APRIL 1987/$2

AIR FORCE MAGAZINE

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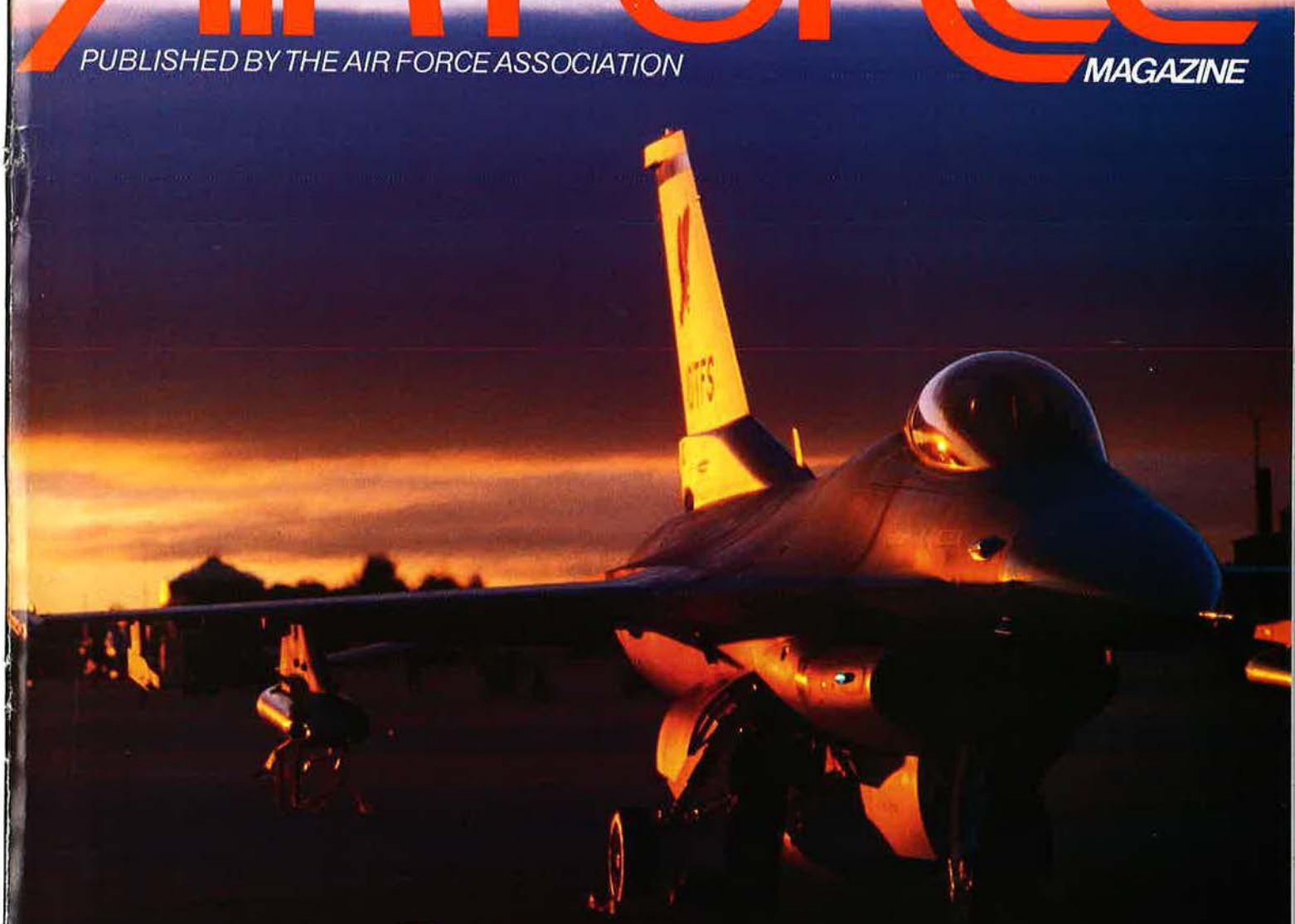

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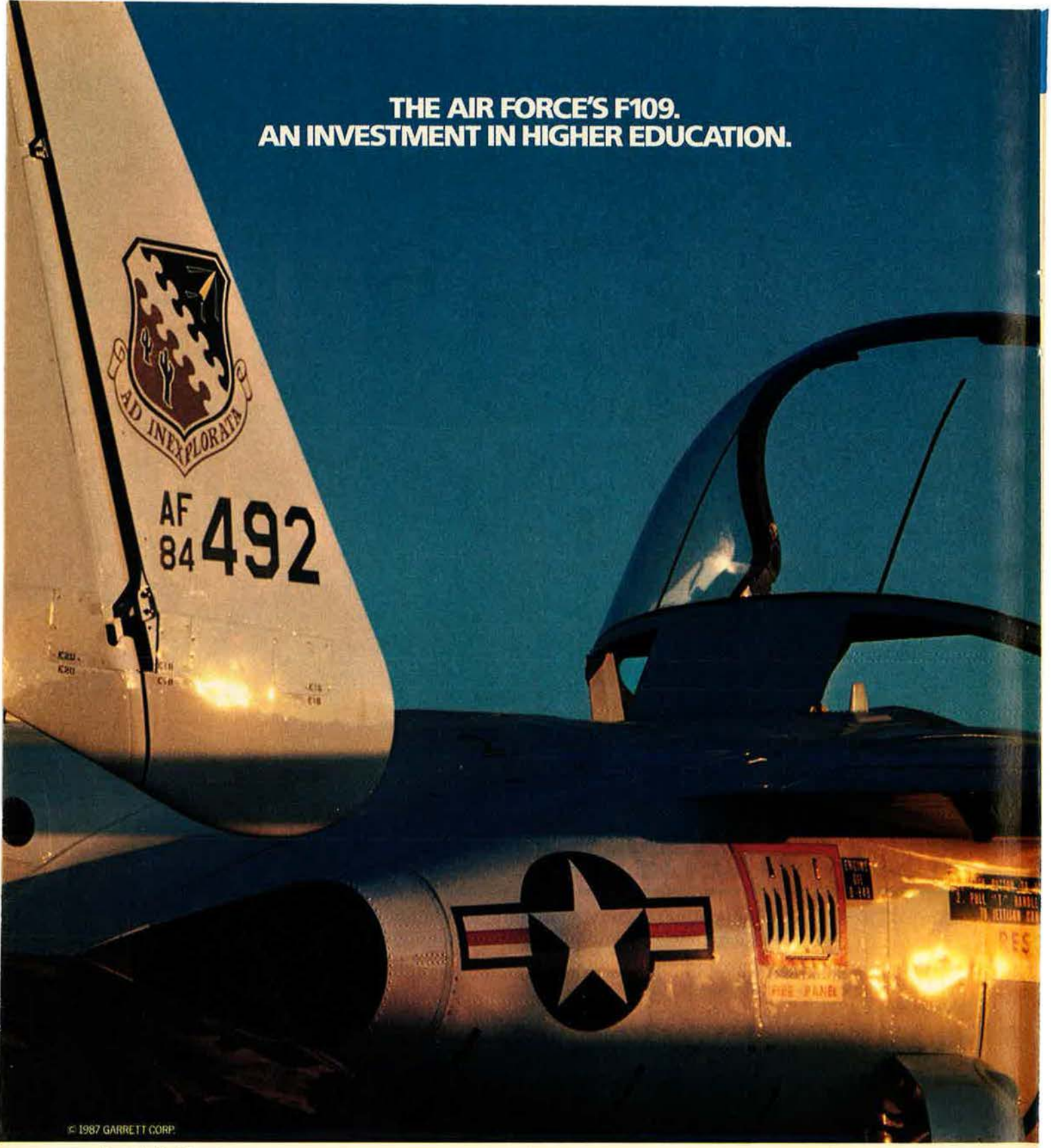

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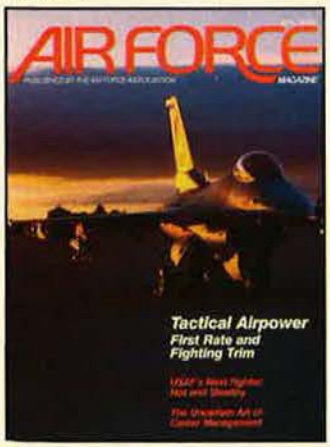

About the cover: Crewmen prepare a new F-16C from the 10th TFS, 50th TFW, for an early morning sortie from Hahn AB, Germany. A special section on "Tactical Airpower" begins on page 46. (Cover photo by SSgt. Fernando Serna, USAF)

Special Section: Tactical Airpower

Features

Departments

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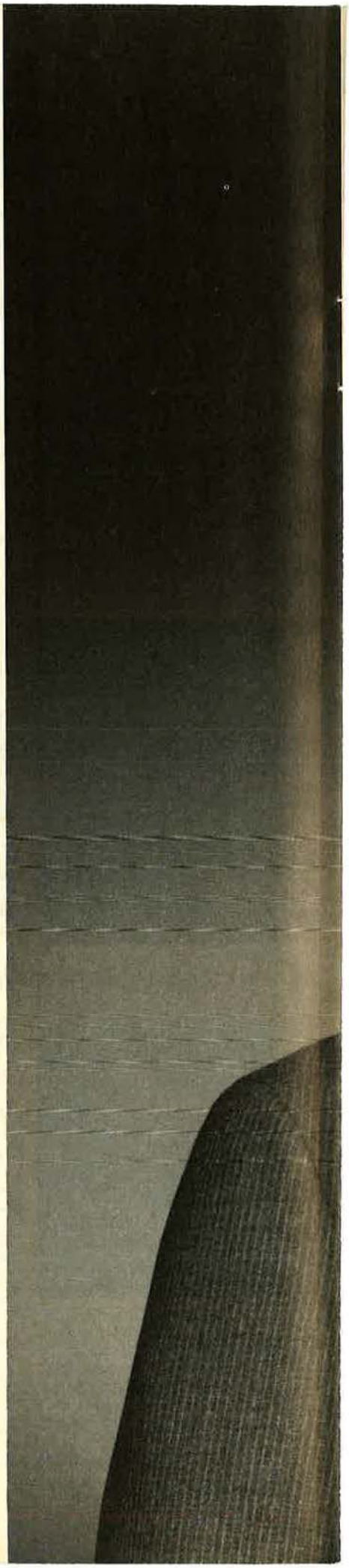
C-17

"C" as in citizen



NEW U.S. AIR FORCE AIRLIFTER TO FLY WITH AIR NATIONAL GUARD AND AIR FORCE RESERVE.

When the C-17 begins operations with the Air Force in 1992, it will also see duty with the Air Guard and Reserve. This is an example of how the needs of the Guard and Reserve are included in early acquisition and planning. Of the 210 C-17s to be built, 48 will be dedicated to Guard and Reserve units across the country.

This assignment for the C-17 is part of continuing efforts to provide our nation's citizen-soldiers with front line equipment.

MCDONNELL DOUGLAS

AN EDITORIAL

The Rise of the Ilities

By John T. Correll, EDITOR IN CHIEF

IN THIS month's special section, we survey the posture of theater airpower today and look ahead to the changes in store between now and the end of the century. By all accounts, the performance gains in the next generation of tactical weapons will be spectacular—in speed, range, accuracy, power, and more.

Less attention-grabbing but perhaps just as important to the actual combat punch delivered will be the remarkable advancements seen in "the ilities." One of the most significant characteristics of US military thinking in the 1980s is emphasis on the readiness and sustainability of forces and on the reliability and maintainability of weapon systems. There has always been some concern for "the ilities," as they used to be called, but too often they have played a weak second fiddle to other considerations. By contrast, today's force planner is inclined to think less about numbers of aircraft on the ramp and more about the number of sorties that can be put in the air.

There are numerous indications that the Pentagon is serious about this change in priorities. The Air Force has already announced that it will appoint an assistant secretary for readiness and support this year. It had said previously that, in awarding contracts, it intended to give reliability and maintainability equal weight with the traditional source-selection factors of cost, schedule, and performance. In an increasing number of cases, the Air Force has passed over low bidders to buy from vendors who were stronger on reliability and maintainability.

The motivation to improve system reliability is compelling. Maintenance consumes more man-hours than almost anything else the Air Force does. Twenty-eight percent of the enlisted force and some 4,000 officers are assigned directly to maintenance specialties. An appreciable number of others, from wing commanders to supply people, work on maintenance-related matters at least part of the time. Maintenance is expensive in terms of personnel, spare parts, repair facilities and equipment, and other support costs, including airlift. The Air Force estimates that if it could double the reliability of spare parts for the tactical fleet, it could buy up to four squadrons' worth of new F-16 fighters with the savings. And since the military-age population of the United States is declining, it becomes imperative to find better ways to accomplish labor-intensive functions.

For the next few years, the combat posture of the force will likely depend, even more than it does now, on the quality of maintenance and the reliability of the systems maintained. Aircraft procurement has tailed off for budgetary reasons, and funding is down for readiness and sustainability. It is essential that theater squadrons be able to generate and regenerate sorties with the aircraft they have on hand.

Fortunately, in-service rates are high for USAF's newer aircraft. The reliability of airborne components is better than ever, and combat systems have become progressively easier to maintain. A leading example of the trend is the F-16 fighter, which requires only about half the maintenance man-hours per flying hour that the older F-4 does. The best news of all is that the biggest gains in reliability are yet to come.

Donald C. Latham, Assistant Secretary of Defense for C³I, popped a few eyeballs at AFA's recent tactical warfare symposium when he said that the Air Force hopes to achieve a Mean Time Between Failure (MTBF) of 10,000 hours with the avionics in its next fighter aircraft. If that sounds farfetched, consider the improvements seen already. A new digital scan converter for B-52 bombers, for instance, is guaranteed by the manufacturer to go 4,000 flying hours between repairs. It replaces a unit that needed work every 230 hours. The new one also costs less.

The trend is so strong that the Air Force now believes it has been too timid in setting reliability specifications. Systems—particularly electronic systems—usually last much longer in actual use than the contract prescribed. Major commands have been told that when specifying requirements for new systems, they should insist on at least double the reliability and half the maintenance of predecessor systems.

Moreover, the minimum acceptable MTBF for avionics line-replaceable units is now 2,000 hours. With 2,000-hour reliability, a wing ought to average only one LRU failure a month in peacetime. In combat, it would mean a ninety percent chance that any given LRU would make it through the first thirty days of fighter operations without failure. In an aircraft with twenty-five LRUs, there would be a ninety percent probability that none of them would fail for a couple of days.

The Air Force has also ordered "environmental stress screening"—a regimen of thermal and vibration testing—to find weak or faulty electronic components before they leave the factory. This "shake and bake" process, it hopes, will reduce the rate of defective parts to one in 1,000 in FY '87 and to one in 10,000 by FY '90.

Greater reliability does not always mean higher cost, but when it does, the expense is usually a good investment. Class "S" parts for the Inertial Upper Stage cost $24 million, compared to $1.1 million for class "B" parts. Testing, however, indicated that the lower-quality parts would have sixty times as many failures, leading to an additional cost of $100 million over the life of the system. The tradeoff penalties to achieve reliability are no longer as severe as they once were. The technologies that underlie reliability—very-high-speed integrated circuits foremost among them—are the same ones that lead to many of the major gains in system performance.

The frontiers of reliability are not yet closed. Most of the dramatic gains so far have been in the area of electronic systems. There are certain to be breakthroughs in other kinds of systems across the board, and the sooner the better. Should the United States find itself engaged in war again, the outcome could well rest on the once-neglected ilities. ■

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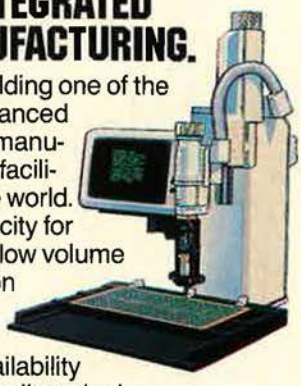

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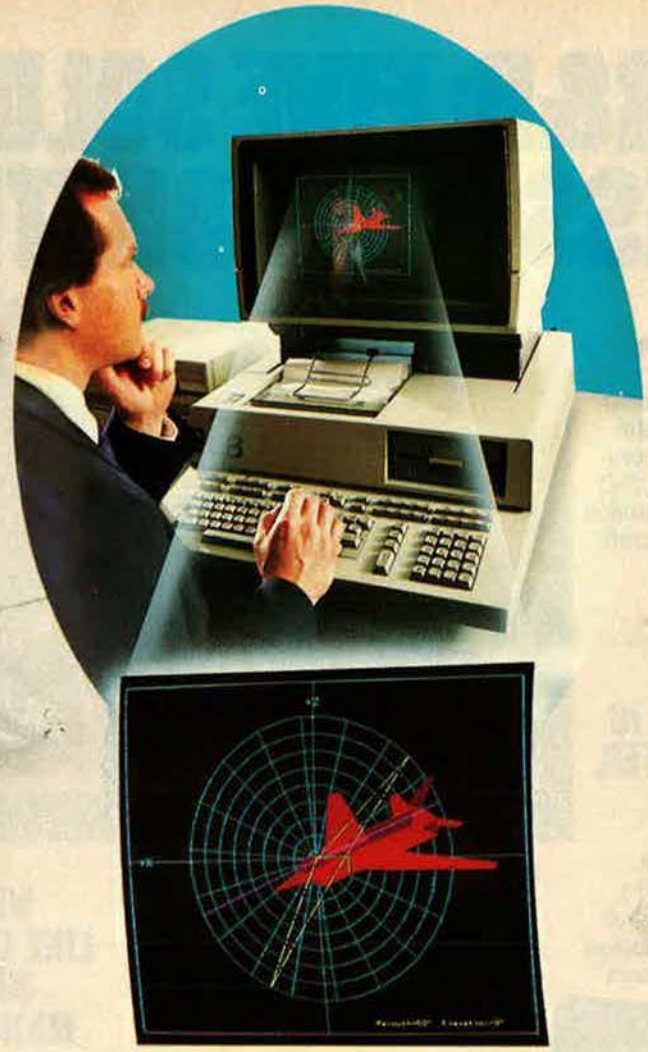

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Software Acquisition

Re: "The Software Crisis" in the May 1986 issue and "Coming Up Short in Software" in the February 1987 issue.

The first article pointed out several initiatives that the Air Force and DoD were undertaking to attack the software crisis: Project Bold Stroke, SDIO, STARS, and Ada. The second bemoaned the fact that software advances have not kept up with hardware technology. But in neither article did I see where the Air Force software acquisition process was examined.

After twenty-one years in Air Force software, principally in tactical C^3 systems, it occurs to me that that is where we ought to start if we really want to improve Air Force software.

First of all, the Part I specifications are poorly written and too detailed and put the emphasis on the wrong syllable. They stress in excruciating detail how each program should work, what other programs should be interfaced, and what conditions should be accommodated. But they seldom stress what capabilities are required. Capabilities need to be described in terms and sufficient detail to allow the contractor to use his ingenuity to solve the many problems he will face during development. We need to concentrate on capabilities, not program names and table sizes.

Second, the preliminary design review/critical design review suffer in execution. At PDR, all questions put to the contractor are "too detailed for the current design level." At CDR, all changes to the detailed design will have a schedule and cost impact. The Air Force reviewers are trapped in a Catch-22.

Third, the Hq. ESD system program office project officers are frequently very junior officers—sometimes second lieutenants. Even an eight-year captain is at a disadvantage when confronted with a half dozen twenty- or thirty-year veterans on the contractor's side.

The final criticism of the software acquisition process concerns the fact that once software is finally delivered, it often does not meet mission requirements. Invariably, the software requires the operator to satisfy the software requirements rather than the software satisfying the operator requirements. In the current jargon, it is not "user friendly."

Part of this comes from the specification issue mentioned above. But another large portion of the problem is derived from the Air Force's preference for fixing the software after delivery rather than during development. Studies have shown that costs for fixing problems after delivery are often 100 times more than for those fixed during development.

We apparently believe that providing Air Force system operators in large quantities on site, working with the contractor, is too expensive. But many times during development, the contractor's programmer has alternative solutions to providing a given capability. Without an operator's guidance, he will provide either the most straightforward or the most elegant software solution, not the most operator-useful one. It will be years after the software is delivered before this type of problem can be fixed by the Air Force.

We should concentrate on preventing mission-inhibiting solutions from ever reaching the field. More operator involvement should help and, in the long run, should be much cheaper.

The situation is not all bad. The apparent recognition by our senior leadership of software's vital role in helping all of us accomplish the mission is very encouraging.

Maj. Donald Lucas, USAF
Tinker AFB, Okla.

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.

Central American Policy

Three cheers for Gen. T. R. Milton's on-the-mark assessment of the Iran/Contra affair and the effect of the affair's fallout on US efforts in Central America *(see "The Bay of Piglets," February '87 issue, p. 88).*

It seems the time has arrived for the US government to develop a solid foundation of national support for our Central American policy. That foundation can come only from a clear, consistent, and cohesive policy. Congress (possibly still in the shadow of Vietnam) seems to have lost its historical perspective. And the news media seems to justify its existence through sensationalism, overreporting, and speculative editorializing. A recent Gallup poll shows a substantial drop in the confidence of the American public in the accuracy of the news media.

With a clear, coordinated policy built on a strong national foundation, all relevant government agencies will function effectively. We, as a nation, soon have to open our eyes to the very serious threat that exists in Central America.

If congressional politicking and media sensationalism continue to command our attention, we will be in deep trouble indeed.

John Lewis
Norfolk, Conn.

At What Cost SDI?

I agree with J. David Byrd III that it certainly is foolish to ask or expect any defensive system to be perfect *(see "Airmail," February '87 issue, p. 8).* I doubt any technically informed person believes that an impregnable defense against missile attack, to say nothing of all nuclear weapons, is plausible or that impregnability is necessarily the yardstick against which any defensive system must be measured.

However, it is precisely this vision of SDI that President Reagan has adopted to justify the program. Mr. Byrd should recognize that so long as the Administration chooses to promote this as a real possibility, as President Reagan continued to do at Reyk-

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javik, public debate will continue to revolve around this point. . . .

On the other hand, Mr. Byrd should bear in mind that although an imperfect defense is acceptable in a conventional conflict, it does not follow that an imperfect nuclear defense would also be adequate. A five percent attrition rate spelled defeat for the Germans in 1940, but even one nuclear warhead leaking through to hit a major city could kill more Americans than have died in all wars in this century.

However, Mr. Byrd does recognize that SDI's real value is as a tool to maintain deterrence. In other words, by eliminating an aggressor's confidence in his ability to launch a perfectly successful attack, it would cause the aggressor to stay his hand for fear of the damage he would suffer in the inevitable counterattack.

But in that case, SDI as a defensive system has no special advantages over other methods of assuring a survivable retaliatory force, such as elusive basing. Indeed, the unparalleled complexity and technological difficulty of any substantial system would seem to make it a less desirable option. The same research money, if channeled into research programs designed specifically to bolster civilian industry, would do more to strengthen the US economy than would SDI-focused research.

Even proponents admit that the cost of developing and deploying any kind of large defensive system would cost at least $200 billion, and possibly much more. That $200 billion could buy 3,600 SICBMs or 1,500 rail-mobile MX missiles. Further, the Scowcroft Commission, the Pentagon, and AIR FORCE Magazine have all argued convincingly that our existing triad of forces is not in imminent danger of losing the ability to launch a devastating response to any foreseeable attack.

In light of this, it is difficult to see the justification for the Administration's desire nearly to double SDI spending next fiscal year. The same result, the continuation of Mutual Assured Deterrence, could be purchased more cheaply and without stirring up antagonisms with allies and enemies alike.

Carey P. Sublette
Riverside, Calif.

Checked MATE?

First, let me say that the following is my own opinion and not that of any organization that employs me. I was delighted and surprised to find an article about automatic test equipment (ATE) in the January issue *(see "Making Test Sets March in Step," January '87 issue, p. 89).* Testing is usually a forgotten world, added to a system as an afterthought.

However, the article was simplistic and one-sided. Not everyone thinks MATE (Modular Automatic Test Equipment) is a good idea. Author John T. Correll states that MATE is meeting with opposition because the program managers don't want to spend the money to get it going. The fact is that the MATE operating system is slow and not user-friendly. Money is a concern, but even more so is the ability to do the job.

The idea behind MATE is to prevent obsolescence by having a standard interface into which new equipment can be connected when the old equipment becomes unsupportable. What does one do when the interface becomes obsolete because of the growing complexity of digital circuitry requiring higher clock rates and more digital pins per chip? Mr. Correll admits in his article that the MATE test sets will have to be "adjusted" to handle VHSIC and Ada. Just look at the history of the Atlas test language to see how well standardization works in this industry. The MATE version differs from the IEEE version, and they are both too slow.

The concerns that the program managers have are not just with their budgets, and they are not the only ones with concerns. Someone has said that "there will be no more improvements. We are happy with what we have, and we will call it MATE."

(P.S.: Only a handful of waivers to the MATE directive has been granted because the MATE SPO has not specified how they want the waivers to be presented to them.)

Dennis A. Ludwig
Warner Robins, Ga.

Misleading Analogy?

I was pleased to read Dr. Jacques S. Gansler's article drawing attention to the rapid rise in the real unit cost of military aircraft and the consequent fall in the annual number of aircraft acquired *(see "The Dangerous Dive in Aircraft Production," December '86 issue, p. 112).* I agree with many of his observations, having presented a British perspective on this issue in the May 1983 edition of *Aerospace,* but I am less hopeful that the rise will be significantly checked by improve-

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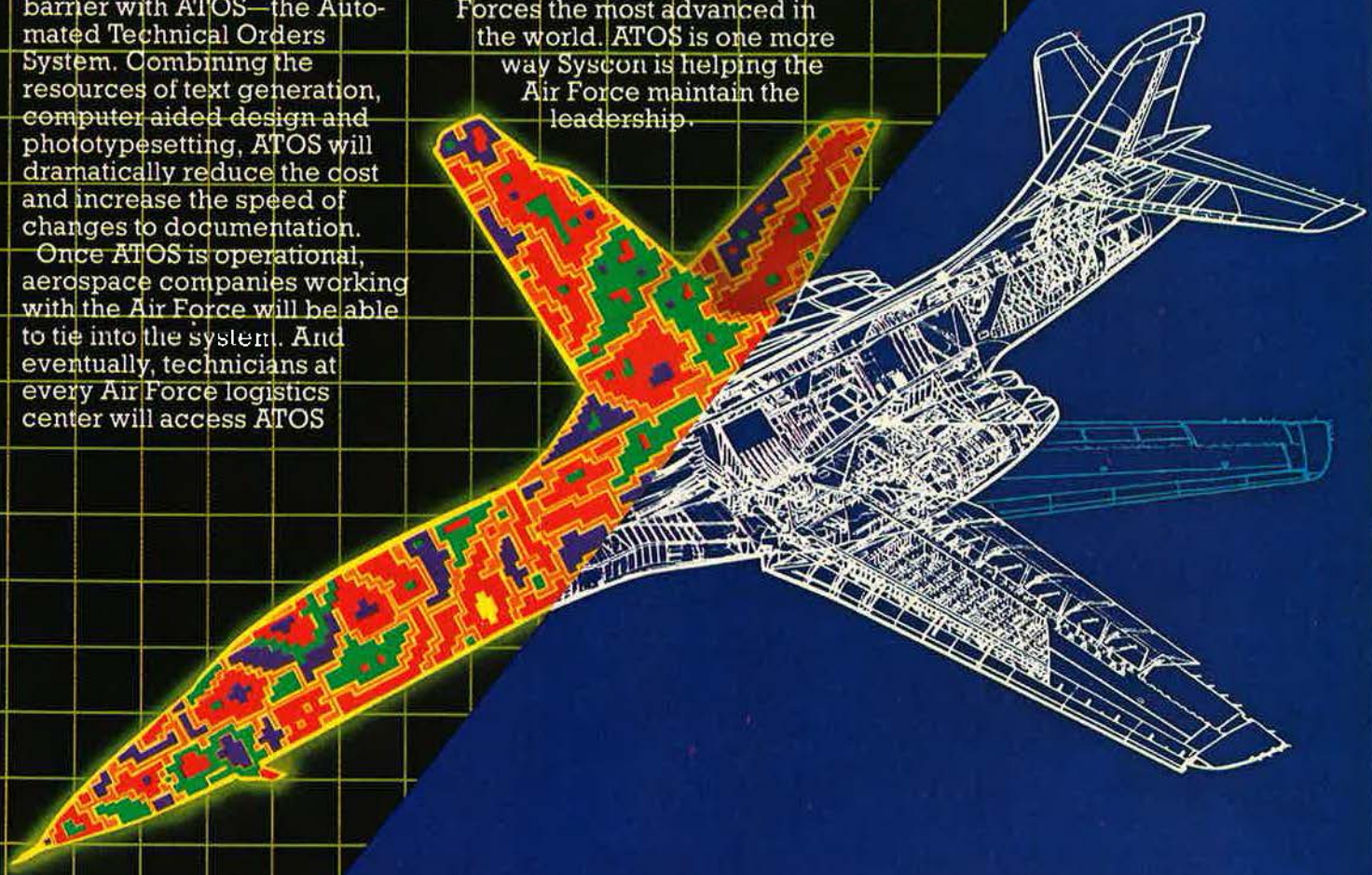

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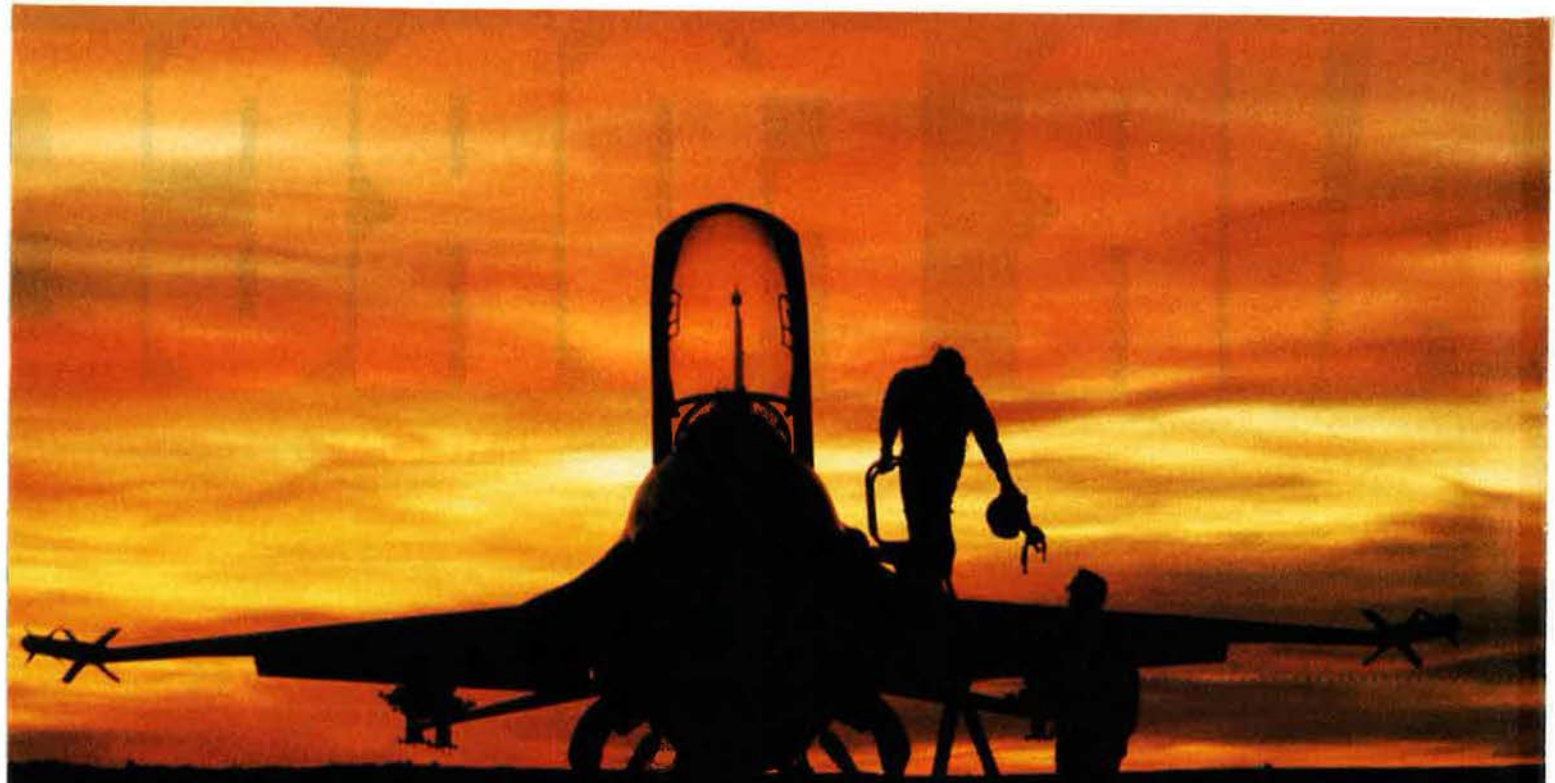

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ments in manufacturing technology and acquisition organization. The historical growth occurred despite continued efforts to achieve such improvements.

However, there is one of Dr. Gansler's paragraphs in which he draws a potentially misleading analogy between military aircraft production and the civilian electronics industry (computers, data processing, communications, etc.) and suggests that the military might learn from that industry's achievements in improving performance and simultaneously reducing cost.

I do not decry that achievement or deny that most organizations can learn from others' methods, but it is important to emphasize the very important difference in the functions of civilian and military equipment. The former has to exploit and overcome the laws of science, but the latter has *additionally* to equal or surpass the performance of the enemy's equipment. In the civilian marketplace, inferior performance means a few points off market share, but in military combat, a similar inferiority can mean disaster. . . .

I contend that equipment that has to compete directly for victory or prize money will inevitably rise in cost more rapidly than other equipment that provides its owner with commercial or leisure facilities—see, for example, the multimillion-dollar yachts that raced recently for the America's Cup. I strongly suspect that television sets would be more expensive if some quirk of nature stipulated that only the more sophisticated half of those in a particular neighborhood could receive simultaneously.

Technology has immeasurably widened the scope for choice between quality and quantity in military equipment, but so far has been less help to the officers and officials responsible for making the best selection.

Dr. D. L. I. Kirkpatrick
Attaché, Defence Equipment (Air)
British Embassy
Washington, D. C.

Air America Ire

To say that Gen. T. R. Milton's article "Operating in the Shadows" in the December 1986 issue upset the membership of the Air America Club would be an understatement. It is distressing to read an armchair report of that quality from a general officer.

I think it is in poor taste to pick apart the small, underfinanced operation of which Eugene Hasenfus was a part. As civilians, they certainly didn't carry Geneva cards, much less enough parachutes for fellow crew members. At least they were trying to help the cause of freedom.

The General's disparaging remarks about the attire of Air America personnel in Southeast Asia disturbs me greatly. I invite the man to strap into an Air America C-123 of those days and spend the full day carrying max loads, often under enemy fire, into strips that could best be described as marginal. I suspect that by day's end, his appearance would reflect a sweaty, dusty, and no doubt weary look. His use of the term "raunchy" is an extremely unfair overall description of one of the most efficient air operations in that part of the world.

AIRMAIL

The encouraging part came when we read the letters in the February 1987 "Airmail" by Col. Robert M. Byrom and Sam McGowan. They recognized and understood the circumstances much better than the General ever will. . . .

Leon V. LaShomb
Chairman of the Board
Air America Club
Marion, Tex.

The Corps Contribution

Jeffrey P. Rhodes's article "Improving the Odds in Ground Attack" in the November 1986 issue bent your credibility a little. It just isn't possible to write a serious article on "ground attack" without some discussion of Marine Corps contributions.

I'm sure a naval aviator could provide you a longer list, but even an unfeathered Marine knows about dive bombing (1919), close air support itself (1927), and SEAD and all-weather CAS (both in the Korean War). And our basic organization for combat—the Marine Air-Ground Task Force, or MAGTF—is unique in the world, being specifically designed to provide the optimum integration of air and ground forces and fire in support of our combat mission.

Don't get me wrong—I don't regret that the CINC forced me to subscribe. But your readership suffers when educational articles reflect either service dogma or a "not-invented-here" approach. In the interests of combat proficiency and to placate the current jointness jag, the various aviation communities should be sharing, not shielding.

Col. G. D. Batcheller, USMC
Scott AFB, Ill.

• *Author Jeffrey P. Rhodes replies: "Colonel Batcheller is certainly right in pointing out the Marine contributions to attack aviation, but he misses the point of the article. No air arm—be it the Air Force with F-15Es, F-16s, F-4s, F-111s, and A-10s, the Marines with AV-8Bs and F/A-18s, or the Army with AH-1s and AH-64s—is going to win the war by itself. It is going to take a combined effort, with each service doing its part and, given the current conditions, a little bit extra besides. The article emphasized Army-Air Force cooperation, because the Army is the service with which the Air Force will have to work closest."*

Air Defense Fallout

What is going on here? First I read that a USAF major general, charged with defending our northern border, testified before the Senate Armed Services Committee that the air defense version of the F-16 is the wrong aircraft for performing continental air defense of the US. Then I learn that the Defense Department's Director of Operational Test and Evaluation believes the F-16 is "no threat to anyone" in the continental air defense role. Yet Congress ignores these views and authorizes modifying F-16s for use by the Air National Guard in the air defense mission!

My test and operational experience in flying and evaluating the F-4, F-14, F-15, and F-16 strongly supports the view that the F-16 is the least desirable of these four aircraft for performing the air defense role against cruise-missile-equipped aircraft. If budget constraints preclude procuring F-14s or F-15s, why don't we install upgraded radars in F-4s as an interim solution until procurement of the Advanced Tactical Fighter permits more F-15s to be sent to the Air National Guard?

Is the General Dynamics lobby so powerful that it can persuade congressional representatives to ignore the advice of the military experts? United States citizens are paying more and getting less!

Jeffrey G. Canclini
Dayton, Ohio

The selection of the F-16A as the Air Defense Fighter raises some serious questions.

Clearly, the upgraded F-4 proposed by the North Dakota ANG is a superior aircraft for the air defense mission. The point that the F-4s are an average of twenty years old is invalid for two reasons. First, studies have proven that an upgraded F-4 could last well into the next century. Second, the aircraft was proposed as an interim measure until a more capable interceptor could be purchased. The proposed modifications would make the F-4 a specialized air defense fighter. This seems to be what the ANG has in mind, obviously feeling that the threat posed by Soviet cruise missiles is sufficient to warrant a single-purpose aircraft.

The Air Force, however, seems preoccupied both by the tactical threat and by its goal of obtaining forty tactical wings to counter that threat. To that end, the fact that the F-16 ADF will retain its air-to-ground capability must be an important point in its favor. Still, it would seem more effective to modify existing F-16A/Bs to the more capable C/D standard and use them to expand the tactical forces directly. Such a program would go a long way toward offsetting the massive cuts in tactical aircraft procurement in the FY '88 budget.

The ANG needs a specialized air defense fighter to counter the Soviet cruise missile threat effectively, and TAC needs as many F-16C/Ds as it can get. Rather than taking F-16s out of TAC and transferring them to the ANG, it would seem to make more sense to modify existing F-4s for the air defense mission and to upgrade existing F-16s to the C/D standard.

John Haazen
Southport, Manitoba
Canada

• *The Air Force chose the modified F-16A over the F-20 as its air defense fighter as a result of competition that involved those two aircraft only. Congress, which then approved USAF's selection, originally had authorized wider competition involving all possible fighters for the mission, but Grumman and McDonnell Douglas chose not to enter it with their F-14 and F-15, respectively. USAF considered modifying F-4s for the mission, but decided against it for a number of reasons, notably the F-4's age in relation to the costs of upgrading it. Even those who criticize USAF's selection on grounds that the modified F-16A may be less than ideal as an air defense fighter concede that it shapes up as the best USAF can do at a time of tighter budgets and of increasing need to maintain force modernization.*—THE EDITORS

Australian Tiger Moths

I am researching a book on the de Havilland DH.82A Tiger Moth aircraft in Australia.

In 1942, seven Australian-built Tiger Moths were transferred to USAAF's Fifth Air Force from the Royal Australian Air Force (RAAF). Two (RAAF serial numbers A17-494 and -495) were allotted to the 46th Air Base Group at Darwin and left RAAF Richmond in New South Wales for Darwin on June 18. Four (A17-580 through -583) were issued to USAAF at 2 Aircraft Depot, RAAF Richmond, on October 6. The last (A17-547) was issued at 3 Aircraft Depot, RAAF Amberley, on December 18. No USAAF tail numbers were allotted, and they may have continued to be identified by their RAAF serial numbers.

In addition, eighteen Tiger Moths were delivered direct to USAAF in May or June 1942. These aircraft, factory

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numbers 902 through 907 and 954 through 965, carried no RAAF serials. Again, no USAAF tail numbers were allotted, and these aircraft may have been identified by their factory numbers. Four were shipped to New Caledonia, with the remainder operating on the Australian mainland or in New Guinea.

I would welcome any information readers might provide about the units to which these aircraft were assigned, the use to which they were put, and their ultimate fates. Photographs would, of course, be especially welcome.

Julian D. Forsyth
P. O. Box 727
Civic Square, A.C.T. 2608
Australia

CAF B-25 and B-17

The Arizona Wing of the Confederate Air Force is restoring a World War II B-25J-10, serial number 43-35972.

We would like to hear from anyone who has had any contact with this combat vet. We are trying to locate records, photos, and information on this aircraft for the period from 1944 to 1959. We are specifically searching for information for the period from June to November 1944. The aircraft was assigned to the 437th Bomb Squadron, 319th Bomb Group, in Corsica from November 1944 to December 1944. She flew fifteen combat missions.

We are also trying to locate information on a Boeing B-17G, serial number 44-83514. We are looking for anything about the aircraft during the period from March 27, 1945, to the summer of 1947 and from 1949 to 1956. . . .

We are also trying to locate records on B-17Gs that were converted to either B-17 lifeboat or radar carriers and that served with USAAF, USAF, or USN as rescue, AEW, or weather-function aircraft.

We would like very much to contact anyone who flew, maintained, or has photos or stories about these aircraft and the organizations to which they belonged. All material will be copied, handled with extreme care, and returned. This information will be used to help restore both aircraft and construct a display tracing the history of these aircraft. It will also be used to write a booklet on both aircraft.

SSgt. Roger P. Sprung, USAF
3107 N. Carriage Lane
Chandler, Ariz. 85224

CG-4 Troop Glider

The Cradle of Aviation Museum, a rapidly growing air and space museum on Long Island, just east of New York City, is seeking a Waco CG-4 troop glider for exhibit.

This historic aircraft participated in many notable actions during World War II. More than 700 were built on Long Island by Dade Brothers Co. George Dade is active in the museum development and is also a member of the Arnold Chapter of AFA.

If anyone knows the whereabouts of a CG-4 or any airframe components—in any condition—the museum would like to obtain them for static restoration. Please contact the address below.

Josh Stoff
Curator
Cradle of Aviation Museum
Museum Lane, Mitchel Field
Garden City, N. Y. 11530

AIRMAIL

"Lone Wolf" Operations

In doing some research on the Fifteenth Air Force at the Air Force Historical Research Center, I came upon a monograph dated January 18, 1945, that describes "Lone Wolf" bombing operations.

"Lone Wolf" involved the dispatch of single aircraft or small formations for night and bad-weather harassment attacks against targets in Germany and Austria—627 missions were flown between October 25 and December 12, 1944.

I would very much like to hear from anyone who participated in these missions. I would also appreciate being allowed to copy any photographs of the aircraft involved in these operations.

Dr. Richard H. Marcus
Department of History
University of Wisconsin,
Eau Claire
Eau Claire, Wis. 54702-4004
Phone: (715) 836-5501

Army Aviation in Hawaii

I am an aviation and feature writer at the Honolulu *Star-Bulletin.* Along with Bob Chenoweth of the US Army Museum of Hawaii, I am in the midst of writing a book about Army aviation in Hawaii prior to the Pearl Harbor attack.

We're looking for any photos, memories, mementos, or information about Air Corps tours in the Islands. Anything provided will, of course, be treated with care, returned promptly, and properly credited.

Even snapshots would be helpful, since we're trying to provide a complete impression about aviation life in those days.

I can be reached at the address given below.

Burl Burlingame
1030 Aoloa Pl., 201B
Kailua, Hawaii 96734
Phone: (808) 263-6087

History of Nuclear Weapons

I am presently completing a definitive history of US nuclear weapons development since 1945.

In connection with this effort, I am currently seeking unclassified color or black-and-white slides or photos of active and retired nuclear devices, weapons, and warheads aboard aircraft or missiles, on test stands, or on public display.

Any reader with photos of these items can contact me at the address below. Loaned pictures will be copied and returned promptly. In addition, a free copy of the book will be provided to contributors upon publication later this year.

Chuck Hansen
1086 S. Bernardo Ave.
Sunnyvale, Calif. 94087

Project Nan

I would like to hear from anyone who knows anything about Project Nan. This 1945 project pertained to a proposed post-World War II airfield near the center of the Seward Peninsula in Alaska.

I would also like to learn the name and issue of the magazine (circa 1944) that carried a first-person story by Army Air Forces Lt. Leon Crane detailing Lieutenant Crane's December 1943 parachute jump from a B-24 aircraft east of Fairbanks, Alaska. His account was titled "I Was Lost 84 Days in the Arctic." It may have appeared in *American Magazine,* which is now defunct.

Lt. Col. Lyman L. Woodman,
USAF (Ret.)
3001 Widgeon Lane
Unit 8
Anchorage, Alaska 99508

Military Retirees

I am gathering information for a book on military retirees. I am looking for retirees who would be willing to answer a questionnaire dealing with their preparation for retirement from the military and their satisfaction with life outside the military.

If you are interested, please contact me at the address below.

Steve Lynch
Box 225
Princess Anne, Md. 21853

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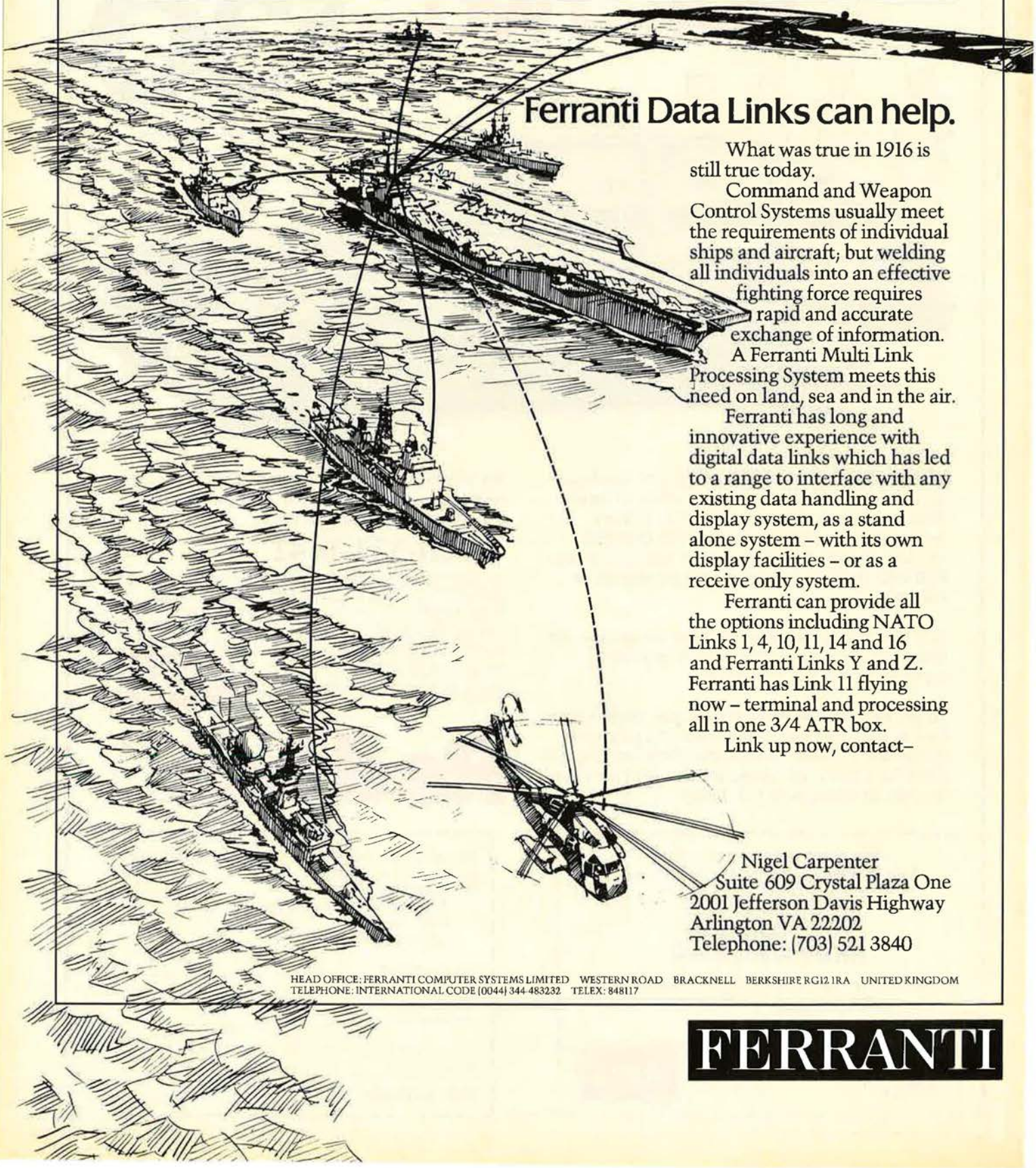

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AIRMAIL

Gunships in SEA

I have recently begun researching two little-known gunships used in Vietnam—the Tropic Moon 3 B-57 and the AC-123 Black Spot. I am looking for information on their characteristics and their tours in Vietnam. Photographs of these aircraft would be especially helpful.

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

Chris Diehl
20 Magnet St.
Stony Brook, N. Y. 11790

F-4 Awards

I am collecting data about the F-4 and hope to acquire some assistance from readers.

I am trying to complete a year-by-year list of wing and squadron of the year awards as well as other special awards presented to F-4 units or personnel.

Any assistance in this area would be greatly appreciated.

Lee R. De Haven
P. O. Box C-24860
Represa, Calif. 95671

AFROTC Det. 190

If you are a University of Illinois AFROTC alumnus, the 190th Cadet Group would like to hear from you.

The cadet group historian is currently in the process of organizing our alumni association and would like to reach all alumni by the occasion of the forty-year anniversary of our detachment in 1989.

If you received a commission through the University of Illinois AFROTC program, send us your name, rank, current mailing address, job assignment, and year of graduation. If you know of any fellow alumni, we would like to hear about them, too. In return, we will send you a copy of our alumni newsletter with information on the latest happenings at Detachment 190.

Please contact the address below.

AFROTC Det. 190
University of Illinois
223 Armory Bldg.
505 E. Armory
Champaign, Ill. 61820
Phone: (217) 333-1927

AFROTC Det. 850

We would like to hear from the alumni, faculty, and staff of AFROTC Detachment 850 at the University of Utah for the purpose of constructing a history of the detachment.

Please send us a short biography, briefly telling us what has happened in your career since graduation. If possible, we would also like to receive a current unit patch.

Please contact us at the address below.

AFROTC Det. 850
2009 Annex Bldg.
University of Utah
Salt Lake City, Utah
84112-1107

Collectors' Corner

I am working on a patch collection for the Castle Air Museum at Castle AFB, Calif. I'm looking for patches from World War II to the present for the museum's collection.

We have more than 700 patches on display at the museum, and we would like to expand our collection. Any readers who can assist us in this endeavor should contact the address below.

TSgt. Frank Flynn,
USAF (Ret.)
2709 Hillcrest St.
Atwater, Calif. 95301

I am working on a collection of Air Force patches and insignia. I am especially interested in patches from World War II and the 1960s.

I am also looking for patches for the 4080th Strategic Reconnaissance Wing at Laughlin AFB, Tex.

Any help would be greatly appreciated. Please contact me at the following address if you can give me any assistance or wish to trade.

A1C Donald Tyson,
USAF
5808 E. Hwy. 98
Apt. 108
Panama City, Fla. 32404
Phone: (904) 871-6191

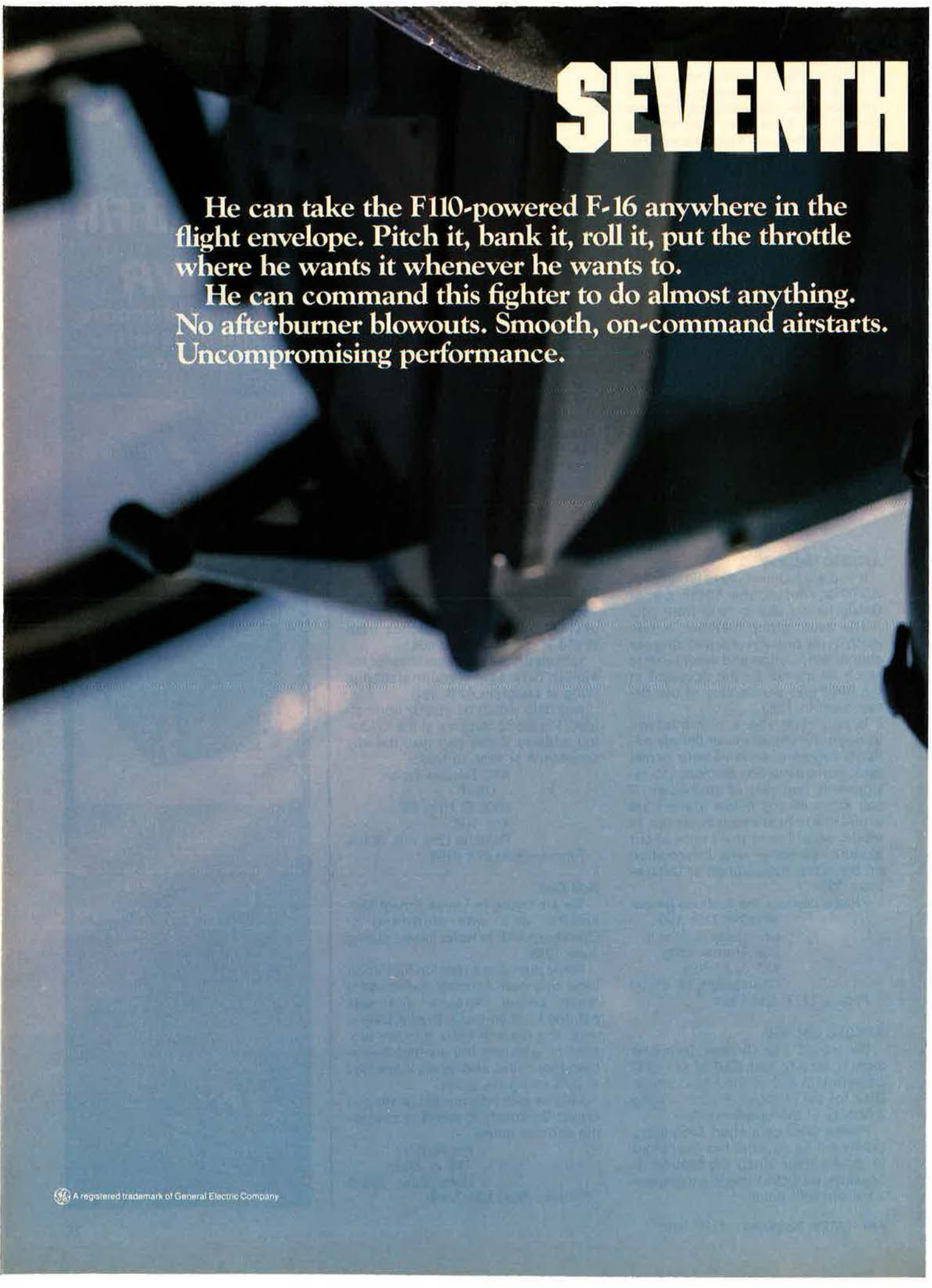
Roll Call

We are trying to locate Ernest Berkowitz, who was stationed at Dyersburg AAB in Halls, Tenn., during June 1945.

While planning a reunion for this air base this past summer, we found a mural called "Tribute" that was painted by then-Corp. Ernest Berkowitz. The town of Halls is in the process of restoring the six-foot-by-sixteen-foot mural, and we are interested in contacting the artist.

Anyone with information relating to Ernest Berkowitz is asked to contact the address below.

Pat Higdon
719 W. Main
Halls, Tenn. 38040
Phone: (901) 836-7448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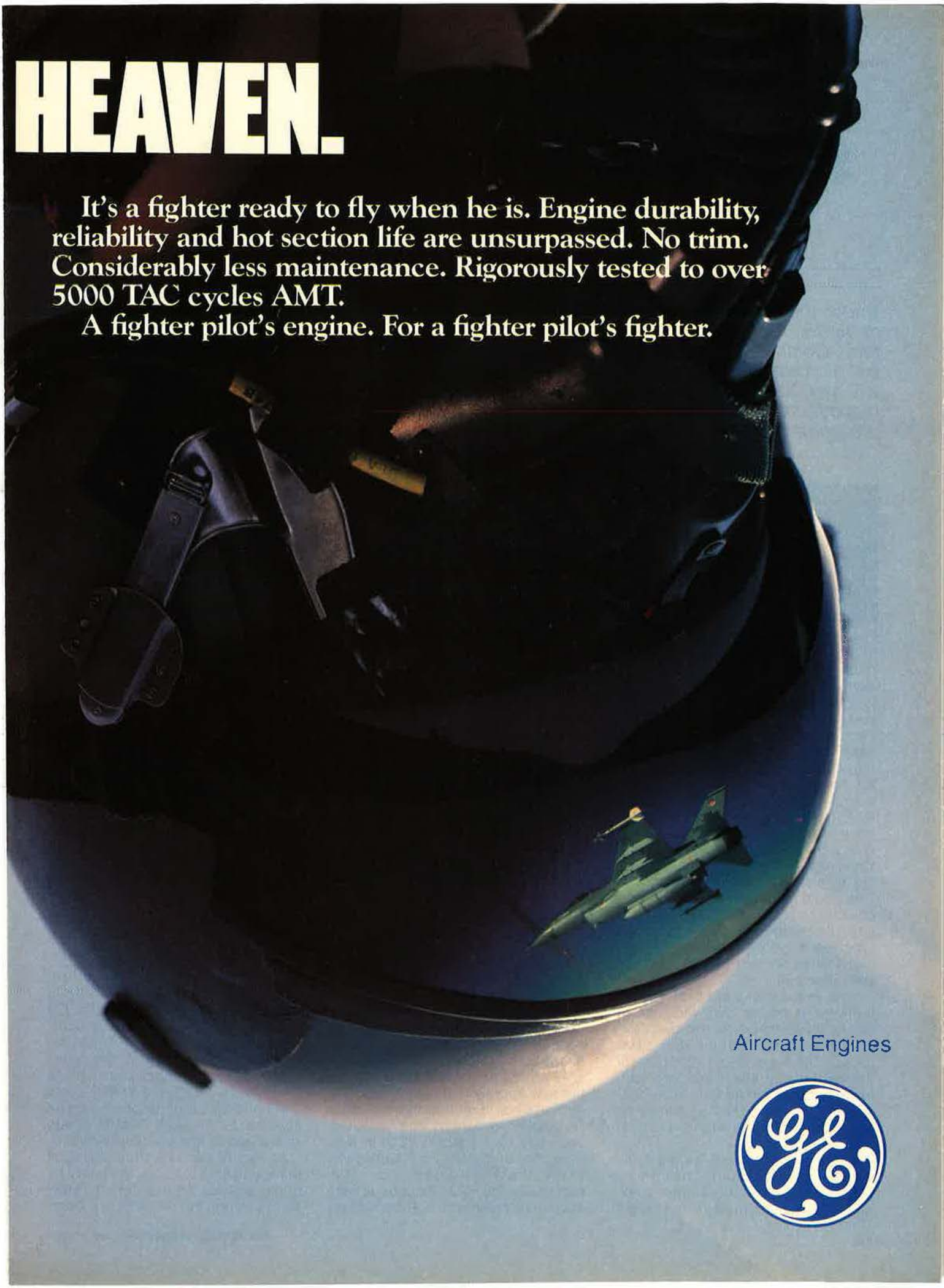
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IN FOCUS...

Streamlining and Restructuring

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

Under the new acquisition structure, the role of Systems Command is recast. It still allocates resources, but will be out of the direct management chain on most programs.

Washington, D. C., March 4

The Air Force, in line with the Goldwater-Nichols DoD Reorganization Act of 1986, is now implementing several major changes that include transferring the Comptroller and Inspector General from the Air Staff to the Secretariat, cutting the Secretariat and the Air Staff by 441 staff slots and reassigning those positions to operational functions in the field, and reducing headquarters staffs throughout the service by ten percent.

In announcing these adjustments, Air Force Secretary Edward C. Aldridge, Jr., also reported that the service, in response to another congressional directive, is dropping officer levels by 1,300 slots this year. He stressed that the Air Force is "objecting to having to make those cuts." This year's reduction, he pointed out, equates to about one percent of the total officer strength and is to be followed by a two percent cut in FY '88 and a three percent reduction in the year after that.

This mandated series of reductions, he warned, is "very, very disruptive, [and] we would like to avoid it. We have been very explicit with Congress." The cut in officer strength will not necessarily affect end strength, however, since the Air Force is authorized to up its civilian and enlisted force manpower levels in a corresponding fashion.

Another significant change involves "reorganizing our headquarters acquisition functions into a combined staff arrangement that pools the resources of the Air Staff and the Secretariat." In practical terms, this entails taking "the Deputy Chief of Staff for Research, Development, and Acquisition and [putting this structure] under the [new] Office of the Assistant Secretary of the Air Force for Acquisition." The Air Force Secretary added that "during the next six months, the Air Force will study the possibilities of integrating these staffs into a more streamlined arrangement."

In addition, the functions of the Assistant Secretary for Financial Management, over the coming months, will be transferred to other offices, in the main to the Air Force Comptroller. By July 1, 1987, an Assistant Secretary of the Air Force for Readiness and Support will be created for the express purpose of overseeing readiness and sustainability and heightening "this critical combat capability in support of our theater commanders," he announced. Lastly, the Under Secretary of the Air Force will "develop a plan of action to integrate the programs of the three Assistant Secretaries with an eye on improving the service's ability to develop broad program goals and objectives."

The reorganization will also have major impact on Air Force Systems Command. Secretary Aldridge has just issued a directive that establishes a three-tiered acquisition structure. Under this arrangement, the program manager will report to a product division program executive officer (PEO), who, in turn, will answer to the service acquisition executive (SAE). While the Air Force's Assistant Secretary for Acquisition will carry out this function at present, Secretary Aldridge pointed out that, in the future, either the Under Secretary or the Secretary himself might act as the SAE.

As a first step toward implementing the new approach, he explained, the Air Force has identified sixteen key or "executive" programs and assigned each one to a specific PEO. In one case, that of the National Aerospace Plane, the AFSC Commander will function as the PEO; the other fifteen executive programs will be supervised by the AFSC component commands, such as Aeronautical Systems Division and Space Division, or, in some cases, by Air Force Logistics Command, he pointed out.

Even though AFSC is no longer in the direct management chain involving acquisition programs carried out by its product divisions, "it continues to have the function of resource allocation." The AFSC Commander will also continue to act as the "four-star spokesman" for the acquisition community in dealing with industry, Secretary Aldridge pointed out.

The Secretary added that the Air Force looked at the possibility of disestablishing AFSC, but decided against such a change. The functions performed by the command would have to be duplicated at the component commands' level, with the effect of increasing rather than decreasing the overall personnel requirements and costs. What the reorganization eliminates is the layering process that has plagued the structure in the past, he said.

So far as the revised Air Force Secretariat and Air Staff structure is concerned, he pointed out that the Inspector General will "continue to have some responsibilities to the Chief of Staff, [even though] he will report directly to me." He added that on matters of operational readiness inspections and flight safety—areas that "deal with the military forces themselves"—the Inspector General has responsibilities also to the military head of the service.

So far as the Office of the Comptroller of the Air Force is concerned, Secretary Aldridge acknowledged that the new arrangement does not preclude the possibility that the present three-star position might be changed to a civilian slot "sometime in the future." Another possibility is the eventual creation of a fifth Deputy Chief of Staff, perhaps focused on requirements, he said. Five DCSs are authorized by law, but only four exist.

As part of the new streamlining of the acquisition process, Secretary Aldridge ordered the transfer of two elements of Air Force Systems Com-

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TAPSA/Ayer

CASA

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For further information, contact: Construcciones Aeronáuticas, S. A. Rey Francisco, 4. 28008 Madrid. Spain. Phone: 248 53 09. Telex: 44729. Or contact: CASA Inc.: 14102 Sullyfield Circle, Suite 200. Chantilly. Virginia 22021. Phone: (703) 378 22 72. Telex: 90-1109.

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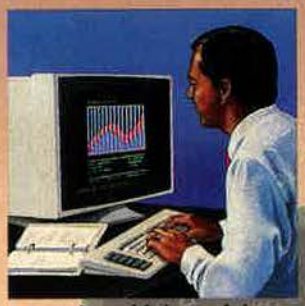

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mand to other organizations. Wilford Hall Medical Center in San Antonio, Tex., goes to Air Training Command, and the Air Force Satellite Control Facility and the associated host base support responsibilities of Onizuka AFS in California are assigned to Air Force Space Command.

Ballistic Missile Ban "Premature"

The Joint Chiefs of Staff are about to complete a comprehensive assessment of what it would mean to this country's national security to enter into an accord with the Soviets to eliminate all ballistic missiles—regardless of how based—within ten years, according to JCS Chairman Adm. William S. Crowe, Jr. (At the Reykjavik summit meeting last fall, the US, in seemingly impromptu fashion, reportedly agreed to a Soviet plan to scrap *all* ballistic missiles within ten years after cutting the two countries' inventories of ICBMs and SLBMs in half within five years. The superpowers' dialogue collapsed subsequently because of Soviet intransigence over SDI, the Strategic Defense Initiative.)

In response to questions from this writer at a recent press breakfast meeting, Admiral Crowe termed ten years a "very short period" for such a fundamental restructuring of US strategic deterrence, which "took forty to fifty years to build." He added that it would be extremely difficult to accomplish the dismantling of these weapons while at the same time building up other capabilities in order to maintain viable deterrence levels during and after the transition.

While the JCS Chairman declined to discuss details so as not to preempt the pending report to the White House, he expressed concern about potential Soviet breakouts from such an accord. Once committed by treaty to the total elimination of ballistic missiles, whether based on land, at sea, or potentially on aircraft, this country, "I am sure," would abide by it. The consequences would be "quite grave [and] dire" if the Soviets "cheated in a significant way or violated [the accord] in a significant way," Admiral Crowe pointed out.

The Joint Chiefs of Staff are also apprehensive about the high costs associated with replacing the ICBM and SLBM forces by other, possibly brand-new forms of strategic nuclear deterrence as well as by the widely but mistakenly held view that such an action represents a "money-saving proposition." Extending this contention beyond the "zero ballistic missile" concept embraced by some

IN FOCUS...

members of the Administration, Admiral Crowe termed it "very unlikely that you—just on the basis of arms control—could save money and keep the country safe."

The notion floated at the Reykjavik superpower summit that all nuclear weapons could be eliminated by arms-control accords, the JCS Chairman suggested, is "premature. We are too bound up with them, too interwoven." Both this country and the NATO allies need to remember that the reduction of destabilizing nuclear weapons on the basis of "viable, effective, and verifiable agreements" entails the development of other costly capabilities by the US and the European allies: "Many Europeans believe that the big virtue of arms reductions is that we will have defense on the cheap. I disagree."

The Chairman—who, under the statutory provisions of the Goldwater-Nichols bill, is assuming broader responsibilities, including that of military advisor to the President—said "things have changed" since last year when the Joint Chiefs of Staff were not informed about the "zero ballistic missiles" concept and other issues germane to their concerns. "Now I hear about everything," he added with a chuckle.

The provisions for Pentagon reorganization stipulated by the Goldwater-Nichols bill and other recent legislation are being implemented at a prudent pace, he pointed out. Formation of a Unified Transport Command (UTC) and a Special Operations Command is on the agenda of the Joint Chiefs. He added that "we are considering locating the Special Operations Command at [MacDill AFB in] Tampa, Fla." The nature and scope of UTC have not yet been nailed down completely. But the Joint Deployment Agency, now a part of the US Readiness Command headquartered at MacDill AFB, will probably be incorporated into the new structure, he suggested.

The Air Force is known to favor transformation of the Military Airlift Command into UTC. The latter would have oversight over transport functions performed by other services. Under this plan, MAC would become a component command of UTC, with the CINCUTC also serving as the Commander of MAC.

Clearly, the most difficult provision of the Goldwater-Nichols bill involves the creation of a joint personnel system, Admiral Crowe stressed. "This is very complicated, [since it affects] the personnel systems of all four services." Creating a pool of joint officers and meeting the spirit of the legislation without derailing current personnel procedures and the promotion flow have proved "to be very difficult. . . . We may go back to Congress and ask for some relief after we have made every attempt" to apply the legislation in a viable fashion.

Some of the major changes in the functions of the Chairman and of the Joint Staff stipulated by the Goldwater-Nichols bill have not yet been implemented. These include the expanded role of the Chairman in shaping the defense budget and the responsibilities to be assigned to the new Vice Chairman of the Joint Chiefs of Staff with regard to the Pentagon's acquisition process. In the latter instance, Admiral Crowe pointed out, there are still open questions about how Gen. Robert T. Herres, the recently appointed Vice Chairman, is to interface with the OSD acquisition hierarchy.

The provision that the Chairman furnish independent advice on the scope and direction of the defense budget, Admiral Crowe explained, presupposes independent analytical and net assessment capabilities. In the past, this advice represented the corporate consensus of all the Chiefs, who drew on the resources of their respective services, with the result that the analytical resources of the Joint Staff never grew beyond "fledgling" levels, he pointed out. Building up a sophisticated net assessment structure within the Joint Staff will probably take two to three years, Admiral Crowe predicted. Until both the data base and the people who know how to use it profitably are in place, the Chairman's ability to provide independent budget advice will remain circumscribed, he acknowledged.

He viewed prospective Capitol Hill action on the FY '88–89 budget with apprehension. Because the military "at best is operating in the margin—we know we are going to be outnumbered in personnel and equipment, and we have had two years of reductions—[even] small cutbacks can mean large increases in risk." With many programs already stretched out and others canceled, "We now see bow waves developing in intermediate maintenance." As spare part acquisition is slowed, sortie rates will inevitably decline in phase, Admiral Crowe stressed.

Pointing out that "I hear a lot of talk about political reality in Congress," he countered that neither the Soviet threat nor the state of the US armed forces "justifies going to zero or negative growth in our defense appropriations." Wedded to Lenin's dictum that "quantity has a quality all its own," the Soviets continue to build up their already immense warmaking potential. US efforts at catching up, on the other hand, are "still at midstream."

In addition, while the Pentagon is told to scale back its expenditures and force levels, this is coupled to the inconsistent mandate to "build up at the same time for low-intensity conflict and to combat terrorism and insurgency." In combination, these factors ought to send a clear and central message to Congress, he suggested, that the time is "inappropriate to cut back the military."

Turning to specific aspects of the Soviet threat, he termed Soviet progress in quieting their submarines a "very significant development." As a consequence, it becomes "more difficult for us to carry out our plans and mission." Staying ahead in submarine warfare capability is "one of the great technological fights in the world today," he asserted.

IN FOCUS...

Media reports and optimistic musing by some Administration and congressional elements to the contrary notwithstanding, the Strategic Defense Initiative is "not in the parking lot," waiting to be employed, the JCS Chairman cautioned. "That's just not true. We are not anywhere near there." The Joint Chiefs see "SDI as a research program" whose progress suggests "that the research is going to lead to something earlier than we had expected."

Operational deployment of a "first phase" of the Strategic Defense Initiative, the JCS Chairman predicted, is probably not possible before the mid-1990s and depends on "what kind of testing is allowed and what the testing shows." Until the test data is in and evaluated, predictions about what a first-phase SDI system will look like and how soon it can be deployed fall largely into the realm of speculation, he added.

The Joint Chiefs of Staff favor expeditious development of a European ATBM (antitactical ballistic missile) defense that, after a fashion, would serve as precursor to SDI, he said. Such a system could draw on technological spinoff from SDI that this country would be "happy" to provide. He added, however, that the European NATO members are still in the early stages of groping with this multinational program and are not "moving with the speed of light."

B-1B Status Report

AFSC Commander Gen. Lawrence A. Skantze told the recent AFA Symposium in Orlando, Fla., and subsequently the National Press Club in Washington, D. C., that "the B-1B is behind schedule in the electronic warfare area." But, he pointed out, "we know why, and [we] can fix it. The B-1's defensive avionics problem was driven by the need for concurrency. We needed the B-1 on the ramp as soon as possible, so we started development and production at the same time.

"To make milestones, we released designs on the basis of very promising lab test results. When we got into flight testing, the gremlins emerged—as is often the case."

In general, he explained, the fast

THE F-16 SET A NEW SURGE RECORD IN THE

While deployed at a remote air base, 18 U.S. Air Force F-16 Fighting Falcons engaged in a training exercise that set a new standard in combat fighter readiness.

Over the course of 16 flying days, the planes and their pilots flew an average of 48 sorties. Then on the last day, in one 12-hour period, they flew 144 sorties. Sortie effectiveness was 100 percent. Turnaround reliability was 97 percent.

In fact, if it weren't for regulations that limit a

pace and significant degree of risk associated with the B-1B program were dictated by the pressing need for a modern penetrating bomber. At the time of the go-ahead decision in 1981, "there was little hope of seeing the emergence of a viable ATB [advanced technology or "Stealth" bomber, the long-term solution to the bomber modernization challenge] before the 1990s. In the final analysis, the only way to modernize the manned bomber leg quickly was to build a limited number of highly effective B-1Bs, deploy them as rapidly as possible, and, in effect, buy the time for the ATB development, since the B-1B, alone, could not provide the long-term enduring penetration capability that an ATB offered."

Hence, the Air Force decided to buy 100 B-1Bs with an initial operational capability in 1986 at a cost of $20.5 billion (FY '81 constant dollars) and, in parallel, to work on the long-term risk reduction, development, and production of 132 ATBs to be deployed in the early 1990s.

Today, General Skantze pointed out, "we have all 100 B-1Bs on contract, we achieved the initial operational capability [last] September, and to date we have delivered thirty-four aircraft on schedule."

The Air Force is spending $500 million a month to ensure that the B-1B production rate of four aircraft per month is stable. While it would have been possible to lower the overall risk associated with high concurrency by lowering the production rate to three aircraft per month, this would have driven up the cost by between $3 billion and $4 billion and delayed full operational capability—meaning delivery of the 100th aircraft, scheduled for June 1988—in a significant way. Because the Air Force and the contractors held fast to the compressed production and checkout schedule, the program—on the basis of best present estimates—will be completed on time and on cost, he stressed. He added that while the B-1B is "not yet as capable as we had planned, we are absolutely confident that as the aircraft matures, it will be."

In the transition from the B-1A to the B-1B—and the associated requirement to function initially as a penetrator and ultimately as a cruise-missile launch platform—"the empty weight of the B-1B was increased about 7,000 pounds" to permit a 50,000-pound payload and a 25,000-pound fuel weight increase. The resulting 82,000-pound increase in gross weight was possible, General Skantze explained, because the aircraft's General Electric F101 engines have higher thrust and lower specific fuel consumption than what is specified in the contract, meaning that the B-1A "had excess energy over that required for the low-altitude, high-subsonic penetration mission of the B-1B."

The aircraft, he stressed, "meets the weight and range specifications we contracted for." The retrofit of stall inhibition systems and stability enhancement devices will increase the aircraft's range "over that specified in the contract [without exceeding] the cost baseline," General Skantze reported.

The Chairman of the House Armed Services Committee, Rep. Les Aspin (D-Wis.), reported, meanwhile, that a General Accounting Office review of the B-1B program purports to show that the "fixes" of the program "are likely to cost in excess of $3 billion—and perhaps way in excess." The report, he said, brought out "six key problems: the diagnostic set, fuel leaks, avionics, the terrain-following radar, defensive avionics, and flight stability."

He announced that the committee planned to probe these issues in special hearings. ■

CAPITOL HILL

By Brian Green, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., Feb. 27

ICBMs Key Hearings

Secretary of the Air Force Edward C. Aldridge, Jr., at a Senate Armed Services Committee (SASC) hearing, argued that delays in the ICBM modernization program are responsible for the deficiencies in the Air Force's ability to perform its most important mission—strategic deterrence. In a subsequent hearing, Air Force Chief of Staff Gen. Larry D. Welch identified the inability to destroy hardened Soviet military targets as the greatest shortfall in the Strategic Air Command's operational capability. General Welch pointed to deployment of the MX Peacekeeper as the most cost-effective means of correcting the shortfall.

When pressed to rank strategic programs, General Welch rated the Small ICBM lower than the B-1, MX, Trident D-5 SLBM, and the ATB. He emphasized, however, that the fact that both the MX and Small ICBM are funded in the Air Force budget indicated that both programs should be continued. Secretary Aldridge also argued that the MX, in the garrison/rail-mobile basing mode, could be made very survivable, even in the absence of SICBM deployment, by dispersing the Peacekeepers from their garrisons in response to any perceived risk of strategic attack.

In other hearings, Secretary of Defense Caspar Weinberger indicated that his top strategic priority remained SDI, but he and Chairman of the Joint Chiefs of Staff Adm. William J. Crowe generally agreed with the Air Force Chief's priorities. Gen. John T. Chain, Jr., Commander in Chief of the Strategic Air Command, also indicated during questioning at a Senate Appropriations Committee hearing that he would prefer the MX to the SICBM, if forced to choose.

Arms-Control Resolution

By a vote of 93–2, the Senate passed a resolution expressing "full support for [the President's efforts] to achieve mutual, equitable, balanced, verifiable, and stabilizing nuclear arms-reduction agreements with the Soviet Union. . . ." The resolution also urges the Soviets not to link arms-control progress to SDI, cautions the Soviets not to exploit US domestic and alliance politics for their own benefit, and condemns Soviet violations as "an important obstacle to the achievement of acceptable arms-control agreements."

ABM Pact in Limbo

Secretary Weinberger has told the Senate Armed Services Committee that SDI research has progressed more rapidly than expected and that further experiments would have to go beyond the bounds permitted by the "narrow" interpretation of the 1972 Antiballistic Missile (ABM) Treaty. He said a shift to the broader interpretation of the treaty is "imminent." He also said that a decision on early deployment of SDI-related systems would not be made this year or next.

Advocates of the narrow interpretation of the ABM Treaty maintain that development and testing of advanced ABM systems is prohibited. The broader interpretation, which was accepted as legally correct by the Reagan Administration in 1985, argues that development and testing of advanced ABM systems is permitted and that only deployment is prohibited. The Administration has abided by the narrow interpretation during recent SDI tests.

Sen. Albert Gore, Jr. (D-Tenn.), who adheres to the narrow interpretation, has questioned the right of the Administration to "unilaterally" reinterpret the ABM Treaty.

Aspin Memo on B-1

Rep. Les Aspin (D-Wis.), Chairman of the House Armed Services Committee (HASC), has released a memo in which he claims that the $800 million requested by the Air Force to develop fixes for early operational difficulties in the B-1 bomber is "only the tip of the iceberg." Representative Aspin maintains that the "fixes are likely to cost in excess of $3 billion—and perhaps way in excess."

Representative Aspin cites six areas of difficulty: diagnostic sets (which indicate repair needs), fuel leaks, offensive and defensive avionics, terrain-following radar, and aerodynamic stability. The Air Force continues to maintain that the B-1 is operational and capable of carrying out its assigned strategic missions. The B-1's problems are known, the Air Force asserts, and can be fixed within the original $20.5 billion cost ceiling.

Committee Approves TTBT

The Senate Foreign Relations Committee has approved two resolutions by voice vote that will lead to consideration of the 1974 Threshold Test Ban Treaty (TTBT) by the full Senate. The US has abided by the 150-kiloton test limit imposed by the treaty, although it has never been approved and ratified and despite apparent Soviet violations. The Reagan Administration agreed to push for ratification as a result of a bargain struck with pro-arms-control legislators in the FY '87 defense authorization conference.

In January, the Administration submitted reservations to the treaty that called for improved verification procedures to be negotiated with the Soviet Union and requested a second vote, the first for the treaty and the second to approve the results of the negotiations.

One of the approved resolutions, sponsored by Committee Chairman Sen. Claiborne Pell (D-R. I.), calls for Senate approval of the TTBT and ratification by the President provided that improved verification procedures can be worked out. No second vote would be required.

The other resolution, sponsored by several committee Republicans, would require that the verification measures be negotiated prior to a vote on the TTBT and the verification measures, and advice and consent be based on the whole package. The sponsors argued that the Pell resolution raised serious constitutional questions by granting a priori approval of the improved verification provisions.

The resolutions now go to the full Senate. ■

DEFENSE DIALOG

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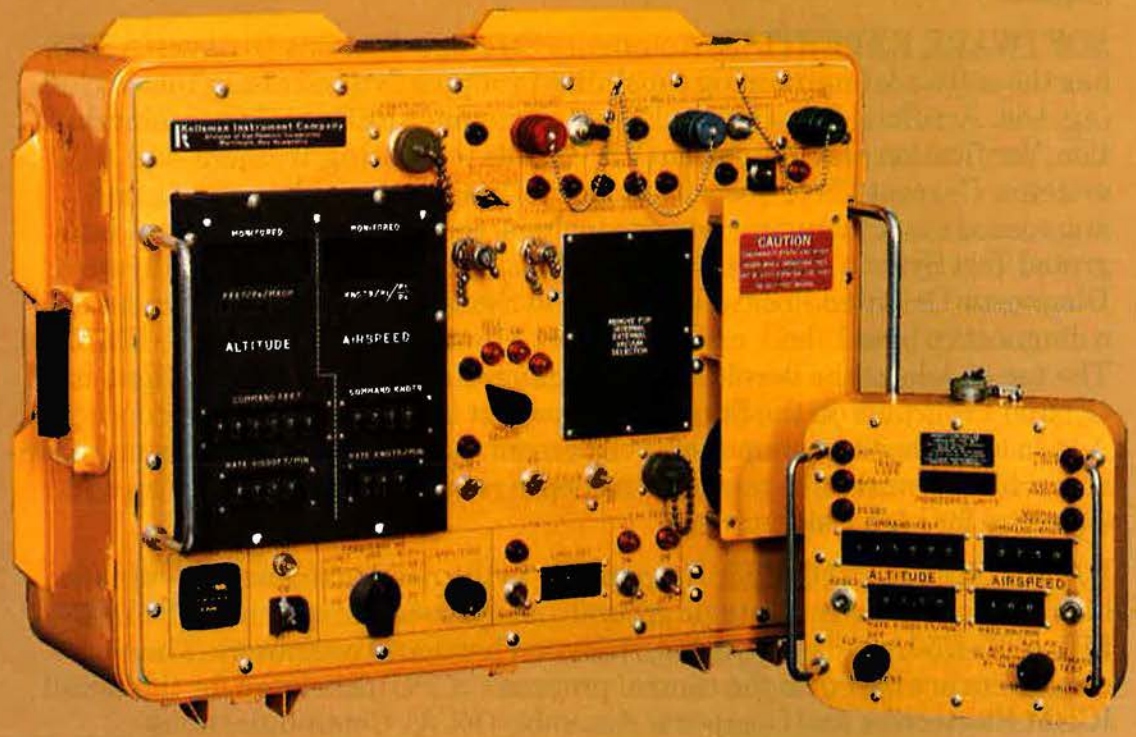

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AEROSPACE WORLD

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

By Jeffrey P. Rhodes, AERONAUTICS EDITOR

Washington, D. C., March 2

★ Last December, President Reagan gave development go-ahead for a rail-garrison mobile basing mode for the LGM-118A Peacekeeper ICBM (intercontinental ballistic missile). The rail-garrison concept was a response to the congressional directive that only fifty of the planned 100 Peacekeeper missiles be based in conventional underground silos.

The President announced then that F. E. Warren AFB, Wyo., where the fifty LGM-118s housed in silos will be based, would become the main operating base (MOB) for the rail garrison because of the extensive support structure already in place there.

In mid-February, the Air Force identified ten existing facilities that are being considered as candidates for the additional rail-garrison bases. Located in eight states, all but one of the ten bases are west of the Mississippi River. The candidate bases are Blytheville and Little Rock AFBs, Ark.; Barksdale AFB, La.; Wurtsmith AFB, Mich. (which has been chosen as the first operational base for the one-warhead, mobile Small ICBM); Whiteman AFB, Mo.; Malmstrom AFB, Mont.; Grand Forks and Minot AFBs, N. D.; Dyess AFB, Tex.; and Fairchild AFB, Wash. These ten bases were culled from a list of twenty-one.

To be considered as a candidate base, the facility had to be within the forty-eight contiguous states and had to be either a Strategic Air Command base or one where SAC is a major tenant. All but Little Rock AFB is a host SAC base. After meeting those conditions, the base had to have access to the national rail network, had to be relatively close to F. E. Warren, and had to have no mission or land-use conflicts. The eleven bases disqualified failed to meet one of the last conditions.

The Air Force will now prepare a Facility Siting Report and an Environmental Impact Statement (EIS) on each of the remaining sites. The EIS reports are scheduled to be completed by late 1988 or early 1989. Final site selection will be made after that.

The fifty Peacekeeper missiles will be dispersed by twos on twenty-five six-car trains. The trains will be located at a minimum of six garrisons. In time of national emergency, the trains would be moved from their protective igloos at the garrisons and onto the nation's railroad network. The missiles will be in special boxcars with fold-down roofs. Once at a predetermined site, the missiles could be erected out of the boxcars and launched if necessary.

For FY '87, $120 million has already been approved for rail-garrison development. The requested amount of research and development money for FY '88 is $590 million, but in FY '89, the request jumps to $1.2 billion.

In a related note, one of the seventy-foot-tall Peacekeeper ICBMs was successfully launched from Vandenberg AFB, Calif., on February 13. The missile flew 4,100 miles to a target within the Kwajalein Missile Test Range in the Pacific, and the seven unarmed Mk 21 warheads carried by the missile impacted into two separate target areas. This was the sixteenth launch in a twenty-flight test program of the Peacekeeper.

★ Quietly and without much fanfare, one of the most successful airplane programs in history came to an end on January 16. On that day, the last two Northrop F-5 aircraft built were delivered to the emirate of Bahrain in the Middle East.

These two airplanes represented the end of the line for the F-5 program, in which 2,610 aircraft were built for the US and thirty other nations over a period of twenty-four years. Of these, more than 2,000 F-5s are still flying.

The last two airplanes, both F-5E Tiger IIs, stopped by Air Force Systems Command's Aeronautical Systems Division headquarters at Wright-Patterson AFB, Ohio (which managed the F-5's Foreign Military Sales [FMS] production program), before leaving for Bahrain.

Begun as a company-funded proj-

An era ended on January 16, when the last of 2,610 Northrop F-5s were delivered. The emirate of Bahrain in the Persian Gulf bought the last two. The F-5 has been one of the most successful Foreign Military Sales (FMS) programs ever. This F-5E (left) and F-5F (right) are in the markings of the air force of Bahrain.

ect in 1955, the prototype of the F-5A, the N-156F Freedom Fighter, was first flown on July 30, 1959. In 1962, the F-5 was selected by the US government to be put into production for Military Assistance Program (MAP) countries. The first production F-5As flew in 1963. Deliveries to Tactical Air Command, whose pilots would serve as instructors for the allied pilots, began in 1964. The US Air Force acquired a squadron of F-5s for full-scale operational evaluation in Vietnam in 1965. The greatly improved F-5E aircraft, whose nickname is Tiger II, first flew in 1972.

Interestingly, the General Electric J85 engines that have powered all of the F-5s were originally designed to power long-range missiles.

The F-5 was the first high-performance fighter to incorporate features that would increase reliability and reduce operating and support costs. Northrop had coproduction and licensing arrangements for the plane with Canada, the Republics of China and Korea, the Netherlands, Spain, and Switzerland.

Of the F-5 aircraft built, 1,192 were F-5A/Bs and 1,418 were F-5E/Fs. A number of RF-5 reconnaissance aircraft were also built. The B and F models were two-seaters. The F-5 FMS program twice received the Air Force's Organizational Excellence Award.

Both the US Air Force and Navy currently use F-5s for adversary training. The Air Force has its "aggressor" F-5 squadrons at Nellis AFB, Nev., at RAF Alconbury, England, and at Clark AB in the Philippines. The Navy operates its F-5 squadrons at NAS Miramar, Calif., and at NAS Oceana, Va.

AEROSPACE WORLD

McDonnell Douglas will build an upgraded version of the reliable Delta rocket as USAF's new Medium Launch Vehicle (MLV). These workers at the company's Huntington Beach, Calif., facility are welding the liquid oxygen tank for a Delta to be launched next fall.

★ The nation's spacelaunch recovery effort received a boost on January 21 when McDonnell Douglas was chosen over two competitors to manufacture the new Medium Launch Vehicle (MLV). The new launch vehicle, an upgraded version of the reliable Delta rocket, will primarily be used to launch Navstar GPS (Global Positioning System) satellites.

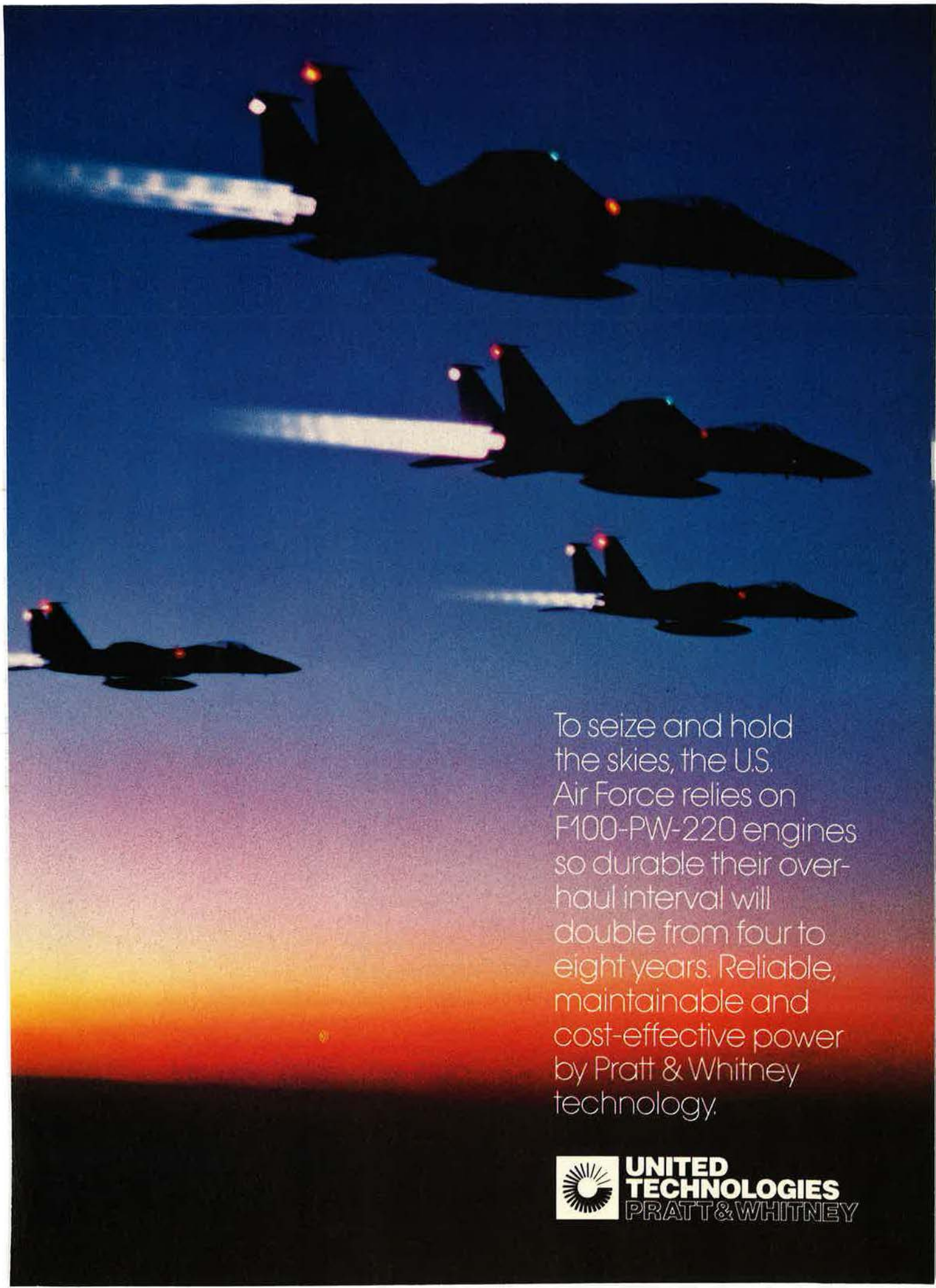
While the new launch vehicle will be used to launch most of the satellites in the twenty-one-satellite GPS constellation (eighteen operational satellites and three on-orbit spares), the Space Shuttle will be used to augment the new fleet of launchers. Once completed, the Navstar system will provide accurate positioning information to planes, ships, and even ground troops anywhere in the world.

The $316.5 million contract awarded to McDonnell Douglas calls for seven MLVs to be built and launched over the next three years, with an option to build thirteen more. If the options are exercised, the total contract award will add up to more than $669 million. An additional $3 million for each of the twenty launchers can be awarded as performance incentives.

The new launch vehicle, which will be developed in two phases and will be named Delta II, will differ from the older Delta in several ways. The first stage will be lengthened by twelve feet to accommodate a larger fuel tank, there will be an addition of a rate gyroscope for control stability, and the payload fairing diameter will be increased from eight feet to 9.3 feet by means of a new bulbous cover. Higher-performance strap-on solid rocket boosters will be developed and added in the second phase, and the main engine expansion ratio will be increased from 8:1 to 12:1. The first nine Delta IIs will use the existing strap-on rockets.

A single launch of a Delta II is scheduled for 1988, followed by six launches in 1989, seven in 1990, and the final six in 1991, if the options are exercised. Fabrication will take place at the McDonnell Douglas Astronautics Co. in Huntington Beach, Calif., with final assembly to take place at

Not quite making a fashion statement, these members of the 112th Tactical Fighter Group wearing chemical protective suits head to the designated "Chemical-Free Area." These members of the Pennsylvania Air National Guard were at an Operational Readiness Inspection held in Michigan. (USAF photo by MSgt. Marty Coyne)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AEROSPACE WORLD

the company's new plant in Pueblo, Colo. From there, the Delta IIs will be shipped to the Kennedy Space Center in Florida.

Delta rockets have been in use since 1960, and the type has a 97.7 percent reliability record in forty-five launches over the past nine years.

The Delta II, which will have a payload capacity of more than 8,000 pounds for low-earth orbit, was chosen over the General Dynamics Atlas/Centaur combination and the Martin Marietta Titan 34D booster. The Boeing/Hughes Jarvis launch vehicle was excluded from the competition because it was judged to be overqualified for the MLV role.

★ When the Thunderbirds, the Air Force's Air Demonstration squadron, begin their thirty-fourth air show season this spring, the team will also have an updated and remodeled hangar facility to call home.

Since moving from Luke AFB, Ariz., to Nellis AFB, Nev., in 1956, the Thunderbirds have been able to make only minor self-help facelifts to the hangar building. That situation changed after military construction program funds were appropriated several years ago to remodel the facility from the ground up.

The renovation, which began in 1984 and was completed late last year, gives the team suitable room to conduct operations as well as to display their historical artifacts.

The historical display, which takes up a majority of the ground floor of the building, contains pictures, plaques, and other memorabilia presented to the squadron at many of the team's worldwide show sites. Additionally, a large (seven-foot by twenty-one-foot) mural depicting the eight aircraft types the team has flown since its inception in 1953 is also on display. The mural was painted by aviation artists Matt and Mark Waki of Salt Lake City, Utah.

The facility was rededicated at the end of January with numerous general officers and former Thunderbirds in attendance. Among the attendees at the ceremony were Gen. and Mrs. Wilbur L. Creech. General Creech, former Tactical Air Command commander and Thunderbird, was one of the guiding forces behind the remodeling effort. The present TAC Commander, Gen. Robert Russ, was also at the rededication.

Public tours of the hangar facility are available.

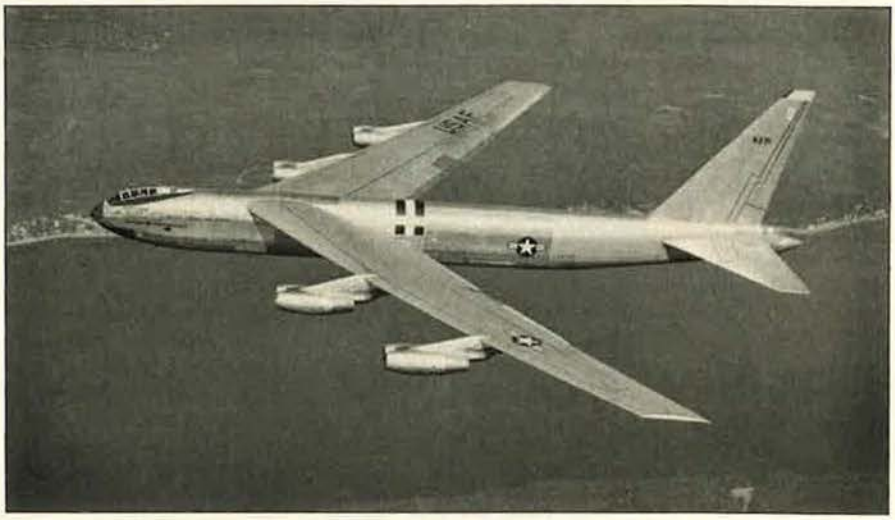
In a related note, the 1987 Thunderbirds show schedule was recently released, and it includes sixty-eight performances in the continental United States as well as a proposed overseas tour late in the season.

The team is scheduled to open the season on March 14 at Davis-Monthan AFB, Ariz., and will close nine months later on November 8 at Edwards AFB, Calif. The team will visit thirty-four states on their travels this year. A full listing of show sites, as well as information about the Thunderbird museum, is available from the Thunderbirds Public Affairs Office, P. O. Box 9733, Nellis AFB, Nev. 89191.

★ In recent testimony before the Senate Defense Appropriations Subcommittee, Gen. John T. Chain, Jr., Commander in Chief of Strategic Air Command, stressed not only the need for strategic modernization on the nuclear side but also in the conventional arena as well. As part of that conventional capability, he cited the need to keep the Boeing B-52 bombers in the fleet and in use for the type's full useful life.

General Chain said in part: "It is imperative that we help bolster the nation's conventional capabilities to make nuclear war less likely. Theater commanders require a large, long-range, fully capable conventional bomber force to do their mission. Our strategic bombers are an essential

Col. Raymond J. Bartholomew (center), US Element Commander of the Berlin Air Safety Center (BASC), was recently promoted. After the usual ceremony, Col. Lonnie R. Spivey (right) and Soviet BASC Element Commander Col. Mikhail Prokofiev (left) teamed up to pin Soviet AF colonel shoulder boards on Colonel Bartholomew. The BASC is the only organization in the city where the occupying powers work together daily. (USAF photo by Roman Harcsztark)



April 15 marks the thirty-fifth anniversary of the first flight of the YB-52, shown here. Although the XB-52 rolled out first, the YB-52 made the type's first flight because of damage suffered by the prototype during a pneumatic system pressurization test. The venerable B-52s will be used as cruise missile carriers and in conventional roles well into the 1990s.

element of their warfighting capability. When timeliness, range, and payload are considered, there are conventional missions that cannot be accomplished and areas of the world that cannot be reached without SAC bombers.

"To enhance SAC's near-term conventional capability to meet increasing theater requirements, I have directed all bomb wings to immediately achieve the capability to conduct conventional as well as nuclear operations. Additionally, we have initiated a comprehensive program to capitalize on our inherent conventional warfighting capability by fully integrating today's technology into the long-range bomber force. We are expanding the weapons delivery capability of our B-52s, improving the delivery accuracy of our systems, implementing a realistic training program to fully qualify our flying and maintenance crews in conventional operations, and pursuing a family of conventional weaponry that provides a precision strike capability, standoff range, and the ability to suppress enemy air defense.

"To ensure our future capability to provide theater CINCs the conventional striking power they need for deep strikes beyond the reach of tactical air forces, we need to dedicate non-ALCM [air-launched cruise missile] B-52Gs to a conventional role.

AEROSPACE WORLD

The first McDonnell Douglas F-15E dual-role fighter recently began its test program in earnest. But before the new Eagle left the factory in St. Louis, Mo., it was flown with Martin Marietta LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) pods and Dash-4 conformal fuel tanks with their low-drag, tangential stub weapons pylons.

Also, I am persuaded that we must keep B-52s in the inventory for the full period of their useful life. They have been bought and paid for and have a huge capability in the area the theater commanders need most.

"By combining our planned force enhancements with maintenance of the B-52 force structure, we will be able to provide theater commanders an enormous warfighting capability at an affordable price and increase their flexibility in applying significant conventional airpower in their area of operations. We need to utilize the existing combat capability and amortize the nation's sunk cost in our B-52 aircraft.

"The bottom line is that this is a very important issue and cannot be pushed aside. We as a nation cannot afford, particularly at a time of constrained resources, to take any bomber out of service."

"Haven't I seen you someplace before?" is probably the question Lt. Col. Gary Stevens asked when he saw this CH-53 helicopter after arriving recently at Sembach AB, West Germany. Colonel Stevens had to abandon this same helicopter fifteen years ago in a Vietnamese jungle after a landing mishap, but the CH-53 was rebuilt and still flies on. (USAF photo by SrA. William J. Sharp)

★ It has been said that aircraft often have human qualities. A good airplane is just as hard to keep down as a good man, and a friend is a friend, whether it has two arms and legs or four rotor blades.

Such is the case of a certain Sikorsky CH-53 helicopter and Lt. Col. Gary L. Stevens, both of the 601st Tactical Air Support Squadron at Sembach AB, West Germany. But fifteen years ago and half a world away, man and machine were together under quite different circumstances.

The CH-53, with a young Captain Stevens at the controls, was assigned to the 21st Special Operations Squadron in Southeast Asia. Sent out on a troop insertion deep in the jungle, the helicopter was carrying fifty-five troops, or more than three times its seating capacity, because of mission conditions. With a grossly overloaded helicopter, Captain Stevens faced some unique problems. The CH-53 had no hovering ability, and takeoffs and landings would have to be made like a fixed-wing aircraft.

Captain Stevens reached the landing zone only to have the helicopter

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Its guidance system is a simple CO_2 laser, mounted on the aircraft. With only an aft-looking receiver on the missile, the amount of expensive "throwaway" hardware is held to an absolute minimum. And because HVM is a "wooden round" with no warhead, storage and handling are simpler, safer and cheaper.

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The system can track and attack multiple targets simultaneously—any ground vehicle, fixed or mobile. In live fire tests an HVM was purposely aimed more than 100 feet off-target. Automatic guidance brought the missile to impact near the target center.

With no bulky on-board guidance system or warhead, the HVM is small enough to permit a large loadout—up to 24 per aircraft, at a low installed drag.

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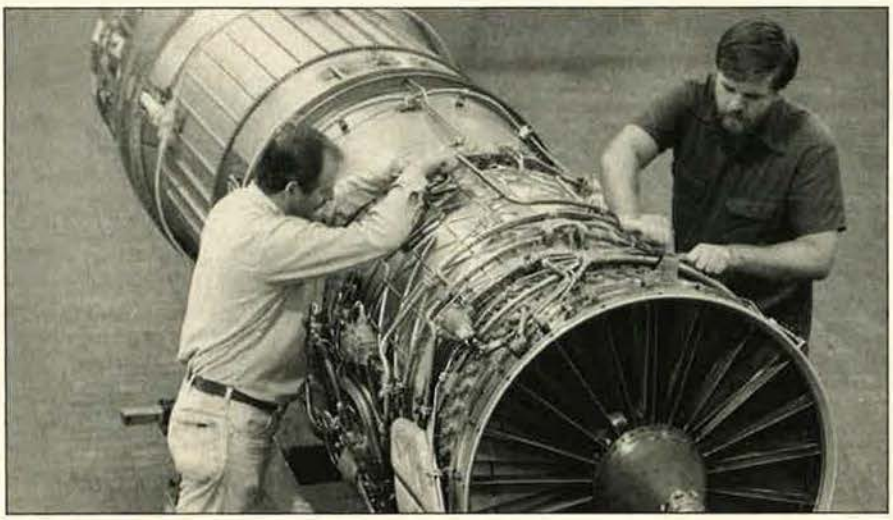
AEROSPACE WORLD

break through the dry mud crust at touchdown. The CH-53 sustained major rotor and airframe damage and had to be abandoned. After being in the middle of a firefight, the CH-53 was field-stripped by mechanics, and the big chopper was pulled out by an Army CH-54 Skycrane. The CH-53 was taken to Ubon RTAFB, Thailand, where a major overhaul was performed. When repairs were completed, Captain Stevens performed the first functional flight test on the reworked aircraft.

The CH-53 was relocated to Sembach on deactivation of the 21st SOS. It added a couple more stories to its history by being used for Presidential support missions in Europe. It was also struck by lightning on a mission to France.

Colonel Stevens was recently assigned to Sembach, and he found his "good buddy" on the flight line. "When I first arrived in Thailand, some of these CH-53s had less than 100 total flying hours. Today, most of them have as many as 5,000," he said.

The duo has seen a lot of miles since they last met, but the friendship is still there.



Workmen at Pratt & Whitney's plant in West Palm Beach, Fla., adjust an F100-PW-220 engine destined for an F-15 or F-16. For the first time in the four-year history of the Alternate Fighter Engine program, Pratt & Whitney got a majority of the contract awards.

★ For the first time in the four-year history of what has been called the "Great Engine War," Pratt & Whitney will build a majority of the fighter engines to be purchased in FY '88. The engines will be fitted to both new F-15s and F-16s in 1989. Pratt & Whitney will build approximately fifty-five percent of the engines, while General Electric, the other competitor in the Alternate Fighter Engine program, will build the remaining forty-five percent.

Under the FY '88 award, Pratt & Whitney will build 181 F100-PW-220 engines, of which 109 powerplants will go into F-15s and the remaining seventy-two engines to F-16 aircraft. General Electric, meanwhile, will build 147 F110-GE-100 engines, all of which will go into F-16s. The Air Force has requested forty-two F-15s and 180 F-16s in FY '88, which will take up 264 of the 328 engines contracted for. The remaining engines will be used as spares.

The bids tendered for next year's buy included lower acquisition costs, improved warranties, expanded product support, and reduced support equipment prices from both manufacturers. The contract value for the FY '88 buy is approximately $1 billion. The Air Force forecasts that as a result of the yearly AFE competition, an excess of $4 billion will be saved in life-cycle costs.

Since 1984, General Electric has been awarded approximately fifty-five percent (669) of the 1,208 engines bought, while Pratt & Whitney has received contracts for the other forty-five percent (539 engines). The split of work has been roughly 55/45 percent for each of the last three years (including FY '88), but in 1984 (the FY '85 buy), GE got a whopping seventy-five percent of the contract award.

★ **NEWS NOTES—Rogers Dry Lake** in California, the site of Edwards AFB and the Air Force Flight Test Center, **was named a National Historic Landmark** by the US National Park Service in ceremonies held on January 29. The lake bed was recognized because of its significance in the development of aircraft and aerospace technology. *(For more on the history of Edwards AFB, see "Airing It Out at Edwards" on page 84 of this issue.)*

At the same ceremony, the outdoor display of aircraft that have contributed to the history of Edwards was renamed the Jimmy Doolittle Airpark.

The first F-111 test aircraft serves as the backdrop at the ceremony dedicating the museum airpark at Edwards AFB, Calif., in honor of Gen. Jimmy Doolittle. Museum curator Doug Nelson is the speaker.

AEROSPACE WORLD

The first of ten Sikorsky UH-60 Black Hawk helicopters to be modified for aerial refueling arrives at its home at Eglin AFB, Fla., on February 3. The 55th Aerospace Rescue and Recovery Squadron is the only Air Force unit to fly the UH-60s. (USAF photo by TSgt. Lee Schading)

A complete museum is planned for the base.

Retired Arizona **Sen. Barry Goldwater,** a lifelong supporter of aviation and recent recipient of the Distinguished Flying Cross, was appointed by President Reagan in late January **to sit on the Board of Visitors of the US Air Force Academy** in Colorado Springs, Colo. Also, the 2,700,000-acre **bombing and gunnery range** in the Sonora Desert near Gila Bend Air Force Auxiliary Field (a part of the Luke AFB, Ariz., complex) **has been renamed in the former Senator's honor.** Dedication ceremonies are currently scheduled for late March.

In order to enhance readiness by promoting a more experienced and stable pilot force, **the Air Force will increase the active-duty service commitment of pilots to eight years.** The new commitment will apply to those officers who enter Undergraduate Pilot Training (UPT) on or after June 15, 1988, and the eight-year hitch will begin when training is completed. The active-duty commitment for pilots goes to seven years starting this June.

The **last of seventy-six Lockheed C-5A aircraft to undergo wing modifications** arrived at the company's Marietta, Ga., facility in mid-January. The $1.5 billion project involves replacing the five main load-carrying wing boxes with segments made of an aluminum alloy that provides greater strength and better corrosion protection. The modification effort, which began in 1982, will extend the aircraft's useful life by thirty years.

The **first of ten Sikorsky UH-60A Black Hawk helicopters** modified to "Credible Hawk" standard **was delivered to the Air Force's 55th Aerospace Rescue and Recovery Squadron** (ARRS) at Eglin AFB, Fla., on February 3. The modifications include a 117-gallon internal auxiliary fuel tank, a new fuel management system, and an air-to-air refueling probe. The modification work, done to improve the UH-60's capability to conduct long-range search-and-rescue missions, was performed at Sikorsky's Troy, Ala., facility. The 55th ARRS is the only unit in the Air Force to fly the UH-60s. Since delivery in 1982, the ten helicopters have assisted in saving more than fifty lives. The modifications are expected to be completed by early 1988.

Brig. Gen. William P. Hallin, the Air Force Competition Advocate General, recently released the **first-quarter FY '87 statistics for the Air Force competition program,** and they are the **best first-quarter totals ever.** More than sixty-one percent of the procurement dollars were competed, sole-

SENIOR STAFF CHANGES

PROMOTIONS: To be **General:** William L. **Kirk.**

To be **Lieutenant General:** Charles A. **Horner;** Charles **McCausland.**

To be **Brigadier General:** Billy A. **Barrett;** Charles L. **Bishop;** John L. **Borling;** Phillip E. **Bracher;** Michael J. **Butchko,** Jr.; Donald J. **Butz;** Jimmy L. **Cash;** Clifton C. **Clark,** Jr.; Stephen B. **Croker;** Lawrence E. **Day.**

Robert E. **Dempsey;** Dennis D. **Doneen;** Jeffrey T. **Ellis;** Howell M. **Estes** III; John S. **Fairfield;** Charles E. **Fox,** Jr.; John C. **Fryer,** Jr.; Joseph K. **Glenn;** Buster C. **Glosson;** Eugene E. **Habiger.**

Donald G. **Hard;** Peter D. **Hayes;** James L. **Jamerson;** Thomas G. **Jeter,** Jr.; James M. **Johnston** III; Jay W. **Kelley;** Walter **Kross;** Charles D. **Link;** Bruce J. **Lotzbire;** Noah E. **Loy;** Robert M. **Marquette,** Jr.

Frank K. **Martin;** James C. **McCombs;** Stephen M. **McElroy;** James W. **Meier;** Michael D. **Pavich;** David J. **Pederson;** Frederick W. **Plugge** IV; Joseph W. **Ralston;** Peter D. **Robinson;** Ralph R. **Rohatsch,** Jr.

Ervin J. **Rokke;** Michael E. **Ryan;** Thomas E. **Schwark;** Hanson L. **Scott;** Stephen R. **Shapiro;** Daniel J. **Sherlock;** Stanley O. **Smith;** Ronald C. **Spivey;** William A. **Studer;** James P. **Ulm.**

RETIREMENT: L/G Marc C. **Reynolds.**

CHANGES: M/G (L/G selectee) Charles A. Horner, from DCS/Plans, Hq. TAC, Langley AFB, Va., to Cmdr., 9th AF, TAC, and Cmdr., USCENTCOM Air Forces, Shaw AFB, S. C., replacing L/G (Gen. selectee) William L. Kirk . . . **L/G (Gen. selectee) William L. Kirk,** from Cmdr., 9th AF, TAC, and Cmdr., USCENTCOM Air Forces, Shaw AFB, S. C., to CINC, Hq. USAFE, and Cmdr., AAFCE, Ramstein AB, Germany, replacing retiring Gen. Charles L. Donnelly, Jr. . . . **M/G (L/G selectee) Charles McCausland,** from Cmdr., Ogden ALC, AFLC, Hill AFB, Utah, to Vice Cmdr., Hq. AFLC, Wright-Patterson AFB, Ohio, replacing retired L/G Marc C. Reynolds. ■

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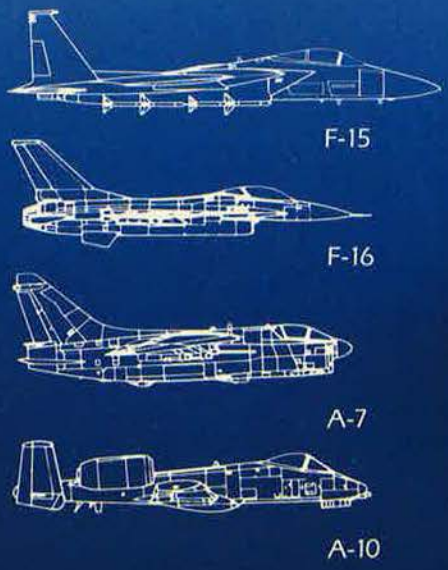

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source awards were less than ten percent, and more than ninety percent of contractual actions were competed. The Air Force goals for FY '87 are to compete fifty-five percent of the dollars, keep sole-source awards under ten percent, and competitively award more than ninety percent of the contractual actions.

Following the lead of Great Britain, **France has decided to buy three Boeing E-3A Sentry** airborne warning and control system (AWACS) aircraft, French Defense Minister André Giraud announced in late February. The contract for the three aircraft (with an option for two more) and the radar equipment inside amounted to roughly $550 million. Additional equipment to be bought, such as communications gear, brings the total to more than $800 million. Boeing agreed to buy equipment for the aircraft from French firms in an amount equal to 130 percent of the purchase price, just as the company had agreed to buy British equipment in the $1.2 billion deal for the RAF's aircraft. Most of the French buy-back will come in the form of General Electric/SNECMA CFM56 turbofan engines, which are built as a cooperative effort by the two firms.

AEROSPACE WORLD

Lt. Col. Charles L. Ranta (right) and Lt. Col. Varis Purkalitis (left) both recently passed the 3,000-hour milestone on the same flight in their F-4C. Both men are with the Nebraska Air National Guard.

General Dynamics was recently awarded a $33,225,649 contract by Air Force Systems Command's Aeronautical Systems Division at Wright-Patterson AFB, Ohio, **to develop a digital flight-control system for F-111s.** GD will build eight copies of the system, two to undergo flight test, five to go through ground test, and one to serve as a backup. First flight of the digitally equipped F-111s will begin in 1989. The contract also provides for options to procure up to 400 units over a four-year period. The upgrade will result in improved F-111 safety, reliability, and maintainability.

★ **DIED—Gen. William F. McKee, USAF (Ret.),** who served as Vice Chief of Staff under Gen. Curtis LeMay and later headed the Federal Aviation Administration, on February 28 at Air Force Village, San Antonio, Tex. He was eighty. After graduation from West Point in 1929, he spent several years in the Coast Artillery Corps before transferring to the Army Air Corps. He went on to head the wartime Air Transport Command and, later, Air Force Logistics Command. After retirement in 1964, he joined NASA until President Johnson appointed him FAA Administrator. General McKee was also in charge of the program to build an American supersonic transport. He oversaw the design of the plane, but Congress later denied funding, and the project was halted. General McKee's military career spanned thirty-five years. Among his decorations was the Distinguished Service Medal with two oak leaf clusters. ■

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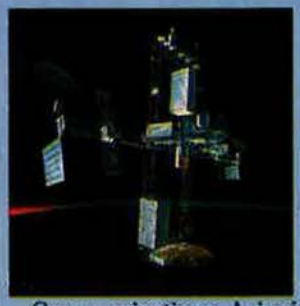
BEYOND THE BLUE HORIZON



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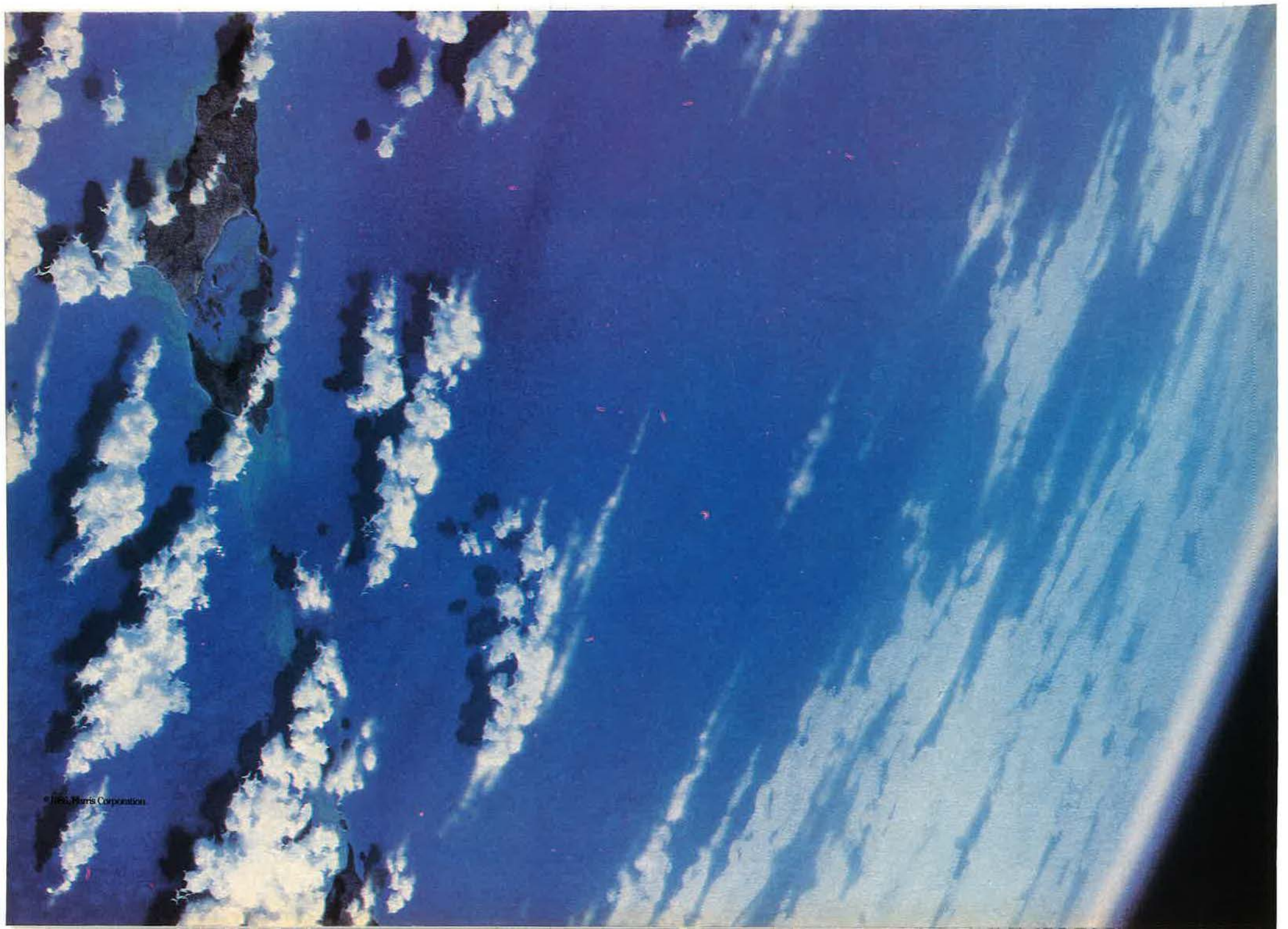
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The Air Force won't have its forty tactical wings as soon as it thought. But the fighter and attack units it does field will be first rate and fighting trim.

BY JOHN T. CORRELL, EDITOR IN CHIEF

Thirty-Seven Wing

BOWING to fiscal reality, the Air Force has decided to level off for awhile on its plan to field forty combat-coded fighter and attack wings. For the time being, it will settle for thirty-seven wings and concentrate on supporting them properly.

Budgets for the next few years will not buy enough fighters to achieve the forty-wing goal. In addition, USAF will be converting 270 of its F-16A fighter and attack aircraft into interceptors for modernization of the air defense fleet. The fighter-attack force stood at 36.7 wings at the beginning of 1987 and had been projected to top thirty-seven wings before the year was out.

But as Gen. Robert D. Russ, TAC Commander, told AFA's Tactical Air Warfare Symposium in Orlando, Fla., January 29–30, there was no desire to push ahead with a force structure of "hollow units," short on flying hours and spare parts. The Air Force chose instead to stabilize at thirty-seven wings, a number that it can keep ready in peacetime and that it could sustain in combat if war began.

It isn't an ideal arrangement. Even with additional wings, the United States would still have to shuttle its forces around to meet worldwide commitments. War plans in the major theaters depend critically on time for reinforcements to arrive from Stateside bases. Some assets—such as tankers, airlifters, and specialized aircraft for electronic combat—are in short supply.

But if the force is short on numbers, the quality is impressive. Modern equipment, ordered during the defense surge of the early 1980s, is coming on line steadily. USAF will continue to trade out its older tactical aircraft as far-ranging F-15E dual-role fighters and more late-model F-16s enter service. Gen. Charles L. Donnelly, Jr., CINCUSAFE, reported that mission-capable rates in Europe are the highest in history—87.5 percent for F-16s and 79.3 percent for F-15s. The rate of aircraft out of commission because of maintenance or supply is at an all-time low, he said.

If NATO has time to bring in its full complement of reinforcements in a crisis, General Donnelly said, "the Soviets would be foolish to come across the border, because we're going to crack 'em good!" Gen. Carl E. Vuono, Commander of the Army's Training and Doctrine Command, attested at the symposium that cooperation between air and ground battle units has never been smoother. The tactical air

forces may field only thirty-seven wings, but they will be very good wings indeed.

The Plans for Change

Moreover, all of the tactical air forces—active-duty commands, the Air Guard, and the Reserve—are together on a carefully considered concept of how their capabilities ought to evolve in the years ahead. In Orlando, General Russ's presentation emphasized modernization plans for the attack force and evolution of tactical reconnaissance—which he said will include at least five squadrons of unmanned vehicles—in the not-too-distant future.

• *The attack force.* Distinction between close air support and battlefield air interdiction will blur in the fluid combat scenarios of the 1990s. Replacements will be needed for the aircraft that perform those missions today. *(See "New Roadmap for AirLand Battle," March '87 issue, p. 108.)*

The Air National Guard's highly regarded A-7 will be updated, becoming the A-7 Plus with the addition of two plugs, an afterburning turbofan engine, and a series of avionics modifications. The Air Force, supported strongly by the Army, wants to phase the relatively slow A-10 attack aircraft out of high-intensity combat duties and replace it with an F-16 variant called the A-16. Substantial numbers of A-10s would be converted to OA-10s to form the forward air control fleet of the future. General Russ reminded the symposium audience that the A-16 would be part of, not an addition to, the F-16 procurement already planned. He also acknowledged that the Office of the Secretary of Defense may insist on seeing other options before going along with the A-16 proposal.

A questioner from the audience asked about the importance of stealth, or low observability, in close air support and battlefield air interdiction. General Russ pointed out that "every airplane was stealthy before we had radar" but that gunners still managed to shoot down a lot of them in those days. Stealth is important, he said, but "in an environment where you have to persist and stay in the area—rather than come in and go out—you have to have more than [stealth alone] to survive."

• *Tactical reconnaissance.* The current recce force consists of thirteen RF-4 squadrons, primarily film-based units. In the early 1990s, they will begin changing over to electro-optical technology. An EO-based squadron, General Russ said,

will cost only about a third as much as a film-based unit. It will require about half the number of personnel, a seventh the number of vans, no water or chemicals, and less than half the supporting airlift.

For the transition, the Air Force is working up a three-part sensor package. These sensors—for visual low altitude, visual medium altitude, and infrared—will also be used by the Navy. The same sensor suite will be installed in RF-4 aircraft and in an unmanned vehicle that the Navy is developing for both services. The drone should appear around 1993.

"We hope to build, initially, at least five squadrons of unmanned vehicles," General Russ said. The drones would be assigned to RF-4 units and would be the reconnaissance platform of choice against heavily defended fixed targets. Since the unmanned vehicles will fly a programmed mission, though, they will be unable to detect, avoid, or react to a mobile enemy. The manned reconnaissance aircraft will be around for awhile.

The size of the RF-4 fleet will decline, primarily through attrition, until the late 1990s, at which point the Air Force will be in the market for a replacement. When the new aircraft enters service, the reconnaissance fleet will probably begin building up again. General Russ said that no decisions have been made about a successor for the RF-4, but that it will most likely be a modification of some existing aircraft.

• *Composition of the force.* Of today's 36.7 tactical wings, only 14.7 are flying aircraft currently in production. That ratio will improve, however, as more F-16s are delivered to replace F-4s. In its new budget proposal, the Air Force is requesting forty-two F-15Es and 180 F-16C/Ds in FY '88 and hopes to keep a procurement pace of 222 fighters annually for several years thereafter. TAC will also be taking over the FB-111s from Strategic Air Command, enough for one tactical squadron in FY '90 and another in FY '92.

In the air defense fleet, the last of the old F-106 interceptors will be gone soon, and the F-4s will be retired by 1991. Air defenders will convert completely to F-15s and F-16s, and these are the airplanes they will be flying for the next decade.

General Russ and General Vuono assured the symposium audience that the two services regard USAF's attack aircraft and the Army's attack helicopters as complementary, not competing with each other for missions. In modern theater warfare, they said, there would be more than enough targets for everybody. "The Army and the Air Force have decided that the combination of the attack helicopter and a fixed-wing close air support aircraft provides us with the maximum amount of flexibility and the maximum amount of firepower," General Russ said.

A question about airfield denial weapons drew a pointed response from General Russ. "We have tried for years to develop a good airfield munition," he said. "We have had one failure after another. We finally said, let's buy the French Durandal because at least it works—maybe not as sophisticated as we'd like, but a heck of a lot better than rolling in at 8,000 feet and having everybody and his brother clean your clock. I'd rather come in at a couple hundred feet at high speed." Work continues, he said, on a better anti-airfield munition.

Toughening Up in Europe

In Europe, the quality improve-

A senior airman ground-crew member checks the wing trailing edge on an F-111 belonging to the 20th TFW at RAF Upper Heyford in the United Kingdom. USAFE has the capability to perform depot-level maintenance on F-111s and other front-line fighters.

ments to the force are strikingly visible. General Donnelly reported that the new fighters are performing superbly and that they are easy to maintain. All tactical aircraft in USAFE are now equipped with jam-resistant Have Quick radios, and the command has upgraded to newer versions of the Sparrow and Sidewinder missiles.

Despite modern weapons and high-tech equipment, people still make USAF function. SrA. Sylvia F. Wagner of Hahn AB, West Germany, is a good example. (USAF photo by SSgt. Fernando Serna)

Training is improved, too. Air Combat Maneuvering Instrumentation (ACMI) sorties, for example, have increased by nearly forty percent over the past five years. The European Distribution System, the C-23 Sherpa, is in service, moving spare parts around the theater. General Donnelly estimates that, in wartime, the Sherpa shuttle could mean the difference in 600 sorties a day getting off the ground.

To take some of the pressure off strategic airlift requirements in the event of war, USAFE has prepositioned 500 C-141 loads of critical mobility equipment at the point of intended use or in centrally located facilities. The Minimum Essential Facilities program will provide aircraft parking space and put seven days' worth of fuel and munitions at the European bases to which reinforcement squadrons from the US would deploy. Even so, the insufficiency of intertheater airlift remains one of General Donnelly's main concerns.

Another is that there aren't enough precision standoff weapons to cover every situation in which they would be useful. "We cannot afford one standoff weapon for every target," he said. "We have to missionize the standoff weapons to go after certain targets that are high value and that can, in fact, be hit. We will zero in on the critical targets and go after them with our smart standoff weapons."

Should the Soviet Union and the Warsaw Pact ever attack Western Europe, USAFE bases would be struck in the first wave. Consequently, extensive effort goes into preparations to absorb such a blow and keep the bases in operation. General Donnelly said that it takes a USAFE runway repair team just four hours to patch twelve big craters and have the surface ready to taxi on and fly from. They do this with precast concrete slabs that, in peacetime, are used for parking lots. That not only gets double duty from the material but also solves a storage problem.

The linchpin of the European Distribution System is the Shorts C-23A Sherpa. These short-haul cargo planes, based at Zweibrücken AB, West Germany, carry spare parts and engines (as shown here) to bases throughout USAFE. (USAF photo by MSgt. Patrick Nugent)

Fuel trucks moving about a flight line under attack would present a lucrative target to the enemy. USAFE, therefore, is storing its fuel in hardened underground tanks with lines leading directly into aircraft shelters, where refueling can be done without exposure. The command has sixty-eight semihardened and chemically filtered operations facilities and is at work on other sheltering and hardening projects to support all critical wartime activities.

A new chemical protection mask, now being introduced, is lighter than its predecessor and allows better visibility. The number of hospital beds available on a contingency basis has increased by more than 100 percent in the past three years. Four Flying Ambulance Surgical Trauma (FAST) teams stand ready to deploy within four hours to anywhere in the command. Complete depot-level repair can be done in Europe on four types of aircraft—the F-15, the F-4, the A-10, and the F-111. In addition to the obvious benefits, General Donnelly said, this provides a "warm base" for expediting maintenance in wartime.

In a program to promote a sense of heritage and pride, USAFE is actually encouraging "nose art"—the painting of names and pictures on airplanes. Since bureaucrats tend to dislike nose art as much as the troops tend to like it, this form of decoration has been in disfavor in recent years. A standard objection is that it interferes with camouflage. USAFE overcomes this easily. The aircraft shelters are stocked with cans of spray paint. The nose art will disappear quickly if the balloon goes up.

Blue Water and Electronics

What forces in Europe are preparing for, basically, is to fight a modern, high-intensity version of the classic air-land battle. The situation in the Pacific is different. With the exception of Korea, Pacific Air Forces' ingress routes to potential targets are all over blue water. This limits the advantage to be gained by low-level flying tactics. "You might be able to hide behind a hill, but it's kind of hard to hide behind a wave," Maj. Gen. H. T. Johnson, Vice CINCPACAF, told the symposium.

This means that PACAF crews would be extraordinarily reliant on electronics to enable them to penetrate contested airspace, avoid detection, and elude threats. "Our greatest concern in the Pacific is electronic combat," General Johnson said. PACAF is intent on controlling essential parts of the electromagnetic spectrum, denying its effective use to the enemy, and reducing his opportunities to engage US aircraft with his fighters and SAMs. Assuming that Soviet Far East forces follow doctrine, General Johnson said, they would plan to jam a third of PACAF's electronics, destroy another third, and expect the remaining third to collapse on its own.

Currently, PACAF has only one offensive electronic combat asset—a squadron of F-4G Wild Weasel radar suppression aircraft—based forward in the theater. They would have to hold the line until EC-130H Compass Call (communications jamming) and EF-111A (radar jamming) reinforcements arrived. No US ally in the Pacific has an offensive electronic combat capability. PACAF would very much like to have its own jamming aircraft, available to go at the first shot of war. Their absence forces the command to depend heavily on defensive electronic combat systems and techniques.

Moreover, those defensive electronic combat systems are in urgent need of improvement. "We presently deploy with threat-warning receivers and self-protection devices that are programmed for a single subtheater threat," General Johnson said. "To truly meet the total threat, we must place emphasis not only on expected target area threats but also on en route threats, including Soviet naval systems. This means we need a responsive Area Reprogramming Capability [ARC]." Reprogramming is faster—once a decision to reprogram has been made—than it used to be, General Johnson said, but "we further need to reduce this decision time from days to hours." In anticipation of Area Reprogramming, PACAF has modified its radar-warning receivers so they can be updated in minutes with a change of software.

The PACAF tactical fleet is completely outfitted with Have Quick radios, a jam-resistant but non-secure communications system. Anticipating that the enemy will eventually find a way to counter Have Quick, PACAF continues to voice its requirement for secure, unjammable communications.

Such exercises as Team Spirit help improve readiness. This technician is from the 1843d Electronic Installation Group. (USAF photo by SSgt. Marvin D. Lynchard)

This pilot is proving the old adage that "you train like you fight." Before rolling in on a target in this training mission, the F-16 driver ejects a flare to draw off any potential surface-to-air missiles.

General Johnson said that the command practices emissions control—keeping communications to a minimum to avoid giving away the position or intention of battle elements—and "frequency deconfliction," or management of the electromagnetic spectrum in such a way that enough jamming power can be applied to disrupt enemy communications without jamming one's own at the same time. The use of electronic combat equipment and techniques is a major part of exercises and training in the Pacific, he said. At the Crow Valley range in the Philippines alone, US and allied aircrews fly more than 20,000 training sorties a year, with heavy jamming and intense electronic action built into the curriculum.

Heavy Metal

"When timeliness, range, and payload are considered, there are conventional missions that cannot be accomplished and areas of the world that cannot be reached without SAC's strategic bomber and tanker forces," Brig. Gen. George W. Larson, Jr., Assistant DCS/Plans at Strategic Air Command, said at the symposium.

SAC plans to allocate more of its bomber fleet to theater operations

The only offensive electronic combat assets assigned to the Pacific are the F-4G Wild Weasel aircraft of the 3d TFW at Clark AB, the Philippines. As a result of all the vast open-ocean distances US forces would have to cover in that area, electronic combat takes a high priority.

(see "Bombers for the Battlefield," January '87 issue, p. 20), and the theater CINCs will take all of the sorties they can get under this arrangement. Eventually, every SAC bomber—including, probably, the Advanced Technology Bomber when it gets here—will be assigned some conventional tasking.

A major limitation is that the only precision-guided weapon that SAC now has for standoff attack is the Harpoon missile, designed for use against ships. For theater missions, SAC hopes to add a precision weapon with terminal guidance that it could fly into a target as small as an office. The technology to do that is available, and candidate weapons are being evaluated, General Larson said.

"Today, our conventional bombers are required to overfly the target, penetrate terminal defenses, and pay critical attention to route planning," he said. The new standoff weapon will enhance the bomber force's conventional capability and reduce the danger to aircrews, but SAC has other improvements in progress as well. In contrast to the standard, easy-to-predict approach routes that heavy bombers took to their targets in the Vietnam War, current tactics emphasize random patterns that will keep the enemy guessing. There is more emphasis in training on low-level night operations as well.

"The work on improved accuracy has already netted significant improvements that benefit conventional capability," General Larson said. "The offensive avionics systems recently incorporated into the B-52 have cut the Circular Error Probable [CEP] in half." When the Global Positioning System is installed, he said, that will lead to a further decrease of eighty-seven percent in the CEP.

Gulf States Turbulence

US military presence in Southwest Asia is minimal, but US interest in the area is anything but. Two major exports from this part of the world—oil and terrorism—are of compelling concern to the United States and its allies. In addition, an unpredictable development in the Iran-Iraq war could shift the regional power balance in a direction that would have global consequences.

The Soviet Union is interested in the area, too, and has been building up its Southern TVD (or theater of military operations), which now has thirty mechanized and armored divisions and nearly 1,000 tactical aircraft at its disposal. That force has changed in composition as well as in size. In 1978, for example, it included nine air defense regiments and nine fighter-bomber regiments. Currently there are four air defense regiments and eighteen fighter-bomber regiments. The Soviets continue to be a major supplier of arms to the Iraqi side in the Gulf war.

US Central Command, which coordinates American military interests in the area, has only 400 people there, involved with a security assistance program that totaled $2 billion last year. These people also do a great deal of listening and talking. CENTCOM has 6,100 C-141 loads of ammunition prepositioned in Southwest Asia. If it ever had to take a direct hand in matters there, it would call on all of the US armed forces for troops and support. The air component of CENTCOM consists of conventionally armed B-52s and the tactical squadrons of Ninth Air Force.

Maj. Gen. Davis C. Rohr, Deputy CINCCENTCOM, speaking at the Orlando symposium, said that the sweeping size of Southwest Asia and the general lack of infrastructure lead most states to emphasize tactical airpower in their military planning. Of the nineteen nations in CENTCOM's area of responsibility, only one—little Djibouti—does not have a tactical air force. Iraq has a large tactical air force, but General Rohr said that only recently did the Iraqis begin to use their Russian and French fighter-bombers with real authority against Iranian oil facilities and other targets in the Gulf.

A member of the audience asked what air bases CENTCOM might use should it ever need to deploy forces to Southwest Asia. General Rohr replied that "we wouldn't go in unless asked," but that "many of the Gulf states are happy for us to be over the horizon. Should we need to go in to protect almost anybody except Iran, we would be invited and invited relatively rapidly." ■

It's now possible to pack the equivalent of ten Cray computers into a system the size of a coffee can. And that's just one possibility.

The Vast Potential of Tactical Technology

BY EDGAR ULSAMER, SENIOR EDITOR (POLICY & TECHNOLOGY)

FROM "neuro computers" that can squeeze the processing capacity of up to ten huge Cray computers into a system the size of a coffee can to the prospective transfer of the A-10s to the new Special Operations Command, AFA's Tactical Air Warfare Symposium spotlighted a host of new, diverse developments and hardware issues. The symposium also provided a forum for Assistant Secretary of Defense for C³I Donald C. Latham, who gave the first public description of how the Defense Department is restructuring the acquisition process, as well as for AFSC Commander Gen. Lawrence A. Skantze, who presented an in-depth status report on the B-1B program.

Tacair, General Skantze told the AFA meeting, faces three major integration challenges in the coming decade. "The first is mission integration, meaning our force mix of air-to-air, air-to-ground, and dual-role fighters. The second is integration of tactical and strategic forces. Finally, aircraft design itself is a process of integrating airframe, engine, avionics, and weapons."

Systems integration of the latter type is central to the design of the Advanced Tactical Fighter (ATF). Over the next three months, the ATF will be scrubbed by a rigorous systems requirements review process, he said. The starting point of the integration effort is "how the crew member fits into the weapon system as a subsystem himself." Key concerns in this context are G-induced loss of consciousness, temporal distortion, and a "less obvious interference to winning in combat—information overload." The object is to "offload whatever functions we can from the pilot to expert systems."

Integrated From the Ground Up

AFSC's Aeronautical Systems Division has launched a "fighter battle management" program in order to design ATF from the ground up as a true "first-look/first-kill fighter." By making man/machine interfaces the ATF's central cockpit design parameter, the Air Force expects to take a major step toward gaining back "something we lost years ago—the ability to control airspace on the 'red' side of the FEBA," the forward edge of the battle area.

Serving the same end is ATF's "totally integrated avionics suite," which encompasses fire-control, flight-control, and propulsion systems. Using the so-called Pave Pillar avionics integration concept, which is based on very-high-speed integrated circuit (VHSIC) technology, "we will integrate the functions of communications, navigation, and identification through the ICNIA [integrated communications navigation identification avi-

Photonic devices (an example, shown in the inset, are the optical gates for a Cray computer) are the key to future battle management. Because photonic devices are small and lightweight, they will find a natural use on equipment in Special Operations missions, such as those performed by this MC-130 and by the MH-53H.

onics] program and the functions of electronic warfare through the INEWS [integrated electronic warfare system] program."

General Skantze added that "more money is going into avionics systems and prototyping—$900 million—than into either the engines or airframes." Avionics costs for the ATF are likely to account for about forty percent of the aircraft's production flyaway costs. Prototype avionics systems are scheduled to begin test flight in two years. As a result, when ATF enters full-scale development in late 1990, the avionics systems, along with the engine and the airframe, will have undergone an extensive design review and prototype checkout, the AFSC Commander told the AFA meeting. Secretary Latham reported that "we are hoping to put avionics in the ATF that have 10,000 hours MTBF [mean time between failures]—that's doable at a reasonable cost."

Pointing out that "virtually every air-superiority fighter has been called on sooner or later to become an attack aircraft and drop bombs," General Skantze suggested that ATF, even though "first and foremost a fighter pilot's idea of a fighter . . . probably will evolve as its predecessors have."

This same principle of airpower's "indivisibility" suggests also that strategic airpower will continue to be called on to perform tactical roles and missions. Citing the B-1B as a case in point, he said it "would be unconscionable not to employ the new bomber as we would any other tactical airpower asset" if it can be used to take out high-priority tactical targets and thereby make "the difference between success or failure on the field of battle."

Rejecting the notion that the B-1B won't be able to perform conventional warfare missions adequately because of alleged performance shortcomings, he emphasized that the "new bomber's Mach 0.85 penetration speed at 200 feet altitude combined with its one-square-meter radar cross section makes it an [outstanding] airplane" for both strategic and tactical missions. *(See also "In Focus . . ." on p. 22 of this issue.)*

The tactical air challenge of the next decade and beyond boils down to three key criteria for both the force planners and hardware developers, General Skantze suggested:

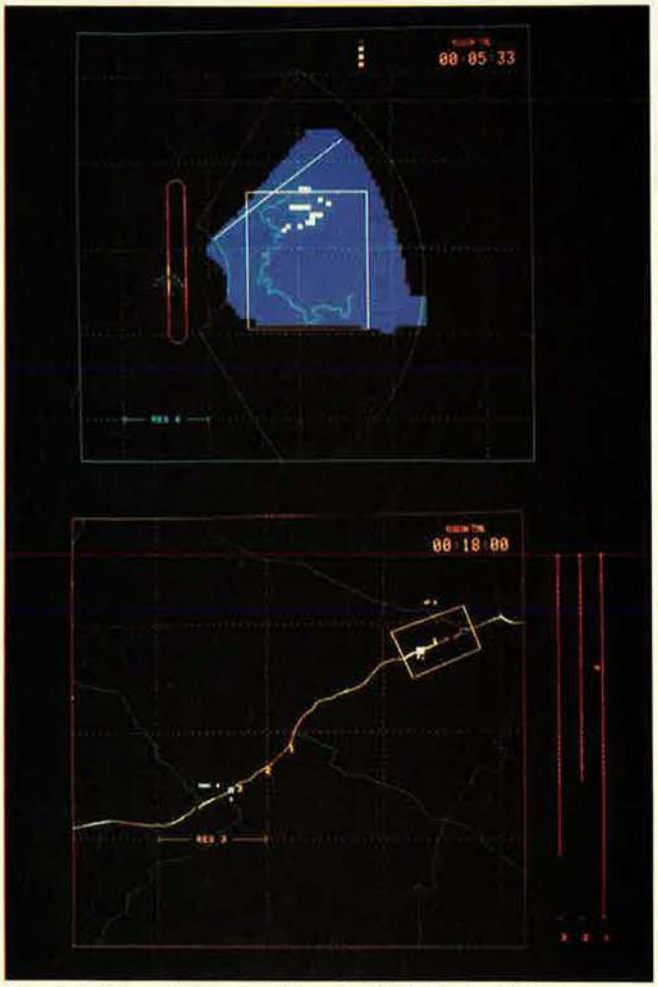
- "Deliver a fighter force mix—single and dual-role planes—prepared to clear the air of bandits [and] then take out the enemy on the ground;
- "Apply the lessons of history when integrating strategic and tactical forces; and

• "Design [into systems] the technical advantage needed to fight outnumbered and win."

General Skantze stressed that stealth technology is and must remain this country's "high-leverage" technical advantage in the tactical warfare arena and will keep the Soviets from "denying us the low-and-fast sanctuary." Low-observable technology, he added, can be applied broadly to both manned and unmanned weapon systems. Other speakers at the symposium cautioned, however, against treating stealth as a panacea in perpetuity since stealthy weapons can't hide from such audiovisual sensors as eyes and ears.

The Dawn of Real-Time Battle Management

"We are on the verge today of going to real-time battle management, something we probably should have crossed over many years ago," said Lt. Gen. Melvin F. Chubb, Jr., Commander of AFSC's Electronic Systems Division (ESD), during the AFA meeting. Real-time battle management is made possible by the confluence of several technological advances, he explained. Some of these are of a near-term nature and center on such hardware developments as JSTARS (Joint Surveillance and Target Attack Radar System), which can "provide [battle management] data instantly to the Army and the Air Force in any form they want," and JTIDS (Joint Tactical Information Distribution System), which makes it possible to disseminate battle management information instantly to all users on the ground and in the air. Over the longer term, photonics, "neuro computers," and the associated VHSIC wafer technology point the way to revolutionary advances in real-time battle management, according to the ESD Commander.



The Joint Surveillance and Target Attack Radar System (JSTARS) will provide Army and Air Force commanders real-time battlefield information. These actual JSTARS displays show levels of enemy activity (top) and can plot directions, speeds, and possible engagement points of those targets.

Photonics, especially in the form of fiber optics and optical discs, is the key to a new world of data fusion and artificial-intelligence-enhanced decision-making, he suggested. "We are really trying to get out of the world of [electrons] and get into the world of photons, which provide much greater speed," he added. Photonics makes it possible to have "literally one million gates on a device the size of a dime," which in turn leads to computers that can perform "one million billion operations per second." A huge Cray computer, by comparison, handles only about 1,000 billion operations in the same time. The "neuro" computer, patterned after the human nervous system, synthesizes these advanced technologies so that the combined processing capacity of between five and ten Cray computers can be compressed into a system the size of a coffee can, General Chubb told the AFA meeting.

Another photonic device of vast potential, he said, is essentially "just a piece of glass into which you can put any number of colors to create a multiplexer." The resultant capacity is far in excess of what could be attained by electronic means. At the same time, the power levels required to drive such a system are dramatically lower than those for conventional devices.

In practical terms, these advanced battle-management capabilities will serve in both tactical and strategic warfare missions, including advanced surveillance and tracking tasks associated with SDI and air defense against cruise missiles that feature low radar cross section designs. In this context, he pointed out that by moving to radars operating at lower frequency ranges—such as OTH-B (over-the-horizon backscatter)—"that's a help" in coping with stealthy aircraft and missiles.

Sensors Across the Spectrum

In addition, the big change in the shift to multimode surveillance and tracking systems is that "we are not just looking at radar [but also at such sensors as] infrared, acoustics, and electro-optics—all across the spectrum." The Air Force is doing work in this area at the laboratory level that can't be discussed because of security considerations, he added. Recent progress in IR detection, General Chubb reported, has led to equipment that even at this early stage is a hundred times better than "anything we have had before [and] lets us see tanks and aircraft through smoke."

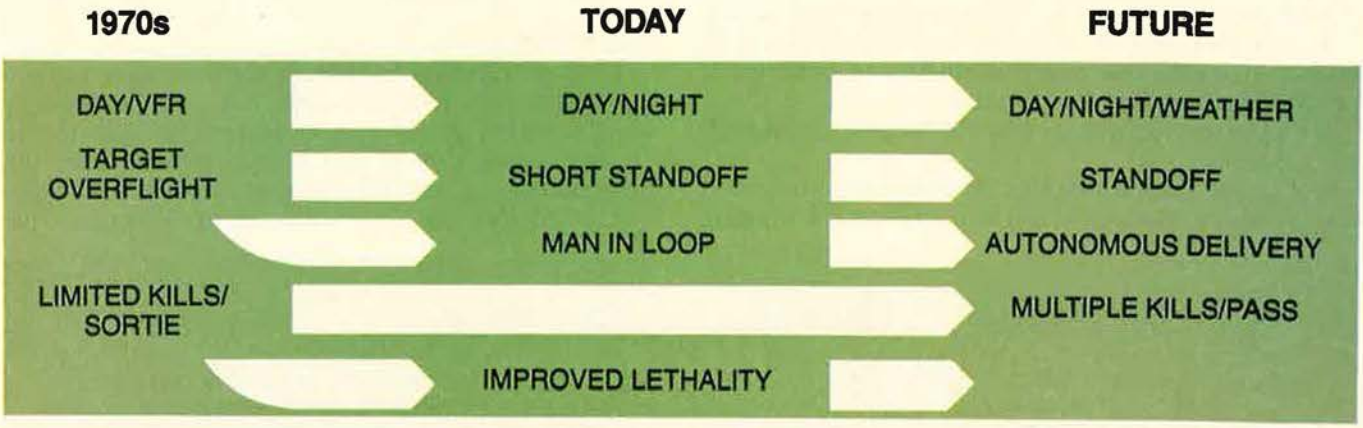
The ability of advanced multimode sensor systems to detect a hard-to-find enemy is increasing rapidly because we "now can hear him, see him, and listen to him." Key to these boosts in detection capability are new computer technologies and "smart skins," which involve the use of sensors embedded in the surface of aircraft and other air vehicles. Among the latest developments in smart-skin technology is the "ability to change the wrinkles" of the skin as required to optimize sensor performance.

USAF's smart-skin technology has progressed to the

point where the detection and tracking capabilities of the huge ground-based Pave Paws phased-array radar system could be duplicated by an aircraft with advanced smart skins, the ESD Commander told the AFA meeting. The very large Pave Paws radars—four of which will be operational this year—provide warning of Soviet SLBM launches. Since they can't be hardened or hidden, they could easily fall prey to a "precursor attack" keyed to decapitating the US national command authorities and associated requisite C^3 systems.

Another recent advance in battle management—sponsored by ESD and the associated Rome Air Development Center (RADC)—centers on rapid software prototyping, General Chubb told the AFA meeting. Rather than having to wait three months to change the software, "we now can change displays instantly to meet a commander's needs and preferences. If he wants to see Soviet attack [options and capabilities], we can do this right up front."

TACTICAL WEAPON IMPROVEMENTS



IMPROVED EFFECTIVENESS/SURVIVABILITY
REDUCED MANPOWER INTENSITY

JSTARS and JTIDS

In extolling JSTARS's broad utility, General Chubb explained that the system's data links "permit us to pull off data for both the Army and Air Force to any level they want. . . . We can provide radar images of many targets [and] present SAR [synthetic aperture radar] images in graphics form. By superimposing these images on vast stores of terrain information available from knowledge-based artificial intelligence systems . . . we can predict very easily, [for instance], whether a target is likely to be a tank or not and whether he is likely to be on a road or not."

A new Army system is already capitalizing on this information bonanza by bringing this "real-time battle management data to the front-line troops, either very detailed in a spotlight mode or in a surveillance mode," thereby making it possible to scan an entire corps region. The basic design of JSTARS is sufficiently flexible "so that even if the [Air Force and Army] change close air support doctrines in the next ten years, this system can adapt" to new requirements, the ESD Commander said.

JSTARS entered full-scale development in September 1985 with the award of a contract to a Grumman/Norden/Boeing team. That effort is centered on refurbishment and modification of a C-18 test aircraft to serve as the JSTARS platform. A production decision, General Chubb predicted, will be made early in the next decade. He added that the US Army "desperately needs [the system's corps]-wide surveillance capability."

Among the host of benefits accruing to the Air Force from JSTARS is real-time targeting for F-16s. F-16 pilots have proven their ability time after time to drop bombs with extreme accuracy, but, during the fog of battle, they are likely to be handicapped by the fact that they can't be provided the location of mobile or relocatable targets in a timely fashion. But because JSTARS can detect, track, and transmit exact enemy locations and position update information to friendly attack forces in the air and on the ground, "instead of hitting targets that were targets twenty-four hours ago, we can hit them in real time," the ESD Commander said.

JTIDS, General Chubb explained, complements JSTARS by allowing commanders to inform operators about the location of both friendly and enemy forces, ingress and egress corridors, and targets. JTIDS must overcome two major design challenges, General Chubb acknowledged. One is to present the data without worsening the already critical information overload in the cockpit, meaning "the trick is to make this imagery very clear." The other "secret behind JTIDS is to bring the [terminals] down in size and cost through evolutionary VHSIC technology. The trick is to get from a cube and a half to about half a cubic foot" in order to use the equipment in small combat aircraft while at the same time to drive the price down and reliability up, General Chubb pointed out.

War In the Shadows

Lt. Gen. Harley A. Hughes, USAF's Deputy Chief of Staff for Plans and Operations, told the symposium that both the White House and the Pentagon believe that for the remainder of this century, low-intensity conflict (LIC), or "war in the shadows, is the most active threat

facing the US." Defining LIC as a limited politico-military struggle to achieve political, social, economic, or psychological objectives, General Hughes stressed its paradoxical nature: "While the risk of LIC to vital national interests is relatively low—[compared to full-scale wars]—the probability of [its] occurrence is relatively high." Even though LIC does not threaten the US with the apocalyptic destruction of nuclear war, "it acts as a cancer on our alliances—and continually challenges [this country's] economic, political, and military credibility," he told the AFA meeting. The cumulative effect is that LIC challenges this country's ability to operate as a world power. Concomitantly, "the military view is that we have to maintain world-power status to ensure national security, and that means dealing with LIC."

Specifically, LIC poses a host of threats, which includes:

- Curtailed or no access to vital resources;
- Gradual loss of US military basing and access rights;
- Growing threats to key sea lines of communications;
- A gradual shift of allies and trading partners from cooperative relations with this country to positions of accommodation with hostile interests; and
- Expanded opportunities for Soviet political and military gains.

US policy concerning this often-protracted form of sometimes psychological and sometimes "real" warfare centers on the recognition that indirect—rather than direct—application of US military power is the most appropriate and cost-effective way of countering the LIC challenge. The LIC threat, General Hughes pointed out, continues to grow in a geographic as well as a technological sense. Regardless of whether LIC is an active part of Soviet grand strategy or merely provides occasional targets of political opportunity, the US must be prepared to deal with Soviet activity in this area, he suggested.

The flood of modern weapons into the Third World increases the threat to US forces around the world and expands the risk of US involvement in this form of ambiguous conflict. With shoulder-fired surface-to-air missiles becoming ubiquitous throughout the Third World, the threat to US airpower is increasing around the globe, General Hughes warned. Most ominous is the prospect that "some state-sponsored terrorists will eventually cross the nuclear or biological [warfare] threshold," he added.

Five Criteria

The Joint Chiefs of Staff recognize that military action in low-intensity conflict hinges not only on cautious consideration of the use of force but also on the "technological level of that force." While neither the definition of LIC nor US doctrine associated with this type of conflict has been settled by the Pentagon, five

OSD's New Acquisition Structure

In line with the recommendations of the White House Blue Ribbon (Packard) Commission on Defense Management, the Ninety-ninth Congress created the new position of Under Secretary of Defense for Acquisition (USDA), leading to significant changes in how the Pentagon and the services develop and buy weapon systems. *(See also "In Focus . . . " on p. 22 of this issue.)* While some of the details concerning the new structure are still under review, the key elements, Secretary Latham told the AFA symposium in Orlando, have been approved by Defense Secretary Caspar W. Weinberger.

The position of the Under Secretary of Defense for Acquisition (occupied by Richard P. Godwin, a former top-ranking industry executive) is at the same "Level II" as the Deputy Secretary of Defense and the service Secretaries. The USDA's principal deputy slot is a Level III position, on a par with the Department's Under Secretary for Policy.

The USDA serves as the defense acquisition and procurement executive as well as the principal assistant to the Secretary of Defense for acquisition management. His portfolio includes all activities relating to acquisition, including research and development, production, logistics, command control communications and intelligence activities to the extent that they relate to acquisition, military construction, and procurement. In addition, the Assistant to the Secretary of Defense for Atomic Energy reports to the Pentagon's new acquisition executive. So do the Defense Advanced Research Projects Agency, the Defense Communications Agency, the Defense Logistics Agency, the Defense Nuclear Agency, and the Defense Systems Management College.

In a departure from the original plan, the Under Secretary does not have direct line authority over the service acquisition executives and their subordinate structures. Such an arrangement would be inconsistent, in the view of the Defense Department's General Counsel, with the statutes that established the service Secretaries as the heads of their military departments. Nevertheless, the USDA has the authority to "direct" the service Secretaries on all matters falling under his cognizance, which leaves him with "ample authority to carry out his responsibilities and to oversee the service acquisition executives and the acquisition programs of the military departments," even though the service acquisition executives continue to report directly to the service Secretaries.

A number of boards and committees are part of the new structure, which entails some changes in nomenclature. The Defense Systems Acquisition Review Council, the venerable DSARC that underwent a metamorphosis to the Joint Requirements Management Board (JRMB) recently, becomes the Defense Acquisition Board. Two other bodies are being formed—the Research and Development Council and the Production and Support Council. Ranking below these organizations will be a series of specialized committees, Secretary Latham told the AFA meeting. The current total of some 120 committees involved in acquisition matters will be reduced to about ten panels.

The USDA organization will include the Director of Defense for Research and Engineering; the C^{3}I Assistant Secretary, with various defense agencies, including the Defense Intelligence Agency (DIA) and National Security Agency (NSA), under him; the Assistant Secretaries for Research and Technology as well as for Acquisition and Logistics; and, possibly most significantly, a "program operations shop."

The latter organization, he explained, will maintain and coordinate the R&D and acquisition activities of the services and DoD agencies. The program operations office is to perform two other main functions, he added. It will contain a plans and resources element that carries out programming and budgeting and develops an "acquisition operations plan" that translates service and joint requirements into a cohesive entity. Also, there is an acquisition systems management organization that manages the new complex board structure and provides analytical support for the USDA.

The Air Force, along with the other services, was in the midst of setting up its corresponding acquisition organization and policies as this went to press.

The Fairchild A-10 will be replaced as the primary close air support aircraft in the coming years, but it will find a home with the Special Operations Forces.

criteria can probably indicate when the US should—or should not—consider military involvement in LIC, General Hughes explained. These preconditions center on:

- Clearly defined political/military objectives;
- Popular support from the public and Congress;
- The fact that US vital interests are clearly at stake;
- The availability of US forces properly sized and tailored to achieve the objectives; and
- The recognition that US military forces should be committed only as a last resort.

A significant development in terms of the US approach to low-intensity conflict, General Hughes pointed out, is the recent creation of a Coordinating Board for LIC on the National Security Council that is to include representatives from the Departments of State and Defense, the Central Intelligence Agency, and the government's economic development agencies.

As it has in the past, LIC will continue to rely heavily on the US Special Operations Forces for a variety of reasons. For one, individual SOF groups are oriented to specific regions by dint of specialized equipment, skills, and training. Also, SOF units are trained to operate autonomously in twelve-member or even smaller groups, yet possess a wide range of skills. They can carry out independent operations for extended periods, are able to organize and manage larger forces, know how to coordinate and direct fire support, and hence are well suited for what General Hughes termed LIC's central military component: security assistance missions. "Whether the task is teaching small unit patrol skills, defense of key installations, organizing freedom fighters, or civic/humanitarian assistance to the local populace," the Special Operations Forces have been trained for all of them.

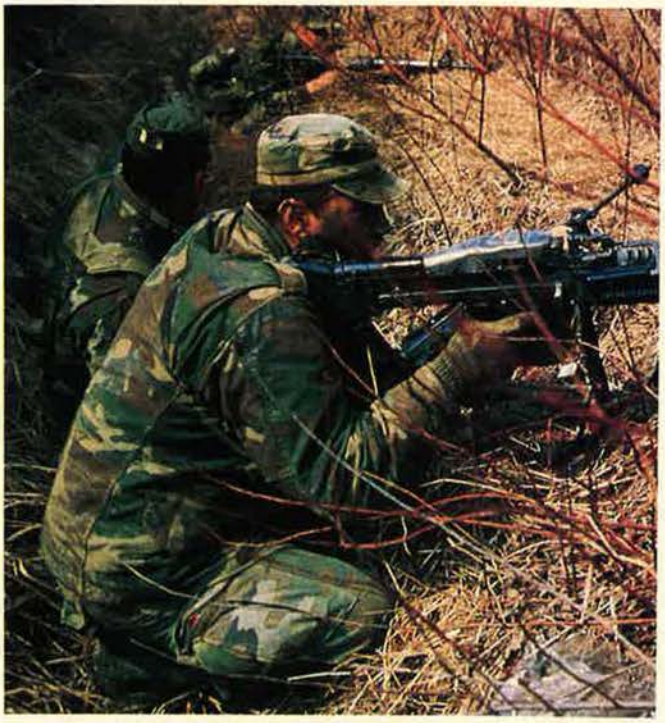
The importance of the SOFs to low-intensity warfare notwithstanding, there is a clear-cut need for joint military operations under certain LIC scenarios, General Hughes said. Adjustments in Air Force doctrine have maximized airpower's effectiveness for LIC applications, he stressed. Key here is the realization that "we can't apply hardware and doctrine [in a] straightforward [manner], as we would in an attack on Central Europe." When the Air Force is called on to protect US interests "using equipment designed for other battlefields, we must apply force with a new approach to tactics and techniques that accounts for the realities of the LIC environment."

As a case in point, he cited a low-intensity conflict initiative formulated by Tactical Air Command that revolves around specially equipped A-10s going after targets that the SOFs "paint" with laser designators. This approach meets a pivotal LIC requirement—the ability to perform "precision attack while minimizing the possibility of collateral damage," he explained. General Hughes predicted that the A-10 force will eventually be assigned to the Special Operations Forces.

Over the coming two years, the Air Force is allocating about $2.5 billion to its special operations forces, while the US Army will spend about $1.9 billion for this purpose. Except for high-tech intelligence-gathering and communications equipment as well as some standoff weaponry, the Air Force's existing inventory of conventional warfare weapons is fully suitable for LIC missions, General Hughes said. In the case of airlift, he said the upgrading of the some forty existing H-53s to Pave Low status "will give us . . . the ability to perform the long-range infiltration and exfiltration mission for the foreseeable future."

Modernizing Tacair's Munitions

The Air Force is taking a major step forward in air-to-ground weapons with the Autonomous Guided Bomb (AGB) program, the first launch-and-leave munition designed for ground attack. Maj. Gen. Richard E. Steere, Commander of AFSC's Armament Division, explained during the AFA meeting that this munition uses an IR seeker that can recognize targets and guide the bomb to the target. "It does not require a data link or designation



Security assistance missions, such as the air base defense this team is training for, are the central military component of low-intensity conflict.

The AIM-120A AMRAAM (Advanced Medium-Range Air-to-Air Missile), shown here on an F-16, will make possible multiple kills per pass. The AIM-120A is a follow-on to the aging AIM-7 Sparrow missile.

by another aircraft, as [do all existing tactical air-to-ground munitions], and provides a true launch-and-leave capability while substantially reducing the pilot's work load."

The Autonomous Guided Bomb program is a candidate for the congressionally mandated Conventional Defense Initiative (CDI), a conglomerate of high-payoff technology programs that in combination could bolster US conventional warfare capabilities across the board, he explained. The key challenge associated with the AGB program is to make the weapon "affordable and available for fielding as quickly as possible."

Another munition program of high promise is the joint-service Hypervelocity Missile (HVM), a small, fast, low-cost, laser-guided munition that makes possible multiple-vehicle kills on a single pass. Armament Division's work on the HVM technology demonstration program, General Steere pointed out, has been limited in scope and in the number of test firings, however, because of developmental problems. One of the difficulties is getting the guidance signal to penetrate the rocket plume and into the vehicle at those velocities.

The HVM is a 5,000-feet-per-second, sixty-six-pound missile costing about $8,500. It can be used against all vehicles, including armor. Initial HVM tests at Eglin AFB, Fla., showed the theoretical feasibility of getting signals through the exhaust plume, but, because of time and funding constraints, did not deal with the challenge of getting multiple signals to multiple weapons, the AD Commander acknowledged. The Division is now working on HVM technology demonstrations that "are a little more sophisticated than the last one, but by no means are all that is necessary for us to say we are ready to go."

The Division's single largest program—AMRAAM, the advanced medium-range air-to-air missile—entered its initial production phase last year. This high-performance launch-and-maneuver missile, General Steere explained, makes possible multiple kills per pass due to its active radar guidance. The pilot launches the weapon without need to illuminate the target and can shift his attention to another quarry immediately. This all-aspect, all-weather follow-on missile to the AIM-7 Sparrow will be deployed on the Air Force's F-15s and F-16s as well as on the US Navy's F-14s and F/A-18s. In addition, the missile is compatible with such NATO aircraft as the Tornado, the Sea Harrier, and Germany's F-4F.

AMRAAM is also a candidate weapon for ATF, General Steere pointed out. No firm decision has been made yet on how to "armor ATF." Depending on how that decision goes, AMRAAM might be provided with folding fins to permit internal carriage by the supersonic aircraft, he said.

In discussing the host of munitions programs AD has in progress, General Steere hinted at the possibility of extending the range of the AGM-130, a rocket-assisted version of the GBU-15 glide bomb guided by either IR or TV sensors. Advanced propulsion concepts are under consideration to increase the AGM-130's present range beyond twenty-five miles, he said.

Probably the most telling message to emerge from the AFA symposium's comprehensive preview of tactical air warfare trends—in marked contrast to the upbeat tone of the R&D forecasts—was Secretary Latham's warning of congressional budget cuts that might lead to a paralyzing "procurement squeeze." The Administration, he pointed out, requested a modest real growth of three percent a year for both the FY '88 and FY '89 defense budgets. Even these levels, he said, "in no way [allow the US] to play catchup" with growing Soviet defense investments. If, as Congress has already indicated, defense spending will again be reduced to below the current level, "the situation in the outyears becomes ominous. The whole procurement account [because of fixed, inflexible levels in the O&M and pay sectors] goes to zero if Congress [perpetuates] the no-growth or negative-growth budget trends of the past few years," he warned. ■

It now appears that USAF's fighter of the future can have speed and maneuverability without stinting on low observables.

The ATF: Hot and Stealthy

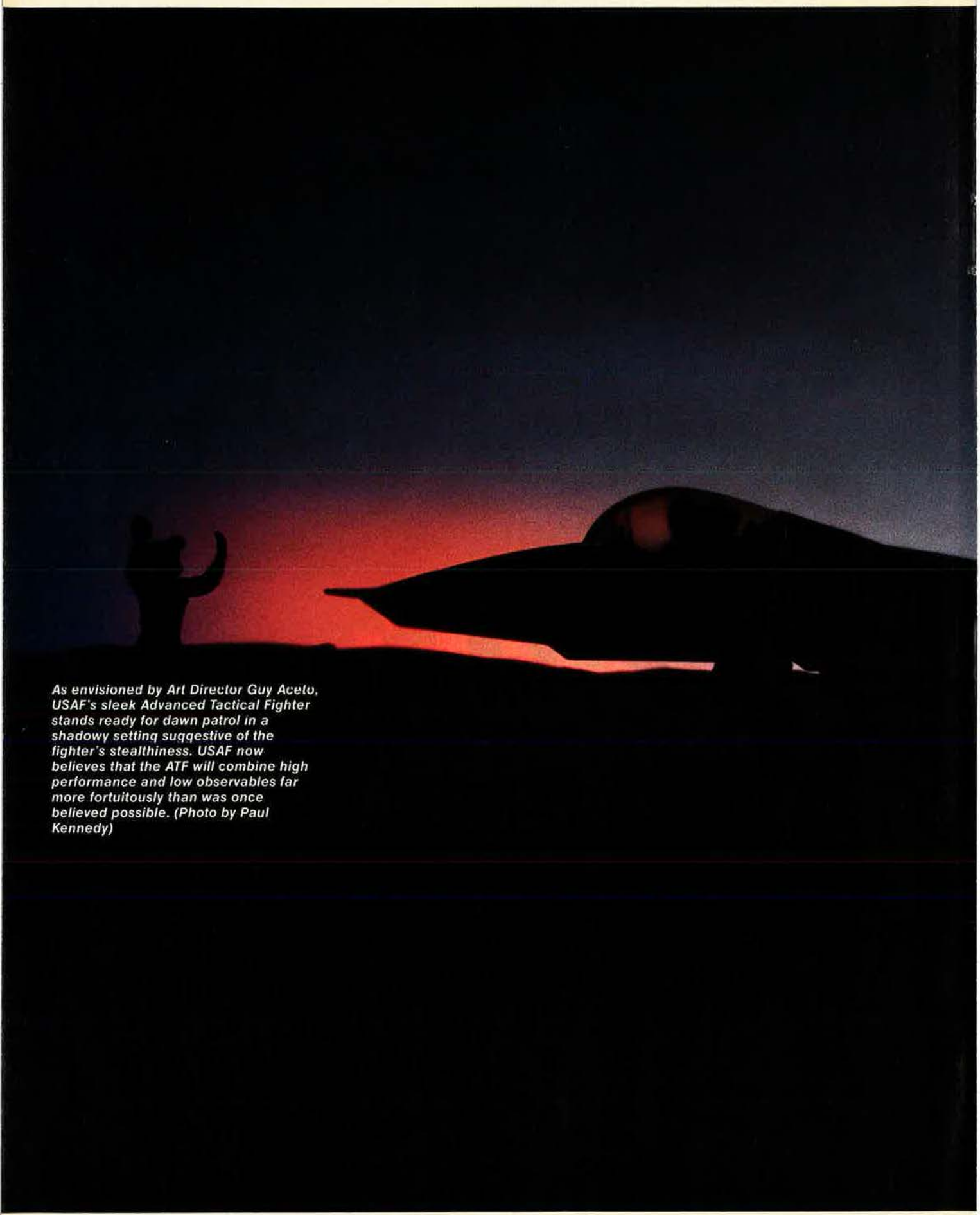
BY JAMES W. CANAN
SENIOR EDITOR

THE Advanced Tactical Fighter (ATF) is shaping up as a hotter, harder-to-spot, air-superiority aircraft than the Air Force once dared dream it could ever be.

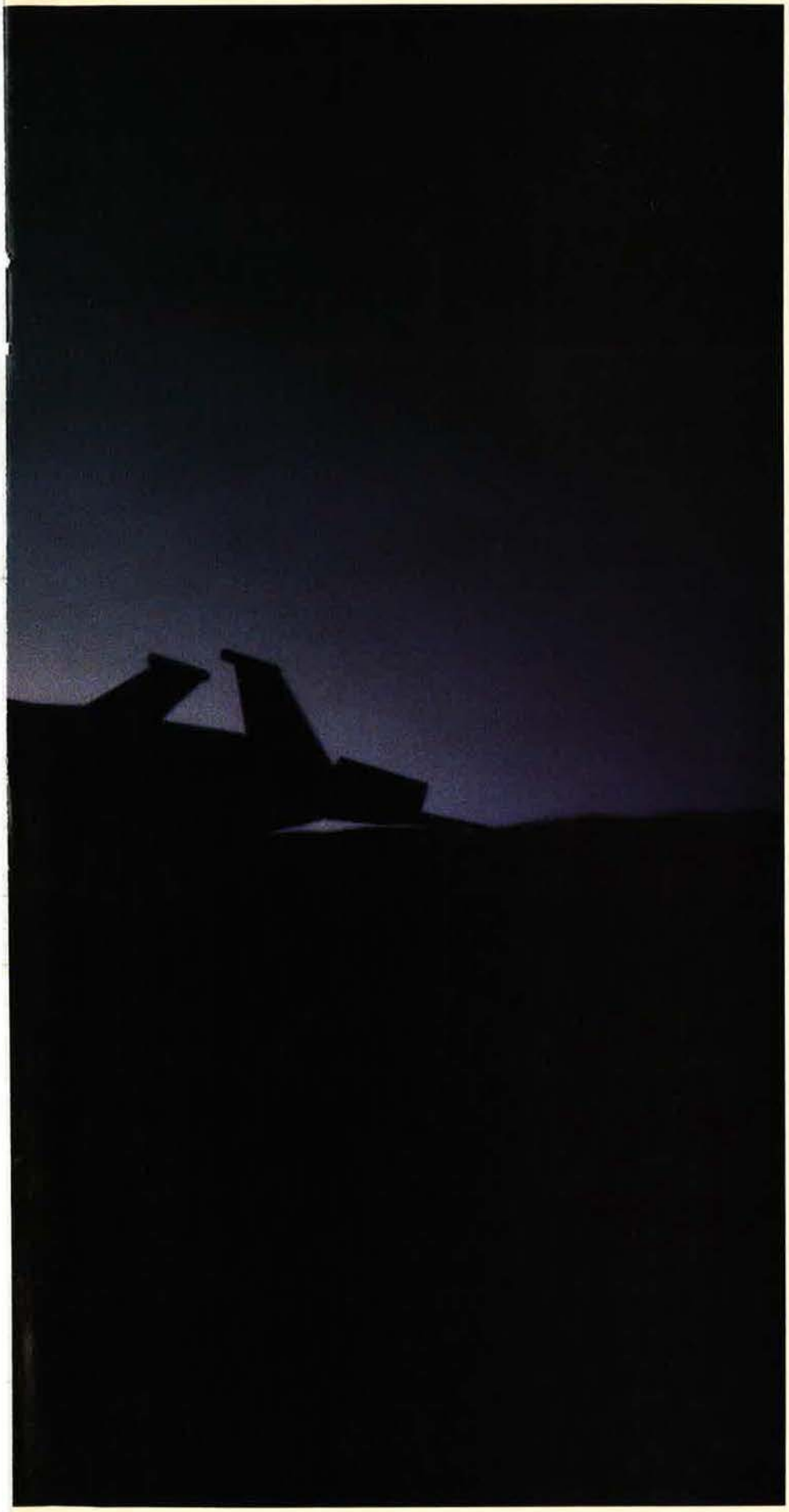
Air Force and aerospace industry officials involved in the ATF program increasingly refer to the fighter as "revolutionary"—not merely "advanced"—in comparison with the highly capable F-15 it is destined to succeed.

In working up its ATF requirements, the Air Force once assumed that the fighter would have to be short on "stealth" in order to be long on performance, or the other way around. Low-observables technologies were not considered to be compatible with those that make for speed and maneuverability.

One camp inside the Air Force, worried that stealth becomes perishable as detection technologies



As envisioned by Art Director Guy Aceto, USAF's sleek Advanced Tactical Fighter stands ready for dawn patrol in a shadowy setting suggestive of the fighter's stealthiness. USAF now believes that the ATF will combine high performance and low observables far more fortuitously than was once believed possible. (Photo by Paul Kennedy)



and devices are refined, wanted the ATF to be hot. Another camp, convinced that even the hottest fighters will be vulnerable in tomorrow's air-combat environment, wanted the ATF to be stealthy.

The problem was that USAF's assessment of the threat to be expected from Soviet fighters and surface-to-air weapons by the mid-1990s left little doubt that the ATF, which will be operational then, should really be a whole lot of both, if at all possible.

Now there is growing confidence that it will be just that.

"We will be able to have our cake and eat it too," asserts Dr. Thomas E. Cooper, Assistant Secretary of the Air Force for Research, Development, and Logistics.

Col. James A. Fain, Jr., who took over late last year as the ATF program manager at Air Force Systems Command's Aeronautical Systems Division, puts it this way:

"In general, as it turns out, things that are aerodynamically smart to do are also smart to do in terms of low observables. At first, people thought the two were in opposition, but they're really not. They're complementary to a large extent. The cleaner—the more aerodynamic—you make the aircraft, the better off you are.

"As we look at the threat, that [low-observables] technology is certainly offering us a lot of capability [in the ATF]. We should make certain that we take advantage of all that technology."

Colonel Fain ranks low observables among the "critical technology-driven issues" to be resolved in the ATF program's demonstration/validation (demval) phase. Others are "avionics, including software, and the engine-airframe performance combination."

He has already made major moves toward their resolution. He is credited in the industry and at the Pentagon with having led the ATF airframe and engine companies into coalescence of their design and development work and with having gone a long way toward mollifying critics of the plan for ATF avionics by explaining to them what those avionics are all about.

"What everybody has to understand," says Colonel Fain, "is that in the ATF, we have a totally new

The Advanced Tactical Fighter takes wing as imagined by Art Director Aceto. In all its performance characteristics, the ATF is expected to be a revolutionary fighter, far surpassing today's F-15C. USAF plans to begin producing ATFs in 1995 and to have twenty-four in operation by the end of that year. (Photo by Paul Kennedy)

way of viewing avionics. It's new technology, a totally new architecture. It's not black boxes. It's plug-in modules that are racked and stacked and changed according to scenarios. It's common signal processors running things, such as the radar, electronic warfare, stores management, and infrared search and track. It's VHSIC [very-high-speed integrated circuits] and so on."

Taken as a whole, the ATF demval phase is "certainly challenging," Colonel Fain says, adding: "Can we meet all the challenges? I hope so. But the real question before us in demval is whether we will be able to describe an airplane that we will be able to defend in terms of its cost as against its combat utility. That's the total challenge in demval. All other issues fall under that."

Prototypes From Two Teams

Lockheed, teamed with Boeing and General Dynamics, and Northrop, teamed with McDonnell Douglas, are the prime contractors in competition for the ATF full-scale development (FSD) contract to be awarded in 1990. They were selected last October 31 to take their designs through the fifty-month demval phase. Each will build two prototypes—the Lockheed YF-22 and the Northrop YF-23—for flight testing that is expected to begin within two years.

Whatever the precise makeup of the eventual production-line ATF, it is bound to be a fighter such as the world has never seen. Details of its planned flight characteristics and its visual, radar, and infrared signatures are classified, but what already meets the eye is startling enough.

"The ATF will be a mind-boggling performer," asserts Sherman N. Mullin, a Lockheed vice president who heads the Lockheed-General Dynamics-Boeing ATF team. "In comparison with the F-15C, if you take any [flight-envelope] parameter, the ATF will be not just a twenty percent improvement, but a double or triple improvement.

"What we've found is that we can lower the observables by a lot and yet decrease the performance by very little. The tradeoffs are much less harsh than we anticipated."

Del Jacobs, Northrop Aircraft Division's vice president of advanced design, has this to say about the fighter:

"In our design innovations over the last three years, we found that, in combination, stealth, speed, and maneuverability are mutually reinforcing. We didn't expect the synergism to be as great as it is. We thought they would pull in different directions."

As a result, Mr. Jacobs says, "the transition to the ATF from the great fighters that are out there right now will be equivalent to the transition from the propeller age to the jet age at the end of World War II in terms of tactics and the way air battles will be fought."

The Air Force says Lockheed and Northrop were chosen over Boeing, General Dynamics, Grumman, McDonnell Douglas, and Rockwell International for the demval prime contracts because their ATF proposals were the most balanced in combining the fighter's performance, low observables, cost, reliability, and maintainability.

Among all those companies, the winners apparently had the advantage of greatest experience with actual aircraft programs involving low observables—Northrop with its Advanced Technology Bomber (ATB) and Lockheed with projects dating back to the SR-71 Blackbird of the 1960s.

At the time of the demval contract awards, Col. Albert C. Piccirillo, then the ATF program manager, now retired, described the Lockheed and Northrop designs as "very close to one another on signatures and also very high in performance."

In the ATF proposed by either company, he said, "if you pull back on the stick at a high Mach number, you will find yourself on the fringe of space."

Outperforming the F-15

At the ATF's optimum cruising altitude, exceeding that of the high-flying F-15 by tens of thousands of feet, its greatly streamlined, energy-efficient engines will far surpass those of today's fastest fighters in terms of their thrust-to-weight ratios at supersonic speeds.

The engines will be capable of providing such speeds, without using afterburners, somewhere between Mach 1 and Mach 2.

This "dry" supersonic persistence will give the fighters the combat radius they will need to fly cover for far-ranging air-to-ground attack aircraft and to attain and maintain local air superiority well beyond the Forward Edge of the Battle Area (FEBA)—a direly coveted capability that the F-15, given what it would come up against today, would not usually have.

One minor ATF performance tradeoff that has already been made in deference to low observables, according to various officials, is the reduction by one-half G of the fighter's originally planned transonic maneuvering capability at medium altitude.

Withal, said USAF's Dr. Cooper, "the ATF will be extremely maneuverable. It will not sacrifice essential performance requirements for LO [low observables]. We don't want to go beyond eight to nine Gs in any event, since that's about the [physical] limit of man."

Another tradeoff that was made in working up the ATF's system requirements is a twenty percent reduction of the combat radius that Tactical Air Command originally wanted the fighter to have—when the ATF was envisioned as a bigger, heavier machine. Even so, its combat radius on internal fuel will be twice that of the F-15C.

The range reduction was in keeping with the 50,000-pound gross-weight objective that the Air Force settled on for the ATF. This puts it in the weight class of the F-15 and is a goal that the Air Force believes it must shoot for in order to meet its seemingly stringent design-to-cost target for the ATF.

USAF intends to produce 750 ATFs at a unit flyaway cost of $35 million, as measured in Fiscal Year '85 dollars and in anticipation of a production run of seventy-two fighters a year. By comparison, an F-15 now costs $25 million; a Navy F-14, which a naval version of the ATF may someday replace, $40 million.

The $35 million cost goal was set by Dr. Cooper in behalf of the Secretary of the Air Force and in consultation with the blue-suit fighter and R&D communities, in which there were some misgivings about it being too low.

Dr. Cooper says the cost goal is a reasonable one. "It's not a cheap

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price to pay, after all," he declares. "It's forty percent higher than the cost of an F-15. It doesn't include R&D costs. We're not saying it's an absolute cap, but it's necessary as a means of maintaining cost discipline throughout the ATF program.

"Affordability will be the key to the program's success. We'll still be buying F-16s when we introduce the ATF into our procurement budget—for long-lead items—probably in 1991, and we'll have to be able to justify the ATF's cost amid all others."

Production Starting in 1995

The Air Force plans to put the winning ATF variant into full-scale production around the beginning of 1995 and to have twenty-four operational fighters on the ramp by the end of that year.

Its goal in the demval phase, which began last November, is to lower the risk of FSD to the point that it can be undertaken with reasonable confidence and, if possible, under fixed-price contracting.

In this regard, Lockheed and Northrop are said to have also excelled in their proposals for risk-reduction fallback positions during demval, many of them in the potentially thorny arena of the ATF's supersophisticated, digital, modular avionics.

"It's fairly clear that we'll have to make some tradeoffs in demval," Colonel Fain declares. "That's what demval's for. We're not telling the contractors specifically what to do or how to do it. We've given them requirements, but no milspecs. But we haven't just given them their money [$691 million apiece for the primes] and told them to walk off and come back and see us four years later, either.

"They're off and charging hard, trying to get that last little bit of technical edge over each other. It's good competition—the program manager's best friend."

The prototyping approach in the ATF program—one that requires engine and avionics prototypes as well—should help the Air Force avoid mistakes of the past, Colonel Fain says. He notes that some programs were pushed into FSD on the tenuous basis of paper designs and isolated hardware for justifying major technological presumptions and then "sometimes fell short, ended up with bad names, and left people disappointed or downright angry."

This won't happen with the ATF program, he declares. "At the end of the demval phase, we'll be able to say precisely what we can and cannot do in full-scale development."

Once a fighter pilot in Southeast Asia, Colonel Fain came to the ATF program late last year with solid credentials and a reputation for getting tough jobs done. He took hold of the foundering LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) program at ASD a few years ago, for instance, whipped it into shape, and got it approved for production.

LANTIRN's success was sorely needed. The system will make an enormous difference in the combat capability of the tactical air forces, enabling them to fight around the clock and under the weather.

Expressing what seems to be widespread sentiment, one ATF contractor describes Colonel Fain as "the right man in the right place at the right time" on the ATF program, adding: "He's an energizer."

Colonel Fain is given credit for two major management accomplishments right out of the blocks in the ATF's engines and avionics programs.

The engines must be capable of reversing thrust to give the fighter short-landing capability and certain kinds of maneuvering capability and of vectoring thrust—up to twenty degrees away from the aircraft's centerline—to give it short-takeoff capability and to greatly enhance its maneuverability in all combat regimes.

Two-Dimensional Nozzles

This requires engine nozzles that are described as 2-D—for two-dimensional—because they do both jobs. But they must also be what ATF program officials call "tailored"—built so that their operation and configuration do not enlarge the aircraft's radar and infrared signatures to unacceptable levels.

Until the demval contracts were awarded, the ATF's competing engine companies—General Electric and Pratt & Whitney—had no way of knowing which airframe companies they would be working with or what those companies specifically had in mind for airframe-engine matchups, with nozzles as the central issue.

"It was an insoluble problem when there were seven airframe companies [the original ATF competitors] dealing with two engine companies," says Lockheed's Mr. Mullin. "There was no way to focus on it. Generic nozzles for ground-testing engines wouldn't hack it. They were totally unacceptable from the signature standpoint."

Under Colonel Fain's guidance, Lockheed and Northrop worked independently and intensely with the engine companies through last November, December, and January "to establish the program to get tailored nozzles," says Mr. Mullin, and by February, "it was looking good."

The Air Force will require Lockheed and Northrop to power one or both of their prototype airframes with both prototype engines. Each contractor is designing its ATF to accommodate both engines in anticipation that the Air Force will eventually buy both for the production ATFs, just as it is doing with P&W and GE engines for its F-16s and will do for its F-15E dual-role fighters.

Mr. Mullin notes that the ATF's new engine technologies and structures technologies will give it "excellent maneuverability at supersonic speeds" and that "it will have great energy going for it—a tremendous amount of fighting capability—when it goes into combat."

Current fighters cannot sustain supersonic speeds while in combat. They usually wind up fighting in the transonic/subsonic regime, lighting afterburners only to enter and to disengage from combat supersonically.

In its ability to sustain supersonic flight and, thus, to stay in a high-energy state, the ATF will be capable of calling on that energy for maneuverability, speed, or altitude—whatever the combat situation calls for.

Thrust-vectoring or other advanced design techniques will make the ATF capable of tight turns at high speeds while delivering its all-aspect radar missiles and IR missiles and while firing its gun.

"The ATF," predicts Northrop's Mr. Jacobs, "will have as much of an

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energy-maneuverability advantage over today's new Soviet fighters—the Su-27 and the MiG-29—as they now have over the Goodyear blimp."

P&W and GE were scheduled to freeze the designs of their flying-prototype ATF engines about the time this issue went to press. The engines are expected to be ready for ground testing in a year or so and to be mated with the airframe prototypes in time for their flight-testing in late 1989.

The ATF's engines will probably embody less than half the number of stages that are in the hot sections of today's fighter engines and about forty percent fewer parts. Thus, they should be exponentially more durable, reliable, and maintainable.

Highly Integrated Avionics

The fighter's avionics will be highly integrated in the framework of the Pave Pillar architecture developed by ASD in recent years. At its core is the VHSIC common signal processor for such elements as the radar, Integrated Communications, Navigation, and Identification Avionics (ICNIA), Integrated Electronic Warfare Systems (INEWS), and Infrared Search and Track (IRST).

The whole affair will make extensive use of common modules and high-speed data buses.

A major challenge in the demval phase lies in pulling together all the avionics elements and supporting technologies into a form that will be suitable for acceptable-risk, full-scale development of the ATF to be put into initial production—one that some Air Force officials have taken to describing as the "vanilla" ATF.

All avionics elements may not be totally ready for incorporation in the ATF during FSD, but the Air Force plans to endow it with as many of them as it will need in order to get off to a good start in production and in operation.

Given the complexity of the avionics and the prospect that avionics costs will be the highest of all in the ATF program, some critics have questioned whether USAF will be able to provide the ATF with all the avionics capability that it now plans and whether the costs will be exorbitant if it does.

Colonel Fain has done a great deal to mollify such critics by giving them to understand that INEWS and ICNIA, for example, "are not black boxes." Instead, as he has pointed out, "they're technologies—tech bases that provide whole groups of common modules that are run by one processor, and they can be changed overnight.

"The ATF's avionics suite will be the most flexible thing you've ever laid your eyes on," Colonel Fain asserts, "and we've got the whole [avionics] world out there competing for it, which ought to drive its costs down considerably."

Lockheed's Mr. Mullin also expresses confidence that the ATF's avionics will do the job at affordable costs.

"We asked ourselves, 'Could we really implement the Pave Pillar common modules?' and we found that the answer is yes," he says. "As to affordability, Pave Pillar architecture is the only way to go."

In the Lockheed-Boeing-General Dynamics team's ATF development, Lockheed is in charge of working up the fighter's central digital avionics, including cockpit displays and controls and the integrated mission processors, to be made up of liquid-cooled common modules containing VHSIC technology. Lockheed will subcontract much of the work.

General Dynamics is responsible for designing the team's ICNIA and INEWS avionics and for overseeing subcontracts to build those systems.

"We use the terms 'tailored ICNIA' and 'tailored INEWS,'" Mr. Mullin explains. "The reason is that those programs are really technologies with broad objectives, not all of which are required for the ATF. I can't think of a set of technology programs that has ever provided more bang for the buck than the Air Force is going to get from Pave Pillar, VHSIC, ICNIA, and INEWS."

Boeing is in charge of designing the Lockheed team's ATF radar and IRST, which Mr. Mullin describes as "a critically important sensor with a tremendous field of coverage—and [it's] passive, which is vital to low observables."

Flying Avionics Lab

Beginning in about two and a half years, Boeing will test the Lockheed team's avionics in a 757 airliner configured as a "flying avionics lab."

Northrop's Mr. Jacobs emphasizes that Northrop and McDonnell Douglas expect to share the work about equally throughout the life of their ATF program and that they "have worked together and known each other at the management engineering and manufacturing levels for twelve years" in their sharing of the Navy F/A-18 program, with McDonnell Douglas as the prime.

Northrop is in charge of systems integration for the team's ATF. McDonnell Douglas's principal areas of activity are avionics, weapons integration and support, and some airframe elements.

A critical challenge to both teams in the demval phase will lie in building a window for the fighter's IRST sensor to look through that will be in keeping with low observables.

"It's really a supersonic FLIR [forward-looking infrared] window," says Colonel Fain. "We've got a lot of subsonic FLIR windows, but running in the rain at Mach 0.9 is not the same thing as running in the rain at Mach 1.6 in terms of seeing out of those windows.

"So we're faced with finding out how to build the aperture. In terms of LO, what kind of material or coating will it need? This is one of our biggest challenges."

Another is the distribution and sizes of the ATF's antennas. They are expected to be quite small, roughly the size of shotgun shells.

"Their elements," said Colonel Piccirillo late last year, "are now handmade and very expensive. The problem is in getting their costs down and getting them in time."

The Navy has agreed to evaluate the ATF as a possible replacement for its F-14 fleet air defense interceptor near the turn of the century. It could wind up buying 500 to 600 of the fighters, which will be built with prospective Navy requirements in mind.

This would benefit both services by lowering the ATF's unit production costs. The Air Force cannot count on it happening, however, and must meanwhile concentrate on building a superb fighter at an affordable cost that, as Colonel Fain puts it, "will be with us for a long time." ■

Current fighters have given the US a decade of air superiority. By the 1990s, though, the ATF becomes crucial.

Spreading the Firepower, Extending the Battlefield

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

THE MOST significant principle of warfare learned since World War I is that in order to deter war—or to wage a successful war against traditional military forces—a nation must be able to achieve air superiority. To do this, a nation must have highly capable aircraft that can be used to achieve air superiority quickly and completely. For the United States, the Advanced Tactical Fighter (ATF) is such an aircraft. It is the most important tactical airpower program of the next decade. The ATF offers us the opportunity to capitalize on American technology to maintain air superiority over enemy territories, as well as over our own, and do it well into the twenty-first century.

In the future, we will continue to conduct the missions we do today (offensive counterair, defensive counterair, interdiction, and close air support), but against more modern defenses. *All* these tactical air missions except defensive counterair require us to penetrate enemy airspace.

However, a new dimension is being added to air warfare. Newer Soviet fighters are now able to find and shoot down penetrating low-flying attack aircraft. Soviet fighters are being equipped with a highly capable look-down radar and an excellent shoot-down missile system. Direction and guidance of these fighters will be provided by their new airborne warning and control system. Our penetrating aircraft will have to operate against these

To succeed in its mission as the air superiority fighter of the 1990s, the ATF will have to have the ability to get the first jump on any adversary, as this Lockheed artist's concept suggests.

airborne threats as well as against the ground-based surface-to-air threats.

The Aircraft for the Job

For us to deal with this formidable threat, we must develop an aircraft that can provide local air superiority for our penetrating force. The ATF will be designed to do exactly that, thus spreading the firepower of our combined forces across large areas and extending the battlefield far into enemy territory instead of only to the point of contact between the armies.

A lot of homework was done before the tactical air forces could develop a definitive requirement for the ATF. First, we needed to know if our current fighters could be modified to do the job. Certainly, if a derivative of a current aircraft could do the job, then spending billions of dollars to develop a new airplane would be unwise. However, the current generation of fighters could be improved only marginally and at best provide us parity in the quality arena.

An aircraft was needed that would provide the Air Force with a significant improvement in capability—a *revolutionary* change rather than an evolutionary change. In light of the Soviets' practice of developing new aircraft every several years, we needed an aircraft that would be dominant for twenty-plus years.

One argument that has been made is that we needed a new aircraft because it has been a long time since we have had a new fighter; the F-15 came into the inventory in 1974, and the ATF is not programmed in until the mid-1990s. While this is true, the main reason we need to develop the ATF is to counter the evolving Soviet threat. The new dimension of the threat, as we've seen, is driving us to develop the ATF now.

How we go about developing this new fighter is also important. We plan to follow a design philosophy similar to that followed in the past with other air-superiority aircraft. All the modern technologies available will be incorporated in the ATF's structure, propulsion, avionics, aerodynamics, and low observables. The performance and weapons requirements will logically lead to a major advance in flight-control technology. In addition, the ATF will incorporate unprecedented levels of reliability and maintainability (R&M) to ensure that it can sustain the intense levels of flying that would be required in an all-out conventional battle against numerically superior forces.

First-Look, First-Shot Capability

One of the most important advantages of the ATF will be its first-look, first-shot capability. Historically, some eighty-five percent of the aircraft shot down in air combat never saw the attacker. Therefore, the first rule of all air combat is to see the enemy first.

The ATF will have sophisticated new sensors and other associated systems to allow our pilots to see the enemy first. It will also have the capability to beat future enemy surface-to-air threats, allowing it to penetrate the enemy's airspace and operate in the face of his best defenses. The ATF will be able to cruise at supersonic speed at less than full power, further complicating the enemy's problem. Its maneuverability will surpass that of any aircraft projected into the next century.

The integrated airframe, engines, avionics, and sensors of the ATF will make use of advanced very-high-speed integrated circuit (VHSIC) technology, allowing it to store, evaluate, process, and transfer vast amounts of information among the various systems of the aircraft. This will be the most highly integrated avionics suite ever assembled in a fighter aircraft, representing a ten-fold increase over the computer capability of our most advanced fighter, the F-15. The on-board sensors and associated offensive weapons will enable the ATF to negate the enemy's defenses as well as to find and destroy enemy aircraft.

The air battles of the future will be so intense that, without help, pilots will not be able to absorb, sort, and prioritize the hundreds of pieces of information needed to win the fight. Even with all the great advantages in technology, the pilot must still look outside the cockpit during the battle. Therefore, we are making sure that the cockpit is the most efficient and effective ever developed.

The pilot will be able to fight an air battle and defeat other defenses at the same time by using head-up display technology. This advancement includes a command system that allows him to interface with the aircraft to check aircraft status, select weapons, change operating modes, and identify targets while keeping his eyes out of the cockpit and his hands on the stick and throttle. Incidentally, some have implied that we are developing an airplane that goes beyond the limits of our pilots. This is simply not true. The ATF will be sophisticated and rugged, but has been designed to ease the pilot's job, not complicate it.

All of this capability is irrelevant if the aircraft isn't readily available for combat. The reliability and maintainability of military aircraft have steadily increased with each generation of new aircraft; we are designing the ATF to have better reliability and maintainability than any military airplane in history. The ATF will be designed to check its own complex systems to the point of telling the crew chief which individual circuit groups are malfunctioning. VHSIC technology and new design features will reduce the number of moving parts and thus reduce failures to a minimum. The ATF will offer a 100 percent increase in reliability over the F-15.

Another advantage of increased R&M is the decrease in manpower needed to support a typical ATF squadron. Compared to the F-15, the number of different maintenance specialties required to support the ATF will be reduced by two-thirds and total manpower requirements will decrease by one-third.

These improvements will have other positive effects on our overall combat readiness by reducing the amount of airlift required to deploy and support a typical fighter

These F-15 Eagles from the 36th TFW at Bitburg AB, West Germany, represent the state of the art in the world of air superiority.

One of the main reasons the ATF is needed—the Soviet Su-27 Flanker. As the threat grows, so must the capability to defeat it. (Model and photograph by Erik Simonsen)

squadron. We are short of airlift capability, and our get-well date is many years away. By introducing the R&M improvements with the ATF, we will be able to deploy more tactical fighters with fewer airlift aircraft. A squadron of ATFs will be able to deploy faster than any other fighter squadron in the world and do it with less than half the airlift requirement.

Right Number, Right Kind

The Soviets believe strongly in the value of large forces. We see the application of this philosophy in nearly every Soviet weapon system. They believe in shock power, numbers, and ruggedness. Because we do not want to spend as much as the Soviets do for national defense, we must get the most capability for the best price. For us, this usually means that we have to build superior weapons but in fewer numbers, usually for a lower total price. However, the right number of the right kind of aircraft is what we need.

It does the United States no good to have a great airplane if we can afford only a few of them. We need sufficient numbers of ATFs to meet our commitments and to deter Soviet aggression. We have proved that weapon systems can be both effective and affordable through the use of competitive procurement processes. We cannot afford to accept a new weapon system with cost overruns and delayed delivery schedules.

The level of technological achievements in this country is such that when we apply the proven American concepts of competition and pride to weapons development, our defense contractors give us the best possible product for the best possible price. Today, defense contractors have many incentives to produce results at a reasonable cost. We have encouraged them to be accountable to the taxpayer. The ATF will be developed and procured using this proven process. If they want a piece of the action, they will have to perform.

We plan to buy the ATF through a fly-before-buy prototyping process. We have two contractors, or teams of contractors, to develop and build flying prototypes of the ATF. In addition, we will have all the integrated avionics systems prototypes built and tested in the same time frame. Two engine contractors will build and install their best engine candidates in these prototypes. The result will be a complete set of systems to choose from when the time comes to make a choice. This concept has worked in the past and will work with the ATF as well.

The idea of prototyping the ATF will also allow us to make decisions and changes early in the program and avoid costly problems or surprises after we have already bought the airplane. The best attribute of this idea is its commonsense approach to ensuring that the military gets what it pays for. We would not think of buying a new car without first driving it to see if it will meet our needs. Likewise, we should not commit ourselves to a particular aircraft design until we are confident it meets our requirements. By competing different prototypes and paying attention to performance and capability, we believe we can not only get the quality we need but buy the quantity we need as well. And that is the key to overall effectiveness in the tactical airpower business. The right numbers of the right kind of aircraft will ensure that we can meet our commitments well into the twenty-first century.

The Overriding Consideration

The need for the ATF by the mid-1990s is well documented and supported by the nature of modern warfare. It is an aircraft needed and driven by not only the future threat but the present one as well. Our current fighters have provided us with a decade of superiority. If we are to fulfill our commitments into the next century, we must continue with the sound and logical development process already under way in the ATF program. By using the American competitive process and American industrial know-how, we will get the quality we need at a price our nation can afford.

The overriding consideration is that we must be able to win any war we fight. Losing is not an option. We must win. The Advanced Tactical Fighter will ensure that we have the best chance to do just that. ■

Gen. Robert D. Russ is Commander of Tactical Air Command, a position he has held since 1985. He had previously served as TAC's Vice Commander and as DCS/Research, Development, and Acquisition at Hq. USAF. A 1973 graduate of the National War College, General Russ was a distinguished graduate of the Air Command and Staff College in 1965. He completed pilot training in 1956. During the Vietnam War, he flew 242 combat missions, fifty of them over North Vietnam, as a member of the 12th Tactical Fighter Wing.

The STOL Demonstrator will explore the feasibility of operating fighters from short, bumpy airstrips.

Landing on Less

BY JEFFREY P. RHODES, AERONAUTICS EDITOR

A LITTLE more than a year from now, a McDonnell Douglas F-15 Eagle that, like all F-15s, is nearly forty-three feet wide from wingtip to wingtip and sixty-four feet long is scheduled to take off from a runway only fifty feet wide and 1,500 feet long.

It will not be an ordinary F-15 at the end of that runway, but a one-of-a-kind article that has been modified as part of the STOL (short take-off and landing) and Maneuvering Technology Demonstrator program (SMTD).

"This is really the next generation for airplanes," said William H. (Bill) Brinks, who served as the SMTD Program Manager at McDonnell Douglas before moving over to head the company's YF-23A Advanced Tactical Fighter efforts earlier this year. "It is the same kind of change as when we went from props to jets."

The SMTD program is a research effort initiated by the Flight Dynamics Laboratory of AFSC's Aeronautical Systems Division to give supersonic fighters a STOL capability and enhanced maneuverability and cruise performance as well. The five-year effort is divided into three phases, with the first twenty-four months being devoted to design of the various components and the last thirty-six months reserved for ground and air testing of the SMTD F-15 test-bed. The F-15 was chosen because of its mature airframe and because it is the safest fighter in the Air Force inventory.

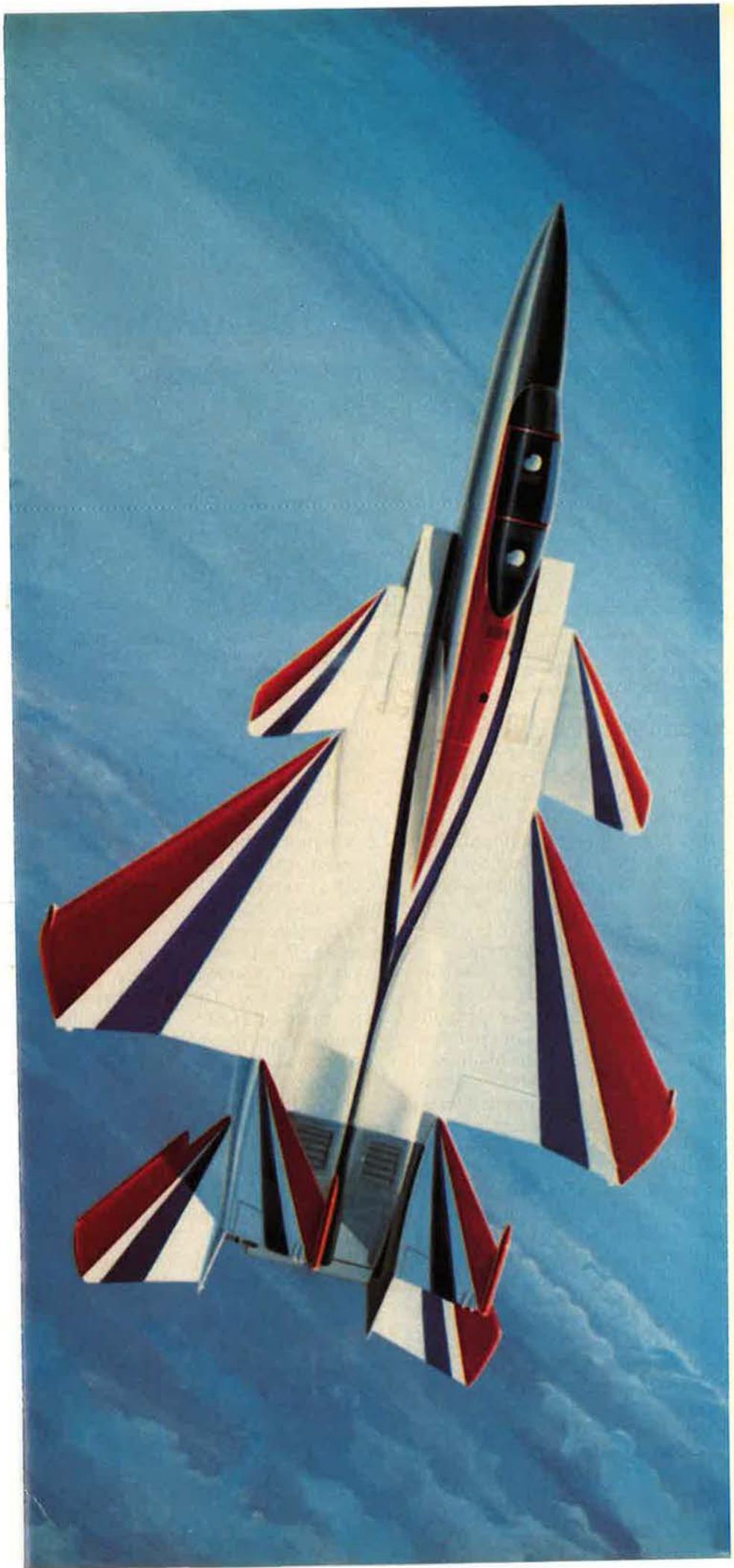
A Remarkable Airplane

The SMTD F-15 will be a remarkable airplane. Not only will it be able to take off and land in an incredibly short space but, among other things, it will offer a twenty-three percent improvement in instantaneous turn rate over a standard F-15 (1.95 nautical miles for the SMTD F-15 vs. 2.54 nm for the "plain" F-15 at Mach 1.6 at 50,000 feet). The SMTD F-15 will be able to decelerate to cornering speed (Mach 1.8 to Mach 0.9) in twenty-five seconds as opposed to a regular F-15's forty-two seconds, and the SMTD F-15 will "come over the fence" with a sink rate of 10.5 ft/sec at 119 knots, in contrast to a standard F-15's approach speed of 135 knots and sink rate of six ft/sec.

The answer to how the SMTD test-bed will be able to accomplish these amazing feats lies in the four areas of modifications being done to the F-15B (serial number 71-290, which was the first full-scale development B model back in 1971 when the F-15 program began). Two-seat capability will be retained in the test-bed.

The most sweeping modification is that, for the first time ever, an airplane's engines will be integrated into the flight-control system. By means of two-dimensional nozzles fitted to each of the SMTD's Pratt & Whitney F100 derivative engines, the demonstrator will be able to use the engine's thrust forces like the airplane's control surfaces.

Through the use of articulated



Resplendent in its red, white, and blue paint scheme, the STOL Maneuvering Technology Demonstrator is being put through its paces in this artist's concept. Prominent among the SMTD F-15's modifications are the thrust-vectoring nozzles and the fully movable canards. This concept will become reality next year.

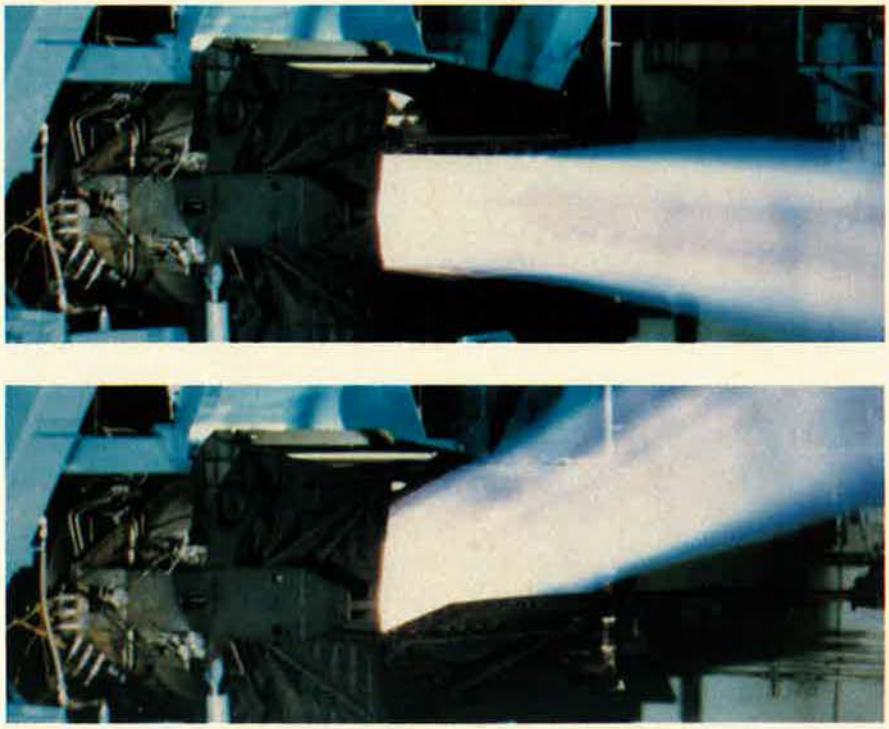
louvers in the nozzle and by directional vanes on the top and bottom of the structure, the nozzles will provide the SMTD test-bed with vectored and reverse thrust. So, as the engines are throttled up, the louvers direct the thrust upward, forcing the aft end of the F-15 down slightly and the nose up. By "popping a wheelie," the SMTD F-15 will reach a flight attitude while still at the end of the runway and will be able to take off twenty-five percent sooner than an F-15C, which requires 2,100 feet of runway at full power with no afterburner. Because the nozzles can be operated independently, an improvement of nearly thirty percent in roll rate compared to a standard F-15 and a near thirty-three percent improvement in pitch rate under the most favorable flight conditions are predicted.

The 36.5-inch-wide rectangular nozzle fits on the thirty-eight-inch-diameter engine by a transition duct that offers the advantage of a relatively short length and minimal area change in the space of the two openings. Made of titanium honeycomb, the four flat and four conical pieces of the duct are approximately three-tenths of an inch thick. The duct is capable of withstanding temperatures of up to 600 degrees Fahrenheit, and the assembly weighs only twenty-seven pounds, excluding the weight of the cooling liners.

The other main visible modification to the SMTD F-15 is the addition of two large canards mounted

on the intake fairings. These movable canards, which are modified F/A-18 Hornet stabilators, are important to the overall stability of the SMTD F-15 in flight and are another reason maneuverability will be much improved. The canards will be positioned at a twenty degree upward cant above the mean chord of the wing for a big improvement in effectiveness.

All of the standard F-15 flight-control systems except the stick and rudder pedals were removed for the installation of the fly-by-wire Integrated Flight Propulsion Control (IFPC) system that will operate the nozzles, the canards, and the regular control surfaces, such as the rudders and ailerons, as a single system. Pilot input sensors will provide electrical signals to the digital computers, which in turn will position the control surface actuators. The flight-control computer is a 1750A four-channel microprocessor that can initiate 1,000,000 instructions per second to the system.



The two-dimensional vectoring engine nozzles will enable the SMTD to take off, land, and maneuver in remarkably short distances. This test of the nozzle on a Pratt & Whitney F100 derivative engine shows the louvers in the 36.5-inch space vectoring the engine's thrust upward.

This computer-generated simulator image shows the specified area the SMTD F-15 must take off and land in—fifty feet wide by 1,500 feet long. The runway it's superimposed on is 200 feet by 8,000 feet.

"The airplane will be a little computer-dependent," said Mr. Brinks in a clear understatement. "To crank up the aircraft, you will first have to turn on the flight-control system."

"New Wave of Technology"

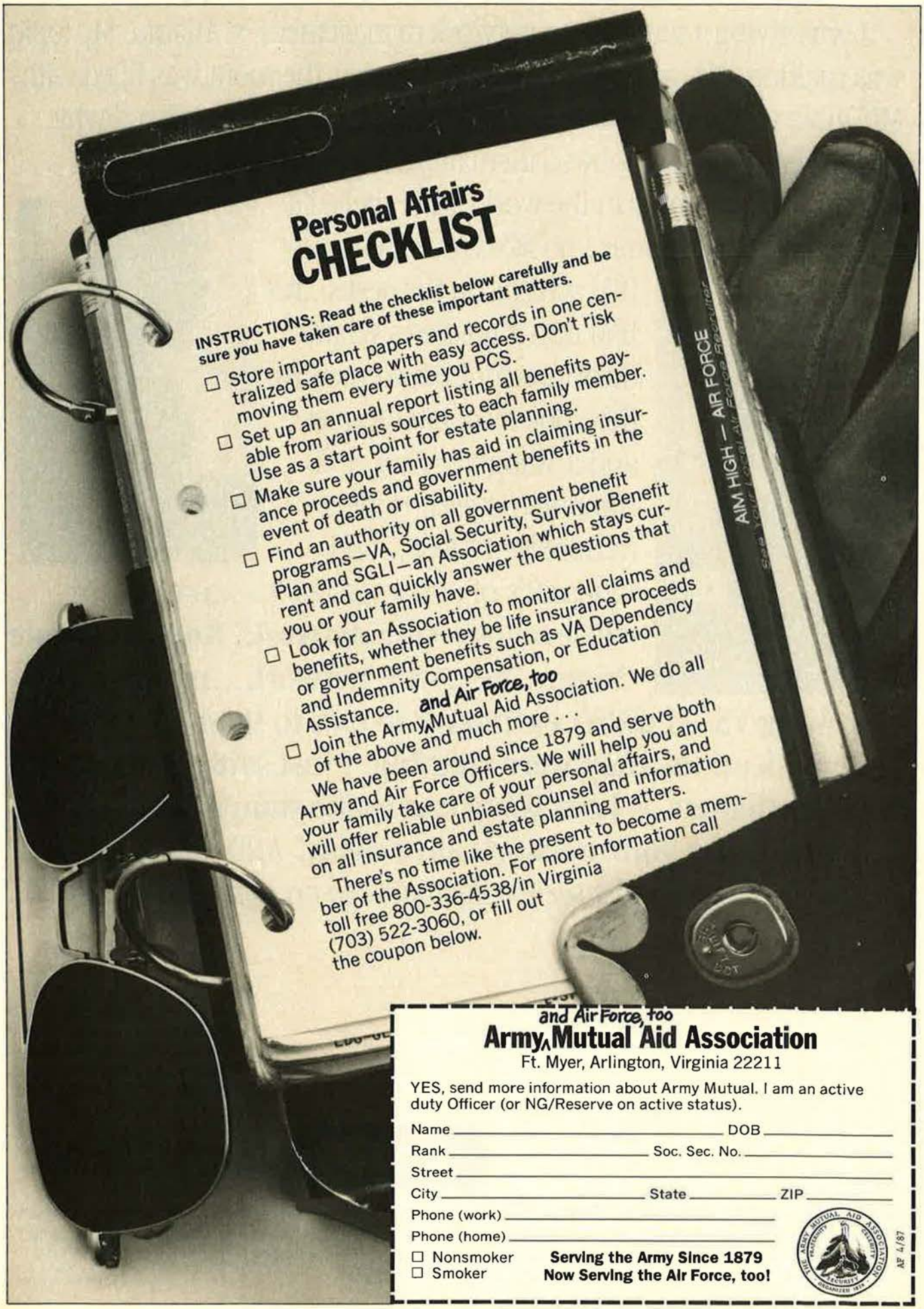
The SMTD F-15 will also have beefed-up landing gear that will be able to handle extremely high sink rates as well as bumps of up to four and one-half inches. The bumps will be used in testing to simulate landings on the kind of repaired runways that would be encountered in a combat situation. The nose gear was tested last November at the Flight Dynamics Laboratory and performed as advertised on bumps of up to seven and a half inches and sink rates of up to fourteen ft/sec.

Unlike the new F-15E, the SMTD F-15 will utilize standard bias-ply tires that will stand up better to repaired runways. The SMTD F-15 will also use aluminum-lithium wing skins that are nine percent lighter than the aluminum panels currently used. The new panels are also five percent stronger and have more than twice the fatigue life of the aluminum skins. Each panel is sixty-eight inches by ninety-five inches and weighs only 127 pounds.

All equipment for the SMTD program will be delivered in the next few months, and after assembly, ground testing will begin. First flight is expected next March, and then, after shakedown at McDonnell Douglas's St. Louis, Mo., plant, the SMTD F-15 will go to Edwards AFB, Calif., to begin the test program in earnest. The test program will include flights with 6,000 pounds of stores, including a centerline tank and four AIM-7 Sparrow missiles.

The SMTD program is being conducted under a $118 million contract. The Air Force directly contributed $75 million, with the other $43 million being cost-shared with the contractor. Counting items contributed by a team of subcontractors at no cost to the program, the total cost-sharing value comes close to $100 million.

"This is the new wave of technology," concluded Mr. Brinks. "It will give us much more capability for our armed forces. In fact, this program could lead to fighters [other than such vertical-takeoff planes as the AV-8B] that will use short strips of highway for their operations." ■



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The readiness and sustainability of combat squadrons has never been better.

A Force That Can Fight

BY MAJ. MICHAEL B. PERINI, USAF

THE Air Force would have to have its act together the day that trouble started. A major modern conflict would allow little time to prepare or to mobilize. It's likely that the entire war would be fought with the assets and capabilities the Air Force could muster at the beginning.

This means that the aircrews and

The increase in spare parts stock since 1980 has nearly doubled what would be the wartime sortie generation rate. Here, an airman prepares an F-16 from the 401st TFW at Torrejon AB, Spain, for flight.

troops must be trained, their equipment ready to go, stocks of munitions, fuel, and spare parts on hand, and the support infrastructure in place. Today's force measures up well against that yardstick—a big change from the situation a few years back when the state of military readiness and sustainability had become a national concern.

The improvements are seen in flying hours, aircraft availability rates, sortie generation, spare parts and munitions stocks, and more. Some problem areas remain, but there is real credibility to USAF's claim that it is better manned, trained, and equipped than at any previous point in its history.

New weapon systems recently put into service are more reliable and easier to maintain. The increase in spare part stocks since 1980 has nearly doubled the rate at which fighter sorties could be generated in wartime. Moreover, cannibalization—the practice of taking parts off one airplane to fix another one—has declined by almost half. Mission-capable rates are up twelve percent since the beginning of the decade. Aircrews get eleven percent more flying time than they did in 1980. The number of fighter crews participating in such major exercises as Red Flag and Cope Thunder has increased by ninety-three percent.

In addition to all of this, the Air Force is now able to do a much better job of readiness and sustainability management than previously.

New Tools

In August 1986, the method of indexing unit resources and training—previously known as UNITREP, the Unit Status and Identity Report—was revised and renamed SORTS, or the Status of Resources and Training System. Among other things, it improves on the old combat rating (C-rating) system, which did not give a complete assessment of whether or not a unit was ready to undertake its wartime mission. It counted resources but not force structure or the capacity to deploy and persist in combat. SORTS takes these factors into account. It also revises the C-rating categories, eliminating some long-familiar definitions such as "fully combat ready" and "not combat ready." *(See chart on p. 82 for new C-rating definitions.)*

Furthermore, the Air Force now measures how its capability in specific wartime tasks has changed over time. It figures, for example, that it achieved the following gains between 1980 and 1985:

- Ninety percent increase in strategic bomber capability against hardened command bunkers.
- Eighty percent increase in ICBM capability against very hard targets (*e.g.*, an SS-18 silo).
- Twenty percent increase in the capability of strategic defense interceptors against an array of targets (Soviet bombers or cruise missiles).
- Twenty-five percent increase in strategic airlift capability (in millions of ton-miles per day).
- Ten percent increase in tactical airlift capability (in tons per day).
- Sixty-five percent increase in capability of USAF fighters against the Flogger-D.
- Ninety percent increase in tactical air-to-ground capability against bridges and trucks in a European war scenario.

In the future, the Air Force will provide commanders with direct-output measures of warfighting posture. Using the Air Force Capability Assessment Program (AFCAP), unit commanders will be better able to highlight deficiencies and assess improvements.

Mission-capable rates are up twelve percent since the beginning of the decade, and part of the reason for that improvement can be found in the dedication of the maintenance troops. The Air Force claims it is better manned, trained, and equipped now than at any previous point in its history.

Prepositioning of war material is another key reason readiness is up. In fact, the current inventory would permit the Air Force to fly 100 percent of projected wartime sorties with full weapon loads. These Mk 84 practice bombs are waiting to be uploaded at Misawa AB, Japan.

AFCAP is a comprehensive system that will integrate resource levels for petroleum, oil, and lubricants (POL), munitions, and supply parts with such other factors as aircrew, aircraft, and maintenance status. A computer production model for the fighter forces will be operating this summer, and by the fall of 1990, models will be operating at MAJCOM headquarters for all mission areas.

Stopping the War-Stoppers

Munitions are a major "must." Since 1981, the Air Force has improved its situation in air-to-air munitions by 127 percent and in air-to-ground weapons by fifty-five percent. Although a declining trend in munitions funding is projected through FY '92, there will be an integrated, steady acquisition strategy to improve total combat capability. Procurement of AIM-9 and AIM-7 missiles continues while the new AMRAAM air-to-air missile is being developed.

The existing air-to-surface inventory permits the Air Force to fly 100 percent of projected wartime sorties with full weapons loads, although many missions would be flown with general-purpose munitions rather than with precision ordnance. The Air Force reports large munitions stockpiles of general-purpose bombs, cluster munitions, and older, less-capable guided weapons. Procurement is under way on a new generation of highly effective weapons, such as the AGM-130, which is a rocket-powered version of the GBU-15 (121 bombs in FY '88), the AGM-88A HARM missile (1,748 units in FY '88), and the AGM-65 IIR Maverick (2,100 missiles in FY '88).

Training with inert and combat munitions is vital to improving the readiness of both aircrews and munitions specialists. During FY '86, the training munitions funding account supported more than 1,655,000 flying hours. Aircrews use approximately 3,000 live weapons annually during Red Flag training. A Red Flag goal is to have each crew participate in a live ordnance mission. Funding for training munitions, however, will be reduced by fifteen percent in the new budget, which will make the Air Force's goal to have each air-to-air aircrew to fire a missile every three years more difficult to attain. Today, approximately seventy percent of air-to-ground tactical aircrews have live munitions experience.

The Air Force says it is improving stock levels of bulk-petroleum prepositioned as War Reserve Material (WRM). More than a thirty percent shortfall in storage capacity still exists, though, with major limitations in Europe, the Pacific, and Southwest Asia.

In the next five years, the Air Force plans to fill more than 6,000,000 barrels of on-base WRM storage capacity. Over the same period, the Defense Logistics Agency should allocate an additional

Time in the Air

Programmed flying hours per month for active-duty squadrons.

AIRCRAFT	FY '87	FY '88	FY '89
B-1	—	20.2	20.0
B-52	20.8	20.8	20.7
KC-135	17.4	17.7	17.6
FB-111	16.2	16.0	16.0
C-130	25.9	29.4	29.1
C-141	33.9	35.1	35.1
C-5	15.1	13.5	13.5
F-4	16.5	16.5	16.7
A-10	23.0	23.0	23.0
F-15	19.2	19.3	19.3
F-16	19.7	19.8	19.8
F-111	19.2	19.2	19.2

The New C-Ratings

C-1 = Unit possesses the required resources and is trained to undertake its FULL wartime mission.

C-2 = Unit possesses the resources and has accomplished the training necessary to undertake the BULK of its wartime mission.

C-3 = Unit possesses the resources and has accomplished the training necessary to undertake MAJOR portions of its wartime mission.

C-4 = Unit requires additional resources and/or training in order to undertake its wartime mission, but, if the situation dictates, it may be directed to undertake PORTIONS of its wartime mission with resources on hand.

C-5 = Unit is undergoing a service-directed resource change and is not prepared at this time to undertake its wartime mission.

6,000,000 barrels, at least, of new terminal storage to Air Force requirements. By FY '92, both programs, if executed as planned, will substantially reduce prepositioned WRM-storage shortfalls after factoring in growths in requirements.

Malpositioning is another potential war-stopper. Depending on how an armed conflict of the future developed, some portion of theater stockpiles of POL, munitions, and spare parts could be malpositioned. "The greatest problem of malpositioning involves munitions," says Lt. Gen. Leo Marquez, USAF's DCS/Logistics.

Almost half the in-theater munitions are located at central storage facilities and require intratheater airlift and ground transport to get to the point of use. Worse still, some munitions earmarked for specific theaters are stored in the US and might require a month or more to reach the battle area. To solve this problem, the Air Force is investing in programs to make better use of existing storage facilities in the European theater and is building new, more strategically positioned facilities in the Pacific.

The Air Force manages approximately 890,000 different spare parts and has substantially improved its spares support posture in the last few years. In FY '85, the budget contained almost $4 billion for spares. Lower-than-expected inflation rates, acquisition reforms, and improvements in reliability and maintainability have freed dollars for significant investments in sustainability.

Building stockpiles of war reserve consumables and spare parts is a slow and expensive process because of long procurement lead times—eighteen to thirty-six months for munitions and approximately two years for spare parts. Even so, improvements have resulted in more available airframes, a better force balance, and increased combat capability. The "Total Not Mission Capable Supply" rate—which reflects aircraft degraded for lack of spare parts—has decreased by thirty-nine percent since 1982.

As a result of better supply and maintenance, squadrons in Europe had twenty-nine more aircraft available every day in FY '86 than they did in FY '85. From FY '85 to FY '86, USAFE reduced maintenance downtime from 19.8 percent to 15.7 percent and supply downtime from nine percent to 7.5 percent. Mission-capable rates in USAFE are now at an all-time high.

Tough budgets reduced funding for spares in FY '85–86, and that will be felt in terms of sorties lost in FY '87 and FY '88. "We must work to stabilize funding," says General Marquez. "We cannot allow peaks and valleys that have historically plagued dollar investments in combat capability."

O&M Is Tight

Operations and Maintenance (O&M) funds buy key ingredients of

As a result of better supply and maintenance, squadrons in Europe had twenty-nine more aircraft available every day in FY '86 than they did in FY '85. By using USAFE's fleet of Shorts C-23A Sherpas, spare parts and engines are easily distributed on the European Distribution System (EDS), thus increasing readiness even more. The C-23As are based at Zweibrücken AB, West Germany. (USAF photo by MSgt. Patrick Nugent)

An airplane on the ground for maintenance is one that cannot carry out its mission. To help improve readiness, equipment must be relatively easy to fix and must be accessible. Here, a sergeant is working on an F-16 from the 50th TFW at Hahn AB, West Germany. (USAF photo by SSgt. Fernando Serna)

readiness and sustainability: flying hours, training, weapon system maintenance and support, upkeep of facilities and equipment, and quality-of-life programs for Air Force people. For the Air Force, O&M funding represents twenty-three percent of its FY '88 budget request, or $21.3 billion.

There is little flexibility to absorb shortfalls. Approximately eighty-five percent of the Air Force O&M budget is fixed, allocated to "must pay" bills. As Secretary of Defense Caspar Weinberger told reporters at a January press conference, "Once the force and activity levels have been set, support funding cannot be reduced without decreasing the effectiveness and readiness of those forces."

In its annual report to Congress, the Air Force says that "although the pace of [readiness and sustainability] improvement will be slowed, our FY '88 funding will enable us to increase spare part stocks and equipment inventories for our mobility and tactical forces, continue existing aircraft modifications, improve our inventory of modern munitions, and train more effectively." Decreased purchasing power in the O&M account—two percent below last year, after inflation—will worsen the backlogs in aircraft depot maintenance and facility maintenance, though.

In the new budget, depot maintenance funding drops by $168 million, which will lead to an increase of seventeen percent in the backlog. By the end of the year, that total backlog will translate into $1.1 billion worth of spare parts unavailable for force readiness. The Backlog of Maintenance and Repair (BMAR), already running more than double the congressional containment level, will increase again. The O&M share of the budget does not permit reducing the BMAR and also supporting adequately the approved force structure.

The Air Force has instituted almost 300 major initiatives to control costs and improve reliability and readiness. Among these are:

- Containerized Ammunition Distribution System (CADS). Container ships are being used increasingly, so the Air Force is developing procedures and acquiring equipment to move munitions overseas in ISO (International Standardization Organization) containers.
- The Logistics Capability Measurement System (LCMS). This system will develop, implement, and refine a family of related data bases and models providing credible estimates of warfighting capability.
- Automated Tech Order/Computer-Aided Logistics. This program will integrate Air Force efforts to achieve a predominantly automated and integrated mode of weapon system support. It will provide users with weapon system technical information that is easily accessible, relevant, timely, and usable.
- Airlift of Tactical Shelters and Air/Surface Containers. By FY '89, the services will have more than 10,000 tactical shelters supporting combat forces. The Army will also have a requirement for 150 container movements monthly to Europe. This initiative will develop systems and acquire equipment for the military airlift system to handle ISO tactical shelters and containers.

Make It Rugged

From here on, given a slowdown in funding, the Air Force must continue emphasizing modifications and other improvements contributing most to warfighting requirements. General Marquez told a group of aerospace engineers and designers that "I'm not enamored with how complex you can make it. I want it to work. I don't want it to break. And if it breaks, I want to be able to fix it fast. Make it maintainable, make it accessible, make it rugged."

The Air Force is revitalizing its ABO—Air Base Operability—program to keep bases functioning in time of conflict. USAF is asking Congress for more than $220 million in FY '88 for hardening, force dispersal, camouflage, concealment, deception, air base ground defense, rapid runway repair, and removal of unexploded ordnance.

"I see the flight line of the future as being a very Spartan affair, with handheld or highly mobile equipment that can be used quickly and efficiently on numerous weapon systems by a handful of qualified technicians," General Marquez says. ■

Maj. Michael B. Perini is now a student at the Armed Forces Staff College, Norfolk, Va. Previously Deputy Chief of the Operational Forces Branch in the Secretary of the Air Force's Office of Public Affairs, he was an Education With Industry (EWI) trainee with Air Force *Magazine during 1982–83 and continues to be a regular contributor. He joined the Air Force in 1972, commissioned through AFROTC, and has served in a variety of public affairs assignments. His degree from Washington State University is in social studies, and he has a master's from the University of Southern Mississippi.*

Here—in the opinion of a blue-ribbon panel of blue-sky people—are the top ten airplanes of all time.

The

THE *Fortune 500,* the Associated Press basketball poll, Casey Kasem's "American Top 40" radio show. America loves lists. As the previous examples indicate, people want more than the number-one answer—they usually want at least the top ten responses to whatever subject is being surveyed.

With that thought in mind, a number of aviation notables were asked to enumerate, in their opinion, the top ten aircraft of all time. The respondents could use any criteria they felt appropriate—aircraft they flew, historically significant aircraft, or aircraft they admired. Some panelists listed the aircraft in order of significance, others chronologically.

Most panelists—Paul Garber, Robin Olds, David McCampbell, Joe Foss, Haywood Hansell, Ed Heinemann, Chuck Yeager, Scott Crossfield, Steve Canyon, and John W. R. Taylor—had trouble reducing their lists to just ten airplanes. Two others, Curtis LeMay and Gunther Rall, named only the few aircraft they felt were truly significant.

With the panel representing a broad cross section of the aviation community, sixty-eight different aircraft made the final list. Fighter and attack aircraft came out on top, with thirty different types getting at least one vote each. Eleven varieties of experimental or special-duty airplanes were named, while ten sorts of transports or airliners appeared on at least one ballot. Six kinds of trainers, five types of bombers, and four aircraft that could only be classified as "other" were also named. Only two panel members picked helicopters.

There was some consensus, though, in this highly unscientific poll. Four airplanes (the Wright 1903 Flyer, the Vought F4U Corsair, the Bell X-1, and the General Dynamics F-16) each got three votes, while two types (the Douglas DC-3 and the Supermarine Spitfire) garnered four mentions. But the top airplane of all time, at least according to this panel, is the North American P-51 Mustang, named on six of the ten ballots.

Here are the panelists and their picks, which are certain to start some arguments.

Paul Garber

- 1903 Wright Flyer
- Blériot XI
- Curtiss Hydro-aeroplane
- Verville-Sperry Racer
- Junkers F-13
- Ryan NYP *Spirit of St. Louis*
- Piper J-3 Cub
- Douglas DC-3
- Sikorsky XR-4
- Bell X-1
- de Havilland Comet
- Boeing 707 Stratoliner
- North American X-15

Paul Garber, Historian Emeritus of the National Air and Space Museum in Washington, D. C., leads off because he is the oldest member and one of only two panelists who have seen the entire history of flight. Born in Atlantic City, N. J., in 1899, he was present when Orville Wright conducted tests with the Wright Military Flyer at Fort Myer, Va., in 1909.

Mr. Garber first formulated his list twenty-five years ago in response to a query by Kevin Brown, aviation editor for the Hearst newspaper chain. He assembled a group of aviation notables that included Jimmy Doolittle, Charles Lindbergh, famed designer Grover Loening, Jerome Hunsaker from the Massachusetts Institute of Technology, and John Victory, Secretary of

Paul Garber, dean of the panelists, stands in one of the restoration areas of the National Air and Space Museum's Silver Hill, Md., facility. That complex is named in his honor.

Top Ten

BY JEFFREY P. RHODES
AERONAUTICS EDITOR

An element of what this panel selected as the Top Airplane of All Time—the graceful North American P-51 Mustang—flies over Texas.

the National Advisory Committee for Aeronautics (NACA).

Starting with a field of 100 airplanes, each member of the group chose his personal list of the top ten. After several hours of spirited discussions, the list had been winnowed. General Doolittle asked how many there were then. Mr. Garber replied there were thirteen, and General Doolittle said, "That's good enough. Let's go home." The list stood at these thirteen. Eight airplanes on Mr. Garber's original list made the final cut.

Of the thirteen, seven represented "firsts." The Wright Flyer, of course, is credited with being the first heavier-than-air craft to fly under its own power. The Blériot was the first plane to be flown country-to-country across the English Channel. The Curtiss was the first to take off and land on water. The *Spirit of St. Louis* was the first plane to be flown solo and nonstop across the Atlantic Ocean. The XR-4 was the first production helicopter. The X-1 was the first plane to break the sound barrier in level flight, and the Comet was the first jet airliner.

The Racer and the X-15 were chosen because they represented outstanding technical achievements. The others were selected because of their practicality, durability, and contributions to aviation.

A graduate of the University of Maryland, Mr. Garber was the first curator of the National Air Museum. He also received a patent for controllable gunnery practice targets in World War II. He says that "this is still a darn good list." Although officially retired, he can still be found most days in his office at NASM.

Robin Olds

- Lockheed P-38 Lightning
- North American P-51 Mustang
- Republic P-47 Thunderbolt
- Supermarine Spitfire
- Focke-Wulf Fw-190D-9
- Lockheed P-80 Shooting Star
- North American F-86 Sabre
- McDonnell Douglas F-4 Phantom II
- McDonnell Douglas F-15 Eagle
- General Dynamics F-16 Fighting Falcon

Retired Brig. Gen. Robin Olds is the only ace with victories in non-

Robin Olds holds the record for longest span between aerial kills—twenty-two years. Here, then-Colonel Olds prepares to lead the 8th TFW on another mission over Vietnam.

consecutive wars. He shot down twelve Luftwaffe planes over Europe in World War II and, after missing combat action in the Korean War, added four more victories (at age forty-four) in Vietnam, more than twenty years later. An All-America tackle in football at West Point in 1942, General Olds later flew a P-80 to a second-place finish in the 1946 Thompson Trophy Race. That same year, he was a participant in the first dawn-to-dusk transcontinental flight, from March Field, Calif., to Washington D. C., and back.

General Olds, who has received many decorations, including the Air Force Cross, the Silver Star, and the Distinguished Flying Cross with five oak leaf clusters, picks the P-51 and the F-4 as his all-time favorites.

The P-51, General Olds says, "was the best ever. . . . It had range, firepower, climb rate, speed, ruggedness, maneuverability, excellent pilot visibility, ease of maintenance, and in every way was a joy to fly. . . . And it had the British K-14 gunsight—a better device than that I found in the F-4C twenty-two years later!"

Calling the F-4 "a bird for its time," he notes the Phantom II had "speed, range, power, work load . . . and was surprisingly maneuverable. [It] could (and did) outduel the MiG-21 at low altitude—used properly, [it could also] hold its own against the MiG-17. What a machine!" In 1967, when he was asked to tell about his first aerial victory in Vietnam, then-Colonel Olds is quoted as saying, "To make a wonderfully long story short, the MiG lost."

As for the F-4's modern-day counterparts, the F-15 and F-16, all General Olds could say is that "I wish I were twenty-five years old [again]. They are as far advanced, as remarkable, as joyful as the P-51 was compared to the P-12."

General Olds, who flew 105 combat missions over North Vietnam as Commander of the 8th Tactical Fighter Wing, later served as the Commandant of the US Air Force Academy in Colorado Springs, Colo. Now living in Steamboat Springs, Colo., General Olds retired in 1973, thirty years to the day after graduating from the US Military Academy. He will turn sixty-five later this year.

David McCampbell

- Consolidated NY
- Stearman NS Kaydet (a.k.a. PT-13/PT-17/PT-18)
- North American SNJ Texan (T-6)
- Beechcraft SNB (UC-45/AT-9/AT-11/F-2)
- Boeing F4B-4 (P-12)
- Grumman F3F
- Grumman F4F Wildcat
- Grumman F6F Hellcat
- Vought F4U Corsair
- Consolidated PBY Catalina (OA-10)

On October 24, 1944, then-Cmdr. David McCampbell, USN, led six other Hellcats of VF-51 from the USS *Essex* into battle against forty Japanese fighters that were escorting twenty bombers near Leyte in the Philippines. None of the enemy bombers got through that day. Commander McCampbell and his men shot down twenty-seven aircraft and tallied eight more probables. The remainder of the bogies fled. Commander McCampbell's total of nine confirmed kills set the American record for victories in a single engagement. He also had two probables in that fight, and McCampbell, later promoted to captain, was awarded the Medal of Honor for his actions.

***David McCampbell is the top Navy ace of all time and also holds the American record for most victories in a single engagement—nine. Here, then-Commander McCampbell taxis his Grumman F6F Hellcat,* Minsi III, *on the deck of the USS* Essex.**

With his total of thirty-four confirmed kills, Captain McCampbell was the leading Navy ace of World War II. His total has never been matched by any naval aviator of any country in any war. But he almost did not get the chance to fly.

He graduated from Annapolis in 1933 during the depths of the Depression. As an economy move, the lower half of his class was not commissioned. He tried to get into Army flight training, but was rejected because of bad eyesight. Recalled to active duty in 1934, then-Ensign McCampbell was rejected for Navy flight training, again because of his eyes. He later went to a civilian doctor who cleared him, the Navy retested him, and he passed. He then went on to win his gold wings. In addition to the Medal of Honor, Captain McCampbell was also awarded the Navy Cross, the Silver Star, and the Legion of Merit.

Although he praised all of the aircraft on his list, Captain McCampbell gave special accolades to the F4F and, not surprisingly, the F6F. "The Wildcat was a good workhorse—a good sturdy airplane. The Hellcat, on the other hand, was a fine aircraft. A good fighter, it did just about everything a pilot asked of it." The F6F was responsible for three-quarters of all Navy air-to-air kills in World War II.

The seventy-seven-year-old Captain McCampbell now lives in Lake Worth, Fla.

Joe Foss

- Grumman F4F Wildcat
- Vought F4U Corsair
- North American P-51 Mustang
- Lockheed F-80 Shooting Star
- Piper PA-18 Super Cub
- Aero Commander
- Douglas C-47 Skytrain
- McDonnell Douglas F-15 Eagle
- General Dynamics F-16 Fighting Falcon
- Boeing F4B-4

It can be said without fear of contradiction that Joe Foss's life has been varied. During his career, Joe Foss has been a Marine ace (in World War II), a recipient of the Medal of Honor, a colonel in the Air Force during the Korean War, Governor of South Dakota, fourteenth president of the Air Force Association, first national fund-raising chairman for Easter Seals, and commissioner of the old American Football League.

His two tours in the Pacific as executive officer of VMF-121 on Guadalcanal lasted only sixty-three days, but then-Captain Foss made the most of them. He shot down twenty-six Japanese airplanes in that span, and he was the first ace of World War II to equal Eddie Rickenbacker's World War I victory total. His remarkable flying skill and inspired leadership in defense of Guadalcanal were two factors listed in his Medal of Honor citation. He is still the second leading Marine ace of all time.

All of his aerial victories came in the Grumman Wildcat, of which he says, "It had a great combination of durability and firepower."

Two unusual airplanes made Brigadier General Foss's (he attained his star while in the Air National Guard) list—the Piper Super Cub and the Aero Commander. "The Cub has gone everyplace," noted Governor Foss. "It's very dependable, and it can land and take off like a crow on a post. I chose the Aero Commander because I think it is the easiest aircraft ever to fly on instruments." The Commander is also quite maneuverable, as anyone who has seen stunt pilot Bob Hoover do loops in one on a dead engine will attest.

Then-Marine Capt. Joe Foss pats the cowling of his Grumman F4F Wildcat, the plane he used to shoot down twenty-six Japanese aircraft in sixty-three days.

The F-15 makes his list because, as General Foss says, "I always wanted to get into a plane that could accelerate going straight up." The F4B-4 made the cut because it was the first fighter plane that then-Lieutenant Foss flew back in the 1930s.

Now living in Scottsdale, Ariz., and still quite active, General Foss turns seventy-two this month.

Haywood Hansell

- Boeing B-17 Flying Fortress
- Boeing B-29 Superfortress
- North American P-51 Mustang
- Supermarine Spitfire
- Republic P-47 Thunderbolt
- Consolidated B-24 Liberator
- Lockheed P-38 Lightning
- Martin B-10
- Curtiss P-40 Warhawk
- Curtiss P-36 Hawk

For a pilot who spent most of his career in and around bombers, retired Maj. Gen. Haywood (Possum) Hansell has a surprising number of fighters on his list. All of the planes, though, are ones General Hansell has flown and ones he admires.

He notes the B-17 for its endurance, saying, "It could take more damage and keep on flying than the others could. It was also a major factor in how we won the war in Europe."

The Spitfire, though, the most visible symbol of the Royal Air Force's struggle against the Luftwaffe in the Battle of Britain, was "the nicest flyer of the lot," General Hansell says.

Born not quite three months before the Wright brothers flew at Kitty Hawk, N. C., in 1903, General Hansell earned his bachelor's degree in mechanical engineering from Georgia Tech in 1924. He entered training as a flying cadet in 1928 and was commissioned a year later.

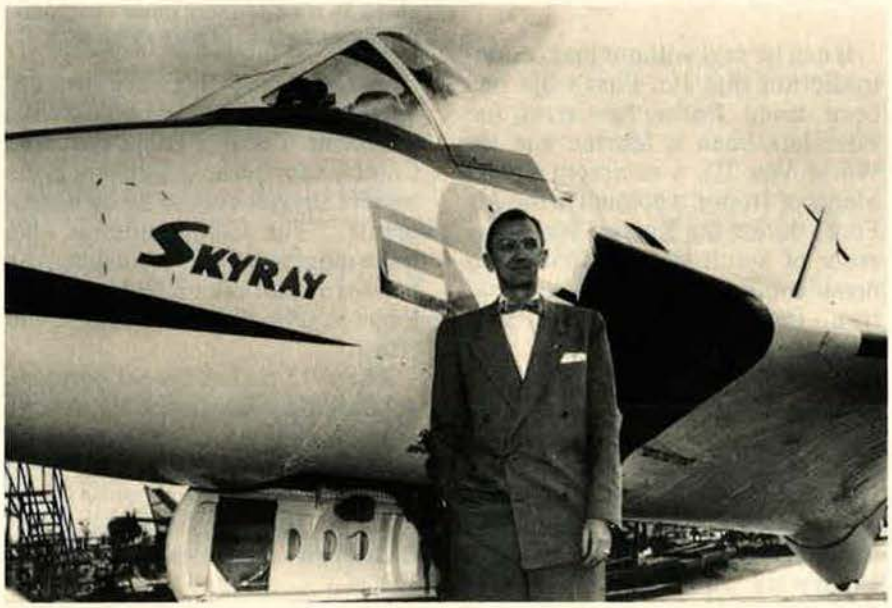
Then-Brig. Gen. Haywood (Possum) Hansell points to the target for today during a briefing of XXI Bomber Command on Saipan during World War II. General Hansell's work with the B-29 in the Marianas helped prove the Superfortress's worth.

Early in his career, he served in the Public Relations Section as assistant executive officer to the Chief of the Air Corps, but he later went on to command the 1st and 3d Bomb Wings of Eighth Air Force in England. After tours that included the positions of Deputy Commander of the Allied Expeditionary Air Forces and as Deputy Chief of Staff, he was assigned to lead the newly formed XXI Bomber Command on Saipan in the Pacific.

He flew the first B-29 to the still-unfinished Isley Field on Saipan in October of 1944, and he led the first large-scale Superfortress mission against Japan a month later. His work helped to prove the B-29's worth in combat. General Hansell, who holds the Legion of Merit and the Silver Star among his decorations, now lives in Hilton Head, S. C.

Ed Heinemann

- Douglas SBD Dauntless (A-24)
- Supermarine Spitfire
- North American P-51 Mustang
- Douglas A-20 Havoc
- Douglas A-26 Invader
- Messerschmitt Me-262
- Douglas AD Skyraider (A-1)
- Douglas F4D Skyray
- Douglas A3D Skywarrior (A-3)
- Douglas A4D Skyhawk (A-4)



"Mr. Attack Aviation"—designer Ed Heinemann—stands in front of one of his own creations, the Douglas F4D Skyray. Mr. Heinemann was awarded the Collier Trophy in 1953 for the Skyray, which set several speed records.

One of the most prolific designers in the history of aviation has been Edward H. Heinemann. Responsible for the design and development of more than twenty major airplane projects, Mr. Heinemann was a strong advocate of reducing weight and complexity, which led to very durable and quite capable airplanes.

Several of Mr. Heinemann's designs had long production lines or served for much longer than was expected. The A-4, for example,

was in continuous production for twenty-five years, and a large number of "Heinemann's Hot Rods" are still flying. The A-26 fought in three wars (World War II, Korea, and Vietnam), and several variants of the A-3 (on which the Air Force's B-66 was based) are still soldiering on twenty-five years after the type's first flight. Almost 18,000 copies of his designs were built over the years.

Mr. Heinemann concluded his formal education at age seventeen, but he obtained his engineering knowledge through independent study and practical experience. He learned to fly in 1926 and continued to verify his designs personally until well into the Dauntless's test program in the 1930s.

He began his career as a fire engine body designer and then joined Douglas Aircraft as a draftsman in 1926. After several jobs with other aviation firms, he returned to Douglas in 1932.

During the next twenty-two years, he worked his way up to the position of Chief Designer and earned the title of "Mr. Attack Aviation." When he first started at Douglas, his drafting table sat in a thirty-foot-by-fifty-foot room. The design section had 150 people working in it by 1936, but when Mr. Heinemann left to become a Douglas vice president in 1958, there were more than 1,200 engineers working for him.

A holder of sixteen patents, Mr. Heinemann was also instrumental in the development of such aviation equipment as ejection seats, cartridge injector-type bomb racks, low-drag streamlined bombs, flight data computers, and atomic bomb cases.

Mr. Heinemann, who was awarded the 1953 Collier Trophy for his work with the record-setting F4D Skyray, chose most of his top ten on the basis of technical merit. "The German design team did a whale of a job with the Me-262, [the world's first production jet fighter], considering all the constraints they were under." He also said that the Spitfire was truly "a remarkable airplane. Just a great piece of engineering."

Mr. Heinemann, seventy-nine, lives in Southern California. He left Douglas in 1960 and retired as a corporate vice president of General Dynamics in 1973.

Chuck Yeager

- Ryan PT-22 Recruit
- North American P-51 Mustang
- Bell P-59 Airacomet
- Bell X-1
- North American F-86 Sabre
- North American F-100 Super Sabre
- Northrop T-38 Talon
- Lockheed SR-71
- General Dynamics F-16 Fighting Falcon
- Northrop F-20 Tigershark

Still "pushing the outside of the envelope," as he did on October 14, 1947, when he broke the sound barrier, Chuck Yeager now flies high-performance airplanes as a consultant.

It's not often that a pilot makes the most significant flight of his career with broken ribs, but that's exactly what happened to then-Capt. Chuck Yeager on October 14, 1947. That's the day he flew the Bell X-1 to 670 mph in level flight to become the first pilot to break the sound barrier. He later became the first person to exceed Mach 2.5 in the Bell X-1A.

While his speed dashes won him the prestigious Collier, McKay, and Harmon Trophies, Yeager, who retired as a brigadier general in 1975, also gained fame as a fighter ace in World War II and as a "regular" test pilot. In addition to the new P-80s and P-84s, he flew captured German airplanes after the war at Wright Field in Dayton, Ohio, and he also wrung out a MiG-15 over Okinawa after a North Korean pilot, Kim Suk Ho, defected to the South during the Korean War.

But far from being just a test pilot, General Yeager also commanded several tactical fighter wings, was our Defense Attaché to Pakistan, served as vice commander of Seventh Air Force, and directed the Air Force Inspection and Safety Center at Norton AFB, Calif., among other duties, during his thirty-four-year career. Included among his military decorations are the Silver Star and Legion of Merit.

General Yeager, who has flown more than 178 types of aircraft during his career, is one of the few panelists to highlight trainers—the aircraft where all pilots start—in his list. "The PT-22 gave many pilots their first taste of an airplane, whereas the T-38 is the modern PT-22. It's been training modern pilots for so long." The T-38 has indeed been Air Training Command's workhorse. It is in its twenty-sixth year of helping pilots earn their wings.

He cites the SR-71, the F-16, and the F-20 as being among the best uses of technology to achieve a goal. "The SR-71 is truly a marvel. It took technology and set new standards. The F-16 is notable because it is the first fly-by-wire [no mechanical linkages to the control surfaces] airplane, and the F-20 integrated modern technology into the cockpit."

General Yeager, sixty-four, now lives in California and is a consultant to Northrop.

Scott Crossfield

- 1903 Wright Flyer
- Ryan NYP *Spirit of St. Louis*
- Douglas World Cruiser
- Douglas DC-3
- Messerschmitt Bf-109
- Supermarine Spitfire
- Bell XS-1
- Douglas D-558-II Skyrocket
- Boeing 707 Stratoliner
- North American X-15

A man whose middle name should probably begin with "X" rather than "S" is A. Scott Crossfield. A test pilot *extraordinaire,* Mr. Crossfield participated in the X-1, X-2, X-3, X-4, X-5, XF-92, X-15, and D-558 experimental programs during his career as a test pilot for NACA and North American Aviation. He was the first man to reach Mach 2 (in the D-558-II) and the first to pass Mach 3 (in the X-15) and survive. (Mel Apt was the first to pass Mach 3, but he was killed after his X-2 went out of control and crashed.)

An aeronautical engineer by training and trade (bachelor's and master's degrees from the University of Washington), Mr. Crossfield is another pilot on this panel who almost didn't get off the ground. He developed a heart condition after a childhood bout with pneumonia, but overcame his handicap and soloed in 1938. He entered the Naval Reserve and was a World War II fighter pilot and gunnery instructor.

A Fellow of the American Institute of Aeronautics and Astronautics and a cofounder of the Society of Experimental Test Pilots (SETP), Mr. Crossfield looked beyond the obvious reasons when he made some of his picks. "The Douglas World Cruiser was not just the first to circle the globe. It created the 'strategic' world—no country was now immune to being reached by air." He called the XS-1 (later known as the X-1) a tool "for breaking a mental barrier," not just a technological one. He cited the 707 for "giving us mass freedom of mobility."

The X-15, Mr. Crossfield noted, "put us on the way to the stars." Indeed it did, as the X-15 was the first airplane to go Mach 4, 5, and 6, and a number of X-15 pilots exceeded fifty miles in altitude to qualify for astronaut wings. Although it's not on his final list of ten, Mr. Crossfield was the only panelist to mention the Rutan *Voyager* in conversations.

A past winner of both the Collier Trophy and SETP's Iven C. Kincheloe Award, Mr. Crossfield, sixty-five, is now a technical consultant to the House of Representatives Committee on Science and Technology in Washington, D. C. His record of 130 flights in rocket planes still stands.

Scott Crossfield earned the title of "Fastest Man Alive" several times, as he was the first pilot to exceed Mach 2 and first to pass Mach 3 and survive. He and the plane in this picture are both in Washington, D. C., as Mr. Crossfield is a consultant to Congress, and the North American X-15 is in the National Air and Space Museum.

Steve Canyon

- Curtiss JN-4 Jenny
- Stearman PT-17 Kaydet
- Douglas DC-3/C-47 Skytrain
- Douglas C-54 Skymaster
- Douglas DC-2½
- Curtiss P-40 Warhawk
- North American P-51 Mustang
- Boeing B-17 Flying Fortress
- Boeing B-29 Superfortress
- Vought F4U Corsair

Mr. Air Force himself, Col. Steve Canyon, whose exploits were chronicled on both the comics pages of the newspaper and in a 1958–59 television series, was off on a secret mission to some remote corner of the world when AIR FORCE Magazine first contacted his office to solicit his views. Colonel Canyon relayed his picks via a special radio link to his good friend Milton Caniff, who in turn passed the Colonel's choices on to the magazine.

Assigned to Air Transport Command during World War II, the courageous, intelligent, and dashing Colonel Canyon (official service number AO 041 044) first came to the public's attention in 1947. That's when Mr. Caniff stopped relating the tales of Terry Lee, Flip Corkin, and others and started following the career of then-Mr. Canyon, who was running Horizons Unlimited, a shoestring air taxi operation.

"Colonel Canyon spent most of his flying time, especially in the early days, in the left seat of a Gooney Bird [C-47], so naturally it's on his list," noted Mr. Caniff. "And Steve thinks the C-54 was probably the best-handling large transport aircraft." Colonel Canyon saw the DC-2½, a jury-rigged affair that had one wing off a DC-2 and one wing from a DC-3, while on a trip to China. "He thought they did a remarkable job with it," said Mr. Caniff. The B-17 was placed on the list because Colonel Canyon felt it "was practically the whole Air Force [in World War II]."

Mr. Caniff is quite a story in him-

If there's one individual who personifies the United States Air Force, it's Col. Stevenson Canyon—pilot,* bon vivant, *and media star.

self. A 1930 graduate of Ohio State, he helped pay his way through college by drawing cartoons at $17 per week for the Columbus *Dispatch*. Asked by the War Department to draw a weekly cartoon feature for camp newspapers, Mr. Caniff was later given an Award of Merit for "Male Call," the strip in which Miss Lace was introduced. A past president of the National Cartoonists Society, Mr. Caniff once had one of his "Terry and the Pirates" strips read into the *Congressional Record*.

Mr. Caniff, eighty, is still drawing in his studio in New York. Colonel Canyon, ageless, was given the ultimate honor a number of years ago when a large granite statue of him was erected in Idaho Springs, Colo., and the adjoining valley was renamed, naturally enough, "Steve Canyon."

John W. R. Taylor

- 1903 Wright Flyer
- Blériot XI
- Boeing 247
- Hawker Hurricane
- Vought-Sikorsky VS-300
- Heinkel He-178
- Hawker P.1127
- Boeing 747
- British Aerospace/Aérospatiale Concorde
- Rockwell Space Shuttle Orbiter

John W. R. Taylor is the world's most consulted authority on airplanes—although not always in person. His books are regarded by the aviation world as the definitive sources of information. As Editor in Chief of the highly respected *Jane's All the World's Aircraft* since 1959, Mr. Taylor elevates the word "credibility" to a new level. He is also the only member of the panel who has never learned to pilot an airplane.

John W. R. Taylor, Editor in Chief of* Jane's All the World's Aircraft, *and his true number one of all time, wife Doris, celebrate a recent wedding anniversary.

A one-time designer and technical writer with Hawker Aircraft Ltd., Mr. Taylor worked with the legendary designer Sydney Camm. Only the fourth editor in the seventy-eight-year history of *Jane's*, Mr. Taylor has written more than 200 books and thousands of aviation articles during his career. He has been a Contributing Editor of AIR FORCE Magazine for many years.

His choices for the top ten, like Mr. Garber's, concentrate on "firsts." The Boeing 247 was the first all-metal monoplane airliner and also the first passenger plane to have retractable landing gear. Thirty-five years later, the 747 "was the first real skyliner, and it made mass transit possible," Mr. Taylor noted. The other airliner on this list, the Concorde, represents "a new generation of air travel. It is also the first airplane to spend most of its life over the speed of sound."

The Hawker P.1127 was the first V/STOL (vertical or short takeoff and landing) combat aircraft. "It started what should be the future of all combat aircraft," said Mr. Taylor. The VS-300 was Igor Sikorsky's first practical helicopter, and in 1939, the He-178 was the first jet-powered aircraft to fly.

Mr. Taylor was the only panelist to include the Space Shuttle Orbiter on his list. "It is pioneering flight into space," he said. One aircraft that was not a "first" was the Hawker Hurricane. Even though the Spitfire got the lion's share of publicity, "the Hurricane won the Battle of Britain," said Mr. Taylor. "It destroyed more planes than all other defenses, on the ground and in the air, added together. It gave the world time to win World War II."

A Fellow of the Royal Aeronautical Society, the Royal Historical Society, and the Society of Licensed Aircraft Engineers and Technologists, Mr. Taylor, now sixty-four, edits the yearly editions of *Jane's* out of his home in Surbiton, near London.

Gen. Curtis LeMay, the guiding force behind the development of Strategic Air Command and former Chief of Staff of the Air Force, named the six aircraft that he felt were truly the best of the best. The General, who now lives in Newport Beach, Calif., chose the B-17, the P-51 (yet another vote for the Mustang), the DC-3, the B-29, the SR-71, and the B-52 as his top airplanes.

German **Gen. Gunther Rall,** who is credited with 275 victories during World War II, picked the two airplanes he had the most experience with—the Messerschmitt Bf-109 and the Lockheed F-104 Starfighter.

By its very nature, the business of flying does not lend itself to any true consensus on the top ten (or twenty) airplanes of all time. But then again, that's part of the wonder of flight. ■

The tarpaper shacks are gone, and so is a bit of the raw drama of the early days. But test pilots still probe the future here, and flight-test activity has increased in recent years.

Airing It Out at Edwards

BY GEN. T. R. MILTON, USAF (RET.)

EDWARDS AFB, Calif., named for a popular young test pilot who was killed in 1948 in a YB-49 Flying Wing crash, sits on the edge of the world's largest dry lake. Covered with a few inches of water during seasonal rains, the lake served as Cecil B. De Mille's Red Sea in the film epic *The Ten Commandments*. The surface is impervious to water, and what little accumulates simply sloshes back and forth as a resurfacing agent.

In the old days, we knew the place as Muroc, the backward spelling of Corum, the name of a family who pioneered the area. One of the ways the Army Air Forces made its men eager to get to combat in the early 1940s was a few days' deployment at Muroc. There, between sorties against the 650-foot wooden model of a Japanese heavy cruiser, affectionately called the *Muroc Maru,* airmen huddled in tar-paper shacks and counted the days. The cruiser's outline, incidentally, is still visible on the desert sand.

Recently, the experimental aircraft *Voyager* focused a bit of lighthearted attention on Edwards when it wobbled home after its nine-day trip around the world. The idea of a man and a woman flying 25,000 nonstop miles in that flimsy-looking contraption aroused the sort of interest and excitement not seen since Lindbergh's day, proving that the American public is a long way from being jaded.

Then and Now

This giant natural airfield and bombing range was first exploited in the early 1930s by Lt. Col. H. H. "Hap"

Edwards AFB, old and new. The Grumman X-29 (top) represents the state of the art in technology and also in the testing of that technology. The Air Force Flight Test Center is a far cry from the tent city training area (lower photo) set up on Rogers Dry Lake early in World War II. During this gas-mask drill, Northrop A-17s pass low overhead.

—Photo by Erik Simonsen

Arnold when he commanded March Field. It was not until after World War II, however, that Muroc began to take on new importance as a test site, thanks largely to the vision of Brig. Gen. Albert Boyd. The area was still primitive, but the dry lake was perfect for testing the new jets.

"Pancho" Barnes, an earthy and colorful woman who lived nearby, provided a substitute Officers' Club and VOQ. An accomplished pilot herself, she made her home the unofficial desert headquarters for Edwards's aviators and shortly became part of test-pilot legend. It was during Pancho's time that the celebrated exploits of Chuck Yeager, Pete Everest, Jack Ridley, Scott Crossfield, and others took place, and pictures of the ramshackle Barnes establishment figure prominently in the history of those days.

In the end, the Air Force made an enemy of Pancho Barnes by condemning her property in the interest of expanding the test center's real estate. That expansion, like the exploitation of the area itself, was a farsighted move. For some reason, an airfield seems to attract real-estate developers who, left to their own inclinations, will quickly surround it and then bedevil it with complaints about noise. Even a base plunked down in a desert wilderness will soon find itself encroached upon unless it takes early protective steps. The 306,000 acres that constitute the Air Force Flight Test Center at Edwards AFB provide a comfortable enclave for the work going on there today.

The tar-paper shacks are long gone, replaced by attractive and functional cinder-block buildings. With family quarters, a golf course, bowling alleys, and other amenities, the base has an air of permanence and self-sufficiency. The developers, of course, are approaching Edwards, but the 306,000 acres do keep them at a distance.

With missiles and space commanding so much attention, it is something of a surprise to learn that flight testing has had a substantial increase in activity these past few years. In 1980, there were 1,800 test hours flown; this past year, 5,600 flying hours were devoted to experimental testing. The Strategic Defense Initiative and various missile programs notwithstanding, the manned airplane is plainly here to stay.

NASA Programs

Unlike the glamorous times of the 1950s when records were being set in new and experimental airplanes, most of the current programs at Edwards involve new systems on airplanes that, if not exactly old, are well settled in the inventory. An exception is the X-29, the Grumman aircraft on which the wings appear to be backward. The X-29 is a joint NASA/Air Force project funded by the Defense Advanced Research Projects Agency, and it is a purely experimental machine. Nevertheless, the X-29 has proved to have surprisingly good flight characteristics, thanks to digital fly-by-wire flight controls. Without that modern increment, the X-29 would be unflyable, ten times more unstable than a fully loaded F-16. As it is, this strange bird can pull 6.4 Gs and perform acceptably throughout the fighter envelope. NASA maintains the Dryden Flight Test Center at Edwards where the X-29 is hangared. While this odd-looking airplane is not intended for production, it is a learning device for technologies that doubtless will turn up in the Advanced Tactical Fighter.

Another project in the NASA hangar is the Advanced Fighter Technology Integration effort (AFTI)—again a joint NASA/Air Force project, with additional participation by the US Army. This is a fascinating excursion into the future, using an F-16A as the test-bed. A forward-looking infrared device ties in with the flight

Flight test is the name of the game at Edwards. New technologies are tried out, and production aircraft, such as these prototype F-15s, are put through every kind of test imaginable, including a full spin-test regime. While new speed or altitude records are not being set seemingly every week as they once were, there is still much activity going on at Edwards.

—Photo by Erik Simonser

—Photo by Erik Simonsen

With each new generation of aircraft to be tried out at Edwards comes a new generation of aircraft to fly chase. Here, an F-4E taxis out to follow some other airplane as it flies its appointed rounds.

controls to provide automatic maneuvering during approach to target. The pilot gives a voice command for weapon selection as casually as ordering a beer. The computer then readies the weapon and changes the instructions for the automated flight controls. If the pilot should lose consciousness, the computer orders a pull-up and talks to him until he comes to. Where it all ends is anyone's guess, but AFTI is no pipe dream. The test is nearing first-phase conclusion.

There is also in the NASA hangar an F-111 with a new wing, one with variable camber. Camber is the curve of an airfoil section from the leading edge to the trailing edge. Unlike the X-29, which changes camber with external devices, this Boeing wing is smooth and changes camber internally, an exploitation of exotic new materials now available to aircraft design engineers. A wing capable of changing camber automatically for any maneuver results, of course, in the optimum wing for any mission. It is reasonable to expect this sort of wing in the next generation of fighters.

Air Force Projects

NASA's end of the flight line is home to these exotic aerodynamic programs. Meanwhile, under the watchful eye of Col. Roy Bridges, an astronaut Shuttle pilot returned to military duties, the rest of the long flight line is busy with various Air Force flight-test projects.

The F-16 is becoming the Air Force tactical workhorse—an ironic turn of events when we remember the early opposition to this airplane, which was originally viewed as a lightweight fighter for other air forces, not ours. In any case, the F-16 has long since subdued the opposition and is now going through an inevitable growth process. As it becomes heavier, the F-16 loses a little of its early agility, but its capabilities are steadily increasing.

The most impressive new addition to these capabilities is LANTIRN—Low-Altitude Navigation and Targeting Infrared for Night—which will allow fighter pilots to attack targets with precision at night and below the weather. The system is housed in two pods electronically linked to the aircraft's flight- and fire-control systems. It sounds scary to a pilot from an earlier generation, but the test pilots say it works fine. In fact, to make certain the system wasn't for experienced hands only, two second lieutenants from operational F-16 squadrons were brought in as part of the test. One had 300 hours in the F-16, and the other had about fifty. Neither, according to the test director, had difficulty catching on to LANTIRN operation.

The Air Force plans to buy 350 pods for the F-16C and enough for all F-15Es. This latter airplane, with a weapon system operator in the back seat, will doubtless be a more effective user of LANTIRN. Under some weather and combat conditions, the pilot work load in the F-16C could be a very heavy one.

The F-15, meanwhile, is also spreading out over the mission spectrum. In its E version, the F-15 will have LANTIRN, conformal tanks, and—naturally—more weight and drag. It will also have an impressive ability to hit targets around the clock at extreme range while retaining the ability to defend itself in air combat. The weapons programmed for the F-15E are all launch-and-forget, and the fire-control system allows for ready handoffs between pilot and his weapon system operator.

The F-15 joint test force is also trying out a new life-support system designed to offset the alarming trait of modern fighters to overstress pilots into fatal blackouts. Forced breathing, a chest squeezer, and a helmet bladder are added to the G-suit in this design—not exactly leisure wear, but if it keeps a pilot conscious in high Gs, what matters a little discomfort?

There are other tests going on with the F-15, an airplane now approaching middle age but still improving, most certainly, in the area of engine reliability because of new digital fuel controls. If certain congressmen can be persuaded of the error of their position, F-15 crews would like to resume antisatellite testing. The weapon used for this mission is a simple one, and the actual warhead, a cylinder eighteen inches in diameter, is inert, but smart. It homes on its target by infrared, once it is placed in the general area. The actual F-15 maneuver to fire the missile is a simple zoom at about 39,000 feet, although the timing and release point have to be extremely precise. In other words, any F-15 pilot can do it if there are some able computer types on hand to set things up.

The B-1B Effort

The most-watched program on the line, however, is the B-1B Joint Test Force. Like all Air Force test programs at Edwards, this one involves the contractors and the Air Force working side by side. Because the B-1B is in a certain amount of trouble and has more than its share of opponents, these troubles have been highlighted in the press. Unfortunately, whether by design or through ignorance, some of the allegations about the airplane have been either blown out of proportion or are irrelevant.

The fuel leaks have been a problem, at first a serious one. With wet wings a design imperative in order to achieve the range and payload specifications, fuel had to

be put in almost every conceivable hollow place. Sealing thus became a precise and difficult job, and the first airplanes proved that the Rockwell people had a lot to learn. They are learning, and there is confidence that the problem as a major deficiency is fast disappearing.

There are other difficulties, however, that are more serious. One is the potential of the airplane to pitch up—"depart" is the descriptive term we use these days—under certain aft-center-of-gravity conditions. Correcting this would be easy if the B-1B had fly-by-wire digital flight controls, but its controls were designed sixteen years ago and, therefore, are mechanically linked. Besides, every angle of sweep as the wing changes back and forth creates a different airplane. The fix on this, a stall inhibitor, is in sight and should eliminate pitch-up as a worry.

While they are working this on the B-1B, it seems unaccountable that there should be no provision for a head-up display. Anything flying that fast and that low should give the pilot an easier scan.

The electronic-countermeasures system is a disappointment and one that urgently needs correction. Once again, the estimate is two years to get the ECM in order. At the same time, the B-1B needs a reliable tail-warning apparatus. Since the latter is really nothing more than an elaborate fuzzbuster, it ought to come along in due course.

In short, there are problems with this big bird, but in the opinion of the Air Force test pilots and engineers, they are outweighed by its capabilities.

They emphasize that the B-1B is a low-altitude, long-range bomber, a fact that is often ignored by its critics. At low altitude, the terrain-avoidance radar works very well, and the ride along the treetops is a delight compared to similar missions in the B-52. What is more, the B-1B cruises at Mach 0.85—about 560 knots—on the deck, making it a very difficult target for an interceptor. Because it was designed for just that mission, low altitude, it does not perform impressively above 25,000 feet. Anyone criticizing it on that basis is taking a shot in the wrong direction.

From the original B-1A, the airplane has grown by about 80,000 pounds at maximum gross weight with the same engines, so there has naturally been some performance degradation, but for its primary job—to go in fast and low—it is still what the Air Force wanted. The problems have been disappointments, although not unexpected ones, and the fixes appear within early realization. In what amounts to a minor miracle, the airplane is coming into SAC at programmed cost.

This is just a sampling of what is going on at this test center in the desert. Edwards is basically military, but only basically, for aircraft industry people and civil servants make up at least half the population. Indignant proponents of the wrong-headed theory that the military-industrial complex is at the root of all evil would have a field day at Edwards. The military-industrial complex is hard at work there, hand in hand—if, in the opinion of some contractors, a trifle too closely linked at times. There are those in the aircraft industry who would like a return to the old days when the contractors did the early testing on their own. Nowadays, both the Air Force and the contractors are on the same learning curve.

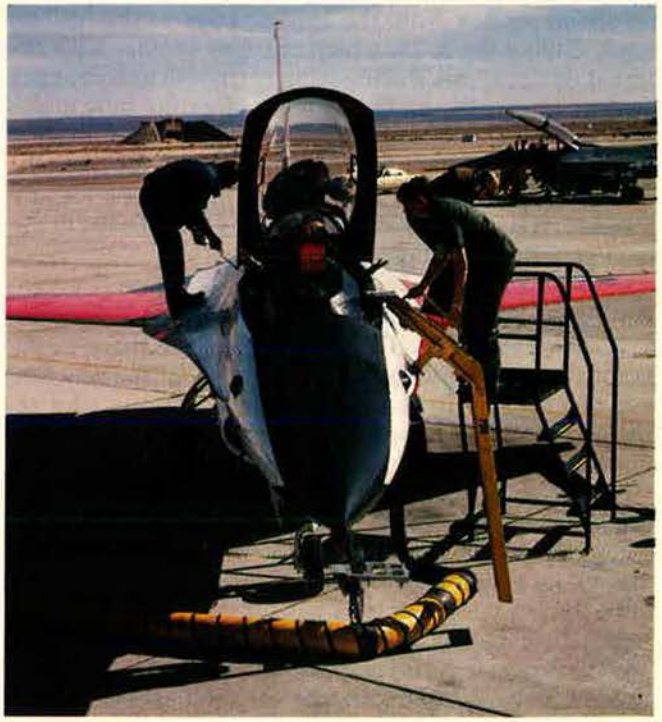
Test Pilot School

If the military is to participate so completely in all phases of experimental testing, the Air Force must have test pilots, flight-test engineers, and flight-test navigators with the right credentials. The USAF Test Pilot School exists for just that purpose. The entrance requirements, while stiff enough to rule out most people, serve only as a preliminary screening device. Each year, a board then selects twenty-five, of whom fifteen are pilots, eight are engineers, and two are navigators. Twenty of these are from USAF, one from the US Navy, and the remaining four from friendly countries. The course runs eleven months and turns out the kind of people presently carrying on the test work at Edwards. They are also the kind of people the aircraft industry would like to have, but the Air Force has inserted the usual hook: Air Force graduates have a four-year active-duty commitment. Not that there has been any indication of a rush to the exit, but the commitment is there in case.

The foreign students are selected by their own countries and have performed well in the school, even though they sometimes lack certain academic requirements. In fact, the overall failure rate is minimal, a reflection of the rigid screening that includes, for pilots, a flight check.

The academic portion of the course extends over ten weeks. As an ominous warning that this is a serious school, it begins with examinations in physics, thermodynamics, mechanics, and calculus. Pilots and engineers go through this phase together, studying such subjects as supersonic aerodynamics, energy concepts, and—inevitably—report writing.

The flying phase takes the pilots through a variety of airplanes, from the T-38 to the KC-135. Bomber pilots fly the F-4, and fighter pilots try their hand at the KC-135. Before they complete the course, all pilots will



—Photo by Erik Simonsen

Testing doesn't necessarily stop once an airplane type is in the inventory. Here, one of the first F-16s built goes through a preflight exam before taking on some new tasking.

—Photo by Erik Simonsen

Test pilots have to be ready to fly almost anything that's given to them. Consequently, there are a number of different types of aircraft to practice on. Getting ready to tackle this day's assignments are pilots in an F-4E (far left), an RF-4E (right), an F-15 (near background), and an F-111 (far background). The ramp at Edwards is frequently congested.

have flown in as many as sixteen different types of aircraft. The school turns out test pilots without reference to whether they are fighter test pilots or the multiengine variety. The navigator engineer students are expected to perform in anything with an extra seat.

If the Air Force goes to a two-track pilot-training concept, there will have to be some adjustments in the test pilot school philosophy of treating all pilots equally, or so it would seem.

In a way, this school, more than anything else, is the essence of the Flight Test Center. Its graduates permeate the organization at Edwards, from the Commander, Maj. Gen. William T. Twinting, down to the captain heading out to an F-16 with the breezy remark that "someone has to do it." Whatever its wild-blue-yonder aspects may have been in days gone by, testing is now a precise and careful, step-by-step business. Testing is expensive, and the money to wring out new systems is perennially tight. Besides, there is the cost of the airplanes themselves. From the $243 million B-1B on down, these airplanes are almost literally worth their weight in gold.

Crucial Work

Some of them, such as the F-15 and F-16, will be around for years to come in the testing business, for systems have become perhaps more important than the airplanes themselves. It is a long reach, for instance, from a bare F-16A, the kind the Thunderbirds fly, to an F-16C equipped with LANTIRN and flight controls tailored to various missions. A new $30 million facility, the Ridley Test Center, named for Lt. Col. Jack Ridley, a gifted test engineer who was killed in 1957 in a C-47 crash in Japan, will provide computer telemetry direct from aircraft to the computer mission control and so allow more to be done with fewer people. The test pilot, however, remains the key factor.

Superior systems, then, coupled with superior munitions, are going to be a decisive factor in any future war. It was acceptable, if not exactly popular with aircrews, to take heavy aircraft losses in World War II. Airplanes were relatively cheap, and the production lines back home could turn them out almost like automobiles. Even crew training was, by present standards, simple and inexpensive. There wasn't all that much to learn.

It is a statement of the obvious to say we cannot ever again fight an air war of attrition. The systems being tested at Edwards are aimed at lowering the rate of loss. High accuracy means fewer airplanes have to go, and launch-and-leave munitions cut down on target exposure. Night attack, with LANTIRN lighting the way, should become less hazardous than daylight sorties and equally accurate. Life-support systems under test will keep pilots conscious and functioning under maximum stress.

There are no dramatic exploits on the test horizon to match such flights as Iven Kincheloe's soaring to 126,000 feet in the X-2, the X-15's explorations of the outer atmosphere, and Chuck Yeager's breaking of the sound barrier. Those were dangerous and pioneering times at Edwards, and they made possible what is going on today.

And so, although there may not be any headlines coming out of the Flight Test Center's daily grind in the next few years, the work the test pilots and engineers are doing is crucial to our future status as an air power. ■

Gen. T. R. Milton, USAF (Ret.), is a longtime Contributing Editor to this magazine. Regular readers look forward to his monthly column, "Viewpoint." His forty-year military career included combat service with Eighth Air Force in World War II, participation in the Berlin Airlift, command of Thirteenth Air Force in the Philippines, service as Air Force Inspector General and USAF Comptroller, and duty as US Representative to the NATO Military Committee. He retired from active duty in 1974 and makes his home in Colorado Springs, Colo.

The Military Personnel Center must manage around the shortages, overages, peaks, and valleys and chart long-term career development for 90,000 line officers.

The Uncertain Art of Career Management

BY BRUCE CALLANDER

THEIR contract required the Wright brothers to deliver one flying machine and teach two officers to fly it. In late 1909, Wilbur Wright began to train Lts. Frank P. Lahm and Frederic E. Humphreys at College Park, Md. Both soloed on October 26. After less than three weeks of training, however, both officers were returned to ground jobs under an Army rule limiting the amount of time an officer could be away from his primary duties.

Fortunately for the future of military aviation, the Wrights threw in a couple of flying lessons for a third officer, Lt. Benjamin D. Foulois. Although he had yet to solo, the Army gave Foulois its only airplane and sent him to Texas with orders to see what use he could make of the machine. Foulois, in effect, became the Army's first career rated officer. By 1931, he was a major general and chief of the Army Air Corps.

In retrospect, the Army may have seemed shortsighted in pulling Lahm and Humphreys out of the cockpit immediately after undergraduate pilot training. Such a move today would doubtless earn the Air Force a congressional inquiry. At the time, however, the action made sense. The Army had paid the Wrights $30,000 for an aircraft and training for two officers. But it had already made a substantial investment in preparing Lahm and Humphreys for their primary duties. It would have been wasteful to let them dabble any longer in the still-unproven field of aviation.

Almost eighty years later, in fact, the Air Force applies much the same rule in reverse. Having invested a small fortune in each of its pilots, it jealously guards the resource.

Under today's Officer Career Development Program, pilots and navigators can both expect to spend at least their first six years of service in the cockpit. Sometime thereafter, they may "broaden" briefly in other assignments, attend professional military schools, and hone their skills in staff and command duties. But, once rated, they are considered forever rated, and few can expect to stray far from the primary mission of flying.

Nonrated officers also are "careered" so far as possible in their original specialties. They are reassigned when the needs of the service dictate and allowed to broaden in other duties when it is appropriate to their development, but most will be held closely to the career patterns drawn for their specialties. For both rated and nonrated officers, USAF's stated primary purpose of career management is to "prepare an officer to assume additional responsibilities within the defense establishment." The secondary purpose is to prepare the officer for advancement.

The concept is probably as old as that of an organized military establishment. Only recently, however, has the need for management become so critical and the process so refined. Since the turn of the century, technology has increased the number and variety of military specialties, many of them associated with aviation. Training costs have risen sharply, and the need to manage skilled resources has grown accordingly. Yet only within the last decade or two has the service had the means to create a formal career-development program.

In the beginning, of course, the Army considered flying no more than an interesting sideline for officers. There were no career aviators, much less any ground officers specifically trained to support them.

A small cadre of officers emerged from World War I with a vision of airpower as a major element of warfare, but the Army didn't share it, and only a relative handful of officers managed to carve out careers in flying alone.

World War II proved the worth of airpower and paved the way for the independent Air Force, but it did not give the new service a ready-to-wear career force.

Raw Materials

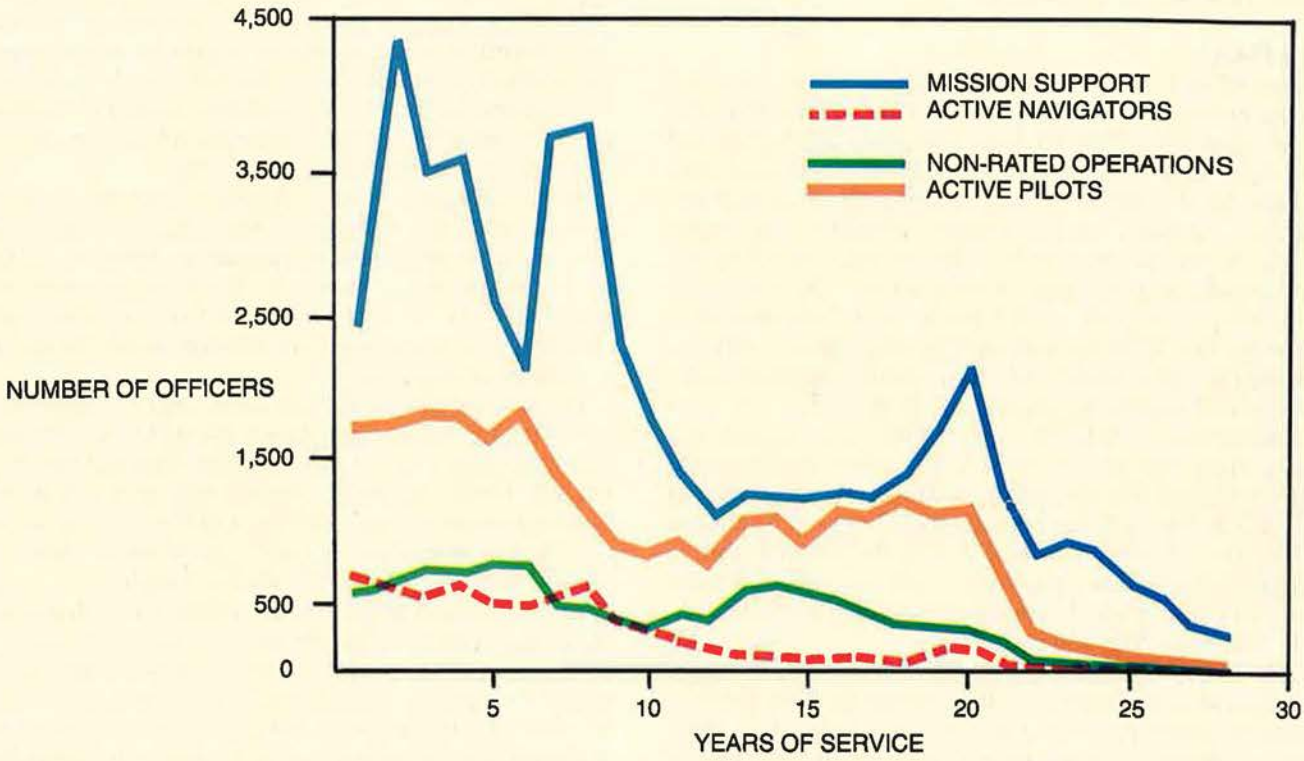
In the explosive growth of mobilization, the aircraft inventory had doubled several times over. Flyers had been recruited out of high school, promoted rapidly, and, in some cases, rocketed into leadership positions that would have taken them a full career to reach in normal times. Support forces had been built to match. Once the war was over, most of the aircraft had been scrapped, and most of the wartime troops had been sent home.

Those who stayed became charter members of a new and exciting enterprise, but its organization was all too familiar to any who remembered the Army years. Like the Army Air Forces, the new USAF was a collection of squadrons, groups, wings, and numbered air forces. "Unit manning" was the prime management concept. "Unit vacancy" was the key to promotion and, to a large extent, to career advancement.

Some critics of today's centralized force lament the passing of those largely self-contained units and their sense of close camaraderie. If the old system fostered unit spirit, however, it could be stifling to those trapped in the wrong place at the wrong time. More to the point, it could be wasteful of those increasingly expensive human resources. The Air Force was again recruiting college graduates for its officer corps. The cost of flight

Who's On Board

Number of Officers by year group



training was climbing. Nonrated specialties were becoming not only more numerous but also more demanding. The Air Force, which had depended on the Army for support officers for most of its first forty years, now had to grow its own.

As the new Air Force doubled its size and began to chart a new course for itself, it was clear that it needed a better way to keep track of individuals, see that their skills were developed, and make sure that they were not lost in the shuffle. Ideally, such a system should bring in the right number of new officers with the right mixture of skills, guide them through a series of assignments that would increase their specialized talents and leadership abilities, and lead them, in time, to the upper positions of responsibility in their career fields and in the force.

Laying out career courses for each field was relatively simple. The Air Force had inherited a rudimentary career field system from the Army. With a few refinements, it would serve the new force. Not so simple was the process of making a theoretical system work in the real world. Career patterns were all well and good in a force that stayed the same size, kept the same weapons, did the same job, and always had the right numbers and types of people at its disposal whenever it needed them.

But what if budget cuts shrank the force or an emergency required a sudden expansion? What if weapons changed, as they did with the advent of jets and missiles? What if USAF took on new missions? What if the right kinds of people were not available in the needed numbers? What if too few officers were willing to stay in once they were trained? Any one of those or a dozen other conditions could change the dynamics of the force, affect the service's ability to perform its mission, and throw those neat little career patterns into a cocked hat.

What was needed was an accurate, running reading on the makeup of the officer force, a reliable estimate of future requirements, and a formal system for moving officers through the career steps—all easier said than done. Forecasting needs and managing resources in a large and still-growing force was like trying to write your name on a passing fighter plane. By the time data could be collected, it was out of date. Even if it were current, it wasn't of much use without a realistic forecast of future requirements.

Cause and Cure

Fortunately, the same burst of technology that had created a flood of new weapons and matching specialties and the resulting management headache had also produced the means for absorbing great quantities of information and reducing it to useful forms.

By the late 1960s, computers were able not only to collect mountains of data but also to analyze them and—given the right instructions—to predict trends and patterns. Parallel improvements in communications made it possible to put such information together while it still was reasonably fresh and useful.

The Air Force, like the private sector, began computer "modeling"—building a theoretical force with mathematics and then seeing how it would be affected by a variety of changes. Like computerized war gaming, personnel modeling allowed planners to reduce strength, change the mix of skills and ranks, add missions, sustain casualties, order early releases, replace weapons, and simulate dozens of other major changes before actually making them. And if it could create and manipulate this make-believe world, the computer could just as easily insert a make-believe officer into it and plot his or her

course through a full career. The Air Force now had the tools to point officers toward realistic career goals and coach them en route through the countless twists and turns they would encounter.

The Plan

One of the earliest, most ambitious efforts to chart career courses for officers was known as TOPLINE (the Total Objective Plan for Line officers). TOPLINE had two main aims. One was to give the Air Force a moving picture of the officer force, showing all its peaks and valleys, overages and shortages, strengths and weaknesses from the past to the present and, by educated guesswork, project them into the future. The other purpose was to provide career profiles for each specialty, showing the training and assignment squares officers should fill, the options they had, and the ultimate goals they could expect to reach if all went well.

The term "TOPLINE" has fallen into disuse, but many elements of it survive in the more sophisticated Officer Career Development Program now administered by the Air Force Military Personnel Center at Randolph AFB, Tex. While MPC still charts the general course and provides career specialists to advise individual officers, it is asking local commanders to play an increasing role in counseling and monitoring.

Like TOPLINE, today's program draws on past experience and predictions of future trends to chart the progression patterns within the utilization fields. It is more precise, however, in holding officers within their career areas, particularly in the case of rated officers. The program covers just under 90,000 line officers, divided about equally between the operations and mission support specialties. (Physicians, dentists, judge advocates, and other nonline officers are handled separately within their own disciplines.)

Operations includes rated officers (pilots and navigators), missile specialists, weapons controllers, and officers in the new space specialties. Newly added to the grouping are operations management officers (19XX), who need not be rated but fill billets related to flying. USAF needs about 1,100 of them, and in October, it will begin a school to "grow" them. Meanwhile, it will fill the positions with rated officers working temporarily outside their primary flying skills.

The mission support skills cover all the line officers not in the operations category. While they are not as tightly bound to their specialties as rated officers, they also are expected to remain in or close to the disciplines in which they are trained and developed.

The Snapshot

To chart the course of an individual officer, the Air Force first must look at the total force and decide where it is headed in the outyears. At the end of FY '86, for example, total strength was down substantially from the Vietnam-era peak, but had recovered from the lows of the drawdown period and the poor retention era of the late 1970s.

While the total numbers are encouraging, the uneven input of past years has left some gaps in "middle management" that the Air Force will have to deal with in coming years. By specialties, the trends are more pronounced.

Pilot strength is close to requirements now, for example, but there will be some shortages by the 1990s. These will be mainly in year groups six through eleven (mostly captains) because of the drop in flight training in the late 1970s. The shortfall should pose no major problem unless retention of young pilots begins to deteriorate, a possibility that officials are watching closely as commercial airlines continue to woo military aviators. There still are some modest overages in senior pilots, but they will work out gradually with retirements.

In the navigator skills, strength is running about four percent over requirements. This is partly because of a drop in the requirement for navigators in two-seat fighters, a requirement expected to return in some late-model aircraft. As with pilots, there is some shortage of navigators in year groups six through eleven despite the overall good manning.

In the nonrated operations skills, there is about a two percent shortfall overall. Space specialties in particular are undermanned, but that situation should improve as the Air Force begins to receive officers from its new Undergraduate Space Training (UST) school in Colorado. Weapons controller skills are down a little, and missile officers are slightly over strength.

In the mission support area, overall manning is running about ninety-nine percent, but there are shortages of majors and lieutenant colonels, and conditions vary widely by specialty. Logistics, for example, is on track in terms of total numbers, but experience levels are low. Manning in some technical skills is down (to about ninety-four percent), and there are shortages in the relatively new computer information systems area.

Engineering skills, which were in short supply a few years ago, are now manned at about 102 percent, an improvement that officials credit largely to the engineer bonus. Intelligence officer requirements have grown in recent years.

While overall manning is good, the field is somewhat "bottom heavy" (disproportionately well manned in the junior officer grades), meaning that the experience level is low and future managers will be hard to come by.

Staying on Top of It

While the manning trends in these and dozens of other fields have some impact on the future assignments of individual officers, the Air Force has long realized that the solution is not to shuffle people frantically between the overage and shortage areas of the moment. Rather, it is to chart career-long courses that can be adapted to changing requirements without wasting an officer's talents.

The map for the individual officer is a Career Progression Guide, a detailed year-by-year chart of progress through his or her utilization field.

The guide for pilots is more rigid than that for some other skills, but it gives a good example of how the system works. A pilot's early years are dedicated to flying, first in undergraduate training and then either in combat crew training or, in a few cases, in flight instructor duties.

This initial cockpit duty is dictated by law. Since 1974, the Aviation Career Incentive Act (the flight pay law) has said that rated officers, both pilots and navigators, must spend specific portions of their careers in opera-

tional flying—six of their first twelve years and eleven of their first eighteen years of aviation service.

These "gate" requirements actually govern only entitlement to continued flight pay, but as a practical matter, they set the pattern for a rated officer's career. Once past the initial cockpit duty, however, the officer can begin filling other squares by taking a course in professional military education, holding a low-level staff assignment, or "broadening" in nonrated duties.

In the flying skills, broadening is usually a fairly formal process of moving into the "rated supplement," a sort of holding pattern in which flyers may stray briefly from the cockpit but remain available for flying as needed. Interestingly, the supplement was conceived during a period when the Air Force had an overage of rated officers, particularly in the upper grades. Many of the flyers placed in it resented what they thought was a step toward grounding them completely. In some cases this proved to be true. As it turned out, however, what began as an unpopular solution to the overage problem has become a coveted option for officers looking for ways to prepare for executive and command positions.

The Air Force has set a ceiling of 2,880 on the number of officers in the supplement, and selection is competitive. Most officers spend no more than three years at a time in the nonrated duties. Some flyers would like to stay longer, but their training and experience represent too great an investment. Others would prefer to stay indefinitely in the cockpit and say they would forgo career advancement to do so. At some point, however, most are convinced that full careers are not possible without some growth beyond the area of flying alone.

Whether an officer remains in his or her field or broadens, however, there are many ways to go. Overseas tours, staff duties, education with industry, and other programs are open. Many officers complete intermediate and senior service schools, take advanced courses in their own fields, earn graduate degrees, and get an early taste of command. Ideally, the succession of assignments and experiences will lead through progressively more responsible positions to the higher levels of management and command.

The career pattern is similar for officers in the operations and mission support skills, although broadening is somewhat less tightly controlled for nonrateds. Mission support officers, for example, may find it easier to change fields, particularly if the move is in line with changing Air Force requirements.

Where Do I Go From Here?

Whatever direction an officer's next career step takes, it usually begins when he or she is due for a routine reassignment—on return from overseas, at the end of a directed or fixed-tour assignment, or at some other point where a change of station is required anyway. The process begins about ten months before the officer is available to move and involves the Air Force Military Personnel Center, the officer's immediate commander, and the individual.

Commanders are furnished computer-generated career counseling briefs on their officers, giving details of their past assignments, performance, and capabilities. For the operational skills, there are also assignment guides, soon to be available also for mission support officers as well. The officer is counseled by the commander, encouraged to talk with the appropriate assignment specialist at MPC, and allowed to express his or her desires for the next career move. In fact, the officer's desires should already be on record in AF Form 90 (the Officer Career Objective Statement). It lists not only the preferences for the next assignment but his or her long-range goals.

Some officers are convinced that if this "dream sheet" is given any attention at all in the assignment process, it is used mainly to thwart their desires. Not so, say assignment officials. Personal preferences are given serious attention, particularly if they indicate realistic aspirations. When the individual's desires are overridden, it is usually because they call for an unreasonable departure from the career course or would not be of the most benefit to the officer. From the standpoint of morale and retention, the Air Force is better off when it can mesh an officer's preferences with its own requirements.

One increasingly valuable area for broadening is expected to be in joint assignments, once considered a detour if not a dead end to career progression. Last year, Congress passed a law making major changes in the organization of the Joint Chiefs of Staff and joint staffs. It created the position of Vice Chairman, made the JCS Chairman principal military advisor, and called for creation of a joint specialist cadre. This last provision did not create a "purple-suit" category of Defense Department officers as some critics had feared it would, but it does require special treatment of officers assigned to joint duties.

There are to be 1,000 specially designated positions for joint service officers. They must be nominated, complete one of the joint professional military education schools, and have experience in joint duty assignments. Many questions about the program must still be answered, but it seems certain that officers with joint assignments under their belts will have a career advantage.

Similar opportunities are opening in the new operations management field, and more can be expected as the space specialties develop.

The Realities

For all the effort to manage the force on a long-range basis and shepherd officers through logical career patterns, however, career management remains an inexact science, largely because of circumstances beyond the Air Force's control. The service must operate with tight budgets and adjust to changing commitments, missions, and technology. It must draw its members from an open society not always supportive of the military. It must adapt to contemporary lifestyles and aspirations. And it must cope with retention rates that seem, at times, to change with the winds.

The Air Force still feels the impact of a sharp drop in total accessions in the late 1970s, for example. Input began to climb slightly through the mid-1980s, but has dropped a little recently. The ripple effects of any shortfall are felt years later in a lack of middle management. Similar problems can be expected from new economy moves.

The services have been ordered to cut officer strength by one percent in FY '87, two percent in 1988, and three

percent in 1989. The Air Force plans no large, involuntary Reductions in Force (RIF) at present, but it has lowered accessions for FY '87. It is delaying the callup of some ROTC graduates and other new officers. It will separate some marginal members and relax separation rules to let others go voluntarily. Actions for later years have yet to be decided, but if the cuts are not rescinded and cannot be met in other ways, they could include some selective early retirement board action and some RIFs.

Budget cuts will also force sharp reductions in permanent changes of station (PCS) at a time when the services are still feeling the effects of past actions to limit moves. The critical problem is with overseas moves, which involve about forty-two percent of the PCS shifts but represent some seventy-five percent of travel-dollar expenditures.

In recent years, the Air Force has made numerous efforts to encourage members to stay overseas longer. Tour lengths also have been increased, both overseas and in some CONUS assignments, and in FY '86, some overseas tours were extended involuntarily. Despite such efforts, the service is still short of travel funds. To compound the problem, some past actions, such as extending tours, have only postponed costs to a later date, not eliminated them.

This year, the Air Force plans still more travel economy moves. It will offer members new incentives to stay overseas longer. In effect, they will be considered to be on indefinite tours unless they ask to be returned on their original rotation dates. Members will also be held longer in some CONUS assignments. If these actions don't yield the desired savings, the Air Force will have to consider more drastic actions, such as freezing members in their assignments and cutting overseas troop strength. USAF officials have consistently said they do not want to cut overseas forces without corresponding reductions in commitments, but they may have no choice.

One economy action that officials say they are not considering is putting new curbs on dependent travel as a means of cutting costs. The few times dependents have been barred from overseas, it had a disastrous impact on morale and retention. Officials are not eager to risk a repeat of that situation, and it seems unlikely they will have to. Much of the saving from barring dependent travel is offset by the cost of moving families to Stateside locations and paying separation allowances while members are overseas.

The Hidden Costs

Even if dependent travel is not disrupted, however, force cuts, reduced PCS, and other economy moves usually come at a cost. For some officers, for example, progress through the neatly drawn career courses could be slowed if not seriously detoured. Schooling, training, and career broadening assignments could be delayed for lack of PCS funds. Assignment freezes and slow advancement are not so hard on those who like being where they are. They can be intolerable for those already unhappy in their jobs and eager to move on.

Most important from USAF's point of view is what further belt-tightening will do to future retention. The Air Force measures retention in terms of Career Continuation Rates—a complicated scale showing the percentage of officers with more than four years' service who are expected to be aboard after eleven years.

So far, rate projections through the early 1990s are mixed, but not too disturbing. The nonrated operations skills look good. There is some decay in mission support. Engineer retention is up from the 1979 low of thirty-four percent, but has dipped a little lately. Navigator rates also have improved from forty-four percent in 1979 to seventy-five percent and more lately. Officials credit new command opportunities in the field. Pilots are another matter. Airlines have increased hiring and lowered criteria. Despite some turmoil in the industry, the demand is expected to continue, and the Air Force is already feeling some increase in pilot losses.

Added to the familiar difficulties of tight money is the fact that life is changing in the services, just as it is in society in general.

In recent years, the Air Force has had more female officers, more working wives, more single parents, and more in-service couples than ever before. The traditional lifestyles on which many of its past policies were based no longer apply. How well the service can adapt to the changes will also bear on how well it can retain the members it needs.

As it has done time and again, the Air Force is keeping a wary eye on its continuation rates and studying the reasons people give for leaving the service. Surveys show that one-third of all officers make the decision to stay or separate at least a year before they are eligible. About eighty percent talk it over with friends, sixty percent talk with their supervisors, but only about half talk with their commanders.

The question remains: Why do people leave? Poor pay, once the prime complaint, is now fairly low on the list of gripes. Higher are the lack of say in assignments, being in undesirable geographic locations, the poor quality of supervision, and limited job satisfaction. Ironically, however, the reasons officers most often give for staying are mirror images of the complaints. They like their assignments, find their jobs rewarding, and respect their bosses and coworkers.

USAF's challenge for the next few years will be to keep its career program intact despite growing pressures to cut corners and find quick-fix solutions. Officials are looking for new, affordable incentives to attract and hold officers. Local commanders can expect to be drawn increasingly into the effort of career counseling and retention. Ways must be found to give officers, if not their first choice of assignments, at least the sense that they are headed in the right direction and making progress.

Against force cuts, mounting budget constraints, and growing political pressures, the job won't get any easier. But it has probably never been more important. ■

Bruce Callander was a Fifteenth Air Force B-24 bombardier during World War II and was recalled to active duty as an information officer during the Korean War. Between tours of active duty, he earned a B.A. degree in journalism at the University of Michigan. He joined the staff of Air Force Times *in 1952 and became the Editor in 1972. Now a free-lance writer, Mr. Callander wrote the article "The Evolution of the Air Force NCO" for our September '86 issue.*

The Path of Duty

Though Germany's surrender was imminent, Lt. Raymond Knight's war was not over.

BY JOHN L. FRISBEE
CONTRIBUTING EDITOR

BEFORE the Allies landed in France on June 6, 1944, ground action against the Axis was confined largely to North Africa, Sicily, and the Italian peninsula, where Allied armies landed early in September 1943. With Mussolini out of power, the Italians switched sides on September 3, but in anticipation of that defection, Hitler had moved a formidable force into Italy and had taken control of the war on that front.

After fifteen months of bitter fighting over difficult terrain, the Allies had breached successive German defensive lines before weather halted their advance north of the Arno River in the winter of 1944–45. From the start, the Italian campaign had been secondary to a buildup of forces for the invasion of Western Europe. The 350th Fighter Group, for example, had flown obsolete P-39s and P-400s until August 1944. Twelfth Air Force in Italy was frequently short of aircraft and parts.

Despite their secondary status, Allied air forces in Italy had conducted a classic interdiction campaign and had won complete air superiority over what few aircraft the Luftwaffe could send to the peninsula. There was no significant air opposition after November 1944, but in the absence of fighter planes, the Germans had defended all vital targets with unusually heavy concentrations of antiaircraft guns. This was the status of the war on December 7, 1944, when 2d Lt. Raymond L. Knight reported for duty with the 350th Fighter Group, based at Pisa on the Arno.

In the next four months, often flying his P-47 in weather that grounded the medium bombers, Lieutenant Knight completed more than seventy interdiction and close-support missions. He was twice wounded in action and was promoted to first lieutenant. Then on April 5, 1945, the Allies began the final drive that would push the Germans back across the Po River. Escape routes to German-held territory had been blocked by Allied air action.

Raymond Knight must have known that the war was almost over. "Why stick your neck out now?" many pilots might have asked. Not Ray Knight. On the morning of April 24, he volunteered to lead a flight of three P-47s against German fighters and bombers that had been spotted on a well-defended field a few miles north of the Po. Knight went down alone to reconnoiter the field and discovered eight Luftwaffe planes under camouflage. He then led his flight in a strafing attack, destroying five enemy planes himself while his wingmen accounted for two more.

Later that day, Knight again volunteered, this time to look over an airfield at Bergamo, forty miles north of Milan. While the other Jugs held out of AA range, Knight made a low-level pass and was hit by flak several times. He found a squadron of twin-engine bombers and some fighters. After leading his flight in a strafing attack, Knight returned alone to make ten more passes, destroying six loaded bombers and two fighters. His P-47 was hit again.

The next morning, April 25, Knight returned to Bergamo with a flight of four P-47s. He knew there were still enemy aircraft there. And so was the deadly flak. In one strafing run, he destroyed a bomber on the runway while the other pilots burned two more of the few remaining bombers. Knight's fighter was critically damaged, but knowing the shortage of aircraft in his group, he decided to attempt a return to base rather than bail out over friendly territory. Over the Apennines, the plane crashed, and Lieutenant Knight was killed. A few days later, the Germans opened surrender negotiations, and on May 2, the war in Italy ended.

—Photo by J. Robertson, courtesy of David Weatherill and William J. Bennett

Lt. Ray Knight beside his bullet-pocked P-47. His was the last AAF Medal of Honor of World War II.

The goal of every true fighter pilot is to become an ace, but there are no credits given and little glory earned for shooting up enemy planes on the ground, the most dangerous of fighter tactics. Genuine heroism is not a virtue to be coldly calculated in terms of risk and possible gain, however. *The* war was virtually over, but Raymond Knight's war was not, as long as there was still a threat to the men on the ground he was there to protect. He was driven by duty, not by thoughts of personal glory.

Ray Knight would have been proud of the Medal of Honor awarded him posthumously and perhaps a little surprised. It was a rather special award of our highest decoration for valor. He was one of only two fighter pilots to be so honored during the war in Europe—the other was Col. James Howard *(see "Valor" in the November '83 issue)*—and Knight's was the last Medal of Honor earned by an AAF airman in World War II. ■

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The antenna 'bumps' of the ASPJ distinguish this F/A-18C Hornet externally from the currently operational F/A-18A

MCDONNELL DOUGLAS

MCDONNELL AIRCRAFT COMPANY (Division of McDonnell Douglas Corporation), Box 516, St. Louis, Missouri 63166, USA

The new F/A-18C version of the US Navy/Marine Corps Hornet is almost identical externally to the F/A-18A, except for the small antenna 'bumps' for its airborne self-protection jammer (ASPJ) on the forward fuselage and dorsal and tail sections. New internal systems will give it much improved combat capability.

MCDONNELL DOUGLAS F/A-18 HORNET

The F/A-18 had its origin in the same USAF lightweight fighter prototype programme that produced USAF's F-16 Fighting Falcon. In the Spring of 1974 DoD had accepted a proposal from the Navy to study a low-cost lightweight multi-mission fighter, then identified as the VFAX. In August of that year Congress terminated the VFAX concept, directing that the Navy should consider instead versions of the General Dynamics YF-16 and Northrop YF-17 prototypes that were then under evaluation for USAF.

McDonnell Douglas concluded that Northrop's contender could be redesigned at minimum cost to meet the Navy's requirements. It then teamed with Northrop to propose a derivative of the YF-17, for which it would serve as prime contractor. Identified as the Navy Air Combat Fighter (NACF), this derivative received the name Hornet when selected for development. Two single-seat versions were proposed originally, of which the F-18A was intended for fighter duties and the A-18 for attack missions. Except for a small amount of operational equipment and missile armament, the two proved so similar that a single configuration, known as the F/A-18, was able eventually to undertake both missions. Under an agreement announced on 8 April 1985, McDonnell Douglas became prime contractor for all existing and future versions of the aircraft, with Northrop as principal subcontractor. The following versions have been announced:

F/A-18A. Initial single-seat production version, ordered as escort fighter/interdictor to replace F-4, armed with fuselage mounted Sparrow missiles, and as attack aircraft to replace A-7, with FLIR and a laser tracker that are being developed as part of the Hornet programme, replacing the Sparrows. In

the Summer of 1986, an F/A-18A made the first successful launch of a Harpoon anti-ship missile from a Hornet at the Pacific Missile Test Center off Point Mugu, Calif., using a line-of-sight launch technique. Harpoon launch modes will be incorporated in aircraft delivered from Autumn 1989.

F/A-18B. Tandem two-seat version of F/A-18A for training, with combat capability, known formerly as TF/A-18A. Fuel capacity reduced by under 6 per cent.

F/A-18C and F/A-18D. Single- and two-seat aircraft purchased from FY 1986. Generally similar to F/A-18A/B, but with NACES ejection seats, improved mission computer, and a flight incident recording and monitoring system (FIRAMS) that adjusts the aircraft's centre of gravity automatically in flight by controlling the transfer of fuel between the internal fuel tanks. Provision for carriage of AMRAAM air-to-air and IIR Maverick air-to-surface missiles, airborne self-protection jammer, and reconnaissance equipment. First flight (F/A-18C) Summer 1986; deliveries scheduled to begin in October 1987. F/A-18C/Ds delivered from October 1989 will, in addition, carry equipment for all-weather night attack missions, including a FLIR navigation pod, raster HUD, and pilot's night vision goggles. Flight testing of night attack version expected to begin later this year.

F/A-18L. Proposed multi-role land-based version. No orders announced by January 1987.

F/A-18(R). The US Navy began evaluation of a simple reconnaissance conversion of the standard F/A-18A in the Autumn of 1982. This involves removal of the gun from the aircraft's nose, and its replacement by a twin-sensor package with two windows in a slightly bulged underfairing. Sensors can include a Fairchild-Weston KA-99 low/medium-altitude panoramic camera and/or Honeywell AAD-5 IR linescan. Additional sensors, including a low altitude camera, are being studied. The F/A-18(R) can be converted overnight to the fighter/attack configuration within the operational squadron. Flight testing of the first F/A-18 fitted with reconnaissance equipment began on 15 August 1984.

CF-18A. Version for Canadian Armed Forces, which plan to purchase 138, including 40 **CF-18B** two-seaters. Selection announced on 10 April 1980. First example made its initial flight on 29 July 1982. Deliveries began with CAF901 and CAF902 on 25 October 1982 and are scheduled to continue at the rate of two per month until 1988. By 1 March 1986 a total of 77 CF-18s had been delivered. First CAF unit was No. 410 Squadron, based at CFB Cold Lake, Alberta, followed by No. 425 at Bagotville, Quebec, and Nos. 439, 409, and 421 Squadrons of No. 1 Canadian Air Group at Sollingen, West Germany. CF-18s are replacing CF-101s, CF-104s, and CF-5s. By comparison with US Navy version, CF-18 has different ILS, added spotlight on port side of fuselage for night identification of other aircraft in flight, and provision for carrying LAU-5003 rocket pods.

Australian F/A-18A/B. Versions for the Royal Australian Air Force. The intention to procure 75 Hornets was announced on 20 October 1981. Two of the RAAF F/A-18Bs were manufactured by McDonnell Douglas, and were delivered by air from NAS Lemoore, Calif., to RAAF Williamtown, near Sydney, a distance of 7,700 nm (14,260 km; 8,860 miles), in 15.2 h on 17 May 1985, refuelled in flight by KC-10 tankers. The first F/A-18B assembled in Australia by Government Aircraft Factories made its first flight on 26 February 1985, and was delivered to the RAAF on 4 May. The first Australian manufactured aircraft (F/A-18B A21-104) was first flown on 3 June 1985. The RAAF's F/A-18s (57 single-seat F/A-18As and 18 two-seat F/A-18Bs) are replacing Dassault Mirage III-Os. Three operational squadrons are being formed, with deliveries scheduled for completion in 1990. The first operational squadron, No. 3 based at Williamtown, took delivery of its first F/A-18As (A21-8 and A21-9) in Autumn 1986.

EF-18. Version for Spanish Air Force, which ordered a total of 72 in May 1983, with an option on 12 more. Spanish designations are **C.15** (single-seat) and **CE.15** (two-seat). First aircraft (a CE.15) rolled out 22 November 1985, and was delivered by air to Spain with three other two-seaters in Summer 1986. By October 1986, nine EF-18s had been delivered to the Spanish Air Force at Zaragoza. IOC planned for 1987. As part of EF-18 industrial cooperation programme, Construcciones Aeronauticas SA (CASA) of Madrid is manufacturing horizontal tail surfaces, flaps, leading-edge extensions, speed brakes, rudders, and rear side panels for F/A-18s.

On 22 January 1976 it was announced that full scale development had been initiated by the US Navy, with initial funding of $16 million. Total cost of the development programme included the production of 11 F-18s for the flight test programme. A total of 1,377 Hornets, including the 11 development aircraft, is planned for construction into the 1990s, for the US Navy and Marine Corps. More than 150 of those built will be two-seat trainers. Deliveries of all versions totalled 375 by March 1986, including 287 F/A-18As and F/A-18Bs to the US Navy; the overall total had passed 400 by September 1986. Northrop builds the centre and rear fuselage sections, which are delivered totally assembled to McDonnell Douglas at St Louis, where final assembly and testing are centred.

The first Hornet (160775) made its first flight on 18 November 1978, the second flew on 12 March 1979, and all 11 development aircraft were flying by March 1980, including two TF/A-18A two-seat combat-capable trainers. The first batch of nine production Hornets was authorised in FY 1979, followed by 25 in FY 1980, 60 in FY 1981, 63 in FY 1982, 84 each year from FY 1983 to FY 1987, and 96 per year from FY 1988. In the fourth quarter of 1979, a Hornet became the first modern jet aircraft to complete initial sea trials within one year of its first flight, and the first production aircraft was delivered to the US Navy for operational evaluation in May 1980.

Two-seat EF-18 of the Spanish Air Force, by which it is designated CE.15

The first development squadron (VFA-125) was formed at NAS Lemoore, Calif., in November 1980. Operational evaluation and Navy BIS (Bureau of Inspection and Survey) trials began in early 1982. Fleet training began in mid-1982 and the Hornet officially entered operational service on 7 January 1983, with Marine Fighter/Attack Squadron 314 at MCAS El Toro, Calif., and later with VMFA-531 and VMFA-323. On 1 February 1985 the first Atlantic Fleet F/A-18A operational squadrons began forming at Cecil Field NAS, Fla., after training at NAS Lemoore, Calif. Also in February, two F/A-18A squadrons, VFA-113 'Stingers' and VFA-25 'Fist of the Fleet', embarked in the aircraft carrier USS *Constellation* for the aircraft's first extended deployment at sea.

In late 1986 the following US Marine Corps and US Navy squadrons were operational with F/A-18As: VMFA-115 'Silver Eagles' and VMFA-251 'Thunderbolts' at MCAS Beaufort, S. C.; VMFA-314 'Black Knights', VMFA-323 'Death Rattlers', and VMFA-531 'Gray Ghosts', all at MCAS El Toro, Calif.; VFA-106 'Gladiators', VFA-131 'Wildcats', VFA-132 'Privateers', VFA-136 'Knight Hawks', and VFA-137 'Kestrels' with Atlantic Fleet, Cecil Field NAS, Fla.; and VFA-25 'Fist of the Fleet', VFA-113 'Stingers', VFA-125 'Rough Raiders', VFA-192 'Golden Dragons', VFA-195 'Dambusters', and VFA-303 'Golden Hawks' with Pacific Fleet, Lemoore NAS, Calif.

The F/A-18A first saw combat action in April 1986, when aircraft from VFA-131, VFA-132, VMFA-314, and VMFA-323, operating from the car-

McDonnell Douglas F/A-18A Hornets of US Navy squadron VFA-113 'Stingers'

rier USS *Coral Sea*, attacked targets in Libya.

In February 1986 the F/A-18A was selected to replace the US Navy Blue Angels Flight Demonstration Squadron's A-4F Skyhawks from 1987. Eleven early production aircraft, not suitable for shipboard operation, have been fitted with smoke-generating systems and special seat harnesses. The Blue Angels began training on the F/A-18A at El Centro NAF, Calif., in January 1987.

The following information applies to the single-seat US Navy F/A-18C, but is generally applicable to all versions:

TYPE: Single-seat naval multi-mission fighter.

WINGS: Cantilever mid-wing monoplane. Anhedral 3°. Sweepback 20° at quarter-chord. Multi-spar structure primarily of light alloy, with graphite/epoxy interspar skin panels and trailing-edge flaps. Boundary layer control achieved by wingroot slots. Full span leading-edge manoeuvring flaps have a maximum extension angle of 30°. Single-slotted trailing-edge flaps, actuated by Bertea hydraulic cylinders, deploy to a maximum of 45°. Ailerons, with Hydraulic Research actuators, can be drooped to 45°, providing the advantages of full span flaps for low approach speeds. Leading- and trailing-edge flaps are computer programmed to deflect for optimum lift and drag in both manoeuvring and cruise conditions, and ailerons and flaps are also deflected differentially for roll. Light alloy wingroot leading-edge extensions (LEX) permit flight at angles of attack exceeding 60°. Wings fold upward through 100°, by means of AiResearch mechanical drive, at the inboard end of each aileron.

FUSELAGE: Semi-monocoque basic structure, primarily of light alloy, with graphite/epoxy used for access doors/panels. Titanium firewall between engines. Airbrake in upper surface of fuselage between tail fins. Pressurised cockpit section of fail-safe construction.

TAIL UNIT: Cantilever structure with swept vertical and horizontal surfaces, made primarily of graphite/epoxy over light alloy honeycomb core. Twin 20° outward-canted fins and rudders, mounted forward of all-moving horizontal surfaces (stabilators), which have 2° anhedral and are actuated collectively and differentially by National Water Lift servo-cylinder hydraulic units for pitch and roll control.

LANDING GEAR: Retractable tricycle type, with twin-wheel nose and single-wheel main units. Nose unit retracts forward, mainwheels rearward, turning 90° to stow horizontally inside the lower surface of the engine air ducts. Bendix wheels and brakes. Nosewheel tyres size 22 × 6.6-10, 20 ply, pressure 24.13 bars (350 lb/sq in) for carrier operations, 10.34 bars (150 lb/sq in) for land operations. Mainwheel tyres size 30 × 11.5-14.5, 24 ply, pressure 24.13 bars (350 lb/sq in) for carrier operations, 13.79 bars (200 lb/sq in) for land operations. Ozone nosewheel steering unit. Nose unit towbar for catapult launch. Arrester hook, for carrier landings, under rear fuselage.

POWER PLANT: Two General Electric F404-GE-400 low bypass turbofans, each producing approx 71.2 kN (16,000 lb thrust). Self-sealing fuel tanks and fuel lines; foam in wing tanks and fuselage voids. Internal fuel capacity approx 6,435 litres (1,415 Imp gallons; 1,700 US gallons). Provision for up to three 1,250 litre (275 Imp gallon; 330 US gallon) external tanks. Flight refuelling probe retracts into upper starboard side of nose. Simmonds fuel gauging system. Fixed ramp air intakes.

ACCOMMODATION: Pilot only, on Martin-Baker Navy Aircrew Common Ejection Seat (NACES), in pressurised, heated, and air conditioned cockpit. Upward opening canopy, with separate windscreen.

SYSTEMS: Two completely separate hydraulic systems at 207 bars (3,000 lb/sq in). Max flow rate 212 litres (56 US gallons)/min. Bootstrap type reservoir, pressure 5.86 bars (85 lb/sq in). Quadruplex digital fly by wire flight control system, with direct electrical backup to all surfaces, and direct mechanical backup to stabilators. Garrett air-conditioning system. General Electric electrical power system. Oxygen system. Fire detection and extinguishing systems.

AVIONICS AND EQUIPMENT: Include an automatic carrier landing system (ACLS) for all-weather carrier operations; a Hughes Aircraft AN/APG-65 multi-mode digital air-to-air and air-to-ground tracking radar, with air-to-air modes which include velocity search (VS), range while search (RWS), track while scan (TWS), which can track ten targets and display eight to the pilot, and raid assessment mode (RAM). Itek ALR-67 radar warning receiver; airborne self-protection jammer (provisions); General Electric quadruple-redundant flight control system; two AYK-14 digital computers; Litton AN/ASN-130A inertial navigation system; two Kaiser multi-function CRTs, central Ferranti/Bendix CRT and head-up display; Conrac communications system control; Normalair-Garrett digital data recorder for Bendix maintenance recording system; flight incident recording and monitoring system (FIRAMS); Smiths standby altimeter; and Kearflex standby airspeed indicator, standby vertical speed indicator, and cockpit pressure altimeter. Garrett APU for engine starting and ground pneumatic, electric, and hydraulic power.

ARMAMENT: Nine external weapon stations with a combined capacity of 7,710 kg (17,000 lb) of mixed ordnance at high *g*. These comprise two wingtip stations for AIM-9 Sidewinder air-to-air missiles; two outboard wing stations for an assortment of air-to-ground or air-to-air weapons, including AIM-7 Sparrows, AIM-9 Sidewinders, AIM-120 AMRAAMs, and AGM-65 Maverick missiles; two inboard wing stations for external fuel tanks or air-to-ground weapons, including AGM-84 Harpoon missiles; two nacelle fuselage stations for Sparrows or Martin Marietta AN/ASQ-173 laser spot tracker/strike camera (LST/SCAM) and Ford AN/AAS-38 FLIR pods; and a centreline fuselage station for external fuel or weapons. Air-to-ground weapons include GBU-10 and -12 laser guided bombs, Mk 82 and Mk 84 general purpose bombs, and CBU-59 cluster bombs. An M61 20 mm six-barrel gun, with 570 rounds, is mounted in the nose and has a McDonnell Douglas director gunsight, with a conventional sight as backup.

DIMENSIONS, EXTERNAL:

Wing span	11.43 m (37 ft 6 in)
Wing span over missiles	12.31 m (40 ft 4¾ in)
Wing chord: at root	4.04 m (13 ft 3 in)
at tip	1.68 m (5 ft 6 in)
Wing aspect ratio	3.5
Width, wings folded	8.38 m (27 ft 6 in)
Length overall	17.07 m (56 ft 0 in)
Height overall	4.66 m (15 ft 3½ in)
Tailplane span	6.58 m (21 ft 7¼ in)
Distance between fin tips	3.60 m (11 ft 9½ in)
Wheel track	3.11 m (10 ft 2½ in)
Wheelbase	5.42 m (17 ft 9½ in)

AREAS:

Wings, gross	37.16 m² (400.0 sq ft)
Ailerons, total	2.27 m² (24.4 sq ft)
Leading-edge flaps, total	4.50 m² (48.4 sq ft)
Trailing-edge flaps, total	5.75 m² (61.9 sq ft)
Fins, total	9.68 m² (104.2 sq ft)
Rudders, total	1.45 m² (15.6 sq ft)
Tailplanes, total	8.18 m² (88.1 sq ft)

WEIGHTS:

Weight empty	10,455 kg (23,050 lb)
Max fuel weight: internal	4,926 kg (10,860 lb)
external	3,053 kg (6,732 lb)
Fighter mission T-O weight	16,651 kg (36,710 lb)
Attack mission T-O weight	22,328 kg (49,224 lb)

PERFORMANCE:

Max level speed	more than Mach 1.8
Max speed, intermediate power	more than Mach 1.0
Approach speed	134 knots (248 km/h; 154 mph)
Acceleration from 460 knots (850 km/h; 530 mph) to 920 knots (1,705 km/h; 1,060 mph) at 10,670 m (35,000 ft)	under 2 min
Combat ceiling	approx 15,240 m (50,000 ft)
T-O run	less than 427 m (1,400 ft)
Combat radius, fighter mission	more than 400 nm (740 km; 460 miles)
Combat radius, attack mission	575 nm (1,065 km; 662 miles)
Ferry range, unrefuelled	more than 2,000 nm (3,706 km; 2,303 miles)

An F/A-18A Hornet of VMFA-314 lands on the USS *Coral Sea* *(Brian M. Service)*

SUKHOI

PAVEL OSIPOVICH SUKHOI DESIGN BUREAU, USSR

For the 1986 World Aerobatic Championships, held in the UK, the Soviet team entered three modified versions of the Sukhoi Su-26 that had first been seen at the 1984 Championships in Hungary. In the men's event, the new Su-26Ms took the team prize, with third, fourth, and twelfth places in the individual results. Soviet women also captured the team prize, with first, fourth, and fifth individual places.

SUKHOI Su-26M

Compared with the original Su-26, the modified Su-26Ms that took part in the 1986 World Aerobatic Championships (c/n 06, 07, and 08) were identified by a sharp-cornered (rather than rounded) rudder, and reduced fuselage side glazing.

TYPE: Single-seat aerobatic competition aircraft.

Power plant of the Sukhoi Su-26M is a 268 kW (360 hp) Vedeneyev M-14P nine-cylinder radial *(M. J. Hooks)*

Sukhoi Su-26M aerobatic single-seaters won both the men's and the women's team prizes at the 1986 World Championships *(M. J. Hooks)*

WINGS: Cantilever mid-wing monoplane of tapered planform. Specially developed symmetrical wing section, variable along span; slightly concave in region of ailerons to increase their effectiveness; leading-edge somewhat sharper than usual to make aircraft more responsive to control surface movement. Thickness/chord ratio 18% at root, 12% at tip. No dihedral, incidence, or sweep at quarter-chord. One-piece two-spar stressed skin structure, without ribs, covered with three-lamination glassfibre/epoxy (GFRP). Foam filled front box spar with carbonfibre reinforced plastics (CFRP) booms and wound glassfibre webs. Channel section rear spar of CFRP. Outer 67% of each wing trailing-edge formed by plain aileron with CFRP box spar, GFRP skin, and foam filling. Each aileron, actuated by pushrods, has ground adjustable tab on trailing-edge and two suspended triangular balance tabs. No flaps.

FUSELAGE: Oval-section, with basic welded truss structure of VNS-2 high strength stainless steel tubing. Lower nose section of truss removable to facilitate detachment of wings. Three-lamination GFRP skin panels, with duralumin reinforcement, are all quickly removable for access to interior. Light alloy engine cowlings.

TAIL UNIT: Conventional cantilever fin and tailplane of similar construction to wings. Horn balanced rudder and elevators of similar construction to ailerons and each with ground adjustable tab. Elevators actuated by pushrods, rudder by cable.

LANDING GEAR: Non-retractable tailwheel type. Arched cantilever mainwheel legs of titanium alloy. Mainwheels size 350 × 135 mm, with hydraulic disc brakes. Sprung steerable tailwheel connected to rudder.

POWER PLANT: One 268 kW (360 hp) Vedeneyev M-14P nine-cylinder radial engine, driving a three-blade Hoffmann variable-pitch metal propeller. Optional V-530TA-D35 two-blade variable-pitch propeller. Steel tube engine mounting. Fuel in glassfibre lined foam plastics tank bonded into each wingroot section between spars; total capacity 130 litres (28.5 Imp gallons; 34.3 US gallons). Port wing tank only is used in competition; starboard tank supplements it for ferry flights. Oil capacity 22.6 litres (5 Imp gallons; 6 US gallons). Fuel and oil systems adapted for inverted flight.

ACCOMMODATION: One-piece pilot's seat of GFRP, inclined at 45° and designed for use with PLP-60 back-pack parachute. Sideways hinged (to starboard) jettisonable canopy. Safety harness anchored to fuselage structure.

SYSTEM: Electrical system of 24/28V, with 3kW generator, batteries, and external supply socket.

AVIONICS: Briz VHF radio.

DIMENSIONS, EXTERNAL:

Wing span	7.80 m (25 ft 7 in)
Wing chord: at root	1.95 m (6 ft 4¾ in)
at tip	1.10 m (3 ft 7¼ in)
Wing aspect ratio	5.6
Length overall	6.82 m (22 ft 4½ in)
Height overall	2.78 m (9 ft 1½ in)
Tailplane span	2.95 m (9 ft 8¼ in)
Wheel track	2.20 m (7 ft 2½ in)
Wheelbase	5.05 m (16 ft 6¾ in)
Propeller diameter	2.40 m (7 ft 10½ in)

AREAS:

Wings, gross	10.85 m² (116.8 sq ft)
Ailerons (total)	1.18 m² (12.70 sq ft)
Fin	0.34 m² (3.66 sq ft)
Rudder	0.89 m² (9.58 sq ft)
Tailplane	1.10 m² (11.84 sq ft)
Elevators (total)	1.53 m² (16.47 sq ft)

WEIGHT:

Normal competition T-O weight	720 kg (1,587 lb)

PERFORMANCE:

Max level speed	192 knots (355 km/h; 220 mph)
Normal cruising speed	140 knots (260 km/h; 161 mph)
Max rate of climb at S/L	1,008 m (3,307 ft)/min
g limits	+ 11/−9

F + W

SWISS FEDERAL AIRCRAFT FACTORY, CH-6032 Emmen, Switzerland

F + W MIRAGE IMPROVEMENT PROGRAMME

At the end of 1985 the Swiss government approved funding for an update programme for Mirage III aircraft of the Swiss Air Force, which has 52 of these aircraft (30 III-S, 18 III-RS, two III-BS, and two III-DS) in its inventory. Main elements of this programme involve the installation of non-moving canard surfaces just aft of the engine air intakes, and addition of a very narrow strake on each side of the extreme nose, the former to improve manoeuvrability and low-speed handling, and eliminate buffeting, the latter to increase stability in yaw near the upper limit of the flight envelope.

F + W, the Swiss government's official aircraft establishment, had begun flight testing this configuration on a Swiss Air Force Mirage III-S single-seat fighter (J-2301) on 23 August 1983. A second aircraft (J-2302) was converted subsequently for operational evaluation by Swiss Air Force pilots. The canards are of similar size and shape to those on the Dassault Mirage 3 NG *(nouvelle génération)* prototype, and have a span about one-third that of the wings. The nose strakes, which extend along part of the pitot and the tip of the radome, are approx 0.5 m (1 ft 7¾ in) long and less than 5 cm (1.97 in) wide.

Other improvements forming part of the upgrade package include new audible warning and visual angle of attack monitoring systems, to alert the pilot when approaching limits of the flight envelope; substitution of Martin-Baker Mk 4 ejection seats in place of the original Mk 6 seats; addition of infrared and passive/active ECM; provision of more powerful VHF radios; wing strengthening; means for carrying two underwing 500 litre (110 Imp gallon; 132 US gallon) IMI auxiliary fuel tanks and a 730 litre (160.5 Imp gallon; 193 US gallon) centreline tank; mounting of improved blast deflectors for the two internal guns, to allow firing at high angles of attack; and a new camouflage paint scheme. The retrofit programme was expected to be undertaken over the period 1986–90.

Swiss Air Force Mirage III-S evaluation aircraft, modified by F + W with nose strakes and fixed canards

IAI

ISRAEL AIRCRAFT INDUSTRIES LTD, Ben-Gurion International Airport, 70100 Lydda (Lod), Israel

IAI LAVI (YOUNG LION)

In the 1990s the Lavi is intended to become the workhorse of the Israeli Air Force, which has a requirement for at least 300, including about 60 combat-capable two-seat operational trainers. Its primary roles will be those of close air support and interdiction, with secondary capability for air-to-air self-defence to and from the target. Design characteristics include high-speed penetration, a high degree of manoeuvrability, first-pass bombing accuracy, and battle damage tolerance for safe recovery. The aircraft has nine independently commanded control surfaces for maximum manoeuvrability, and can carry an external load of fuel and weapons totalling more than 7 tonnes. It is claimed to be the equal of the General Dynamics F-16 in air-to-air roles, and superior to that aircraft in the ground strike role.

The Lavi is slightly smaller than the F-16, and has close-coupled delta main wings and canard surfaces, incorporating proven state of the art technology. Approximately 22 per cent of the structure, by weight, is built of composite materials. This includes many components made from graphite epoxy (carbonfibre), such as wing skins, spars, and substructure, the vertical tail, the all-moving foreplanes, control surfaces, and various doors and panels. In many cases, development and initial production of such advanced technology components is taking place in the USA, before series manufacture is transferred to Israel. Production of composites will be undertaken eventually by MMCA Ltd, a new subsidiary of IAI based at Beer-Sheva.

Deliveries of the Lavi are intended to begin in 1990, initially to replace the Israeli Air Force's A-4 Skyhawks and later the Kfir-C2/C7. Initial operational capability is planned for 1992. The two-seat version will replace Skyhawks and F-4 Phantoms at present used in the training role. Series production is intended to be at the initial rate of one per month, increasing to 30–36 per year by the mid-1990s.

The Lavi (known earlier as Super Kfir and Arye) received programme go-ahead, after a number of design changes, in February 1980, and the PW1120 turbojet was selected as power plant in June 1981. Prototype construction was authorised by the Israeli government in early 1982, and the basic design was frozen later that year, full scale development starting in October 1982. Six two-seat flight development aircraft are being built (two aerodynamic prototypes and four for weapons/systems testing), plus a static test article. Following a 21 July 1986 rollout (of the second prototype), the first flight was made on 31 December 1986. The flight test programme is scheduled to last for three years. Recent changes are understood to include an increase in control surface areas, to counter any stability problems that might arise during flight testing.

TYPE: Single-seat close air support and interdiction aircraft, with secondary capability for air defence; and combat-capable two-seat operational trainer.

WINGS AND FOREPLANES: Cantilever low-wing monoplane. Low aspect ratio 'swept delta' main wings (54° on leading-edges), close-coupled with hydraulically actuated all-moving foreplanes of similar planform. Leading-edge flaps over outer half of each wing. Hydraulically actuated inboard and outboard elevon on each trailing-edge. Substructure and skins of carbonfibre. First eight shipsets of wings (five for prototypes and three for other testing) designed, developed, and produced by Aerostructures Division of Grumman Aerospace Corporation. Foreplanes manufactured by IAI.

FUSELAGE: Conventional semi-monocoque structure, 'waisted' in accordance with area rule and incorporating composite materials as well as metal. Door type airbrake on each side of upper rear fuselage.

TAIL UNIT: Sweptback fin and hydraulically actuated rudder; first six carbonfibre fins (five for prototypes and one for ground test) produced by Grumman. Twin outward canted ventral fins under rear fuselage. No horizontal tail surfaces.

LANDING GEAR: SHL retractable tricycle type, with single wheel on each unit. Reshef nosewheel steering. Goodyear wheels, tyres, and brakes.

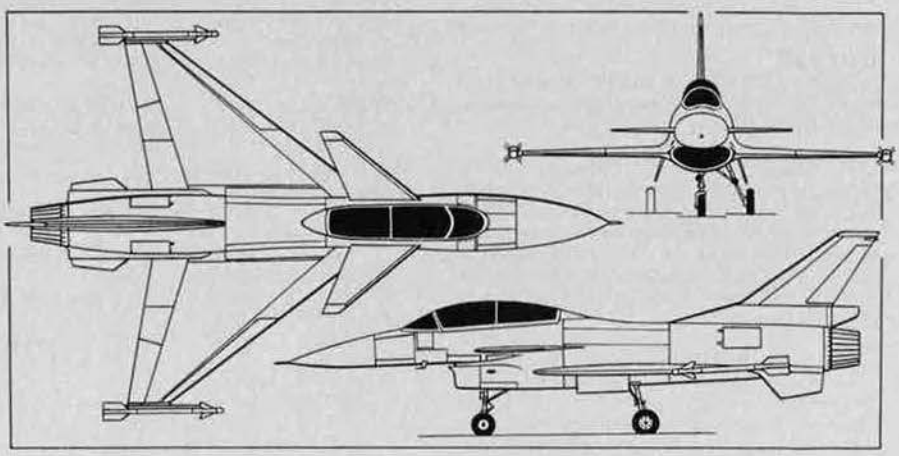
POWER PLANT: One 91.7 kN (20,620 lb st) Pratt & Whitney PW1120 afterburning turbojet. Fixed geometry single-shock ventral intake, based on that of General Dynamics F-16. Max internal fuel capacity 3,330 litres (732 Imp gallons; 880 US gallons) in integral tanks occupying most of main wing volume. Single-point pressure refuelling. Provision for in-flight refuelling (probe and boom receptacle on prototypes, receptacle only on production aircraft). Fuselage centreline and two underwing hardpoints are 'wet' for carriage of IMI auxiliary fuel tanks, typically of 1,325 litres (291.5 Imp gallons; 350 US gallons) or 2,270 litres (499 Imp gallons; 600 US gallons) capacity.

ACCOMMODATION: Single or tandem ejection seats, inclined at 10°, under one-piece 'teardrop' cockpit canopy.

SYSTEMS: Garrett AiResearch environmental control system for air-conditioning, pressurisation, and engine bleed air control. Pneudraulics bootstrap type hydraulic system, pressure 207 bars (3,000 lb/sq in), with Abex pumps. Electrical system powered by Sundstrand 60kVA integrated drive generator, for single-channel AC power at 400Hz. SAFT main and Marathon standby battery. Garrett AiResearch EPU for emergency hydraulic and electric power; Garrett Turbine Engine Co secondary power system.

AVIONICS: Elta Electronics fully computerised onboard communications system. Tamam advanced inertial navigation system. Elbit Computers Ltd is prime contractor for the integrated display system, which includes a Hughes Aircraft wide angle holographic head-up display, three multi-function displays (two monochrome and one colour), display computers, and communications controller. Pilot can operate most systems through a single El-Op up-front control. Lear Siegler/MBT quadruple-redundant digital fly by wire flight control system, with stability augmentation, MBT control unit, and Moog tandem servo-actuators for inboard and outboard elevons, foreplanes, and rudder. No mechanical backup. Sundstrand actuation system, with geared rotary actuators, for leading-edge flaps. Cockpit is designed to minimise pilot workload in high *g* and dense threat environment, and provides full HOTAS (hands on throttle and stick) operation. Astronautics air data computer. Elta multi-mode I band pulse-Doppler radar, developed from the EL/M-2021B, will include automatic target acquisition and track-while-scan in the air-to-air mode, and beam-sharpened ground mapping/terrain avoidance and sea search in the air-to-surface mode. The radar's coherent transmitter and stable multi-channel receiver are intended to ensure reliable lookdown performance over a broad band of frequencies, as well as high resolution mapping. An Elta programmable signal processor, backed by a network of distributed, embedded computers, will provide optimum allocation of computer power and considerable flexibility for algorithm updating and system growth. Advanced versions of Elbit ACE-4 mission computer (128K memory) and SMS-86 stores management systems, both compatible with MIL-STD-1553B or similar databus; SMS-86 will be capable of managing both conventional and 'smart' weapons and sensors. Integrated radar warning and electronic warfare self-protection system, by Elta Electronics, is designed to provide rapid threat identification (IFF) and flexible response (ECM). This computer

The Lavi flew for the first time on the last day of 1986



Two-seat version of the IAI Lavi close support, strike, and air defence fighter *(Pilot Press)*

based, fully automatic system will use active and passive countermeasures, including internal and externally podded power-managed noise and deception jammers and an Elisra radar warning receiver.

ARMAMENT: Internally mounted single-barrel 30 mm cannon, with helmet sight. Four underwing hardpoints for air-to-surface missiles, bombs, rockets, and other stores. Seven underfuselage stores attachments (three tandem pairs plus a 'wet' point on centreline). Infra-red air-to-air missile (Shafrir or Sidewinder) at each wingtip. Typical ground attack load could consist of eight 1,000 lb cluster bombs (six mounted semi-conformally under fuselage and two on underwing pylons), plus a 2,270 litre (499 Imp gallon; 600 US gallon) drop tank under each wing, a 1,325 litre (291.5 Imp gallon; 350 US gallon) centreline tank, and an air-to-air missile at each wingtip. Other combinations can include six underfuselage Mk 82 or Mk 117 bombs, with two more of the same under each wing; or, for air defence role, four underwing air-to-air missiles (making a total of six).

DIMENSIONS, EXTERNAL:

Wing span	8.78 m (28 ft 9⅓ in)
Wing aspect ratio	2.3
Length overall	14.57 m (47 ft 9⅓ in)
Height overall	4.78 m (15 ft 8¼ in)
Wheel track	2.31 m (7 ft 7 in)
Wheelbase	3.86 m (12 ft 8 in)

AREA:

Wings, gross	33.05 m² (355.75 sq ft)

WEIGHTS AND LOADING:

Weight empty, equipped	less than 7,000 kg (15,432 lb)
Max external load	approx 7,257 kg (16,000 lb)
T-O weight:	
basic, 'clean'	9,990 kg (22,024 lb)
with max external stores	19,277 kg (42,500 lb)
Max wing loading	583 kg/m² (119.5 lb/sq ft)

PERFORMANCE (estimated):

Max level speed above 11,000 m (36,000 ft)	Mach 1.8 (800 knots; 1,482 km/h; 921 mph CAS)
Low-altitude penetration speed:	
two infra-red missiles and eight 750 lb Mk 117 bombs	538 knots (997 km/h; 619 mph)
two infra-red missiles and two 2,000 lb Mk 84 bombs	597 knots (1,106 km/h; 687 mph)
Air turning rate at Mach 0.8 at 4,575 m (15,000 ft):	
sustained	13.2°/s
max	24.3°/s
Max rate of roll	300°/s
T-O run	approx 305 m (1,000 ft)
Combat radius:	
air-to-ground lo-lo-lo	600 nm (1,112 km; 691 miles)
air-to-ground hi-lo-hi with two Mk 84 or six Mk 82 bombs	1,150 nm (2,131 km; 1,324 miles)
air-to-air, combat air patrol	1,000 nm (1,853 km; 1,151 miles)
g limits	+9/−3

ILYUSHIN

SERGEI VLADIMIROVICH ILYUSHIN DESIGN BUREAU, Moscow Central Airport, Khodinka, Moscow, USSR

This design bureau has been made responsible for the smallest of the new generation of transport aircraft that are being developed and produced jointly by various Comecon nations and Yugoslavia for operation at the turn of the century. Its designation, Il-114, presumably indicates its relationship to the 18/32-passenger Il-14, the last small airliner produced by Ilyushin.

ILYUSHIN Il-114

Intended to replace aircraft in the class of the 44/52-passenger Antonov An-24, the Il-114 is being designed for short-haul and feeder services from both paved and grass surfaces. Equipment will be to the latest Soviet standards for ICAO Category I and II operations. Service life is intended to be 30,000 hours and 30,000 landings.

TYPE: Twin-turboprop short range passenger and freight transport.

WINGS: Cantilever low-wing monoplane. Dihedral from roots. Conventional all-metal structure. Double-slotted flaps, inboard and outboard of engine nacelle, and aileron occupy entire trailing-edge of each wing. Airbrake forward of each flap section. Two tabs in each aileron.

FUSELAGE: Conventional metal semi-monocoque structure of circular section.

TAIL UNIT: Conventional cantilever metal structure, with sweptback vertical surfaces. Two tabs in rudder; one in each elevator.

LANDING GEAR: Retractable tricycle type, with twin wheels on each unit, manufactured by WSK-PZL Krosno. Hydraulic retraction, with emergency extension by gravity. Oleo-pneumatic shock absorber in each unit. Nosewheels steerable ±55°. Brakes on mainwheels. All wheel doors remain closed except during retraction or extension of the landing gear.

POWER PLANT: Two 1,864 kW (2,500 shp) turboprops, each driving a six- or eight-blade WSK-PZL Warszawa-Okecie propeller with spinner.

ACCOMMODATION: Flight crew of two, plus stewardess. Four abreast seats for 60 passengers in main cabin, at 75 cm (29.5 in) seat pitch, with central aisle. Airstair type passenger door at front of cabin on port side. Galley, cloakroom, and toilet at rear, with emergency escape slide by door on starboard side. Emergency exit over each wing. Baggage hold door at front of cabin on starboard side. Optional large carry-on baggage shelves in lobby by main door at front of cabin.

AVIONICS: Digital avionics for automatic or manual control by day or night, including automatic approach and landing in limiting weather conditions (ICAO Category I and II).

DIMENSIONS, EXTERNAL:

Wing span	30.00 m (98 ft 5¼ in)
Length overall	25.46 m (83 ft 6½ in)
Diameter of fuselage	2.80 m (9 ft 2¼ in)
Height overall	8.60 m (28 ft 2½ in)
Propeller diameter	3.60 m (11 ft 9¾ in)

WEIGHTS:

Weight empty	13,000 kg (28,660 lb)
Max payload	6,000 kg (13,227 lb)
Max T-O weight	20,250 kg (44,640 lb)

PERFORMANCE (estimated):

Max cruising speed	270 knots (500 km/h; 310 mph)
Approach speed	97–102 knots (180–190 km/h; 112–118 mph)
Optimum cruising height	6,000–8,000 m (19,685–26,250 ft)
Balanced field length:	
paved	1,400 m (4,600 ft)
unpaved	1,650 m (5,415 ft)
Range, with reserves:	
with 5,400 kg (11,905 lb) payload	540 nm (1,000 km; 621 miles)
with 3,500 kg (7,715 lb) payload	1,538 nm (2,850 km; 1,770 miles)

FOKKER

FOKKER AIRCRAFT BV, PO Box 12222, 1100 AE Amsterdam-Zuidoost, Netherlands

The Fokker 50 twin-turboprop short-haul transport aircraft, described in the October 1986 *Jane's Supplement*, is now in service. Fokker's other new-generation transport, the twin-turbofan Fokker 100, made its first flight late last year and is due to enter service in the coming Autumn.

FOKKER 100

The Fokker 100 is based generally on the airframe of the F28 Fellowship Mk 4000 (1986–87 *Jane's*), but has a 5.74 m (18 ft 10 in) longer fuselage, enabling it to accommodate 107 passengers at 81 cm (32 in) pitch in standard configuration, compared with 85 at 74 cm (29 in) pitch in the F28. The much-redesigned wings have a 1.5 m (4 ft 11 in) extension of each tip; new leading-edges, with reduced kink; new trailing-edges, including new flaps; and a different outer-wing aerofoil section. These changes have the effect also of altering the overall wing profile, providing an increase of approx 18 per cent in area and some 30 per cent in aerodynamic efficiency. Accompanying this extensive redesign are structural changes that include the widespread use of glassfibre, aramid and carbonfibre composite materials, and an upgraded suite of digital avionics to ARINC 700 series standard. Under the designation A-1, the original F28 prototype (PH-JHG) has been rewired and reconfigured as an avionics testbed for the Fokker 100.

Artist's impression of Ilyushin Il-114 twin-turboprop airliner *(Jane's/Mike Keep)*

Two Fokker 100 prototypes will carry out a 1,200 hour flight test programme leading to FAR/JAR certification in October 1987. The first of these (PH-MKH) made a successful first flight, ending with an automatic landing, on 30 November 1986. This aircraft is powered by Rolls-Royce Tay Mk 620 turbofans, as selected for the standard version of the aircraft, but the Fokker 100 is also offered with the higher rated Mk 650 version of the Tay engine. Both are expected to comply with the Stage 3 requirements of FAR Pt 36 which came into operation in 1986.

Deliveries, to launch customer Swissair, are due to begin shortly after certification. By January 1987 the following orders and options for the Fokker 100 had been placed:

	Orders	Options
*GPA Fokker 100 Ltd	40	60
*International Lease Finance Corporation	8	—
KLM	10	5
Swissair	8	6
USAir	20	20
Undisclosed	3	—

**Leasing agencies*

TYPE: Twin-turbofan short/medium-haul transport.

WINGS: Cantilever low/mid-wing monoplane, based generally on F28 Mk 4000 (1986–87 *Jane's*) but with extensive design and structural changes including use of composites materials. Single-cell two-spar light alloy torsion box structure com-

prising centre-section (integral with fuselage) and sweptback, dihedral outer panels. Fail-safe construction, mainly of aluminium alloy, with aileron shrouds and wingroot fillets of aramid fibre. Adhesive bonding of metal components. Hydraulically actuated ailerons, each with aluminium alloy inset tab, and two-segment double-slotted Fowler trailing-edge flaps, are of carbonfibre. Ailerons are Menasco powered. Five-segment aluminium alloy spoilers/lift dumpers, forward of each pair of flaps, are also actuated hydraulically. Wingtips are of composites materials. Entire wing assembly manufactured by Shorts (UK), except for root fillets (Fokker). Hot air anti-icing of leading-edges.

FUSELAGE: Circular section semi-monocoque fail-safe structure, of mainly aluminium alloy construction. Nosecone is of aramid fibre; fuselage side panels, and skin over rear support frame for airbrakes, are of glassfibre. Metal structures have adhesive bonding. Hydraulically actuated light alloy petal airbrakes form tailcone when closed. Nose/flight deck module and centre-fuselage built by Fokker; MBB (Germany) responsible for forward and rear cabin sections and airbrakes.

TAIL UNIT: Cantilever T tail, with sweepback on all surfaces. Aramid fibre dorsal fin and carbonfibre rudder; remainder built of aluminium alloy, with extensive use of honeycomb sandwich skin panels. Variable incidence tailplane, and rudder, actuated hydraulically, with electric and manual operation respectively in an emergency; elevators have hydraulic boost. Menasco powered controls for elevators and rudder. Fin, dorsal fin, and entire horizontal tail by MBB, rudder by Fokker. Hot air anti-icing of leading-edges.

LANDING GEAR: Hydraulically retractable tricycle type, with twin wheels and Dowty Exports shock absorber on each unit. Main units retract inward into wing/body fairing; nose unit (steerable ±73°) retracts forward. Nosewheel doors manufactured by Shorts (UK). Goodyear tyres, size H40 × 14-19 on main units (pressure 8.96 bars; 130 lb/sq in) and size 24 × 7.7-10 (pressure 5.86 bars; 85 lb/sq in) on nose unit. Goodyear multiple-disc carbon brakes, with anti-skid system.

POWER PLANT: Standard power plant of two 61.6 kN (13,850 lb st) Rolls-Royce Tay Mk 620-15 turbofans, pylon mounted on sides of rear fuselage; nacelles (with carbonfibre cowl doors) and thrust reversers supplied by Grumman. Also available with 67.2 kN (15,100 lb st) Tay Mk 650 turbofans. Fuel in 4,870 litre (1,071 Imp gallon; 1,286.5 US gallon) main tank in each wing and 3,300 litre (726 Imp gallon; 872 US gallon) tank (seven flexible cells) in wing centre-section, giving total standard internal capacity of 13,040 litres (2,868 Imp gallons; 3,445 US gallons). Refuelling point under starboard wing, near wing/fuselage belly fairing. Oil capacity (two engines) 23 kg (51 lb).

ACCOMMODATION: Crew of two on flight deck, plus three or four cabin attendants. Standard accommodation for 107 passengers, in five-abreast seating (2 + 3) at 81 cm (32 in) pitch. Optional layouts include 12 first class seats (four-abreast) at 91 cm (36 in) pitch plus 85 economy class (five-abreast) at 32 in; 55 business class at 86 cm (34 in) plus 50 economy class at 32 in, all five-abreast; or 119 tourist class passengers at 74 cm (29 in) pitch. Aircraft for Swissair configured for 84 passengers (8 first class, 53 business class, and 23 economy). Standard layout includes two galleys, two stowage/wardrobe compartments, and a carry-on baggage compartment at front, with two toilets and two wardrobes at rear. Overhead bins, capacity 0.05 m³ (1.7 cu ft) per passenger, in all configurations. Reduced galley and stowage space in 119-seat layout. Outward opening passenger door at front of cabin on port side, with outward opening service/emergency door opposite on starboard side. Two overwing emergency exits (inward opening plug type) on each side are standard; additional Type I emergency exit aft of wing on port side is optional (standard on 119-seat version). Two underfloor baggage/cargo holds (one forward of wing, one aft), each with downward opening door on starboard side. Entire accommodation pressurised and air-conditioned.

SYSTEMS: Garrett air-conditioning and pressurisation system. Two fully independent hydraulic systems for actuation of flight control surfaces, landing gear, brakes, and nosewheel steering. Garrett pneumatic system. Sundstrand electrical system. Oxygen system for flight crew and passengers. Garrett thermal anti-icing system for wings and tail unit. Electric anti-icing of flight deck windows, pitot tubes, static vents, angle of attack vanes, and ice detector probe. Garrett GTCP 36-150 APU for on-ground operation of environmental control system.

AVIONICS: Standard avionics include dual VHF com (to ARINC 716), PA system (ARINC 715), ATC transponder (ARINC 718), triple AHRS (ARINC 705), dual radio altimeters (ARINC 707), dual VOR with marker beacon receiver (ARINC 711), dual ILS (ARINC 710), dual ADF (ARINC 712), dual DME (ARINC 709), Collins primary flight display (PFD) and navigation display (ND) for each pilot, dual digital air data systems (ARINC 706) with computer driven instruments, weather radar (ARINC 708 on ND), dual flight management control system (FMCS) plus full flight regime autothrottle system, and Collins digital automatic flight control and augmentation system (AFCAS) for Cat. IIIA automatic landing. Optional avionics include single or dual HF com (ARINC 719), third VHF com, Selcal (ARINC 714), second ATC, third ILS, third radio altimeter, dedicated display for weather radar, and Cat. IIIB autoland capability.

The relationship of the Fokker 100 to the F28 Fellowship that it replaces is clearly evident in this flight photograph of the prototype

DIMENSIONS, EXTERNAL:

Wing span	28.08 m (92 ft 1½ in)
Wing chord: at root	5.57 m (18 ft 3¼ in)
at tip	1.09 m (3 ft 7 in)
Wing aspect ratio	8.4
Length overall	35.53 m (116 ft 6¾ in)
Fuselage: Length	32.50 m (106 ft 7½ in)
Max diameter	3.30 m (10 ft 10 in)
Height overall	8.50 m (27 ft 10½ in)
Tailplane span	10.04 m (32 ft 11¼ in)
Wheel track	5.04 m (16 ft 6½ in)
Wheelbase	14.00 m (45 ft 11¼ in)
Passenger door (fwd, port):	
Height	2.21 m (7 ft 3 in)
Width	0.86 m (2 ft 9¾ in)
Service door (fwd, stbd):	
Height	1.28 m (4 ft 2½ in)
Width	0.61 m (2 ft 0 in)
Cargo compartment doors (fwd and rear, stbd):	
Height (each)	0.95 m (3 ft 1½ in)
Width (each)	0.90 m (2 ft 11½ in)
Height to sill (MTOW):	
fwd door at front	1.35 m (4 ft 5¼ in)
fwd door at rear	1.41 m (4 ft 7½ in)
rear door	1.56 m (5 ft 1½ in)
Overwing emergency exits (four, each):	
Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck:	
Length	21.19 m (69 ft 6¼ in)
Max length of seating area	18.80 m (61 ft 8¼ in)
Max width	3.10 m (10 ft 2 in)
Width at floor	2.89 m (9 ft 5¾ in)
Max height	2.01 m (6 ft 7¼ in)
Max floor area	58.48 m² (629.5 sq ft)
Max volume	107.58 m³ (3,799 cu ft)
Overhead stowage bins (total)	5.23 m³ (184.7 cu ft)
Additional baggage space (total)	3.00 m³ (105.9 cu ft)
Underfloor compartment volume:	
fwd	9.8 m³ (346 cu ft)
rear	7.36 m³ (260 cu ft)

AREAS:

Wings, gross	93.5 m² (1,006.4 sq ft)
Ailerons (total)	3.528 m² (37.98 sq ft)
Trailing-edge flaps (total)	17.00 m² (182.99 sq ft)
Spoilers (total)	2.65 m² (28.52 sq ft)
Rudder	2.30 m² (24.76 sq ft)
Elevators (total)	7.68 m² (82.67 sq ft)

WEIGHTS: (A: standard version with Mk 620 engines; B: design targets for version with optional Mk 650 engines):

Typical operating weight empty:	
A	23,870 kg (52,625 lb)
B	24,170 kg (53,285 lb)
Max payload (weight-limited):	
A	11,280 kg (24,870 lb)
B	12,570 kg (27,710 lb)
Max fuel: A	10,470 kg (23,080 lb)
B	11,685 kg (25,760 lb)
Max ramp weight: A	43,320 kg (95,500 lb)
B	44,680 kg (98,500 lb)
Max T-O weight: A	43,090 kg (95,000 lb)
B	44,450 kg (98,000 lb)
Max landing weight: A	38,780 kg (85,495 lb)
B	39,915 kg (88,000 lb)
Max zero-fuel weight:	
A	35,150 kg (77,490 lb)
B	36,740 kg (81,000 lb)

PERFORMANCE (A, estimated, at max T-O weight except where indicated):

Max operating speed	Mach 0.75 (320 knots; 593 km/h; 368 mph CAS)
Design approach speed at max landing weight	129 knots (239 km/h; 149 mph)
Max rate of climb at S/L	152 m (500 ft)/min
Max operating height	10,670 m (35,000 ft)
FAR T-O field length for a 300 nm sector (S/L, ISA)	1,500 m (4,922 ft)
FAR landing field length at max landing weight (S/L, ISA)	1,360 m (4,462 ft)
Range with 107 passengers and baggage, minimum fuel speed schedule	1,340 nm (2,483 km; 1,543 miles)

OPERATIONAL NOISE LEVELS (FAR Pt 36, estimated):

Flyover	85.4 EPNdB
Approach	97.0 EPNdB
Sideline	93.6 EPNdB

GYROFLUG

GYROFLUG INGENIEURGESELLSCHAFT mbH, Flughafen, 7570 Baden-Baden/Oos, Federal Republic of Germany

Dipl-Ing Peter Krauss and Herr Jörg Elzenbeck built, and in April 1977 flew for the first time, the first Rutan VariEze two-seat homebuilt aircraft to be completed in Europe (D-EEEZ). They decided to develop, manufacture, and market a modified version, known as the Speed Canard, as a ready to fly, certificated production aircraft that would conform to the requirements of FAR Pt 23. In August 1978, with Dipl-Ing Wolfgang Schiller, they formed Gyroflug for this purpose at a facility in Ludwigsburg; activities were transferred to the Glaser-Dirks sailplane factory at Bruchsal in April 1979.

Gyroflug SC 01-160 Speed Canard; 17th production aircraft

After the death of Herr Krauss the company was reorganised under the managing directorship of Herr Schiller, and in April 1980 Dipl-Ing Rudolf Voit-Nitschmann was appointed as chief engineer responsible for bringing the Speed Canard to production standard. The company was relocated to Baden-Oos in February 1984; at the end of that year all holdings were acquired by Gyroflug's present managing director, Dr-Ing Christian Hoseit, and the company became a member of the Justus Dornier Group. In mid-1986 it had a workforce of 15 people; a new factory was under construction in the second half of that year.

GYROFLUG SC 01 and SC 01 B SPEED CANARD

As well as being slightly larger overall than the Rutan VariEze, from which it is basically derived, the Speed Canard differs in a number of important details. Its swept wing retains the NASA winglets, though currently of a larger size, that have proved so successful on the original design, but utilises a new aerofoil section offering considerable reduction in drag. Instead of retaining the glassfibre/foam core structure of the VariEze, the Speed Canard is made of GRP and CFRP composites laid up in female moulds, giving a lighter structure optimised for series production. Wings and other glassfibre components are manufactured by Glaser-Dirks; final assembly and flight testing are by Gyroflug.

Construction of the first prototype (D-EEEX, c/n A-1) began in late 1978, and this aircraft made its first flight, with a DFVLR test pilot, on 2 December 1980. Initial test flights revealed the need for a number of design changes before it could be approved for series production. Of these, the principal one was the adoption of a new Eppler aerofoil section, claimed to give a 30 per cent reduction in drag, and a new 'first' flight with this modified wing was made by D-EEEX on 10 July 1981. A second airframe (c/n A-2) was completed in 1982 for static testing, followed by a second flying prototype (D-EEEW, c/n A-3), which made its initial flight on 17 April 1983 and enabled the Speed Canard to receive German LBA type certification on 30 September that year.

Series production began with the fourth aircraft (D-EELZ, c/n S-4), and 20 examples of this initial version were built by September 1985 for customers in Germany (17), Switzerland (2), and Belgium (1). As built with the standard O-235 engine, they are designated **SC 01**; some examples have been retrofitted with the more powerful O-320 engine, in which form they are known as the **SC 01-160**.

Beginning with c/n S-24, current production models are designated **SC 01 B** (O-235 engine) and **SC 01 B-160** (O-320 engine). These versions, which first flew in the Summer of 1985 and received LBA certification on 26 March 1986, differ in having NASA winglets of doubled area, plus other minor improvements. Ten B/B-160s had been ordered by May 1986, at which time production (which is to order) was at the approximate rate of one per month. A number of earlier Speed Canards have also been modified to the current B/B-160 standard. British and Dutch certification of the aircraft was anticipated by the end of 1986, as was a decision on whether to proceed with a four-seat version.

TYPE: Two-seat sporting aircraft.

WINGS: Cantilever mid-wing monoplane. Short-span centre-section strakes, sweptback approx 60° on leading-edges, without anhedral or dihedral. Main wings have an Eppler E793 aerofoil section, with thickness/chord ratio of 15.6%, anhedral angle of 5° 54′, and 22° sweepback at quarter-chord. Single-spar structure of GRP and CFRP, without ribs. Each wingtip is upswept at nearly 90° to form a slightly outward canted NASA type winglet with inset rudder. Centrally located aileron in each wing trailing-edge. No flaps. No aileron or rudder tabs. Main wings are detachable for transportation and storage.

FOREPLANE: Narrow-chord cantilever structure, of Eppler E1231 aerofoil section, mounted high on nose. Balanced elevator, with fixed tab near inboard end, on each trailing-edge. Construction (GRP and CFRP) similar to that of wings.

FUSELAGE: Oval-section nacelle type, of GRP composites construction.

LANDING GEAR: Tricycle type, with fixed main units and electrically retractable nosewheel which is carried on a carbon/Kevlar strut moulded to conform to the outside contour of the fuselage, eliminating need for a fairing door. Main units, carried on cantilever self-sprung carbon/Kevlar struts, are fitted with Cleveland wheels (tyre size 5.00-5), Cleveland disc brakes, and speed fairings. The Scott nosewheel, which retracts rearward, is fitted with a size 10 × 3.5-4 tyre. Nosewheel strut is hinged to allow aircraft to be parked in a 'kneeling' position with only the wheel exposed.

POWER PLANT (SC 01 and SC 01 B): One 86.5 kW (116 hp) Avco Lycoming O-235-P2A flat-four engine, mounted in the rear fuselage and driving a Hoffmann HO-V113B-L/LD 150 + 2A three (composites)-blade variable-pitch pusher propeller with spinner. Fuel in two integral tanks (one in each wing centre-section strake) with combined capacity of 160 litres (35.2 Imp gallons; 42.3 US gallons). Oil capacity 6 litres (1.32 Imp gallons; 1.58 US gallons).

POWER PLANT (SC 01-160 and SC 01 B-160): One 119 kW (160 hp) Avco Lycoming O-320-D1A flat-four engine, driving an MT-Propeller (Mühlbauer) MTV-6-C/LD 152-07 three-blade variable-pitch propeller. Fuel capacity as for lower powered versions. Oil capacity 8 litres (1.76 Imp gallons; 2.11 US gallons).

ACCOMMODATION: Pilot and passenger in tandem, on semi-reclining seats in individual cockpits. Side-stick controls. Separate one-piece moulded canopies, both opening sideways to starboard. Space for 15 kg (33 lb) of baggage aft of rear seat. Both cockpits heated and ventilated.

ELECTRICAL SYSTEM: Alternator to provide power to actuate nosewheel extension/retraction mechanism.

AVIONICS AND EQUIPMENT: To customer's requirements. Can be equipped to full IFR standard, including autopilot.

DIMENSIONS, EXTERNAL:

Wing span	7.77 m (25 ft 6 in)
Foreplane span	3.60 m (11 ft 9¼ in)
Foreplane chord, constant	0.34 m (1 ft 1¼ in)
Wing aspect ratio	7.70
Foreplane aspect ratio	10.62
Length overall	4.70 m (15 ft 5 in)
Fuselage: Length	4.40 m (14 ft 5¼ in)
Max width	0.74 m (2 ft 5 in)
Max depth	1.06 m (3 ft 5¾ in)
Height overall: 01	1.60 m (5 ft 3 in)
01 B	1.81 m (5 ft 11¼ in)
Wheel track	1.66 m (5 ft 5¼ in)
Wheelbase	2.47 m (8 ft 1¼ in)
Propeller diameter	1.52 m (5 ft 0 in)
Propeller ground clearance	0.31 m (1 ft 0¼ in)

DIMENSIONS, INTERNAL:

Cockpits:	
Max combined length	2.80 m (9 ft 2¼ in)
Max width	0.64 m (2 ft 1¼ in)
Max height	0.99 m (3 ft 3 in)

AREAS:

Wings, gross	7.84 m² (84.39 sq ft)
Foreplane, gross	1.22 m² (13.13 sq ft)
Ailerons (total)	0.376 m² (4.05 sq ft)
Winglets (total): 01	1.10 m² (11.84 sq ft)
01 B	2.20 m² (23.68 sq ft)
Rudders (total)	0.168 m² (1.81 sq ft)
Elevators (total, incl tabs)	0.33 m² (3.55 sq ft)

WEIGHTS AND LOADINGS (A: with O-235, B: with O-320 engine):

Weight empty: A	420 kg (926 lb)
B	440 kg (970 lb)
Max fuel: A, B	115 kg (253 lb)
Max payload with 100 litres (22 Imp gallons; 26.4 US gallons) fuel:	
A	188 kg (414.5 lb)
B	204 kg (450 lb)
Max T-O weight: A	680 kg (1,499 lb)
B	715 kg (1,576 lb)
Max landing weight: A, B	680 kg (1,499 lb)
Max wing/foreplane loading:	
A	75.05 kg/m² (15.38 lb/sq ft)
B	78.92 kg/m² (16.16 lb/sq ft)
Max power loading:	
A	7.86 kg/kW (12.92 lb/hp)
B	6.01 kg/kW (9.85 lb/hp)

PERFORMANCE (at max T-O weight, A and B as above):

Never-exceed speed:	
A, B	197 knots (365 km/h; 226 mph) IAS
Max level speed at S/L:	
A	146 knots (270 km/h; 168 mph)
B	159 knots (295 km/h; 183 mph)
Max cruising speed, 75% power:	
A at 1,830 m (6,000 ft)	143 knots (265 km/h; 165 mph)
B at 2,135 m (7,000 ft)	153 knots (283 km/h; 176 mph)
Econ cruising speed, 65% power:	
A at 3,050 m (10,000 ft)	138 knots (257 km/h; 160 mph)
B at 3,350 m (11,000 ft)	148 knots (275 km/h; 171 mph)
Stalling speed:	
A, B	57 knots (105 km/h; 66 mph) IAS
Max rate of climb at S/L:	
A	300 m (985 ft)/min
B	396 m (1,300 ft)/min
Service ceiling: A	4,420 m (14,500 ft)
B	5,640 m (18,500 ft)
T-O run: A	450 m (1,475 ft)
B	350 m (1,150 ft)
T-O to 15 m (50 ft):	
A	700 m (2,300 ft)
B	540 m (1,770 ft)
Landing from 15 m (50 ft):	
A, B	700 m (2,300 ft)
Landing run: A, B	300 m (985 ft)
Range with max fuel, no reserves:	
55% power:	
A	1,025 nm (1,900 km; 1,180 miles)
B	815 nm (1,510 km; 938 miles)
Range at S/L with max fuel, 45 min reserves:	
75% power:	
A	728 nm (1,350 km; 839 miles)
B	553 nm (1,025 km; 637 miles)
45% power:	
A	1,011 nm (1,875 km; 1,165 miles)
B	715 nm (1,325 km; 823 miles)
g limits: A, B	+4.4/−2.2

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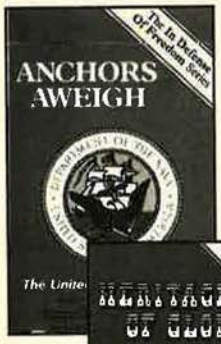

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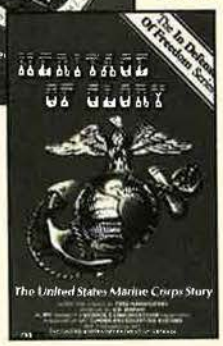

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AIRMAN'S BOOKSHELF

Gallic Airpower

A History of French Military Aviation, by Charles Christienne and Pierre Lissarrague (translated by Frances Kianka). Smithsonian Institution Press, Washington, D. C., 1986. 531 pages with illustrations, bibliography, and index. $45.

Every year there appears a veritable torrent of scholarly and popular histories of the major air forces of the world. This flood of studies tells us once more of American, British, and German pilots and planes, of the strategies, tactics, and battles long past or of recent occurrence.

As odd as it may seem, there has long been a dearth of historical accounts and analyses of French military aviation. Now, two eminent French scholars have come forth with a new work that attempts valiantly—but not without problems—to fill this vacuum.

The story of French military aviation begins with the development of observation balloons in the eighteenth century. The French were the first Europeans to use such devices as aerial observation posts; their early aeronauts can accurately be described as the true ancestors of all modern aviators. Balloon companies were formed as early as 1794 for use during the French Revolution.

By the late nineteenth century, "captive" balloons began to give way to the more sophisticated rigid dirigible. The French, rivaled only by the Germans, led the world in dirigible technology before World War I. But the emerging, more promising airplane brought further evolution of the dirigible to a virtual standstill.

Just as Col. Charles Renard had spearheaded the development of the dirigible as a formidable military platform during his day, Capt. Ferdinand Ferber led the early French pioneers into heavier-than-air flight. Because of his innovations, France took an early lead in both civilian and military aeronautics. French biplanes designed by Ferber saw limited combat action, the first *escadrilles* (squadrons) were formed, and aircrews received training in aerial bombing and gunnery.

When World War I erupted in 1914, however, the Germans held a distinct qualitative lead in military aviation. But because of the twin emphases on sport flying and the development of a dynamic aeronautics industry, France enjoyed a large pool of pilots and engineers from which to build a force that would ultimately prove to be the difference in the aerial battles of that war.

The first year of the war saw the subordination of strategy and tactics to the development of airplanes that could fight effectively. Real aerial combat was born in 1915; the next year, at Verdun, the fighter plane came of age. That year witnessed the birth of the then-revolutionary notion that aerial superiority, secured by massed aircraft operating as an independent force, was a prerequisite to battlefield victory.

Technical progress by 1918 was amazing in light of the rather primitive state of aeronautics only four years earlier. The French Blériots of 1914 had a top speed of eighty kilometers an hour; the later Spads could attain 220 kmh. The prewar ceiling of 1,000 meters had risen to 7,000 meters. Aerial armor was introduced, along with radio and aerial photography and, for the pilots, oxygen, electrically heated flying suits, and parachutes. French-built aircraft were admired for their power and efficiency, and French strategy had successfully combined airpower and armor during the war.

Yet by the time of the Armistice in 1918, the great lessons of the air war seemed to have escaped the French military. Interservice rivalry and the prevailing notion that the fledgling French Air Force had not proved itself sufficiently pushed the French Air Force and French aviation industry to a low priority in military planning—a result that would prove disastrous in the next war.

The war had seen the birth of a new French hero. The aviator had become a romantic figure in French eyes, but jealous generals and admirals downplayed the role of airpower. (As late as the 1960s, one prominent French general described pilots as "frivolous, pleasure-loving types.")

In the interwar years, the Air Force was demoralized by demobilization and suffered severe budget cuts that negated any viable role for airpower in French war planning. The once-formidable French Air Force crumbled into obsolescence. New fighter and bomber aircraft were neglected, modern antiaircraft weapons never reached production, aging relics continued to fly from grass fields, and the officer corps dwindled precipitously in number.

As the authors note, "French aviation was suffering from the fact that the ranking military leaders simply did not believe in it." Hiding behind the false security of their Maginot Line, army commanders virtually assured that their outmanned, outgunned, and outdated Air Force would face defeat. In war, the valiant aircrews would have precious few alternatives but to go up and throw away their lives for the honor of their country.

Though World War II began in September 1939, the ensuing "Phony War" on the Western Front gave France a brief respite during which to attempt to match the size and quality of the Luftwaffe. Even so, when the Germans launched their western offensive in May 1940, they still enjoyed a 5:2 ratio over the French in modern combat aircraft. The French Air Force fought the Luftwaffe heroically, but to no avail. With the surrender of France and the creation of the Vichy government, the French Air Force was suddenly reduced to a small, impotent, German-dominated territorial organization. For practical purposes, the French Air Force disappeared in all but name.

The accomplishments of military aviation in World War II ratified the immense significance of airpower in modern warfare. But, as happened after World War I, the French military resisted the lessons of the war. While

acknowledging the contributions of airpower, military leaders again subordinated the French Air Force to the army and navy. And so has it largely continued, even given the nuclear realities of the 1980s.

A History of French Military Aviation is a well-organized and attractive book. Profusely illustrated, it contains more than 400 photographs of vintage and modern aircraft and the airmen who flew them. A special feature is the twelve full-page reproductions of oil paintings depicting French military aviation history. In addition, the book includes useful statistical tables, orders of battle, unit and personnel data, and a complete index.

Unfortunately, this otherwise fine book contains some glaring weaknesses. Despite its bulk, the entire work is sketchy and generalized. While it offers an excruciatingly detailed chronological account of the evolution of French aviation, the authors do not address tactics and strategy in depth or present any analysis of doctrine. In addition, vital political aspects of French military history tend to be neglected.

But overall, this work is a readable, interesting, and informative effort that goes a long way toward filling a void in the study of French aviation history. It is a welcome addition to the story of Western military aviation and the men and aircraft that contributed so much to its rich traditions.

—Reviewed by Dr. William J. Teague. Dr. Teague teaches American government at the University of Texas at Dallas and is a regular reviewer for this magazine.

New Books in Brief

Air Leadership, edited by Richard H. Kohn and Joseph P. Harahan. This Project Warrior Study, part of a series of historical volumes produced by the Office of Air Force History, presents the proceedings of a 1984 conference that examined air leadership by considering case studies of two prominent commanders—Gen. Carl A. Spaatz, first Chief of Staff of the US Air Force, and Rear Adm. William A. Moffett, Chief of the Navy's Bureau of Aeronautics during the 1920s. In their examinations of the backgrounds and professional experiences of these two men, conference participants address broader questions of leadership, reaching conclusions about that intangible quality that are certain to reverberate for today's airman. With notes and index. Published by the Office of Air Force History; available from Superintendent of Documents, GPO, Washington, D. C., 1986. 168 pages. $6.50.

The Grim Reapers: Fighting Squadron Ten in World War II, by Peter Mersky. The pilots of VF-10—the "Grim Reapers"—saw three years of action in the Pacific theater during World War II as members of the only Navy unit to fly in combat each of the three major carrier-based fighters of the war (the F4F Wildcat, the F6F Hellcat, and the F4U Corsair). Embarked aboard the legendary *Enterprise* and later on the *Intrepid,* the Reapers flew against the enemy over Guadalcanal, during the Marianas Turkey Shoot, and finally over the Japanese home islands. Author Mersky, relying on contemporary action reports, war diaries, and reminiscences by former pilots, spins out a gripping tale of naval air combat in this harvest of Reaper lore. With photos, appendix, and bibliography. Champlin Museum Press, Mesa, Ariz., 1986. 132 pages. $10.95.

Land-Based Air Power in Third World Crises, by David R. Mets. Dr. Mets undertakes in this scholarly work a critical examination of how land-based airpower can be used to attain political objectives during crisis. In studying historical incidents that he characterizes as ranging from "simple" to "complex," the author underscores the utility of such assets "to signal intentions, demonstrate support, modify behavior, and terminate conflict." While he lauds the flexibility and responsiveness of airpower in such situations, he outlines its shortcomings, which include basing and overflight restrictions and, in situations involving airlift of supplies, the inability to transport relatively large volumes of cargo. Given rising turbulence in the Third World, Dr. Mets's work merits serious attention by civilian and military policymakers. With illustrations, notes, bibliographical essay, and index. Published by Air University Press; available from Superintendent of Documents, GPO, Washington, D. C., 1986. 168 pages. $5.

A Missing Plane, by Susan Sheehan. This factual account of the discovery of a downed B-24 in the jungles of New Guinea more than three decades after it crashed rivals the best of suspense fiction. On March 24, 1944, 2d Lt. Robert E. Allred, his crew, and nineteen passengers were reported missing during a routine flight. Thirty-eight years later, the wreck was discovered on the slopes of the rugged Owen Stanley Range, and the Army's Central Identification Laboratory was called on to excavate the site and recover any remains. Author Sheehan, in tracing the story of the downed aircraft from Stateside to the doomed last flight to the painstaking recovery and identification effort by the CIL team, mines high drama from the ore of this wartime tragedy. G. P. Putnam's Sons, New York, N. Y., 1986. 201 pages. $18.95.

The Soviet Cosmonaut Team, by Gordon R. Hooper. Billed as "a comprehensive guide to the men and women of the Soviet manned space program," this book is destined to become a valued reference work in the years ahead. In the first section of the book, the author details Soviet spaceflight logs, crew assignments, individual space programs, training centers, and other background subjects. The more extensive second section presents nearly 100 biographies of the cosmonauts—Soviet or otherwise—who flew on Soviet space missions. Author Hooper, a specialist on the Soviet manned space program, is a Fellow of the British Interplanetary Society. With photos. Published by GRH Publications; distributed by Univelt, Inc., San Diego, Calif., 1986. 320 pages. $25.

Soviet Ground Forces: An Operational Assessment, by John Erickson, Lynn Hansen, and William Schneider. While other works have addressed the hardware and organization of the Red Army, this book focuses on how the Soviets would employ their air and ground forces in a land war. After tracing the evolution of the Soviet Army since World War II, the authors study Soviet procedures for conduct of offensive and defensive combat operations, combat under special conditions, logistics, personnel, command and control, battlefield coordination, special operations, and other pertinent subjects. In light of Soviet emphasis on the combined-arms offensive, special attention is given to integration and employment of air-land forces. While the authors concede the Soviets a near-invincible defensive conventional combat capability, they express doubt that the Soviet military could "maintain the norms it has set for the ratios of forces necessary to achieve victory." Military professionals will find much to ponder in this meaty book. With figures, glossary, bibliography, and index. Westview Press, Boulder, Colo., 1986. 268 pages. $26.

—Reviewed by Hugh Winkler, Assistant Managing Editor.

AFA's Industrial Associates

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AFA INTERCOM

By Robin Whittle, AFA DIRECTOR OF COMMUNICATIONS

Memorial Dedicated at McGuire AFB

More than 3,000 people, including Defense Secretary Caspar Weinberger, New Jersey Gov. Thomas Kean, and Rep. H. James Saxton (R-N. J.), turned out on a Saturday morning in November for the dedication of a memorial to the legendary Maj. Thomas B. McGuire, Jr., at the Air Force base named in his honor. It was a dream come true for AFA's Bill Demas, who came up with the idea of a memorial and immediately got to work on it when he was president of the local McGuire AFA Chapter in 1977–78. (During his two-year term as president, the McGuire Chapter was named the outstanding chapter in the nation for an unprecedented two consecutive years, and Mr. Demas was named AFA's Man of the Year for 1978.)

Almost a decade and hundreds of thousands of dollars later, the completed memorial proved worth the wait. Featuring a P-38 Lightning perched high atop a dramatic concrete edifice created by architect Ken Gardner, the memorial is a fitting tribute to a man who torched the skies in a P-38 named *Pudgy*. The nickname was an endearment for his young wife, who would lose him to legend over Negros Island in the Philippines on January 7, 1945, but only after he had scored thirty-eight kills, making him one of the top aces of World War II, second only to Dick Bong, who scored forty victories.

That fateful day, Major McGuire had gone to the aid of a friend in combat and did not have time to release his drop tanks. The mistake caused *Pudgy* to spin out of control, and plane and pilot went in. His final act of heroism earned him the Medal of Honor. McGuire's widow, Marilyn Beatty, was among the distinguished guests at the dedication, which was emceed by Col. Jerold L. Weiss, Commander of the 438th Military Airlift Wing.

"When I was in New Guinea . . . I can't tell you how comforting it was to those of us in the infantry and usually in the mud to see this very distinctive [P-38] silhouette," recalled Secretary Weinberger, according to press accounts. "For one thing, we knew it wasn't a Zero, and we also knew it was manned by some extraordinary, able, and capable people who were helping us."

At McGuire AFB, N. J., dignitaries, including Secretary of Defense Caspar Weinberger, assemble beneath the P-38 memorial to World War II ace Maj. Thomas B. McGuire, Jr. The dedication ceremony took place last November. See the accompanying story for details.

McGuire epitomized what an American soldier should be, Secretary Weinberger noted. "He was daring and yet careful of his men, he was proud, not boastful, he was decisive and flexible, and he was caring and yet as exacting as a leader has to be. He was leadership born of deeds—and uncommon valor."

The Secretary also expressed his congratulations to the Thomas B. McGuire, Jr., Foundation, which was founded and is presided over by Mr. Demas to raise funds for the memorial, "for this gift to New Jersey, to America's military veterans, and to the nation."

Governor Kean, in proclaiming November 7 "Maj. Thomas B. McGuire Day," praised McGuire as an ordinary citizen who demonstrated extraordinary courage and ability and who, in the end, gave his life while trying to rescue a friend. Such ordinary citizens, the Governor said, have paid the price for the way of life we enjoy in this country.

During the dedication, Mrs. Beatty and Secretary Weinberger unveiled a

A Tip of the AFA Hat

A tip of the hat to AFA's McGuire Chapter, which over the years has purchased thirteen Jimmy Doolittle and Ira Eaker Fellowships in AFA's Aerospace Education Foundation. Further, records show that the Chapter annually purchases fifty Scott Associate plaques from the Foundation to honor blue-suiters—enlisted and officer—at McGuire AFB. It also demonstrates its support of the enlisted ranks and the Foundation by purchasing a table at the Iron Gate Chapter's prestigious Air Force Salute in New York City and filling the table with outstanding enlisted members. Hats off to Chapter President Esther F. Gregory and McGuire Chapter officers for their support of the Aerospace Education Foundation and for making AFA's commitment to the enlisted ranks a reality at McGuire AFB.

plaque at the base of the memorial that bears a replica of the P-38 McGuire flew in combat. Four F-4s from the 108th Tactical Fighter Wing of the New Jersey Air National Guard streaked across the sky in a poignant missing-man formation that concluded the ceremonies as taps was played and a rifle salute fired.

In recounting the effort that led to the successful completion of the memorial, which includes a "Freedom Walk" that is impeccably groomed and a museum housing McGuire memorabilia, Mr. Demas said it truly represented the American spirit of volunteerism.

"We went to the charities, the townships, the clubs, and even sold a magazine, recounting the McGuire story, to raise funds," Mr. Demas said. The Foundation raised $500,000 and solicited an army of volunteers, including the American Bricklayers Association, which donated 30,000 bricks and laid them for the memorial.

"One of the greatest difficulties was locating a P-38," Mr. Demas recalled. At one point, they located one at the Smithsonian's Silver Hill, Md., complex, but it was in thousands of rusted pieces, "and even that plan fell through," he said. With that, Mr. Demas almost gave up. But the hard-charging Greek native kept trying, and eventually he got word of a P-38 in California that was to be donated to the Air Force Museum at Wright-Patterson AFB, Ohio.

"With the help of a lot of people, we were able to bring it to McGuire AFB on May 5, 1981, but not without difficulty. It broke down en route, and we had to go to the Smithsonian Institution for parts," Mr. Demas said. It arrived in camouflage markings and required "20,000 hours of volunteer time for restoration to its original beauty," he said.

The Lightning was placed on its pedestal in 1982, and the project was finished in 1983, but the dedication was delayed in the hope of getting President Reagan to attend.

"It was a disappointment that those plans never came to pass, because this project was truly a volunteer effort, but we were pleased that Secretary Weinberger and the other dignitaries could be with us," Mr. Demas said.

Other dignitaries participating in the dedication were Gen. Duane H. Cassidy, CINCMAC; Maj. Gen. Francis R. Gerard, New Jersey National Guard Commander; Maj. Gen. Jack W. Sheppard, Twenty-first Air Force Commander; Brig. Gen. Michael J. Jackson, USAF (Ret.), Chairman of the Dedication Committee; Col. Francis S. Gabreski, USAF (Ret.), top living US ace, representing the American Fighter Aces Association; and Bill Demas, founder and President of the Thomas B. McGuire, Jr., Foundation.

Also in the audience were six Medal of Honor recipients and numerous members of Major McGuire's unit—the 475th Fighter Group, known as "Satan's Angels"—who were honored the night before at a banquet sponsored by AFA's Maj. Thomas B. McGuire, Jr., Chapter and the McGuire Foundation. The Army Command at Fort Dix provided its 19th Army Band, and a squad from the 2d Battalion, 3d Brigade, fired the rifle salute with the playing of taps.

INTERCOM

A special session of Pennsylvania's Superior Court was convened to honor Judge John Brosky, seated, a former AFA National President and Board Chairman, for distinguished contributions to the legal profession. More than 400 of his colleagues and friends attended the event.

Court Convenes to Honor Judge Brosky

The Chief Justice of the Superior Court of Pennsylvania convened a Special Session on December 9 for one purpose—to honor Judge John G. Brosky for his nearly thirty years of outstanding contributions as a member of the judiciary. But it was much more than a session in court. More than 400 members of the judiciary, the Bar Association, elected officials from city, county, state, and federal levels, as well as business and community leaders from throughout the United States joined the entire Court of Judges in honoring Judge Brosky, who is a former AFA National President (1981–82) and Board Chairman (1982–84).

AFA National Director Carl J. Long, who attended the session, said that part of the ceremonies included the unveiling of a portrait of Judge Brosky by artist Ray W. Forquer. The painting had been commissioned by the Allegheny County Bar Association to commemorate Judge Brosky's achievements and contributions to the legal profession.

"People came from all over the United States, including Hawaii, to honor the Judge, and it's the first time I've ever seen him speechless. It was a complete surprise, and he was choked up," Mr. Long said.

Another surprise came when the Judge was escorted to a special reception for additional well-deserved honors and testimonials. Among his achievements during a distinguished career are establishing the foundation for the Equal Rights Amendment to the Pennsylvania Constitution and acting as lead jurist in declaring many laws in the Divorce Code unconstitutional. He was named "Man of the Year" in law by the Pittsburgh Jaycees and the Chartiers Valley Chamber of Commerce, and he received the State Humanitarian Award from the Pennsylvania Domestic Relations Association, to name just a few of his many honors.

On the Scene

A big Texas welcome was extended to **Lt. Gen. Kenneth L. Peek,** Commander of Eighth Air Force, by AFA's Fort Worth Chapter when the General addressed the December meeting. City Councilman **Steve Murrin** was on hand to present the proclamation declaring December 11 "General Peek Day." Other meeting highlights in-

cluded the installation of officers and presentation of an AFA Life Membership to **Mary Sue Keith,** wife of AFA National President **Sam Keith,** who also attended.

In other Fort Worth Chapter news, officials played a vital role in making Carswell Memorial Park a reality. Carswell AFB is now the only base to have its namesake buried on its property in a fitting parklike setting. Maj. Horace S. Carswell, Jr., was a native of Fort Worth and Medal of Honor recipient who died in a B-24 crash in 1944. Chapter officials led the way in raising funds and helping generate local interest in the project, which, in the end, attracted the support of top business and community leaders and the Air Force. A committee of local citizens led by Texas AFA leader **Earle North Parker** saw the concept through to the dedication last October.

AFA Board Chairman **Marty Harris** presented the National Medal of Merit to Enid Chapter President **Oscar Curtis** during a chapter meeting at Vance AFB, Okla., recently. The Chapter was honored with an Outstanding Community Partner Award, one of five chapters nationwide honored for recruiting a total number of Community Partners equal to or greater than two percent of their overall chapter membership in 1986. **Ken Lohse** was Enid Chapter President last year.

On February 7, AFA's General E. W. Rawlings Chapter in Minnesota held its annual "Salute to the Enlisted Ranks" at the Air Force Reserve Base NCO Club. Senior Enlisted Advisors of the Air Force Reserve, Air National Guard, and USAF Recruiting Service were invited to conduct a panel discussion. Enlisted personnel from local military units were invited as Chapter guests.

Tom Lemons, then-Mayor of Oregon City, Ore., authored a guest "Speaking Out" column in the *Enterprise Courier* on his experiences in leading a group of area civic leaders with local Sheriff **Bill Brooks** to Hq. SAC at Offutt AFB, Neb., last fall. The group was greeted by AFA National Vice President for the Northwest Region **Phil Saxton** and **Lt. Col. Dick Sheffield.**

Mr. Lemons recounted the excitement of the group when it was learned they would be viewing, firsthand, the in-flight refueling of a B-52. "It was incredible!" he wrote. The former Mayor said the briefings on US/USSR defense budget comparisons and SAC operations were informative. He also described the Underground Command Center where the CINCSAC and his senior staff convene in time of war as "totally awesome."

After a briefing and question-and-answer period with current CINCSAC **Gen. John T. Chain, Jr.,** who described the SAC mission and his duties, Mr. Lemons said, "It is difficult to imagine the realm of his responsibility." The civic leaders were also treated to a "practice alert." The former Mayor said words failed him in "trying to convey to you the coordination and speed with which an alert is portrayed. No one wants war, but it provides one with a sense of well-being knowing our defense system is so well coordinated," he concluded.

Sid Hatfield, President of AFA's General Bruce K. Holloway Chapter in Knoxville, Tenn., presented AFJROTC cadets from Heritage High School with two plaques and $1,000 for winning in two categories in the Aerospace Education Foundation's 1986 AFJROTC contest on "Aerospace Education Requirements for the Year 2000." Cadets **John Tuck** and **Dick Baker** accepted the honors on behalf of the unit. In 1985, Heritage High walked away with top honors in the contest for its presentation on the

Lined up to offer a Texas-size hello to Lt. Gen. Kenneth L. Peek (left), Commander of SAC's Eighth Air Force, were (from left) Sam Keith, AFA National President; L. B. (Buck) Webber, Fort Worth Chapter President; C. Wayne Calhoun, Chapter Vice President for Operations; Billy S. Lyons, Vice President, Programs; Al Leferink, Jr., Treasurer; Robert E. Copley, Secretary; and Thomas J. Kemp, Vice President, Awards.

Jess Larson—1904–87

One of AFA's longtime leaders and senior statesmen, Jess Larson, died of cancer on February 25 and was buried at Arlington National Cemetery on March 2. He served two terms as AFA's National President, from 1964 to 1967, and then three terms as Board Chairman, until 1971. He was honored with a unique award that cited him as "AFA Man of the Years." USAF also presented him its highest civilian decoration, the Exceptional Civilian Service Award.

Born June 22, 1904, in Oklahoma, Mr. Larson attended the University of Oklahoma, studied law, and was admitted to the Oklahoma bar in 1935. During World War II, he commanded the 45th Division's 160th Field Artillery in Italy and was wounded in combat. He resigned his Army commission in 1952 and accepted a Reserve commission in USAF. He retired as a major general.

Mr. Larson became the first Administrator of the General Services Administration in 1949 and served in that position until 1953, when he returned to private law practice in Washington, D. C.

He became an active AFA leader in 1962 as Chairman of AFA's Air Reserve Council and, in subsequent years, traveled extensively in AFA's behalf and served tirelessly on all of AFA's major committees, including the Executive, Finance, Membership, and Awards Committees.

Jess Larson was twice AFA President, three times Board Chairman.

This Is AFA

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

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

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INTERCOM

theme "Aerospace Education in Our Area." Cadets are gearing up for this year's contest on "The Significance of Women in Aerospace." Entries are due to Foundation headquarters by April 10.

AFA's Metropolitan Philadelphia Chapter, led by President **John Gross,** enjoyed an active November. The Chapter participated in the tristate Arnold Air Society/Angel Flight Conclave, and one member, **Henry Coffin III,** a World War I balloonist who knew General "Hap" Arnold and his family well, was luncheon speaker.

Also in November, Chapter members celebrated Veterans Day with an address by an engineer from General Electric who showed slides depicting the accuracy and sophistication of today's satellites. Chapter officials were on hand for the planting of a spruce sapling at the Hap Arnold Athletic Field in honor of General Arnold. The event was sponsored by the Arnold Air Society/AFJROTC cadets from Lower Merion High School. Another activity in November was a luncheon in honor of Air Force Chief of Staff **Gen. Larry D. Welch,** held in conjunction with local groups.

The 1986 Aviation Hall of Fame Induction Ceremony held in Huntsville, Ala., was, according to former AFA National Director and current Alabama AFA Vice President **Dr. Frank Lugo,** "impressive." **Lt. Gen. Benjamin O. Davis, USAF (Ret.),** and **Robert P. Hudgens** were the two living inductees. Inducted posthumously were **Wernher von Braun** and **Edward A. Stinson.** Three former inductees present at the ceremony were **Brig. Gen. Robert D. Knapp, USAF (Ret.),** of AFA's War Eagle Chapter; **Brig. Gen. John Dyas, USAF (Ret.),** of AFA's Mobile Chapter; and **Carl Lund,** also a member of the Mobile Chapter. Dr. Lugo is on the Board of Directors of the Alabama Aviation Hall of Fame.

In Massachusetts, AFA's Chicopee Chapter is now the Maj. John S. Southrey Chapter . . . In California, Merced County Chapter is now the Maj. Gen. Charles I. Bennett, Jr., Chapter . . . AFA's Mansfield Chapter in Ohio is now the Frank P. Lahm Chapter.

December 30 marked the chartering date for AFA's newest state organization—Kentucky AFA, led by **Bryan J. Sifford** . . . Four new chapters are the Maui Chapter in Puunene, Hawaii, led by **Pat Jardin;** the Peace River Chapter in Port Charlotte, Fla., led by **Joseph Musil;** the Quad Cities Chapter in Moline, Ill., led by **Gerald O. Black;** and the Blue Hen Chapter in Milford, Del., led by **J. Richard Williamson.** ■

UNIT REUNIONS

American Defenders of Bataan and Corregidor
The American Defenders of Bataan and Corregidor will hold a reunion on May 24–31, 1987, at the Pointe Resort in Phoenix, Ariz. **Contact:** Austin Patrizio, 414 Richmond Pl., Leonia, N. J. 07605. Ralph Levenberg, 2716 Eastshore Pl., Reno, Nev. 89509.

Hammond Army Airfield
The Louisiana Balloon Festival and Airshow Committee and the Hammond Chamber of Commerce are planning to hold a reunion on May 29–31, 1987, in Hammond, La., for groups that were stationed at Hammond Army Airfield and the Hammond Bombing and Gunnery Range during World War II. **Contact:** Christina Buehler, % Citizens National Bank, P. O. Box 2188, Hammond, La. 70404. Phone: (504) 542-2274.

Jolly Green Ass'n
Members of the Jolly Green Rescue Forces will hold a reunion on May 15–16, 1987, at the Ramada Beach Resort in Fort Walton Beach, Fla. **Contact:** Jack Allison, 2007 Bayshore Dr., Niceville, Fla. 32578. Phone: (904) 678-8135.

Red River Valley Pilots Ass'n
The Red River Valley Fighter Pilots "River Rats" will hold a reunion on April 29–May 3, 1987, in Las Vegas, Nev. **Contact:** J. D. Allen, 6753 W. Carrera Dr., Las Vegas, Nev. 89103. Phone: (702) 873-5959. Red River Valley Fighter Pilots Association, 8612 Tamarac, Wichita, Kan. 67206. Phone: (316) 685-2915.

Tuskegee Airmen, Inc.
The Tuskegee Airmen will hold their sixteenth annual convention/reunion on August 26–30, 1987, in San Francisco, Calif. **Contact:** Lt. Col. Theodore A. Wilson, USAF (Ret.), 2950 Carlow Way, San Francisco, Calif. 94080. Phone: (415) 589-1919. Tuskegee Airmen, Inc., 5221 Fallon Ave., Richmond, Calif. 94804.

USAF Helicopter Pilots
Pilots who graduated from the USAF Helicopter Pilot School between 1942 and 1971 will hold a reunion on July 2–4, 1987, in Reno, Nev. **Contact:** Nick Conti, 4705 Pinesprings Dr., Reno, Nev. 89509. Phone: (702) 827-0701.

Warbirds
The sixteenth annual Gathering of Warbirds will be held on August 14–16, 1987, at the Madera Municipal Airport in Madera, Calif. **Contact:** Harold Kindsvater, P. O. Box 5138, Fresno, Calif. 93755. Phone: (209) 255-5812.

1st Fighter Control Squadron
Personnel of the 1st Fighter Control Squadron, Fifth Air Force, will hold a reunion on May 14–17, 1987, at the Sheraton West Port Inn in St. Louis, Mo. **Contact:** Chester W. Driest, 687 E. Wacker St., Hernando, Fla. 32642. Phone: (904) 489-5067.

7th Combat Cargo Squadron
Members of the 7th Combat Cargo Squadron will hold a reunion on May 14–17, 1987. **Contact:** Curtis Krogh, 601 Indiana St., Racine, Wis. 53405. Phone: (414) 633-4373.

15th Constabulary Squadron Ass'n
The 15th Constabulary Squadron will hold a reunion on September 18–20, 1987, at the Lexington Hotel in Arlington, Tex. **Contact:** Harry D. Nicholas, 3610 Yorkshire Dr., Arlington, Tex. 76013.

17th Photo Recon Squadron
The 17th Photo Reconnaissance Squadron will hold a reunion on June 18–21, 1987, at the Antlers Hotel in Colorado Springs, Colo. **Contact:** Mrs. Henry Hitzelberger, Rte. 2, Box 472, Gassville, Ark. 72635. John H. Rodolf, 3113 S. Florence Ct., Tulsa, Okla. 74105.

20th Air Force Ass'n
Members of the 20th Air Force will hold a reunion on May 1–3, 1987, at the Capitol Plaza Holiday Inn in Sacramento, Calif. **Contact:** Elbert B. Smith, 7811 Compass Lake Dr., San Diego, Calif. 92119. Phone: (619) 697-6123.

20th Tactical Fighter Wing
The 20th Tactical Fighter Wing will hold its reunion on September 17–20, 1987, in Fort Walton Beach, Fla. **Contact:** John J. Kropenick, 7 Maple Ave., Shalimar, Fla. 32579. Phone: (904) 651-0559.

29th Air Service Group Ass'n
The 29th Air Service Group will hold its reunion on July 13–18, 1987, at the Quality Inn in Northwood, Ohio. **Contact:** Frank Pace, 315 W. 15th St., Dover, Ohio 44622. Phone: (216) 343-7855.

31st Fighter Group
The 31st Fighter Group will hold a memorial dedication in England on September 24–October 2, 1987. **Contact:** Lt. Gen. Albert P. Clark, USAF (Ret.), 17255 Fairplay Dr., Monument, Colo. 80132.

34th Bomb Group
The 34th Bomb Group will hold a reunion in England on May 28–June 5, 1987. **Contact:** Harold Retuka, 11 Atavia St., Duluth, Minn. 55811.

Class 41-F
Members of Cadet Flying Class 41-F are planning to hold a reunion in March 1988 in San Antonio, Tex. **Contact:** John L.

Sherlock, 4672 Flamingo Park Ct., Fremont, Calif. 94538.

Class 42-A
Pilot Class 42-A (Kelly Field) will hold a reunion on October 15–18, 1987, at the Hyatt Orlando in Orlando, Fla. **Contact:** Brig. Gen. Dan Lee Smith, USAF (Ret.), 3750 Galt Ocean Dr., Apt. 211, Fort Lauderdale, Fla. 33308.

Class 42-D
Pilot Class 42-D, which attended primary training at LAMA, Avon Park, Fla., will hold a reunion on August 7–9, 1987, in Washington, D. C. **Contact:** John Ferrara, 6651 Little River Turnpike, Alexandria, Va. 22312. Phone: (703) 354-3420.

Class 48-A
Members of Pilot Class 48-A are planning to hold a fortieth-year reunion in October 1987 at Randolph AFB, Tex. **Contact:** Col. John W. Oliver, Jr., USAF (Ret.), Box 296, Salado, Tex. 76571.

Class 63-A
Members of Class 63-A (Williams AFB, Ariz.) will hold a twenty-fifth-year reunion on July 31–August 2, 1987, at the Arizona Golf Resort in Mesa, Ariz. **Contact:** Col. Don E. Wells, USAF, 245 Doral Way, Colorado Springs, Colo. 80908.

65th Troop Carrier Squadron
The 65th Troop Carrier Squadron will hold its reunion on July 29–August 2, 1987, in Austin, Tex. **Contact:** Bud Hawkey, 106 Union Dr., New Madison, Ohio 45346. Phone: (513) 996-3851.

78th Fighter Group Ass'n
Members of the 78th Fighter Group who were stationed at Duxford Aerodrome, Cambridgeshire, England, will hold a reunion on June 11–14, 1987, at the Galt House in Louisville, Ky. **Contact:** Al Wendt, 811 N. Forrest, Arlington Heights, Ill. 60004. Phone: (312) 255-3733.

81st Bomb Squadron
Members of the 81st Bomb Squadron, 12th Bomb Group, will hold their reunion on September 17–19, 1987, in Kansas City, Mo. **Contact:** Bob Piper, 3201 Norton, Independence, Mo. 64052. Phone: (816) 833-0816.

82d Fighter Group Ass'n
The 82d Fighter Group will hold a reunion on September 17–19, 1987, in Boise, Idaho. **Contact:** Richard Lingenfelter, P. O. Box 5541, Boise, Idaho 83705.

83d Bomb Squadron
Members of the 83d Bomb Squadron, 12th Bomb Group, will hold a reunion on October 7–10, 1987, at the Stouffer's Hotel in Arlington, Va. **Contact:** Lewis E. Berry, 3330 Independence St., Grove City, Ohio 42123. Phone: (614) 875-9542.

90th Bomb Group
The 90th Bomb Group "Jolly Rogers" will hold a minireunion on May 7–9, 1987, in Springfield, Ohio. The annual reunion will be held on October 8–10, 1987, in Arlington, Va. **Contact:** MSgt. Tom Keyworth, USAF (Ret.), 38 Crestlyn Dr. E., York, Pa. 17402. Phone: (717) 741-3998.

UNIT REUNIONS

92d Bomb Group
The 92d Bomb Group will hold a reunion in England on May 28–June 5, 1987. **Contact:** Sheldon Kirsner, 2603 Cathedral Dr., St. Louis, Mo. 63129.

97th Bomb Wing
Members of the 97th Bomb Wing will hold their reunion on September 25–26, 1987, in Lompoc/Santa Maria, Calif. **Contact:** Richard E. Jones, 4277 Rigel Ave., Lompoc, Calif. 93436. Phone: (805) 733-1819.

111th Tactical Recon Squadron
The 111th Tactical Reconnaissance Squadron will hold a reunion on September 3–7, 1987, at the Patrick Henry Inn in Williamsburg, Va. **Contact:** James O. Cooper, 116 Orchard Ave., Rocky Mount, Va. 24151. Phone: (703) 483-5497.

305th Bomb Group
Members of the 305th Bomb Group will hold their reunion on September 9–12, 1987, in St. Louis, Mo. **Contact:** Abe Millar, P. O. Box 757, Sanger, Tex. 76266. Phone: (817) 458-3516.

310th Bomb Wing
Veterans of the 310th Bomb Wing will hold a reunion on September 17–19, 1987, at the Imperial Palace Hotel in Las Vegas, Nev. **Contact:** Hal Fulmer, 3337 Racquet St., Las Vegas, Nev. 89121. Phone: (702) 733-7069.

314th Composite Wing
Members of the 314th Composite Wing will hold a reunion on July 16–19, 1987, in Nashville, Tenn. **Contact:** Bob Kindell, Mel Hiller, or Louis Buddo, Box 35372, Louisville, Ky. 40232.

325th Fighter Group
The 325th Fighter Group "Checkertails" will hold a reunion on June 11–14, 1987, in Philadelphia, Pa. **Contact:** Dan Penrod, 69 Keswick Ave., Pittsburgh, Pa. 15202. Phone: (412) 766-6190. George W. Liston, 13655 N. E. 10th, #201, North Miami, Fla. 33161. Phone: (305) 891-6917.

352d Fighter Group Ass'n
The 352d Fighter Group will hold a reunion on October 1–4, 1987, at the Ramada Valley Hotel in Scottsdale, Ariz. **Contact:** Richard J. DeBruin, 234 N. 74th St., Milwaukee, Wis. 53213. Phone: (414) 771-0744.

355th Fighter Group Ass'n
Members of the 355th Fighter Group will hold a reunion on October 8–11, 1987, in Orlando, Fla. **Contact:** Robert E. Kuhnert, 4230 Shroyer Rd., Dayton, Ohio 45429. Phone: (513) 294-2986.

364th Fighter Group
Veterans of the 364th Fighter Group who served in Honington, England, will hold a reunion on October 29–31, 1987, in Williamsburg, Va. **Contact:** Dan Leftwich, 6630 Caldero Ct., Dayton, Ohio 45415. Phone: (513) 890-3641.

386th Bomb Group Ass'n
The 386th Bomb Group will hold its reunion on September 23–27, 1987, in St. Louis, Mo. **Contact:** Barnett "Skip" Young, 5658 Eichen Circle, Fort Myers, Fla. 33907.

392d Bomb Group
The 392d Bomb Group will hold a reunion on June 26–28, 1987, in Tulsa, Okla. **Contact:** William H. Richards, #313, 5206 S. Harvard, Tulsa, Okla. 74135.

393d Bomb Squadron
Members of the 393d Bomb Squadron will hold a reunion on May 28–30, 1987, at Pease AFB, N. H. **Contact:** Capt. Robert Ott, USAF, PSC Box 2267, Pease AFB, N. H. 03801. Capt. Greg Schumann, USAF, General Delivery, Pease AFB, N. H. 03801. Phone: (603) 430-2171.

447th Bomb Group
The 447th Bomb Group will hold a reunion on July 9–12, 1987, in Colorado Springs, Colo. **Contact:** Orlando "Pete" Petrillo, 955 W. Pasadena Ave., Elyria, Ohio 44035.

Coming Events

April 24–25, **Alabama State Convention,** Mobile . . . April 24–25, **South Carolina State Convention,** Myrtle Beach . . . May 9, **Connecticut State Convention,** Vernon . . . May 16, **Oregon State Convention,** Portland . . . June 5–7, **New York State Convention,** Albany . . . June 13, **Louisiana State Convention,** Barksdale AFB . . . June 19–21, **New Jersey State Convention,** Cape May . . . June 19–21, **Ohio State Convention,** Warren . . . July 17–19, **Pennsylvania State Convention,** Harrisburg . . . July 17–19, **Texas State Convention,** Dallas . . . July 31–August 1, **Colorado State Convention,** Lowry AFB . . . July 31–August 2, **Florida State Convention,** MacDill AFB . . . July 31–August 1, **Missouri State Convention,** Kansas City . . . August 7–9, **Arkansas State Convention,** Fort Smith . . . August 19, **Delaware State Convention,** Dover AFB . . . August 20–23, **California State Convention,** Vandenberg AFB . . . August 21–22, **Illinois State Convention,** Glenview NAS, Chicago . . . August 21–23, **Utah State Convention,** Salt Lake City . . . August 28–30, **Arizona State Convention,** Phoenix . . . August 29, **Indiana State Convention,** Fort Wayne . . . September 14–17, **AFA National Convention and Aerospace Development Briefings and Displays,** Washington, D. C.

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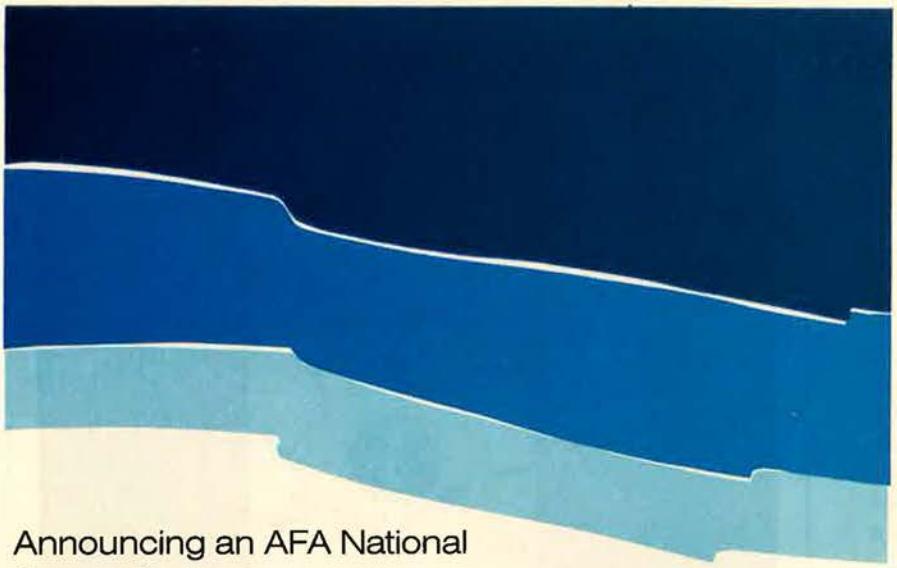

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Because of outstanding attendance at our first symposium on "The Military Imperatives in Space," we have scheduled another — with a brand-new, one-day format for the busy executive.

Gen. John L. Piotrowski, the new Commander in Chief of the United States Space Command, will keynote this symposium. The featured speaker will be the Hon. Edward C. Aldridge, Jr., Secretary of the Air Force. Other symposium speakers include Gen. John T. Chain, Jr., Commander in Chief, SAC; Gen. James A. Abrahamson, Director, SDI; Lt. Gen. Aloysius G. Casey, Commander, Space Division, Air Force Systems Command; Dr. Robert C. Duncan, Director, DARPA; and Retired Adm. S.R. Foley, Assistant Secretary for Defense Programs, Department of Energy. Dr. William R. Graham, the President's Science Advisor, and other high-level speakers have been invited.

Make your plans NOW to attend! For more information, call Dorothea Barnes or Dottie Flanagan at (703) 247-5800.

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WHEN: May 21, 1987

WHERE: Clarion Hotel
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449th Bomb Group Ass'n
The 449th Bomb Group "Flying Horsemen" will hold a reunion on September 23–25, 1987, at the Clarion Hotel in Colorado Springs, Colo. **Contact:** Richard F. Downey, 4859 Stanhope Dr., St. Louis, Mo. 63128. Phone: (314) 892-4597.

452d Bomb Group Ass'n
Members of the 452d Bomb Group who served at Deopham Green, England, will hold a reunion on September 10–13, 1987, in St. Louis, Mo. **Contact:** Rom Blaylock, P. O. Box 2526, New Bern, N. C. 28561.

454th Bomb Group Ass'n
The 454th Bomb Group will hold a reunion on October 20–24, 1987, in Orlando, Fla. **Contact:** Ralph Branstetter, P. O. Box 678, Wheat Ridge, Colo. 80034.

457th Bomb Group Ass'n
The 457th Bomb Group and attached units that were stationed in Glatton, England, will hold a reunion on September 24–27, 1987, in Burlington, Vt. **Contact:** Homer Briggs, 811 N. W. B St., Bentonville, Ark. 72712. Phone: (501) 273-3908.

459th Bomb Group Ass'n
The 459th Bomb Group, Fifteenth Air Force, will hold a reunion on September 24–27, 1987, at the Sheraton Riverside Hotel, Riverside, Calif. **Contact:** John Devney, 90 Kimbark Rd., Rochester, N. Y. 14610. Phone: (716) 381-6174.

465th Bomb Group
Members of the 465th Bomb Group are planning to hold a reunion on September 17–20, 1987, in Dayton, Ohio. **Contact:** James Althoff, 2 Mt. Vernon Lane, Atherton, Calif. 94025. Phone: (415) 325-8356.

507th Fighter Group
The 507th Fighter Group will hold its forty-fourth-year reunion on September 4–6, 1987, at the Crystal City Marriott in Arlington, Va. **Contact:** E. T. O'Connell, Jr., 7803 Killebrew Dr., Annandale, Va. 22003. Phone: (703) 256-2737. James H. Mosbey, Jr., P. O. Box 163, Watkinsville, Ga. 30677. Phone: (404) 769-7375.

567th Army Air Force Band
Members of the 567th Army Air Force Band are planning to hold a reunion in late summer of this year in Louisville, Ky. Friends as well as those acquainted with members of this unit are welcome. **Contact:** Bernard L. Crutcher, 636 Raven Dr., Frankfort, Ky. 40601. Clayton E. Grinage, Sr., 2202 Bancroft Lane, #7, Houston, Tex. 77027.

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.

UNIT REUNIONS

586th Bomb Squadron
The 586th Bomb Squadron will hold a reunion on May 7–10, 1987, in San Antonio, Tex. **Contact:** Lt. Col. John C. Beale, USAF (Ret.), 4206 Shadow Oak Woods, San Antonio, Tex. 78249. Phone: (512) 493-0221.

781st Bomb Squadron Ass'n
Members of the 781st Bomb Squadron, 465th Bomb Group, will hold a reunion on September 17–20, 1987, at Wright-Patterson AFB, Ohio. **Contact:** James M. Synder, 1226 Royal Oak Dr., Winter Springs, Fla. 32708. Phone: (305) 365-7938.

1603d Air Base Group
Members of the 1603d Air Base Group and the 1261st Air Transport Squadron who served at Wheelus Field, Libya, during 1948–51 will hold a reunion on October 2–5, 1987, in Colorado Springs, Colo. **Contact:** H. D. Grover, 3524 S. Perry St., Montgomery, Ala. 36105. Phone: (205) 264-8643.

7167th Air Transport Squadron
Members who served between 1957 and 1962 with the 7167th Air Transport Squadron and the 2d Aeromedical Evacuation Group will hold a reunion on May 28–31, 1987, in San Antonio, Tex. **Contact:** Ann DeStefano Carretto, 1918 Green Ridge Ct., Abilene, Tex. 79602. Phone: (915) 672-8423. Jane Glass, 12005 Mossbrook Cove, Austin, Tex. 78750. Phone: (512) 258-6035.

Ogden ALC
A twenty-year reunion is in the planning stages for second lieutenants who graduated in 1967 from Officer Training School and were assigned to the Ogden Air Materiel Area Maintenance (OOAMA), Ogden Air Logistics Center, Hill AFB, Utah.

Please send your preferred reunion date to one of the addresses below.

Maj. R. P. Milich, USAFR
832 Bears Den Rd.
Youngstown, Ohio 44511
or
L. K. Dumas
OO-ALC/MM
Hill AFB, Utah 84056

310th Tactical Fighter Training Squadron
The 310th Tactical Fighter Training Squadron is planning a reunion for this year and would like to hear from members who served with the 310th Fighter Squadron in World War II and the 310th Fighter-Bomber Squadron in Korea.

Please contact the address below.

Lt. Col. "Gibber" Gibbs, USAF
310th TFTS/CC
Luke AFB, Ariz. 85309
Phone: (602) 856-7730

AFA CHAMPLUS® . . . . Strong Protection

When a Single Accident or Illness Could Cost *You* Thousands of Dollars, You Need AFA CHAMPLUS®. . . for *Strong* Protection against Costs CHAMPUS Doesn't Cover!

For military retirees and their dependents . . . and dependents of active-duty personnel . . . more and more medical care is being provided through the government CHAMPUS program.

And, of course CHAMPUS pays 75% of allowable charges.

But today's soaring hospital costs—nearly $550 a day in some major metropolitan medical centers—can run up a $20,000 bill for even a moderately serious accident or illness.

Your 25% of $20,000 is no joke!

AFA CHAMPLUS® protects you against that kind of financial catastrophe *and* covers most of your share of routine medical expenses as well.

HOW AFA CHAMPLUS® WORKS FOR YOU!

WHO IS ELIGIBLE?

1) All AFA members under 65 years of age who are currently receiving military retired pay and are eligible for benefits under Public Law 89-614 (CHAMPUS), their spouses under age 65 and their unmarried dependent children under age 21, or age 23 if in college. (There are some exceptions for older age children. See "Exceptions and Limitations".)
2) All eligible dependents of AFA members on active duty. Eligible dependents are spouses under age 65 and unmarried dependent children under age 21, or age 23 if in college. (There are some exceptions for older age children. See "Exceptions and Limitations".)

EXCEPTIONAL BENEFIT PLAN

(See chart at right)

FOUR YEAR BASIC BENEFIT. Benefits for most injuries or illnesses may be paid for up to a four-year period.

PLUS THESE SPECIAL BENEFITS . . .

1) Up to 45 consecutive days of in-hospital care for mental, nervous, or emotional disorders. Outpatient care may include up to 20 visits of a physician or $500 per insured person each year.
2) Up to 30 days care per insured per year in a Skilled Nursing Facility.
3) Up to 30 days care per insured per year and up to 60 days lifetime in a CHAMPUS-approved Residential Treatment Center.
4) Up to 30 days care per insured per year and up to 60 days lifetime in a CHAMPUS-approved Special Treatment Facility.
5) Up to 5 visits per insured per year to Marriage and Family Counselors under conditions defined by CHAMPUS.

YOUR INSURANCE IS NON-CANCELLABLE

As long as you are a member of the Air Force Association, pay your premiums on time, and the master contract remains in force, your insurance cannot be cancelled.

ADMINISTERED BY YOUR ASSOCIATION . . . UNDERWRITTEN BY MUTUAL OF OMAHA

AFA CHAMPLUS® insurance is administered by trained insurance professionals on your Association staff. You get prompt reliable, courteous service from people who know your needs and know every detail of your coverage. Your insurance is underwritten by Mutual of Omaha, the largest individual and family health insurance company in the world.

AFA OFFERS YOU HOSPITAL BENEFITS AFTER AGE 65

Once you reach Age 65 and are covered under Medicare, AFA offers you protection against hospital expenses not covered by Medicare through the *Senior Age Benefit Plan* of AFA Hospital Indemnity Insurance. Members enrolled in AFA CHAMPLUS® will automatically receive full information about AFA's Medicare supplement program upon attainment of Age 65 so there will be no lapse in coverage.

AFA CHAMPLUS® BENEFIT SCHEDULE

Care	*CHAMPUS Pays*	*AFA CHAMPLUS® Pays*
	For Military Retirees Under Age 65 and Their Dependents	
Inpatient civilian hospital care	CHAMPUS pays 75% of allowable charges.	CHAMPLUS® pays the 25% of allowable charges not covered by CHAMPUS.
Inpatient military hospital care	The only charge normally made is a $7.30 per day subsistence fee, not covered by CHAMPUS.	CHAMPLUS® pays the $7.30 per day subsistence fee.
Outpatient care	CHAMPUS COVERS 75% of outpatient care fees after an annual deductible of $50 per person ($100 maximum per family) is satisfied.	CHAMPLUS® pays the 25% of allowable charges not covered by CHAMPUS after the deductible has been satisfied.
	For Dependents of Active-Duty Military Personnel	
Inpatient civilian hospital care	CHAMPUS pays all covered services and supplies furnished by a hospital, less $25 or $7.30 per day, whichever is greater.	CHAMPLUS® pays the greater of $7.30 per day or $25 of the reasonable hospital charges not covered by CHAMPUS.
Inpatient military hospital care	The only charge normally made is a $7.30 per day subsistence fee, not covered by CHAMPUS.	CHAMPLUS® pays the $7.30 per day subsistence fee.
Outpatient care	CHAMPUS covers 80% of outpatient care fees after an annual deductible of $50 per person ($100 maximum per family) is satisfied.	CHAMPLUS® pays the 20% of allowable charges not covered by CHAMPUS after the deductible has been satisfied.

NOTE: Outpatient benefits cover emergency room treatment, doctor bills, pharmaceuticals, and other professional services.

There are some reasonable limitations and exclusions for both inpatient and outpatient coverage. Please note these elsewhere in the plan description.

Against Costs CHAMPUS Doesn't Cover

APPLY TODAY!
JST FOLLOW THESE STEPS

hoose either AFA CHAMPLUS® Inpatient verage or combined Inpatient and Outtient coverage for yourself. Determine e coverage you want for dependent embers of your family. Complete the enosed application form in full. Total the emium for the coverage you select from e premium tables on this page. Mail the plication with your check or money der for your initial premium payment, ayable to AFA.

AFA's CHAMPLUS®

XCEPTIONS & LIMITATIONS

overage will not be provided for condions for which treatment has been reeived during the 12-month period prior the effective date of insurance until ne expiration of 12 consecutive months f insurance coverage without further eatment. *After coverage has been in orce for 24 consecutive months, preexisting* conditions will be covered reardless of prior treatment. Children over ge 21 (age 23 if in college) will continue be eligible if they have been declared ncapacitated and if they were insured nder CHAMPLUS® on the date so delared. Coverage for these older age hildren will be provided at slightly higher ates upon notification to AFA.

XCLUSIONS

his plan does not cover and no payment hall be made for:

- routine physical examinations or immuizations
- domiciliary or custodial care
- dental care (except as required as a ecessary adjunct to medical or surgical eatment)
- routine care of the newborn or wellaby care
- injuries or sickness resulting from eclared or undeclared war or any act hereof
- injuries or sickness due to acts of intenonal self-destruction or attempted suide, while sane or insane
- treatment for prevention or cure of alcoholism or drug addiction
- eye refraction examinations
- Prosthetic devices (other than artificial mbs and artificial eyes), hearing aids, rthopedic footwear, eyeglasses and conact lenses
- expenses for which benefits are or may e payable under Public Law 89-614 CHAMPUS)

PREMIUM SCHEDULE

Plan 1—For military retirees and dependents (Quarterly Premiums)

Inpatient Benefits

Member's Attained Age	Member	Spouse	Each Child
Under 50	$21.88	$27.35	$14.85
50–54	$32.70	$40.88	$14.85
55–59	$39.78	$49.73	$14.85
60–64	$45.80	$57.25	$14.85

Inpatient and Outpatient Benefits

Under 50	$30.82	$36.98	$37.13
50–54	$42.35	$50.82	$37.13
55–59	$56.01	$67.21	$37.13
60–64	$64.48	$77.38	$37.13

Plan 2—For dependents of active-duty personnel (Annual Premiums)

Inpatient Only	None	$ 9.68	$ 5.94
Inpatient and Outpatient	None	$38.72	$29.70

APPLICATION FOR AFA CHAMPLUS®

Group Policy GMG-FC70
Mutual of Omaha Insurance Company
Home Office: Omaha, Nebraska

Full name of Member _____
Rank Last First Middle

Address _____
Number and Street City State ZIP Code

Date of Birth _____ Current Age ____ Height ____ Weight ____ Soc. Sec. No. _____
Month/Day/Year

This insurance coverage may only be issued to AFA members. Please check the appropriate box below:

☐ I am currently an AFA Member.

☐ I enclose $18 for annual AFA membership dues (includes subscription ($14) to AIR FORCE Magazine).

PLAN & TYPE OF COVERAGE REQUESTED

Plan Requested (Check One)
☐ AFA CHAMPLUS® PLAN I (for military retirees & dependents)
☐ AFA CHAMPLUS® PLAN II (for dependents of active-duty personnel)

Coverage Requested (Check One)
☐ Inpatient Benefits Only
☐ Inpatient and Outpatient Benefits

Person(s) to be insured (Check One)
☐ Member Only
☐ Spouse Only
☐ Member & Spouse
☐ Member & Children
☐ Spouse & Children
☐ Member, Spouse & Children

PREMIUM CALCULATION

All premiums are based on the attained age of the AFA member applying for this coverage. Plan I premium payments are normally paid on a quarterly basis but, if desired, they may be made on either a semi-annual (multiply by 2), or annual (multiply by 4) basis.

Quarterly (annual) premium for member (age ____) $_____

Quarterly (annual) premium for spouse (based on member's age) $_____

Quarterly (annual) premium for ____ children @ $ $_____

Total premium enclosed $_____

If this application requests coverage for your spouse and/or eligible children, please complete the following information for each person for whom you are requesting coverage.

Names of Dependents to be Insured	Relationship to Member	Date of Birth (Month/Day/Year)

(To list additional dependents, please use a separate sheet.)

In applying for this coverage, I understand and agree that (a) coverage shall become effective on the last day of the calendar month during which my application together with the proper amount is mailed to AFA, (b) only hospital confinements (both inpatient and outpatient) or other CHAMPUS-approved services commencing after the effective date of insurance are covered and (c) any conditions for which I or my eligible dependents received medical treatment or advice or have taken prescribed drugs or medicine within 12 months prior to the effective date of this insurance coverage will not be covered until the expiration of 12 consecutive months of insurance coverage without medical treatment or advice or having taken prescribed drugs or medicine for such conditions. I also understand and agree that all such preexisting conditions will be covered after this insurance has been in effect for 24 consecutive months.

Date _____, 19 ____ _____
Member's Signature

Form 6173GH App.

Application must be accompanied by a check or money order. Send remittance to: Air Force Association, Insurance Division, 1501 Lee Highway, Arlington, VA 22209-1198

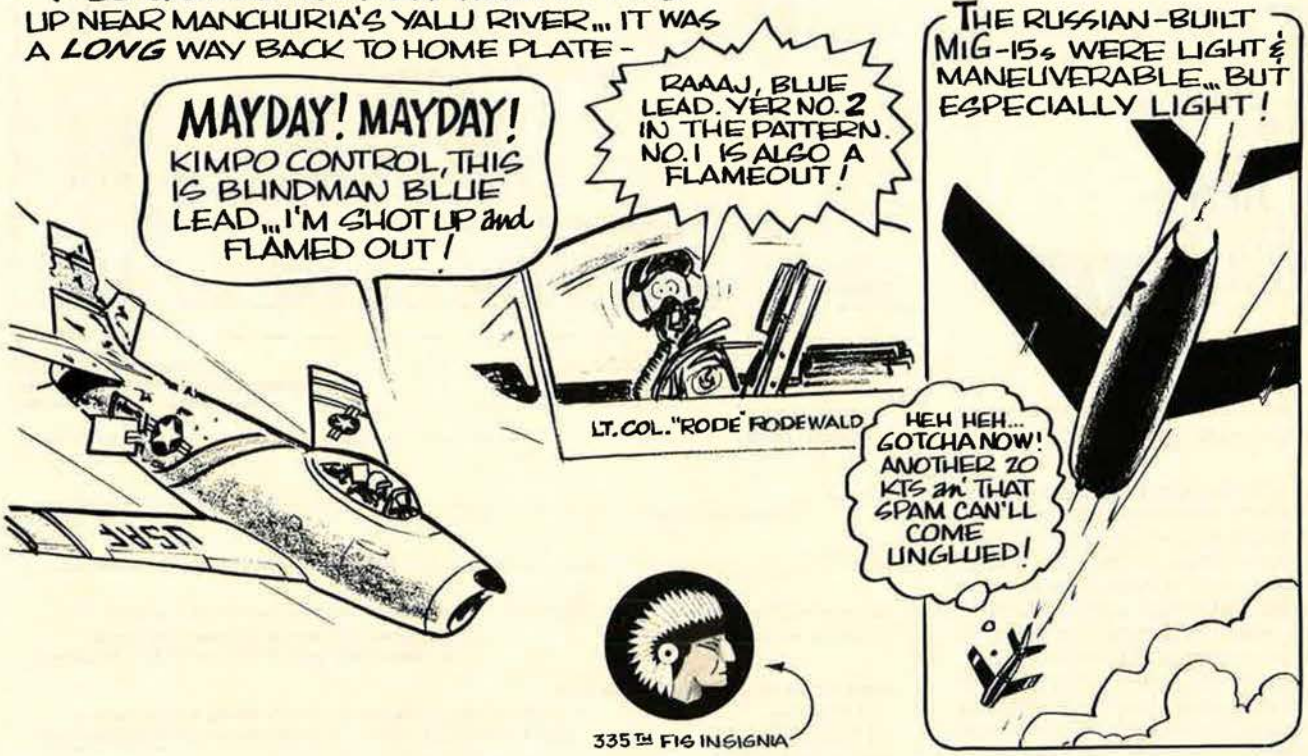
4/87

Bob Stevens'

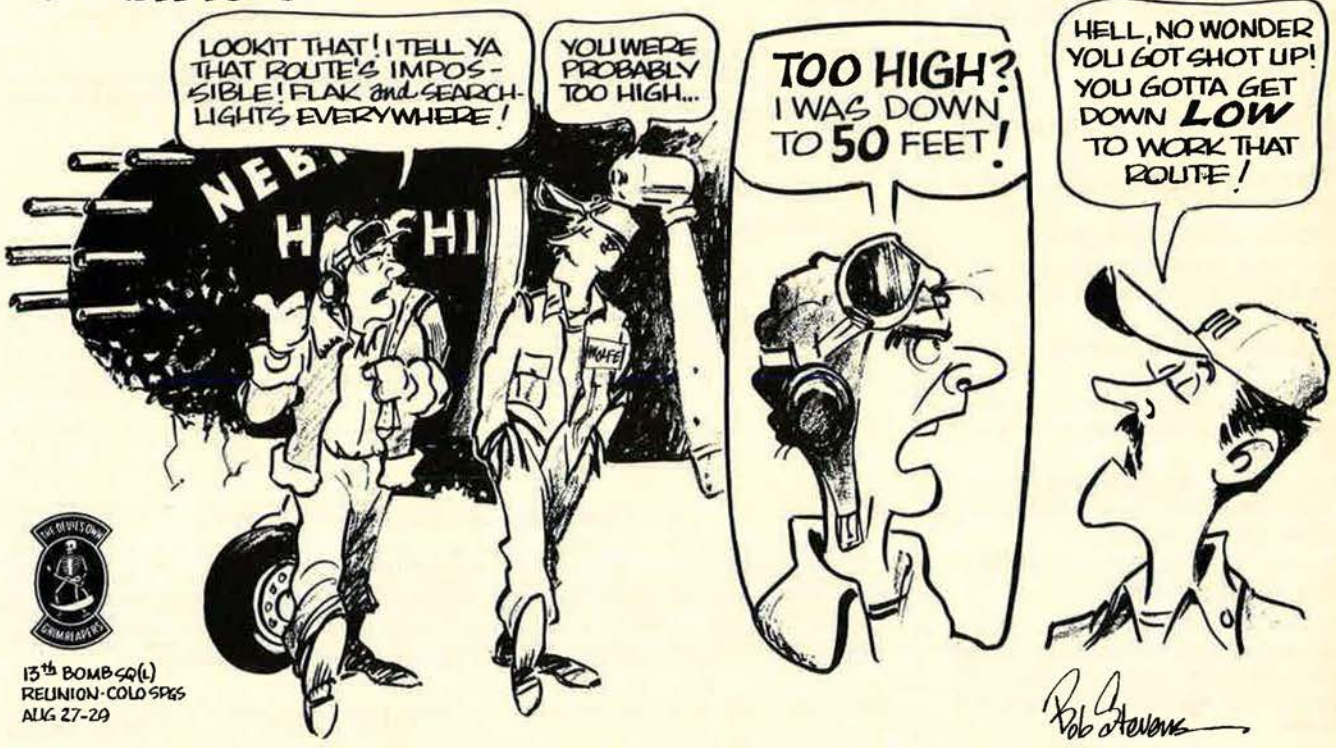
"There I was..."

IT WAS CALLED "THE FORGOTTEN WAR," A "U.N. POLICE ACTION," AND A LOT OF UNPRINTABLE THINGS. FACT IS, THE KOREAN CONFLICT (1950-53) CLOBBERED ABOUT THE SAME NUMBER OF PEOPLE IN 3 YRS AS 'NAM DID IN 12+. IN THIS DIRTY, MISERABLE WAR, JET COMBAT CAME OF AGE.

F-86 SABRES WERE BAPTIZED BY FIRE UP NEAR MANCHURIA'S YALU RIVER... IT WAS A *LONG* WAY BACK TO HOME PLATE -

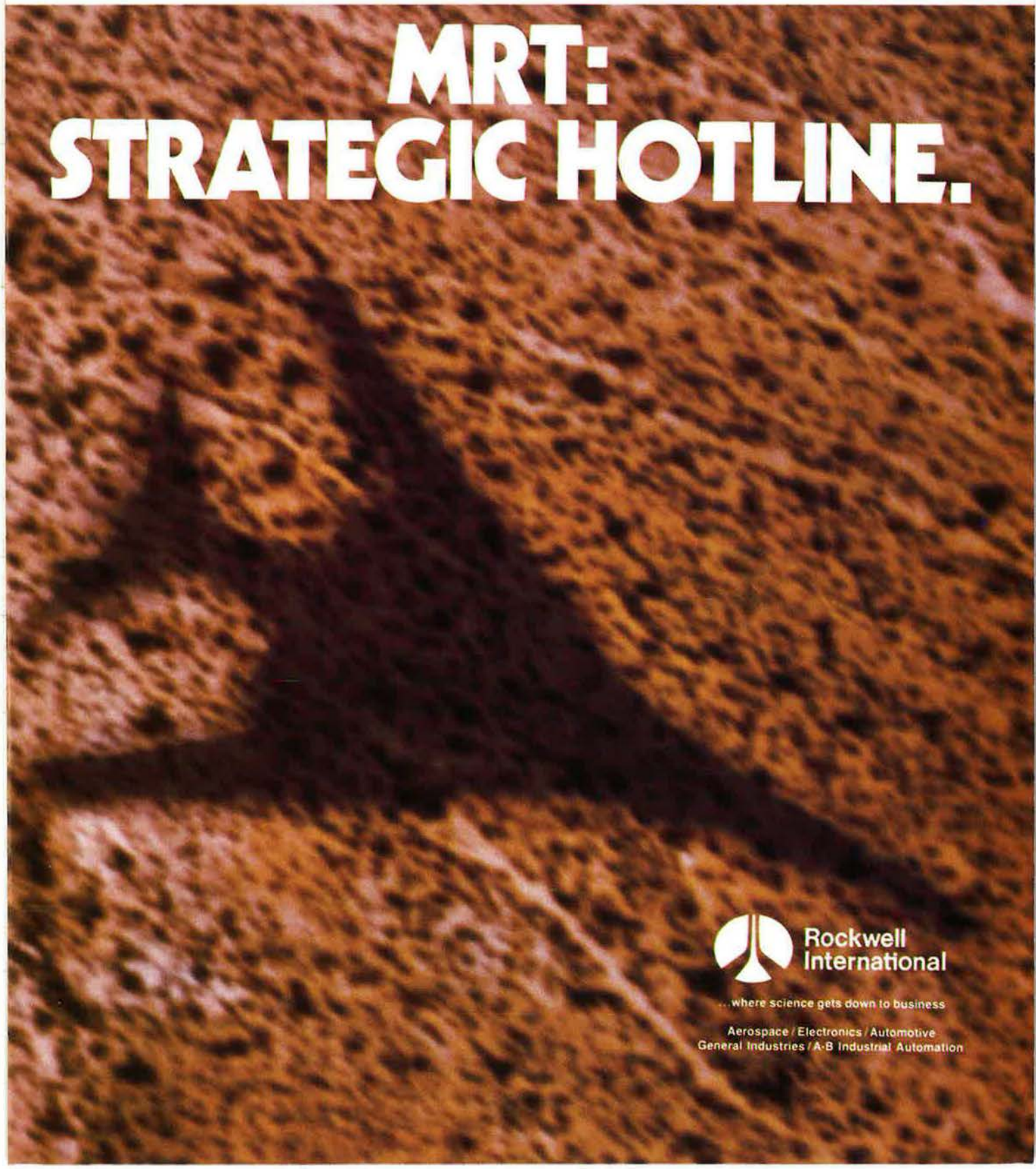


B-26 "INVADERS" PROWLED NORTH KOREA BY NIGHT, DISHING OUT - *and TAKING* - A WHOLE LOT OF DAMAGE:



13th BOMB SQ(L) REUNION · COLO SPGS AUG 27-29

From Rockwell International, Collins Miniature Receive Terminal (MRT): Designed to provide reliable VLF/LF connectivity to the U.S. bomber fleet under high-threat environments. ■ Selected for use on the B-1B and B-52G and H, the MRT system automatically receives, decrypts, processes and prints messages propagated at VLF/LF frequencies within the Minimum Essential Emergency Communication Network (MEECN). ■ It is compatible with the USAF 487L Survivable Low Frequency Communication System (SLFCS) and the Navy Verdin/Enhanced Verdin System (EVS). ■ The MRT system incorporates proven aircraft EMI/EMC features, and can be used on a variety of platforms. ■ Contact: Collins Defense Communications, Rockwell International, 3200 E. Renner Road, Richardson, Texas 75081. U.S.A. (214) 705-3950. Telex 795-530. ■ **Collins Defense Communications: The Integration Specialists.**



"WHEN YOU BUILD 100,000 OF ANYTHING, YOU GET PRETTY GOOD AT IT."

Maybe you remember the Katydid, Talos, Honest John, and the Nikes. Some of these missiles go back almost 40 years. About to the time I joined this company.

Today you know us for Dragon, SMAW, Tomahawk and Harpoon. They're missile systems which for four decades have helped put credibility into America's defense posture.

Forty years and 100,000 missiles have taught us a lot about guidance: Radar, laser, infrared, Tercom. We designed and today build the terrain-correlation guidance system for the land-attack Tomahawk.

Our work with metals and composites has led to major advances in airframe technology. And we've selected and integrated sure-fire propulsion systems—turbo fans and ram-jets, liquids and solids, single and multiple stages. Systems that do the job.

Today, we're ready with the people, the facilities and equipment, and the dedication to meet the demand for even more advanced, more reliable and supportable missile systems. As we've done for the past 40 years.

John F. Yardley

President
McDonnell Douglas
Astronautics Company

MCDONNELL DOUGLAS