m (56 ft 4¾ in)
Height overall	5.61 m (18 ft 4¾ in)
Tailplane span	5.79 m (19 ft 0 in)
Wheel track	3.47 m (11 ft 4½ in)
Wheelbase	7.62 m (25 ft 0 in)
Cargo door:	
Height:	1.30 m (4 ft 3¼ in)
Width	1.36 m (4 ft 5½ in)
DIMENSIONS, INTERNAL:	
Cabin: Max width	2.10 m (6 ft 10¾ in)
Max height	1.76 m (5 ft 9¼ in)
Baggage compartment volume	6.30 m³ (222.5 cu ft)
AREA:	
Wings, gross	22.0 m² (236.8 sq ft)
WEIGHTS (estimated):	
Basic operating weight empty	4,900 kg (10,802 lb)
Max fuel	980 kg (2,160 lb)
Payload with max fuel	1,820 kg (4,012 lb)
Max payload	2,000 kg (4,409 lb)
Baggage	450 kg (992 lb)
Max ramp weight	7,740 kg (17,064 lb)
Max T-O weight	7,700 kg (16,975 lb)
Max landing weight	7,550 kg (16,645 lb)
Max zero-fuel weight	6,900 kg (15,212 lb)
PERFORMANCE (ISA, estimated, at max T-O weight except where indicated):	
Max cruising speed at 9,150 m (30,000 ft), 95% of MTOGW	340 knots (630 km/h; 391 mph)
Max rate of climb at S/L	762 m (2,500 ft)/min
Rate of climb at S/L, one engine out	244 m (800 ft)/min
Max operating altitude	12,200 m (40,000 ft)
FAR 25 balanced T-O distance:	
ISA at S/L	1,200 m (3,937 ft)
ISA + 20°C at 1,525 m (5,000 ft)	1,500 m (4,921 ft)
FAR 135 landing distance at max landing weight:	
ISA at S/L	1,200 m (3,937 ft)
ISA + 20°C at 1,525 m (5,000 ft)	1,330 m (4,364 ft)
Range with max passenger payload at 10,670 m (35,000 ft), IFR reserves for 100 nm (185 km; 115 mile) diversion and 45 min hold	700 nm (1,296 km; 805 miles)

Launching an LSI/DS SkyEye R4E-40 on a reconnaissance mission

LSI/DS

DEVELOPMENTAL SCIENCES (Astronics Division of Lear Siegler Inc), 1930 South Vineyard Avenue, PO Box 50000, Ontario, California, USA

Since 1971 Developmental Sciences, which became the Astronics Division of Lear Siegler Inc in April 1984, has designed and built, under contract to various US agencies and manufacturers, a number of advanced RPVs for research and other purposes. Details of several of these have appeared in previous editions of *Jane's*. Recent designs have included the Gunsight, Locomp, and AED air vehicles (1983–84 edition), development of which is continuing in 1986. More recently, however, main activities have been concentrated on the SkyEye R4E-40 RPV system, supporting foreign and domestic operators of this system.

LSI/DS's SkyEye mini-RPV programme started in late 1972, and the prototype flew for the first time on 26 April 1973. Details of the early models can be found in the 1980–81 and previous editions of *Jane's*. First flight of the improved SkyEye R4D was made in 1978, and this model was described and illustrated in the 1982–83 *Jane's*.

LSI/DS SKYEYE R4E-40

From its success with the R4D, and its work on the US Army Aquila programme, for which it built the first 38 air vehicles, LSI/DS began in 1980 to develop a family of R4E SkyEyes that respond to customers' needs for a variety of missions, payloads, and vehicle sizes. The R4E has an entirely different airframe configuration to that of the R4D, and has been in operational service in Thailand since 1983 (R4E-30) and with the US Army (R4E-40) since 1984.

The SkyEye can perform both day and night missions that include real-time surveillance, reconnaissance, tactical weather observation, artillery and naval gunfire and close air support, laser designation and rangefinding, battle damage assessment, coastal and maritime patrol, elint/sigint/comint, ECM, communications relay, and weapons delivery and emplacement. Operational suitability in many of these roles has already been demonstrated successfully.

The system is completely mobile, being transportable by ground vehicles, military transport aircraft, or naval vessels. A typical ground based SkyEye unit consists of four to six RPVs, a mobile command and control shelter, a mobile launch system, and a personnel/equipment transport vehicle.

Joint Lear Siegler/US Army operations in 1984–85 included reconnaissance patrols along the Honduran/Nicaraguan border after launch from airfields at Puerto San Lorenzo and Palmerola in central and southern Honduras. Four SkyEyes were delivered to the US Army in late 1984, with a further four funded in mid-1985.

Operations have included night launch and recovery, and the use of both daylight and LLLTV payloads, FLIR sensors, and a panoramic camera. SkyEye is expected to be a major contender in the US Army's IEW-UAV competition (intelligence and electronic warfare unmanned air vehicle).

Brief details of other R4E versions were given in the 1984–85 *Jane's*. The following description applies specifically to the R4E-40:

TYPE: Multi-mission mini-RPV.

AIRFRAME: Cantilever high-wing monoplane with a fuselage pod, twin tailbooms, twin sweptback fins (one with rudder), and an enclosed tailplane with central elevator. Inboard wing panels are sweptback, with ailerons on their trailing-edges; outer panels have swept leading-edges, non-swept trailing-edges, and are set at an anhedral angle. The engine is mounted at the rear of the fu-

LSI/DS SkyEye R4E-40 RPV, used operationally by US Army in Central America

selage pod, driving a pusher propeller, and there is an extendable landing skid beneath the fuselage. Airframe construction is primarily of graphite (carbonfibre) and Kevlar reinforced epoxy, and is fully sealed for long life in hot and humid climates. The SkyEye can be fitted with a rail or pod under each wing, in line with the tailboom, for the carriage of external stores (*e.g.*, chaff).

POWER PLANT: One LSI/DS modified Kawasaki 440 cc two-cylinder two-stroke engine (nominal rating 28.3 kW; 38 hp), driving a two-blade fixed-pitch wooden pusher propeller (variable-pitch propeller optional). Bladder fuel tank in each wing.

LAUNCH AND RECOVERY: All American Engineering HP-3403 hydraulic/pneumatic catapult launcher. The HP-3403 is self-contained, can be truck mounted, and can launch a vehicle within ten minutes of being started, so eliminating both the recurring expense of a rocket boost and its associated infra-red, noise, and visual signatures. System contains enough engine fuel for 20 launches. The RPV uses a simple extendable-skid landing system that allows a pilot, after brief training, to land the RPV safely by monitoring the TV picture from the RPV's nose camera. The RPV is flown in the landing pattern to a short field; full pitch-up is then applied while the RPV limits elevator position to provide an approach speed safely above stalling speed. A specially designed shock attenuation system compensates for not flaring the RPV, and the vehicle skids to a straight stop in a few hundred feet. As a backup to the skid landing, for use in rough terrain or in an emergency, a low altitude (less than 61 m; 200 ft), 12.8 m (42 ft) diameter cruciform parachute (housed in the wing centre-section between the fuel tanks) is deployed.

GUIDANCE AND CONTROL: Radio/TV command guidance system, with fully equipped three-axis autopilot for stability and precise control, even in very rough air. LSI/DS guidance and control unit includes vertical gyro, yaw rate gyro, barometric altitude transducer, vertical accelerometer, airspeed transducer, and compass. Aircraft can be operated in four different modes, in-flight selected from the command console: (1) rate mode, commanding rate of climb/descent and turn, used for target tracking and other tasks requiring continuous manoeuvring of the RPV; (2) attitude mode (used, for example, to align vehicle weapons with a target, or for landing); (3) automatic (pre-programmed) mode; and (4) manual mode, in which uplink commands are applied directly to the RPV's control surfaces. (Manual is an electrically redundant mode, used in case of autopilot failure; because of SkyEye's low speed and high intrinsic stability, it can be operated safely without autopilot.) The type of data link used depends upon customers' specific requirements, and both analog and digital links can be specified. Avionics and data link equipment are housed in a rear fuselage bay, together with the electrical system equipment, which comprises a 980W engine driven alternator (2 kW alternator optional) for 28V DC power, and an emergency battery which provides 5 min flying time in the event of alternator failure.

OPERATIONAL EQUIPMENT: The large payload volume and weight capacity permit the accommodation of a wide variety of payloads, carried individually or in combinations. Demonstrated examples of payloads carried by the R4E-40 include gyro stabilised daylight and low light level TV systems in combination with panoramic cameras or communications repeaters; a standard US Army common module gyro stabilised FLIR (Texas Instruments AIR-360/3) in a gimballed 'chin' turret, in combination with infra-red linescanners (Texas Instruments RPV-700); and nose mounted TV with underwing rocket launchers (up to six 10 kg rockets or tubes for 2.75 in rockets). Other payloads can include multiple meteorological sensors, a laser designator/rangefinder, two 33 kg (73 lb) underwing pods of fuel or ejectable items such as chaff, leaflets, flares, or communications jammers.

DIMENSIONS, EXTERNAL:
- Wing span: 5.36 m (17 ft 7 in)
- Wing aspect ratio: 7.9
- Length overall: 3.72 m (12 ft 2½ in)
- Propeller diameter: 0.79 m (2 ft 7 in)

AREA:
- Wings, gross: 3.63 m² (39.1 sq ft)

WEIGHTS:
- Weight empty: 127 kg (280 lb)
- Max payload: 63.5 kg (140 lb)
- Max standard fuel: 45.5 kg (100 lb)
- Max launching weight: 236 kg (520 lb)
- Max weight for parachute recovery: 190.5 kg (420 lb)

PERFORMANCE:
- Max level speed ('clean' configuration): 136 knots (252 km/h; 156 mph)
- Max rate of climb at S/L: 305 m (1,000 ft)/min
- Service ceiling:
  - AUW of 227 kg (500 lb): 4,575 m (15,000 ft)
  - AUW of 190.5 kg (420 lb): 6,100 m (20,000 ft)
- Typical command and control range: 80 nm (148 km; 92 miles)
- Max endurance:
  - 63.5 kg (140 lb) payload, at S/L: 7 h 42 min
  - 63.5 kg (140 lb) payload, at 4,875 m (16,000 ft): 6 h 24 min
  - 45.5 kg (100 lb) payload, at S/L: 8 h 12 min

PARTENAVIA

PARTENAVIA COSTRUZIONI AERONAUTICHE SpA, Via Cava, 80026 Casoria (Naples), Italy

PARTENAVIA P. 86 MOSQUITO

Powered by an Italian KFM 112M flat-four engine, the prototype of this lightweight two-seater flew for the first time on 27 April 1986, little more than a year after the initiation of design work. Production Mosquitos, to which the detailed description applies, will have a more powerful engine. They will conform with FAR Pt 23 Utility category standards, in the hope of attracting a production order from the Aero Club d'Italia.

TYPE: Two-seat light aircraft.

WINGS: High-wing monoplane, with single streamline section bracing strut each side. Constant-chord non-swept wings, of NACA 63A-416 (mod) section, with 1° 30' dihedral and 3° incidence. Two-spar torsion box structure of 2024-T3 aluminium alloy, with trailing-edge split flaps and plain ailerons. No tabs.


The prototype Partenavia P. 86 Mosquito two-seat light aircraft

FUSELAGE: Semi-monocoque forward fuselage and tubular tailboom, all of aluminium alloy.

TAIL UNIT: Cantilever all-metal stressed skin structure of 2024-T3 aluminium alloy, with front and rear channel section spars. Fixed incidence tailplane, mounted above tailboom on short pylon. Endplate fins and rudders. No rudder tabs; trim tab in centre of elevator.

LANDING GEAR: Non-retractable tricycle type, with Partenavia leaf spring shock absorption. McCreary wheel size 5.00-5, and tyre size 360 × 120-165 mm (5 ply), on each unit; tyre pressures 1.72 bars (25 lb/sq in) on main gear, 1.03 bars (15 lb/sq in) on nose unit. Cleveland 30-18 brakes.

POWER PLANT: One 59 kW (80 hp) Limbach L 2000 flat-four engine, driving a Hoffman two-blade fixed-pitch propeller with spinner. Alternative engines include Lycoming O-160 of same power. Single integral fuel tank in wings, capacity 70 litres (15.4 Imp gallons). Refuelling point on inboard section of starboard wing. Oil capacity 2.5 litres (0.55 Imp gallons).

ACCOMMODATION: Side by side seats for pilot and one passenger, with baggage space behind seats. Upward opening door, with window, on each side of cabin. Cabin ventilated via ram air intake in wing leading-edge.

AVIONICS: King or Collins VHF com/nav radio, ADF and ATC transponder at customer's option.

DIMENSIONS, EXTERNAL:
- Wing span: 10.00 m (32 ft 9¾ in)
- Wing chord, constant: 1.25 m (4 ft 1¼ in)
- Wing aspect ratio: 8.0
- Length overall: 6.775 m (22 ft 2¾ in)
- Fuselage: Max width: 1.22 m (4 ft 0 in)
- Height overall: 1.923 m (6 ft 3¾ in)
- Tailplane span: 2.80 m (9 ft 2¼ in)
- Wheel track: 2.00 m (6 ft 6¾ in)
- Wheelbase: 1.567 m (5 ft 1½ in)
- Propeller diameter: 1.65 m (5 ft 5 in)
- Propeller ground clearance: 0.325 m (1 ft 0¾ in)
- Cabin doors (each):
  - Height: 0.90 m (2 ft 11½ in)
  - Max width: 0.60 m (1 ft 11½ in)
  - Height to sill: 0.975 m (3 ft 2½ in)

DIMENSIONS, INTERNAL:
- Cabin: Length: 0.90 m (2 ft 11½ in)
  - Max width: 1.00 m (3 ft 3¼ in)
  - Max height: 1.00 m (3 ft 3¼ in)
  - Floor area: 0.86 m² (9.26 sq ft)
  - Volume: 0.82 m³ (28.96 cu ft)
- Baggage space: Volume: 0.42 m³ (14.83 cu ft)

AREAS:
- Wings, gross: 12.50 m² (135.2 sq ft)
- Ailerons (total): 1.028 m² (11.07 sq ft)
- Rudders (total): 0.61 m² (6.57 sq ft)
- Tailplane: 1.34 m² (14.42 sq ft)
- Elevators (total): 0.80 m² (8.61 sq ft)

WEIGHTS AND LOADINGS:
- Basic weight empty: 320 kg (705 lb)
- Max fuel weight: 50 kg (110 lb)
- Max T-O and landing weight: 540 kg (1,190 lb)
- Max wing loading: 43.2 kg/m² (8.85 lb/sq ft)
- Max power loading: 9.15 kg/kW (14.88 lb/hp)

PERFORMANCE (at max T-O weight):
- Never-exceed speed: 150 knots (278 km/h; 172 mph)
- Max level speed at S/L: 97 knots (180 km/h; 112 mph)
- Max cruising speed at S/L: 86 knots (160 km/h; 99 mph)
- Econ cruising speed at S/L: 80 knots (148 km/h; 92 mph)
- Stalling speed:
  - flaps up: 41 knots (76 km/h; 47 mph)
  - flaps down: 36 knots (67 km/h; 42 mph)
- Max rate of climb at S/L: 235 m (770 ft)/min
- Service ceiling: 3,995 m (13,100 ft)
- T-O run: 149 m (490 ft)
- T-O to 15 m (50 ft): 311 m (1,020 ft)
- Landing from 15 m (50 ft): 120 m (395 ft)
- Range with max fuel at econ cruising speed, allowances for start, taxi, T-O, descent, and 30 min reserves: 340 nm (630 km; 391 miles)

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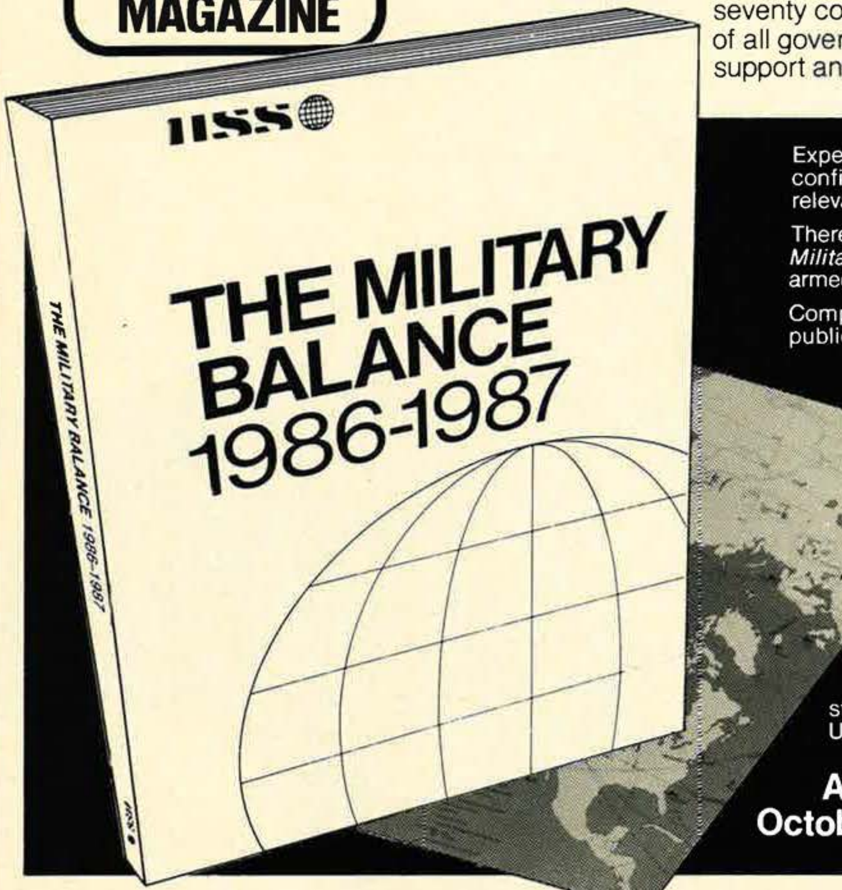

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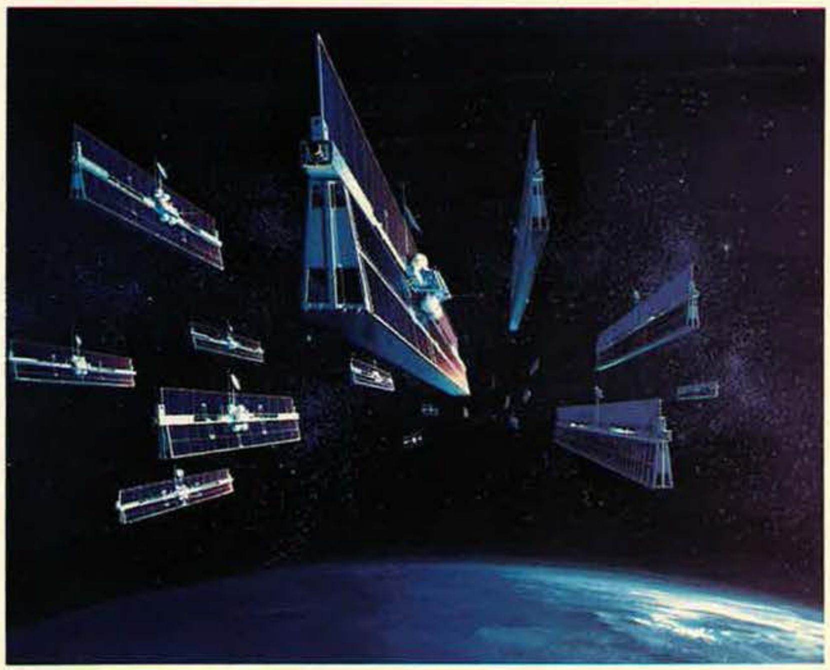
The Art of

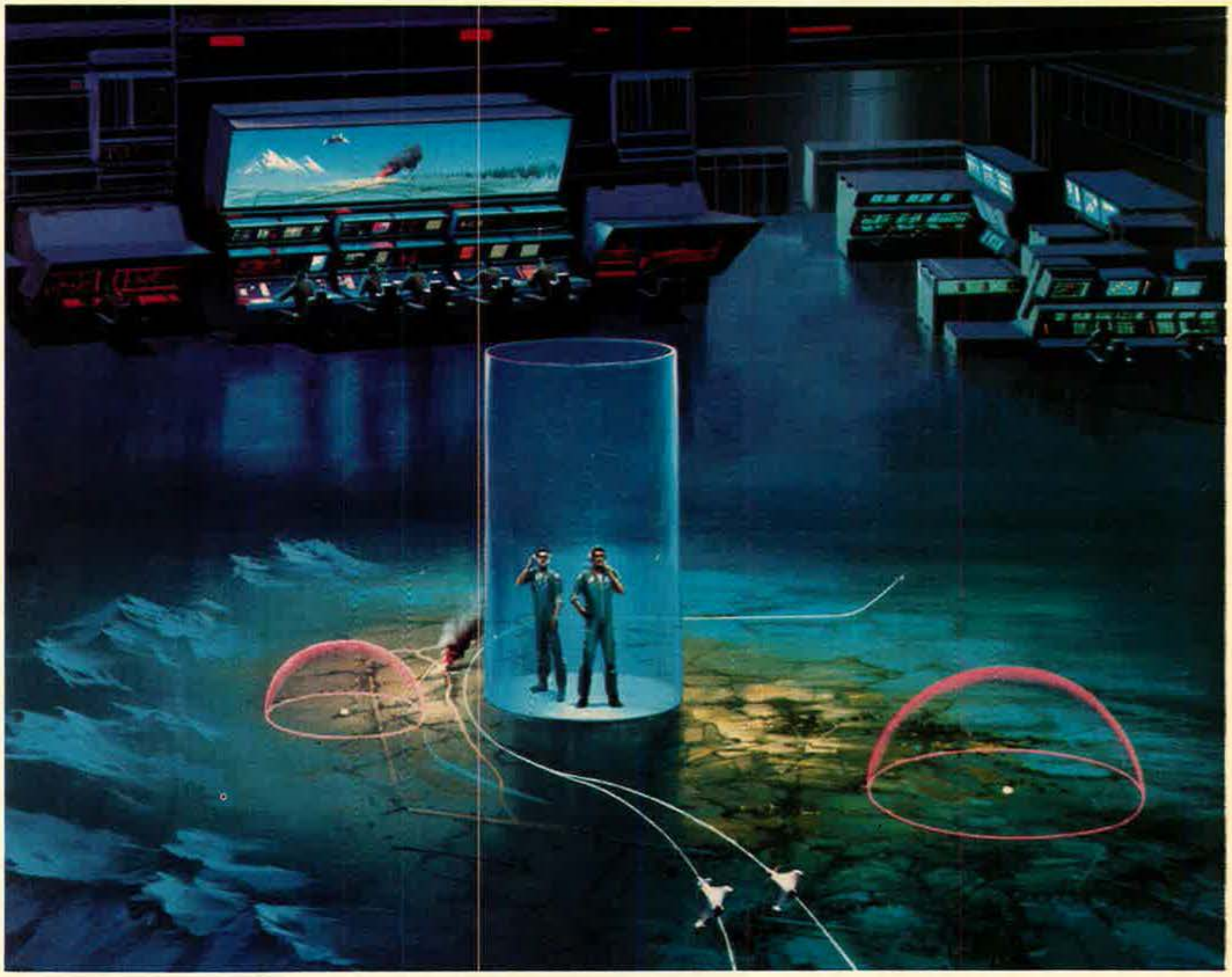
the Future

A SPECIAL REPORT

Tomorrow's Air Force, as foreshadowed in USAF's Project Forecast II study, takes shape in the futuristic artwork on these pages. Faithful to Forecast II's spirit and substance, the artists portray the forms and functions that the study's choice technologies and systems concepts are expected to forge in "revolutionizing the way the Air Force carries out its mission in the twenty-first century." This is the art of the possible, not of the improbable.



LEFT: The National Aerospace Plane, a major Forecast II initiative, will embody many of the technologies and systems flagged by Forecast II as crucial to USAF's future. ABOVE: This depiction of a "distributed sparse array of spacecraft" shows relatively small satellites, each featuring phased-array sensors, operating in coordination with one another in space.



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ABOVE: *Battle management processing and display systems of the future would incorporate the swiftly advancing technologies of computers, software, and artificial intelligence, all at the service of combat commanders.* RIGHT: *Intratheater V/STOL transport aircraft would take advantage of the best and latest in avionics, propulsion, and other aeronautical technologies to transform airlift operations in combat zones for the better.*

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The Art of the Future

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Project Forecast II envisions laser-firing spacecraft that would defend other spacecraft against attack. The "spacecraft defender/satellite protection" concept is a major one among Forecast II priorities, as are others having to do with USAF's increasing need to operate in space and protect the nation's assets there. Strategic Defense Initiative spin-offs should prove a boon in this regard.

The Art of the Future

***RIGHT:* Many of Forecast II's technologies and systems depend in one way or another on "knowledge-based systems," meaning those that combine human and artificial intelligence in service of functions such as those depicted here. *BELOW:* Taking off and landing vertically or in short distances is increasingly an imperative for USAF combat aircraft. Shown here is a "super" V/STOL fighter that just may evolve from a test-bed program already under way at USAF's Aeronautical Systems Division.**

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SofTech
Software AG
Space Applications Corp.
Space Ordnance Systems
Sperry Corp.
Standard Manufacturing Co., Inc.
Stewart & Stevenson Services, Inc.
Sundstrand Corp.
Sverdrup Corp.
Syscon Co.
System Development Corp., A Burroughs Co.
Systems and Applied Sciences Corp.
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.
3M Stormscope Weather Mapping Systems
Titan Systems, Inc.
Tracor, Inc.
Trident Data Systems
TRW Electronics & Defense Sector
TRW Space & Technology Group
United Airlines Services Corp.
United Technologies Corp.
Universal Propulsion Co., Inc.
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.
Walter Kidde Aerospace Operations
Western Gear Corp.
Westinghouse Electric Corp.
Westinghouse Electric Corp., Baltimore Div.
Wild & Leitz Technologies Corp.
Williams International
Wyman-Gordon Co.

usually came back, even when it was shot up.

The P-38 Lightning, the Air Corps's first production plane to fly faster than 400 miles per hour, brought a whole raft of problems for the Lockheed team to conquer. Chief among these was the phenomenon of "compressibility," or the buildup of air ahead of the airplane at high speeds. Although they didn't master the mystery of compressibility, a way of avoiding it was found by adding external dive brakes to the P-38.

The Skunk Works came into being during the war when Johnson single-handedly went after and got a contract for the P-80. Using wooden B-17 engine crates and twenty-three engineers "scrounged" from around the plant, he set up the Skunk Works next to the wind tunnel in the Burbank plant. The Works got its name from the still belonging to the hairy Indian in Al Capp's "Li'l Abner" comic strip who would combine skunks, shoes, and sundry other items to make his "kickapoo joy juice." The name just seemed to fit.

The F-104 and U-2 were the next aviation advances to come out of the Skunk Works, which had five separate facilities during the course of its career. The days of the old Skunk Works are all but over now, but its crowning technical marvel—the SR-71—still flies today.

The Blackbird was unlike anything else that Kelly Johnson had been involved in. Literally everything—fuels, structural materials, manufacturing tools, fluids, sealants, paints, plastics, wiring, engines—had to be designed from scratch. The facts that design work began in August 1959 and that the airplane is still the highest (above 80,000 feet) and fastest (Mach 3+) thing in the sky today are testament to Johnson and the Skunk Works team.

Far from being just a litany of aircraft projects, this autobiography also deals with Kelly Johnson the man. He talks about his three marriages and the tragic deaths (one by cancer and the other by a long ordeal with diabetes) of his first two wives. All of his high-pressure work also took a toll on him. Kelly had two triple-bypass heart operations and had half of his stomach removed because of ulcers, and he discusses his health problems candidly.

He also talks with great pride of his extensive working ranches and his penchant for working hard and playing hard. An insight into his character is gained when he tells of deciding whether a new bridge on his Lone Star Ranch near Vandenberg AFB, Calif., should be stressed for carrying farm equipment or Minuteman missiles. (The missiles eventually won out.) These are the chapters in which this interesting book is at its very best.

This book works on a number of levels. Besides being Johnson's autobiography, it gives historical insights into some of the milestone events of aviation. It also details some effective managerial techniques and even gives a list of the Skunk Works' fourteen basic operating principles. The specialist will find these discussions of value, but they are neither too "inside" nor last long enough to bore the layman.

Johnson occasionally wanders off on tangents, and the book does have a small number of minor flaws. But these missteps are few and insignificant. Overall, *Kelly: More Than My Share of It All* is a good look at a fascinating man who has led, and who continues to lead, a perfectly charmed life.

—Reviewed by Jeffrey P. Rhodes, Defense Editor.

New Books in Brief

Air Interdiction in World War II, Korea, and Vietnam, edited by Richard H. Kohn and Joseph P. Harahan. This book is the second in the series of "senior statesmen" roundtable discussions sponsored by the Office of Air Force History. In this compilation, former air commanders Gen. Earle E. Partridge, Gen. Jacob E. Smart, and Gen. John W. Vogt address the issue of air interdiction—what it is, what its objectives are, and how they participated in its planning and execution during their respective careers. Pointing out that air interdiction can have "significant and possibly decisive effect" during battle, the roundtable panelists stress the need for adequate intelligence and strike systems and the importance of on-site tactical decision-making by field commanders to effect air interdiction successfully. This historical overview yields many valuable insights into an often overlooked aspect of air warfare. With photos, bibliography, and index. Published by the Office of Air Force History (available from the Government Printing Office), Washington, D. C., 1986. 104 pages. $4.75.

Jane's Avionics 1986–87, edited by Stephen R. Broadbent. Avionics is a fast-moving field. As Editor Broadbent notes, the term "avionics" had not even been coined when he entered the aerospace industry a little more than twenty years ago. Keeping current in this fast-moving field is made easier with the aid of this annual compilation, which details avionics equipment for sensing, data processing, navigation, flight control, weapons delivery, communications, and almost anything else having to do with electronics and flight. In his Foreword, Editor Broadbent cites the trend toward integrated design of avionics and airframe and the emergence of software as the driving force in avionics as significant developments to track in the years ahead. With photos and index. Jane's Publishing Inc., New York, N. Y., 1986. 550 pages. $112.

Logistics Technology and Management: The New Approach, by Joseph D. Patton, Jr. Logistics—defined simply as the management and integration of resources to support a system and its operations—is emerging as one of the most critical professions in a modern, technologically oriented society. For the military, logistics can be the make-or-break aspect of victory or defeat. This book is a comprehensive, in-depth, and much needed examination of the art and science of logistics. Author Patton, who based this book on his educational program for professional logisticians, here discusses such topics as acquisition, quality control, inventory management, life-cycle costs, and computers and information systems. Professional logisticians will find much to study in this serious book. With figures and tables, references, bibliography, and index. The Solomon Press, New York, N. Y., 1986. 338 pages. $39.

Soviet Naval Forces and Nuclear Warfare, by James J. Tritten. Western analysts tend to gloss over the Soviet Navy in considering the strategic balance of power between the US and the USSR. In this work, author Tritten argues persuasively that the Western tendency to denigrate or ignore the capabilities of Soviet naval forces is shortsighted and dangerous. Rejecting the notion that the Soviet Navy is a "defensive" force, the author contends that "Soviet naval nuclear weapons have distinct military utility and serve the political purposes of quickly ending war favorably and minimizing damage to the homeland." This vigorous analysis poses a significant challenge to the traditional assumption that Soviet naval forces are relegated to a secondary, supporting role. With tables, appendix, and index. Westview Press, Boulder, Colo., 1986. 282 pages. $27.50.

—Reviewed by Hugh Winkler, Assistant Managing Editor.

AIRMAN'S BOOKSHELF

A Charmed Life

Kelly: More Than My Share of It All, by Clarence L. "Kelly" Johnson with Maggie Smith. Foreword by Brig. Gen. Leo P. Geary, USAF (Ret.). Smithsonian Institution Press, Washington, D. C., 1985. 205 pages with illustrations and appendix. $17.50.

Some people lead absolutely charmed lives. These individuals have happy childhoods, they grow up and pursue careers that allow them to do exactly what they want to do, they meet and work with interesting and famous people, they make lasting contributions to their fields, and although they suffer some tragedy and hardship along the way, it can be said that, most of the time, they enjoyed that elusive thing called "fun."

Clarence L. "Kelly" Johnson, who retired partially in 1975 and fully two years later as Lockheed's Vice President for Advanced Development Projects, has led just such a life.

The U-2 and SR-71 reconnaissance planes are Johnson's engineering masterpieces, but over the course of a forty-four-year career during which he three times turned down the presidency of Lockheed, Johnson contributed to forty aircraft designs, including the Electra, Hudson, P-38, P-80, and F-104. More than twenty designs were his original ideas. Kelly Johnson's career not only paralleled Lockheed's history, it also ran in step with most of the milestones in the development of aviation.

One of Johnson's most enduring legacies is Lockheed's Advanced Development Projects section, more popularly known as the "Skunk Works." Johnson developed the Skunk Works around the old KISS axiom—Keep It Simple, Stupid—which was the guiding philosophy for seventeen major projects, including the U-2 and SR-71, that were developed at the Works.

The Skunk Works takes as few people as absolutely necessary for a project, makes them write as few reports as possible, gives them great design flexibility, functions with unshakable trust between the company and the customer, works as secretly as possible, and produces great results. For instance, the P-80 went from design to Army Air Forces acceptance in 143 days, and under a $20 million contract for twenty U-2s, the Skunk Works built twenty-six aircraft and returned $2 million to the government.

During his career, Johnson was a very effective manager, although he could be somewhat autocratic. He was called on the carpet by his superiors a few times early in his career, but he was always willing to listen to others and even had a standing offer of a quarter bet to anyone on his team who disagreed with him and who could back up what they said. Of course, the incentive was not the quarter, but beating the boss. He always insisted that all of the people who worked on any particular airplane be present for the first flight, and afterward, there was a huge party, complete with arm wrestling. He surrounded himself with good people, and he got the most from them.

The seventh of nine children, Clarence Leonard Johnson was born in 1910 in the town of Ishpeming, Mich., to Swedish immigrant parents. In addition to giving him an appreciation for tools and things mechanical, Peter Johnson, a brick mason, steered young Clarence into the local library. After reading and rereading the Tom Swift books, along with other volumes on airplanes, Johnson decided by age twelve that he wanted to design aircraft.

Even as a boy, he had a quick mind. Johnson earned his nickname in grammar school when he was goaded into fighting a school bully. Seeing that this kid Cecil was almost a foot taller than him, Kelly resorted to what is now known as "unconventional warfare"—he kicked the kid behind the knee to trip him and then fell on him, unintentionally breaking the bully's leg. After that, the other kids decided he should have a good fighting Irish name, and they started calling him "Kelly" after the hero of a popular song of the day.

Johnson does not say if he was aware of the works of Carl Jung and the concept of synchronicity, but several times in his early life, seemingly bad things happened to him that would later turn out to have pointed him in the right direction. After graduation from Flint Junior College, a local barnstormer told Kelly that he would not teach him to fly because the money would be better applied to a college education. An auto accident prevented him from playing football at the University of Michigan, so he concentrated instead on his studies. And finally, because of an injury suffered as a child when his sister shot an arrow into his eye, he could not pass the Air Corps physical. After completing graduate school, he went to work at Lockheed.

Circumspection was never one of Kelly Johnson's faults. Starting at $83 a month as a tool designer, the first thing the brash Johnson told his bosses, Cyril Chappellet and Hall L. Hibbard, when he was hired was that their design for the new Electra was unstable in all directions. Nevertheless, Hibbard went ahead and hired him.

After a few months, Johnson was sent back to the wind tunnel at Michigan to iron out the flaws in the Electra design. By adding a double tail, removing the wing fillets, and making a few other changes, the Electra became the airplane it was designed to be.

Now a full-fledged member of the engineering team, Johnson was assigned to analyze the retractable landing gear for Jimmy Doolittle's Orion 9-D, another of the company's designs. Doolittle was to be the first of many famous aviators—Amelia Earhart, Wiley Post, and Roscoe Turner, among others—with whom Johnson would work.

With the coming of World War II, Lockheed and Kelly Johnson shifted to a wartime footing. The first big sale was for more than 200 modified Model 14 Electras to the Royal Air Force. This aircraft, officially called Hudson by the RAF, became known to pilots as "Old Boomerang" because it

Lance Sijan's Incredible Journey

Alone in enemy territory with no food or water and unable to walk, Capt. Lance Sijan refused to give up.

BY JOHN L. FRISBEE
CONTRIBUTING EDITOR

ON the night of November 9, 1967, Lt. Col. John Armstrong, Commander of the 366th Tactical Fighter Wing's 480th Squadron based at Danang, rolled his F-4 into a bomb run. The target was Ban Loboy ford on the Ho Chi Minh Trail in Laos. In the backseat was twenty-five-year-old Capt. Lance Sijan, flying his fifty-third combat mission.

Colonel Armstrong pickled his six bombs at 2039 hours. Almost immediately, the aircraft was engulfed in a ball of fire as the bombs detonated a few feet below the F-4. Neither the FAC controlling the mission nor Armstrong's wingman saw chutes. But there was one chute. Captain Sijan ejected and was drifting toward a flat-topped, heavily forested karst formation. For Sijan, recollection stopped as the 195-pound Captain crashed into the towering trees.

Sometime the next day, Sijan regained consciousness in a haze of pain. He had suffered a compound fracture of the left leg, a crushed right hand, head injuries, and deep lacerations. Most of his survival gear was gone. He tended the broken leg as best he could, then lapsed again into unconsciousness.

The following morning, a flight of F-4s picked up the sound of Sijan's beeper, and a search-and-rescue operation got under way. Throughout the day, Sijan maintained contact with the rescue force, but several attempted pickups were thwarted by NVA gunners. At 1700 hours, a Jolly Green chopper made it in directly over Sijan. In a desperate attempt to crawl through tangled vines to the chopper's penetrator, Sijan lost contact with the rescue force. As darkness fell, the SAR operation was called off.

Early the next morning, the search resumed, but Sijan's radio batteries were depleted. Failing to make contact, the SAR team was recalled. Sijan was on his own. If he were to survive, he must make his way down the steep karst to water and an open area where he could warm the radio batteries and call in a chopper. With a crude splint on his shattered leg and only the thumb and forefinger of his right hand functioning, Lance Sijan began the most incredible journey in the history of Air Force survival efforts.

For several days, Sijan, lying on his back, pushed himself over the sharp rocks with his good right leg, a few painful inches at a time. His only source of moisture was dew licked from foliage in the mornings. There were many falls down the steep slope and periods of unconsciousness and delirium. First his clothing became shredded, then the skin on the back of his body, until he was inching along on raw flesh. At last he found water and pressed on, inch by agonizing inch.

Forty-five days after he parachuted into the forest, Lance Sijan saw ahead the open area he had been looking for. He dragged himself over a bank and fell unconscious in the middle of the Ho Chi Minh Trail, three miles from his starting point.

The young Captain regained consciousness in an NVA road camp, his formerly athletic body little more than a skeleton partially covered by transparent skin. He was given some food and water, but no medical attention. In spite of his pitiful condition, his mind focused constantly on escape. When some strength returned, Lance Sijan overpowered a guard and dragged himself up a trail, only to be recaptured and punished.

Sijan was moved to a temporary prison near Vinh, where he was beaten severely, but refused to give any military information. The guards, who had never seen a human in such ghastly condition, refused to touch him. Sijan was put in the care of Maj. Bob Craner and Capt. Guy Gruters, an F-100 FAC crew who had been shot down near Vinh. The latter had been in Sijan's squadron at the Air Force Academy. In his lucid moments, Sijan gave them the details of his long, painful journey.

Several days later, the three were loaded on an open truck for a three-night trip to Hanoi in the chill monsoon rains. At Hoa Lo Prison, they were put in a damp cell. Sijan, who had contracted pneumonia and was near death, asked his cellmates to prop him up on his pallet so that he could exercise his arms in preparation for escape from that grim, impregnable bastion.

On January 22, 1968, Capt. Lance Sijan died. When the POWs were freed in early 1973, Craner and Gruters recorded the details of his long fight for freedom and his resistance to torture. Later, they were major sources for Malcolm McConnell's book, *Into the Mouth of the Cat*. On March 4, 1976, President Gerald Ford presented the Medal of Honor posthumously to Lance Sijan's parents, and on Memorial Day of that year, a new dormitory at the Air Force Academy was dedicated in his memory.

Lance Sijan's will to survive with honor was an inspiration to other POWs during the dark days of the Vietnam War, as it should be to all of us. He demonstrated, as few have, the almost limitless capacity of the human spirit to triumph over the depredations of fate and the malevolence of lesser men. ■

force effectiveness, the logical extension of the data in Chart 3 is a war in which the US and its allies have very few aircraft with which to fight.

As a matter of fact, Norm Augustine [Norman R. Augustine, who has been a DoD R&D manager, an Under Secretary of the Army, and president of a major defense contractor and who is the author of the wise and witty *Augustine's Laws*, published in 1982 by the American Institute of Aeronautics and Astronautics] has taken the data from Chart 3 and projected it forward to show that—given the likely resources available in the future—by the year 2054 the DoD will buy one fighter per year. This will obviously be a very-high-performance aircraft, but not adequate to win in the high attrition environment likely for future warfare.

The less-expensive/higher-performance route being pursued by the Air Force in the ATF program is clearly preferable. It represents a challenge for our technologists, but it is the way the commercial world has been operating for some time, and the approach is one that the military world needs to adopt.

"Internationalization" of Industry

A final observation, based on these long-term military aircraft trends, is that there is a rather significant shift toward multinational ventures in the military aircraft arena. This is a direct consequence of the extremely high cost of developing and producing new aircraft. As the data in Chart 4 shows (for the same 132 new aircraft types produced by NATO nations in the last three decades), there has been a reduction of almost four to one in the number of single-country new aircraft to the point where, in the 1980s, the number of multinational new aircraft types equaled that of the single-country new aircraft.

Considering that, historically, most nations have believed it important to have a self-sufficient defense industry, this result may seem quite surprising. Nonetheless, it is consistent with broad trends toward internationalization that are being seen across the full spectrum of defense equipment. In the US, for example, we have recently "discovered" that large (and growing) shares of our critical weapon system components and subsystems—especially electronics—are now produced offshore. It is also consistent with trends in commercial aircraft (for example, with the European Airbus and the more recent joint venture between Boeing and its Japanese partner on the next large commercial aircraft).

What is unique to the military case, however, is that these multinational aircraft programs are often not done for purely economic considerations. The dual—and conflicting—objectives of self-sufficiency and economies of scale often result in multinational developments that conclude with each participating nation independently—and noncompetitively—building its own aircraft in very limited quantities, thereby losing the potential for multinational economies of scale. Overall, this internationalization of the defense industry—both at the component and system levels—is a policy area crying for attention.

In conclusion, it is fair to say that none of the trends pointed out here should surprise anyone who has been following the aircraft industry. Rather, what may come as a surprise is the magnitude of the shift and the consistency of the long-term trends. What is necessary now is for people to face these realities and their implications (in terms of structural adjustment of both the aircraft industry and of our military strategy and posture) and/or for people to work seriously on ways to attempt to reverse these trends (by actually utilizing advanced technology to lower the basic cost of weapon systems and by using advanced manufacturing technology and competitive market forces to drive down these costs still further). This is obviously a formidable challenge, but the alternatives are even less appealing. ■

THE MULTINATIONAL OPTION

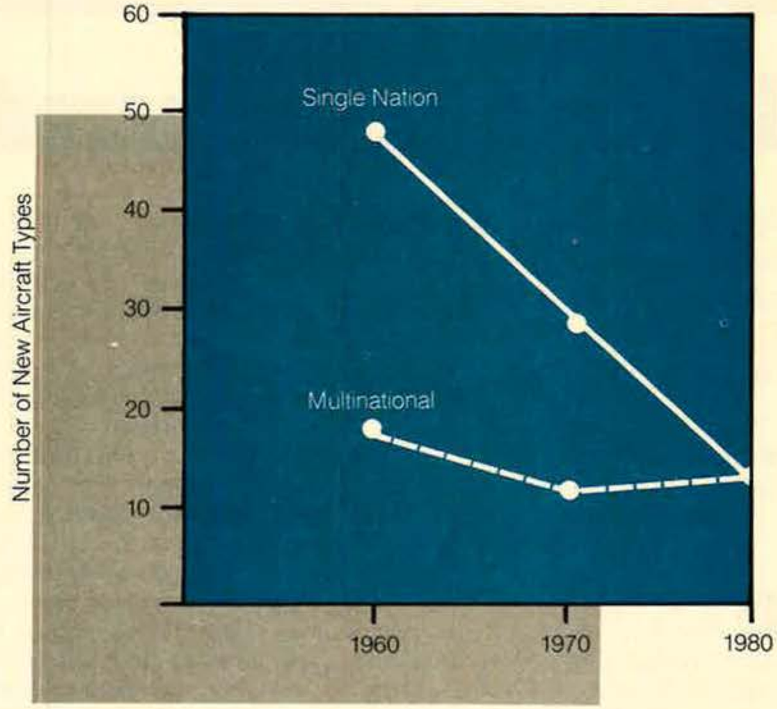


Chart 4. ***The 1980s have seen an "internationalization" of aircraft development and production. The data here reflects the trend in NATO, although the movement is broader than that.***

Dr. Jacques S. Gansler is Vice President of The Analytic Sciences Corp. (TASC). He is a former Deputy Assistant Secretary of Defense, a former industrial executive, and the author of The Defense Industry *(MIT Press, 1980). He is also a faculty member of the Kennedy School of Government at Harvard University. His most recent contribution to* Air Force *Magazine was "What Ails the Acquisition Process?" in the July '85 issue.*

tried to incorporate rapid advances in expensive and high-risk technologies—often before they are "ready." Despite our initial success in meeting F-16 design-to-cost goals, subsequent modifications have driven up the cost, pushing it closer to the curve on Chart 2.

Off the Curve

The Air Force's management is determined to move the cost of its next-generation fighter aircraft (the Advanced Tactical Fighter, or ATF) "off the curve." By looking at the data in Chart 2 and performing preliminary analyses of the cost for the ATF in the absence of any design-to-cost philosophy, one could expect that, by the time of its deployment, a unit production cost approaching—or even exceeding—$100 million would have been likely. This is plotted on Chart 2 as "Option A." Instead, the Air Force has chosen a number in the $35 million to $40 million unit production-cost range—shown as "Option B" on Chart 2—and will use this as a principal criterion in the selection of the winning designs and contractors.

Meeting these dual goals of advanced performance at an "affordable" price will be a formidable engineering challenge when you consider, for example, the difficulty of fabricating stealth airframes. To succeed, it will undoubtedly also require the early application of advanced manufacturing technology.

Finally, to *keep* costs down while continuing to improve performance as the program evolves will likely require market incentives, such as continuous competition between two producers (of both the aircraft and its principal subsystems). This technique ("dual sourcing") has historically been found to have very significant performance and cost benefits when it has been applied to defense weapon systems and is usually well worth the added investment costs for the second producers.

Clearly, new aircraft must move off of the historical cost curve. The reason is shown by the data in Chart 3, which illustrates the decline in the average number of fighters bought by the US each year over the last four decades. Similar quantity reductions have been found for bombers and for our NATO allies. Only the significant increases in defense budgets brought about by the Reagan Administration prevented this quantity trend from dropping further over the last few years.

It is the data in Chart 3 that has the most critical implications for military effectiveness. We could manage to fight a war with fewer types of aircraft, and if we had sufficient resources, we could afford to pay for enough aircraft, no matter how high their individual cost. However, with the limited resources that the nation is willing to set aside for security, it is obvious that even though we continue to spend billions of dollars for military aircraft each year, the number of aircraft that we can buy will fall as the unit cost goes up.

The military issue is that *numbers do matter.* Whether you believe that overall force effectiveness goes up as the numbers are squared (as did Frederick W. Lanchester, a famous British military historian) or believe that numbers—like the performance of individual systems—simply combine to create overall

THE SEVEN PERCENT SLOPE

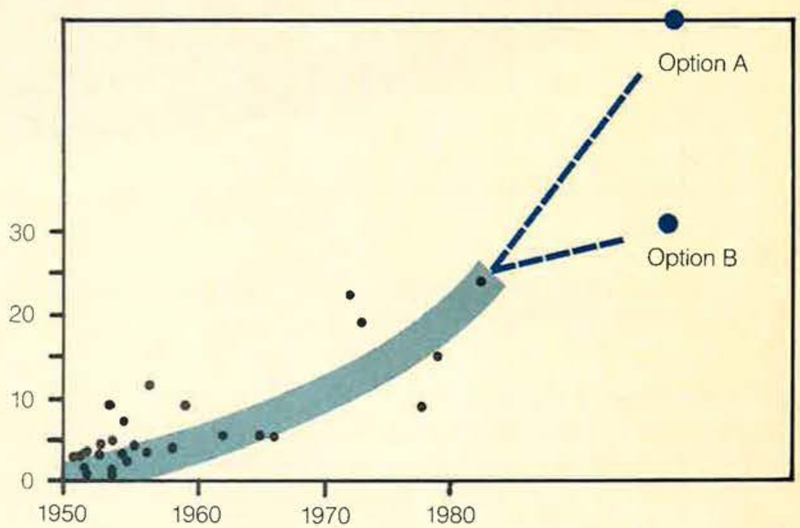


Chart 2. ***The index here is cost (in millions of FY '81 dollars) for the hundredth production unit of various US fighter aircraft. Cost climbs at about seven percent a year, and gains in performance are at approximately the same rate. The Advanced Tactical Fighter (ATF) program will seek to avoid normal extension of the curve—which would be "Option A"—and achieve performance gains at a lower climb in cost ("Option B").***

TOWARD AUGUSTINE'S THEOREM

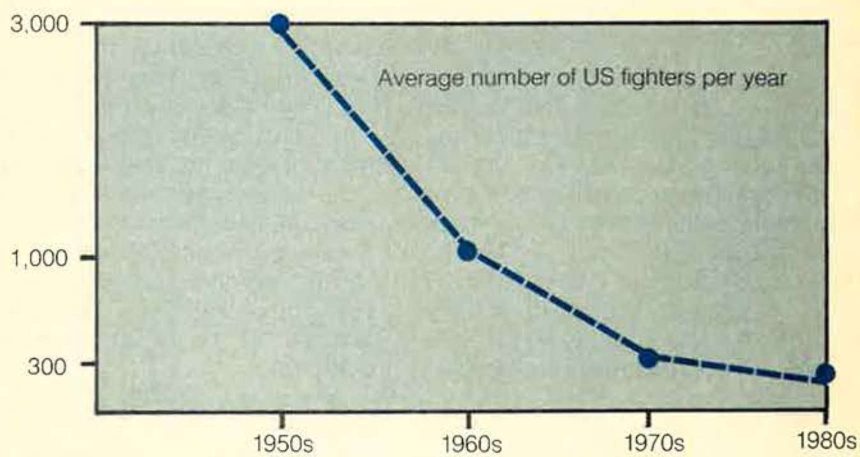


Chart 3. ***A logical extension of the data says Norm Augustine's famous prediction may not be far off — by the year 2054, the Defense Department would buy only one aircraft a year, even though its performance would be impressive indeed.***

THE DECLINE OF VARIETY

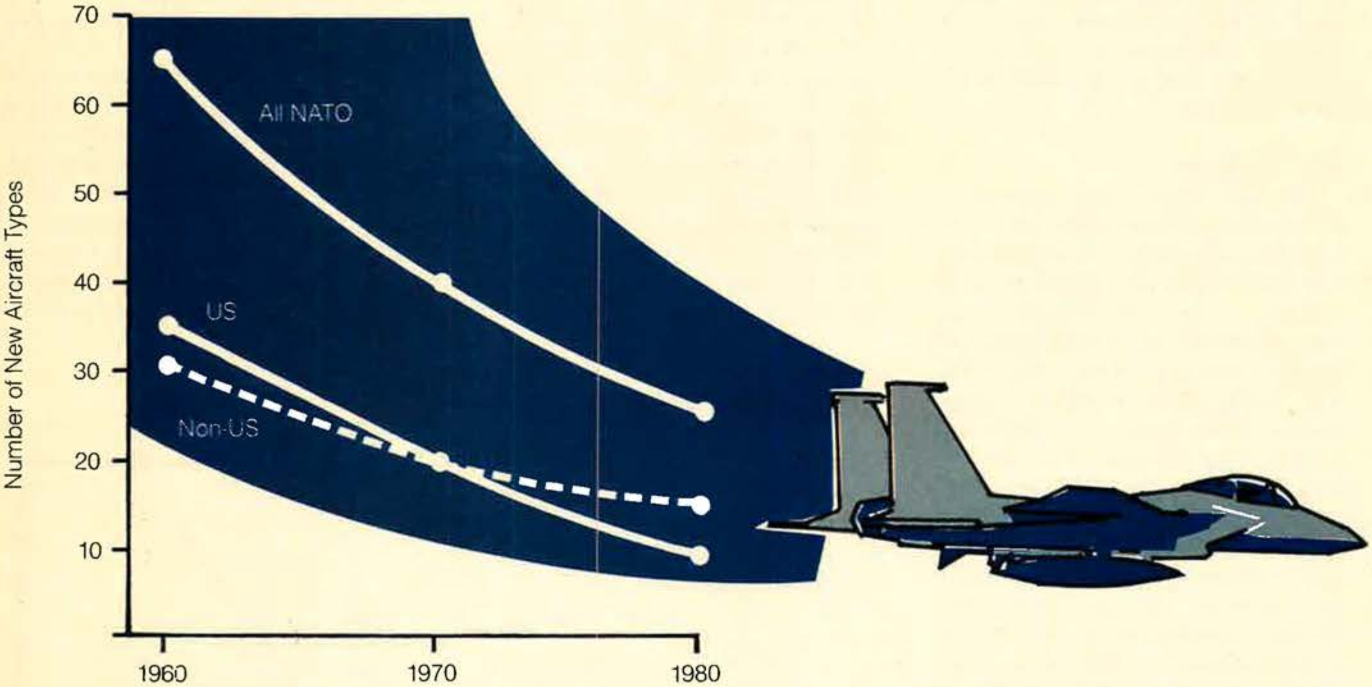


Chart 1. ***Each decade sees fewer types of military aircraft achieve initial operational capability in US and NATO fleets.***

Performance for a Price

While the data on rising unit costs is certainly staggering, this cost growth has been justified on the basis that these higher-cost aircraft are, in fact, providing dramatically higher individual performance. Studies that compare performance from generation to generation of aircraft bear this out.

While it is difficult to compare one aircraft precisely with another, techniques have been developed—frequently based on detailed interviews with pilots to determine important performance parameters—and these show clearly that the US and its allies have been increasing the performance of their aircraft from generation to generation by a compound rate of around five to six percent per year. Thus—within the accuracy of these analyses—it is fair to say that we are essentially getting what we are paying for, *i.e.*, increasing performance for increasing cost.

The challenge, of course, is to find a way to get off this curve—to find a way to control costs without compromising improved performance. It is undoubtedly necessary and advantageous for military aircraft design to keep pace with the state of the art. Yet there are ways to do this and still control costs. Unfortunately, these approaches often face strong institutional barriers. Nontraditional solutions to military mission needs frequently offer high performance at lower costs—for example, using standoff weapons or remotely piloted vehicles—but are "culturally" resisted.

In the same way, compromising maximum possible individual aircraft performance for reduced costs—and greater quantities—means we'd get "less than the best." This may not be "good enough." Many people are not willing to accept the fact that the last few percent of performance gains often increase the weapon's cost by thirty to fifty percent, thus dramatically reducing overall force effectiveness because of the resultant reduced quantities.

A way out of this dilemma appears to be through better application of advanced technology not only to improve performance but *simultaneously* to reduce costs. In recent years, the commercial world has been able to achieve these dual objectives—for example, in electronics. Here, the cost of computers, data-processing systems, communications equipment, etc., has been *falling* rapidly, while the performance has been *increasing* dramatically. The military can learn from such commercial practices.

The Packard Commission recommended that commercially based "design-to-cost" techniques be utilized for defense weapon systems. The design-to-cost philosophy is geared to keeping costs down, but it doesn't necessarily mean that performance will be traded away. In many cases, such new technology as structural composite materials and very-high-speed integrated circuit (VHSIC) electronics can be used to improve the performance of next-generation military aircraft systems as well as to make it possible to build them at low cost.

This "design-to-cost" technique was tried initially on the F-16 aircraft, with a considerable degree of success. However, meeting a low-cost objective in next-generation aircraft has historically proven to be a lower-priority objective. We have

The trend over three decades is clear. Cost and performance have been rising in lockstep with each other. That ratio is no longer acceptable.

The Dangerous Dive in Aircraft Production

BY DR. JACQUES S. GANSLER

WHILE many from the World War II era still remember "skies blackened by military aircraft," trends in aircraft production by the US and its allies since the war paint a different picture. As this article will show, there has been a persistent decline over the last three decades in the total number of aircraft being produced each year and in the number of new aircraft types being introduced into the NATO arsenal.

While aircraft performance has shown dramatic improvements from generation to generation, costs have gone up equally rapidly. The result is a distinct shift toward very few, very-high-performance aircraft in the inventory of each nation. Although this broad trend is well known to aircraft industry observers, the data in this article underscores its magnitude and consistency and raises questions on what the future holds for our military effectiveness if these trends are not reversed.

The clear implication is that new approaches to aircraft design and procurement are needed and needed quickly.

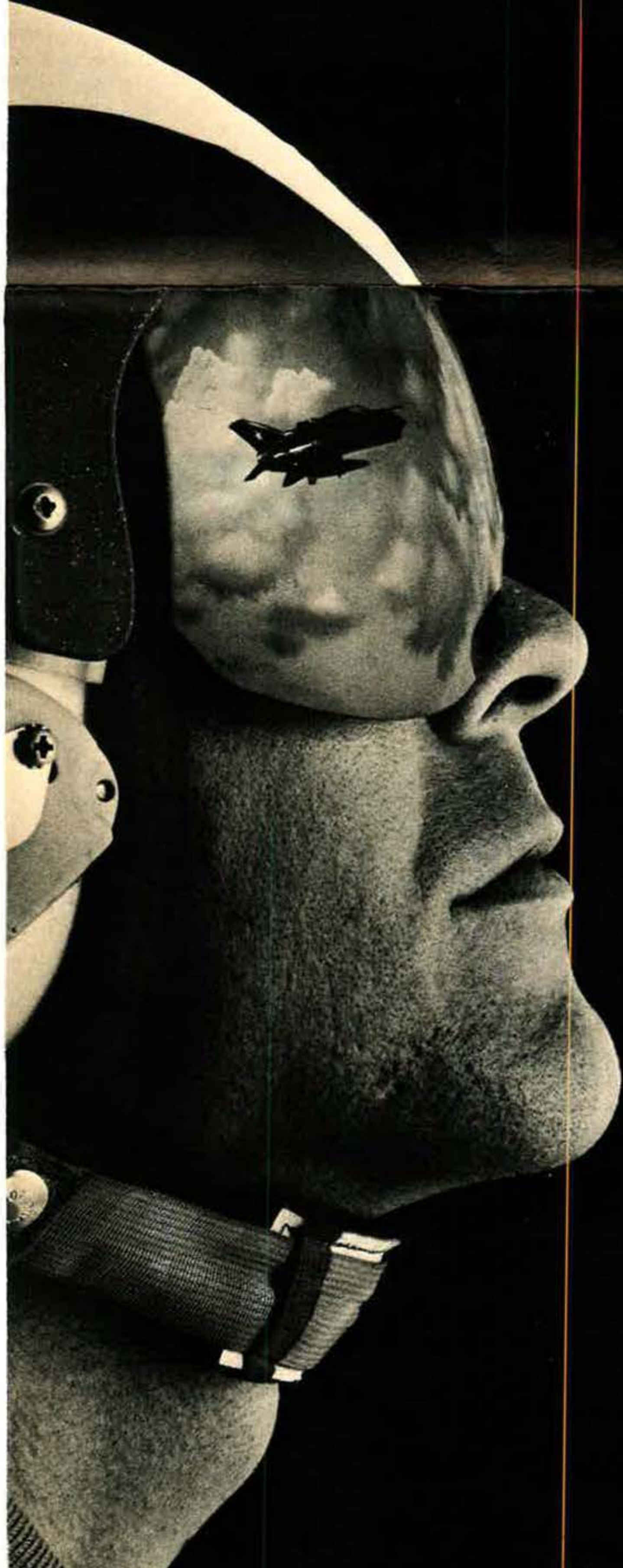
Chart 1 shows the sharp drop in new aircraft types introduced by the US and its allies over the last three decades. The data was compiled for the 132 different types of NATO military aircraft that had their initial operational capability (IOC) in the decades of the 1960s through 1980s. For the US alone, the number of new types of military aircraft has dropped from about thirty-five a decade to eleven.

When one recognizes that many of these different types are, in fact, "major upgrades" of existing aircraft (for example, redesign of the F-15 from a fighter/interceptor aircraft to a strike/ground-attack aircraft), it is clear that this greater-than-three-to-one reduction in new types of aircraft entering the inventory has been a very significant one. Interestingly, the data is consistent for both new US aircraft programs and those of our NATO allies.

This reduction has not been brought about by a lowering of the priority placed on military aircraft by the US and its allies. "Air superiority" remains a basic tenet of NATO strategy. Rather, the reduction in types of aircraft has been driven by the billions of dollars required to develop a new aircraft and by the extremely high cost of producing each one.

As Chart 2 shows, the average unit cost of US fighter aircraft has been growing from generation to generation at a compound rate of around seven percent per year (even after adjusting downward for the effects of inflation and the reduced quantities being produced). This means that each decade has essentially seen a doubling in unit costs. Similar trends have been found for attack aircraft and bombers (as the $20.6 billion for 100 B-1B bombers demonstrates), for non-US NATO fighters (growing at approximately the same annual seven percent compound rate), and even for Soviet fighter aircraft (to the best of our ability to estimate Soviet costs).

Naturally, when the cost of an individual aircraft reaches such a high level, one wants to amortize the development and production facilities expenses across as many aircraft as possible. Thus, it is impractical to have a large number of different types of aircraft in this high-cost environment.



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INTERCOM

By **Robin Whittle**, AFA DIRECTOR OF COMMUNICATIONS

AFJROTC Unit Now in Fort Worth

Had it not been for AFA's Fort Worth Chapter and a number of local civic leaders, Fort Worth, Tex., would have lost its first opportunity to establish an Air Force Junior ROTC detachment after more than nine years of trying to make that dream a reality.

As is so often the case, the issue was one of money. The Fort Worth School Board had been notified that an AFJROTC detachment could be established if all requirements were met, including adequate physical facilities. But state legislation required a number of improvements in curriculum and facilities. Fort Worth school officials, although wanting the unit, were ready to reject the detachment because their budget was more than $1 million in the red.

"That's when the Fort Worth Chapter and an AFA affiliate, the Fort Worth Airpower Council, entered the picture," said AFA National Director Joe L. Shosid, a former AFA National President and Board Chairman who is active in Fort Worth civic affairs. Chapter officials met with school officials and Hq. ROTC representatives and pledged to raise $40,000 for a structure dedicated exclusively to JROTC use at Western Hills High School in Fort Worth.

Hurriedly working behind the scenes, Chapter officials enlisted the support of House Majority Leader Rep. Jim Wright (D-Tex.), Fort Worth Mayor Bob Bolen, the Fort Worth Chamber of Commerce Military Affairs Council, the Greater Fort Worth Civic Leaders Association, and Carswell AFB's 7th Bomb Group Commander, Col. Charles Kucera. An *ad hoc* committee was created, and members secured Air Force agreement to establish the unit based on a pledge letter from AFA officials. The eleven Committee members are all AFA members, and nine of them are Life Members.

"The campaign to raise funds was given a healthy boost when the Fort Worth Division of General Dynamics, an AFA Industrial Associate, donated $10,000, a full one-fourth of the total needed," Mr. Shosid said. This generated $1,000 contributions each from the Fort Worth AFA Chapter, the Fort Worth Airpower Council, and the Civic Leaders Association. Personal letters and follow-up phone calls from committee members quickly produced the needed results. Meanwhile, Fort Worth school officials, acting on the pledge letter, contracted for the building and allocated funds for an officer and NCO to direct the AFJROTC program.

With Carswell AFB, General Dynamics, and more than 14,000 Air Force retirees in the Fort Worth area, there was hardly a dearth of applications for the two AFJROTC positions. After interviewing and making the selections, Western Hills Principal Quince Fulton told Chapter officials that the applicants were all outstanding. "We couldn't go wrong with any of them," he said.

A kickoff program and dedication of the facility took place in early September, and by the time classes were to begin, the minimum enrollment had been obtained.

Committee members who made the hope of an AFJROTC unit a reality were AFA National President **Sam E. Keith, Jr.,** AFA National Director **Joe Shosid,** National Vice President for the Southwest Region **Bryan L. Murphy, Jr.,** Fort Worth Chapter President **L. B. "Buck" Webber,** Airpower Council Chairman **William Quillin,** Civic Leaders Association President **Dr. Gene Wood,** former AFA National Director **Earle N. Parker,** former Fort Worth Chapter President **E. Earl Hatchett,** and **Col. Charles Kucera,** 7th Bomb Group Commander.

On the Scene

AFA's Sedona, Ariz., Chapter hosted the Fifteenth Air Force Band of the Golden West for a special concert at the Poco Diablo Resort that attracted AFA members and guests from the Sedona community. Then-Sedona Chapter President **Stan Beck** took the opportunity to recognize the Chapter's Community Partners, lauding their contributions to the Chapter and the nation. Honored were Guardian Security, Poco Diablo Resort, Sedona Airport Service, Pink Jeep Tours, the Red Rock *News,* Sedona Chevron, and Great Impressions Printers. The AFA Chapter leader also made an ap-

Among those shepherding the effort to establish an AFJROTC unit in Fort Worth, Tex., were, from left, AFA National Vice President for the Southwest Region Bryan L. Murphy, Jr., AFA National Director Joe Shosid, AFA National President Sam E. Keith, Jr., Fort Worth school official Dr. James Bailey, and General Dynamics executive Herbert F. Rogers. See item.

peal for the Chapter's AFROTC Scholarship Fund and stressed the importance of garnering support from local businesses and merchants for AFROTC programs at Northern Arizona University and Embry-Riddle Aeronautical University in Prescott.

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The Fifteenth Air Force Band of the Golden West flew recently to Sedona, Ariz., to play a special public concert at the Poco Diablo Resort Convention Center. The concert was sponsored by AFA's Sedona Chapter. See item.

"AFA is an informed group. You need to tie together aviation and space to show people how we can solve some of society's problems, mainly through education," **Dick MacLeod,** US Space Foundation executive director, told the Colorado AFA state convention. His main concern was the effect of negative news stories on "Middle America's" view of the US space program since the Shuttle disaster. He equated it with the atmosphere the country wallowed in after the Vietnam War. "The country should learn to recognize mistakes, correct them, and move forward."

Also addressing the Colorado convention was **Rep. Ken Kramer** (R-Colo.), who noted that Soviet fears of the US Strategic Defense Initiative exist "because they are aware of its potential." He discussed Soviet antisatellite systems and noted that the United States has only tested its ASAT system.

Addressing the Texas AFA convention, **Gen. Richard L. Lawson,** Deputy Commander in Chief of US European Command, said nations that are satisfied with or even allow their leaders to take part in terrorism deserve whatever response they get to their actions. Various terrorist groups share a

common goal. They are out to rob people of their individual freedoms, choices, and liberties. Quoting Russian dissident and intellectual Aleksandr Solzhenitsyn, General Lawson said that "free men do not understand the value of things and the value of a free society. Given its own way, a free society tends to turn to the creation of things, material things, things that are lovely to look at . . . forgetting the most important thing. A free society will be annihilated by the hordes that want, with low standards, only what they see. . . . Whatever the price, we must keep freedom or all else is hollow indeed," he said.

The marvels of Project Forecast II was the topic of AFSC Chief Scientist **Dr. Bernard Kulp's** address to the California AFA convention. The "super cockpit" of the future would eliminate the maze of instruments that now confronts pilots. The goal is a pilot-friendly cockpit that provides a video image of terrain, enemy fighters, missile batteries, etc. The pilot will be able to aim his weapons by voice command and eye sensor. Some of the promising technologies include antiproton propulsion, a turbine engine with a twenty-to-one thrust ratio, and a computer that can accurately project reliability and maintenance performance. Dr. Kulp challenged the aerospace industry to join the Air Force in long-range research. "We're willing to put half of our R&D budget into these projects. We're serious about it," he said.

AFA's Pueblo Chapter in Colorado helped the town celebrate the sixtieth anniversary of Colorado airmail service by sponsoring a reenactment of the Pueblo leg of the historic mail route that linked Pueblo, Colorado Springs, Denver, and Cheyenne, Wyo., with mail service in the late 1920s. About fifty people turned out to watch pilots **Tom Newell** and **James Walters** take off in a 1940 Stearman biplane en route to Colorado Springs. Their cargo was 245 souvenir letters especially stamped for the occasion that were to be mailed from Colorado Springs to the addresses on the envelopes. Pueblo Chapter officials sold souvenir envelopes, donating proceeds to the Colorado Aviation Historical Society, according to **William Feder,** volunteer director of the aircraft museum and a Pueblo Chapter member. More than 2,000 envelopes were mailed from the four cities, Mr. Feder said. Similar envelopes mailed ten years ago during the fiftieth anniversary now sell for $50, he noted.

AFA's Frederick Crawford Chapter in Cleveland, Ohio, the Cleveland World Affairs Council, and the Northern Ohio Section of the American Institute of Aeronautics and Astronautics joined forces for a banquet featuring **Lt. Gen. James A. Abrahamson,** Director of the Strategic Defense Initiative Organization (SDIO), on what's ahead for the year 2000 and beyond . . . AFA National Director **Dev Devoucoux** presented a W. Randolph Lovelace Memorial Award to AFROTC **Cadet Thaya Poel** in ceremonies at St. Michael's College in Winooski, Vt., recently. AFROTC Detachment 865 at the College is working with the local Burlington AFA Chapter to sponsor joint programs.

Chicagoland-O'Hare Chapter President Harry Sunderland chats with, from left, Chicago AFCEA President Ken Raab and AU National Security Briefing Team members Capt. Peter Faber and Maj. Tom Lusk during a recent AFA/AFCEA meeting.

Air Force ROTC has dedicated part of Heritage Hall at Maxwell AFB, Ala., in honor of Arnold Air Society and Angel Flight and in commemoration of the centennial of Gen. H. H. Arnold's birth . . . AFA's Industrial Associates know a good thing when they see one. They have been lining up to use the Aerospace Education Foundation's Roundtable videotapes, particularly the ones on "Spare Parts," "Artificial Intelligence," and "Competition in Military Procurement."

Active Mifflin County Chapter member **SSgt. Dick Welsh** was named the top Air Force recruiter in Pennsylvania and was honored at the Pennsylvania AFA convention in Wilkes-Barre last summer. He has since moved to State College to recruit nurses for the Air Force from throughout central Pennsylvania. His goal is to recruit six nurses a year . . . A new AFA chapter has been chartered in Gadsden, Ala., and is named for the city. The Chapter President is **Thomas P. Poole.**

Martin Goland, President of the Southwest Research Institute, has been honored with the Alamo Chapter's prestigious Walter W. McAllister, Sr., Patriotism Award, President **Claire Garrecht** reports. The McAllister Award, named for the late Mayor Emeritus of San Antonio, honors a San Antonio civic leader who has worked to promote better understanding of national defense issues and to strengthen the ties between the military and civilian communities in the city. Mr. Goland has served as President of Southwest Research since 1959 and has broad experience in aircraft design, applied mechanics, and operations research. "During more than four decades of service to the research and development community, he has received many prestigious advisory appointments to hundreds of civilian and military agencies and continues to be active in many," the Alamo Chapter leader said.

Air University's National Security Briefing Team has been scheduled to address AFA's Miami Chapter and was on hand to address AFA's Chicagoland-O'Hare Chapter and the Chicago Armed Forces Communications and Electronics Association in late September. The team was honored at AFA's National Convention. In other Miami Chapter news, the Chapter is pushing the Young Astronaut Program and has asked Chapter members to sponsor clubs at their local schools or, if they are unable to do that, to offer to talk to school principals or administrators about build-

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ing support for a local program. Miami's new newsletter, *Recon Report,* is full of good information in a handy, easy-to-mail, small-size format.

A new newsletter has been established for AFA's Gulf Coast Chapter. Called the *Gulf Coast Communicator,* it seeks to "inform AFA members in Southwest Florida." The four-pager includes a membership survey to gauge members' interests and a new reorganization plan devised by Chapter President **Michael J. Holsinger** to "spread out the work load and help build the Chapter. I am seeking three membership chairmen—one for Bradenton, one for Sarasota, and one for the Venice/North Port/Englewood area—to build membership on three fronts. With just a little effort, I am confident that we can increase our membership from the current 200 to more than 300," Mr. Holsinger said.

The Pima Air Museum recently received a restored Lockheed P-80B for exhibit. Present at the acceptance ceremony were, from left, Col. Eben D. Jones, Maj. Kit Stewart, Museum Director Ned Robinson, and AFAer Charlie Niblett. See item.

The Utah State Legislature has approved a Veterans Freedom Memorial on a twenty-three-acre site at Camp Williams, and the Ute AFA Chapter and Utah AFA are helping to raise funds through the state newsletter. Ute Chapter officials also sponsored an Oktoberfest at Union Station in Ogden in September . . . The Western Region Pennsylvania AFA sponsored an anniversary celebration honoring the Air Force and AFA at the Pittsburgh Hilton in early October. The speaker was **Gen. Duane Cassidy,** CINCMAC, reports Regional Director **Tillie Metzger.**

Tucson Chapter members and community organizations helped the 355th Equipment Maintenance Squadron restore to exhibit standard a Lockheed P-80B Shooting Star for the area's Pima Air Museum. The aircraft, 45-08612, was accepted by the Air Force on September 22, 1947, four days after the Air Force became a separate service. Delivery was to the 36th Fighter Group at March Field, Calif., commanded by then **Col. Russ Spicer,** a renowned World War II fighter pilot. No. 8612 participated in the largest mass jet flight accomplished to that date in flying with about eighty other aircraft to the Panama Canal Zone. Shortly thereafter, the unit was transferred to Europe to protect the Berlin Airlift, and the 36th Tactical Fighter Wing is still there, located at Bitburg AB, Germany, flying F-15 Eagles. Interestingly, the immediate past commander of the 836th Air Division at Davis-Monthan AFB, Ariz., was a member of that organization and flew the F-15 over Europe.

"If this Chapter is to continue as a leading chapter of the Air Force Association, it must have new blood, new energy, and vitality, or it will surely wither and eventually die. Fortunately, the administration of Chapter affairs does not require the amount of personal time, effort, and dedication that it did in its formative years. It is guided by a detailed Constitution and By-Laws and a number of well-established and proven practices and operational procedures, including those governing each of the Chapter's special programs. We have a game plan for everything. As a radio personality of years past used to say: 'It's in the book . . . so why don't you join the team?' " That excellent "President's Message" was written by **Betty Hazeleaf,** President of AFA's General Robert F. Travis Chapter in Vacaville/Fairfield, Calif. She was honored at the AFA National Convention with an Exceptional Service Award. ■

UNIT REUNIONS

Reunion Notices

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

AAS/AnF NATCON '87

The Arnold Air Society and Angel Flight National Conclave '87 will be held on April 17–21, 1987, in Dallas, Tex. **Contact:** NATCON '87, Hq. Arnold Air Society, General Samuel E. Anderson Squadron and Flight, AFROTC Cadet Group 845, Texas Christian University, Fort Worth, Tex. 76129. Phone: (817) 921-7461.

Air Force Intelligence Service/Reserve

Air Force Intelligence Service and Reserve personnel (active and retired) will hold their annual holiday awards banquet on December 10, 1986, at the Officers' Club at Andrews AFB, Md. **Contact:** Col. George G. Noory, USAFR (Ret.), 3500 Everest Dr., Hillcrest Heights, Md. 20748. Phone: (301) 423-1933 or 423-8822.

Air Forces Escape & Evasion Society

The Air Forces Escape and Evasion Society will meet on May 24–27, 1987, in San Antonio, Tex. **Contact:** James J. Goebel, Jr., 9 Georgia Park, Conroe, Tex. 77302. Phone: (409) 273-2828. Ralph Patton, 720 Valley View Rd., Pittsburgh, Pa. 15243. Phone: (412) 343-8570.

9th Troop Carrier Squadron

Members of the 9th Troop Carrier Squadron will hold a reunion on June 4–7, 1987, at the Rodeway Inn in Columbus, Ohio.

AFA State Contacts

Following each state name, in parentheses, are the names of the communities in which AFA Chapters are located. Information regarding these Chapters, or any place of AFA's activities within the state, may be obtained from the appropriate contact.

ALABAMA (Auburn, Birmingham, Gadsden, Huntsville, Mobile, Montgomery, Selma): **Robie Hackworth,** 206 Dublin Circle, Madison, Ala. 35758 (phone 205-532-4920, ext. 29).

ALASKA (Anchorage, Fairbanks): **Theron L. Jenne,** 2501 Benbury Drive, Anchorage, Alaska 99504 (phone 907-377-3360).

ARIZONA (Green Valley, Phoenix, Sedona, Sierra Vista, Sun City, Tucson): **Robert A. Munn,** 7042 Calle Bellatrix, Tucson, Ariz. 85710 (phone 602-747-9649).

ARKANSAS (Blytheville, Fayetteville, Fort Smith, Little Rock): **Thomas P. Williams,** 4404 Dawson Drive, North Little Rock, Ark. 72116 (phone 501-758-6885).

CALIFORNIA (Apple Valley, Edwards, Fairfield, Fresno, Los Angeles, Merced, Monterey, Novato, Orange County, Pasadena, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, Sunnyvale, Vandenberg AFB, Yuba City): **Gerald S. Chapman,** 13822 Via Alto Court, Saratoga, Calif. 95070 (phone 408-379-6558).

COLORADO (Boulder, Colorado Springs, Denver, Fort Collins, Grand Junction, Greeley, Littleton, Pueblo): **Jack G. Powell,** AFAFC/AJ, Denver, Colo. 80279-5000 (phone 303-370-4787).

CONNECTICUT (Brookfield, East Hartford, Middletown, Storrs, Stratford, Torrington, Waterbury, Westport, Windsor Locks): **Joseph Zaranka,** 9 S. Barn Hill Rd., Bloomfield, Conn. 06002 (phone 203-242-2092).

DELAWARE (Dover, Rehoboth Beach, Wilmington): **Horace W. Cook,** 112 Foxhall Drive, Dover, Del. 19901 (phone 302-674-1051).

DISTRICT OF COLUMBIA (Washington, D. C.): **Howard W. Cannon,** 1501 Lee Highway, Arlington, Va. 22209-1198 (phone 703-247-5820).

FLORIDA (Avon Park, Brandon, Broward County, Cape Coral, Daytona Beach, Fort Walton Beach, Gainesville, Homestead, Jacksonville, Leesburg, Miami, Naples, Neptune Beach, New Port Richey, Orlando, Panama City, Patrick AFB, Redington Beach, Sarasota, Tallahassee, Tampa, West Palm Beach, Winter Haven): **Donald T. Beck,** 1150 Covina St., Cocoa, Fla. 32927 (phone 305-636-7648).

GEORGIA (Athens, Atlanta, Columbus, Rome, Savannah, St. Simons Island, Valdosta, Warner Robins): **Robert W. Marsh, Jr.,** P. O. Box 542, Springfield, Ga. 31329 (phone 912-964-1941, ext. 254).

GUAM (Agana): **George W. Baldwin, Jr.,** P. O. Box 8710, Tamuning, Guam 96911 (phone 671-646-4445).

HAWAII (Honolulu): **Don J. Daley,** P. O. Box 3200, Honolulu, Hawaii 96847 (phone 808-525-6296).

IDAHO (Boise, Mountain Home, Twin Falls): **Chester A. Walborn,** 510 E. 13th North, Mountain Home, Idaho 83647 (phone 208-587-7185).

ILLINOIS (Belleville, Champaign, Chicago, Elmhurst, Peoria, Springfield-Decatur): **Walter G. Vartan,** 230 W. Superior Court, Chicago, I l. 60610 (phone 312-477-7503).

INDIANA (Bloomfield, Fort Wayne, Grissom AFB, Indianapolis, Lafayette, Marion, Mentone, South Bend, Terre Haute): **Bill Cummings,** 12031 Mahogany Drive, Fort Wayne, Ind. 46804 (phone 219-672-2728).

IOWA (Des Moines, Sioux City): **Carl B. Zimmerman,** 608 Waterloo Bldg., Waterloo, Iowa 50701 (phone 319-232-2650).

KANSAS (Garden City, Topeka, Wichita): **Cletus J. Pottebaum,** 6503 E. Murdock, Wichita, Kan. 67206 (phone 316-683-3963).

KENTUCKY (Lexington, Louisville): **Jo Brendel,** 726 Fairhill Drive, Louisville, Ky. 40207 (phone 502-897-7647).

LOUISIANA (Alexandria Baton Rouge, Bossier City, Monroe, New Orleans, Shreveport): **James P. LeBlanc,** 3645 Monroe St., Mandev lle, La. 70448 (phone 504-626-4516).

MAINE (Bangor, Loring AFB, North Berwick): **Alban E. Cyr, Sr.,** P. O. Box 160, Caribou, Me. 04736 (phone 207-496-3331).

MARYLAND (Andrews AFB area, Baltimore, Rockville): **Francis R. O'Clair,** 6604 Groveton Drive, Clinton, Md. 20735 (phone 301-372-6186).

MASSACHUSETTS (Bedford Boston, Falmouth, Florence, Hanscom AFB, Lexington, Taunton, West Springfield, Worcester): **Leo O'Hallaran,** 15 Oakwood Rd., Acton, Mass. 01720 (phone 617-264-4603).

MICHIGAN (Alpena, Battle Creek, Detroit, Kalamazoo, Marquette, Mount Clemens, Oscoda, Petoskey, Southfield): **William Stone,** 7357 Lakewood Drive, Oscoda, Mich. 48750 (phone 517-724-6266).

MINNESOTA (Duluth, Minneapolis-St. Paul): **Earl M. Rogers, Jr.,** 325 Lake Ave., S., Suite 703, Duluth, Minn. 55802 (phone 218-727-2191).

MISSISSIPPI (Biloxi, Co umbus, Jackson): **R. E. Smith,** Route 3, Box 282, Columbus, Miss. 39701 (phone 601-327-4071).

MISSOURI (Kansas City, Richards-Gebaur AFB, Springfield, St. Louis, Whiteman AFB): **Raymond W. Peterman,** 11315 Applewood Drive, Kansas City, Mo. 64134 (phone 816-761-7453).

MONTANA (Bozeman, Great Falls): **Ed White,** 2333 6th Ave., South Great Falls, Mont. 59405 (phone 406-453-2054).

NEBRASKA (Lincoln, Omaha) **Donald D. Adams,** FirsTier Inc., 17th & Farnam, Omaha, Neb. 68102 (phone 402-348-7905).

NEVADA (Las Vegas, Reno): **Anthony Martinez,** 2156 C Kietzke Lane, Reno, Nev. 89502 (phone 916-836-0614).

NEW HAMPSHIRE (Manchester, Pease AFB): **Robert N. McChesney,** Scruton Pond Rd., Barrington, N. H. 03825 (phone 603-664-5090).

NEW JERSEY (Andover, Atlantic City, Belleville, Camden, Chatham, Cherry Hill, East Rutherford, Forked River, Fort Monmouth, Jersey City, McGuire AFB, Middlesex County, Newark, Old Bridge, Trenton, Wallington, West Orange, Whitehouse Station): **Jim Young,** 513 Old Mill Rd., Spring Lake Heights, N. J. 07762 (phone 201-449-8637).

NEW MEXICO (Alamogordo, Albuquerque, Clovis): **Louie T. Evers,** P. O. Box 1946, Clovis, N. M. 88101 (phone 505-762-1798).

NEW YORK (Albany, Bethpage, Brooklyn, Buffalo, Chautauqua, Griffiss AFB, Hudson Valley, Nassau County, New York City, Niagara Falls, Patchogue, Plattsburgh, Queens, Rochester, Rome/Utica, Suffolk County, Syosset, Syracuse, Westchester, Westhampton Beach, White Plains): **Maxine Z. Donnelly,** 18 Jackson Place, Massapequa, N. Y. 11758 (phone 516-795-2746).

NORTH CAROLINA (Asheville, Charlotte, Fayetteville, Goldsboro, Greensboro, Kitty Hawk, Raleigh): **Bobby G. Suggs,** P. O. Box 1630, Fayetteville, N. C. 28302 (phone 919-323-5281).

NORTH DAKOTA (Concrete, Fargo, Grand Forks, Minot): **Michael Langlie,** 2901 Columbine Court, Grand Forks, N. D. 58201 (phone 701-772-7211).

OHIO (Akron, Cincinnati, Cleveland, Columbus, Dayton, Mansfield, Newark, Youngstown): **John Boeman,** 10608 Lake Shore Blvd., Bratenal, Ohio 44108 (phone 216-249-8970).

OKLAHOMA (Altus, Enid, Oklahoma City, Tulsa): **Terry Little,** 4150 Timerlane, Enid, Okla. 73703.

OREGON (Eugene, Portland): **Hal Langerud,** 10515 S. W. Clydesdale Terrace, Beaverton, Ore. 97001 (phone 503-644-0645).

PENNSYLVANIA (Allentown, Altoona, Beaver Falls, Coraopolis, Drexel Hill, Erie, Harrisburg, Homestead, Indiana, Johnstown, Lewistown, Mon-Valley, Philadelphia, Pittsburgh, Scranton, Shiremanstown, State College, Willow Grove, York): **David L. Jannetta,** P. O. Box 643, Altoona, Pa. 16603 (phone 814-943-8023).

PUERTO RICO (San Juan): **Fred Brown,** 1991 Jose F. Diaz, Rio Piedras, P. R. 00928 (phone 809-790-5288).

RHODE ISLAND (Warwick): **King Odell,** 413 Atlantic Ave., Warwick, R. I. 02888 (phone 401-941-5472).

SOUTH CAROLINA (Charleston, Clemson, Columbia, Myrtle Beach, Sumter): **Harry E. Lavin,** 28 Little Creek Rd., The Forest, Myrtle Beach, S. C. 29577 (phone 803-272-8440).

SOUTH DAKOTA (Rapid City, Sioux Falls): **John E. Kittelson,** 141 N. Main, Suite 308, Sioux Falls, S. D. 57102 (phone 605-336-2498).

TENNESSEE (Chattanooga, Knoxville, Memphis, Nashville, Tri-Cities Area, Tullahoma): **Jack K. Westbrook,** P. O. Box 1801, Knoxville, Tenn. 37901 (phone 615-523-6000).

TEXAS (Abilene, Amarillo, Austin, Big Spring, College Station, Commerce, Corpus Christi, Dallas, Del Rio, Denton, El Paso, Fort Worth, Harlingen, Houston, Kerrville, Laredo, Lubbock, San Angelo, San Antonio, Waco, Wichita Falls): **Ollie R. Crawford,** P. O. Box 202470, Austin, Tex. 78720 (phone 512-331-5367).

UTAH (Brigham City, Clearfield, Ogden, Provo, Salt Lake City): **Marcus C. Williams,** 4286 South 2300 West, Roy, Utah 84067 (phone 801-731-5037).

VERMONT (Burlington): **Ralph R. Goss,** 8 Summit Circle, Shelburne, Vt. 05482 (phone 802-985-2257).

VIRGINIA (Arlington, Charlottesville, Danville, Harrisonburg, Langley AFB, Lynchburg, Norfolk, Petersburg, Richmond, Roanoke): **Charles G. Durazo,** 1725 Jefferson Davis Highway, Suite 510, Arlington, Va. 22202 (phone 703-360-9098).

WASHINGTON (Bellingham, Seattle, Spokane, Tacoma, Yakima): **Charles Burdulis,** North 5715 Sutherlin, Spokane, Wash. 99208 (phone 509-327-8902).

WEST VIRGINIA (Huntington): **David Bush,** 2317 S. Walnut Drive, St. Albans, W. Va. 25177 (phone 304-722-3583).

WISCONSIN (Madison, Milwaukee): **Gilbert Kwiatkowski,** 8260 W. Sheridan Ave, Milwaukee, Wis. 53218 (phone 414-463-1849).

WYOMING (Cheyenne): **Irene G. Johnigan,** 503 Notre Dame Court, Cheyenne, Wyo. 82009 (phone 307-775-3641).

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Contact: John P. McMahon, 65 E. State St., Columbus, Ohio 43215. Phone: (614) 462-2604.

14th Fighter Group

The 14th Fighter Group and 351st Air Service Squadron will hold a reunion on May 1–3, 1987, in New Iberia, La. **Contact:** Sheril D. Huff, 3200 Chetwood Dr., Del City, Okla. 73115-1933. Phone: (405) 677-2683.

Class 53-D

Members of Class 53-D, Bartow AFB, Fla., will hold a reunion in March 1987. **Contact:** Col. Raymond W. Kahl, Jr., USAF (Ret.), American Consulate Rio, APO Miami 34030.

60th Troop Carrier Group

The 60th Troop Carrier Group will hold a reunion on June 17–20, 1987, in Norfolk, Va. **Contact:** John Diamantakos, 7216 Pine Tree Lane, Fairfield, Ala. 35064. Phone: (205) 923-2323.

64th/65th Aggressor Squadrons

Members of the 64th and 65th Aggressor Squadrons will host a fifteen-year reunion in October 1987 in Las Vegas, Nev. **Contact:** Commander, 64th or 65th Aggressor Squadron, Nellis AFB, Nev. 89191. Phone: (702) 643-4405 or 643-2238. AUTOVON: 682-4405 or 682-2238.

69th Fighter Squadron

Members of the 69th Fighter Squadron will hold a reunion on May 15–18, 1987, at the La Quinta Motor Inn in Dayton, Ohio. **Contact:** George E. Mayer, 7445 Thomas Ave. S., Richfield, Minn. 55423. Phone: (612) 866-6073.

314th Troop Carrier Wing

The 314th Troop Carrier Wing will hold a reunion in early 1987 in Nashville, Tenn. Former and current 314th Troop Carrier Group and Wing personnel are welcome. **Contact:** Bill Jernigan, 307 Dyer Lane, Brentwood, Tenn. 37027. Kenneth A. Chatfield, 4009 Lancashire Dr., Antioch, Tenn. 37013.

461st Bomb Group

Members of the 461st Bomb Group "Liberaiders" will hold a reunion on October 1–4, 1987, at the Holiday Inn and Holidome in Suffern, N. Y. **Contact:** Frank C. O'Bannon, 137 Via La Soledad, Redondo Beach, Calif. 90277.

490th Bomb Squadron

The 490th Bomb Squadron will hold a reunion on May 14–16, 1987, in Des Moines, Iowa. **Contact:** Ivo Greenwell, Rte. 9, Box 638, Claremore, Okla. 74017. LeRoy B. Parsons, 4144 9th St., Des Moines, Iowa 50313. Phone: (515) 243-1641.

815th Troop Carrier Squadron

The 815th Troop Carrier Squadron and the 315th Air Division stationed at Tachikawa AB, Japan, will hold a reunion in early 1987. **Contact:** David Conley, 2648 Club Forrest Dr., Conyers, Ga. 30207. Phone: (404) 922-3076.

820th Civil Engineering Squadron

Members of the 820th Civil Engineering Squadron will sponsor a Red Horse Roundup on April 10–12, 1987, in Las Vegas, Nev. **Contact:** Lt. Jim Schlachter or Lt. Dan Cox, 820th CES/HR, Nellis AFB, Nev. 89191. Phone: (702) 643-4401. AUTOVON: 682-4401.

6147th Tactical Control Group

Members of the 6147th Tactical Control Group "Mosquitoes" who served with the Fifth Air Force in the Korean War will hold their reunion on July 23–26, 1987, at the Mayflower Park Hotel in Seattle, Wash. **Contact:** Orville S. Long, 10621 SE 236th Pl., Kent, Wash. 98031. Phone: (206) 852-1030.

6th Bomb Group

A reunion is in the planning stages for members of the 6th Bomb Group who were stationed on Tinian Island during 1944–45.

Please contact the address below for additional information.

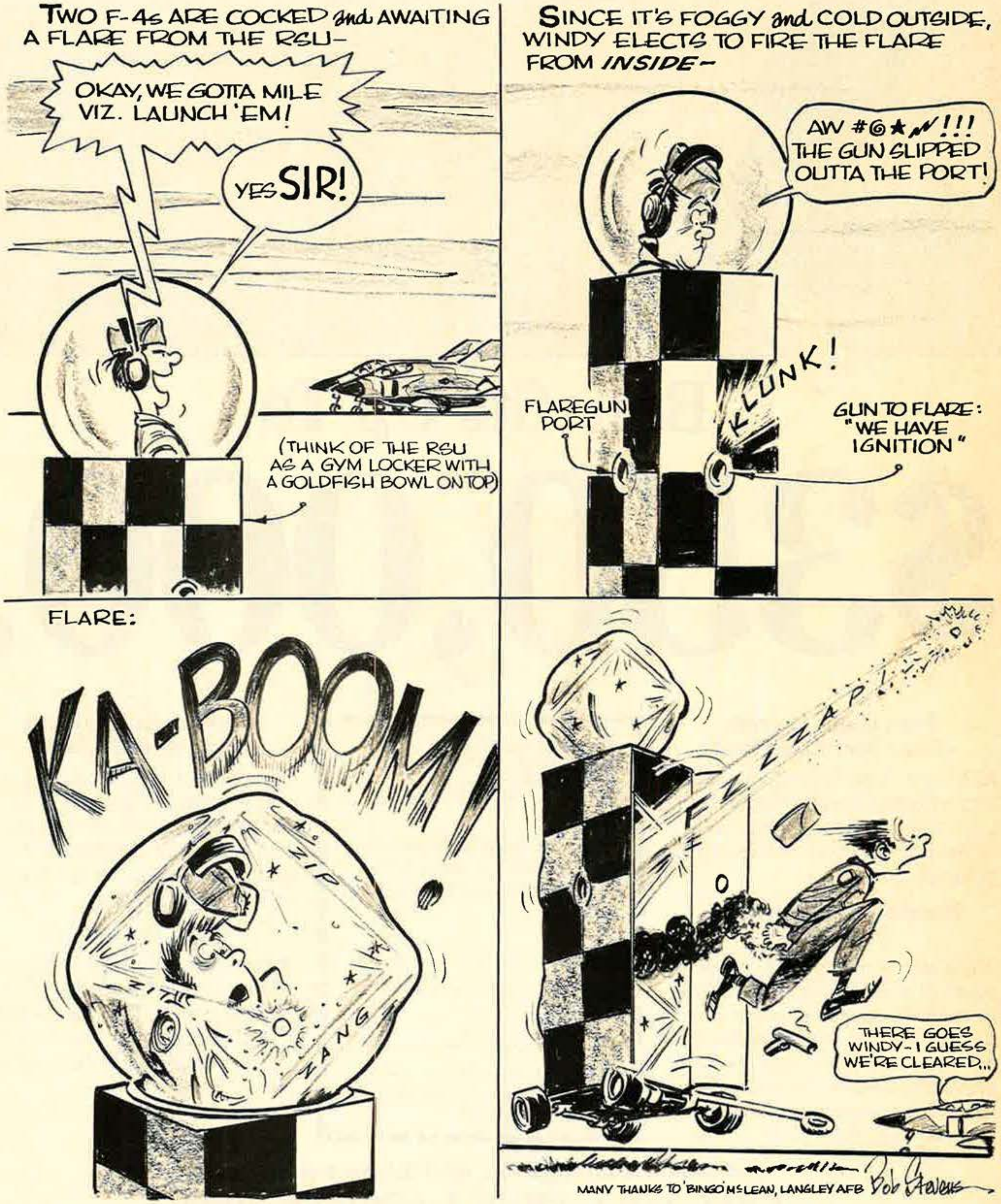
Newell W. Penniman, Jr.
6 Porter Lane
South Hamilton, Mass. 01982
Phone: (617) 468-2806

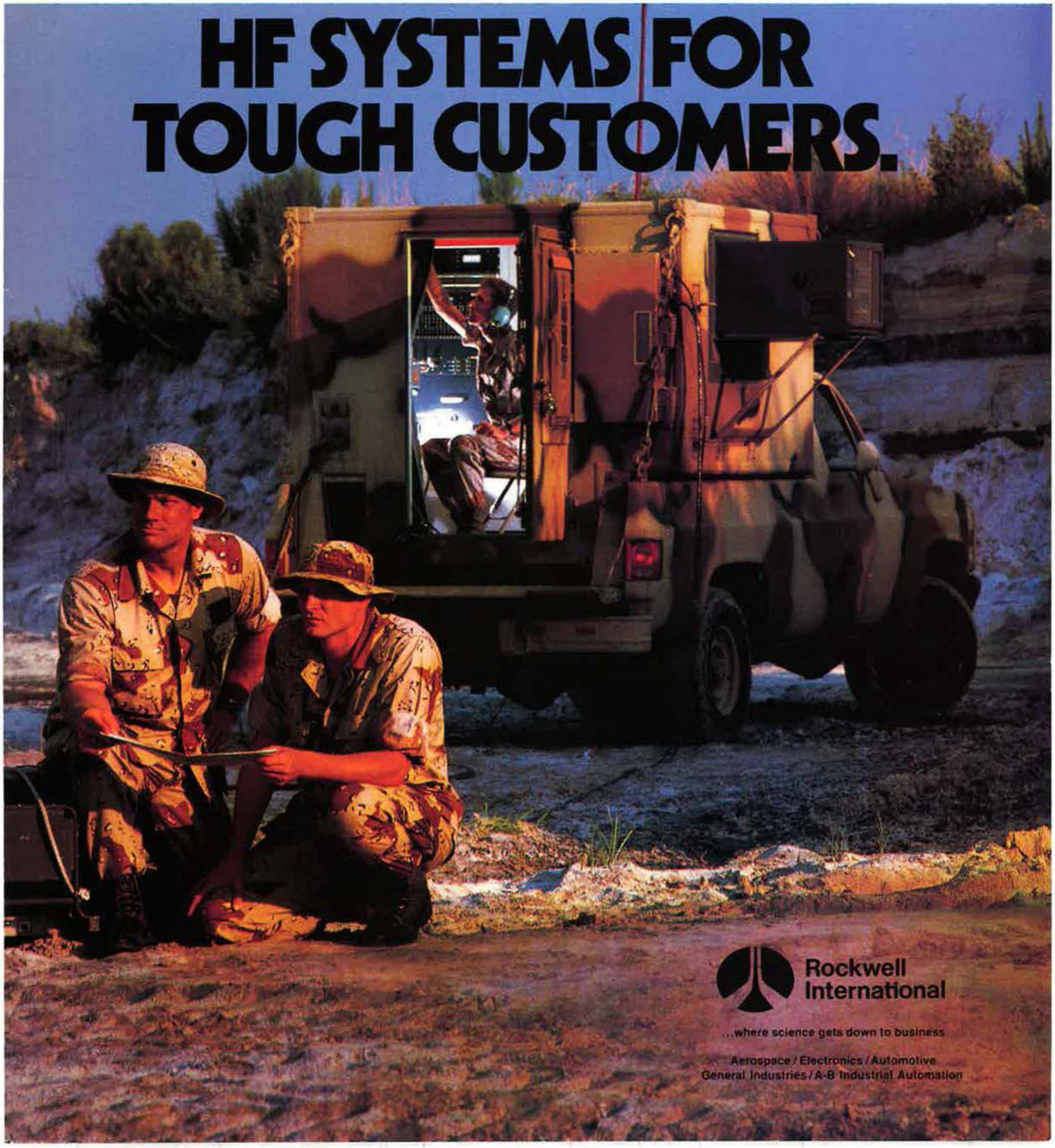
Bob Stevens'

"There I was..."

WINDY and THE FLARES—PT II

REMEMBER "WINDY" WHO SCORED A DIRECT HIT ON A BOMB TRAILER WITH A FLARE? WE PICK UP THE TRUE STORY OF OUR HAPLESS HERO ONCE AGAIN IN THE RUNWAY SUPERVISORY UNIT (RSU)-THIS TIME READY TO LAUNCH THE FIRST FLIGHT OF THE DAY... ARE YOU READY FOR THIS?

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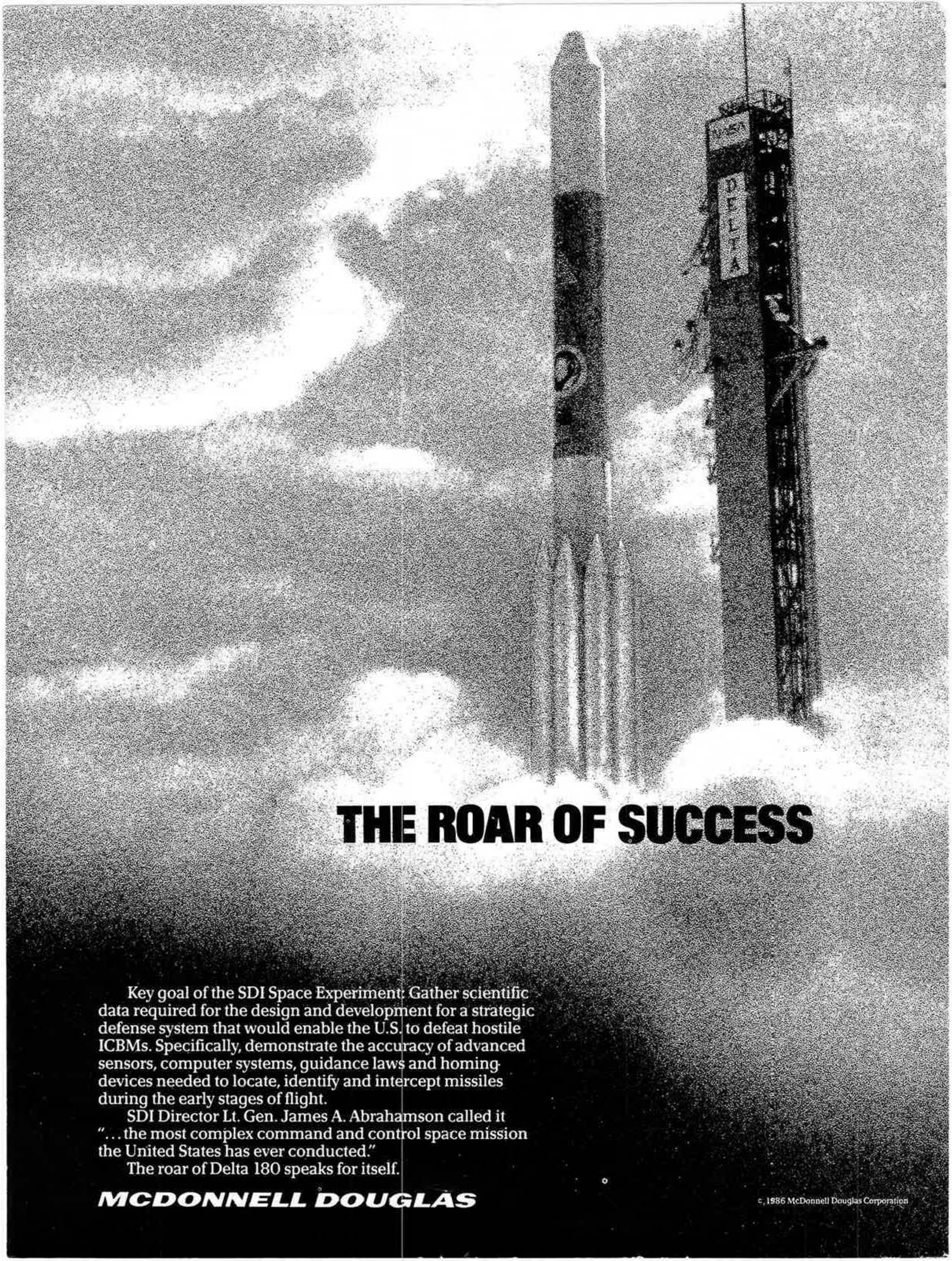
DELTA
THE ROAR OF SUCCESS
Key goal of the SDI Space Experiment: Gather scientific data required for the design and development for a strategic defense system that would enable the U.S. to defeat hostile ICBMs. Specifically, demonstrate the accuracy of advanced sensors, computer systems, guidance laws and homing devices needed to locate, identify and intercept missiles during the early stages of flight.
SDI Director Lt. Gen. James A. Abrahamson called it "... the most complex command and control space mission the United States has ever conducted."
The roar of Delta 180 speaks for itself.
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