JANUARY 1989/$2

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION

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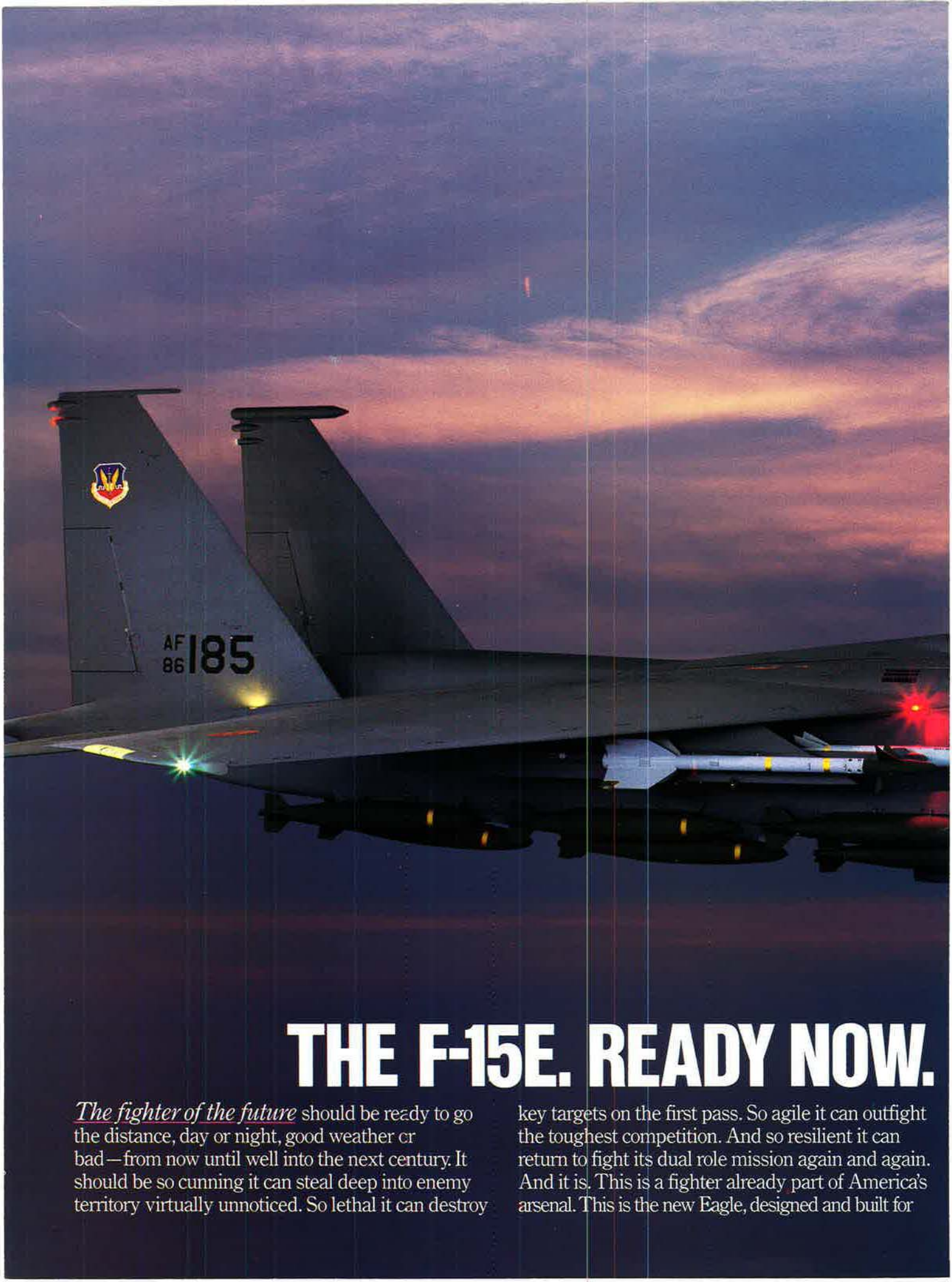

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JANUARY 1989
VOLUME 72, NUMBER 1

AIR FORCE MAGAZINE

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About the cover: This photo of the B-2, the latest USAF aeronautical marvel to make its official public debut, introduces our special section on Aeronautics, which begins on p. 46. (Northrop Corp. photo by John Amrhein)

Special Section: Aeronautics

Features

Departments

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An Editorial

Alliances Are Not Eternal

By John T. Correll, EDITOR IN CHIEF

OLD NATO hands remind us that the great Atlantic Alliance has lived through troubles before. For one reason or another, it has been declared "in disarray" on the average of once every fourteen months since its founding in 1949. It stood firm against formidable pressure in the mid-1980s and countered the deployment of Soviet SS-20s with American cruise missiles and Pershing IIs. In the end, allied solidarity brought the Soviet Union to a serious position on arms control. Looking ahead, NATO's new Secretary General, Manfred Wörner, says that he sees more opportunities than risks.

Let us hope that Mr. Wörner and the old hands are correct in their optimism. Other forecasts are less positive. There is reason to believe that NATO will shortly encounter all the problems it can straddle.

There are four major elements in play. The old dispute about burden sharing within the Alliance and concern about international trade balances are now exacerbated by the prospect of a twelve-nation cartel that the West Europeans plan to establish by 1992. And underlying it all is the phenomenon that one diplomat calls "Gorbymania," the unbridled enthusiasm for Soviet leader Mikhail Gorbachev that seems to be sweeping through many parts of Europe.

A House Armed Services Committee panel last year delved into the burden-sharing problem—the long-standing accusation that the United States spends more than its increasingly wealthy allies do on the common defense. The panel warned that Europeans "are not sufficiently aware of the strong pressure in this country to reduce our defense commitment to our allies unless they are willing to shoulder more of the burden."

This line of discontent intersects with a slightly newer one about the balance of trade. The United States still sells more defense products in Europe than it buys there, but between FY '83 and FY '86, the ratio dropped from 8:1 to 2:1. Moreover, the House panel said, the US is behind by $171.2 billion a year in the overall merchandise trade balance with Europe. The trade balance—like burden sharing—is a complex issue, affected by factors that the public does not understand. What is apparent to the public is that the United States is losing jobs and business. The clamor for protectionist legislation is a powerful influence on Congress.

Then, into the middle of this, the Europeans tossed "Project 1992." Some see this venture as a first step toward unification on a grand scale, but the twelve nations involved are not fully agreed among themselves on ultimate goals. The immediate target, however, is to establish by December 31, 1992, an integrated market with free movement of capital, goods, and labor. That would be enough to create an economic powerhouse—and perhaps, say worried Americans, a near-monopoly market that excludes the United States.

As the Europeans prepare for 1992, they are feeling the oats of their independence a little more than usual. Unfortunately, this occurs in parallel with Gorbymania. The West Europeans, the Germans in particular, are unmistakably more cordial in their attitudes toward the Soviet Union. When that leads them to a divergence of policy with the United States, they almost flaunt it as a matter of pride.

Strong feelings and intemperate words are setting the stage for a rift. The House panel was blunt in its commentary: "The Panel states in the strongest possible terms that Europeans had better be prepared to defend their own territory without a large-scale US ground commitment, because that commitment cannot be guaranteed forever." Such language is matched in equally inflammatory tones by Europeans who say it's time for the Americans to go home.

The House panel observed that "the US and its allies do not agree on the immediacy or level of the threat, even though they face the same adversary," but that Europeans would like the United States to maintain its commitment to NATO defense anyway as "a no-cost insurance policy if our threat assessment turns out to be right and their assessment wrong."

We are drifting in a dangerous direction. Does Europe really want to dump the Alliance that has seen us through forty years of peace and prosperity? Does the United States actually want to retreat into isolationism? Do the Europeans believe that they could replace the US contribution to NATO without wrecking their economies? Do the Americans who want to bring the troops home for financial reasons realize that it would cost $5 billion to rebase them and another $40 billion for airlift and other preparations to redeploy them in the event of crisis or war? Are we prepared to concede to the Soviet Union one of its fondest hopes by splitting up the defense of the West?

It's difficult to believe that reasonable statesmen on either side of the Atlantic are ready to let NATO go under. Some of them, however, may fail to realize how much cumulative strain the present turmoil is putting on NATO, or they may misestimate the amount of strain that the Alliance can bear.

Alliances are not eternal. In our own time, we have seen yesterday's ally, the Soviet Union, become our great adversary while Germany and Japan, our enemies in World War II, are now friends. It is easy for us to forget that alliances tend to shift and change, though, because our relationships with friendly nations have been remarkably stable for the past forty years. The current arrangement has been with the United States and Western Europe so long that we sometimes assume it to be a sure thing, going on forever.

NATO will most probably survive the current troubles, but it would be a mistake to assume that transatlantic difficulties will simply sort themselves out. If we persist in emphasizing our differences and keep putting more pressure on the Alliance that has served us so well, we may do more damage than we ever thought was possible. ■

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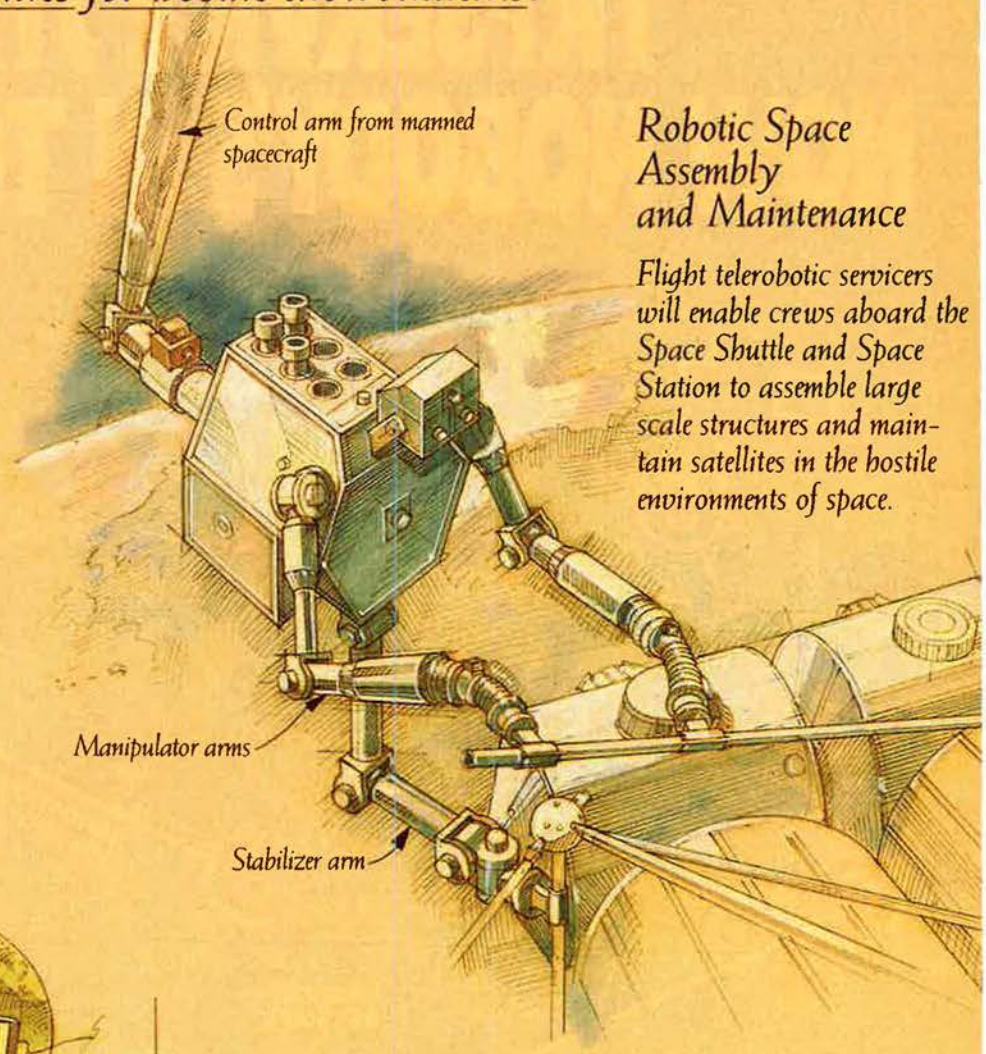

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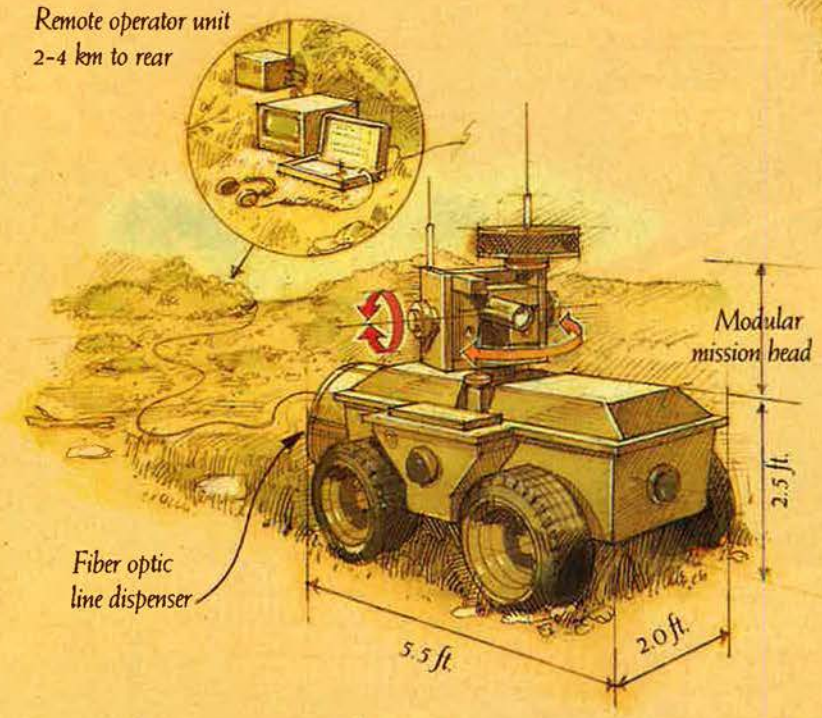

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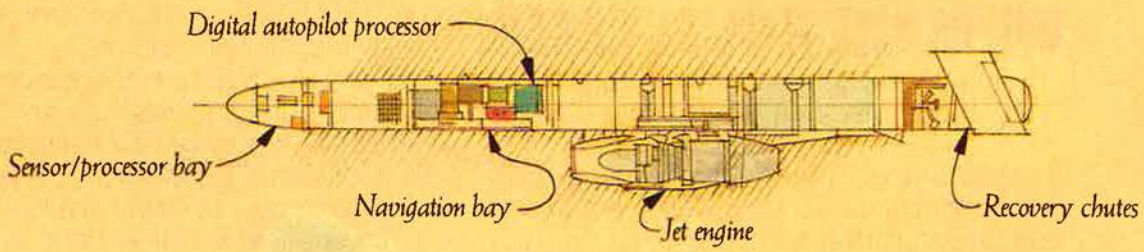

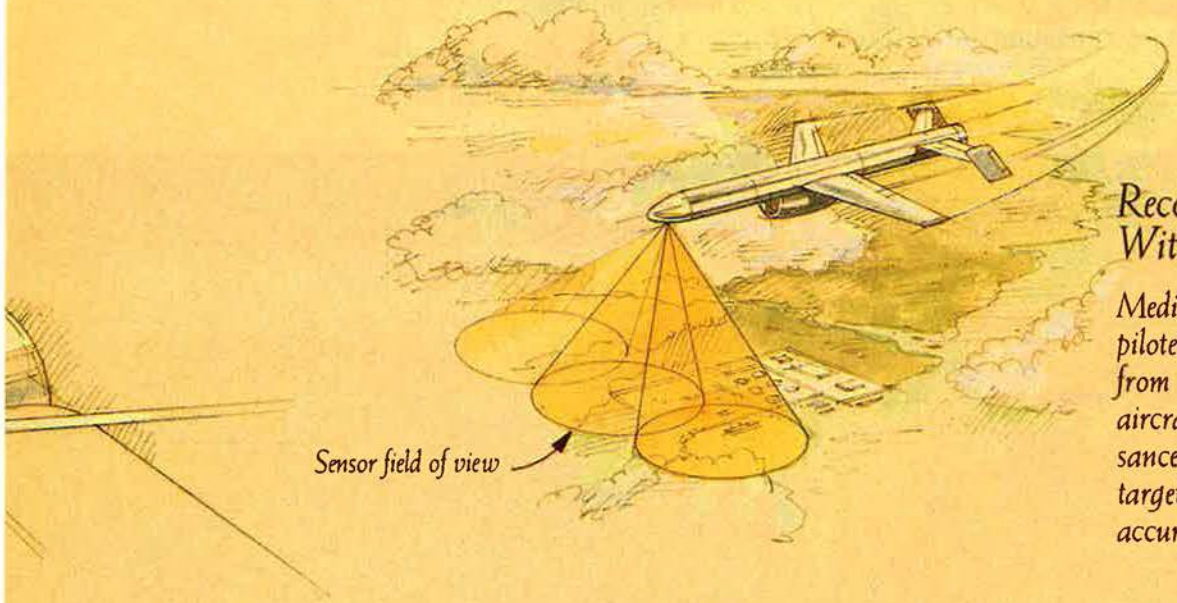

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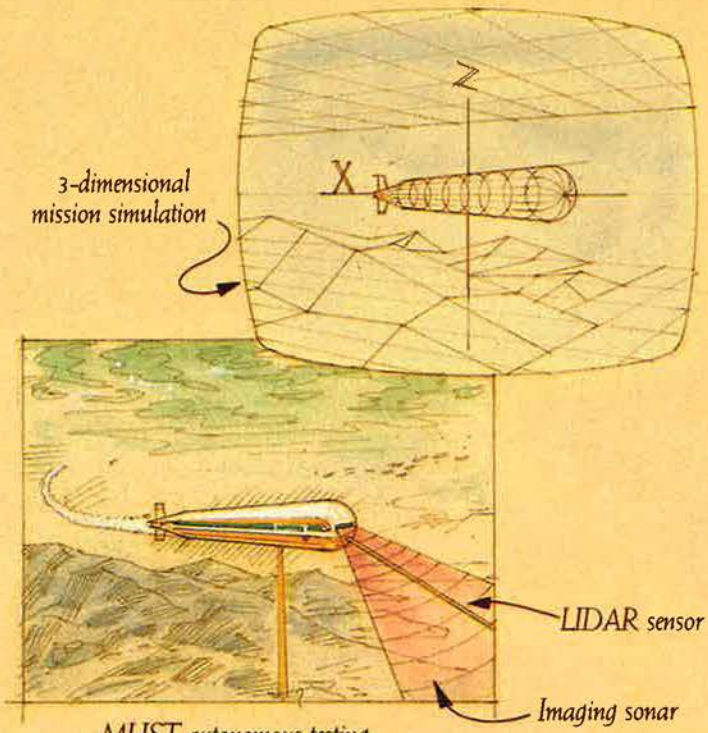

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Airmail

ANG Success

The article "Prelude to Total Force" *[by C. V. Glines, September '88 issue, p. 98]* was of special interest to me.

[I was surprised to read] that the Air National Guard had excelled over the years when compared to the Air Reserve, although it was certainly true. Most old-timers will remember when the Air Guard was sort of frowned upon, and there were strong attempts to do away with it completely—simply because it excelled.

Before 1930, the Air Guard had survived on World War I hand-me-downs, but many of the states had provided good facilities plus other funds and had selected the best personnel available. In the early 1930s, the Air Guard began to receive new aircraft in small quantities directly from the factories, but they were mostly observation aircraft to fit the role of supporting ground troops. Because of the limited terms of active duty for Reserve officers at that time, the Air Guard also acquired some very good personnel, and their performance rapidly improved.

When Pearl Harbor was attacked, many of the units were mobilized, but few continued to operate as units. They became a personnel pool. For example, Lt. Col. Addison Baker, who had come from the Ohio ANG, became one of the Ploesti heroes; Frank Allen from Illinois, a survivor of Ploesti, was later mobilized in the Korean period.

After World War II, the ANG units were reorganized and rebuilt on an expanded basis with World War II aircraft of several types. Their organizational basis was patterned after the Air Force—wings, groups, squadrons, etc. In some cases, such units were quite large and included units from more than one state for operational control, with the administration and financial control remaining in the separate states. This system worked very well and is still in use. The Air Reserve units were also equipped at that time with surplus equipment, but they were without adequate facilities, and administration was weak.

When the Korean War broke, some of the ANG units were mobilized and performed outstandingly during times made difficult by the views of a few Air Force personnel. One such unit was the 136th Wing from Texas. I was told by Gen. O. P. Weyland that the 136th had been the most outstanding wing under his command in Korea. On a visit to the 136th after the Korean War, he was overwhelmed on seeing so many Korean War veterans present in the reorganized and reequipped wing. . . .

An example of bad handling of an ANG unit was the case of the light bomb wing from Illinois with parts of the wing in Wisconsin and Missouri. When mobilized, it was sent to Langley AFB in preparation for overseas duty. When ready, where was it sent? Not to Korea but to France, into an abandoned air base with deplorable or nonexistent facilities—so bad, in fact, that it finally gave the commander such bad health that he had to be returned to the States. . . .

Finally, the special board under Lt. Gen. Leon Johnson was able to overcome much of the political opposition to the ANG when its past performance was thoughtfully analyzed. At that time, it was realized that if the Air Reserve were to survive, it had to follow the successful pattern of the ANG. So the ANG system was adopted, facilities for both the Reserve and the ANG were upgraded, and new first-line aircraft began to arrive. This has continued and accelerated since then, and today—some thirty-five years later—we have some very competent units, some of which now outperform regular Air Force units in several respects. . . .

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.

ANG success over the years seems to be closely related to the stability of the personnel under the technician system, which is the basic system that has been used by the ANG for many years.

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

Army Perceptions

General Gorton's article "Of Mudfighters and Elephants" *[see October '88 issue, p. 102]* hit several spots that bear on the ongoing CAS/BAI debate.

I would like to add the following:

The Army *perceives* that the Air Force will not or cannot support its needs for air support (CAS/BAI, airlift, recce). Associated with this are the Air Support Operations Centers (ASOCs), Forward Air Controllers (FACs), Air Liaison Officers (ALOs), etc., collocated with the Army units that support the air effort.

How does the Army develop such perceptions? Consider that the three corps in CONUS must share the two ASOCs in CONUS with other Command Post Exercises/Field Training Exercises (CPXs/FTXs). Therefore, the corps often do without ASOCs, FACs, etc., during their CPXs/FTXs.

Consider that Guard, Reserve, and active-duty battalion ground FACs and Tactical Air Control Parties (TACPs) are not stationed with battalions. Getting them identified and to the field with the battalion is very, very difficult. (Army Reserve and Guard units hardly know what a FAC is, so they plan CAS/BAI without Air Force liaison.)

Consider that the Army commander, in his opinion, can seldom get all the air liaison and air support when and where he thinks it is needed during his CPXs and FTXs.

Consider the perception of some in the Army and the Air Force that Air Force personnel in the ALO/FAC business are on the second team.

Finally, consider that the priorities of ALOs and FACs are directed at who signs their officer effectiveness reports. For example: During my last visit to a corps in Europe for a CPX,

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Airmail

the ALOs (officers) could not participate, as they were all at an ALO conference at Sembach.

Until the Air Force makes more efforts to support today's battalion, brigade, division, and corps staffs with sorties, participation in staff actions, and becoming part of a team, the Army will perceive that *you fight as you train.*

Dale G. Tyler
Belton, Tex.

Citizens Corps

In the September '88 issue, "Washington Watch" (p. 29) discussed two recent studies that reached radically different conclusions on the relative cost of volunteer and conscript forces. I am not surprised that statistics can be used to prove almost anything, but I believe the cost argument misses the point entirely. Whether it is called "National Service" or "Citizens Corps," the idea of a one- or two-year service obligation for the youth of America stands on its own merit. Efficiency is not the question; service to America and all that goes with it is the question.

This equal employment opportunity should be open to all young Americans without exemption sometime between their eighteenth and twenty-first birthdays. Benefits would be a lifetime of understanding and appreciation for this great country, plus far more mature and responsible adults who return to college, trade school, or a job ready to take full advantage of the opportunity. Teenage unemployment would all but disappear, and teenagers could be headed in the right direction for the rest of their lives with job skills or they could return to school for more education. The Harvard MBA might be delayed a couple of years, but the experience gained would last a lifetime.

Who runs it? People already on the payroll, people who have committed at least twenty years of their lives to developing their self-discipline: the retired military. These people are experienced at developing discipline and desirable traits and attitudes in young people. Whether on an army base, in an inner-city cleanup project, a Peace Corps assignment, or working in a hospital, the long-range benefits would be immeasurable.

Donald B. Hines
Montgomery, Ala.

Warfighting Missiles

The October issue presents some interesting contrasts. You report that the bomber people in SAC have concluded that going to war doesn't mean Doomsday. *[See "On Alert," by Jeffrey P. Rhodes, p. 76.]* Instead, they are preparing to fight their way in and hit militarily relevant targets. The ICBM people don't yet seem to have recognized this. Maj. Gen. Edward P. Barry of BMO asks whether we know what we want to do with ICBMs. *[See "The Dangerous Lull in Strategic Modernization," by James W. Canan, p. 70.]* You go on to state that the Air Force "cannot afford" the Small ICBM. Yet the SICBM is the only missile even on the drawing boards that can be used for warfighting purposes.

MIRVed missiles like the Peacekeeper can be used only for mutual massacre, not for discriminate warfighting. Worse yet, if they are in fixed silos, they invite attack in a crisis. It's long past time the ICBM people learned the lesson the bomber people have relearned: War is about preserving ourselves, not about pushing the Doomsday button. The proper direction for future ICBMs is improved capabilities to survive in and fight a protracted war, rather than more preparations for a nuclear spasm.

Col. Joseph P. Martino,
USAF (Ret.)
Sidney, Ohio

Airpower Roots

My compliments to you for publishing the P-40/F-16 formation picture in your October issue. *[See "Intercom," p. 115.]* It captures the essence of our airpower roots as well as anything I have seen.

One small amplification to the caption that noted that the flight was led by a P-40 flown by AFA's Southwest Region Vice President, Ollie Crawford. The F-16s were flown by former Commander of Twelfth Air Force Lt. Gen. Chuck Cunningham and Lt. Col. Mike Shelton. The F-16s had just completed a low-level navigation training mission and joined up with the P-40 to support the United States Air Force Project Warrior program.

Maj. Gen. L. W. Svendsen, Jr.,
USAF (Ret.)
San Antonio, Tex.

Change in Attitude

As a former Air Force fighter pilot and now an Unmanned Air Vehicle (UAV) instructor pilot, I found your article "On the Horizon: Unmanned Aerial Vehicles" *[by James W. Canan, October '88 issue, p. 84]* interesting.

While I have seen fighter pilots initially scoff at the uses of UAVs, their reaction always changes when they see their assigned target areas on a

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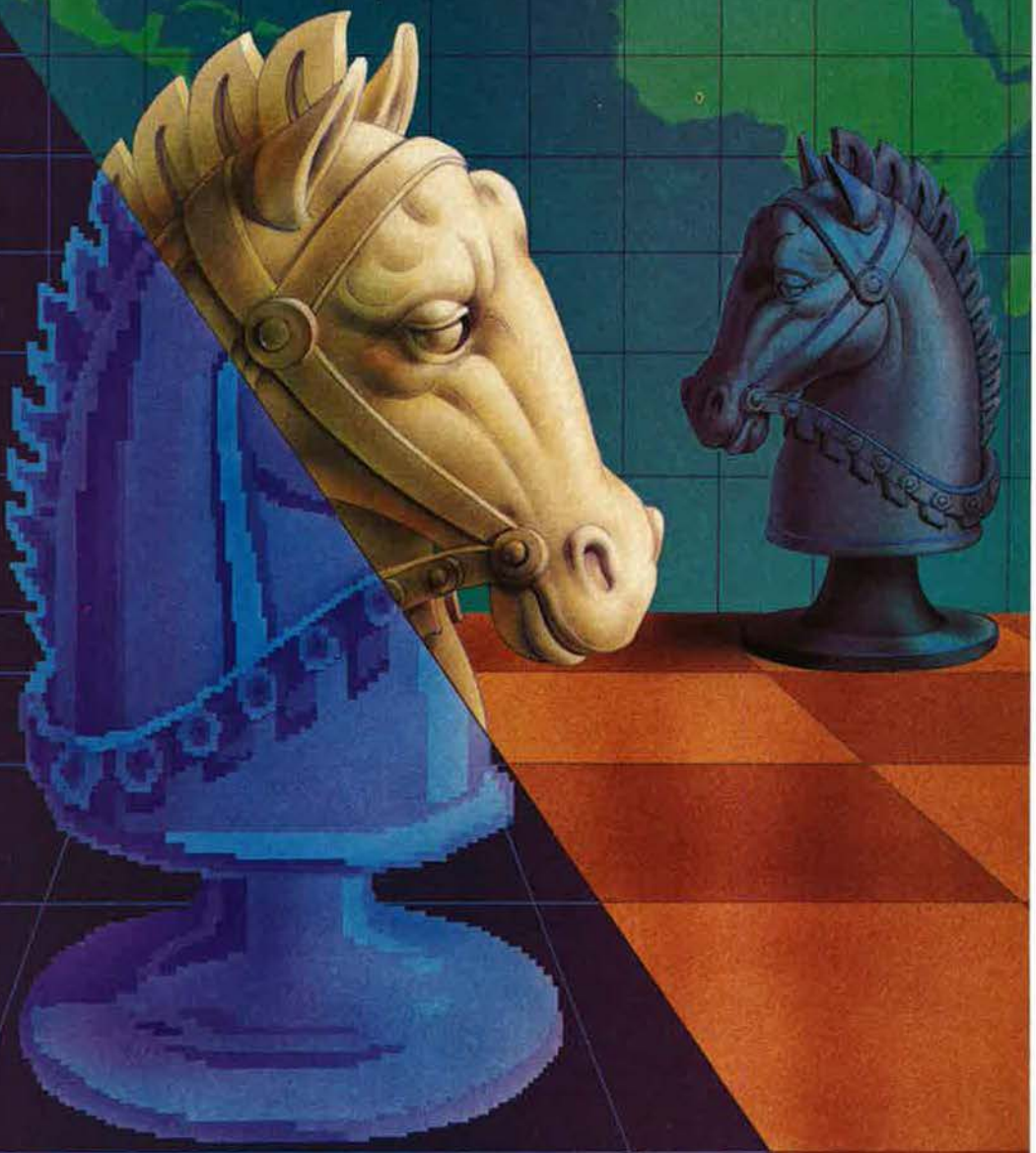

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TV monitor in real time. The TV camera in a short-range UAV system quietly flies over the target area and transmits what is happening at the target as the pilot looks at the TV monitor. I have maneuvered UAVs and TV cameras to look at the run-in heading that the pilot was interested in. This gave him an idea of what he would be looking at from the cockpit. The UAV was away from the area by the time he arrived. The change in attitude of a pilot toward the UAVs is gratifying to me as he sees how the UAV can make a fighter pilot's job easier by removing some of the unknowns about his target just before he goes to his aircraft.

Lt. Col. John E. Grove,
USAF (Ret.)
Glen Rock, Pa.

Limits for UAVs

James W. Canan's article "On the Horizon: Unmanned Aerial Vehicles" (October '88 issue, p. 84) gave the impression that the MTI Radar/Amber UAV combination would replace the Air Force's manned TR-1 and Joint STARS aircraft "maybe sooner than anyone had thought possible." I do not believe this is likely, for two reasons: the complementary role of the UAV-borne system and the prognosis for procurement in the near term.

The MTI radar developed for UAV application by the US Army's Harry Diamond Laboratories and MIT's Lincoln Laboratories is a limited-range sensor that can be used to overfly hostile areas, providing local surveillance and target acquisition. It is particularly useful in finding targets that are using terrain-masking to advantage.

However, several systems must be airborne simultaneously to provide constant surveillance of a division area of influence, whereas TR-1 and Joint STARS, from their standoff positions, can provide constant surveillance for a *corps* area of influence.

TR-1 provides radar imagery (fixed targets), while the Joint STARS emphasis is moving-target detection. Thus, the UAV/MTI radar combination complements the manned aircraft in a large conflict and may be the only airborne radar asset employed in some low-intensity conflict scenarios.

However, the UAV/MTI radar combination, although highly desirable from a user's standpoint, will probably not be fielded quickly because of the UAV programmatic situation. The services (and DoD) have not remembered the lessons learned from the USAF's Compass Cope program, wherein a "jack-of-all-trades" aircraft was designed and flown but was never produced because of a lack of proponents. The DoD Joint UAV program suffers from this same problem: An airframe design is supposed to accommodate a myriad of payloads provided by various users. Egged on by the smaller unmanned-vehicle suppliers who dream of a large program, the multimission-vehicle [programs] result in overdesigns for many missions.

One can predict that a lack of direct user support will prevent other generic platforms planned by the joint DoD program from ultimately being fielded in a timely fashion.

Frank A. Rappolt, Jr.
Eaton Corp., AIL Division
Deer Park, N. Y.

Flag Display

I was impressed with the editorial, "In Defense of Freedom," in your November '88 issue. However, I resent the manner the American flag is displayed on p. 8.

Please remind all concerned that when the American flag is displayed in a pictorial fashion, *no* insignia, design, picture, word, drawing, figure, or object *of any type* should cover any portion of the flag.

Richard Ortega
Winter Park, Fla.

Heroic Corey

Reading in "Valor" of the exploits of Medal of Honor winners Craw and Hamilton *[see November '88 issue, p. 128]*, I was struck by an obvious omission. [Craw and Hamilton] are met by a light truck driven by Pfc. Orris Corey, who drives them through French artillery fire, fighter strafing, "friendly" naval bombardments, and machine-gun fire. They're all riding in the front seat. Craw is killed; Hamilton (and Corey?) go on to negotiate a cease-fire and are imprisoned. The officers get the Medal of Honor. What does Private First Class Corey get? Seems to me he was as much of a hero as the two officers!

Lt. Col. Phil Garey,
USAF (Ret.)
Olympia, Wash.

Back to Rome

It is not my intention to try to draw this discussion out, but I have to agree with Lieutenant Colonel Butler. *[See "Airmail," November '88 issue, p. 15.]* I flew one of the B-25s (321st Bombardment Group) that the 82d escorted over Rome. Colonel Butler's records agree with mine, and both agree with the official Air Force release at the time.

Interestingly, Hitler and Mussolini were meeting on that date at Feltre Villa near Rimini. Adolf's efforts to boost Benito's morale failed in large part because word was received during the meeting of the massive daylight bombing of Rome. These related incidents were mentioned by William L. Shirer in *The Rise and Fall of the Third Reich* and by Winston Churchill in *Closing the Ring.*

The date was July 19, 1943.

Eugene S. Browning
Glendale, Mo.

Total Force in Vietnam

Regarding the letter "The Guard's Proud Record" that appeared in November's "Airmail":

Maj. Gen. John France gave the fine example of gallant service in the Vietnam War by the 120th Tactical Fighter Squadron deployed to Phan Rang AB from May 1968 through 1969. The fighter pilots' combat records are well known and envied, but I remember the enlisted guys who deployed from Colorado and were assimilated into the active support units. Like the regular forces, most did not expect or want to be in South Vietnam, but, once there, worked the twelve-plus hours daily for 365 days without complaint.

During the year the 120th was there, Phan Rang was one of the most frequently rocketed air bases in the country. Before they arrived, it was relatively safe and rocket free. We [on active duty] would kid these good-natured guys that Ho Chi Minh had put the word out that the war could not be won until the Air Guard was wiped out—thus the frequent attacks.

Until the Quayle controversy, I imagine these fellows, like most combat support vets, didn't often think of the war—probably didn't talk about it at all. But this old (happy valley) Phan Rang resident remembers, fondly, those young National Guardsmen who were called, served, and won the admiration and affection of the active forces who had the privilege to serve with them—side by side.

SMSgt. Joe Straus, USAF
2046th Communications Group
Wright-Patterson AFB, Ohio

The Unspeakable Question

The continuing controversy generated by the Air Force's "anointing" the A-16 as the next CAS vehicle, including "No Sitting Ducks" in the July '88 issue, forces consideration of the un-

speakable question: Does USAF really have any interest in providing CAS (as opposed to more glamorous BAI or deep strike) to ground troops? No one seriously questions the heroism, skill, or dedication of the actual aircrews, but rather whether or not USAF as an institution is motivated in this mission area.

The record is not too encouraging. USAF is not known for quick response to unplanned requests. In Vietnam, a policy existed for a while that USAF FACs could not work with non-USAF aircraft, even to support engaged troops.

The current CAS planning doesn't give cause for hope.

It's ironic that the arguments in "Ducks" are the exact reverse of the arguments used by USAF to justify the premature retirement of the A-7, a move thought by many to be motivated by a desire to get rid of a "Navy" airplane. The original USAF specifications for the new CAS vehicle included requirements that had nothing to do with CAS ([such as] clean instantaneous rate of turn), but could only be met by the F-16.

In the recent "evaluation" of alternatives, the arguments against the AV-8B seemed spurious at best—for example, measuring the logistical problems of AV-8Bs operating from remote sites vs. A-16s operating from a main base. A true comparison would be with both operating from the main base. Even there, four hours into the war, the AV-8Bs would be still operational while the A-16s would be hoping someone could fill in the holes in the runways and taxiways.

The most frustrating thing, however, was what happened to Vought's excellent Strikefighter proposal. First, it was delayed and downgraded into the A-7F on the grounds of "affordability." This just doesn't make sense. An all-up Strikefighter costs half or less than half of what a new-build A-16 costs, *plus* most of the spare parts are already bought, paid for, and in the inventory! How can we not afford the all-up Strikefighter, yet afford the A-16? The Strikefighter was at least equal, and arguably superior, to the A-16 as a CAS vehicle.

Now it looks like the A-7F will not even get new engines, but rather rebuilt F100s. Possibly, F110s or either of the IPE engines in the A-7F would make it too big a threat to the A-16.

The final straw is that USAF says there are not enough A-7Ds and Ks to convert to A-7Fs, so another airframe is needed. What's wrong with the nearly 300 virtually identical available A-7Es? Maybe only one thing: They've got "Navy" written on the side.

Don't get me wrong. The F-16 is a fantastic, highly versatile machine. None of the alternatives (except maybe the AV-8B) can match it as an air-to-air vehicle. Maybe that's what USAF really wants. One has to at least wonder, if a MiG-21 is spotted anywhere near a NATO base, whether the "dedicated" A-16s will suddenly sprout AIM-120s and go off to support the ground troops by "winning the air battle."

Cynical? Well, maybe a little. USAF will gain a lot more credibility if the A-16 has the LANTIRN pods permanently attached, has no wiring or hardpoints for radar-guided air-to-air missiles, and has the medium-range air-to-air modes removed from the radar. After all, this is supposed to be a CAS bird isn't it?

Art Hanley
Citrus Heights, Calif.

Chemical Defense

While I applaud the attention paid to realistic training efforts being made by the Air Force, I could not help but notice the inattention to detail displayed on the cover [of the October issue] and, probably, on p. 52.

The problem is in the attachment of the M6A2 hood to the M17 mask. The technical order clearly states that the cords around the voicemitter-outlet valve opening should be tied on the inside under the outlet valve cover. This is not just nit-picking. Proper attachment ensures a good seal around the voicemitter and outlet valve and allows easy conversion of the hood to the proper position for use in hot or cold weather.

I do not mean to imply that we are failing in our readiness mission. We are making great progress. However, those of us who teach things like chemical defense must continue to stress the real-world importance of getting the details right.

Capt. Michael K. Martin, USAF
Keesler AFB, Miss.

Institutionalizing Offsets

I read with great interest the article by F. Clifton Berry, Jr., "You Scratch My Export and I'll Scratch Yours," published in the September '88 issue of AIR FORCE Magazine. As an active practitioner in the field of worldwide offsets and industrial benefits, I can state it was very well written.

Offsets are indeed a fact of life in major international defense sales. The country most advanced in this area, Canada, which conceived and institutionalized this concept, maintains its use as an industrial and regional economic development tool.

In theory, countries with the highest level of internal technological and industrial economic development should be the first to discontinue the use of offsets linked with major weapons purchases. The reason for this is that as a nation's industry acquires worldwide competitive capability, the underlying purpose for use of the offset system would have been fulfilled.

However, since the use of offsets mandates the development of a new government agency and the consequent "institutionalization" of the process, it will prove extremely difficult to eliminate the offset process. The process creates its own international government support group inside the host government. Canada is currently wrestling with this problem.

I agree with the article's statement that US industry must allow for offsets in marketing and pricing. This is particularly true with direct offsets (using the definitions in the article), since these offsets will by definition involve a "premium," consisting of the nonrecurring costs necessary to establish a follow-on producer with a lower future volume of sales over which to amortize its nonrecurring or start-up costs. The follow-on producer will also be higher on the manufacturing learning curve.

More important, though, is that US industry must establish the skills to deal in the international marketplace. The offset process links direct international commercial marketing programs with the primary Foreign Military Sales (FMS) agreement (if FMS is used rather than commercial-direct).

Traditionally, the FMS process has stood as a shield for many US firms, protecting them from the requirements of international business. Now the offset process has breached the FMS contracting wall, placing a premium on international marketing and business skills that the US defense industry is significantly lacking, compared to its foreign counterparts.

K. Barry Marvel
Defense Consultants International
Salt Lake City, Utah

Bomber Arguments

Arguments will continue to "swirl around the bomber issue" for a few more years before it is accepted that "the versatile instrument" has seen its day. A modern bomber is far too ex-

pensive a vehicle to deliver conventional weapons, and it is too slow and vulnerable for nuclear weapons delivery unless, of course, you are initiating a preemptive strike.

Col. Peter Boyes,
USAF (Ret.)
Rancho Murieta, Calif.

Weapon-System Definition

Your article "Fighting Under Attack" on p. 50 of the October '88 issue brings into sharp focus how expansive a weapon system really is.

More than aircraft, aircrew, maintenance, fuel, bullets, and bombs, the definition [of a weapon system] is now (and actually always has been) all of the above *plus* a reasonably protected environment and facilities compatible with the equipment. If any element is not functioning in concert with the rest of the system, the mission is degraded.

Over the past few years, Cleveland Pneumatic has been working through the USAF technical community to develop a solution for part of the program: a passive, easily retrofitted, rough-field modification to the F-15 (and F-16) landing gear that provides a significant improvement in the aircraft's ability to taxi, take off, and land on substandard surfaces. The design has been thoroughly lab-tested, has been incorporated into the McDonnell Douglas F-15 STOL Demonstrator, and is original equipment on a nonmilitary aircraft.

We have a solution to a real problem, but to date, amazingly, there is not a "requirement" to solve the problem.

Is there something wrong here?

Michael Winslow
Cleveland Pneumatic Co.
Cleveland, Ohio

German Helicopters

I am currently putting together a book about German helicopter developments during World War II and am seeking to uncover as much information as possible on the two Focke Achgelis Fa 223 helicopters and the two Flettner Fl 282 helicopters that fell into American hands at the end of the war.

I would very much welcome hearing from any reader who can assist with putting together a complete picture of the movements of these helicopters. I am especially seeking to contact a Major Hawkinson and a Captain Bennett who made a number of flights accompanying these helicopters to Cherbourg.

Any material loaned would be copied and returned as quickly as possible. I hope someone out there is able to assist.

S. M. Coates
150 Uplands Rd.
West Moors, Wimborne
Dorset BH 22 0EY
England

Imphal and Kohima

I am a military historian in the process of collecting relevant material and the reminiscences of ex-servicemen—either their own or their relatives'—who served in the Battles of Imphal and Kohima, which occurred in 1944. Anyone who is willing to participate in this venture, either with information of any kind, or to loan photographs, etc., of the period, would be duly acknowledged, with all material returned as soon as possible.

N. L. Rylatt
Croft Cottage
Near Bank, Shelley
Huddersfield HD8 8LS
West Yorkshire, England

French Bases

I am trying to record the histories of Chambley and Etain Air Bases in eastern France.

I am looking for former USAF members who were stationed there from

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the mid-1950s to 1966 and who could help me with oral histories, souvenirs, documents, and photographs. All loaned material will be copied and promptly returned.

Interested individuals can contact me at the address below.

Jean-Pierre Hoehn
11, Place des Halles
67000 Strasbourg, France

Sabre Search

I would like information, photos, and slides of F-100 Super Sabres in USAF/ANG service 1956–63, for a book on the aircraft. Also special weapons team markings and F-100Ds of the 510th TFS/405th TFW based at Bangkok, Thailand, in 1962.

All material loaned will be taken care of and returned promptly.

R. M. Robinson
37 Home Farm Rd., Houghton
Huntingdon, Cambs. PE17 2BN
England

South Dakota Nose Art

I am attempting to locate anyone who was assigned to Ellsworth AFB, S. D., when the 44th SMW was a flying bombardment wing. I am particularly interested in nose art of the 68th Flying Squadron. If anyone can give me a name or some photos, that would be greatly appreciated. The whole intent is to revive the historical significance that the flying squadrons contributed to the overall mission of the 44th.

Robert E. Watts
1314 Atlas St., #3-301
Rapid City, S. D. 57701

Roll Call

I am writing to obtain information on my father, Capt. Robert L. MacDonald, 0-732041, from Chicago Heights, Ill. He served with the 62d Troop Carrier Squadron of 314th Troop Carrier Group, IX Troop Carrier Command.

J. D. Upton
59 Newsham Way
Romanby, Northallerton
North Yorkshire DL7 8HX
England

Were you with the 558th Bomb Squadron, 387th Bomb Group (Ninth Air Force, B-26s at Chipping Ongar, UK, early 1944)? I need information and especially photos of aircraft and crew of the B-26 lost on a mission to Venlo, Holland, on February 25, 1944. The pilot was squadron commander Maj. Joe Richardson. I am especially hunting photos of tail gunner SSgt. Melbourne D. Hindman of Grangeville, Idaho. The entire crew was killed in action on this mission.

Any and all leads would be appreciated. Please contact the address below.

Mike Minnich
39 Airdrie Rd.
Toronto, Ontario M4G 1L8
Canada
Phone: (416) 422-4483

I am trying to locate TSgt. Norman G. Peterson. Sergeant Peterson was NCOIC of the liquid fuel shop, 8th CES, Kunsan AB, Korea, during 1986–87. Anyone who might know his whereabouts is asked to contact me at the address below.

Michael Dunnagan
2001 Umstead Rd.
Durham, N. C. 27712
Phone: (919) 383-8171

Col. William H. Councill was missing in action in April 1954 on a routine flight from New York to Langley AFB, Va. I was only ten at the time and would now greatly appreciate any information about my father. He was

career Air Force and an officer when the Air Force became an independent branch of the armed services.

Frances I. Councill
Rte. 6, Box 8925
Crawfordville, Fla. 32327

I am trying to locate the widow, or any living relative, of Maj. LeRoy Adolph Schreiber, AO401242, who was one of our leading fighter aces (twelve aircraft) in World War II and was killed in action on April 15, 1944, over Germany.

His wife was Virginia Martin Schreiber, last known (1949) to be living in California.

Please contact me at the address or telephone number below.

Col. Alfred J. Hanlon, USAF (Ret.)
6909 Andover Dr.
Alexandria, Va. 22307
Phone: (703) 768-4353

I would like to hear from anyone who served with the 3918th Air Base Group, which was based at Upper Heyford, Oxfordshire, England, during 1955. Please write to the address below.

Richard Green
76 Quartercroft
Pyramid Close
Weston Favell
Northampton NN3 4DP
England

My uncle was apparently killed when his B-17 went down near Poix Terron, France, on February 25, 1944. I am seeking any information about the 570th Bombardment Squadron, 390th Bombardment Group, and about my uncle, SSgt. Edmund R. Gable, Jr.

Carroll Wilson
1612 Cynthia Lane
Wichita Falls, Tex. 76302

I hope that, after more than forty years, I might locate some of my pilot instructors and say "Thank you" for their abilities. Can the readership assist in finding Tobias Difransesci (Carlstrom Field), John Hodkinson (Gunter Field), Barry T. Bays (Moody Field), and John Proctor (Hendricks Field)?

P. M. Gahagan
2660 N. 66th St.
Wauwatosa, Wis. 53213

I am trying to locate Edward E. Smith. His last known rank is lieutenant colonel (air pilot, probably retired), born September 15, 1936, in Los Angeles. He entered military service around 1954 and was stationed at McConnell AFB, Kan., in 1956, and at Barksdale AFB, La., in 1970–71.

Anyone knowing his whereabouts, please contact the address below.

Debbie Lackey
301 Christopher Todd
Moore, Okla. 73160

I am interested in locating Tactical Air Controllers who served with the 620th Tactical Control Squadron during the years 1967–69. The squadron had sites in Danang, Pleiku, and Dong Ha. Please contact me at the address below.

Robert B. Dunkin
410 Retama
Harlingen, Tex. 78550

We are seeking information about William Corrie, born circa 1915 in Waco, Tex. He was a test pilot for Lockheed, based at Langford Lodge, west of Belfast, Northern Ireland, in 1943–44. Any information would be most appreciated by *Burke's Peerage*. Please contact the address below.

Norma D. Dummer
Brooks Marketing Ltd.
12 Rickett St.
London SW6 1RU
England

6th Bomb Group

I am writing a book on the 313th Bomb Wing, 6th Bomb Group, covering the years 1944–45.

Any information on this unit and its aircraft names, serial numbers, and crews would be helpful.

Extreme care will be taken with any personal material after copying, and all photos will be credited. All items will be returned by security post.

Please contact me at the address below.

Leonardus Groenendyk
G. P. O. Box 93A
Melbourne, Australia 3001

Collectors' Corner

I am in the market for Air Force patches. I would appreciate any spare or unwanted patches that you may have. I would also appreciate any Army, Navy, or Marine patches in the aviation field.

Please send any donations to the address below.

Kim-Xuan Brewer
P. O. Box 73188
Puyallup, Wash. 98373

I am seeking patches from the Air Force squadrons I was assigned to while on active duty from 1965 to 1968. I quickly discovered that these will be hard to find because all my former squadrons have since been deactivated. Specifically, I am looking for patches from the following: 479th Fighter Interceptor Squadron (ADC), 21st Tactical Air Support Squadron (Vietnam), 434th Tactical Fighter Squadron (TAC), and 14th Air Commando Wing (Vietnam).

This is very important to me, and I am willing to pay premium fees. Should anyone possess one of these and not be willing to part with it, I will reimburse the expense for a photocopy.

Robert D. Chiafos
1160 27th St.
Marion, Iowa 52302

I am attempting to collect information about and photographs of Capt. Robert DeLoach related to his service in World War II and immediately thereafter. Captain DeLoach, of Glennville, Ga., served in the 94th Fighter Squadron of the 1st Fighter Group and died in a crash while ferrying an F-86 from the North American plant to March AFB in April 1948 or 1949.

Please contact me at the address below.

Robert V. Phillips
2303 Mimosa Ct.
League City, Tex. 77573

The 355th Tactical Training Wing is in the process of establishing a Wing Heritage Center.

Wanted: any memorabilia depicting the life and times of the old 355th Fighter Squadron stationed in England during World War II and during its tenure in Vietnam as the 355th Tactical Fighter Wing. In an effort to make a clear and concise visual statement of the Wing's achievements and purpose, a proposed 355th heritage center is being established.

To ensure the greatest degree of completeness, such items as leather flying helmets, goggles, log books, medals, or any other flying or maintenance paraphernalia are highly desired. Pictures (with captions if possible) of P-40E, P-47D, P-51B-5, P-51B-15, P-51D-5, F-94C, F-86D, F-105D, F-105F, and A-7D aircraft are also desired. All donations to the Wing would be appropriately designated by a placard acknowledging the donor. Please call SSgt. Rick Rossi at (602) 750-3191 to confirm an item's usability.

SSgt. Rick Rossi, USAF
Historian
Hq. 836th Air Division
Davis-Monthan AFB, Ariz.
85707-5000

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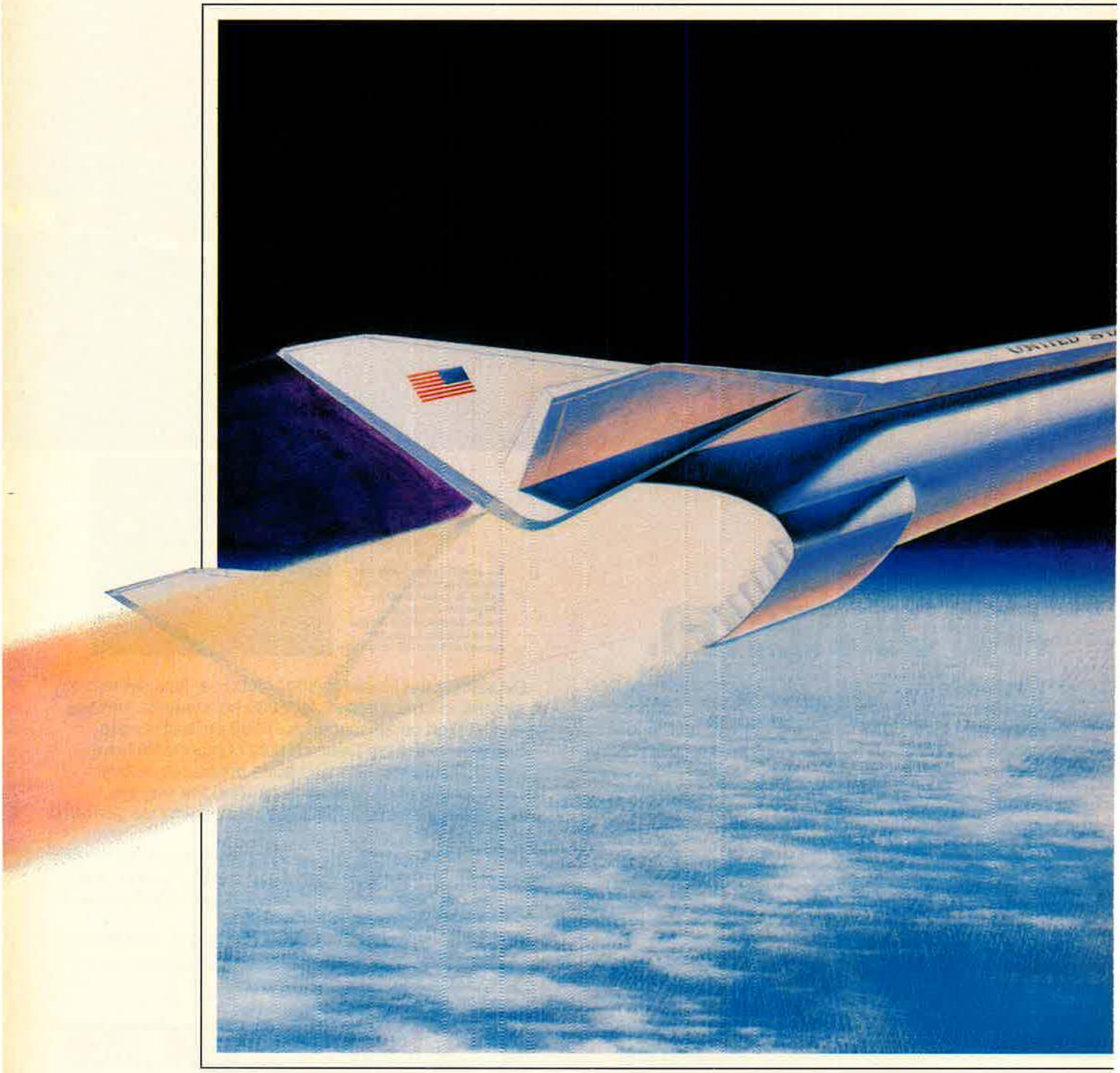

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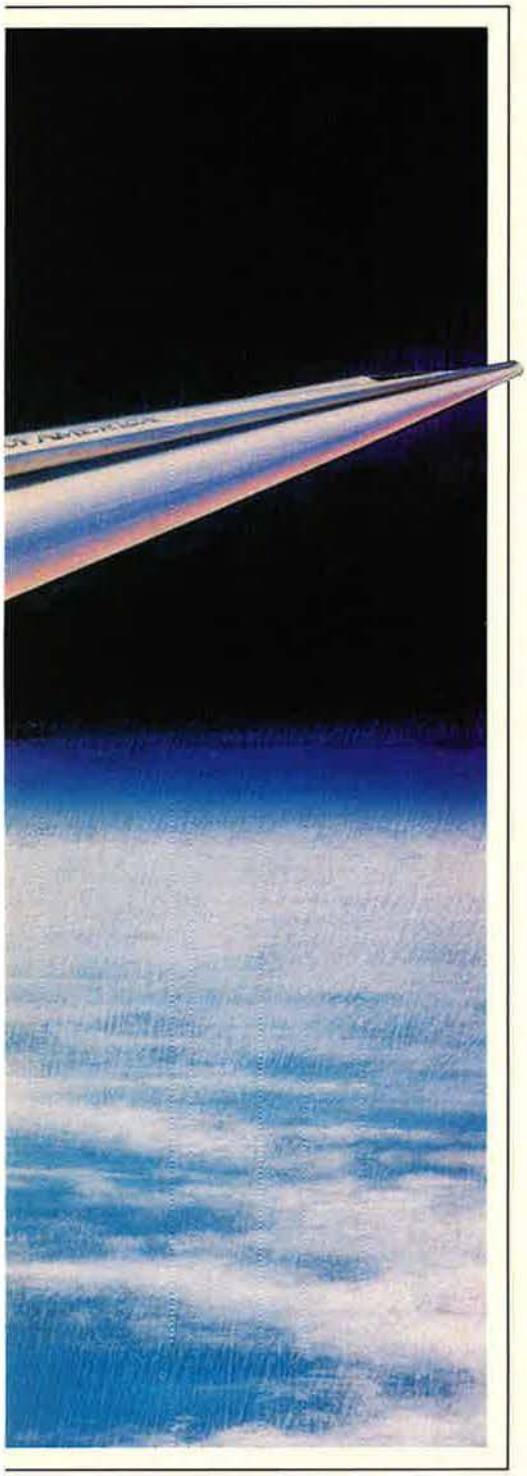

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But the commitment must be made now, and the work must begin now, because indecision or delay could be enormously costly.

Failing to take the initiative now could reduce American aeronautical leadership to a supporting role, and squander a matchless opportunity to advance the state of the art in propulsion. And it would deny us the chance to develop the technology for future aircraft that would be uniquely suited for both military and commercial use, along with an essential United States single-stage-to-orbit capability.

The point is, the moment of NASP has arrived, and its importance to the future of American aerospace leadership cannot be overstated. Nor can the call for unqualified support.

And make no mistake: there will be an aerospace plane. The only question is the flag that it flies: Will it be the stars and stripes . . . or something else?

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O F R O C K W E L L I N T E R N A T I O N A L

The Chart Page

By Colleen A. Nash, STAFF EDITOR

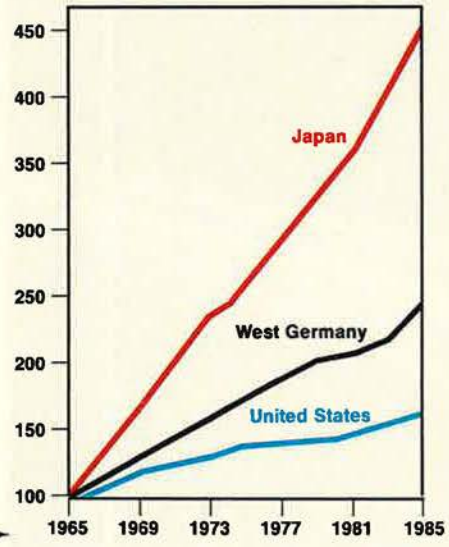
Returning a National Resource

FY	Four-Year Enlistees	FY	Reenlisted	Percent Reenlisting	Number Into National Work Force
1979	46,926	1983	30,788	65	16,138
1980	39,890	1984	24,660	61	15,230
1981	47,461	1985	25,601	54	21,860
1982	40,391	1986	23,393	58	16,998
1983	39,667	1987	25,629	65	14,038
1984	46,420	1988	25,056	54	21,364

In FY '79, 46,926 young people enlisted in the Air Force for four years. FY '83 was the first year in which they were eligible to reenlist, and sixty-five percent did so. The cost to the nation for training the others is not lost, though. Each year, the Air Force sends thousands of young people with valuable training, technical skills, and experience out into the work force.

Sources: Air Training Command; Air Force Military Personnel Center.

Slow Growth In Productivity



This chart compares growth rates in manufacturing productivity, using 1965 as a base year. Japan has experienced a tremendous increase in its productivity growth rate over the years, while the US's increase has been much more modest.

Sources: US Department of Labor, Bureau of Statistics, Office of Productivity and Technology; 1985; Defense Science Board.

DoD's Safer Skies

	FY '82	FY '83	FY '84	FY '85	FY '86	FY '87	FY '88
Army:							
Flying Hours	1.58	1.59	1.54	1.53	1.67	1.71	1.74
Class A Accidents	51	37	40	45	34	38	32
Accident Rate	3.23	2.33	2.60	2.94	2.04	2.22	1.84
Navy:							
Flying Hours	1.63	1.64	1.65	1.70	1.71	1.80	1.78
Class A Accidents	70	56	56	47	58	49	37
Accident Rate	4.30	3.41	3.40	2.76	3.39	2.73	2.08
Marine Corps:							
Flying Hours	0.37	0.38	0.41	0.44	0.44	0.44	0.44
Class A Accidents	20	23	20	25	18	20	14
Accident Rate	5.44	6.01	4.88	5.71	4.12	4.53	3.18
Air Force:							
Flying Hours	3.33	3.39	3.44	3.48	3.46	3.46	3.37
Class A Accidents	70	67	53	61	53	57	55
Accident Rate	2.10	1.98	1.54	1.76	1.53	1.65	1.63
DoD Totals:							
Flying Hours	6.91	7.00	7.04	7.15	7.28	7.41	7.33
Class A Accidents	211	183	169	178	163	164	138
Accident Rate	3.05	2.61	2.40	2.49	2.24	2.21	1.88

A Class A accident is one in which the cost of property damage or personnel injuries is $500,000 or greater, an aircraft is destroyed, or a fatality or permanent total disability occurs. Flying hours are given in millions, and the accident rate is per 100,000 flying hours. DoD logged the best aviation safety record in its history in FY '88. The Air Force flies the most hours and has consistently maintained the lowest accident rate among the services.

Sources: DoD; USAF.

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AIR WAR in Korea

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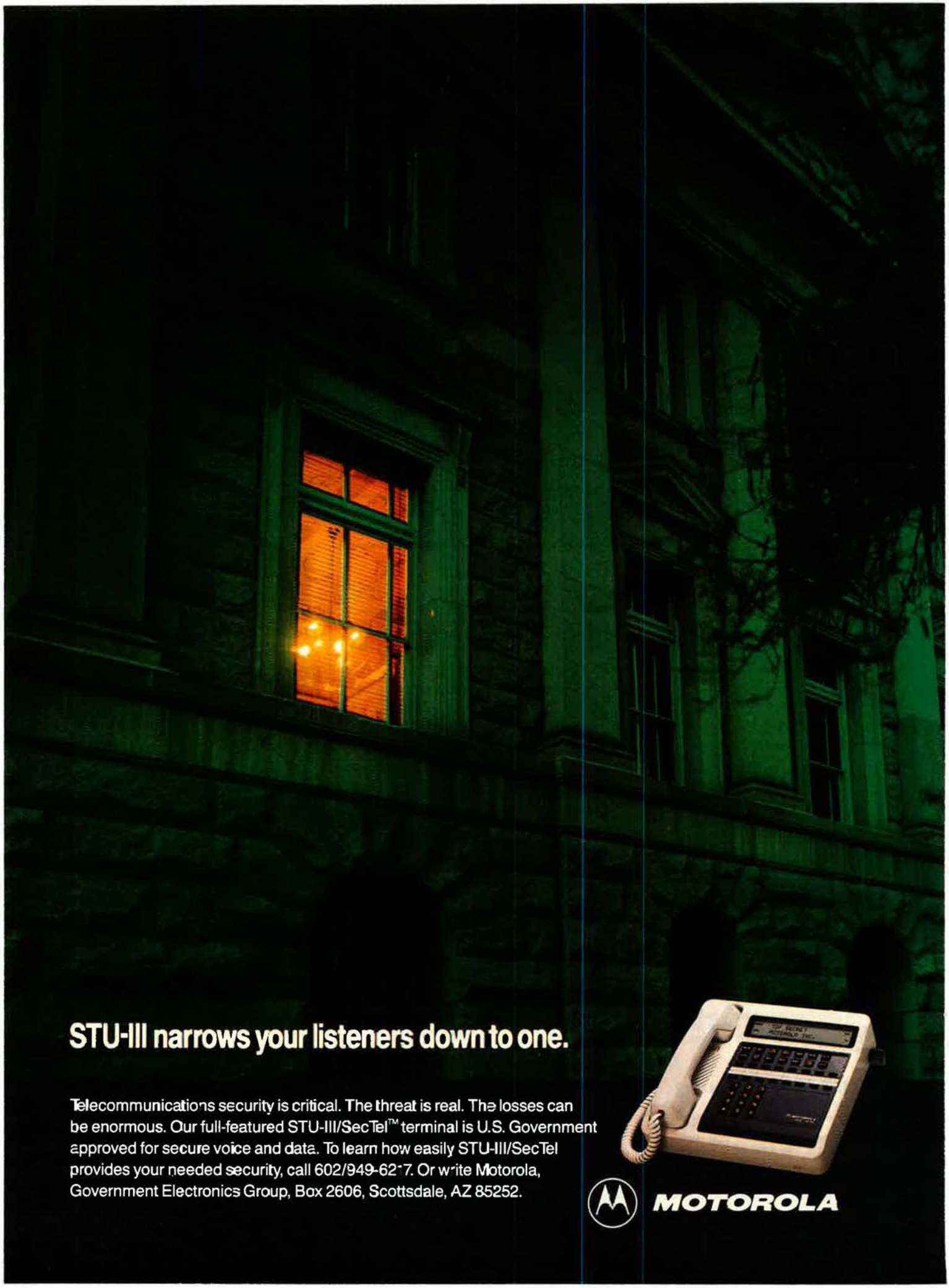

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MOTOROLA

Another Dose of Reform

By John T. Correll, EDITOR IN CHIEF

If Congress doesn't like what the Bush Administration says on defense procurement, it will not wait long to act on its own. Strong medicine may be prescribed, whether the patient needs it or not.

Washington, D. C. The defense management team from the Bush Administration may not have long—a couple of months perhaps—to stake out its position on defense procurement reform. If the administration's opening pitch is unconvincing, Congress is likely to take matters into its own hands.

Over the past twenty years, the defense acquisition process has been studied, investigated, and reformed more times than anyone can remember. Congress, however, is still far from satisfied, and it plans to tackle the problem with fresh vigor in the new session about to begin.

Some of the discontent stems from allegations last summer that industry consultants were privy to inside information, which their clients then used to unfair advantage in securing defense contracts. Even before that, though, Congress felt that the Pentagon had been slippery and evasive in implementing procurement reform measures.

Critics on Capitol Hill charge the Department of Defense with failure to streamline and police the acquisition process sufficiently, and they fault DoD for reluctance to consolidate control in the hands of a powerful "acquisition czar." They chastise the Department for allowing the services to push more programs than reduced budgets can support.

For their part, the services and the Defense Department contend that they have made significant changes in the full spirit of reform. They want a legislative cease-fire and time for the accumulated adjustments to settle. There is virtually no chance that this argument will succeed. Congress is in no mood to back off, not even temporarily.

That's unfortunate, because the reforms already in place are working pretty well. Reporting channels for program managers have been simplified. Cost overruns on major systems—increasing at a rate of fourteen percent a year in 1981—have practically disappeared. Freestyle tinkering with system design in mid-development, once a common practice, is no longer tolerated.

Nevertheless, diagnosticians in and out of government prescribe strong medicine, so it may be forthcoming whether the patient needs it or not.

All sorts of proposals are kicking around. One idea would remove the military services from the procurement process and create an independent acquisition agency to buy weapon systems for the entire Department. Another scheme would pull the Defense Inspector General out of the regular chain of command to give the fraudbusters a freer run. Some activists want to shut the "revolving door" between the Defense Department and industry. They believe the conflict of interest is insurmountable if military officers and civilian officials with procurement authority can accept—or return to—jobs with defense contractors when their government tours end.

Moderates in and out of Congress, however, warn that these are radical measures and unwise. Such proposals make interesting speeches, but there is not much chance that they will find their way into legislation this term. A more likely issue for action—arcane as it may sound to the general public—is the role of the Under Secretary of Defense for Acquisition.

This position was the brainchild of the Packard Commission on Defense Management in 1986. Congress embraced the concept enthusiastically, envisioning a strong acquisition czar with power to deal with intramural squabbling over resources.

Richard Godwin was the first person to hold the new position. He quit, saying he had not been given the authority he needed to do the job. The tenure of his successor, Dr. Robert B. Costello, has been less stormy, but he does not exercise enough power to satisfy Congress either. In introducing an acquisition reform bill last October, Sen. Jeff Bingaman (D-N. M.) accused the Defense Department of "making the Under Secretary dominant in approving programs, but providing others with the primary responsibility for addressing the funding of those programs."

(A compounding factor was that while both Mr. Godwin and Dr. Costello had some background in defense work before they came to the Pentagon, neither of them brought along a recognized reputation in the systems-acquisition field. This limited their effectiveness, even on matters where their authority was not at issue. A better-known veteran of the procurement wars might have been able to squeeze more clout from the charter.)

One interesting indication of progress is that the focus of acquisition reform has shifted. Today, the central issues are organizational, concerned with streamlining the hierarchy and ensuring that it is squeaky clean. A few years ago, the problems lay closer to the bone. Cost overruns were eating the services alive. Baseline discipline was loose. So many people were inserting change orders into the process that some systems were almost reinvented at the same time they were being acquired. The time it took to convert concepts into working weapons was increasing, too. Major steps in the recovery, everyone agreed, were to stabilize the process and eliminate some of the micromanagement.

The situation—at least the part of it that the Defense Department can control—has improved in nearly all of these respects. Acquisition officials

readily admit that the process isn't perfect, but they also reject the charge that sweeping change is necessary to correct fundamental flaws.

"There isn't any other acquisition community anyplace in the world that's providing better equipment," says Gen. Robert T. Herres, Vice Chairman of the Joint Chiefs of Staff. "There isn't any that's providing equipment as good for the same price. So all those critics who say we aren't doing very well need to keep in mind: compared to what?"

Secretary of Defense Frank C. Carlucci adds that "in DoD, we have made the term 'cost overrun' disappear. For the last two years, acquisition costs on major systems have been going down—not up. Those in a hurry to overhaul our system need to reflect on the fact that we now have *cost underruns*."

The military establishment further points out that reform was supposed to involve Congress as well as the services. While the services may have fallen short here and there, Congress has imposed no real changes at all upon itself. If anything, congressional micromanagement is worse than it was before.

The amazing thing is that a process so laden with "oversight" works at all. Industrialist-philosopher Norman R. Augustine says that defense procurements are "controlled by 4,000 laws and 30,000 pages of regulations, issued by seventy-nine offices and watched over by more than 26,000 people in the audit and oversight process, and by twenty-nine congressional committees with fifty-five subcommittees. In a typical year, the Pentagon responds to 720,000 inquiries from Capitol Hill."

A staple of the reform movement has been to remove middlemen from the acquisition chains in the services. Program managers now report directly to Program Executive Officers (PEOs), who, in turn, are straight-wired on program matters to their service's single acquisition executive. In Air Force Systems Command, the commanders of the product divisions (Aeronautical Systems Division, for example) are the PEOs for most programs.

Gen. Bernard P. Randolph, AFSC Commander, is PEO for a handful of big programs, including the National Aerospace Plane. The next level up from the PEO is the acquisition executive—in the Air Force, the Assistant Secretary for Acquisition. Any program manager who feels a need to talk directly with the acquisition executive is free to do so.

Except for matters central to their system acquisitions, though, program managers and PEOs are still responsible to Systems Command. That bothers some reform advocates who would like to further reduce the organizational layering by putting the acquisition commands, such as AFSC, out of business. Their favorite example is that of the controversial John Lehman, former Secretary of the Navy, who abolished the Navy Materiel Command several years ago. The Navy feels that it is getting along just as well without it.

The Air Force, on the other hand, has felt that its Systems Command provides much worthwhile support and management to the program offices. AFSC's acquisition strategy panels, for instance, are available teams of experts in contracting, testing, product assurance, software, competition, technology, financial management, manpower, and other areas. Beware, insiders warn, of streamlining this specialized talent and assistance away from the program manager. In any case, Air Force Systems Command has its own list of achievements to point to in the age of reform.

A staple of the reform movement has been to remove middlemen from the acquisition chains in the services. Program managers now report directly to Program Executive Officers.

AFSC has cut its headquarters manning by seventeen percent. It is experimenting with a "reduced oversight" initiative, in which contractors assume functions previously handled by Air Force personnel assigned to the plants. If this works with the three contractors chosen for the test, Systems Command looks forward to reducing oversight by fifteen percent or more.

In another action, AFSC is trying to speed up the source selection process. In the past, ten months or more might elapse between the release of a Request for Proposal and the eventual signing of the contract. This interval now averages 140 days, and the goal is to get it down to 120. In the best chest-thumping case so far, AFSC moved the Medium Launch Vehicle II through source selection in 114 days. In aid of this, the command now limits the size of the documents it sends out and says it will accept no proposal that exceeds 100 pages.

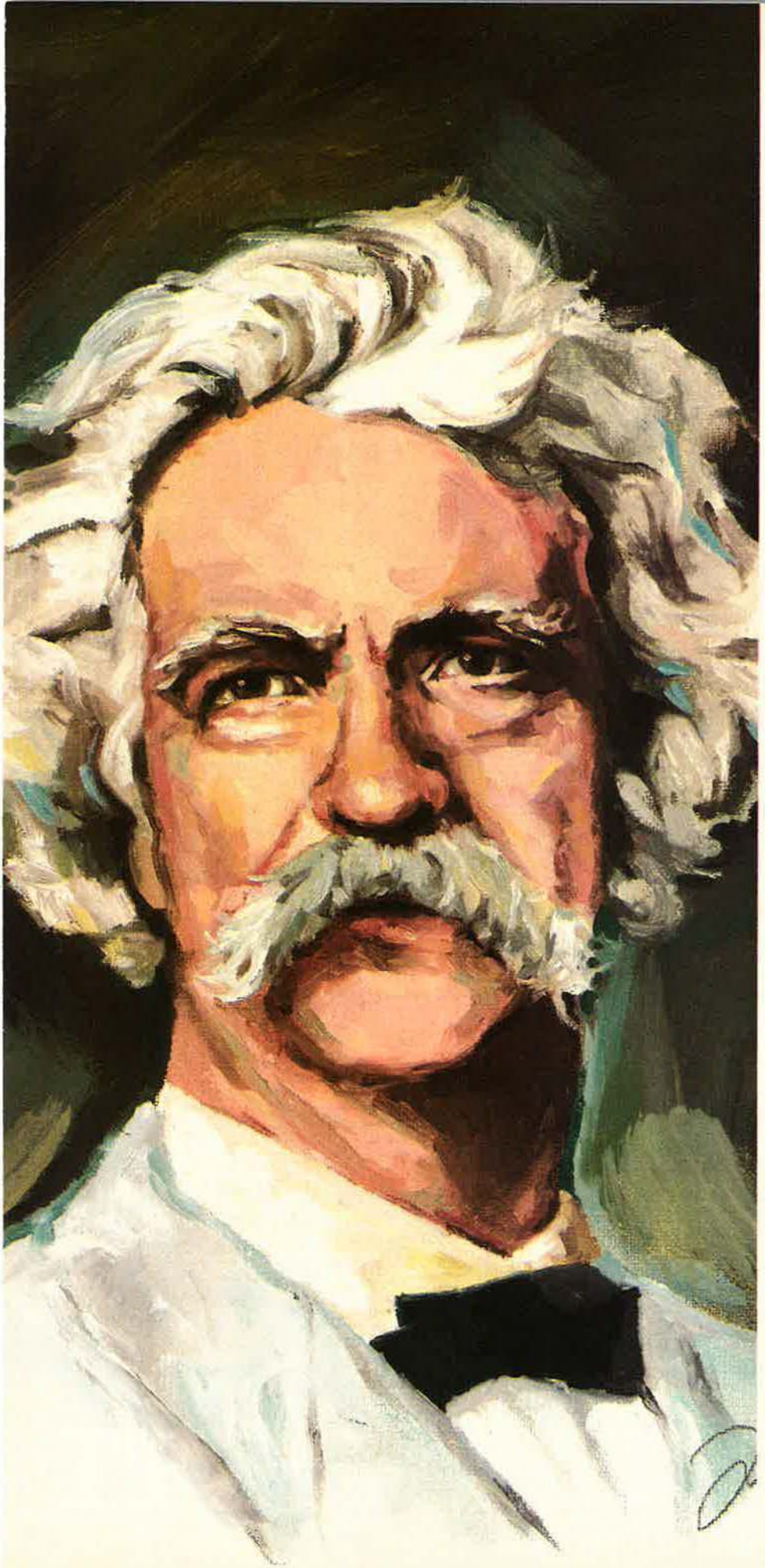
Moreover, the Air Force has led all of the services on baseline discipline. Once the basic concept and configuration of a program is decided, everybody signs up to it. It is not impossible to change the baseline after that, but neither can it be done so casually as it once was.

Acquisition discipline is also tighter at the top Pentagon levels. Here, acquisition reform gets a boost from the Defense Department reorganization directed by the Goldwater-Nichols bill of 1986. That legislation created the position of Vice Chairman of the Joint Chiefs, the job General Herres now holds. In that capacity, he is well situated to narrow the gap between requirements and resources.

Most work on acquisition at the Joint Chiefs-Defense Department level is conducted by three major bodies: the Joint Requirements Oversight Council (JROC), the Defense Acquisition Board (DAB), and the Defense Resources Board (DRB). The JROC was created several years ago to validate and clean up requirements before a proposed system moved into the acquisition cycle. General Herres chairs the JROC, whose members are the vice chiefs of the services.

If a requirement passes muster, the JROC sends the Mission Need Statement on to the DAB, where system acquisitions are approved or disapproved. The Under Secretary for Acquisition chairs the DAB, and General Herres is the vice chairman. The services have representatives, as do relevant staff agencies in DoD. If an acquisition czar is going to exercise clout, the DAB is the place—barring more change in charters and organization—where he's going to do it.

Whenever requirements and programs exceed the money available to fund them—which is always—the action moves to the DRB, to decide on funding priorities. This board has



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grown from an original membership of five to a present total of about twenty, with still others participating by invitation from time to time. It is chaired by the Deputy Secretary of Defense.

In his October remarks, Senator Bingaman cited "artificial distinctions between program approval and funding" in the Defense Department. General Herres and others believe that the Pentagon, coordinating the work of the JROC, the DAB, and the DRB, has made real progress in scrubbing requirements and programs and in aligning them with resources. If Congress wants to reshape those connections, the change would fall somewhere in the makeup and relationship of these three bodies.

• *Stretchouts vs. Cancellations.* Conventional wisdom in the acquisition world says that bad things happen when the military gets into a resources bind and stretches procurement out over time. Generally, this leads to inefficient rates of production, which drive up costs. The classic example is the initial purchase lot of F-15 fighters. Procurement was stretched out from the planned six years to nine, adding $2 billion to the cost—which, at the time, would have bought another 760 airplanes.

William Schneider, defense advisor to the Bush campaign, made quite a ripple, therefore, with his statement in October that a Bush Administration response to smaller budgets would emphasize system stretchouts rather than cancellations. He said that economical production rates are possible in a stretchout if funding is stable. "The problem that has killed the industry has been the annual appropriations cycle and the unpredictability of the annual buy," he said.

The key to an economical stretchout, he declared, is multiyear procurement. Even if the annual buy were lower than program officials might prefer, the size of it would be known and would not change. In support of Mr. Schneider's point, multiyear procurement has done great things when the Defense Department has been allowed to use it. The problem is getting Congress to approve.

"I think Congress is more comfortable with multiyear procurements now than it has been in the past, especially if there's a better consensus over resource aggregates," Mr. Schneider said. "When multiyear procurements were initiated in the early 1980s, there was concern about whether the administration was using [them] as a way of getting a weak program started and having the Congress irrevocably committed to it."

• *The Burro Factor.* Deciding who should be involved in the process is a problem of perspective. Micromanagement is committed by others, usually at some higher level. One's own actions are sensible oversight. If things go wrong, the first question is sure to be: "You mean nobody except the program manager was watching this?"

Almost everyone who has a hand in micromanagement has some legitimate—or legitimate-sounding, anyway—reason for their involvement. Deputy Secretary of Defense William H. Taft IV explains: "There are reviews and reviewers concerned with competition, with exotic technologies, with operational testing, with the industrial base, with specific features of military strategy and doctrine, and with a score of other genuinely important matters—not to mention the purely political interests of the 535 members of Congress."

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The acquisition process, he says, "visits and revisits . . . decisions month after month and year after year, making a program's forward progress depend repeatedly on favorable alignment of every independent-minded star in the governmental galaxy."

Rep. Jim Courter (R-N. J.) was on the mark in 1986 when he said that single-issue advocates persist in bogging programs down with "extraneous provisions concerning how best to resettle homeless burros." So long as the policymakers insist that all federal actions reflect due concern for homeless burros or other special issues, micromanagement is likely to continue.

• *The Revolving Door.* Secretary of Defense Carlucci, arguing against the radical reformers and even some officials in his own Department, put it this way in testimony to the Senate Armed Services Committee: "As we discuss restrictions on officials leaving government service to join the defense industry, we must consider whether such restrictions will discourage good people from joining or staying in our DoD acquisition staff.

"The trade-off for unnecessarily tight career restrictions on acquisition officials may well be quality and expertise available to our nation's overall defense effort. Yes, we should study the adequacy and enforcement of rules governing the career movement of people between DoD and the defense industry. At the same time, we should realize that what some call the 'revolving door' in fact benefits both DoD and the defense industry and advances America's national security.

"DoD gains tremendously when we are able to recruit defense industry professionals. They bring to us valuable business experience and in-depth knowledge to help us be a demanding buyer of defense industry products. Industry and our nation gain when military and civilian professionals leaving government continue to apply their expertise in building a stronger US military."

A few months after Mr. Carlucci said this, the new administration was reportedly unable to persuade some industrialists it had wanted to accept Pentagon posts, since service there might block their return to industry later. It has been noted also that under the "revolving door" rules touted by some, "Mr. Reform" himself, David Packard, might not have served in the Defense Department.

• *Fraud and Misconduct.* The scope of the effort to find and eliminate fraud in defense procurement has been in high gear since the early days of the Reagan Administration. It may be the most thorough investigation of internal problems ever undertaken by the federal government. It has uncovered some fraud—but it has also confirmed that fraud is by far the exception rather than the rule in defense contracting.

As one former official with top credentials in these matters says, "The crooks and the acquisition process are separate problems."

The reformers will be better pleased with their results if they can keep that in mind. ■

Capitol Hill

By Brian Green, CONGRESSIONAL EDITOR

Washington, D. C.

Committee Shifts

The defeat of Rep. Bill Chappell (D-Fla.), Chairman of the House Appropriations Defense Subcommittee, in his bid for reelection will lead to a change in that subcommittee's leadership. Other key defense committee memberships will shift somewhat in the coming session of Congress as a result of retirements and election outcomes.

Representative Chappell's name had surfaced in numerous reports in conjunction with the recent investigation of procurement irregularities at the Pentagon. Another congressman affected by the alleged scandal, Rep. Roy Dyson (D-Md.), survived a very tight election. Representative Dyson is a member of the House Armed Services Committee. Neither Chappell nor Dyson has been accused of any crime.

Representative Chappell's defeat means that Rep. John Murtha (D-Pa.), next in line for the chairmanship of the subcommittee, is likely to take over the leadership reins. Representative Murtha's voting record is similar in many respects to Representative Chappell's. He has generally supported the Peacekeeper, the B-1, and other high-priority, controversial Air Force programs. Last year, he voted in favor of the "narrow" ABM Treaty interpretation (which would limit SDI testing) and US compliance with SALT II's numerical constraints, but he opposed a permanent ban on ASAT testing and a one-kiloton limit on underground nuclear tests. He voted to kill funding for the Small ICBM, a program the Air Force does not believe it can afford in the current tight budget environment.

Senate Appropriations Committee Defense Subcommittee membership will also change due to retirement and an election upset. Committee and Subcommittee Chairman Sen. John Stennis (D-Miss.), Sen. William Proxmire (D-Wis.), and Sen. Lawton Chiles (D-Fla.) all retired from the Senate. Sen. Lowell Weicker (R-Conn.), a maverick, liberal Republican, was defeated by Joseph Lieberman in his bid for reelection. Sen. Dan Inouye (D-Hawaii) is slated to take over the subcommittee. Senator Inouye has generally opposed the Peacekeeper, the B-1B, and other controversial Air Force programs. Last session, he voted in support of US compliance with SALT II constraints, against a very low underground nuclear test threshold, and for lower SDI spending.

Shifts in the House Armed Services Committee will be generated by vacancies due to the death of Rep. Mel Price (D-Ill.), the retirement of Reps. Bob Badham (R-Calif.) and Sam Stratton (D-N. Y.), and the defeat of Reps. Jack Davis (R-Ill.) and Mac Sweeney (R-Tex.). The Senate Armed Services Committee has only two vacancies, resulting from Senator Stennis's retirement and Sen. Dan Quayle's move to the White House.

Overall, the ideological makeup of the Senate and House is not expected to change much. The Democrats gained one seat in the Senate, where they now hold a margin of 55–45, and three seats in the House, where they outnumber Republicans 260 to 175.

Report Bombs B-1

The B-1B "faces increased [maintenance] costs, extended reliance on contractor engineering support, and significant maintainability challenges," according to a report by the General Accounting Office, the investigative arm of Congress. The report maintains that aircraft availability and training have been reduced and that the B-1B has not been mission-capable "a significant percentage of the time" due to maintenance problems.

The Air Force points out that virtually all B-1Bs could be launched in the event of a wartime crisis. It further argues that comparisons between the B-1B and technologically more mature systems are suspect and often unfair to the newer system. Nevertheless, B-1B sortie rates already exceed those of the B-52 and continue to rise. The B-1B flew all the hours for which it was funded in FY '88 and could have flown more had Congress not cut funding.

Military Education Reforms

A House Armed Services Committee panel proposed creating a new professional military education center. According to panel chairman Ike Skelton (D-Mo.), this center would reverse "a shift in all four services from military skills to management skills. . . . An MBA became a prized achievement [in the 1960s]. But the management emphasis hasn't reduced cost overruns, while it has reduced the quality of strategic skills." The panel proposed that the National War College be converted to a National Center for Strategic Studies.

The panel made a number of other recommendations, including:

- Restructure the military school system. Primary-level schools would focus on tactics, intermediate schools on operational art and theater-level force deployment, senior schools on global military strategy, and the new pinnacle school on broad national security strategy.
- Upgrade the faculties of the professional military schools.
- Create a position of Director of Military Education on the staff of the Chairman of the Joint Chiefs.

The reforms are intended to improve the quality of strategic thinking in the military and to emphasize jointness.

A Dilemma?

Soviet General Secretary Mikhail Gorbachev is probably sincere in his efforts to reform the Soviet military, but has not managed to effect any "concrete, operational changes in Soviet military behavior" or to reduce the Soviet military budget, according to a recent report released by the House Armed Services Committee Defense Policy Panel.

While the panel conceded that Western caution was justified "as long as Soviet military capability remains unchanged," it also maintained that the Soviet military "has resisted significant operational changes because Gorbachev's arms-control policies, to date, have not significantly reduced the 'Western threat.' " ■

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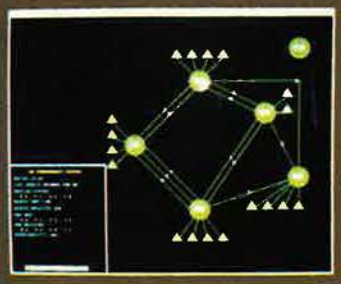

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Aerospace World

By Jeffrey P. Rhodes, AERONAUTICS EDITOR

Washington, D. C.

★ The Air Force has lost two more of its B-1B bombers. On November 8, an aircraft assigned to the 96th Bomb Wing at Dyess AFB, Tex., crashed shortly after takeoff for a training sortie. All four crewmen ejected safely. After that mishap, Strategic Air Command grounded the remaining ninety-eight B-1Bs until a fleet-wide safety inspection had been performed.

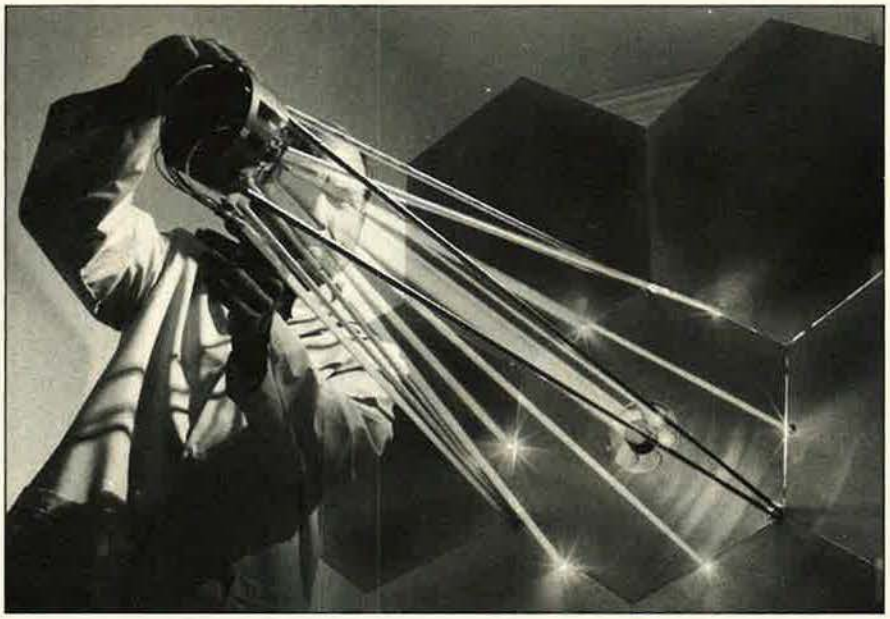
The other loss came on November 18, when an aircraft from the 28th Bomb Wing crashed on approach to the runway at Ellsworth AFB, S. D. The crew ejected, with no major injuries reported. Both accidents were still under investigation as this column was written, and Air Force officials declined to give further details until inquiries were complete.

Spokesmen pointed out, however, that the B-1B still has the best flying safety record of any heavy bomber introduced into service since the 1950s. In 1987—when the Air Force lost the first B-1B in a collision with a pelican on September 28—the B-1B fleet had a Class A mishap rate of 8.2 per 100,000 flying hours. With the two November crashes, the rate for 1988 was 10.67. (A Class A mishap is defined as one that results in a fatality, the loss of an aircraft, or more than $500,000 in damages.)

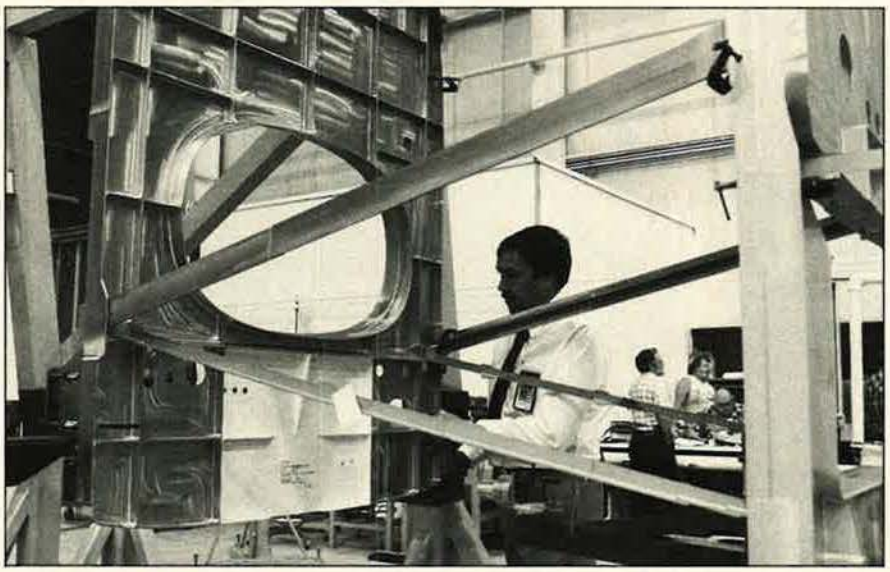
By contrast, the B-52 had Class A rates of 26.9 and 10.2 at a similar stage in its development. The B-58 had rates of 22.0 and 24.9, and the F/FB-111 fleet had rates of 53.6 and 43.4.

★ After seven months of heated debate, the US and the Philippines signed a two-year agreement covering the use of Clark AB and Subic Bay Naval Base (the largest US bases overseas), as well as four other smaller facilities in the Philippines. The future of the bases after the agreement runs out is cloudy.

The government of the Philippines demanded $1.2 billion a year in compensation for the base rights when negotiations began in April 1988. The US countered with an offer of $360 million a year, twice the amount currently paid.



Conventional monolithic primary mirrors for very large reflecting astronomical telescopes now weigh so much that they have become impractical. Dr. Kenneth Lorell, a Lockheed physicist, works with the Advanced Structures/Controls Integrated Experiment in Palo Alto, Calif. The experiment will help Lockheed to develop lighter-weight, segmented, computer-controlled primary mirrors that are accurate to within a few billionths of a meter.



Assembly of the first Rockwell/Messerschmitt-Bölkow-Blohm X-31 Enhanced Fighter Maneuverability (EFM) demonstrator began last November 14 at Rockwell's North American Aviation plant in Palmdale, Calif. Shown here is the forward inlet bulkhead that was secured to the plane's assembly jig. Under the auspices of DARPA/Naval Air Systems Command and the Federal Republic of Germany, two X-31 aircraft will be built. The first is expected to fly later this year.

The compromise package, signed October 17, includes approximately $481 million annually in US aid, food, and housing guarantees in FY '90 and FY '91. The US also agreed to facilitate the transfer of $248 million in aid previously appropriated but not spent. A similar payment of $160 million is also to be expedited.

In return, the Philippines agreed to leave unchanged existing US rights to transits, overflights, or visits by ships and planes carrying nuclear weapons. This allows the US to withhold confirmation or denial of whether ships or planes are carrying nuclear weapons. Storing nuclear or chemical weapons on the islands now requires Philippine Senate approval.

The overall US-Philippine agreement expires in 1991, and negotiations then are likely to be even more acrimonious than those leading to the recent agreement.

★ **APPOINTED**—In an effort to strengthen its ability to stay in step with emerging technologies, **Air Force Logistics Command has appointed Philip P. Panzarella as its first full-time chief scientist/engineer.** Mr. Panzarella will direct AFLC's use of technology in managing Air Force logistics. He will oversee the command's 4,300 scientists and engineers involved in developing and maintaining weapon systems, as well as other programs ranging from information systems to environmental efforts. Mr. Panzarella replaces Earl W. Briesch, AFLC's assistant deputy chief of staff for materials management, who had been doing double duty as chief scientist/engineer.

Lt. Robert B. O'Connor dons what all well-dressed fighter pilots may be wearing within the next two years. The "Combat Edge" vest, designed to fit over a standard flight suit, provides positive pressure breathing assistance and helps reduce the onset of gravity-induced loss of consciousness.

★ **HONORS**—**Dr. Sam B. Williams,** chairman, president, and chief executive officer of Williams International Corp., **was awarded the 1988 Wright Brothers Trophy** in ceremonies on December 9. Dr. Williams was cited for his work in developing the F107 turbofan engine that powers all US air-, sea-, and ground-launched cruise missiles.

The Wright Brothers Trophy is presented annually by the National Aeronautic Association (NAA) to an American citizen who, as a civilian, has rendered significant public service of enduring value to aviation in the United States.

Col. John C. Marshall, Capt. Michael I. Iovieno, CMSgt. James R. Weldon, and TSgt. Joseph W. Gooch were recently named **winners of the 1988 Lance P. Sijan Leadership Awards.**

Colonel Marshall, commander of the 51st Tactical Fighter Wing at Osan AB, Korea, was cited for sustained levels of excellence in numerous areas and for his contributions to readiness of US forces in Korea. Captain Iovieno, formerly a staff services officer at the 39th Combat Support Squadron at Incirlik AB, Turkey, was recognized for his plan to replace dormitory furnishings.

Chief Weldon's fuels management branch at Seymour Johnson AFB, N. C., was selected as best in Tactical Air Command. He was also runner-up in the Air Force Daedalian supply effectiveness competition. Sergeant Gooch was cited for his work in helping transfer thirty-five people and more than $200,000 worth of equipment from the deactivated 19th Avionics Maintenance Squadron at Robins AFB, Ga.

Detachment 1 of the 4th Air Support Operations Group at Sembach AB, West Germany, recently changed over to the High-Mobility Multipurpose Wheeled Vehicle (HMMWV, or "Hummer") for use with the unit's tactical air control parties. Using UHF, VHF/AM, VHF/FM, and high-frequency radios, the two-person TACPs are normally the last to communicate with pilots before the pilots attack a target. The Hummers were used in a Reforger exercise for the first time last fall.

Hummers also serve as the chassis for the new Pedestal-Mounted Stinger (PMS) vehicles, delivered to the Army last November. The man-held, surface-to-air FIM-92 Stinger missiles can be fired either from the turret (under the vehicle's three antennas) or, as shown here, from the remote control unit, which can operate the fire unit from up to fifty meters away.

The awards are presented annually to two Air Force officers and two enlisted troops who have demonstrated the highest qualities of leadership. The awards are named for Capt. Lance P. Sijan, who was posthumously awarded the Medal of Honor.

The 1987 **Secretary of Defense Natural Resources Conservation Award for Installations** was recently presented to **Luke AFB, Ariz.,** in a Pentagon ceremony. The award, which has been given annually since 1962, was accepted by Brig. Gen. Daniel J. Sherlock, 832d Air Division commander, on behalf of Luke for its conservation efforts on the Barry M. Goldwater Air Force Range. Those programs included participation in a project to study Sonoran antelope; improvements to El Camino del Diablo, an unpaved road that has been in use since 1000 A. D.; and research on surface and underground water resources.

★ **PURCHASES—British Aerospace's Civil Aircraft Division** has been awarded a $170 million, five-year follow-on contract for depot-level maintenance, structural fatigue testing, and avionics modifications on the **Air Force's F-111E and F model aircraft** based at RAF Upper Heyford and RAF Lakenheath in England. More than 150 aircraft are scheduled to pass through the BAe plant at Filton between October 1988 and September 1993. British Aerospace had previously replaced ejection capsule pyrotechnics and windshields on the F-111s.

The **Army National Guard has ordered ten Shorts C-23A Sherpa** light cargo aircraft. The aircraft, to be purchased under a $60 million deal, will be used for transporting aviation spares and components between National Guard bases and depots—the same role the Sherpas fill in the eighteen-aircraft European Distribution System (EDS). The C-23s will replace aging deHavilland-Canada C-7 Caribou in the support role. A contractor logistics support (CLS) agreement similar to the Air Force CLS is being negotiated.

On October 28, Air Force Systems Command's Ballistic Missile Office at Norton AFB, Calif., awarded contracts to **General Electric's Reentry Systems Division** in Philadelphia, Pa. ($4.8 million), and **McDonnell Douglas Astronautics Co.,** in Huntington Beach, Calif. ($3.8 million), for research and development of an **earth-penetrating nuclear weapon reentry vehicle.** The contracts are expected to be completed in April 1990.

★ **DELIVERIES—Boeing Aerospace delivered the first two Pedestal-Mounted Stinger** (PMS) air defense fire units to the Army's Missile Command on schedule on November 1 at the company's plant in Huntsville, Ala. The units, called Avengers by the company, are the first of twenty PMS units to be delivered by June 1989 under a $16 million contract. The PMS units feature eight FIM-92 Stinger surface-to-air missiles in two pods on a gyro-stabilized turret. The turret is mounted on a High Mobility Multipurpose Wheeled Vehicle (HMMWV, or "Hummer," the new Jeep-like vehicle) chassis. The PMS units are the first element in the Army's five-part Forward Area Air Defense System to be fielded. The Army has a requirement for 273 PMS units.

The first production **Standoff Land-**

Aeromedical Evacuation Technicians TSgt. Holly A. Kiser (left) and Capt. Virginia A. Schneider inoculate a child against yellow fever as part of Medflag Gabon '88. Units from the US Army, Air Force, Air National Guard, and Navy participated with the Gabonese militia in a mass casualty exercise, demonstrated aeromedical evacuation procedures, and provided humanitarian and civic assistance.

—USAF photo by Maj. Ken St. John

Bombers of yesterday and today could be seen at the two-day awards ceremony and symposium held at the conclusion of Proud Shield '88. Poised on Barksdale AFB's ramp are (left to right) a B-17, a B-52G, and a B-1B. In the background is a SAC KC-10.

Proud Shield '88

There was a lot new about the thirty-second Strategic Air Command Bombing and Navigation Competition held last fall. The most dramatic change, of course, was the addition of the Rockwell B-1B to the "Proud Shield" competition. There were also a number of changes that reflect SAC's increasing emphasis on all types of warfighting.

For the first time, EC-135 crews were allowed to compete in the KC-135 phase of the competition, as the aircraft still have the capability to refuel. Also for the first time, Tactical Air Command F-111 crews were allowed to compete for the Fairchild Trophy, the competition's top prize.

A major change was the addition of the Billy Mitchell Trophy. This award is given to a bomber unit (no B-1B units are eligible, as their primary mission is nuclear deterrence) for conventional bombing accuracy, surviving in an electronic countermeasures environment, and avoiding fighters—all conditions the crews will face in their increasingly important conventional mission.

The "back-to-basics" approach was evident during all phases of the competition. The KC-135 navigators had to perform night celestial navigation on one segment of the flight and during the orbit exercise. The tankers also had to be flown with the autopilot off and the radio silent, an important factor in avoiding detection. The KC-10 crews were also graded on loading and unloading cargo themselves. All of the bomber and tanker crews had to land at an unfamiliar airfield and service their aircraft themselves.

The posting of scores was broadcast live on November 3 via satellite from Barksdale AFB, La., to each of the participating units.

The B-1B units did quite well for their first competition. Crews from Dyess AFB, Tex., won the Dougherty SRAM Trophy for accuracy in simulated AGM-69 Short-Range Attack Missile launches. Ellsworth AFB, S. D., won the Ryan Trophy for low-level bombing. In the Fairchild Trophy standings, McConnell AFB, Kan., was fourth, Dyess was eighth, Ellsworth was thirteenth, and Grand Forks AFB, N. D., was seventeenth out of the nineteen competing teams.

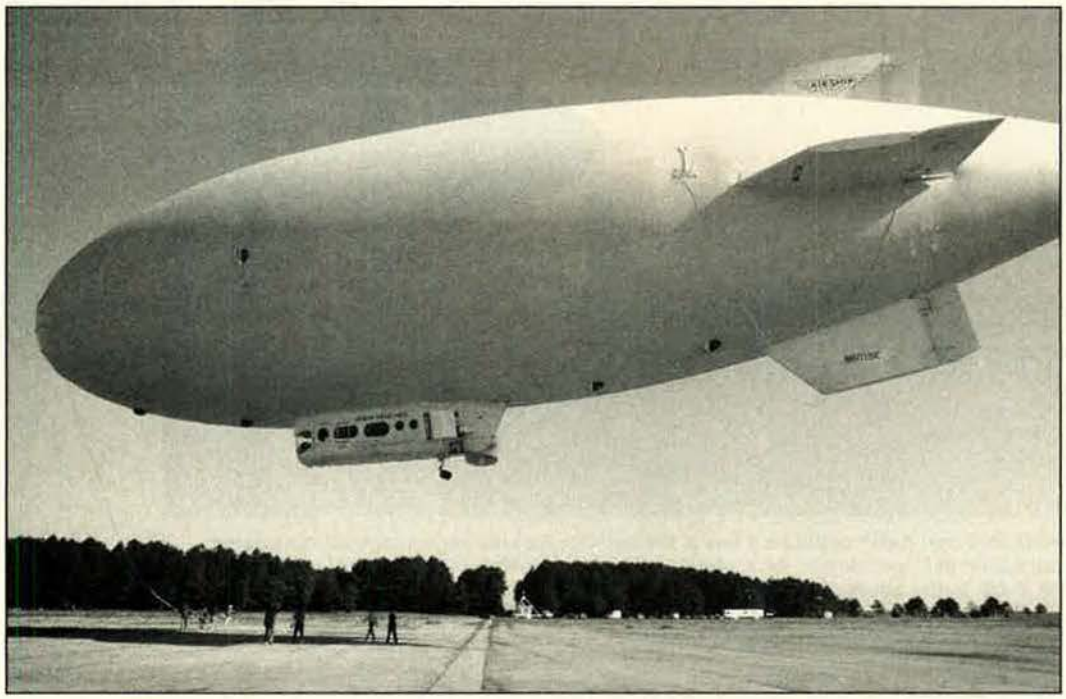
"The real winners are the American people," said the Chairman of the Joint Chiefs of Staff, Adm. William J. Crowe, Jr. "I can see that this competition is not just a matter of life and death with you crews. It is much more important than that. . . . [America] enjoys the fruits of peace because of you."

Here is a list of the top performers at "Proud Shield '88," with the name of each trophy, the category for which it was awarded, and the winning unit and its score. The maximum number of possible points that could be scored in each category are listed in parentheses.

Gen. Muir S. Fairchild Trophy (bomber/tanker team with highest competition effectiveness, excluding the fighter intercept exercise and high-altitude bombing): 5th BMW, Minot AFB, N. D., 0.7380 (1.0); **Richard H. Ellis Trophy** (best KC-10 team): 22d AREFW, March AFB, Calif., 3,902 (4,000); **Gen. John C. Meyer Trophy** (best F/FB-111 unit): 509th BMW, Pease AFB, N. H., 8,980 (10,800); **Brig. Gen. Donald W. Saunders Trophy** (best KC-135 unit): 42d BMW, Loring AFB, Me., 8,249 (10,000); **Gen. Ira C. Eaker Trophy** (best B-1B unit): 96th BMW, Dyess AFB, Tex., 10,003 (13,200); **Maj. James F. Bartsch ECM Trophy** (B-52 unit scoring the most points for ECM): 43d BMW, Andersen AFB, Guam, 2,724 (3,200); **Gen. Russell E. Dougherty SRAM Trophy** (bomber unit with the most points for SRAM): 96th BMW, Dyess AFB, Tex., 2,070 (2,400); **Bruce K. Holloway Trophy** (KC-135 unit scoring the most points in celestial navigation): 42d BMW, Loring AFB, Me., 3,229 (4,000); **Lt. Jack Mathis Trophy** (KC-135 unit with the most points for air refueling and orbit exercise): 96th BMW, Dyess AFB, Tex., 3,319 (3,600); **Gen. William "Billy" Mitchell Trophy** (bomber unit scoring the most points in the conventional bombing, electronic combat exercise, and fighter intercept exercise): 27th TFW, Cannon AFB, N. M., 3,400 (4,000); **Gen. John D. Ryan Trophy** (bomber unit scoring the most points in low-level bombing and time control in the Strategic Route Training Complex): 28th BMW, Ellsworth AFB, S. D., 3,483 (3,800); **Gen. Curtis E. LeMay Trophy** (bomber crew with the most points in low-level bombing and time control): Crew R-76, 27th TFW, Cannon AFB, N. M., 1,082 (1,200); **Gen. Bennie L. Davis Most Improved Unit Trophy** (highest percentage of improvement in the Fairchild or Saunders Trophies over the previous year): 96th BMW (KC-135s), Dyess AFB, Tex.

Awards were also given to the best crew in each participating weapon system. Awards were presented to the crew chiefs of each of the four participating types of aircraft (KC-135, EC/RC-135, B-52, FB-111) who have best improved their aircraft's appearance and condition under SAC's "Glossy Eagle" restoration program.

—J. P. R.



The world's first full-authority, fiber-optic control system was flown on this Airship Industries Skyship 600 at the company's Elizabeth City, N. C., plant. The airship will undergo intensive flight testing to evaluate the system. The Navy expects to incorporate a fly-by-light system into its Operational Development Model airship program. The program is being restructured under DARPA.

Attack Missile (SLAM), a lengthened and heavier derivative of the AGM-84 Harpoon antiship missile, was **delivered to the Navy** in ceremonies at the McDonnell Douglas Harpoon plant in St. Charles, Mo., on November 3. SLAM (designated AGM-84E) combines the propulsion and control systems of the Harpoon with a seeker from an AGM-65 imaging infrared Maverick and a video data link from an AGM-62 Walleye missile. SLAM also has a global positioning system receiver. SLAM allows the aircraft crew to attack land targets, ships in port, or ships at sea from safe ranges in excess of sixty nautical miles. Flight testing is scheduled to begin this month.

★ **MILESTONES**—On October 23, **Airship Industries flew the first** full-authority, **"fly-by-light" (fiber optic) flight-control system** on an aircraft. Test pilot on the one-hour-and-fifteen-minute flight was Dave Burns, the company's chief test pilot. The fly-by-light system was developed by GEC Avionics. Instead of passing electricity down a metal conductor or cable (as in fly-by-wire systems), the control passes a light pulse down an optically perfect, flexible strand of glass to an electric actuator that then moves a control surface, such as a rudder or an elevator. The fiber optic system reduces pilot work load and is resistant to electromagnetic interference and lightning strikes.

The **Air Force launched its last Martin Marietta Titan 34D** from Vandenberg AFB, Calif., on the morning of November 6. The last of sixteen Titan 34Ds ordered in 1982, the booster carried a classified payload. The launchpad, Space Launch Complex 4-East, will be converted for launches of the more powerful Titan IV over the next few months. Launch of the first operational Titan IV, which will be able to boost 10,200-pound payloads to geosynchronous orbit with the Centaur upper stage, is scheduled for early this year from Cape Canaveral AFS, Fla.

The **last of 746 Boeing C/KC-135 aircraft that has had its lower wing surfaces reskinned** to increase operational life **was delivered to the Air Force** on November 7. The work, which consisted of replacing approximately 1,500 square feet of metal on the underside of the wings with a stronger alloy, was done by Boeing Military Airplane Co. under a $400 million contract. The new skins extend the useful life of the aircraft by 27,000 hours.

Standard issue work uniforms for the Air Force now come in olive drab—and dark green and brown as well. **New Air Force recruits recently began being issued** Battle Dress Uniforms **(BDUs)**—camouflage fatigues—as their regular work clothes. The BDUs will cost more than the old olive-drab fatigues, but in the long run, overall costs will be reduced. With the Air Force, Army, and Marine Corps all wearing the same uniforms, the BDUs will now cost less per item to produce. The new uniforms are also adjustable, unlike the old fatigues. No date has been set for complete conversion to BDUs.

The **first Royal Air Force E-3** Sentry Airborne Warning and Control System (AWACS) **crew was declared**

Tactical Symposium This Month

AFA's fifth annual Tactical Air Warfare symposium will be held January 26–27 at the Buena Vista Palace Hotel in Lake Buena Vista, Fla. Registration is $275 for members and $300 for nonmembers.

The tentative lineup of speakers is as follows: Gen. John T. Chain, Jr., Commander in Chief, Strategic Air Command; Gen. Merrill A. McPeak, Commander in Chief, Pacific Air Forces; Gen. Bernard P. Randolph, Commander of Air Force Systems Command; Lt. Gen. Michael J. Dugan, USAF Deputy Chief of Staff for Plans and Operations; Lt. Gen. James P. McCarthy, USAF Deputy Chief of Staff for Programs and Resources; Maj. Gen. Roger P. Scheer, Chief of the Air Force Reserve; and Brig. Gen. Phillip C. Killey, Director of the Air National Guard.

For further information, call Jim McDonnell or Dottie Flanagan at (703) 247-5800.

The IA 63 on Tour

The Air Force's three-phase approach to replacing its trainer fleet is about to get under way with the selection of a business jet to become the new Tanker/Transport Training System (TTTS) aircraft. Aircraft manufacturers are increasingly turning their attention to the second phase of the trainer roadmap—the Primary Aircraft Training System (PATS) airplane that will replace the venerable Cessna T-37.

The PATS aircraft will be an off-the-shelf buy, as a new aircraft development effort would be prohibitively expensive and would take longer than the Air Force and Air Training Command can afford to wait. There are more than forty trainer aircraft in production today around the world. Quite a few of those international manufacturers are actively marketing their aircraft to the US Air Force, and a number of manufacturers not considered airplane-building giants produce some high-quality airplanes.

Fábrica Argentina de Materiales Aeroespaciales (FAMA) has been building aircraft in Argentina for more than sixty years. Best known for the IA 58 Pucará ground attack airplane that gained fame in the 1982 Britain/Argentina conflict in the South Atlantic, FAMA has also produced a trainer, the IA 63 Pampa. The company brought the IA 63 to Andrews AFB, Md., last fall to demonstrate the aircraft to Air Force officials at the Pentagon and at Air Force Systems Command Headquarters.

The IA 63 was designed in the late 1970s to replace the Morane-Saulnier MS.760 trainers used by the Fuerza Aérea Argentina (FAA—the Argentine Air Force). Engineers from Dornier in West Germany were brought in for technical assistance; as a result, the tandem-seat Pampa bears a striking resemblance to the Dornier/Dassault-Breguet Alpha Jet. The Pampa first flew in October 1984, and, after completing a full test program, entered service with the FAA in March 1988.

The aircraft has a single Garrett TFE731 turbofan engine—the same engine that has accumulated more than 2,000,000 hours in the Learjet. The underfuselage location of the engine provides easy access for mechanics, without the need for support platforms.

The Pampa features tricycle landing gear with nosewheel steering and antiskid brakes. The gear retracts hydraulically, but has an emergency gravity drop capability. The airplane has cantilever wings that are tapered with an advanced transonic cross section and single Fowler flap on each wing. The airframe is stressed to +6/−3 Gs.

AIR FORCE Magazine was given the opportunity to fly in the IA 63 before the aircraft traveled to Randolph AFB, Tex., for demonstration flights with ATC officials. It was an impressive ride.

Access to the rear cockpit is by means of a stair-slot. The pilot, 1st Lt. (USAF captain-equivalent) Ruben Lianza, needed an external stair. Visibility from the raised rear seat is excellent. An instructor can see over the top of the student's head and around the Stencel ejection seat into the front cockpit. The IA 63 features Collins avionics, and the panel is laid out well. The instruments provide both digital and analog readouts.

Takeoff speed is just over ninety knots, and the takeoff roll for the standard-configured Pampa (8,377 pounds) is just over 1,000 feet. The Pampa handles very well and is responsive to control inputs. Lieutenant Lianza demonstrated that the aircraft lost little power through a 4-G loop. He was able to maintain a knife-edge pass with minimal effort.

— Photo by Frederick Sutter/DI

The FAMA IA 63 Pampa jet trainer resembles the Dornier/Dassault-Breguet Alpha Jet twin-engine trainer. A Pampa recently visited Andrews AFB, Md., to give USAF officials a closer look.

The IA 63 is designed for primary through advanced training, and is comparable to the Pilatus PC-9, Shorts Tucano, and other jets such as the Aermacchi MB.339. The IA 63 is in the $3 million per copy price range.

The airplane has two underwing hardpoints for ordnance and a centerline hardpoint for a 30-mm gun pod. This gives the Pampa the capability for fighter lead-in training, should the Air Force decide to buy it, or a limited ground attack role for other export customers.

The FAA has fifty Pampas on order, with an option for fifty more. The Argentine Navy has expressed an interest in the airplane, as have New Zealand, several Latin American countries, and Israel.

Almost seventy-one percent of the Pampa is fabricated in America now, so it meets the specifications of the "made in America" act. However, FAMA does not have the production capability for the 650 aircraft called for under the specifications for the ill-fated T-46 program. The company is negotiating with several US manufacturers for a licensing or teaming arrangement.

As for the other parts of the training system approach, FAMA does not make simulators or procedure trainers, so the company would have to forge an agreement with companies that specialize in simulators.

—J. P. R.

combat-ready in early November. The crew of seventeen has been training for the past year and a half with the NATO AWACS squadron at Geilenkirchen, West Germany. The RAF crew is now integrated into the NATO Squadron, and a second RAF crew is in training. Three complete crews and a course design team will be fully trained by the time the first of seven RAF E-3s is delivered to the RAF Waddington in 1991.

Soviet cosmonauts Vladimir Titov and Musa Manarov broke the world space endurance record on November 12 by remaining on board the *Mir* ("peace") space station **as they passed the 326-day mark.** The Soviets now have eight cosmonauts who have spent more than 300 days in space.

The **Pratt & Whitney F117-PW-100 turbofan engine,** which will power the Air Force's new C-17 airlifter, **completed a 150-hour endurance test** at P&W's West Palm Beach, Fla., facility on November 14. That was the last test the engine had to pass prior to the type's certification by the Federal Aviation Administration. Formal certification was expected to come last month. The F117 is the military version of the PW2040 commercial engine. Since 1984, the PW2000 series has accumulated more than 1,000,000 hours on the Boeing 757s of five airlines.

McDonnell Douglas recently delivered the last of 138 CF-18 fighters on order to the Canadian Armed Forces. The more-than-$7-billion program began in 1980, with first de-

For The Tanker, Transport, Training System

EXPERIENCE IS THE BEST TRAINER

Implementation of Air Training Command's Tanker, Transport, Training System (TTTS) will be the most significant change in USAF pilot training methodology in 30 years. It will affect every aspect of the United States Air Force pilot training system.

The day-to-day operation of this program is no place for beginners. Proven Performance, Recognized Safety, and Demonstrated Reliability plus Economical Operation are vitally essential to overall success.

Cessna's T-47 "Silverwings" has all the required credentials and more. Its durability, efficiency and safety have been proven by over 50,000 flight hours in a real-life military training environment. The Cessna T-47 "Silverwings" was developed from its commercial counterpart, the Cessna Citation. Cessna was recently presented the Collier Trophy for Aeronautical Excellence for its unparalleled safety record of the worldwide

fleet of Citation aircraft. Other past Collier Trophy recipients include Orville Wright, Glenn Curtis, Neil Armstrong and the F-16.

The TTTS is a totally integrated pilot training system including a myriad of components required for a student to earn the coveted silverwings of a USAF pilot.

Cessna, together with its team members: General Dynamics and Link Training Systems, offers USAF the most effective combination of proven training aircraft, large scale system integration experience, off-the-shelf flight simulators, and curriculum development expertise.

When training our nation's Air Force pilots, there is no substitute for actual experience and proven performance.

Cessna
a General Dynamics company

A new single-piece windscreen for the LTV A-7 jet (right) is being tested by the 162d Tactical Fighter Group, ANG, in Tucson, Ariz. The new windscreen, made of multi-layered polycarbonate between two layers of acrylic, improves visibility by twenty percent, requires thirty percent fewer spare parts to maintain, and offers greatly improved birdstrike protection. AFSC's Aeronautical Systems Division is managing development and flight testing.

liveries in 1982. Six CF-18s—F/A-18 Hornets with some specific equipment changes—have been lost to crashes. The CF-18 fleet recently topped the 100,000-flight-hour mark, making the Canadians the first international F/A-18 customer to hit that plateau. In addition to Canada and the US Navy and Marine Corps, Spain and Australia fly Hornets. Switzerland and Kuwait have F/A-18s on order.

★ **NEWS NOTES**—The Air Force acknowledged the existence of the **Lockheed F-117A Stealth fighter** as this magazine was on deadline for last month's issue *(see p. 35)*, and here are **some additional details** about the airplane.

USAF acknowledged the F-117A's existence because of the need to start flying the aircraft in the daytime to integrate it fully into the operational force. Go-ahead for the project was given in 1978; the single-seat, twin-engine fighter first flew in 1981. The F-117A was declared operational in 1983.

There have been three accidents involving the aircraft, which has no official nickname. The first incident was an early production crash, and the Lockheed test pilot was able to get out. No date has been given for that accident. Two fatal mishaps, both involving Air Force pilots, occurred on July 11, 1986, at Bakersfield, Calif., and on October 14, 1987, at the Nellis AFB range in Nevada.

Fifty-nine aircraft are being procured, and fifty-two (including the three crashed F-117s) have been delivered. The remaining seven aircraft are in production at Lockheed Aeronautical Systems Co.'s plant in California. The aircraft are based at the Tonopah Test Range Airfield in Nevada and are flown by pilots of the 4450th Tactical Training Group at Nellis. Everything else about the F-117A is still classified.

The Air Force continues to fly safer. For the fifth consecutive fiscal year *(see "The Chart Page," p. 22)*, **the Air Force logged fewer than 1.8 Class A mishaps per 100,000 flying hours in FY '88.** The FY '88 rate of 1.63 included twenty-four aircraft types with spotless records. Military Airlift Command recorded its first mishap-free year in FY '88. Alaskan Air Command, Air Force Logistics Command, and the US Air Force Academy also recorded no major mishaps last year.

There have been some **strange aircraft on the decks of Navy ships re-**

—Photo by Paul Jackson

On January 1, No. 2 Squadron, based at RAF Laarbruch, West Germany, will have completed conversion from SEPECAT Jaguars to Panavia F.3 Tornados for the reconnaissance role, becoming the first European tactical reconnaissance squadron of any type to rely entirely on infrared video sensors rather than on conventional photographic film. A second RAF squadron, No. 41, will convert to video reconnaissance next year.

January Anniversaries

• *January 20, 1914:* Under the command of Lt. J. H. Towers, the Navy's aviation unit from Annapolis, Md., arrives at Pensacola, Fla., to set up the first naval air station.

• *January 24, 1919:* Army Air Service pilot 1st Lt. Temple M. Joyce makes 300 consecutive loops in a Morane fighter at Issoudun, France. There is no word on whether or not he was able to walk when he finally landed.

• *January 1–7, 1929:* A world endurance record for refueled airplane flight is set by Maj. Carl "Tooey" Spaatz, Capt. Ira Eaker, Lts. Elwood "Pete" Quesada and Harry Halverson, and SSgt. Roy Hooe in the Fokker C-2A *Question Mark.* The crew remains aloft over Los Angeles for 150 hours, forty minutes, and fourteen seconds.

• *January 23–27, 1929:* The aircraft carriers USS *Lexington* (CV-2) and USS *Saratoga* (CV-3) participate in fleet exercises for the first time.

• *January 8, 1944:* Developed in only 143 days, the prototype Lockheed XP-80 Shooting Star, nicknamed *Lulu Belle,* makes its first flight at Muroc Dry Lake, Calif., with Milo Burcham at the controls. It was the first American fighter to exceed 500 miles per hour in level flight.

• *January 11, 1944:* The first US use of forward-firing rockets is made by Navy TBF-1C Avengers against a German submarine.

• *January 22, 1944:* Mediterranean Allied Air Forces planes fly 1,200 sorties in support of Operation Shingle, the amphibious landings at Anzio in Italy.

• *January 25, 1949:* The just-over-one-year-old US Air Force adopts blue uniforms.

• *January 8, 1959:* NASA requests eight Redstone-type launch vehicles from the Army to be used in the Project Mercury development flights. Four days later, McDonnell Aircraft Co. is selected to build the Mercury capsules.

• *January 22, 1959:* Air Force Capt. William B. Whiute sets a record for the longest nonstop flight between points in the US, as he flies a Republic F-105 Thunderchief the 3,850 miles between Eielson AFB, Alaska, and Eglin AFB, Fla., in five hours and twenty-seven minutes.

• *January 8, 1964:* The newest Air Force decoration, the Air Force Cross, is posthumously awarded to Maj. Rudolf Anderson, Jr., the reconnaissance pilot who was the only combat casualty of the Cuban Missile Crisis of 1962.

• *January 6, 1979:* The 388th Tactical Fighter Wing at Hill AFB, Utah, receives the first operational General Dynamics F-16A fighters. The first Air Force Reserve F-16s were delivered to the 419th TFW at Hill on January 28, 1984.

cently. The 22d Tactical Air Support Squadron at Wheeler AFB, Hawaii, was recently deactivated, and six of the unit's Rockwell OV-10A Bronco aircraft were shipped to NAS North Island, Calif., on the USS *Cleveland* (LPD-7), using opportune sealift. The unit's seven remaining OV-10s will be shipped the same way. The sealift saved the Air Force close to $200,000 in shipping charges. The aircraft were flown from North Island to George AFB, Calif., where they were inspected.

Army helicopter crews from the 82d Airborne Division at Fort Bragg, N. C., recently operated with the Navy amphibious assault ship USS *Nassau* (LHA-4). Flying OH-58 Kiowa, UH-60 Black Hawk, and AH-64 Apache helicopters, the Army pilots made more than 500 accident-free landings and takeoffs from the ship.

Scientists at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif., **ordered the *Voyager 2* spacecraft to "hang a right"** on November 12. The "turn" (actually a one-mph slowing of *Voyager's* 42,666-mph speed) will bring the spacecraft 6,200 miles nearer Neptune when it flies by the eighth planet from the sun on August 24 of this year. The turn will also allow the spacecraft to take "close-up" pictures (within 24,000 miles) of one of Neptune's moons, Triton. In November, *Voyager 2* was 2,600,000,000 miles from earth and 257,700,000 miles from Neptune. *Voyager 2* was launched in August 1977; it flew past Jupiter in 1979, Saturn in 1981, and Uranus in 1986. After passing Neptune, the spacecraft will fly out of the solar system and into deep space.

"This Actually Happened" Department: **A Navy S-3 Viking** antisubmarine warfare aircraft from the carrier USS *Theodore Roosevelt* (CVN-71) **was given a parking ticket** on October 25 when the crew overshot a runway at a base in southern England and landed on a public road. No one was hurt in the incident. Unreported was whether the Navy had to pay court costs in addition to the $21 fine.

★ **DIED**—Retired Army **Gen. Lyman L. Lemnitzer,** brilliant World War II planner, military diplomat, and later Chairman of the Joint Chiefs of Staff, on November 12 of kidney failure. He was eighty-nine.

General Lemnitzer helped plan Operation Torch, the November 1942 amphibious landings in North Africa. Prior to the invasion, General Lemnitzer and Gen. Mark Clark traveled by British submarine on a secret mis-

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At a November 7 ceremony held at the Arnold Engineering and Development Center, Arnold AFB, Tenn., to commemorate issuance of the Gen. H. H. "Hap" Arnold stamp were three past commanders and the current commander of AEDC. From left: Maj. Gen. Lee Gossick, USAF (Ret.), Col. Ward Protsman, USAF (Ret.), Col. Pat Condon, and Maj. Gen. Dave Lowe, USAF (Ret.). The US Postal Service formally issued the stamp with a commemorative postmark **(see "Intercom," p. 117).**

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sion to persuade the Vichy French not to oppose the Anglo-American landings. Their efforts were partially successful. General Lemnitzer later helped negotiate the surrender of Italian troops and the capitulation of German forces in Italy.

General Lemnitzer led the 7th Infantry Division in the battles of Heartbreak Ridge, The Punch Bowl, and Mundung-ni Valley during the Korean War. He was awarded the Silver Star for conspicuous gallantry at Chorwon Valley. He became Army Chief of Staff in March 1959 and JCS Chairman in September 1960. He then served as Supreme Allied Commander in Europe until his retirement in 1969.

Retired Royal Air Force **Air Marshal Sir Harold Martin,** who helped train 617 Squadron for the famous "dambuster" raids in 1943, on November 3. The cause of death was not reported. He was seventy.

On May 15, 1943, Sir Harold flew one of the eighteen Avro Lancaster bombers that participated in the raids against the heavily defended Möhne, Eder, and Sorpe dams in an attempt to do critical damage to power and water supplies in the Ruhr Valley (the Möhne and Eder were breached). Sir Harold was later RAF commander in West Germany and chief of NATO's 2d Allied Tactical Air Force. He retired in 1974.

Retired Marine Corps **Brig. Gen. Frank H. Schwable,** who commanded the first US night fighter squadron during World War II, on October 28 of emphysema. He was eighty.

General Schwable trained with the RAF in Europe and North Africa in the use of radar prior to returning to the US. He helped in the formation of VMF(N)-531 at MCAS Cherry Point, N. C., in November 1942. The squadron began training with two North American SNJ-4 trainers and then received Brewster SB2A Buccaneers and modified Lockheed PV-1 Venturas. General Schwable later shot down four Japanese aircraft, with a fifth probable. He commanded the Marine Air Wing during the Korean War. He was shot down and held captive for fourteen months until the cease-fire in 1953. He retired in 1959.

★ **UPDATE**—The first Chinese weather satellite, **Fengyun 1, is reportedly tumbling and out of control.** The satellite was launched September 7 *(see "Aerospace World," November 1988, p. 28)* and was put into a sun-synchronous orbit. It relayed its first pictures ninety minutes after liftoff. ■


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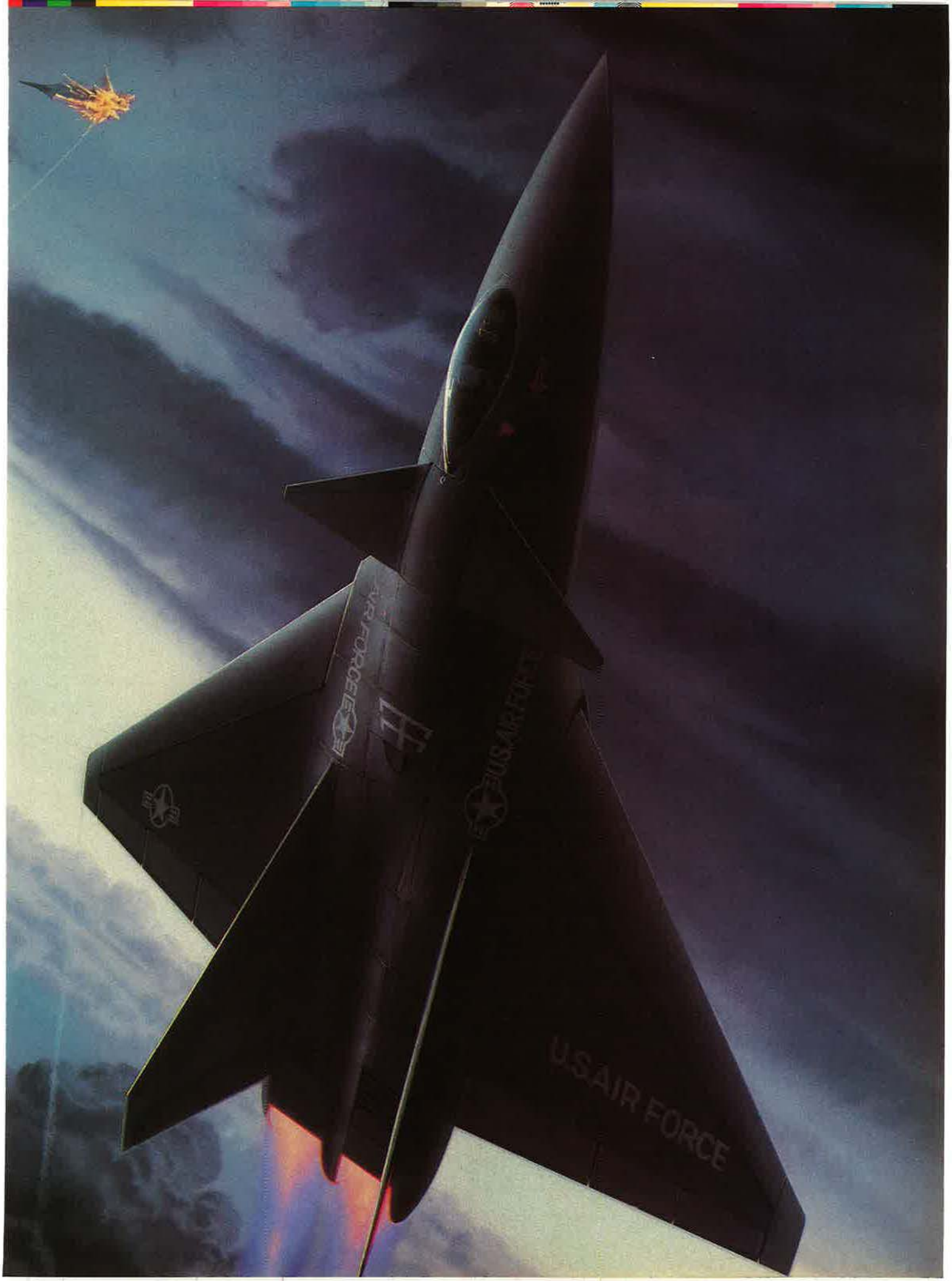

AIR FORCE
USAIR FORCE

Prototypes of the Advanced Tactical Fighter begin flying next year. Program managers report excellent progress—and see the ATF as progenitor of technologies for fighters of the future.

The ATF and Its Friends

BY ROBERT S. DUDNEY
SENIOR EDITOR

THE rakish, high-technology flying machine will be more than just an exotic addition to the Air Force's stable of aircraft. It shapes up as "the cornerstone of our future tactical fighters."

Lt. Gen. Mike Loh, Commander of the Air Force Systems Command's Aeronautical Systems Division, attributes that significance to the Advanced Tactical Fighter, a futuristic craft that ASD is set to begin flying in prototype form next year.

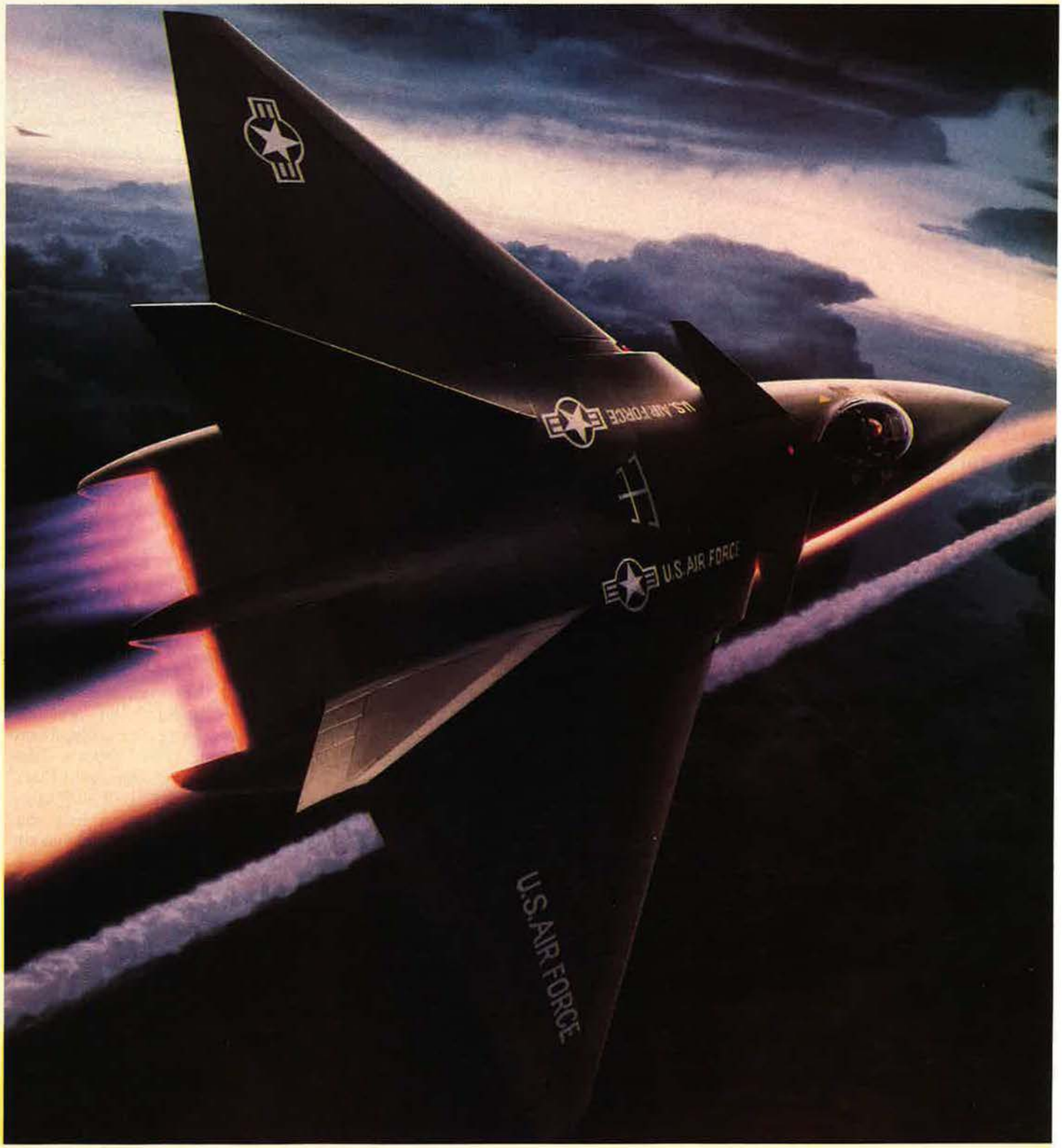
General Loh means that the innumerable revolutionary aerospace technologies now being stimulated and perfected by the high-profile ATF effort will feed the Air Force's appetite for developing new fighters on a wide-ranging scale.

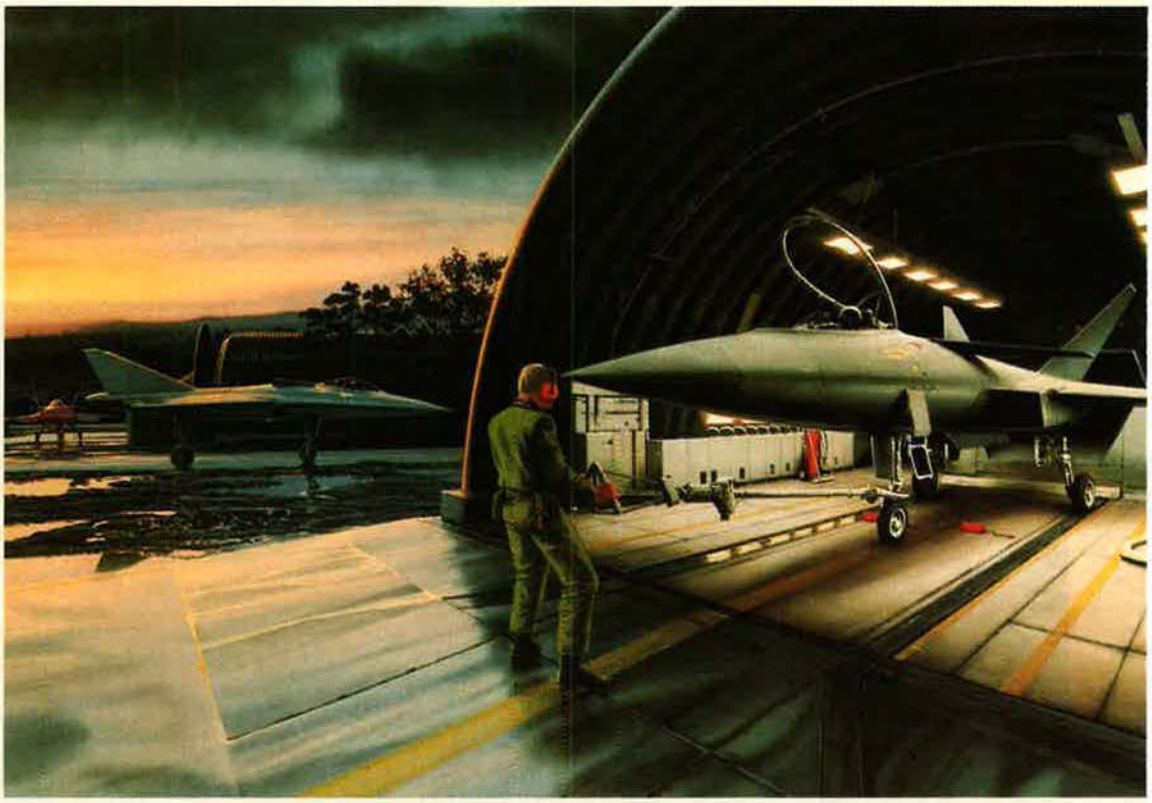
For example, standard F-16s and F-15s, destined for heavy duty into the next century, may receive ATF-type engines and avionics. Even "low-observable" technologies that provide "stealthiness" for ATF might well be infused into either or both of these aircraft.

"Absolutely," claims General Loh. "Applications of low-observable technology to those aircraft can happen. . . . We're studying all of that now. We see lots of mileage in F-15s and F-16s as we bring ATF along."

Further in the future, say officers,

Given the new fighter's $9.9 billion development cost, USAF has set high goals for it. Prototypes are to fly early next year.





Initial ATF deployment, now scheduled for the mid-1990s, probably will come in Europe. Advanced technologies, Air Force officials claim, will make the ATF more reliable and easy to maintain, increasing USAF's ability to generate the large number of sorties that may be needed in a conflict with the Warsaw Pact.

more ATF technologies may work their way into a proposed Agile Falcon makeover of F-16, the Air Force version of the Navy A-12 Advanced Tactical Aircraft, future ATF clones, and other airplanes not yet in public view.

"The ATF is far more than just a single aircraft development program," claims General Loh. "The ATF is bringing along with it the whole technological base—avionics, structures, materials, flight controls, engines, cockpits, microprocessors—for future fighters."

Fueling the revolution are ATF's awesome goals. Plans call for ATF not only to be able to elude detection, cruise at supersonic speeds without afterburner, take off over short distances, and handle better than any other fighter. It will also have to be reliable and easy to service, with its avionics blended in ways once thought impossible.

Whatever the precise makeup of the final, production-line aircraft, however, this much is certain: The air-superiority ATF shapes up as a technological progenitor in the same way that its predecessor, the original F-15 Eagle, was father to many technologies that have found their way into the F-16, F-111, and F-15E.

In light of ATF's development cost of $9.9 billion (measured in 1985 dollars), Air Force officers are promoting the airplane's broader legacy as a distinct political plus. "This is a point people often overlook," General Loh says. "Development of ATF is expensive. There is no doubt about it. But the payoff goes well beyond ATF itself."

Helping to make the payoff possible, for ATF as well as its aeronautic friends, has been the pioneering work by ASD technologists at Wright-Patterson AFB, Ohio, and its many aerospace contractors.

Picking Up Momentum

The ATF project itself is picking up momentum. Prime contractors Lockheed (teamed with General Dynamics and Boeing) and Northrop (teamed with McDonnell Douglas) are far along in competition for a $7 billion full-scale development contract that will be awarded in January 1991.

They are nearing the moment of truth in a fifty-month demonstration and validation phase aimed at reducing ATF's development risk. Each is fabricating two prototype airframes—Lockheed's YF-22A and Northrop's YF-23A—that must be ready to go no later than early 1990 for a year of flying. The primes also must complete ground-based prototypes of ATF's avionics in time for critical demonstrations starting late this year.

Similarly, ATF prototype engines are nearing completion at powerplant builders Pratt & Whitney and General Electric. Three models of their respective engines, the P&W YF119 and the GE YF120, are being hammered together for use in both ATF airframes.

For Col. James A. Fain, Jr., ASD's program director for the ATF, progress to date leaves little doubt that the prototypes will be ready on schedule. "We are definitely going to get an aircraft into the air in early 1990," reports Colonel Fain. "No question about that."

Although the details of ATF's proposed flight characteristics, signatures, and electronics are heavily classified, there can be little question that it will be a fighter of unprecedented power.

The Air Force isn't budging from its position that the ATF must possess a unique first-look, first-kill power—the ability to find and kill a foe before being targeted in return—among other attributes.

That's for the future. What ASD will be looking for in its prototypes, reports General Loh, will be a demonstration of "supersonic cruise without afterburner in a low-observ-

able-shaped planform that exhibits fighter handling qualities and fighter maneuverability."

What gives ASD officials confidence that they can do what's never been done before is the array of new technologies that the ATF effort is both extending and bringing to life.

One obvious area of high-technology exploitation for ATF—and for its aeronautic descendents—concerns development of advanced airframes.

The ATF's contractors and associated ASD laboratories now are deeply engaged in a multifaceted exploration of structures, materials, and flight controls. The goal: Use advanced technologies to reduce ATF weight, drag, and signatures and in the process meet USAF's unyielding demand for a resilient, hard-to-spot, extremely agile air vehicle.

Evidence is they are succeeding. "The airframes are coming together," reports Colonel Fain. "We're comfortable with how they're going to build the airframes, what kind of materials they'll use."

One result will be highly advanced flight controls. The ATF contractors are pushing the state of the art in the technologies of fiber optics, digital fly-by-wire electronic controls, and the like to improve aircraft handling and stability. Explorations proceed into possible use of "active" wing surfaces. Also among technologies being explored are self-repairing flight-control systems that would permit an aircraft to complete its mission even after being damaged in battle.

Development of advanced materials is also getting a boost. For more efficient aerodynamic and structural design with reduced weight, plans call for widespread use of composite materials—as much as fifty percent of the total airframe. Areas of interest include graphite epoxy, thermoplastics, and carbon structures—materials that will impart great strength and endurance without adding much weight or cost.

A version of the Pratt & Whitney YF119 powerplant, featuring a two-dimensional exhaust nozzle, undergoes sea-level testing at the company's West Palm Beach facility. Use of these kinds of nozzles on the aircraft is expected to give ATF great maneuverability and responsiveness in air combat.

Low Observables

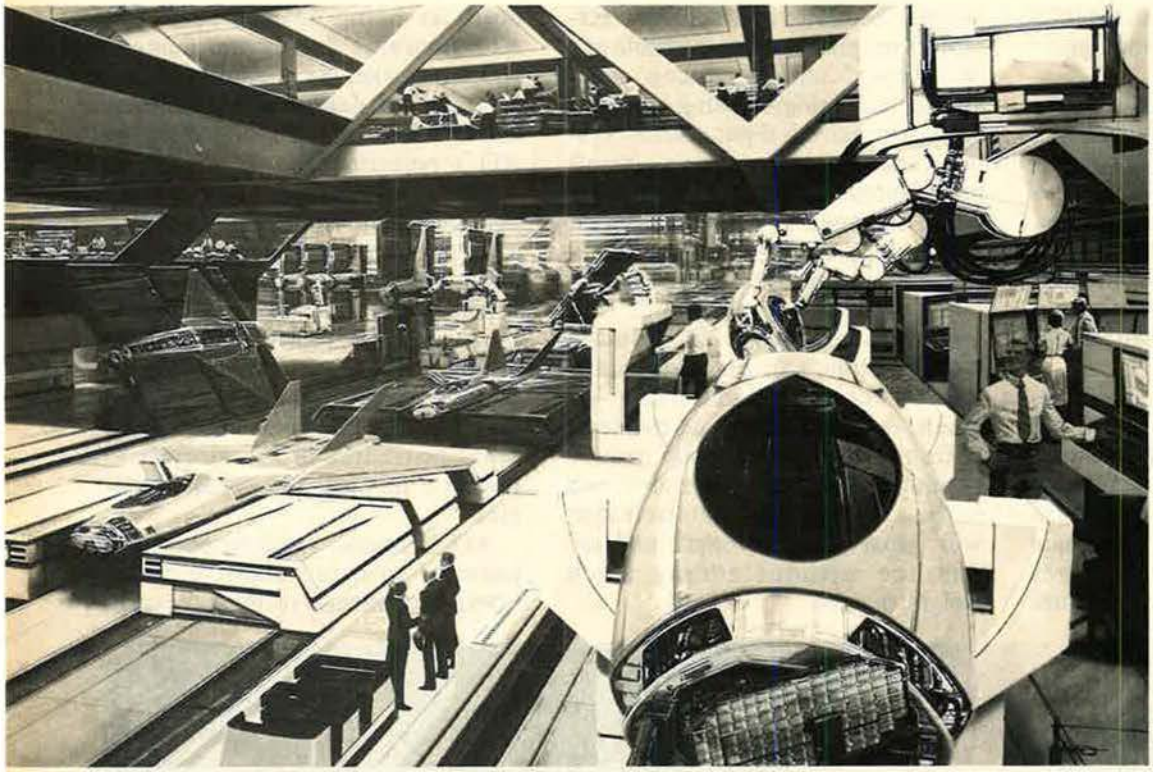
The ATF's greatest contribution may come in the area of advanced "low-observable" technologies needed to reduce the aircraft's visual, electronic, and infrared signatures. Conformal sensors and internal weapons carriage will help. Also under way is exploration of advanced coatings and radar-absorbing materials. Some believe the ATF's radar cross section will be a small fraction of the F-15's.

Colonel Fain ranks low observables among the most critical technologies being developed in the ATF airframe during the demonstration phase. He is confident that a significant degree of stealthiness can be achieved without sacrificing ATF's performance.

"We're working on the last ten percent" of the equation, he says. "I haven't found any major hiccups, major disasters, major problems, working that last few percent. I think we know pretty much where we are in the LO arena. . . . We are going to have a low-observable aircraft that will be blended with the other attributes of the aircraft to give us a very effective weapon system."

ATF's engine requirements also promise to bring about a major boost in advanced propulsion technologies applicable to future fighters no less than to ATF itself. In simplest terms, engine technologists are finding ways to increase the thrust, stabilize the weight, enhance the flexibility, and expand the reliability of a powerplant.

Research by ASD and its contractors is producing high-strength, heat-resistant alloys and cooling techniques, plus new turbine blade designs and combustion technologies. These are expected to enable ATF's engines to develop thrust of 32,000 pounds or more.



Unless budget pressure forces a change in Air Force plans, either Lockheed or Northrop will build to an annual production rate of seventy-two ATFs for an overall force of 750 of the new fighters. Lockheed's concept of what the production line would look like includes use of robotic processes and interchangeable tooling.

At the same time, the weight of the engines is being kept within bounds, possibly by use of new nonmetallic materials. The ATF engines will have fewer parts, perhaps forty percent fewer, than engines of today.

Taken together, these factors are expected to enable the ATF's powerplants to far outpace those of the F-15 and F-16 in terms of their thrust-to-weight ratios at supersonic speed and at high altitudes. This will permit the new fighter to cruise at supersonic speeds, somewhere between Mach 1 and Mach 2, without using the afterburner. Specific fuel consumption thus will decline. Such "dry" supersonic flight will give ATF a much wider combat radius and fighting energy.

Both prototype engines, based initially on technologies developed in the ASD Aero Propulsion Laboratory's Joint Advanced Fighter Engine program, are in altitude testing. Colonel Fain is satisfied with their progress. "They look good," he says. "I don't see any major problems."

Other new technologies are expanding the ability of an aircraft to vector the direction of its engine thrust. A key to this feature of ATF is development of advanced engine nozzles and control mechanisms.

The prototype nozzles to be installed on the twin-engine aircraft will demonstrate an ability to vector thrust by twenty degrees, up or down, in the same or opposite directions. Once perfected, this feature would provide the ATF with short-takeoff capability and the power to make tight turns at high speeds, among other maneuverability attributes.

The mating of engines and airframes shapes up as yet another ATF technology. The problem: How to integrate the engine/nozzle complex with the airframe in ways that will provide performance over a large flight envelope—from subsonic to supercruise, high to low altitude—and also reduce drag and signatures. The answer is anything but clear.

"We're concerned about engine/airframe compatibility," reports Colonel Fain. "We've got a lot of work to do in that area."

The same could be said of the Advanced Tactical Fighter's exotic, supersophisticated avionics suite, a system that will lie at the heart not only of this fighter but also, in all likelihood, of future ones.

Much work remains in the incomparably tough task of creating a totally "integrated" layout. The effort entails pulling together all functions and support technologies in a coherent system of thoroughly blended elements that will make today's disjointed systems obsolete.

The prize is great: a single central nervous system capable of coordinating sensors, flight and propulsion controls, weapon controls, cockpit displays, and countermeasures. The payoff would come in the form of powers for detecting, identifying, and engaging foes beyond visual range, enhanced situational awareness, expanded self-defense, reduced signatures, higher reliability, lower pilot work load, and lower cost.

In pursuing that goal, ATF developers have turned the airplane program into a huge "kicker"—financial and otherwise—for technologies that hold the key to future avionics effectiveness.

Among the technologies being evaluated are next-generation, very-high-speed integrated circuit (VHSIC) chips; advanced multimode, active-element-array radars; shared apertures; shared antennas; laser ranging; infrared search and track; "smart-skin" sensors; advanced cockpit displays; voice-recognition systems; fiber optics; and systems of artificial intelligence.

Awesome Amounts of Data

In a very real sense, the technology most critical to the integrated avionics system is integration itself.

The ATF's developers are devising means for fusing awesome amounts of data from multiple sources to provide reliable, instantaneous satisfaction of needs, from target classification and weapon selection to optimum flight path.

Within the framework of Pave Pillar architecture developed at ASD's Avionics Laboratory, ATF contractors are developing VHSIC common signal processors to communicate with and tie together such avionics elements as radar, infrared search and track, and collections of major offensive and defensive functions.

The latter include Integrated Electronic Warfare Systems (INEWS) and Integrated Communication Navigation Identification Avionics (ICNIA), both under development for years at ASD and avionics houses.

Colonel Fain and his chief avionics deputy, Lt. Col. John Borky, make it clear that no INEWS or ICNIA "black boxes" themselves will make it into the system. They are viewed as technologies only, technologies that will be incorporated, to a greater or lesser degree, in common modules run by VHSIC processors and high-speed data buses.

This, in the words of one ATF officer, amounts to "a massive change in the way we do business" in avionics. The benefits are that modules selected from a limited variety of multipurpose units could be tailored for specific requirements. They would eliminate many sources of avionics failures by using fewer cables and connections. As small units with common specifications, they could be built by a large number of contractors, thereby ensuring competition and lower cost.

The entire approach is experimental. The principal risk is that, in the new world of integration, one contractor working on one piece of the avionics puzzle may be proceeding along an altogether different path from those working on others.

Fears of this type were eased in recent months by some startling successes. Example: When a piece of applications software written by one ATF contractor was installed in a processor built by another, they played together harmoniously on the first flip of a switch. That came as a mighty relief to ATF officials.

"I didn't expect 'em to plug the software in and make the thing turn on right away," says Colonel Fain. "That's very positive. Very, very positive for my very, very cautious approach to avionics."

Even so, officers say all avionics elements may not be ready for the first ATFs that become operational in 1995. More broadly, while the basic goals for ATF remain unchanged, it will not possess each and every one of the features laid out for it originally. As ATF officers have acquired more hard data, trade-offs have been made.

"Our expectations for ATF have been lowered over the past two years," explains General Loh. "With any 'paper' airplane, expectations are always somewhat higher than the reality. That was true of the F-15."

Elimination of some features was in keeping with a 50,000-pound weight objective that the Air Force has set for the ATF. Elimination of others was associated with a limit of $35 million, in unit flyaway cost, that USAF has set. The service wants to build 750 ATFs at that price in 1985 dollars based on a production run of seventy-two fighters a year. Because weight usually means cost, the two limits are obviously interrelated.

Saving Weight and Money

Last fall, Air Force leaders undertook a major review of the ATF's performance goals to determine where to save weight and money, making a number of specific design decisions.

In earlier reviews, ATF transonic maneuvering capability had been reduced by one-half G, and the fighter's internal weapons carriage was lowered somewhat. While it still wants a short-landing capability, the Air Force dropped its requirement for thrust reversers when it learned that they would add significant cost and weight to the aircraft. Now, ATF will make short landings by using mobile, ground-based arresting barriers that are scheduled to be put in place for other aircraft.

For technologists now developing the ATF's exotic avionics suite and cockpit, much work remains to be done. Contractor prototypes of the ATF's totally integrated avionics will undergo the first phase of a long series of critical demonstrations in late 1989.

Such technology trade-offs are painful. More are yet to come. Says Colonel Fain: "We will continue the requirements refinement process throughout dem/val. The requirements will be based on the threat, the cost, and the weight. It is very important that we provide the senior leadership with the best possible aircraft within the cost and weight goals established for the program."

Some observers outside the Air Force, however, speculate about whether the cost and weight figures are firm, unchangeable limits or less-than-ironclad goals. They suggest that the Air Force can ill afford to build a less-than-adequate airplane just to stay within those limits. Faced with a choice, it is possible that USAF could ease cost and weight limitations somewhat.

The ATF's basic performance characteristics will have implications not only for ATF itself. They could affect the politically difficult proposal for the Navy to make use of ATF's technologies.

Under pressure from Congress, the Navy is committed to take a serious look at using a "wet" variant of ATF—a Naval ATF, or NATF—to replace its F-14 Tomcat fleet defender at the turn of the century.

Few question the financial benefits. In taking this step, claims the General Accounting Office, the Navy could avoid the $7 billion cost of developing its own new fighter.

But the Navy has been keeping a close and skeptical eye on the suitability of the Air Force's plane for Navy missions. Some Navy officers had suspected—and some continue to believe—that ATF's capabilities are being compromised in pursuit of arbitrary cost and weight goals.

Officially, the Navy is committed to trying to make NATF a reality. The service last summer assigned a Navy team to Wright-Patterson to oversee development of preliminary system specs. The Navy also has provided funds to Northrop and Lockheed to begin a more detailed look at a possible Navy design. It will participate in ATF source selection, with suitability of design for NATF the uppermost consideration.

"We've just gotten the Navy ATF program started," notes Colonel Fain. "But while we've been looking at Navy compatibility for a couple of years, it's been at very high levels. Based on that, we don't see major show-stoppers."

He sees no significant problem with the Navy's use of ATF avionics or engines. The NATF airframe is a different story. The Navy wants a much larger wing that is capable of changing shape for carrier storage. The plane will need heavier landing gear for carrier use, and this will require heavier beams to be added to NATF. This, he says, can be accommodated.

Colonel Fain refuses to speculate on whether the Navy will make a "firm, in-blood commitment" to the NATF—a decision that could reduce ATF procurement costs by as much as $2 billion due to economies of scale and therefore ease the cost pressures on ATF designers.

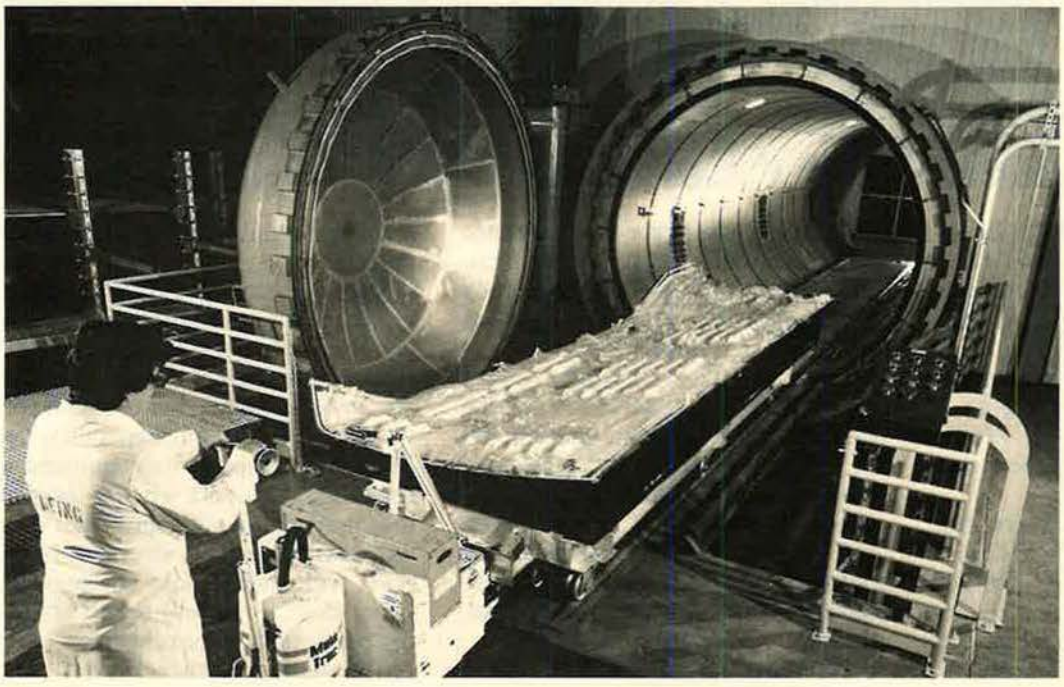
Colonel Fain is taking nothing for granted in this respect. "Let me put it to you this way," the Colonel says. "I have been working up our program without the Navy in there. If the Navy does come in, and all of this [cost reduction] comes to fruition, then we can come in and take advantage of that. But I'm not counting on that right now. If I did, and was wrong, then I've got a program that's not executable."

The fate of NATF aside, Air Force leaders are now establishing formal technological links between their premier fighter program and a number of other USAF projects. The moves are aimed at solidifying the combat strength of future aircraft by ensuring that they benefit from ATF breakthroughs.

The Case of the F-16

The key case in point is the F-16 multirole fighter. Beginning with a directive from Deputy Defense Secretary William H. Taft IV last year that instructed the Air Force to consider ATF technologies for future variants, USAF officials have embraced the concept.

"We'll get a big payoff for the F-16," says General Loh.



Advanced composite materials, similar to the type shown here at the Boeing Vertol Plant in Philadelphia, will be used extensively throughout ATF's airframe to reduce its weight, increase its strength, and lower its cost. The composite sideskin in this photo was developed for the Bell-Boeing V-22 aircraft.

In developing its plan for the "Agile Falcon" makeover of the General Dynamics F-16, the Air Force is eyeing possible incorporation of technologies brought to life by the ATF program. Such advances are considered attractive not only to USAF operators, but to potential European customers as well.

Maj. Gen. Robert Eaglet, director of ASD's F-16 program office, puts it this way: "We need to examine mechanisms to provide for the transfer of technology from ATF to F-16. We've looked at that very aggressively, and we're excited about that."

The ATF technologies would benefit a planned variant of F-16 dubbed the Agile Falcon. Proposed for initial delivery in 1995, the Agile Falcon would feature larger wings, more powerful engines, and newer avionics.

The program is intended to strengthen the F-16 against more powerful Soviet fighters of the next decade. The US also is offering to develop and produce the plane with the Netherlands, Belgium, Norway, and Denmark, original partners in production of the F-16. All four and the US have entered into a two-year predevelopment study agreement ending in 1990. General Dynamics, the F-16's maker, estimates research costs at $600 million.

General Eaglet says that ATF's engine or a derivative could be fitted into Agile Falcon, or it could be used as a design basis for a new ATF-type engine. Also in prospect could be installation of highly advanced low-probability-of-intercept radars and enhanced ATF-type avionics. It is no stretch of the imagination to see some of ATF's low-observable technologies in later versions of the Agile Falcon.

Currently, the Air Force is pursuing modest versions of Agile Falcon for its first phase. Later versions will make heavy use of such ATF concepts as modular avionics architecture. Due to high cost, some of the advanced ATF equipment or components may be unaffordable in the beginning. But officials expect they can be put in later Agile Falcon models and the earliest models can be retrofitted.

"There are lots of [ATF] technologies that already have been flight-demonstrated and can be put into production at roughly the same time as the Agile Falcon," says General Eaglet. "The highly advanced technologies, ones that are being flight-tested and proven for the first time in the ATF program, may be introduced later."

Agile Falcon design already has evolved considerably. First proposed in 1987 by General Dynamics, the new craft was to increase the original F-16's wing surface from 300 square feet to 375 square feet. Now, the figure has grown to 400 square feet. Leading-edge sweep also has been changed. Officers say the bigger planform, bringing higher agility, would be useful in either air-to-air or air-to-ground combat. In fact, says General Eaglet, the aircraft could turn out to be a strike fighter adept in both regimes.

"You'd probably call it an 'F/A-16,' like the Navy calls its plane the F/A-18," he explains. "For the most part, the aerodynamic and engine improvements we're considering for Agile Falcon appear to help the air-to-ground capabilities just as much as they help the air-to-air."

That is fortuitous. The Air Force appears determined to use some form of the F-16 as its replacement in the 1990s for the A-10 close air support aircraft. A Close Air Support Aircraft Design Alternatives study, performed by ASD and presented to Air Force and Pentagon leaders last fall, reinforced the view that the "A-16" would meet Army CAS requirements. The A-16 could be the Agile Falcon itself. The A-16 could also turn out to be a "mission-ized" version of the standard F-16, optimized with technologies that aid in the ground attack mission.

General Eaglet foresees a virtually endless parade of F-16s coming into production over the next decades. The reason is simple: USAF needs a low-cost, lightweight complement to the ATF for air superiority and for ground attack. None other than the F-16 is in prospect.

In this circumstance, as in others, diffusion of technologies made for the ATF itself shapes up as an increasingly critical necessity. ■

A Checklist of Major ASD Systems

Work in progress at the Aeronautical Systems Division, Wright-Patterson AFB, Ohio.

Advanced Cruise Missile Office

AGM-129A Advanced Cruise Missile
Program to develop a second-generation strategic ALCM with increased range, accuracy, and stealth features. Designed for use by B-52 and B-1B bombers. **Contractor:** GD, Williams, McDonnell Douglas. **Status:** Development.

Advanced Tactical Fighter Office

Advanced Tactical Fighter
Development of the Air Force's next-generation air-superiority fighter for operational service starting in the mid-1990s. ATF concept is being studied during demonstration/validation phase, including assessment of ground-based avionics prototypes and flying airframe prototypes designated YF-22A and YF-23A. ATF is expected to include advanced propulsion, flight controls, and fire controls; significant avionics integration; advanced system survivability features; designed supportability characteristics; low-observable technologies; superior subsonic and supersonic maneuverability; supersonic persistence without use of afterburners; greatly increased combat radius. Demonstration will include use of two advanced technology fighter engines, YF119-PW-100 and YF120-GE-100. **Contractor:** Northrop/McDonnell Douglas, Lockheed/Boeing/General Dynamics, GE, P&W. **Status:** Dem/Val.

Aeronautical Equipment Office

Air Base Operability
Development and production of equipment to enhance survivability of air bases; camouflage, concealment, deception, decoys, contingency airfield lighting. **Contractor:** Many. **Status:** R&D, production.

Avionics Subsystems
Acquisition of avionics systems common to many aircraft; standard components. **Contractor:** Many. **Status:** R&D, production.

Common Support Equipment
Production of ground-support equipment capable of supporting many types of aircraft. **Contractor:** Many. **Status:** R&D, production.

Mark XV Identification, Friend or Foe (IFF) System
Development of secure, antijam, highly reliable replacement for the aging Mark XII IFF system; interoperable with NATO; usable by USAF, Army, and Navy aircraft. **Contractor:** Bendix, TI. **Status:** R&D.

Modular Automatic Test Equipment (MATE) System
Management system to govern procedures, architecture, hardware, and software in systems that use automatic test equipment. **Contractor:** Many. **Status:** Continuing.

Productivity, Reliability, Availability, and Maintainability Program
Program to increase combat power and reduce support costs of Air Force by improving equipment efficiency and exploiting lower lifetime cost alternatives. **Contractor:** Many. **Status:** Continuing.

Reliability and Maintainability Technology Insertion Program (RAMTIP)
Program to develop and accelerate incorporation of promising new technology into current and future systems. **Contractor:** Many. **Status:** Continuing.

B-1B Bomber Office

B-1B Bomber
Production of 100 manned penetrating strategic bombers to replace vintage B-52 bombers and carry out SIOP and possibly conventional bomb missions. Program responsibility passes to AFLC in January 1989. **Contractor:** Rockwell, Boeing, Eaton, GE. **Status:** PMRT.

B-2 Bomber Office

B-2 Advanced Technology Bomber
Development of a four-engine, low-observable, flying-wing type of

strategic penetrating bomber, designed specifically to be able to avoid enemy radar. Supplements and then supplants the B-1B in penetrating role. Plans call for construction of 132 of these two-place intercontinental aircraft. The B-2 design and manufacturing program has made extensive use of computer-aided design and manufacturing. Initial operational capability scheduled for the early 1990s. **Contractor:** Northrop, Boeing, LTV, GE, Hughes, Link. **Status:** Production.

C-17 Transport Office

C-17A Aircraft
Development and production of USAF's latest airlifter, to augment C-5, C-141, and C-130. Will be used for (1) rapid intertheater deployment of Army and other units directly to overseas areas and (2) airlift of outsized cargo over both intertheater and intratheater ranges close to forward line of battle. **Contractor:** McDonnell Douglas. **Status:** FSD, initial production.

EC/Reconnaissance Office

Advanced Tactical Air Reconnaissance System (ATARS)
Development of electro-optical and infrared sensors, digital recorders, and management system for recon aircraft, UAVs, and fighter aircraft pods. **Contractor:** Control Data. **Status:** FSD.

Airborne Self-Protection Jammer F-16 Integration
Navy/Air Force program to develop internal ECM against radar missiles. **Contractor:** ITT, Westinghouse. **Status:** FSD.

EF-111A Upgrade Program
Program to update ALQ-99E processor and receiver subsystem to meet EW threat of the 1990s. **Contractor:** None. **Status:** FSD.

F-4G Wild Weasel Performance Update Program (PUP)
Initiative to provide a new, more powerful signal processor and receiver group for the 1990s. **Contractor:** McDonnell Douglas. **Status:** Production.

Have Charcoal/Interactive Defensive Avionics System
Development of improved infrared countermeasure jammers to protect aircraft from heat-seeking missiles. **Contractor:** None. **Status:** FSD.

Manned Lethal Suppression of Enemy Air Defenses
Investigation of alternatives for replacement of F-4G. **Contractor:** None. **Status:** Concept exploration.

MJU-10B IR Flare
Provides IR antimissile diversionary protection for F-15. **Contractor:** Kilgore, Tracor. **Status:** Production.

Tactical Countermeasures Dispenser Upgrade (AN/ALE-47)
USAF/Navy program to provide dispenser that can operate together with radar warning receivers and missile warning systems. **Contractor:** Tracor. **Status:** FSD.

Seek Spartan
Application of ATF's Integrated Electronic Warfare System technology to other USAF, Navy, and Army aircraft. **Contractor:** None. **Status:** Dem/Val.

TR-1 Aircraft
Continued production of U-2-type aircraft for high-altitude, long-endurance, penetration surveillance. **Contractor:** Lockheed. **Status:** Production.

TR-1 Ground Station
System to receive and process data collected by TR-1 sensors. **Contractor:** Ford Aerospace. **Status:** FSD.

F-15 Fighter Office

F-15E Dual-Role Fighter
Two-seat version of F-15 to provide long-range, day/night, fair/foul-weather delivery of air-to-ground munitions as well as air-to-air capability. Will include advanced cockpit technology, LANTIRN, ring-laser gyro guidance, conformal fuel tanks, and reconfigured engine bay. **Contractor:** McDonnell Douglas. **Status:** Production.

F-15 Multistage Improvement Program (MSIP)
Incorporation of improved central computer, improved radar, and expanded electronic warfare system to ensure continued superiority of the current F-15 fighter fleet. **Contractor:** McDonnell Douglas. **Status:** Production.

F-15 Radio Frequency Compatibility Program
Initiative to improve compatibility of TEWS with F-15 radar, weapons, and avionics. **Contractor:** McDonnell Douglas. **Status:** Dem/Val.

Memory/Radar Module Test Station
New depot test systems to support F-15's new APG-70 radar and F-15E avionics. **Contractor:** McDonnell Douglas. **Status:** Production.

Mobile Electronic Test Set (METS)
Initiative to enhance supportability of the F-15E Avionics Intermediate Shop. **Contractor:** McDonnell Douglas. **Status:** Production.

Tactical Electronic Warfare System (TEWS) P^{3}I
Provides improvements to ALR-56C Radar Warning Receiver and ALQ-135 countermeasures set on F-15. **Contractor:** Loral, Northrop, Tracor. **Status:** Production.

Tactical Electronic Warfare System Intermediate Support System
Program to provide test system to support new TEWS suite. **Contractor:** McDonnell Douglas. **Status:** Production.

F-16 Fighter Office

F-16 Multimission Fighter
Continued production of the single-engine, lightweight, high-performance F-16 fighter for a range of tactical missions, including air-to-air and air-to-ground. Multinational Staged Improvement

Program provides F-16C/D with capability to employ advanced systems such as LANTIRN and AMRAAM. F-16A/B undergoing modifications as Air Defense Fighter. Planning for Agile Falcon, a proposed codevelopment, coproduction F-16 derivative involving US and European consortium partners, focuses on aerodynamic and avionics improvements. **Contractor:** GD, P&W, GE. SABCA (Belgium), Fokker (Netherlands), Fabrique Nationale (Belgium), Norsk Forsvarsteknologi (Norway), Philips (Netherlands). **Status:** Development, production, deployment.

Joint Tactical Autonomous Weapons Office

Seek Spinner
Development of ground-launched, slow-moving UAV to locate and attack radar emitters. **Contractor:** Boeing. **Status:** Demonstration.

Tacit Rainbow Air Launch (AGM-136A)
USAF/Navy program to produce a high-speed, jet-powered emitter attack weapon that is programmable before launch but can loiter and search for targets after launch from bombers or fighters. **Contractor:** Northrop. **Status:** FSD.

Tacit Rainbow Ground Launch (BGM-136)
USAF/Army program to develop a ground-launched variant of AGM-136A weapons. **Contractor:** Raytheon/McDonnell Douglas/ESI, Boeing/TI/Northrop/LTV. **Status:** Pre-FSD.

LANTIRN Office

Infrared Search and Track System (IRSTS)
Air Force/Navy development of system to detect and track distant airborne threats based on their thermal signatures. **Contractor:** GE. **Status:** Dem/Val.

LANTIRN System
Production of integrated navigation/targeting system for nighttime, under-the-weather ground-attack by F-15E and F-16 fighters. Navigation pod provides FLIR imagery and radar for obstacle avoidance. Targeting pod acquires and automatically tracks targets. **Contractor:** Martin Marietta. **Status:** Production.

Propulsion Office

Engine Component Improvement Program
Continuing engineering support for all air-breathing engines used in manned USAF aircraft. **Contractor:** All major engine firms. **Status:** Continuing.

F101-GE-102 Engine for B-1B
Postproduction support for the engines in the B-1B bomber. **Contractor:** GE. **Status:** Operational.

F110-GE-100 Engine for F-16
Acquisition of the GE engine for the Alternate Fighter Engine program. Installation in new F-16C/D aircraft. **Contractor:** GE. **Status:** Production.

F100-PW-220 Engine for F-15 and F-16
Evolutionary program to improve F100 durability and operability for the Alternate Fighter Engine competition. Increased durability to 4,000 TAC cycles, or nine years' operation, is sought. Includes digital electronic engine control. In production for F-16C/D, already installed in the F-15C/D. **Contractor:** P&W. **Status:** Production.

F100-PW-229 Engine for F-15 and F-16
Increased Performance Engine (IPE) version of the existing F100, being developed for the F-15 and F-16 in the 1990s. Greater thrust and reliability. **Contractor:** P&W. **Status:** FSD.

F110-GE-129 Engine for F-15 and F-16
Increased Performance Engine (IPE) version of the existing F110, also being developed for F-15 and F-16. Will compete with P&W in engine buys of the 1990s. **Contractor:** GE. **Status:** FSD.

F119-PW-100/F120-GE-100 Engine for ATF
Development of two new, state-of-the-art engines for the fighter of the 1990s and beyond. Currently in cem/val phase. Basic engine concepts and technologies are being demonstrated in a ground-test effort. Flight testing in airframe prototypes will begin in early 1990. **Contractor:** GE, P&W. **Status:** Advanced development.

F112 Engine for Advanced Cruise Missile
Production of a small turbofan engine for the second-generation strategic cruise missile. **Contractor:** Williams. **Status:** Continuing.

F117-PW-100 Engine for C-17
Development and acquisition of a version of the commercial PW-2040 turbofan engine, with 40,000 pounds of thrust, to power the C-17A aircraft. **Contractor:** P&W. **Status:** Development.

Propulsion Technology Modernization
Insertion of state-of-the-art technologies in engine manufacturing systems to increase productivity and efficiency. **Contractor:** GE, P&W, Garrett, Williams, Teledyne, Allison. **Status:** Continuing.

T406-AD-400 Engine for CV-22A
Acquisition of the Allison T406 engine for the CV-22 multimission VTOL aircraft. **Contractor:** Allison. **Status:** FSD.

Special Operations Forces (SOF) Office

AC-130U Gunship
Development of side-firing gunships with highly accurate gun suite and new ECM systems. Replacement for aging AC-130s in inventory. **Contractor:** Rockwell. **Status:** FSD.

Joint Vertical Lift Airlift (JVX) (CV-22A)
Development of tilt-rotor aircraft with greater maneuverability and lift capability, plus speed of fixed-wing aircraft. **Contractor:** Bell/Boeing. **Status:** FSD.

MH-60G Pave Hawk
Acquisition and modification of Army UH-60A helicopters for special operations, rescue, and tactical air control. Contains aerial refueling capability and additional avionics. **Contractor:** Sikorsky. **Status:** Production.

MC-130H Aircraft
Acquisition of 21 aircraft with integrated avionics, improved navigation, terrain-following radar, and ECM. Will augment Combat Talon I SOF aircraft. **Contractor:** Lockheed, IBM. **Status:** Production.

SRAM II Missile Office

Short-Range Attack Missile (SRAM II)
Development of a strategic-bomber-borne attack missile of longer range and improved lethality to augment and ultimately replace the AGM-69A SRAM-A. **Contractor:** Boeing. **Status:** FSD.

Systems Office

AGM-86B Air-Launched Cruise Missile (ALCM)
Program to complete integration of AGM-86B cruise missile with the B-1B bomber. **Contractor:** Boeing. **Status:** Deployment.

Airdrop Development Program
Development, test, and production of improved airdrop systems for C-130, C-141. **Contractor:** Ver-Val, Douglas. **Status:** Production.

Air Force Infrared (IR) Maverick (AGM-65D)
Precision-guided, launch-and-leave, air-to-ground weapon to counter armored vehicles and fortified structures. **Contractor:** Hughes, Raytheon. **Status:** Production.

Air Force Infrared (IR) Maverick (AGM-65G)
Incorporates unique tracking algorithms and a pneumatic actuation system in the standard Maverick. **Contractor:** Hughes, Raytheon. **Status:** Production.

Air Force One
Replacement of two aging VC-137 presidential aircraft with two new wide-body planes, modified 747-200Bs. **Contractor:** Boeing. **Status:** Production, modification.

A-7 Prototype Modification Program
Structural modifications and reengining of two A-7D aircraft as prototypes. Will be used to determine future uses of existing A-7 inventory. **Contractor:** LTV. **Status:** Prototyping.

ALQ-172 Electronic Countermeasures (ECM) Set
Major modification of ECM set on B-52H to provide defense against agile and monopulse SAM and interceptor threat. **Contractor:** ITT. **Status:** Production.

Attack Radar Set (ARS)
Upgrading of F/FB-111 attack radar equipment. **Contractor:** GE. **Status:** Production, deployment.

C-5B Aircraft
Production of 50 aircraft to provide intertheater airlift of large and outsize payloads. **Contractor:** Lockheed. **Status:** Production, deployment.

C-22B Air National Guard Support Aircraft
Modification of four Boeing 727s for ANG use as operational support airlift aircraft. **Contractor:** Boeing. **Status:** Modification.

C-26A Aircraft
Acquisition and support of 10 Fairchild aircraft to replace the ANG C-131 fleet. **Contractor:** Fairchild Aircraft. **Status:** Production.

C-27 Aircraft
Acquisition of 10 medium-size STOL aircraft to provide intratheater airlift using unpaved landing surfaces. **Contractor:** None. **Status:** RFP preparation.

Common Strategic Rotary Launcher
Development of launcher for internal carriage of bombs and missiles on B-52H and B-1B bombers. **Contractor:** Boeing. **Status:** FSD.

Cruise Missile Mission Control Aircraft (CMMCA)
Modification of two C-18 airframes to support cruise missile tests. **Contractor:** Electrospace Systems. **Status:** Modification.

KC-10A Aircraft
Acquisition of 60 advanced tanker/cargo aircraft with refueling and cargo capability. **Contractor:** McDonnell Douglas. **Status:** Production, deployment.

KC-135 Improved Aerial Refueling System
Development and test of new aerial refueling systems and subsystems. **Contractor:** None. **Status:** Development.

Peace Pearl
FMS program to design, develop, and produce a new fire-control system for China's F-8 aircraft. Avionics will be used to help upgrade air-to-air capabilities. **Contractor:** Grumman. **Status:** FSD.

Tanker/Transport Training System (TTTS)
Acquisition of 211 business jets to support Specialized Undergraduate Pilot Training. **Contractor:** None. **Status:** RFP preparation.

Terrain-Following Radar (TFR)
Upgrading of the reliability and supportability of F/FB-111 TFR. **Contractor:** TI. **Status:** Production, deployment.

Training Systems Office

Air Defense Fighter Training System
Procurement of ADF training system for training of air defense crews. **Contractor:** GD. **Status:** Development.

ATF Trainer
Comprehensive analysis to develop training system concept to meet requirements for ATF. **Contractor:** Northrop/McDonnell Douglas, Lockheed/GD/Boeing. **Status:** Planning.

B-1B Simulator System
Development and production of system to train all B-1B crews. Includes five Weapon System Trainers, which simulate all four crew positions; two Mission Trainers, which simulate only the offensive/defensive positions, and Cockpit Procedures Trainers. **Contractor:** Boeing. **Status:** Development, acquisition.

B-52 Offensive Avionics System Block II
Development and production of mod kits for nine B-52 Weapon System Trainers and four Offensive Station Mission Trainers. **Contractor:** Singer-Link. **Status:** Continuing.

C-5/C-141 Aerial Refueling Part-Task Trainer
Development of one prototype and production of six units to provide visual, audio, and flight-control cues for realistic air-refueling training. **Contractor:** Reflectone. **Status:** Development, acquisition.

C-17 Aircrew Training System
Investigation of ground-based aircrew training system for C-17 aircrews and maintenance personnel. **Contractor:** Douglas Aircraft, Singer-Link, United Airlines Services. **Status:** Competitive design.

CV-22 Aircrew Training System
Development of total aircrew training system for Air Force crews that use the CV-22. **Contractor:** None. **Status:** Planning.

F-15E Weapon System Trainer/F-15C/D Operational Flight Trainer
Ongoing production of F-15C/D OFTs to a total of 14 simulators. Initial production of F-15E WST. **Contractor:** Loral. **Status:** Production.

F-16 Weapon System Trainer
Procurement of Operational Fighter Trainers, improved Digital Radar Landmass simulators, Electronic Warfare Training Devices, and various LANTIRN simulators. **Contractor:** Singer-Link, GE, AAI, E&S. **Status:** Acquisition.

GBU-15/AGM-130 Part-Task Trainer
Development of PTT to instruct tactical weapon system officers in GBU launch and guidance tasks. **Contractor:** Honeywell. **Status:** Development.

LANTIRN Part-Task Trainer
Development of PTTs in F-15E and F-16 configuration to train aircrews in LANTIRN techniques and operations. **Contractor:** ECC International. **Status:** Development, production.

Modular Simulator Design Program
Program to explore ways to use microcomputers and high-speed data communications in modular flight simulators. **Contractor:** Boeing. **Status:** Development.

Special Operations Forces Aircrew Training System
Planning for a total aircrew training system for MC-130H, MC-130E, AC-130H, and AC-130U crew members. **Contractor:** None. **Status:** Planning.

Tanker/Transport Training System
Investigation of requirements that will result in procurement of 14 Operational Flight Trainers for Specialized Undergraduate Pilot Training. **Contractor:** None. **Status:** Planning.

Aeropropulsion Laboratory

Advanced Turbine Engine Gas Generator
Core-engine program that assesses new high-pressure components, advanced structures, and material technologies in a true engine environment. **Contractor:** Allison, Garrett, GE, P&W. **Status:** Advanced development.

Aircraft Power
Program to develop nonflammable hydraulic system, advanced battery system, highly reliable electrical power system. **Contractor:** Many. **Status:** Research, exploratory and advanced development.

Aviation Fuel Technology
Program to develop advanced fuels and fuel systems for subsonic,

supersonic, and hypersonic aircraft and missiles powered by air-breathing engines. **Contractor:** Many. **Status:** Research, exploratory and advanced development.

Expendable Turbine Engine Concept Demonstrator
Development of a demonstrator engine to help define future technology requirements for small, unmanned, limited-life vehicles. **Contractor:** Allison, GMC, Garrett, Teledyne, Williams. **Status:** Advanced development.

High-Performance Turbine Engine Technologies Initiative
Program to develop and demonstrate revolutionary advances in turbine engine technology through the 1990s. Goal is 100 percent improvement over ATF engines. **Contractor:** Allison, GMC, Garrett, GE, P&W, Teledyne, Williams. **Status:** Exploratory development.

High-Speed Propulsion
Technology programs aimed at rapidly developing an Air Force capability for high-speed flight, including turboramjet engines for Mach 5 interceptors, hydrogen-fueled engines for hypersonic cruise vehicles or space boosters, and new engine options for high-speed missiles. **Contractor:** Many. **Status:** Exploratory development.

Joint Technology Demonstrator Engine
Experimental program to develop demonstrator engines possessing advanced high-pressure core components combined with advanced low-pressure and adaptive components. **Contractor:** Garrett, GE, P&W. **Status:** Advanced development.

Solid-Fuel Ramjet Propulsion
Investigation of solid-fuel ramjets using both hydrocarbon and boron-based fuels. **Contractor:** Atlantic Research, UTC. **Status:** Exploratory development.

Spacecraft Power Technology
Program to provide evolutionary and revolutionary improvements in spacecraft power systems while reducing weight and volume. **Contractor:** Many. **Status:** Research, exploratory and advanced development.

Special-Purpose Power
Initiative to provide technology for special-purpose loads such as high-power microwaves, electromagnetic launchers, and accelerator systems. **Contractor:** Many. **Status:** Exploratory and advanced development.

SUPER (SUrvivable solar PowER system)
Initiative to design, fabricate, and test a survivable solar-power system for use in space. **Contractor:** TRW, Boeing, Martin Marietta, Lockheed. **Status:** Advanced development.

Variable-Flow Ducted Rocket Demonstration
Program to demonstrate new medium-range missile propulsion concept for air-to-air and air-to-ground applications. **Contractor:** Atlantic Research, Hercules. **Status:** Advanced development.

Avionics Laboratory

Adaptive Tactical Navigation System
Design, development, and demonstration, in computer simulation, of adaptive tactical navigation system that combines artificial intelligence and advanced navigation algorithms. **Contractor:** Technical Analytical Sciences Corp. **Status:** Development.

Airborne Imagery Transmission
Development of a modular, wideband, multiple-sensor, jam-resistant, air-to-air data link for transmission of reconnaissance imagery or digital data. **Contractor:** Unisys. **Status:** Development.

Airborne Integrated Antenna System (AIAS)
Program to define requirements and to conduct trade-off studies regarding optimized AIAS architectures. **Contractor:** TRW. **Status:** Concept definition, design.

Air-to-Air Attack Management
Program to develop an integrated set of advanced fire-control algorithms and innovative control and display concepts for a single-seat fighter aircraft in multitarget combat. **Contractor:** Northrop. **Status:** Development.

Air-to-Air Covert Sensor Technology
Definition and design of a future covert electro-optical sensor subsystem to enhance situational awareness by providing missile warning, acquisition, tracking, and identification functions. **Contractor:** None. **Status:** Development.

Artificial Neural Vision Learning System
Investigation of potential application of artificial neural systems technology in an advanced vision system. **Contractor:** None. **Status:** Development.

Automatic Radar Target Identification
Three-phase effort to produce and demonstrate an air-to-air identification system using one-dimensional radar signatures. **Contractor:** None. **Status:** Development.

Common Signal Processor
Program to develop a modular, high-performance, reliable, VHSIC-based digital signal processor for next-generation avionics. **Contractor:** IBM. **Status:** Development.

Coronet Prince Prototype
Packaging of existing countermeasure technology into an aircraft pod to demonstrate effectiveness against ground-based optical and electro-optical tracking systems. **Contractor:** Westinghouse. **Status:** Fabrication.

Cruise Missile Advanced Guidance
Investigation and demonstration of advanced guidance concepts such as CO_2 laser radar measurements and pattern recognition that may provide precise, autonomous, terminal guidance for standoff missiles. **Contractor:** GD, McDonnell Douglas. **Status:** Development.

Embedded Resources Support Improvement Program
Development of software support technologies to improve the software turnaround capability of Air Logistics Centers. **Contractor:** ITT, Hughes, TRW, Booz-Allen & Hamilton. **Status:** Development.

EW Reliability Improvement Program
Effort to increase mean time between failures of candidate EW systems by two orders of magnitude. Envisions integration of MMIC technology into active, phased-array apertures. **Contractor:** TRW, Northrop, Westinghouse, TI, Raytheon. **Status:** Development.

Expert Avionics Code Modifier
Program to provide technologies for rapid and efficient maintenance and modification of avionics application software. **Contractor:** None. **Status:** Development.

Full-Spectrum FLIR
Effort to develop an electro-optical thermal-imaging air-to-ground sensor capable of operating over the future battlefield while enabling the launching aircraft to avoid detection. **Contractor:** None. **Status:** Development.

Generic Algorithms for Vision Learning
Establishment of a test-bed for development of vision experiments that combine advanced learning mechanisms with earlier image operations to form new symbolic representations. **Contractor:** None. **Status:** Development.

Have Glance
Program to develop advanced concepts to counter infrared surface-to-air and air-to-air missiles. **Contractor:** Loral. **Status:** Development.

High-Power Countermeasures
Definition, development, and flight-testing of an improved standoff jamming capability. Elements include very high effective radiated power and fast-switching, narrow-beamwidth, multiple-beam jamming. **Contractor:** Raytheon. **Status:** Concept definition.

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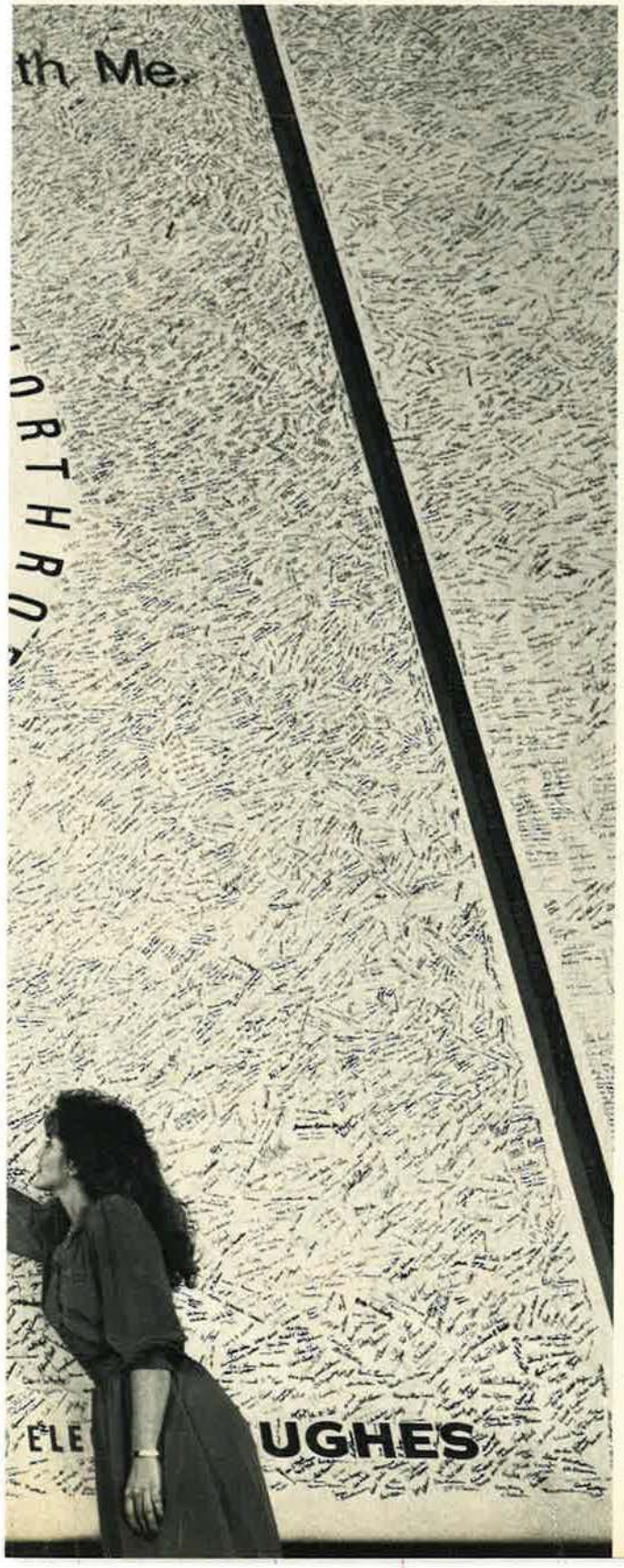

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High-Reliability Head-Up Display
Improvements to reliability of cockpit displays by using solid-state, flat-panel display technology. **Contractor:** GE. **Status:** Completed.

Integrated Communication Navigation Identification Avionics System (ICNIA)
Triservice avionics program to demonstrate that multiple existing and planned communication, navigation, and identification functions can be integrated into one airborne system. **Contractor:** TRW. **Status:** Development.

Integrated Electromagnetic System Simulator
Development of a system to provide a realistic simulation of operational environments that can be used to evaluate integrated CNI functions. **Contractor:** TRW. **Status:** Development.

Integrated Electronic Warfare Analysis & Modeling
Program to analyze, evaluate, and model RF/EO/IR countermeasures concepts and EW advanced development prototype hardware. **Contractor:** None. **Status:** Concept definition.

Integrated Terrain Access and Retrieval System
Program to develop and demonstrate a digital database management system for instantaneous display of terrain data that can be integrated with navigation systems for terrain following and terrain avoidance. **Contractor:** Hughes. **Status:** Development.

Intelligent Avionics
Program to provide a learning-system technology base for next-generation avionics systems that must adapt swiftly to dynamic and hostile environments. **Contractor:** TRW, Verac, Booz-Allen & Hamilton, TI, in-house. **Status:** Development.

Interactive Ada Workstation
Search for improvement in Ada programmer productivity of at least one order of magnitude by using symbol-processing hardware and other factors. **Contractor:** GE. **Status:** Development.

Low Probability of Intercept Radio Brassboard
Development and demonstration of the feasibility of a cost-effective, multimode, LPI/antijam, secure airborne radio system. **Contractor:** None. **Status:** Source selection.

Modular Avionics Maintenance Technology
Design and development of an integrated diagnostics concept to address maintenance issues in Pave Pillar-type avionics. **Contractor:** None. **Status:** Development.

Pave Pace
Design and demonstration of key elements of an advanced avionics architecture for the 21st century. Exploits potential of emerging technologies in parallel processing, opto-electronics and artificial intelligence. **Contractor:** None. **Status:** Concept definition.

Silent Attack Warning System
Development of hardware to demonstrate a state-of-the-art infrared detection system for missile and aircraft warning. **Contractor:** GE, Honeywell, TI. **Status:** Fabrication.

Strategic Targeting Laser Radar Technology
Development and demonstration of critical technologies and components needed to produce a CO_2 laser radar sensor that can permit manned bombers to recognize and target relocatable targets. **Contractor:** None. **Status:** Development.

Tactical Situation Assessment and Response Strategy
Partial demonstration of benefits and risks associated with application of artificial intelligence technologies to integrated defensive processing in the post-2000 fighter. **Contractor:** Loral, Hughes. **Status:** Development.

Ultra-Reliable Radar
Program to demonstrate advanced airborne radar technology with greatly increased mean time between critical failures. Program focuses on development-model radar containing electronically scanned active element array, VHSIC-based common-signal processing. **Contractor:** Westinghouse. **Status:** Development.

VHSIC Avionic Modular Processors
Investigation of an expandable, modular computer system, consisting of the MIL-STD-1750A processor module and external input/output modules. Aims for improvement in throughput and smaller size of equipment. **Contractor:** Westinghouse. **Status:** Development.

Electronic Technology Laboratory

Very-High-Speed Integrated Circuits (VHSIC)
Triservice program to develop two new generations of silicon integrated-circuit technology and provide chips, brassboard modules, pilot production lines, and initial demonstrations. **Contractor:** Phase 1: Honeywell, Hughes, IBM, TI, TRW, Westinghouse. Phase 2: Honeywell, IBM, TRW. **Status:** Phase 1: Qualification. Phase 2: Development.

Flight Dynamics Laboratory

Advanced Fighter Technology Integration F-16
Program to develop, integrate, and validate technologies that will improve lethality and survivability of future advanced military fighters. Technologies include digital flight-control system, automated maneuvering attack system, digital terrain management and display system, and voice-interactive avionics. **Contractor:** GD. **Status:** Ongoing.

AFTI/F-111 Mission Adaptive Wing
Development and flight-test of a wing that increases range, maneuverability, survivability, flexibility, and agility by automatically changing shape in flight in response to pilot commands, flight conditions, and configuration. **Contractor:** Boeing. **Status:** Flight test.

Integrated Control and Avionics for Air Superiority
Development of key control and avionics technologies that will enable cooperating fighter aircraft to engage and defeat multiple airborne threats. **Contractor:** GD, McDonnell Douglas. **Status:** Concept definition.

Mission Integrated Transparency System
Development of a transparency system for advanced tactical aircraft operating in 1995. **Contractor:** GD. **Status:** Demonstration.

Prototype Flight Cryogenic Cooler
Program to develop, integrate, and test advanced cryogenic cooler technologies capable of producing cooling capacities and temperatures that meet SDI requirements. **Contractor:** Garrett, Arthur D. Little. **Status:** Final design, fabrication, and testing.

Self-Repairing Flight-Control System
Development of reconfiguration and on-board maintenance diagnostic technologies capable of improving reliability and maintainability of a flight-control system. **Contractor:** McDonnell Douglas. **Status:** Continuing.

STOL and Maneuver Technology
Program to develop and flight-test, on an F-15 test-bed, advanced technologies to provide STOL capability for supersonic fighters while enhancing cruise performance and maneuverability. **Contractor:** McDonnell Douglas. **Status:** Flight test.

Structural Improvement of Operational Aircraft
Investigation of how to achieve improved durability and reduced cost through design, fabrication, and installation of advanced secondary components in operational aircraft. **Contractor:** LTV. **Status:** Design, flight test.

Supportable Hybrid Fighter Structures
Demonstration of the supportability, durability, weight, and life-cycle cost advantages of an advanced hybrid structure compared to conventional hardware used in major airframe structures. **Contractor:** GD. **Status:** Preliminary design.

Variable Stability In-Flight Simulator Test Aircraft (VISTA/F-16)
Design and production of a high-performance in-flight simulator to replace the NT-33. **Contractor:** GD, Calspan. **Status:** Design.

X-29 Advanced Technology Demonstrator
Development and validation of advanced aerodynamic, structural, and flight-control technologies of a forward-swept-wing aircraft. **Contractor:** Grumman. **Status:** Flight test.

Materials Laboratory

Advanced Structural Metallic Materials
Comprehensive two-part program to research and also conduct exploratory development of aluminum, titanium, and magnesium structural alloys and metal matrix composites. Aims to put into production superior alloys of higher strength, improved resistance to corrosion, and greater resistance to heat. **Contractor:** Lockheed, Rockwell, GE, U. of Va., Metcut, SRL. **Status:** Research. **Contractor:** P&W, Lockheed-Calac, Boeing. **Status:** Exploratory development.

Aircraft Composite Structure Manufacture
Programs to develop better, cheaper, and more efficient ways to provide advanced composite structures for large military aircraft. **Contractor:** Rockwell, Boeing, McDonnell Douglas. **Status:** Manufacturing technology.

Composite Materials Research and Development
Investigation and development of a wide variety of new composite materials for USAF aircraft, spacecraft, missiles, and ICBMs. **Contractor:** Boeing, GD, U. of Dayton Research Institute, others. **Status:** Research, exploratory and advanced development.

Computer-Integrated Manufacturing
Initiative to demonstrate cost and time reductions through improved integration of manufacturing functions. **Contractor:** GD, McDonnell Douglas, Northrop. **Status:** Manufacturing technology.

GaAs Research and Manufacturing Technology
Program to develop ways to improve the yield and establish optimum process for growing high-quality GaAs substances for microwave devices. **Contractor:** Cominco, ATT, Westinghouse. **Status:** Exploratory development.

Hardened Materials/Airborne and Space Subsystems
Development of technology base to be used by systems designers for protecting tactical and space systems from effects of directed energy, kinetic energy weapons, and laser radiation. **Contractor:** TI, McDonnell Douglas, Hughes, Rockwell, Acurex, GE, TRW, Barnes, Lockheed, Arthur D. Little, Perkin Elmer, LTV, GA Technologies, SAIC, Martin Marietta, AVCO. **Status:** Advanced development.

High-Temperature Materials
Development of revolutionary high-temperature materials for application in future gas-turbine engines and for application in hypersonic structures. **Contractor:** Many. **Status:** Advanced development.

Manufacturing Technology for Advanced Propulsion Materials
Initiative to provide new production capabilities for engine components. **Contractor:** GE, P&W. **Status:** Manufacturing technology.

Nonstructural Materials
Development of a variety of lubricants, seals, coatings, foams, and other critical materials. **Contractor:** Hughes, U. of Dayton, GE, TRW, Ultrasystems, others. **Status:** Exploratory development.

Ultralightweight Structural Materials
Development of advanced carbon-fiber matrix composites, ordered polymers, molecular composites, and other types of substances for future USAF aircraft, spacecraft, and missiles. **Contractor:** McDonnell Douglas, Northrop, others. **Status:** Research, exploratory and advanced development.

Laboratory Directorates

Aircraft Composite Structure Manufacturing
Initiative to provide more efficient ways of producing primary advanced composite components for aircraft. **Contractor:** Rockwell, Boeing, McDonnell Douglas. **Status:** Manufacturing technology.

Assault Transport Crew Systems Development
Effort to define and develop crew system concepts for an advanced assault transport to support SOF missions. **Contractor:** None. **Status:** RFP preparation.

Color Head-Down Display
Development of a large-area, direct-view, flat-panel display that will have high contrast even in bright sunlight. **Contractor:** None. **Status:** Development.

Computer Integrated Manufacturing
Initiative tackling problems associated with integration of all manufacturing functions both on and off the factory floor. **Contractor:** Control Data, Northrop, McDonnell Douglas, P&W, Grumman, Rohr. **Status:** Manufacturing technology.

GaAs Manufacturing Technology
Program to address generic manufacturing issues and demonstrate new techniques to improve yield and lower costs in high-volume microwave device production. **Contractor:** Westinghouse, Applied Solar Energy Corp. **Status:** Manufacturing technology.

Manufacturing Technology for Advanced Propulsion Materials
Initiative to provide production capabilities for engine components, incorporating advanced materials systems. **Contractor:** GE, P&W. **Status:** Manufacturing technology.

Panoramic Cockpit Control and Display System
Demonstration of advanced control and display techniques in a full-cockpit simulation. Possible application to F-15 in the mid-1990s. **Contractor:** McDonnell Douglas. **Status:** Development.

Pilot's Associate
Program to apply artificial intelligence technology to cockpit to assist pilots of advanced aircraft by means of managing information and helping to improve situational awareness. **Contractor:** Lockheed, McDonnell Douglas. **Status:** Development, demonstration.

Signature Technology
New management thrust, embodied in a new Signature Technology Directorate, to integrate advanced low-observable technologies across the laboratories and directorates. **Contractor:** None. **Status:** Continuing.

Tactical Aircraft Cockpit Study
Study using crew station mockup to establish firm understanding of the next-generation fighter's crew-station design issues. **Contractor:** Lear Siegler, Midwest System Research. **Status:** Development.

Technology Exploitation
New management thrust, embodied in a new Technology Exploitation Directorate, to oversee transition of maturing, advanced technologies into weapon system acquisition programs. Will provide assessment of competing technology alternatives and will serve as the focal point to coordinate multidisciplinary activities. **Contractor:** None. **Status:** Continuing.

Threat Expert Analysis System
Development of system to provide a fighter pilot with an integrated defensive response to a threat by providing available options and recommendations. **Contractor:** FAAC Perceptronics. **Status:** Development.

Three-D Cockpit Format
Program to assess potential of using stereoscopic 3-D formats on standard CRTs and panoramic displays. **Contractor:** None. **Status:** RFP preparation.

Deputate/Avionics Control

Cost-Effective Avionics
Effort to produce cost-effective avionics, reduce life-cycle costs, increase reliability, standardize avionics subsystems, investigate modular avionics, and develop guidelines for retrofit. **Contractor:**

SAS, ARINC Research, Boeing, Analytical Sciences, Oneida Resources, Tecolote Research, Synernet, Draper Lab, Battelle. **Status:** Continuing.

Deputate/Development Planning

Advanced Transport Technology Mission Analysis
Development of comprehensive database to support MAC preparation of characteristics for a next-generation tactical airlifter and to identify critical technologies. **Contractor:** In-house. **Status:** Continuing.

Aeronautical Applications of HPM Technology
Investigation of timely and efficient use of high-power microwave technology. **Contractor:** None. **Status:** Preconcept definition.

Aeronautical/Space Systems Interface Analysis
Analysis to identify opportunities to enhance aircraft mission capabilities via exchange of data between aircraft and space systems. **Contractor:** Battelle. **Status:** Complete.

Air Interdiction Design Analysis
Analyzes operational capabilities and design impact in cross-service use of future USAF and Navy aircraft. **Contractor:** In-house. **Status:** Continuing.

Close Air Support Aircraft Design Alternatives
Investigation of alternative concepts for new and modified aircraft to replace the A-10 aircraft in future close air support and battlefield air interdiction missions. **Contractor:** SAI, GD, McDonnell Douglas, Lockheed, Boeing, Northrop, Rockwell. **Status:** Complete.

Development of Nonlinear Radar Concept
Development of concepts for exploiting nonlinear part of generalized radar cross section. **Contractor:** Intelligent Signal Processing. **Status:** Continuing.

High-Reliability Fighter Concept
Development of configurations for future tactical fighters that will reduce maintenance requirements and enable aircraft to remain mission-capable for 250 flight hours. **Contractor:** Northrop, McDonnell Douglas. **Status:** Preconcept definition.

Hypervelocity Missile Design Integration
Studies of weapon design and integration methods aimed at maximizing combat utility of such weapons. **Contractor:** In-house. **Status:** Preconcept definition.

Mission Area Planning
Application of AFSC Development Planning process and methodology for use in research and development of future weapons. Identifies deficiencies in current and programmed forces over the next twenty years. **Contractor:** In-house. **Status:** Continuing.

Operational Utility of STOVL
Evaluation of the operational utility of short takeoff and vertical landing air vehicles. Comparative design analysis of conventional takeoff, short takeoff and landing, and vertical landing designs. **Contractor:** In-house. **Status:** Continuing.

Reconnaissance/Attack/Fighter Training System (RAFTS)
Development of concepts for an advanced jet pilot training system that will help student pilots adapt to high-performance aircraft. **Contractor:** Lockheed, GD, McDonnell Douglas. **Status:** Preconcept study.

Special Operations Aircraft
Definition of survivable system concepts and needed capabilities for a new special operations vehicle. **Contractor:** Frontier Technology, Toyon Research. **Status:** Preconcept definition.

Specialized Undergraduate Pilot Training (SUPT) System Concept
Analysis and development of training system concepts for Specialized Undergraduate Pilot Training. **Contractor:** None. **Status:** Preconcept definition.

Strategic Offense 21
Examination of future strategic systems that will be able to hold relocatable targets at risk. **Contractor:** Frontier Technology, McDonnell Douglas. **Status:** Preconcept definition.

Study of Unmanned Air Vehicles
Project to identify promising applications of unmanned air vehicles, define UAV concepts, and provide recommendations for use of UAVs to eliminate force deficiencies. **Contractor:** None. **Status:** Preconcept definition.

Strategic Reconnaissance Aircraft
Definition of viable reconnaissance aircraft concepts and assessment of trans- and post-SIOP data-collection role. **Contractor:** None. **Status:** Preconcept definition.

Transatmospheric Aeronautical Systems
Preliminary design analysis to identify requirements and capabilities of transatmospheric systems. **Contractor:** In-house. **Status:** Preconcept definition.

Deputate/Engineering

Aircraft Structural Integrity Program (ASIP)
Program to tie together all aspects of structural design, analysis, test, and operational use of aircraft to establish service life and track it constantly. **Contractor:** None. **Status:** Continuing.

Avionics Integrity Program
Structured design process to ensure that development of avionics systems meets reliability and safety requirements. **Contractor:** In-house. **Status:** Continuing.

Engine Structural Integrity Program (ENSIP)
Provides organized approach to structural design, analysis, test, and life-cycle management of gas-turbine engines. **Contractor:** None. **Status:** Continuing.

Generic Integrated Maintenance Diagnostic System (GIMADS)
Program to integrate all aspects of an air vehicle's diagnostics capability. **Contractor:** GD, Bell Helicopter, GE, Giordano, Hughes, Marcon, Rockwell, TRW. **Status:** Continuing.

Mechanical Subsystems and Equipment Structural Integrity Program (MECSIP)
Program to adapt integrity-assurance process to air and ground mechanical systems and equipment such as hydraulic, pneumatic, and secondary power systems. **Contractor:** None. **Status:** Continuing.

MIL-PRIME Program
Initiative to streamline acquisition by improving quality of specs and standards placed on contract and eliminate overspecification of programs. **Contractor:** None. **Status:** Continuing.

R&M 2000
Enhanced systems engineering process promulgated to help meet USAF's R&M 2000 goals. **Contractor:** None. **Status:** Continuing.

Senior Engineering Technology Assessment Review (SENTAR)
Program for review and assessment of objectives, approach, and possible payoffs of advanced technology development programs. **Contractor:** None. **Status:** Continuing.

Software Development Integrity Program (SDIP)
Initiative to improve operational capability and supportability of aeronautical weapon system software. **Contractor:** None. **Status:** Continuing.

Value Engineering
Program to reduce acquisition and logistic support costs by implementing high-payoff production processes. **Contractor:** None. **Status:** Continuing. ■

The year 1988 saw the rollout of the B-2 bomber, a glimpse of the Stealth fighter, the return of the US to space, new promise in V/STOL versatility, and much more.

A Year to Remember

BY JOHN W. R. TAYLOR, CONTRIBUTING EDITOR

NOVEMBER 1988 proved an exciting month for anyone concerned with the future of airpower. On November 10, the Pentagon released the first photograph, and brief official details, of Lockheed's F-117A Stealth fighter. Apart from showing how wide of the mark had been all the scale models and artists' impressions produced since the first references to the aircraft appeared in 1977, they answered few of the questions most of us would like to ask.

Before the month ended, Northrop and the US Air Force rolled out the B-2 Stealth bomber prototype at Palmdale, Calif.

Pundits were claiming ten years ago that strategic bombers had outlived their usefulness as primary weapons in a missile age. AIR FORCE Magazine's 1979 "Aerospace Review," on the contrary, continued to deplore President Carter's cancellation of B-1 production and expressed little enthusiasm for the cruise missiles then foreseen as successors to penetration bombers. Today, the deactivation of BGM-109G ground-launched cruise missiles has started, following signature of the INF Treaty, and bombers are back in a big way.

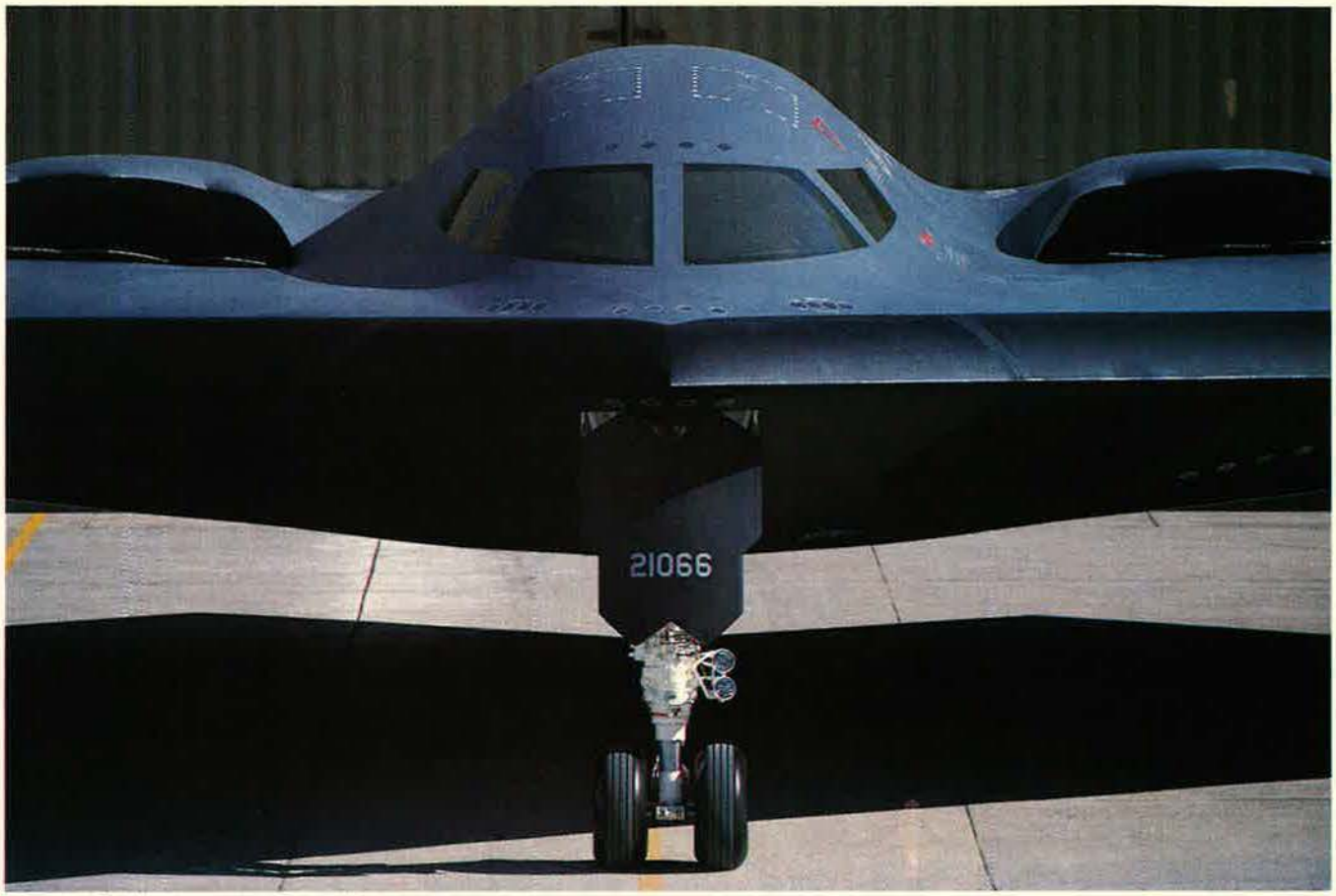
The resurrected B-1B has been subjected to severe criticism whenever Congress and the press have learned of problems that engineers and Air Force personnel regard as inevitable when deploying such an advanced aircraft. Proof that the Soviet Union respects the capability of the B-1B's designers came on August 2, 1988, when US Defense Secretary Frank C. Carlucci was given an opportunity to inspect one of the Soviet Union's newest Tupolev strategic bombers, known to NATO as "Blackjack," at Kubinka Air Base, near Moscow. While it is always unwise to accuse Soviet engineers of copying Western designs, the Tupolev OKB (experimental construction bureau) was clearly inspired by the blended wing/body elegance of the original B-1, familiar through three-view drawings first published in the open press eighteen years ago.

Glimpses of *Glasnost*

Inspiration produced an airplane different from the B-1B in several significant features. As a start, "Blackjack" is considerably larger than the USAF bomber, with a wing span of around 182 feet 9 inches spread, 110 feet fully swept, and with a length of 177 feet. Maximum takeoff weight is estimated at 590,000 pounds, compared with the B-1B's 477,000 pounds. Its maximum weapon load is thought to be 36,000 pounds, all carried internally, against the B-1B's designed 75,000 pounds internally and 59,000 pounds externally. According to the Congressional Budget Office, the B-1B's current basic payload comprises eight AGM-69A short-range attack missiles (SRAMs), with which to destroy hostile defense systems along its path, and eight B61 nuclear free-fall bombs for attacking primary targets during a typical low-altitude terrain-following penetration mission over a 1,300-mile radius.

Until President Mikhail Gorbachev's policy of *glasnost* (openness) led to this exposure of "Blackjack" to a few selected Western guests, it had been assumed that its primary mission would be as a high-altitude standoff cruise missile launch vehicle. To that role must now be added low-level penetration.

The two open weapon bays of "Blackjack" No. 12,



There were happenings at both ends of the technology spectrum last year. The Air Force rolled out the Northrop B-2 bomber (top), and at least four countries have bought powered parawings for infiltrating hostile territory (below).

—Photo by Geoffrey P. Jones

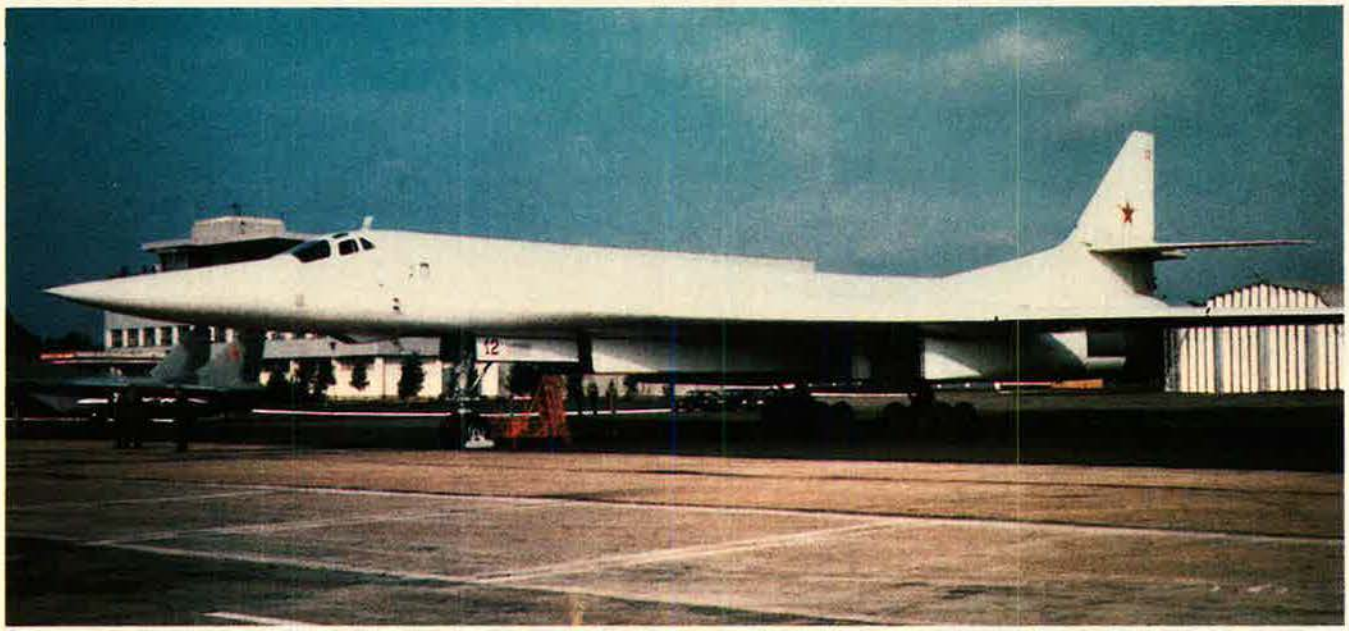
which was inspected externally and internally by Mr. Carlucci and his military aides, each were about thirty-three feet long and housed a rotary launcher. Soviet Air Force General-Colonel Boris F. Korolkov explained that each launcher was able to carry either six air-launched cruise missiles or twelve short-range attack missiles that must be assumed to have the same defense suppression purpose as USAF's SRAMs. The Soviets' current AS-15 (NATO "Kent") subsonic ALCMs, with a range of 1,850 miles carrying a 200 kT nuclear warhead, are expected to be followed by the supersonic AS-X-19.

Location of the four crew members, on individual ejection seats, is similar to that of the B-1B, as is the use of fighter-type sticks rather than wheels or yokes for the flying controls. Major differences between the airframes of the two bombers include "Blackjack's" huge fixed inboard wing panels, providing sufficient internal fuel capacity for an unrefueled combat radius estimated at more than 4,500 miles. These features, combined with sharply raked supersonic engine air intakes, should make possible a choice of Mach 2 cruise at around 60,000 feet or transonic penetration at low altitude. (The B-1B has a maximum speed of Mach 1.25, but it is intended primarily for subsonic missions since the complex intakes of the original B-1 were dropped in favor of the current fixed-geometry type.)

The immense underwing "Blackjack" intakes indicate how little attention the Soviets seem to be paying to Stealth techniques at present. Why should they? The continental US has no densely structured surface-to-air missile defense system comparable to that which B-1Bs would be called on to penetrate during an attack on

Soviet targets. The F-16As and Bs that are being refurbished to undertake air defense fighter duties with the Air National Guard lack the powerful search and fire-control radars, infrared search/track sensors, and heavy armament of the Su-27s, MiG-29s, and MiG-31s of Soviet fighter forces.

Engineers of the Tupolev OKB must be grateful that, because the US has neglected its air defenses for many years, they do not need to contend overmuch with the demands imposed by Stealth requirements or to solve the kind of defensive countermeasure problems that have so far defeated Eaton Corporation's AIL Division on the B-1B. No one questions the capability of Soviet designers in terms of aerodynamics, but their aircraft do not share some of the products of advanced technology that are regarded as the norm for contemporary Western types.



US Secretary of Defense Frank Carlucci was given the unprecedented opportunity to view the Soviet "Blackjack" bomber up close at Kubinka Air Base last summer. Instrumentation on the bomber is regarded as 1960s vintage by engineers in the West. "Blackjack" is considerably larger than USAF's B-1B, which the Soviet plane resembles. The "Blackjack" shown is No. 12.

This is apparent on the flight deck of "Blackjack." The instrumentation would be regarded as 1960s vintage in the West, with a single CRT, for caution and warning data, and no head-up display (HUD) on the example shown to Mr. Carlucci. Much the same standard of instrumentation was evident in the cockpit of the MiG-29 "Fulcrum" exhibited alongside "Blackjack" at Kubinka *(see accompanying illustration),* and in the single-seat and two-seat MiG-29s that took part in the Farnborough Air Show in England last September. However, the modular nature of the instrument displays was claimed to ensure easy removal for servicing. It would equally facilitate the removal of sensitive items. The MiG demonstrators at Farnborough might well have lacked features of their latest operational counterparts. Even the USSR's Warsaw Pact allies must often be content with combat aircraft equipped to a lower standard than those of contemporary Soviet Air Forces.

Lessons of the MiG-29

Bearing in mind that MiG-29s are already flying with the Air Forces of India, Iraq, North Korea, East Germany, Syria, and Yugoslavia, and that they were sent to Farnborough in search of customers rather than mere admirers, it would be wrong to criticize them because they differ from Western practice. Attention has been drawn, for example, to the fact that the radar control panel is mounted low on the port side of the cockpit, which might inhibit its use during high-G maneuvers in combat. But the MiG-29 is intended primarily for BVR (beyond visual range) engagements, rather than for close combat, and has air-to-air missiles to suit this role. The pilot's helmet, which received much attention in Farnborough press reports, weighs an alarming fifteen pounds and embodies a monocular aiming device rather than a genuine helmet-mounted sight, but it does its job, and NATO fighter pilots are years away from having even that degree of sophistication.

The MiG's pulse-Doppler look-down/shoot-down radar is limited to search-while-scan rather than track-while-scan. The laser rangefinder that is integral with the IRST sensor has a range of no more than four miles, but Western fighters lack entirely the IRST that permits a surprise attack on targets by avoiding use of detectable radar emissions. On the debit side, it seems that the landing gear is unlikely to permit operation from grass fields, and the pilot has little flexibility during a mission and a far more restricted all-round field of view than the pilot of an F-15 or F-16 has. There is no evidence that any Soviet combat aircraft smaller than the Su-24 "Fencer" is equipped for in-flight refueling.

On balance, it must be admitted that at last the Soviet Air Forces have fighters good enough to confront the best Western types in Europe, each armed with a heavy load of formidable weapons. Standards of construction are improving year by year. The letter X painted on portions of the MiG-29's airframe (notably at the rear end, as one would expect) indicate areas where groundcrew should not push or lean, because the skin

there is made of honeycomb or carbonfiber. Nonetheless, the traditional Soviet philosophy of "Make it strong, make it simple, but make it work" remains much in evidence. So does the reluctance to design for a service life of 8,000 or 10,000 hours an airplane that will seldom survive a fighting life of 800 hours.

It was a surprise to discover at Farnborough that the MiG-29 has conventional, hydraulically actuated flying controls rather than a fly-by-wire system. But anyone who watched its performance had to be impressed by its handling qualities, as James W. Canan made clear in the November 1988 issue *("Farnborough's Star Attraction," p. 60).* And it would be stupid to ignore the ingenuity of engineers who devised the MiG's FOD-defeating engine intake doors, or what appear to be simple aerodynamic fences forward of the dorsal fins but are really housings for flare dispensers.

Dimensions, weights, and performance details for the MiG-29 were made available by the Soviet sales team and will be recorded in the "Gallery of Soviet Aerospace Weapons" in the March issue of AIR FORCE Magazine. Meanwhile, readers might be interested to know that figures published last year overestimated the wing span by a mere five and a half inches, underestimated the length by five inches, and suggested a takeoff weight exactly halfway between the official figures given by the Soviets for normal and maximum takeoff weights. Overall, size estimates calculated for everything from wing chord to wheel track revealed a margin of error of around one to three percent.

Other Stars

Few visitors to Farnborough 1988 would argue with Mr. Canan's assessment of the MiG-29 as the Show's star attraction. Never before had a first-line Soviet combat aircraft been displayed at a public air show in the West. Its spectacular daily tailslides and knife-edge passes along the full length of the runway were maneuvers never before witnessed by most spectators.

For the writer, however, the prize for the most breathtaking, and operationally meaningful, demonstration went to what Mr. Canan described as the "Apache's eye-popping display." How impressed the late, great Igor Sikorsky, father of the practical single-rotor helicopter, would have been to see the Apache's loops, rolls, and forward flight with the nose inclined almost vertically downward. There could have been no more convincing demonstration of the structural integrity and handling qualities of the US Army's standard attack helicopter. One wonders if the engineers of the Mil and Kamov OKBs might be prepared to exhibit their "Hinds," "Havocs," and "Hokums" in such company. The result could make the 1989 Paris Air Show truly memorable, and anything seems possible now that MiGs have flown at Farnborough.

With the UK, France, Germany, and most other European NATO nations all in the market for battlefield helicopters, the Apache's show presented the strongest possible case for its standardization throughout these forces. This implies no criticism of the Franco-German Eurocopter HAP/PAH-2/HAC program, aimed at developing a smaller and lighter-weight antitank and ground support helicopter for use by the armies of the two partner nations, or of the four-nation Tonal that the UK, Italy, the Netherlands, and Spain proposed to develop from the Italian Agusta A 129. But why reinvent the wheel? Having in production an aircraft as satisfactory as the Apache, there is little point in wasting immense amounts of time and money on helicopters to do the same jobs.

Like the West, the Soviet Union has been slow to build on experience gained with its first operational V/STOL combat aircraft, the Yak-38 "Forger," which began its prototype testing nearly eighteen years ago. During the past year, the existence of a second-generation Yak-41 has been reported, possibly as future equipment for the Soviet Navy's big carriers. Unless Soviet engine designers have been able to perfect a thrust-vectoring turbofan similar to the Harrier's Rolls-Royce Pegasus, which is unlikely, the Yak-41 can be expected to inherit the multiengine lift/thrust configuration of the "Forger." Although second best, this is better than the costly succession of alternative V/STOL configurations that have been tested in the US and Europe over a period of more than thirty years. Two-dimensional vectoring nozzles, of the kind proposed for some of the latest US and European prototypes and design studies, may shorten takeoff runs at the cost of added weight in the worst possible place. Nothing less than genuine STOVL (short takeoff/vertical landing) capability is good enough for the twenty-first century.

Readers of AIR FORCE Magazine might feel weary of being lectured annually by a European editor on the vital importance of STOVL. If so, they may be prepared to listen to the opinions of Ben Rich, one of the brightest stars in Lockheed's galaxy of advanced technology engineers. In a TV documentary broadcast by the BBC a few days before this article was written, he stated his conviction that the next generations of tactical combat aircraft would require STOVL capability to continue operation after their runways had been put out of action. Clearly, it is no coincidence that NASA and Lockheed are collaborating on design concepts for such

The structural integrity and handling qualities of the US Army's standard attack helicopter, the McDonnell Douglas AH-64A Apache, can be appreciated when you see the aircraft in flight.

The McDonnell Douglas F-15 STOL Maneuvering Technology Demonstrator (SMTD) flew for the first time last fall. It will soon be fitted with vectoring nozzles and will begin the second part of its two-phase flight-test program this summer.

an aircraft, powered by a Rolls-Royce hybrid fan vectored-thrust engine.

Tornado—Best of Its Class

Like the Apache and AV-8B, the interdictor/strike Tornado is the best aircraft of its class in the world. During the past year, Saudi Arabia has greatly increased its orders for Tornados, which are joint products of West Germany, Italy, and the UK, via the Panavia Aircraft GmbH consortium. The Royal Air Force has added twenty-six more GR. Mk 1 attack models and fifteen F. Mk 3 interceptors to its original purchase of 394 Tornados, to offset attrition into the twenty-first century. The first of two test-beds for Germany's thirty-five ECR (electronic combat and reconnaissance) Tornados flew on August 18, 1988. It would make good economic sense for USAF also to consider aircraft of this type for its next-generation electronic jamming and Wild Weasel defense-suppression missions.

A model of the Tornado has been exhibited with a fin-tip EW receiver pod and with four AN/ALQ-99 jamming pods under the fuselage and wings, similar to the installation on the EF-111A Raven. Panavia is pressing for a Nunn Amendment award to demonstrate an E-jammer prototype in the US, with Europe supplying the airframe and a US manufacturer responsible for the EW suite.

Transatlantic cooperation of all kinds, and in both directions, can only be in the long-term interests of the NATO alliance. One of the reasons that Europe is developing its own fighter aircraft, the EFA, is that it anticipates technology-transfer problems if it waited instead for the US's Advanced Tactical Fighter (ATF). However, by lacking certain exotic features of the ATF, the EFA may avoid development problems and the degree of cost escalation that has sounded the death knell for so many promising combat aircraft during the last twenty-five years.

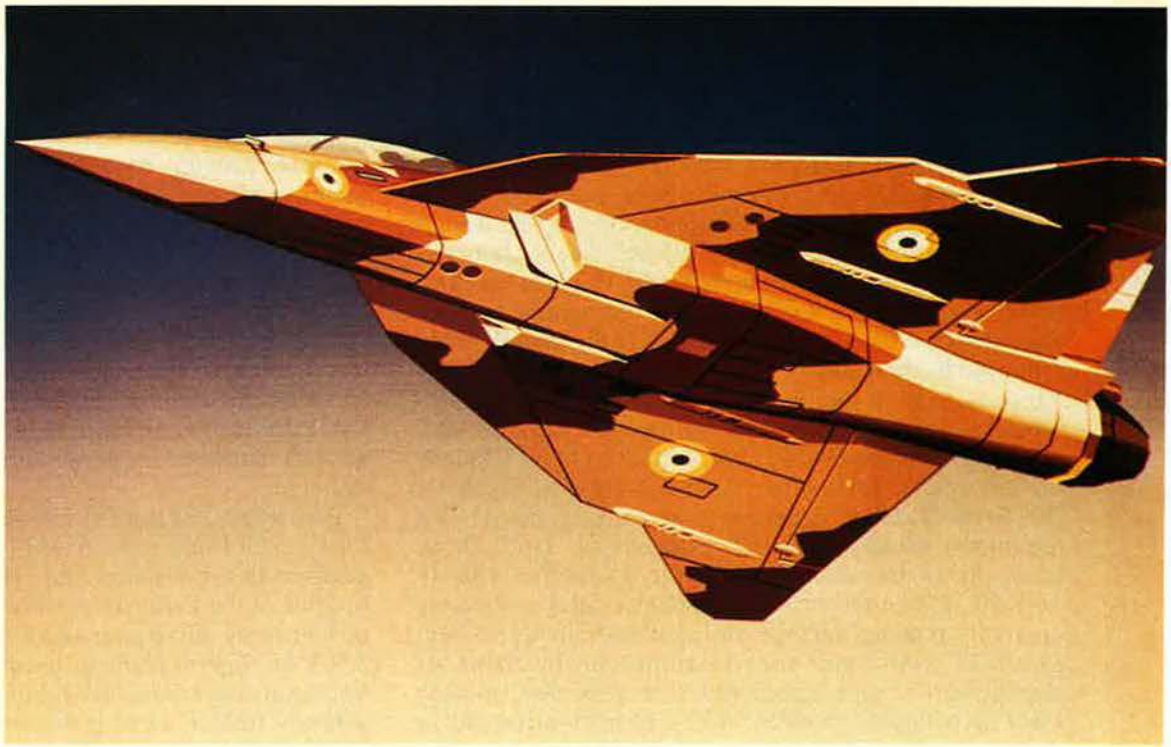
There is no plan to experiment with two-dimensional vectoring jet nozzles in an effort to shorten the EFA's takeoff run. This might seem to make it less attractive than the ATF, if the latter benefits from McDonnell Douglas's vectoring nozzle trials with the F-15 STOL Maneuvering Technology Demonstrator, which flew for the first time on September 7 last year. But the kind of STOL capability conferred by thrust vectoring of this kind is very different from genuine STOVL and will probably represent only a minimal improvement over the takeoff performance predicted for the EFA—and, incidentally, demonstrated by the (albeit lightly loaded) MiG-29 at Farnborough.

The fighter now envisaged by the Eurofighter consortium, linking manufacturers in the UK, West Germany, Italy, and Spain, promises exceptional agility with what is known as "carefree handling" incorporated in the fly-by-wire control system, ensuring that the aircraft will stay within the safe flight envelope whatever the pilot does with his flying controls. Some functions will be voice-operated, and all vital manual operations will be achievable without need for the pilot to remove his hands from the stick and throttle lever. Multifunction color displays, wide-angle HUD, and helmet-mounted sight will be standard.

An indication of the kind of rapid takeoff, sharp acceleration, and vigorous turn rates to be expected with the EFA has been given by the lower-powered British Aerospace EAP (Experimental Aircraft Program) technology demonstrator, which had been tested at speeds up to Mach 1.6+ in 130 flight hours by early November. Grumman claimed—with justifiable pride but a degree of error—that four flights per day during advanced flight-testing by its X-29 research aircraft represented an "unheard-of" achievement. In fact, the EAP has regularly logged four flights a day during testing.

What effect the now-officially launched EFA develop-

Flight test for the BAe Experimental Aircraft Program technology demonstrator went well last year, as the aircraft was flown up to Mach 1.6+ in 130 flight hours. The EAP aircraft is shown here during its handling trials.



The unique compound delta configuration of India's Light Combat Aircraft can be seen in this artist's concept. The LCA will handle both air superiority and close support duties for the Indian Air Force. India is one of several countries developing an indigenous fighter aircraft.

ment program will have on France's plan to produce the Rafale fighter for the French Air Force and Navy remains to be seen. One leading Paris journal alleged that Rafale represents a "bottomless pit that will swallow billions of francs." However, it would be sad to see such an outstanding aircraft abandoned for purely economic reasons, and Prime Minister Michel Rocard has commented: "It is inconceivable that we should not manufacture ourselves the arms of our independence."

Third World Solutions

Alarmed by the potential cost of such aircraft and by the political strings attached so often by governments of East and West when concluding arms deals, more and more Third World nations are seeking alternative methods of equipping their air forces. Often this involves extensive updating of existing aircraft, which has become a major activity of companies like LTV in the US, Dassault in France, and IAI in Israel.

South Africa has undertaken an almost total rebuild of its Mirage IIIs, involving the addition of fixed canards, a multimode radar in a lengthened and drooped nose, and advanced navaids. The end product is renamed Cheetah. Brazil is the third South American nation to seek Dassault's cooperation in modernizing its Mirage IIIs with similar canards and upgraded weapon systems. At the same time, it has completed the project definition phase of a Mach 1.8 aircraft to meet its own future needs. Built primarily of composites and powered by a single afterburning turbojet in the 9,000-pound-thrust class, this is to be developed initially as a two-seat trainer to replace the EMB-326 Xavante. The trainer will then be used as the basis for a single-seat light fighter to replace Brazilian Air Force Mirages and F-5s. The only differences between the two versions of the design will be in the cockpit arrangements and role-dedicated equipment, which will benefit aircrew and ground personnel training, as well as reducing the size and cost of spares inventories. Initially, up to seventy trainers and eighty fighters are required.

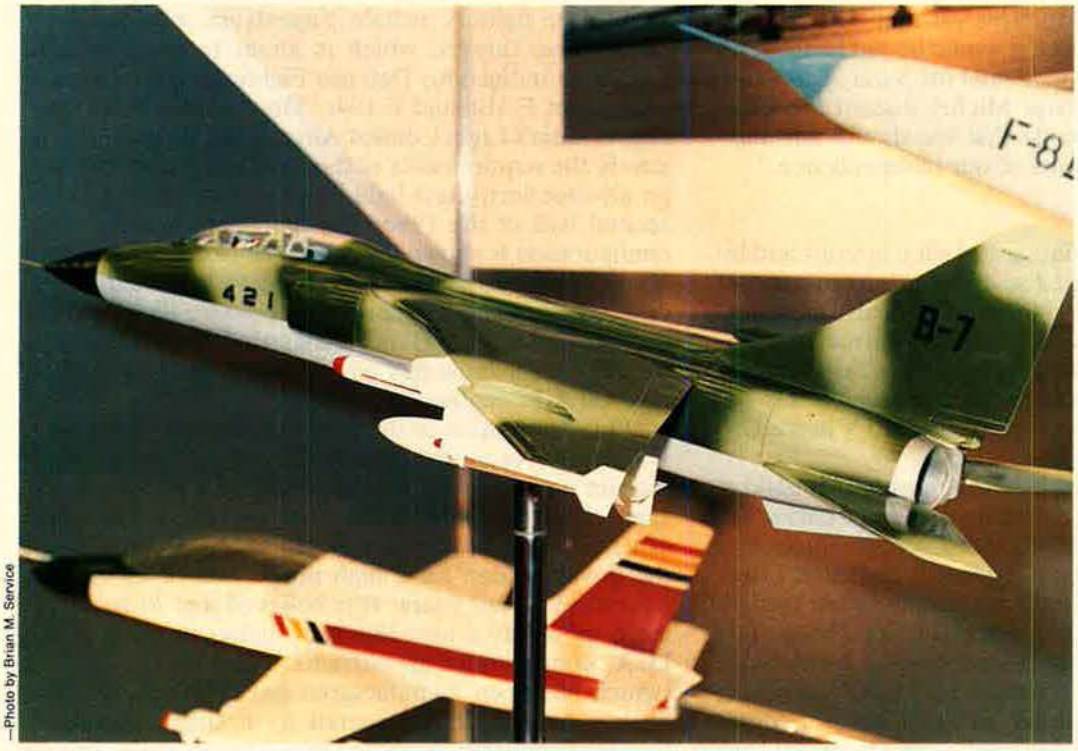
Other nations engaged currently in developing their own future fighters include Yugoslavia, with the Novi Avion, and Taiwan, which is about to begin ground testing an Indigenous Defense Fighter (IDF) to replace its present F-5Es and F-104s. More ambitious in concept is India's Light Combat Aircraft (LCA), intended to satisfy the requirements of the Indian Air Force for use on air-superiority and light close support duties in the second half of the 1990s. Its unique compound delta configuration is shown in the official artist's impression above. Features will include extensive use of advanced composites in the airframe, a fly-by-wire flight-control system, and a single General Electric F404 afterburning turbofan until India has completed development of its own GTX-35 engine for the LCA.

US collaboration in the program, channeled through USAF's Aeronautical Systems Division, is expected to include contributions by Allied Signal's Bendix Aerospace, Lear Astronics, Moog, and Northrop. This represents an important breakthrough, as India has relied on the Soviet Union for a high proportion of its combat aircraft in recent years. It is believed that Moscow offered to supply a new Mikoyan fighter in place of the LCA, consisting of an airframe based on the MiG-21 (which has been manufactured under license by Hindustan Aeronautics), powered by a single Tumansky R-33D afterburning turbofan of the kind used in India's MiG-29s. New Delhi, apparently, was not interested.

China, meanwhile, continues to make impressive progress in building up its aviation industry with the aid of extensive technology transfers from a variety of sources. It is hard to believe that its latest A-5K ground-attack aircraft had its origins in the thirty-six-year-old MiG-19. To the A-5's long-familiar lateral air intakes, increased fuel capacity, and other changes has now been added a new and advanced navigation/attack system, for

which Thomson-CSF of France is prime contractor. Identified by a small, sloping window at the tip of the modified nosecone, the A-5K now has a HUD and laser rangefinder, inertial navigation system, radio altimeter, modern instrument panel, and video camera.

Xian Aircraft Company's new H-7 multirole combat aircraft, revealed at the Farnborough Show, illustrates even better how rapidly China is building up its design capability. Scheduled to begin its flight trials at about the time this feature was being written, the H-7 is in the class of the Soviet Sukhoi Su-24 "Fencer." Its general appearance is shown below in a photograph of the model. More remarkable than the configuration is that the aircraft appears to be of entirely original design, with terrain-following radar, afterburning turbofans, ejection seats, and air-to-surface missiles all claimed to be of Chinese design and manufacture. Two 27,500-pound-thrust WS-6 turbofans are expected to give production H-7s a maximum speed of Mach 1.8 at height. Until these powerplants are ready for use, the prototypes will fly with 20,515-pound-thrust Rolls-Royce Speys. Variants currently planned include an interdictor/strike version for the PLA Air Force and a maritime attack version for the Naval Air Force armed with two of the new Chinese C801 antishipping missiles. A 23-mm twin-barrel gun in the nose and close-range air-to-air missile on each wingtip are intended to give the H-7 secondary air-to-air capability.



—Photo by Brian M. Service

China unveiled its H-7 multirole combat aircraft at the 1988 Farnborough Air Show in England. The aircraft, shown here as a one-eighth-scale model, was scheduled to begin flight test late last year. The H-7 is in the class of the Soviet Su-24 "Fencer."

Do-It-Yourself Airpower

Continually rising costs have led to a completely new way of acquiring military aircraft at the lower end of the performance range during the past year or two. Third World nations have been in the habit of accepting airplanes in knocked-down kit form, as a means of gaining experience before embarking on progressively more extensive local manufacture. National industries in many countries have gained maturity in this way, and the reborn Piper company is taking advantage of the trend by offering its veteran Super Cub in kit form, for economical assembly by commercial concerns or individuals.

Some years ago, Taiwan went one stage further in terms of economy by purchasing plans of the PL-1 two-seater, made available by Ladislao Pazmany of California to amateurs of the Experimental Aircraft (homebuilt) movement. The fifty-five PL-1Bs built by the Aero Industry Development Center at Taichung in 1970–74 served the Chinese Nationalist Air Force well as primary trainers. Other air forces are realizing at last that they, too, can save money by ordering plans or kits, and adopting this do-it-yourself approach, instead of paying for ready-to-fly conventional trainers and similar small aircraft marketed by major aerospace manufacturers at full cost.

Peru hopes to establish a national aviation industry on the basis of Light Aero Avid Flyer kitplanes, which will perform flying training and cropspraying duties in the insignia of the Peruvian Air Force. With Dornier GmbH of Germany providing sixty percent of the funding, AIEP of Nigeria plans to produce a variant of Richard VanGrunsven's Van's RV-6 homebuilt as the Air Beetle primary trainer. Less is known about the Fajr (Dawn) military prototype, of which photographs were released officially in Teheran by the Iranian Islamic Revolutionary Guards Corps, but it looks very like a kit-built Neico Lancair, as sold from Santa Paula, Calif.

Remembering that total sales of US commercially built lightplanes sank disastrously from 11,877 in 1980 to only 1,085 in 1987—the worst year since the late 1920s—it is some small consolation that the little-known, and often impecunious, sport aircraft designers are beginning to fill the gap left by declining numbers of Beechcraft, Cessna, and Piper two- and four-seaters.

Another by-product of high initial and operating

The most revolutionary aircraft to debut in 1988 was the Bell/Boeing V-22 Osprey. The tilt-rotor V-22 brings entirely new standards to transport and support missions.

costs, incongruous tort laws, and the general depression is that the world is becoming very short of experienced pilots. This may be good for military pilots nearing the end of their commissions. It promises chaos for air forces, which are having to reduce their totals of operational squadrons in many countries because trained men can earn more money as airline pilots. Nor does this ensure adequate flight-deck personnel for the commercial operators.

Canada provides a good example of the magnitude of the problem. Some temporary relief is offered by introduction of the Airbus A320 into Air Canada's fleet, because it requires only two pilots instead of the three needed by the Boeing 727 it replaces. But this airline will lose 325 pilots through retirement by 1993. Canadian Airlines International will lose 110 for the same reason and will need some 400 additional pilots by the mid-1990s. Wardair will be looking for the same number, but who is going to train them? The Canadian Armed Forces can hardly be expected to contribute with much enthusiasm, and there was a net increase of only fifteen in the number of instructor ratings held in Canada during the year to summer 1988.

Military Microlights

Few nations in the West can claim a happier outlook than Canada when projecting their future commercial pilot availability. But what about the East? The Soviet training organization, DOSAAF, continues to provide large numbers of aircrew for both the air forces and the commercial airline Aeroflot. Most interesting of all has been an immense growth in the number of microlight flying clubs under the DOSAAF banner throughout the Soviet Union in recent years. In the West, microlights tend to be regarded as a joke by everyone except those who fly them. Even when members of the PLO flew over the supposedly impenetrable border between Lebanon and Israel, and killed Israeli troops at a base inside their own country, there was little interest in the fact that they arrived in powered hang gliders—just about the cheapest and least complex aircraft imaginable.

DOSAAF takes microlights more seriously than we do. As long ago as March 1987, an article in *Red Star* examined in detail the employment of microlights as air cavalry to defeat high-technology air defense systems. Its author, Lt. Gen. I. Lisov, suggested that "they have a special place for operations in the rear of a battle area, destroying bridges and crossing points in the path of approaching reserves, rocket launchers, and command and control centers, as well as performing reconnaissance and correcting fire."

NATO's Assistant Secretary General for Defense Support, the Hon. Mack F. Mattingly, expressed the opinion in the UK magazine *Defence* that NATO might have much more cash available for major tasks if it deployed RPVs, attack drones, and other unmanned aircraft (UMAs) in very large numbers, in four basic configurations. These were (1) small, expendable systems for ECM, decoy, and attack roles, including antiradiation and antiarmor UMAs; (2) small, recoverable vehicles for battlefield surveillance, target acquisition, airfield damage assessment, and communications missions; (3) large, recoverable vehicles capable of penetrating hundreds of miles into hostile territory, in all weathers, for target acquisition and attack with specialized munitions; and (4) very large, survivable systems that could loiter at high altitudes, beyond the range of enemy defenses, to detect and track troop movements far beyond the forward edge of the battle area.

To this last group might be added AWACS UMAs that could one day provide more stealthy, survivable defense systems than current aircraft like the E-3. Continued progress in radar-transparent composites technology, avionics miniaturization, and fuel-efficient powerplants should make such aircraft practicable before too long. Boeing's new giant UMA—of which one not-too-revealing photograph, but no details, may be published—seems like a step in this very important direction.

In 1988, the Space Shuttle *Discovery* carried Americans proudly back into space, and the Soviet Union launched a shuttle that clearly owes much to US pioneering. The CV-22 Osprey is ready to bring new meaning to V/STOL versatility for military duties; there are growing signs that engineers worldwide are thinking seriously about supersonic transports to continue the services that have been performed so proficiently by the Anglo-French Concorde since January 1976; and doubts on the viability of hypersonic transports and transatmospheric vehicles concern only their cost, not their practicability. Generations yet to be born will be able to look back with envy on the progress and achievements of our century, in which powered flight began, one could travel anywhere on earth in twenty-four hours, and man walked on the moon. ■

John W. R. Taylor, a longtime Contributing Editor to AIR FORCE *Magazine, is in his thirtieth year as Editor in Chief of the world-renowned* Jane's All the World's Aircraft. *A Fellow of the Royal Aeronautical Society and the Royal Historical Society, Mr. Taylor compiles or edits for us the galleries of aerospace weapons that appear in the USAF Almanac and Soviet Aerospace Almanac issues of this magazine, the more recent "Gallery of West European Airpower," and last month's "World Gallery of Trainers."*

First the developments and shopping centers build up around the airfield. Then they want the air operation to cut back, quiet down, or close.

Closing In on The Airfields

BY C. V. GLINES

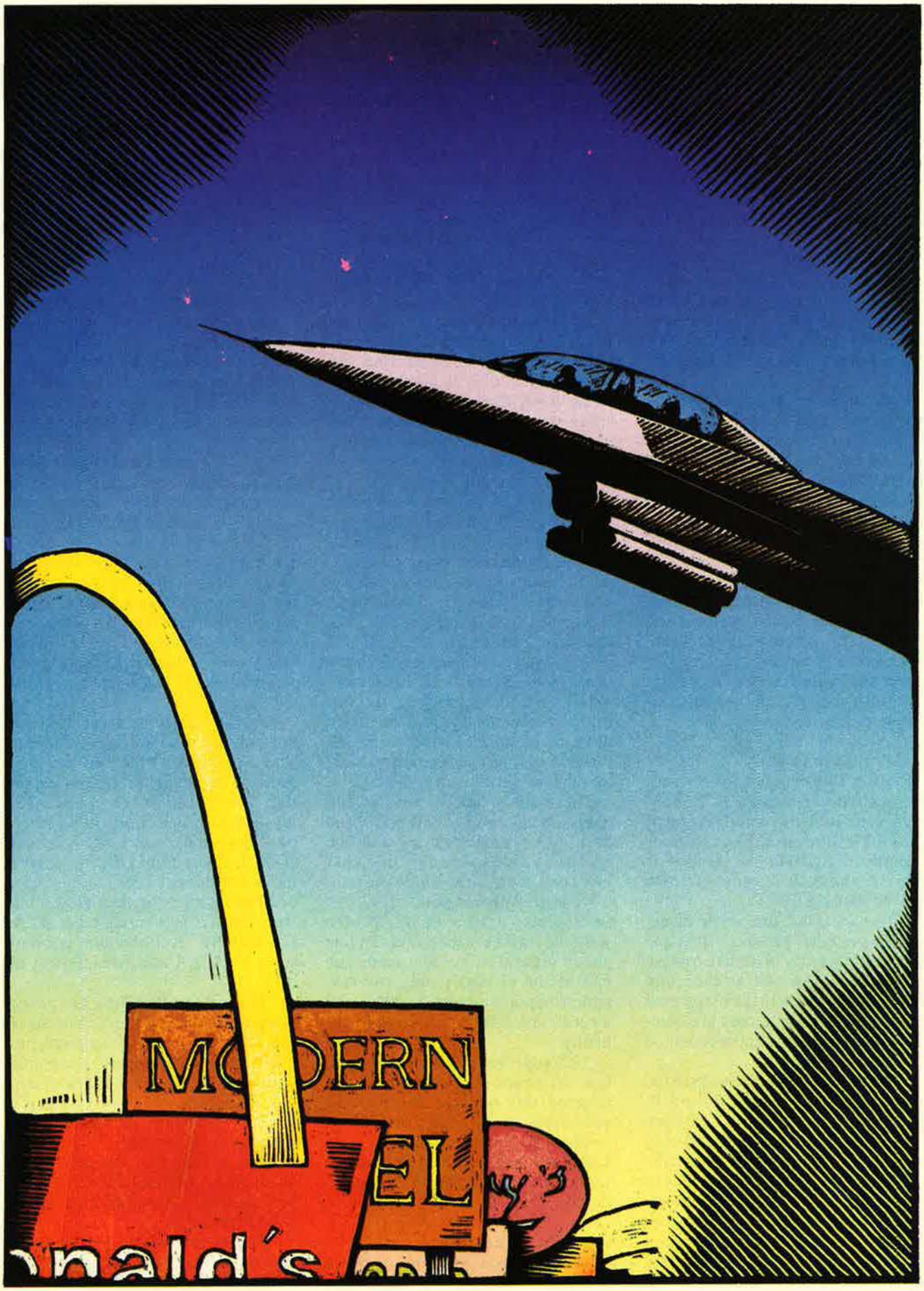
THE typical airfield began life with plenty of open space between itself and the local community. Just as typically, the community soon expanded, filling in the intervening distance at a rapid clip.

Almost everyone understands the need for airports and military airfields. It's a question of location. Virtually no one wants to share a neighborhood with these facilities, which are noisy, often congested, and sometimes dangerous.

It was already a difficult problem in February 1952, when President Harry S. Truman wrote to James H. Doolittle, summarizing the situation this way:

"For some time now, I have been seriously concerned about airplane accidents, both commercial and military, that have occurred in the takeoff and landing of aircraft, especially in heavily populated areas. I have been concerned about the loss of life, and I have been concerned about the anxiety in some of our cities. . . .

"The present location of many of our major airports was determined a number of years ago when the avia-



—Illustration by Randy Lynus

tion industry was new and operations were relatively limited. . . . Since that time, both civil and military air traffic have been growing rapidly, and simultaneously our cities have been continuously spreading out toward these airports. . . .

"In view of these developments, I feel that the nation's policy on airport location and use should be restudied."

Jimmy Doolittle—aviation pioneer, war hero, former president of the Air Force Association, and in 1952, vice president of Shell Union Oil Corp.—agreed to head a commission that would search for solutions.

The commission consulted 264 individuals and took statements from forty-two aviation organizations. Its report, "The Airport and Its Neighbors," made twenty-five recommendations. Had they been followed, they might have prevented many of the problems military and civil aviation experience today. Unfortunately, the report was filed away and largely ignored.

Three recommendations now ring with special relevance: Integrate municipal and airport planning; incorporate cleared runway extension areas into airports; and establish effective zoning laws.

The Pressure Is On

Putting the problem in current perspective is Malcolm F. Bolton, an investment banker and president of AFA's Phoenix Sky Harbor Chapter in Arizona. Mr. Bolton is worried about the future of Luke and Williams AFBs.

"Phoenix is on the verge of explosive growth," he says. "It is the last American city of its size to have no freeways. As fast as time and money can [allow], they are now being built, and once they are complete, they will bring unprecedented growth.

"Already the speculative price of land around the bases is skyrocketing. The freeways go very near both bases, and developers are grabbing land near them as fast as financing can be arranged. Our business works daily with the real-estate industry here to arrange financing through syndication and offshore sources. The Japanese are starting to take a bigger position here, and large tracts of land around both bases are now in master planning.

"Almost none of the developers has an inkling of what Luke or Williams does; certainly the Japanese and other foreign investors don't. Three times now, I've had major developers in our office (representing hundreds of millions of dollars in development plans) ask me in all innocence, 'Why can't you move the bases?' In the last governor's race, one of the favored candidates openly talked of the likelihood of that happening."

Mr. Bolton points out that Air Force supporters tried to get a state law on the books protecting the bases, but political pressure watered down the result. A land-use study was completed recently, but one nearby community is refusing to accept it, claiming that it is biased in favor of the Air Force.

Luke and Williams are not alone in this situation. Historically, bases all over the continental US, once far removed from nearby communities, have been encroached upon by shopping centers, condominiums, industries, schools, hospitals, hotels, and residential areas. It has been a steady encroachment, sometimes not noticed until base commanders find themselves in confrontations with local residents who demand a cutback in operations, alteration of flight paths, noise abatement, or even closure of the field.

The world's oldest continuously operated airport, located in College Park, Md., is now fighting with the Metro (subway) transit line that links one of the area's growing suburbs with Washington, D. C. To save construction costs, Metro wants to build a segment of the line above ground a few feet from one end of the airport's only runway, which handles about 20,000 small aircraft takeoffs and landings annually.

Although encroachment by civilian communities has not yet stopped this historic airport from operating, several Air Force bases —Chanute, Lowry, Hamilton, and Laredo—have ceased flying operations. Others could be on the endangered list.

Planning Is Essential

The encroachment, or "land-use compatibility," problem has been receiving ever-increasing attention within the Air Force and the other services since the arrival of jet aircraft and their accompanying high noise levels.

In the 1960s, the Air Force and the Navy fully realized the relationship between land-use planning and aircraft noise and combined forces to prevent interference with their respective flying missions. In late 1970, the Air Force designed a "greenbelt program" to provide a protective rectangular buffer area of about a mile on each side and extending two and a half miles from the end of base runways. The concept was later refined into the "Air Installation Compatible Use Zone" (AICUZ) program, now used throughout the Department of Defense.

AICUZ uses computer-generated "noise maps" that describe the noise impact created by aircraft operations at each of the eighty-eight installations in the continental United States. The maps show the "Ldn" (day-night average sound level) when each base conducts flying operations. The data are updated frequently. The resulting studies are released to local communities and other government agencies.

Another development was an analysis of USAF aircraft accidents that occurred within ten nautical miles of an airfield. Areas of accident potential were then categorized into Clear Zone (CZ), Accident Potential Zone I (APZ I), and APZ II. It was found that the majority of accidents (sixty-two percent) occurred within the clear zones that were on or immediately adjacent to the airfield. About eight percent were in APZ I and five percent in APZ II.

"That told us that the clear zones warranted special attention because the high incidence of accident potential severely limited acceptable land uses," said Gary D. Vest, Deputy Assistant Secretary of the Air Force (Environment, Safety, and Occupational Health).

The Air Force subsequently spent about $65 million to acquire land in clear zones off the ends of USAF runways.

"The percentages of accidents within the two APZs were such that while purchase wasn't necessary,

some type of land-use control was," Mr. Vest added. "Our recommendation was to limit the number of people exposed, through selective land-use planning."

As a follow-on to the accident study, DoD devised the AICUZ land-use guidelines, now used by the Department of Housing and Urban Development (HUD) to make decisions on applications for mortgage assistance. They are also used by many communities to develop building codes and construction standards.

Bergstrom AFB, Tex., home of the 67th Tactical Reconnaissance Wing, is a case study of how the concepts work in actual practice. There is only one runway at Bergstrom, and it runs north to south. The principal aircraft now being used is the RF-4C.

Bergstrom, on the southeast corner of Austin, is six miles south of Robert Mueller Municipal Airport. Over the years, the handling of civilian and military air traffic has been a nagging problem, directly related to the encroachment of populated areas on Mueller. A classic example of poor land-use planning from decades past, Mueller is being phased out, and a new airport will be constructed at Manor, twenty-five miles northeast of the city. Although general aviation interests want to keep Mueller as a reliever airport, the FAA reportedly supports its closing.

Keeping Tabs on Land Use

The same fate could befall Bergstrom, but the senior leadership and staff are doing their homework. The man who keeps tabs on the land-use situation is Timothy J. Knapp, a community planner and former C-130 pilot with a degree in environmental management.

"It is my job to educate the zoning board concerning accident potential zones, noise footprints, height restrictions, and electronic interference that will result if certain kinds of construction are allowed," he says. "The Air Force wants compatible development, and we stay away from discussions of property values. Those of us responsible locally must be accurate with our data with regard to noise level, rates of climb on aircraft, power settings, flight tracks, and whatever else affects the flying mission. We get our information from the Air Force Engineering and Services Center at Tyndall AFB, Fla., where the computers turn out the noise zone maps we use in briefings. We then combine the noise maps with the clear zone and accident potential zone overlays to develop 'compatible use districts.' "

There are no county zoning laws in Texas, so local officials set the rules.

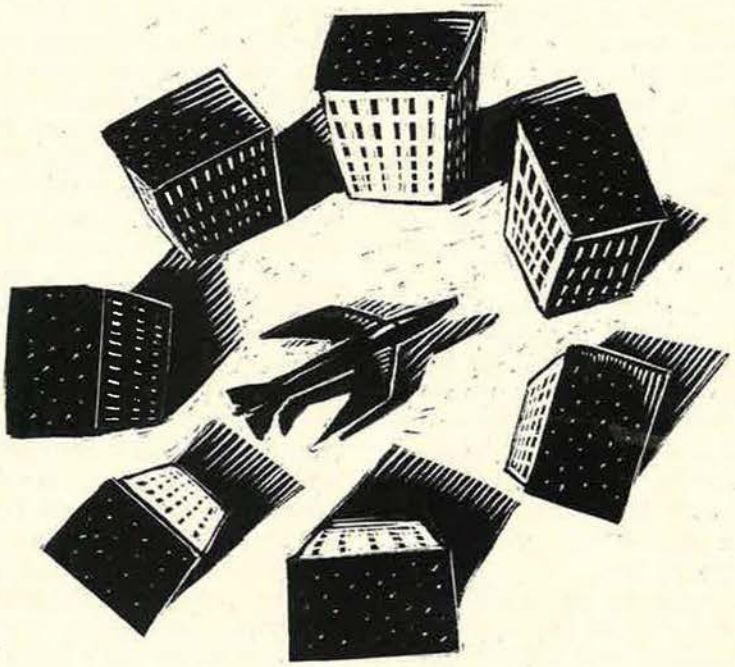
The flying mission at Bergstrom has been affected to some extent. Operations are normally conducted only six days a week from 6 a.m. to 10:30 p.m. Power settings and airspeeds are reduced on takeoff; flight tracks are diverted from populated areas; training is conducted at other fields; and normally, no local flying is permitted after midnight. But there is always the shadow of a fatal threat to Bergstrom's flying mission as developers continually put pressure on Austin's zoning authorities to back off from their restrictions.

One such example is a planned development called Riverside Center, consisting of multilevel office buildings, retail centers, and two five-story hotels. Part of the complex would be only half a mile from the end of Bergstrom's runway in Accident Potential Zone I. Last May, an aircraft crashed near that area after takeoff from Bergstrom. Despite this, the development plan, placed on hold last year, was to be resubmitted to the zoning board last fall.

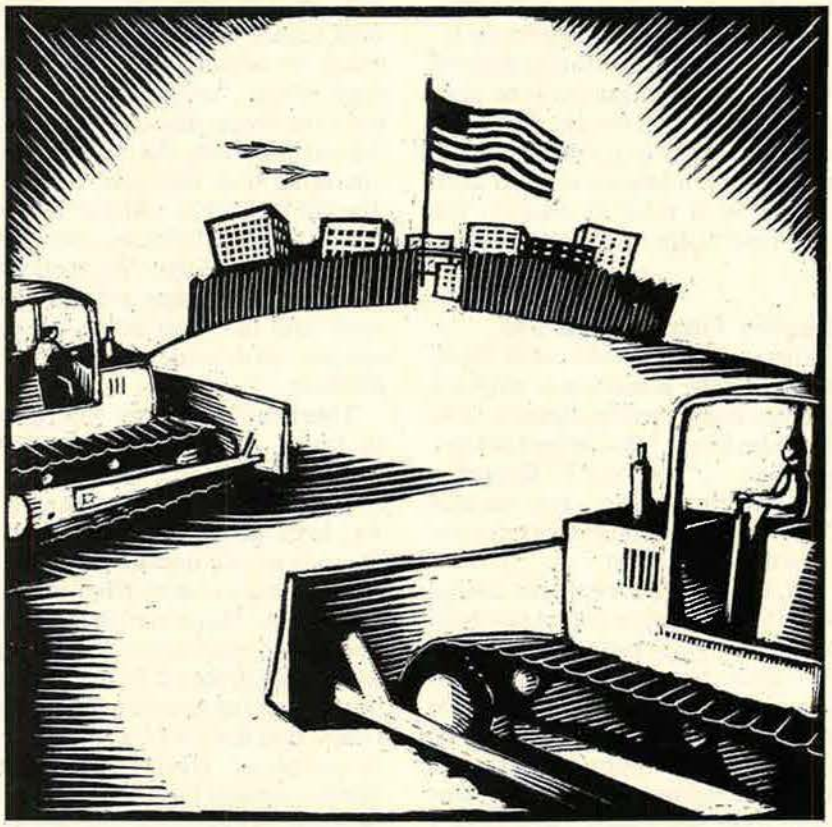
Mr. Knapp became aware of another threat to Bergstrom in the form of a landfill proposed at the southern end of the north-south runway. If approved, there would have been a high probability of loss of aircraft due to birdstrikes. The request was denied for all dumping except building rubble.

In 1980, the Air Force completed acquisition of 40.5 acres in the clear zone off the north end of the runway at a cost of $1.315 million. The area contained a trailer park, homes, apartments, and a cemetery that were directly in the flight path. The cemetery was not purchased.

To keep abreast of local land de-



—Illustration by Randy Lyhus



—Illustration by Randy Lyhus

velopments, the staff works closely with legal officials and checks the local newspapers daily for any mention of construction plans or land sales near the base. "For Sale" signs also attract their attention.

Over time, the Austin area has grown to respect the importance of land-use planning and has developed a comprehensive land-use plan. The area has been divided into sectors; three of them border on Bergstrom. Mr. Knapp's job is to provide up-to-date information when his sectors are affected.

Information, Flexibility, Planning

"City planning must be flexible, and so must the Air Force," Mr. Knapp says. "A base's mission may change, and we must be ready to prepare new briefing materials immediately so that the city fathers will be fully informed. Land-use planning is a continuing activity. Success does not come in big sweeping victories; land use and development hinge on the political process and the local economy."

William L. Cox, the Air Force's AICUZ program manager in the Pentagon, concurs. "We have to make the Air Force message known," he says. "There are tremendous development pressures, especially in the sunbelt areas, that potentially affect the Air Force mission. We aren't advocating 'no growth.' We stress 'compatible growth.' "

Mr. Cox mentioned several bases where unchecked growth could present problems for the Air Force if compatible land-use planning is allowed to slip: Mather, Travis, and March in California; MacDill in Florida; Randolph and Kelly in Texas; and Davis-Monthan in Arizona, in addition to Luke, Williams, and Bergstrom.

"Although our job as planners is to protect the Air Force mission," Mr. Cox says, "we must also protect the public. There's nothing like an aircraft crash to raise public interest on compatible land-use development. We certainly don't want that to happen."

"As we began to publish our AICUZ studies," Mr. Vest said, "land developers and the public had knowledge of aircraft noise and flight patterns that they didn't have before. As a result, many developers now tend to look at places other than around Air Force bases to develop. A large number of jurisdictions have adjusted their plans and their building codes."

The AICUZ program has been "remarkably" successful, Mr. Vest says, "far more so than we thought it would be in the early 1970s. Notwithstanding that success, however, there are places, especially in the southern tier of states where the growth pressures are, that continue to give us quite a challenge. However, there are no bases in the Air Force today that face closure solely because of incompatible land use.

"The really serious challenge today and over the next few years is to obtain and retain the airspace needed so the Air Force can maintain its warfighting capability—especially the MOAs (military operating areas), the low-level routes, and the flight-training areas. When we bring the F-15Es and the F-16s with LANTIRN [Low-Altitude Navigation and Targeting Infrared for Night] into the inventory, that means low, fast night flying. We also have a tremendous challenge to maintain and adjust the SAC IR [instrument routes] structure. The war the Air Force may have to fight is going to depend on our ability to train pilots to fly at 100 to 200 feet in low-visibility conditions.

"There is a public perception in this country that the threat [to national security] has somehow diminished. People don't like noise, and when they don't see a threat, they begin to question the need for the Air Force to make noise or have reserved airspace. Civilian aviation interests continue to chip away at the airspace, and each time we want to create or adjust an MOA, it becomes increasingly difficult." ■

C. V. Glines is a regular contributor to this magazine. A retired Air Force colonel, he is a free-lance writer, a magazine editor, and the author of numerous books. His by-line appeared here most recently with "The Battle Log of Birdman Silver" in the December '88 issue.

E-SYSTEMS

Our Pledge

I pledge allegiance to the flag
of the United States of America
and to the republic for which it stands,
one nation
under God,
indivisible,
with liberty
and justice for all.

— Francis Bellamy, 1892

E-SYSTEMS

The science of systems.

No other military aircraft has endured such assault from the politicians and the news media. The B-1B isn't perfect—but it is very good, and quite capable of performing its mission, reports one who has recently flown the aircraft.

Through Flaps and Flak

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

THE fundamental problem that has always faced the bomber is how to get to the target and then back home. During World War II, the survival of the bomber became a matter of primary concern when losses began to threaten the whole concept of strategic air warfare.

In the early days of our daylight missions over Europe, bombers were meant to defend themselves. Armed with ten .50-caliber machine guns mounted in turrets and in flexible gun positions, B-17s could deliver an impressive amount of lead. But despite wildly exaggerated claims of enemy fighters downed, it soon became clear that bombers on deep penetrations were no match for the Luftwaffe. Some imaginative fellow safely distant from the scene of combat came up with the notion of the B-40. This bird was a B-17 fairly bristling with additional guns and armor, an airborne battleship, and its mission was to add firepower to the formation. The B-40, weighed down by all that armor and ammunition, had a brief and sad combat career, and the few survivors were soon withdrawn. Long-range fighter escort saved daylight bombing in Europe.

In the Pacific, Maj. Gen. Curtis LeMay abandoned high-altitude daylight tactics for his B-29s in favor of low-level night incendiary attacks. He got the results he wanted, and the B-29 losses dropped sharply. Still, what the B-29s did in Japan could scarcely have been called precision bombing; it was more on the order of Air Marshal Arthur "Bomber" Harris's concept for RAF Bomber Command. Whatever one wishes to call it, however, the B-29 strikes helped bring Japan to its knees. The nuclear weapons dropped on Hiroshima and Nagasaki ended the war, although Generals "Hap" Ar-

A B-1B bomber is groomed for a training flight. Despite problems, the B-1B is said to be capable of penetrating Soviet defenses and destroying targets that ICBMs have not already hit. Thus it qualifies as the weapon for deterrence that it was designed to be, according to USAF.

—Photo by MI Seitelman/DI

nold and LeMay both felt strongly that these weapons were not needed.

The bomb changed everything. In the immediate postwar period, chaotic demobilization stripped the United States of any credible conventional strength, but that didn't matter because, to paraphrase the British Boer War jingle, we had the bomb and they had not. In those days, our nuclear monopoly gave us an overwhelming edge, one that allowed a defenseless procession of cargo airplanes to score the first victory in the Cold War by defeating the Soviet blockade of Berlin.

The bomb, and the airplane to deliver it, may have convinced the Soviets to keep their distance, but it did not deter the US Navy. The Admirals' Revolt of 1949 had, as its underlying cause, a concern for the future of naval aviation, threatened by the Air Force and its nuclear bomber, the B-36. In retrospect, that lumbering six-engine airplane was probably a legitimate target, but it was the only intercontinental bomber in the world, whatever its shortcomings, and the admirals had their sights fixed on the strategic mission itself.

In any case, the unseemly interservice squabble ended with the Air Force, and most particularly its Strategic Air Command, in the Pentagon driver's seat. A series of bomber aircraft followed, invariably at the top of Air Force budget priorities. The B-52, in the early 1950s, finally emerged as the intercontinental successor to the B-36.

Intercontinental missiles then appeared on the scene. At first wildly inaccurate, ICBMs had to defer to bombers for those targets requiring a precise strike, but that disparity gradually faded. ICBMs, descending more directly from the old Coast Artillery than from any branch of the aviation family, became the principal strategic weapon, and they also complicated the rationale for a new penetrating bomber.

Low-Level Penetration

It was that doubt that lay behind the cancellation of the XB-70, a high-flying Mach 3 airplane, although antiaircraft missile development has made the XB-70 cancellation look good for sounder reasons. Then, in the late 1960s, the Air Force conceived the B-1 as a low-altitude penetrator with Mach 2-plus dash capability.

The B-1A won high marks on its early test flights; the trouble was to come from the political arena. Gov. Jimmy Carter had made a thinly veiled presidential campaign promise to cancel the B-1A, and Sen. John C. Culver, Iowa Democrat, slipped an amendment into an appropriations bill that made cancellation easy.

When President Reagan ordered the B-1 program revived, the airplane underwent significant changes. It looked the same, but its radar profile was new and sharply diminished, and the avionics were thoroughly modernized. To reduce costs, and also because the high-supersonic capability was of questionable value, the B-1 lost some of its speed. The crew escape capsule was dropped in favor of conventional ejection seats, and various other items such as a head-up display and state-of-the-art instrumentation were left out in the interests of economy. The resulting cockpit is simple, if not Spartan, and perfectly adequate for the job. The systems operators do have one luxury: small side windows allowing a view of the outside world. Whether a sideways glance at trees and rocks flashing by at 640 knots is reassuring or terrifying is, of course, a matter of personal opinion. Anyway, the job doesn't encourage much sightseeing.

Because the B-2, or Stealth, had already been chosen as the next-generation penetrator, B-1B production was limited to 100 airplanes.

For a while, fuel leaks provided headline material, but these have been fixed, and the B-1B today doesn't leak any more than other wet-wing airplanes. There was an early concern about inertial coupling, or pitch-up, following the crash of a B-1A on an experimental test flight. A stall inhibitor is being incorporated into the flight control system that will increase the safe angle of attack and effectively remove the inertial coupling hazard. The

—Photo by Frederick Sutter/IDI

modification should be completed early in 1990. The fuel management procedures leading to the accident cannot be repeated in the production airplanes unless the system is deliberately bypassed.

Certain journalists have seized on the high wing loading of the B-1B as a serious deficiency. The wing loading, at maximum gross weight of 477,000 pounds, is admittedly high—244 pounds per square foot—but what of it? A low wing loading makes for a rough ride at low altitude, and low is where this airplane flies. With its wings swept back the full 67.5 degrees, the B-1B is more a projectile than it is a flying machine.

A Pilot's Dream

From a pilot's standpoint, particularly from the standpoint of a bomber pilot used to the truck-driving technique necessary for the B-52, the B-1B is a dream come true. Flight controls, mechanical with hydraulic boost, are responsive and, for a big airplane, remarkably sensitive. There is even a stick instead of a wheel. Unlike in

most airplanes, the copilot's position is the dominant one, a nice touch for the instructor pilot.

Four F101-GE-102 turbofans in the 30,000-pound-thrust class give the B-1B good takeoff performance. At maximum gross weight and on a hot day, the roll might reach 9,000 feet, but that is the extreme. Standard day takeoff distances at gross weights approaching 400,000 pounds will average 6,000 feet or less. In any case, the B-1B has no problem either taking off or landing on any airfield it is likely to use, even though it has neither thrust reversers nor a drag chute, only excellent brakes.

In this bird, refueling is a pleasant experience. The pilots are at the very front end of the 147-foot fuselage, and the refueling receptacle is just forward of the windscreen, scarcely three feet away. The pilots say that compared to the physical labor involved in a B-52 refueling, B-1B refueling is effortless.

It is down on the deck, however, that this airplane shines. As you descend from the refueling altitude of 20,000 feet, the wings sweep back, and the B-1B is ready to roll. At 640 knots and 200 feet, guided by a terrain-following system that now appears free of bugs, the B-1B becomes a very elusive target, especially with a radar return resembling that of an F-16. Anyone who has flown a fighter at 500 knots or better on the deck, especially on a hot day, will remember the less-than-thrilling side effects, like the helmet banging on the canopy. The B-1B crew could write a letter home for all the bounce in their cockpit. At night, and over rough terrain, its speed and terrain-following capability alone should make it immune to fighter intercept. Even on a clear day, an interceptor will have to rely on a perfect solution.

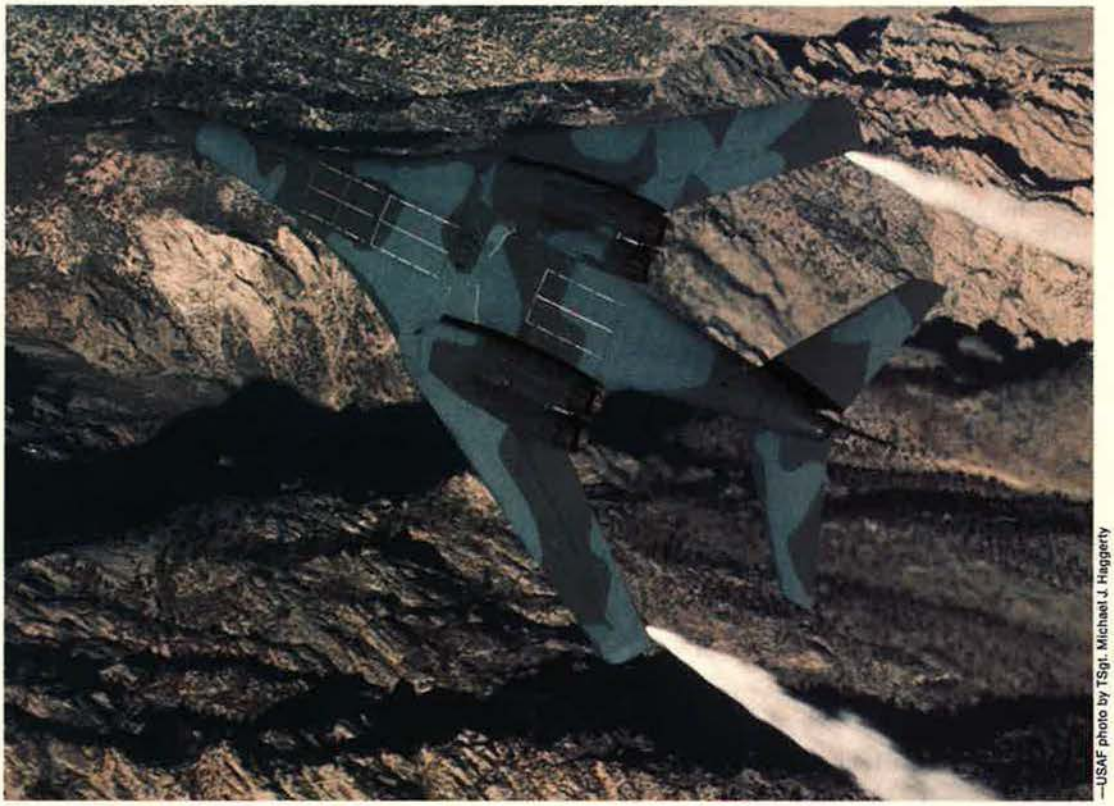
The ECM Question

There are, however, other ways to shoot down a bomber, and this is where the celebrated, or infamous, Eaton ALQ-161 system comes into play. This defensive electronics system continues to be the single most vexing shortcoming in the B-1B's operational capability and the focus of attacks against it. The problem is compounded by ignorance on the subject of electronic countermeasures among the public at large and among those who inform that public.

This business of ECM, however, is an arcane matter, and not just for the public. Most pilots know little about it beyond hoping it will do what it is supposed to do—that is, mislead enemy radar. During World War II, ECM consisted mostly of dumping bundles of shredded tinfoil and muttering a prayer. As the years passed, ECM became more sophisticated, but not always more effective. The top-secret ECM pods hoarded against the day when nuclear war began turned out to be essentially useless when we finally took them to North Vietnam.

Electronic detection and the means to counter it is a never-ending game, and Eaton's goal in conceiving and designing the ALQ-161 was ambitious—to search across the entire spectrum and counter what was found. With 108 black boxes, antennas, and jamming transmitters—and, at 5,000 pounds, weighing almost as much as an average World War II bomb load—the ALQ-161 is complicated beyond the understanding of ordinary mortals. Still, while it may fall short of the ability to jam certain threats, it can listen and locate the entire range of hostile emissions.

On balance, the ALQ-161 is a disappointment, but by no means a failure. The cost to remedy the jamming gaps, according to Eaton Co., will be $520 million. Whether or not the funds will be requested by the Air Force and granted by Congress is still an open question. In all fairness, that money, along with the $600 million



—USAF photo by TSgt. Michael J. Haggerty

A formidable flying machine, the B-1B does its stuff over mountainous terrain, venting fuel, in the photo at right. The author writes that the B-1B, with its range, speed, and other attributes, is "uniquely suited to power projection" and is, in fact, "a very good airplane."

for other fixes, would simply restore the program to its originally estimated cost, but that argument is hard to put across.

Politics and Pelicans

A principal obstacle to further spending on the B-1B is the B-2, the mysterious Stealth bomber. The Stealth was a major reason for President Carter's cancellation of the B-1. The B-1B came into being as an interim bomber, a link between the venerable B-52 and the B-2. From its inception, or at least from its second coming as the B-1B, the airplane has suffered from a curtailed development cycle and a limited production run.

Modifications have been made on an *ad hoc* basis, so there are differences between airplanes. Spare parts have been purchased in a niggardly way. Collision with a fifteen-pound pelican, on a low-level training flight in 1987, set operational readiness back more than a year. While the birdstrike fix is simply one of attaching Kevlar, a tough synthetic fiber, to certain vulnerable areas, it has taken time. All the while, the B-2 lurked down the road as the anointed first-line penetrating bomber and the competitor for funds.

The B-1B is our first-line bomber. Its primary task is to penetrate Soviet defenses and take out the important targets that, for one reason or another, the missiles have not hit. The B-1B's bomb bay has a rotary device designed to launch air-to-surface missiles at some distance from the target. Currently, the operational missile is the AGM-69A short-range attack missile (SRAM-A), now growing a bit old after twenty years. The SRAM II is in the offing and should be a more reliable and accurate weapon.

A nuclear war is difficult to visualize, even in dispassionate military terms. It is at least arguable that air defenses, and everything else for that matter, would be in such a shambles by the time the bombers arrived that penetration would be no problem. In that scenario, the argument over the B-1 ECM becomes academic. It is, in fact, difficult to conjure up a situation where the bombers would arrive ahead of the missiles against an undamaged and fully alerted defense. Nevertheless, it could happen, and so penetration aids must remain a high priority. Even if they serve no other purpose than to introduce another uncertainty into Soviet planning and further strains on the Soviet budget, they are important. Much of the domestic furor over the ECM, however, is a smokescreen.

The real fight over the B-1B has its roots in politics. That fight, in turn, contributed heavily to the cost of the airplane. If the B-1B had not been so vehemently opposed, there would doubtless not have been such prolific subcontracting. Well-organized resistance to the B-1 was also responsible for the years of delay in building the bomber, an airplane that should have been in the squadrons more than a decade ago.

It Fits the Bill

Because there are now only ninety-seven of these airplanes, and because they cost $250 million or so apiece, there is a natural reluctance on the part of the Air Force to discuss the B-1B's role in limited conflicts. Strategic planners abhor the thought of losing one of these birds to some guerrilla with a Stinger. Nevertheless, the B-1B, with its range, its speed, and its all-weather low-level capability, is uniquely suited to power projection. Coming over low, fast, and with a deafening roar, it should be a convincing harbinger of worse things to come. The B-1B can drop dumb bombs with fair accuracy, around 150 feet CEP (circular error probable), but that in itself would be a dumb tactic.

A more sensible and realistic employment of this airplane in a conventional role would be with standoff weapons. At this early stage, however, the B-1B people prefer to focus on the strategic nuclear mission.

No other military airplane has ever been the subject of so much controversy and has had to bypass so many roadblocks on its way to production. Now that the B-1B is in the operational inventory, it remains under the microscope, a perennial candidate for investigative journalism, congressional reports, and political darts. There is no reason to believe the attacks will diminish, at least until a new target appears.

—Photo by Mi Seitelman/IDI

All that aside, however, the fact is that the B-1B is a very good airplane, one that almost surely can penetrate any nation's defense system and deliver a devastating blow. It probably did cost too much, what with one thing and another, and it came along years late. But if there is general acceptance of the need for a bomber in the nuclear triad, and that appears to be beyond argument, the B-1B fits the bill. ■

Gen. T. R. Milton, USAF (Ret.), is a longtime Contributing Editor to this magazine. He retired from active duty in 1974 and makes his home in Colorado Springs, Colo. His forty-year military career included World War II combat service with Eighth Air Force, 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 the US Representative to the NATO Military Committee.

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L T V : L O O K I N G A H E A D

In eighty-five years of powered flight, mankind has continuously pushed the aviation frontier outward.

Higher, Faster, Farther

BY JEFFREY P. RHODES, AERONAUTICS EDITOR

"HIGHER, faster, farther" is the most accurate description of the course aviation has taken over the past eighty-five years. Mankind has continuously pushed the aviation frontier outward.

The desirability of a standard procedure to certify air records was recognized early in the game. In October 1905, representatives from Belgium, Germany, the United States, Great Britain, France, Spain, Italy, and Switzerland met in Paris to form the Fédération Aéronautique Internationale (FAI), the world body of all national aeronautic sporting interests. The FAI today is composed of the national aero clubs of seventy nations and certifies the many national records as the best in the world.

Since 1922, the National Aeronautic Association (NAA), based in Washington, D. C., has been the US representative to the FAI. NAA supervises all attempts at world and world-class records in the United States. NAA sponsors many educational programs as well as the Collier Trophy, the most prestigious award in American aviation.

The following is only a partial list

The title of "Fastest Man Alive" belongs to Col. Eldon W. Joersz, who as a Captain flew this Lockheed SR-71 to a speed of 2,193.16 mph over a straight course at Beale AFB, Calif., in 1976. He is one of four Air Force pilots who hold absolute world records. He is shown here with his backseater, Lt. George Morgan (left).

(as of December 1, 1988) of the records recognized by NAA and FAI. The Absolute World Records are the supreme achievements of all the hundreds of records open to flying machines. The majority of this list, though, covers records set and still held by US military aircrews. (A list of all US records would fill many pages and would still pale in comparison to the records held by the Soviet Union.)

A complete list of records in book form can be obtained from NAA for $7.95. The address is: National Aeronautic Association, 1763 R St., N. W., Washington, D. C. 20009.

Absolute Aviation World Records

(Maximum Performances Regardless of the Class or Type of Aircraft Used)

1. *Great Circle Distance Without Landing*: 24,986.727 mi. by Richard Rutan and Jeana Yeager in *Voyager,* Edwards AFB, Calif., to Edwards AFB, Calif., December 14–23, 1986.

2. *Distance in a Closed Circuit Without Landing:* 24,986.727 mi. by Richard Rutan and Jeana Yeager in *Voyager,* Edwards AFB, Calif., to Edwards AFB, Calif., December 14–23, 1986.

3. *Altitude:* 123,523.58 ft. by Alexander Fedotov in the E-266M, a modified MiG-25 "Foxbat," at Podmoskovnoye, USSR, August 31, 1977.

4. *Altitude in Horizontal Flight*: 85,068.997 ft. by Capt. Robert C. Helt, USAF, in a Lockheed SR-71A "Blackbird" at Beale AFB, Calif., on July 28, 1976.

5. *Altitude in an Aircraft Launched from a Carrier Airplane:* 314,750.00 ft. by Maj. Robert H. White, USAF, in North American X-15 No. 3 at Edwards AFB, Calif., on July 17, 1962.

6. *Speed Over a Straight Course:* 2,193.16 mph by Capt. Eldon W. Joersz, USAF, in a Lockheed SR-71A "Blackbird" at Beale AFB, Calif., on July 28, 1976.

7. *Speed Over a Closed Circuit:* 2,092.294 mph by Maj. Adolphus H. Bledsoe, USAF, in a Lockheed SR-71A "Blackbird" at Beale AFB, Calif., on July 27, 1976.

Class Records Set By US Military Pilots

Class C-1, Group I (Piston Engines)

1. *Altitude With 1,000-Kg Payload:* 47,910 ft. by Maj. Finley F. Ross, USAAF, in a Boeing B-29A Superfortress at Harmon Field, Guam, on May 16, 1946.

2. *Altitude With 2,000-Kg Payload:* 46,522 ft. by Col. E. D. Reynolds, USAAF, in a Boeing B-29A Superfortress at Harmon Field, Guam, on May 13, 1946.

3. *Altitude With 5,000-Kg Payload:* 45,253 ft. by Lt. J. P. Tobison, USAAF, in a Boeing B-29A Superfortress at Harmon Field, Guam, on May 4, 1946.

4. *Altitude With 10,000-Kg Payload:* 41,561.68 ft. by Capt. A. A. Pearson, USAAF, in a Boeing B-29A Superfortress at Harmon Field, Guam, on May 8, 1946.

5. *Altitude With 15,000-Kg Payload:* 39,520.99 ft. by Col. J. B. Warren, USAAF, in a Boeing B-29A Superfortress at Harmon Field, Guam, on May 11, 1946.

6. *Greatest Load Carried to an Altitude of 2,000 Meters:* 33,435.3 lb. by Col. J. B. Warren, USAAF, in a Boeing B-29A Superfortress at Harmon Field, Guam, on May 11, 1946.

7–9. *1,000-Km Speed Over a Closed Circuit With 1,000-Kg Payload; 2,000-Kg Payload; 5,000-Kg Payload:* 369.692 mph by Lt. E. M. Grabowski, USAAF, in a Boeing B-29A Superfortress at Dayton, Ohio, on May 17, 1946.

10. *1,000-Km Speed Over a Closed Circuit With 10,000-Kg Payload:* 357.731 mph by Capt. J. D. Bartlett, USAAF, in a Boeing B-29A Superfortress at Dayton, Ohio, on May 19, 1946.

11–13. *2,000-Km Speed Over a Closed Circuit With 1,000-Kg Payload; 2,000-Kg Payload; 5,000-Kg Payload:* 365.649 mph by Lt. E. M. Grabowski, USAAF, in a Boeing B-29A Superfortress at Dayton, Ohio, on May 17, 1946.

14. *2,000-Km Speed Over a Closed Circuit With 10,000-Kg Payload:* 357.035 mph by Capt. J. D. Bartlett, USAAF, in a Boeing B-29A Superfortress at Dayton, Ohio, on May 19, 1946.

15–17. *5,000-Km Speed Over a Closed Circuit Without Payload; With 1,000-Kg Payload; 2,000-Kg Payload:* 338.39 mph by Capt. James Bauer, USAAF, in a Boeing B-29A Superfortress at Dayton, Ohio, on June 28, 1946.

Maj. Robert H. White set the absolute record for altitude in an aircraft launched from a carrier plane. He is shown here (center) with North American Aviation pilot Scott Crossfield (left) and NASA pilot Neil Armstrong (right) as Mr. Crossfield turns over the "keys" to the first X-15 to be fitted with the Reaction Motors XLR-99 "Big Engine."

18–19. *5,000-Km Speed Over a Closed Circuit With 5,000-Kg Payload; 10,000-Kg Payload:* 266.022 mph by Lt. Col. R. G. Ruegg, USAAF, in a Boeing B-29A Superfortress at Dayton, Ohio, on June 21, 1946.

20. *10,000-Km Speed Over a Closed Circuit Without Payload:* 273.194 mph by Lt. Col. O. F. Lassiter, USAAF, in a Boeing B-29A Superfortress at Dayton, Ohio, on July 29–30, 1947.

Class C-1, Group II (Turboprop Engines)

1. *Great Circle Distance Without Landing:* 8,732.09 mi. by Lt. Col. Edgar L. Allison, USAF, in a Lockheed HC-130 Hercules from Ching Chuan Kang AB, Taiwan, to Scott AFB, Ill., on February 20, 1972.

2. *Distance in a Closed Circuit:* 6,278.05 mi. by Cmdr. Philip R. Hite, USN, in a Lockheed RP-3D Orion at NAS Patuxent River, Md., on November 4, 1972.

3. *Time-to-Climb Speed Over a 15/25-Km Course:* 501.44 mph by Cmdr. D. H. Lilienthal, USN, in a Lockheed P-3C Orion at NAS Patuxent River, Md., on January 27, 1971.

Class C-1.F, Group II (Aircraft With Turboprop Engines)

1. *Great Circle Distance Without Landing:* 2,769.84 mi. by Maj. John H. Pierson, USMC, in a Rockwell OV-10A Bronco from NAS Whidbey Island, Wash., to NAS Patuxent River, Md., on July 5, 1974.

2. *100-Km Speed Over a Closed Circuit Without Payload:* 293.41 mph by Lt. Col. E. L. Nielson, USA, in a Grumman OV-1A Mohawk at Peconic River, N. Y., on June 17, 1966.

Class C-1, Group III (Jet Engines)

1. *Great Circle Distance Without Landing:* 12,532.28 mi. by Maj. Clyde P. Evely, USAF, in a Boeing B-52H Stratofortress from Kadena AB, Okinawa, to Madrid, Spain, on January 10–11, 1962.

2. *Altitude With 5,000-Kg Payload:* 85,360.8 ft. by Maj. F. L. Fulton, USAF, in a Convair B-58A Hustler at Edwards AFB, Calif., on September 14, 1962.

3. *Time-to-Climb to 15,000 Meters:* 1:17.042 min. by Maj. David W. Peterson, USAF, in the McDonnell Douglas F-15A Streak Eagle at Grand Forks AFB, N. D., on January 16, 1975.

4. *Time-to-Climb to 20,000 Meters:* 2:02.94 min. by Maj. Roger J. Smith, USAF, in the McDonnell Douglas F-15A Streak Eagle at Grand Forks AFB, N. D., on January 19, 1975.

5–6. *1,000-Km Speed Over a Closed Circuit With 15,000-Kg Payload; 25,000-Kg Payload:* 676.92 mph by Lt. Col. Robert A. Chamberlain, USAF (and crew), in a Rockwell B-1B at Palmdale, Calif., on July 4, 1987.

7–8. *2,000-Km Speed Over a Closed Circuit With 1,000-Kg Payload; 2,000-Kg Payload:* 1,061.808 mph by Maj. H. J. Deutschendorf, Jr., USAF, in a Convair B-58A Hustler at Edwards AFB, Calif., on January 12, 1962.

9–10. *2,000-Km Speed Over a Closed Circuit With 15,000-Kg Payload; 25,000-Kg Payload:* 669.93 mph by Lt. Col. Robert A. Chamberlain, USAF (and crew), in a Rockwell B-1B at Palmdale, Calif., on July 4, 1987.

11–19. *5,000-Km Speed Over a Closed Circuit Without Payload; With 1,000-Kg Payload; 2,000-Kg Payload; 5,000-Kg Payload; 10,000-Kg Payload; 15,000-Kg Payload; 20,000-Kg Payload; 25,000-Kg Payload; 30,000-Kg Payload:* 655.09 mph by Maj. H. Brent Hedgpeth, USAF (and crew), in a Rockwell B-1B at Palmdale, Calif., on September 17, 1987.

20. *10,000-Km Speed Over a Closed Circuit Without Payload:* 560.705 mph by Lt. Col. Victor L. Sandacz, USAF, in a Boeing B-52D Stratofortress at Ellsworth AFB, S. D., on September 26, 1958.

Class C-1.M, Group III (Jet Engines)*

1–5. *Time-to-Climb to 3,000 Meters; 6,000 Meters; 9,000 Meters; 12,000 Meters; 15,000 Meters:* 1:39.22 min. (3,000 m), 2:56.97 min. (6,000 m), 4:23.51 min. (9,000 m), 5:50.94 min.

(12,000 m), 8:15.20 min. (15,000 m) by Capt. David Glisson, USAF (and crew), in a Boeing KC-135R Stratotanker at Robins AFB, Ga., on November 19, 1988.

Class C-1.N, Group III (Jet Engines)*

1–4. *Time-to-Climb to 3,000 Meters; 6,000 Meters; 9,000 Meters; 12,000 Meters:* 1:42.52 min. (3,000 m), 2:58.21 min. (6,000 m), 4:29.28 min. (9,000 m), 5:43.71 min. (12,000 m) by Maj. Stan Yarbough, USAF (and crew), in a Boeing KC-135R Stratotanker at Robins AFB, Ga., on November 19, 1988.

Class C-1.O, Group III (Jet Engines)*

1–4. *Time-to-Climb to 3,000 Meters; 6,000 Meters; 9,000 Meters; 12,000 Meters:* 2:12.10 min. (3,000 m), 3:46.41 min. (6,000 m), 5:40.33 min. (9,000 m), 7:49.19 min. (12,000 m) by Capt. Robert Locke, USAF (and crew), in a Boeing KC-135R Stratotanker at Robins AFB, Ga., on November 19, 1988.

Class C-1.P, Group III (Jet Engines)*

1–3. *Time-to-Climb to 3,000 Meters; 9,000 Meters; 12,000 Meters:* 2:48.34 min. (3,000 m), 7:13.62 min. (9,000 m), 10:14.80 min. (12,000 m) by Maj. Rod Bell, USAF (and crew), in a Boeing KC-135R Stratotanker at Robins AFB, Ga., on November 19, 1988.

Class C-1.Q, Group III (Jet Engines)

1–6. *1,000-Km Speed Over a Closed Circuit With 5,000-Kg Payload; 10,000-Kg Payload; 15,000-Kg Payload; 20,000-Kg Payload; 25,000-Kg Payload; 30,000-Kg Payload:* 676.92 mph by Lt. Col. Robert A. Chamberlain, USAF (and crew), in a Rockwell B-1B at Palmdale, Calif., on July 4, 1987.

7–12. *2,000-Km Speed Over a Closed Circuit With 5,000-Kg Payload; 10,000-Kg Payload; 15,000-Kg Payload; 20,000-Kg Payload; 25,000-Kg Payload; 30,000-Kg Payload:* 669.93 mph by Lt. Col. Robert A. Chamberlain, USAF (and crew), in a Rockwell B-1B at Palmdale, Calif., on July 4, 1987.

13–21. *5,000-Km Speed Over a Closed Circuit Without Payload; With 1,000-Kg Payload; 2,000-Kg Payload; 5,000-Kg Payload; 10,000-Kg Payload; 15,000-Kg Payload; 20,000-Kg Payload; 25,000-Kg Payload; 30,000-Kg Payload:* 655.09 mph by Maj. H. Brent Hedgpeth, USAF (and crew), in a Rockwell B-1B at Palmdale, Calif., on September 17, 1987.

*Records are provisional until certified by the FAI. They are recognized as US records by NAA.

Newest record-setter is this KC-135R,* Cherokee Rose, *from the 19th Air Refueling Wing at Robins AFB, Ga. The aircraft was flown by crews from four different refueling wings to set sixteen Class C-1 Group III (Jet Engines) time-to-climb records this past November. The records are awaiting certification from the FAI.

Class C-3, Group I Amphibians (Piston Engines)

1. *Great Circle Distance Without Landing:* 3,571.65 mi. by Cmdr. W. Fenlon, USCG, in a Grumman UF-2G Albatross from Kodiak, Alaska, to Pensacola, Fla., on October 25, 1962.

2. *Altitude Without Payload:* 32,883 ft. by Lt. Col. Charles H. Manning, USAF, in a Grumman HU-16B Albatross at Homestead AFB, Fla., on July 4, 1973.

3. *Altitude With 1,000-Kg Payload:* 29,475 ft. by Lt. Cmdr. Don Moore, USN, in a Grumman UF-2G Albatross at Floyd Bennett Field, N. Y., on September 12, 1962.

4. *Altitude With 2,000-Kg Payload:* 27,404.93 ft. by Lt. Cmdr. Fred Franke, USN, in a Grumman UF-2G Albatross at Floyd Bennett Field, N. Y., on September 12, 1962.

5. *Altitude With 5,000-Kg Payload:* 19,747 ft. by Capt. Henry E. Erwin, Jr., USAF, in a Grumman HU-16B Albatross at Eglin AFB, Fla., on March 20, 1963.

6. *Greatest Payload Carried to an Altitude of 2,000 Meters:* 12,162.9 lb. by Capt. Henry E. Erwin, Jr., in a Grumman HU-16B Albatross at Eglin AFB, Fla., on March 20, 1963.

7–9. *1,000-Km Speed Over a Closed Circuit Without Payload; With 1,000-Kg Payload; 2,000-Kg Payload:* 231.96 mph by Cmdr. Wallace C. Dahlgren, USN, in a Grumman UF-2G Albatross at Floyd Bennett Field, N. Y., on August 13, 1962.

10. *1,000-Km Speed Over a Closed Circuit With 5,000-Kg Payload:* 153.65 mph by Capt. Glenn A. Higginson, USAF, in a Grumman HU-16B Albatross at Eglin AFB, Fla., on March 19, 1963.

11. *5,000-Km Speed Over a Closed Circuit With 1,000-Kg Payload:* 151.39 mph by Lt. Cmdr. Richard A. Hoffman, USN, in a Grumman UF-2G Albatross at Floyd Bennett Field, N. Y., on September 16, 1962.

Holding two class records is this B-58 crew, headed by Maj. H. J. Deutschendorf, Jr. (center). Major Deutschendorf is shown with Capt. R. R. Wagener (left), the defensive systems operator, and Capt. W. L. Polhemus, the navigator-bombardier. Major Deutschendorf's son would later achieve fame of a different sort under the name "John Denver."

Class E-1, Helicopters*

1. *Altitude With 1,000-Kg Payload:* 31,165 ft. by Capt. B. P. Blackwell, USA, in a Sikorsky CH-54B Tarhe at Stratford, Conn., on October 26, 1971.

2. *Altitude With 2,000-Kg Payload:* 31,480 ft. by CWO Eugene E. Price, USA, in a Sikorsky CH-54B Tarhe at Stratford, Conn., on October 29, 1971.

3. *Altitude With 5,000-Kg Payload:* 25,518 ft. by CWO Eugene E. Price, USA, in a Sikorsky CH-54B Tarhe at Stratford, Conn., on October 27, 1971.

4. *Altitude in Horizontal Flight:* 36,122 ft. by CWO James K. Church, USA, in a Sikorsky CH-54B Tarhe at Stratford, Conn., on November 4, 1971.

5–6. *Time-to-Climb to 3,000 Meters; 6,000 Meters:* 1:22.2 min. (3,000 m), 2:58.9 min. (6,000 m) by Maj. John C. Henderson, USA, in a Sikorsky CH-54B Tarhe at Stratford, Conn., on April 12, 1972.

7. *Time-to-Climb to 9,000 Meters:* 5:57.7 min. by CWO Delbert V. Hunt, USA, in a Sikorsky CH-54B Tarhe at Stratford, Conn., on November 4, 1971.

8–10. *100-Km; 500-Km; 1,000-Km Speed Over a Closed Circuit:* 161.22 mph (100 Km), 158.19 mph (500 Km), 155.19 mph (1,000 Km) by Maj. A. L. Darling, USA, in a Hughes YOH-6A Cayuse at Edwards AFB, Calif., March 13, 1966.

*Helicopter records in the US are sanctioned by the Helicopter Club of America.

Class E-1.C Helicopters

1–2. *500-Km; 1,000-Km Speed Over a Closed Circuit Without Payload:* 155.24 mph (500 Km), 153.09 mph (1,000 Km) by Col. David M. Kyle, USA, in a Hughes YOH-6A Cayuse at Edwards AFB, Calif., on March 12, 1966.

3. *2,000-Km Speed Over a Closed Circuit Without Payload:* 141.523 mph by CWO Richard D. Szczepanski, USA, in a Hughes YOH-6A Cayuse at Edwards AFB, Calif., on March 20, 1966.

Class E-1.D, Helicopters

1. *Altitude Without Payload:* 35,150 ft. by Maj. E. F. Sampson, USA, in a Bell UH-1D Iroquois at Fort Worth, Tex., on December 11, 1964.

2. *500-Km Speed Over a Closed Circuit Without Payload:* 178.22 mph by Maj. Billy L. Odneal, USA, in a Bell UH-1D Iroquois at Fort Worth, Tex., on November 23, 1964.

3. *1,000-Km Speed Over a Closed Circuit Without Payload:* 178.086 mph by Maj. John A. Johnston, USA, in a Bell UH-1D Iroquois at Fort Worth, Tex., on September 15, 1964.

Class E-1.E, Helicopters

1. *Great Circle Distance Without Landing:* 1,348.81 mi. by Capt. Michael N. Antoniou, USA, in a Bell UH-1D Iroquois from Edwards AFB, Calif., to Rogers, Ariz., on September 27, 1964.

2–3. *Distance and 2,000-Km Speed Over a Closed Circuit:* 1,242.83 mi. and 133.984 mph by CWO Joseph C. Watts, USA, in a Bell UH-1D Iroquois at Edwards AFB, Calif., on September 23, 1964.

Speed Over a Recognized Course—Records Set by a US Military Pilot

Class C-1, Landplanes

Tokyo, Japan, to Chicago, Ill.: 729.25 mph (8:38:42 hours) by Lt. Col. G. A. Andrews, USAF, in a Convair B-58A Hustler on October 16, 1963.

Anchorage, Alaska, to Chicago, Ill.: 524.12 mph (5:26:33.9 hours) by Lt. Col. G. A. Andrews, USAF, in a Convair B-58A Hustler on October 16, 1963.

Tokyo, Japan, to Anchorage, Alaska; London, England: 1,093.44 mph (3:09:41.8 hours) to Anchorage, 692.70 mph (8:35:20.4 hours) to London by Maj. S. J. Kubesch, USAF, in a Convair B-58A Hustler on October 16, 1963.

Anchorage, Alaska, to London, England: 826.91 mph (5:24:54 hours) by Maj. S. J. Kubesch, USAF, in a Convair B-58A Hustler on October 16, 1963.

Tokyo, Japan, to Seattle, Wash., Fort Worth, Tex.; Madrid, Spain: 549.36 mph (8:43:40.83 hours) to Seattle, 550.08 mph (11:41:24.69 hours) to Fort Worth, 328.78 mph (20:22:12 hours) to Madrid, by Maj. Clyde P. Evely, USAF, in a Boeing B-52H Stratofortress on January 10–11, 1962.

Seattle, Wash., to Fort Worth, Tex.; Madrid, Spain: 552.60 mph (3:00:24.62 hours) to Fort Worth, 456.97 mph (11:34:9.22 hours) to Madrid, by Maj. Clyde P. Evely, USAF, in a Boeing B-52H Stratofortress on January 11, 1962.

Fort Worth, Tex., to Washington, D. C.; Madrid, Spain: 604.44 mph (2:00:26.66) hours) to Washington, 577.44 mph (8:35:24.43 hours) to Madrid, by Maj. Clyde P. Evely, USAF, in a Boeing B-52H Stratofortress on January 11, 1962.

Washington, D. C., to Madrid, Spain: 573.12 mph (6:36:38.98 hours) by Maj. Clyde P. Evely, USAF, in a Boeing B-52H Stratofortress on January 11, 1962.

Buenos Aires, Argentina, to Washington, D. C.: 471.45 mph (11:03:57.38 hours) by Gen. Curtis E. LeMay in a Boeing KC-135A Stratotanker on November 13, 1957.

Washington, D. C., to Oslo, Norway; Stockholm, Sweden: 589.14 mph (6:34:49.9 hours) to Oslo, 584.56 mph (7:03:33.4 hours) to Stockholm, by Col. James B. Swindal, USAF, in a Boeing VC-137C Stratoliner on May 19, 1963.

Baltimore, Md., to Oslo, Norway; Stockholm, Sweden; Moscow, USSR: 591.12 mph (6:29:47.2 hours) to Oslo, 586.76 mph (6:58:27.1 hours) to Stockholm, and 563.36 mph (8:33:45.4 hours) to Moscow by Col. James B. Swindal, USAF, in a Boeing VC-137C Stratoliner May 19, 1963.

Philadelphia, Pa., to Oslo, Norway; Stockholm, Sweden; Moscow, USSR: 592.66 mph (6:20:31 hours) to Oslo, 587.88 mph (6:49:11.6 hours) to Stockholm, 563.97 mph (8:24:36.2 hours) to Moscow by Col. James B. Swindal, USAF, in a Boeing VC-137C Stratoliner on May 19, 1963.

New York, N. Y., to Oslo, Norway; Stockholm, Sweden; Moscow, USSR: 593.13 mph (6:11:58.8 hours) to Oslo, 588.31 mph (6:40:36 hours) to Stockholm, 564.12 mph (8:15:54.1 hours) to Moscow by Col. James B. Swindal, USAF, in a Boeing VC-137C Stratoliner on May 19, 1963.

Boston, Mass., to Oslo, Norway; Stockholm, Sweden; Moscow, USSR: 591.94 mph (5:54:14.7 hours) to Oslo, 587.12 mph (6:22:54.1 hours) to Stockholm, and 562.60 mph (7:58:15.7 hours) to Moscow by Col. James B. Swindal, USAF, in a Boeing VC-137C Stratoliner on May 19, 1963.

Moscow, USSR, to Boston, Mass.; New York, N. Y.; Philadelphia, Pa.; Baltimore, Md.; Washington, D. C.: 497.21 mph (9:01:07.8 hours) to Boston, 495.32 mph (9:24:48 hours) to New York, 494.13 mph (9:35:54.9 hours) to Philadelphia, 492.30 mph (9:47:53.2 hours) to Baltimore, 490.06 mph (9:54:48.5 hours) to Washington by Col. James B. Swindal, USAF, in a Boeing VC-137C Stratoliner on May 20–21, 1963.

Stockholm, Sweden, to Boston, Mass.; New York, N. Y.; Philadelphia, Pa.; Baltimore, Md.; Washington, D. C.: 506.44 mph (7:24:45.6 hours) to Boston, 503.02 mph (7:48:31.1 hours) to New York, 501.66 mph (7:59:31 hours) to Philadelphia, 499.50 mph (8:11:33.3 hours) to Baltimore, 496.65 mph (8:18:30.8 hours) to Washington by Col. James B. Swindal, USAF, in a Boeing VC-137C Stratoliner on May 20–21, 1963.

Oslo, Norway, to Boston, Mass.; New York, N. Y.; Philadelphia, Pa.; Baltimore, Md.; Washington, D. C.: 508.28 mph (6:52:34.9 hours) to Boston, 505.62 mph (7:16:21 hours) to New York, 504.18 mph (7:27:19 hours) to Philadelphia, 501.88 mph (7:39:20.9 hours) to Baltimore, 498.81 mph (7:46:18.7 hours) to Washington by Col. James B. Swindal, USAF, in a Boeing VC-137C Stratoliner on May 20–21, 1963.

Los Angeles, Calif., to New York, N. Y.: 1,214.65 mph (2:00:58.71 hours) by Capt. Robert G. Sowers, USAF (and crew), in a Convair B-58A Hustler on March 5, 1962. (Note: This was the last Bendix Trophy Race.)

"No time for an in-flight movie" might have been Maj. James V. Sullivan's thought as he (left) and Maj. Noel Widdifield (center) and their SR-71 reached England from New York in less than two hours in 1974. Here, they're being greeted by SAC's Fifteenth Air Force Commander, Lt. Gen. William F. Pitts.

New York, N. Y., to Los Angeles, Calif.: 1,081.80 mph (2:15:50.08 hours) by Capt. Robert G. Sowers, USAF (and crew), in a Convair B-58A Hustler on March 5, 1962.

Los Angeles/New York/Los Angeles Round Trip: 1,044.46 mph (4:41:14.98 hours) by Capt. Robert G. Sowers, USAF (and crew), in a Convair B-58A Hustler on March 5, 1962.

New York, N. Y., to London, England: 1,806.964 mph (1:54:56.4 hours) by Maj. James V. Sullivan, USAF, in a Lockheed SR-71A "Blackbird" on September 1, 1974.

London, England, to Los Angeles, Calif.: 1,435.587 mph (3:47:39 hours) by Capt. Harold B. Adams, USAF, in a Lockheed SR-71A "Blackbird" on September 13, 1974.

Washington, D. C., to Paris, France: 1,048.68 mph (3:39:49 hours) by Maj. W. R. Payne, USAF, in a Convair B-58A Hustler on May 26, 1961.

New York, N. Y., to Paris, France: 1,089.36 mph (3:19:44.53 hours) by Maj. W. R. Payne, USAF, in a Convair B-58A Hustler on May 26, 1961.

Yakota AB, Japan, to Beijing, China: 318.63 mph (4:00:00 hours) by Lt. Col. Royce Grones, USAF, and Maj. Robyn S. Read, USAF, in a Boeing C-135B Stratolifter on October 3, 1985.

Tokyo, Japan, to Beijing, China: 318.55 mph (4:10:00 hours) by Lt. Col. Royce Grones, USAF, and Maj. Robyn S. Read, USAF, in a Boeing C-135B Stratolifter on October 3–4, 1985.

Class E-1, Helicopters

New York, N. Y., to London, England: 118.14 mph (29:13:35 hours) by Maj. Donald B. Maurras, USAF, in a Sikorsky HH-3E Jolly Green Giant on June 1, 1967.

New York, N. Y., to Paris, France: 118.03 mph (30:46:10.8 hours) by Maj. Herbert Zehnder, USAF, in a Sikorsky HH-3E Jolly Green Giant on June 1, 1967.

Special Records

Class C-1, Group III (Jet Engines)

Efficiency Over an Established Air Route: Efficiency Index: 2.57645, set by Capt. James C. Fleming, USAF, in a Lockheed C-141A StarLifter on December 16, 1978, during a 5:30.00 hour flight from Thule AB, Greenland, to McGuire AFB, N. J.

Speed Over an Established Air Route: 486.31 mph (5:11:59 hours) by Capt. James C. Fleming, USAF, in a Lockheed C-141A StarLifter from McGuire AFB, N. J., to Thule AB, Greenland on December 15, 1978. ■

If Europe locks US firms out of the unified market it envisions, the results could be disastrous, for both the defense industry and the Atlantic alliance.

Bracing for the Crisis of 1992

BY JAMES W. CANAN, SENIOR EDITOR

On the eve of a new administration, the time has come for the government to make it easier for the US defense industry to sell modern arms overseas.

The economic health of the industry is at stake. So is the well-being of the North Atlantic Treaty Organization. Indeed, the future national security of the US and the defense of the West as a whole may hinge on the ability of the US defense industry to remain competitive overseas.

These sentiments were pervasive among panelists of a recent symposium in Arlington, Va., entitled "Armaments Cooperation, Defense Trade, and Security Assistance for the Future." The day-long affair was cosponsored by the American League for Exports and Security Assistance (ALESA) and the Aerospace Education Foundation (AEF), an affiliate of the Air Force Association.

By and large, the panelists agreed that companies making up the US defense industry, with special emphasis on the industry's aerospace element, sorely need clarification and relaxation of the rules now constraining exports of their advanced technologies to friendly nations.

It was said that such a softening of US technology-transfer policy, short of compromising national security, will be essential if these companies are to remain competitive in a market that has become global in scope.

This theme, recurrent throughout the symposium, was struck by the keynote speaker, former Under Secretary of State for Security Assistance, Science, and Technology William Schneider, Jr. At the time, he was serving as a top national security advisor to candidate George Bush, now President-elect of the US.

Dr. Schneider, who is expected to play a key role in the Bush Administration, said that "one of the most urgent needs" confronting it will be to devise "a set of technology-transfer arrangements that facilitate rather than inhibit trade."

As always, such arrangements "must make sure that our technology is adequately protected so that

our sometimes slender technological edge is not eroded," he added.

Dr. Schneider also served on the symposium panel on cooperative armaments development, a panel that included Dennis Kloske, Deputy Under Secretary of Defense for Planning and Resources, and William E. Hoehn of the Senate Armed Services Committee staff.

Our European friends have been cautioned not to "do 1992" at the expense of the coherence of the Atlantic alliance. The danger is that the Europeans will create a "monopoly cartel" and exclude the US.

Other panels and their members were:

- Technology Transfer—Fred W. Garry, vice president of engineering and manufacturing with General Electric Co.; Thomas A. Campobasso, senior vice president of Rockwell International Corp.; and Everett D. Greinke, until recently Deputy Under Secretary of Defense for International Programs and Technology.
- Allocation of Resources—John H. Eisenhour, Chief of the Office of Management and Budget's International Security Affairs Branch; Robert Bauerlein, advisor to the Deputy Secretary of State for Policy and Resources; Henry H. Gaffney, Director of Plans with the Defense Security Assistance Agency; and William E. Schuerch of the House Appropriations Committee staff.
- Offset Policy—C. Allen Urban, vice president of United Technologies Corp., and Patrick Hall, vice president of Rockwell International Trading Co.
- Summation—Lt. Gen. Howard M. Fish, USAF (Ret.), vice president/international of LTV Aerospace and Defense and chairman of symposium cosponsor ALESA.

The general thrust of the symposium was as follows.

Competing on a Global Scale

More and more, US companies are being driven to compete with one another and with their foreign counterparts on a global scale. They will never be able to turn back. Their domestic market has topped out and will stay flat for some time. The US defense budget will not grow and may decline somewhat.

Problems are mounting for US companies in the international arena. The problem of dwindling defense resources is as profound in Europe, where a great deal of the industrial competition takes place, as it is in the US.

This makes for fierce competition between and among US companies and Western European companies for defense contracts on the continent and for military sales contracts throughout the world.

Compounding this is the increasing penchant among Western European nations for devoting their defense resources to European-made products. They have long chafed under their dependence on US military hardware and their inability to sell much of their own hardware to the Pentagon in pursuit of the often illusory "two-way street" of transatlantic NATO arms sales.

Now Western Europe is no longer a captive market for US exports and is bullish about it. The Western European aerospace industry has developed military and commercial technologies and products that are in many respects comparable, and in a few cases superior, to those of the US. The emergence of such technologies has served to justify and stimulate such big-ticket multinational programs as the European Fighter Aircraft (EFA).

US companies have an ever-greater need to take part in such joint ventures in Europe but an ever-tougher time doing so. Their government makes it hard for them to offer their high technologies overseas. Moreover, the Western Europeans resist those US-made technologies in the fear that Washington will forbid their export to other parts of the world once they are embodied in operational weapon systems made in Europe.

The saving grace for the US defense industry, its officials believe, is that some of its best technologies and products will always be coveted and marketable on the continent so long as they are affordable. But another problem, maybe the biggest of all, is now looming.

The twelve-nation European Community is moving to do away with all national trading barriers and form one big unified EC market with no internal boundaries—a customs union, in effect—by the end of 1992. In the process, US companies could be locked out.

This would be disastrous for many of them. It would also badly strain NATO and detract from the defense of the West.

At the symposium, Mr. Kloske said that he has "cautioned our European friends not to 'do 1992' at the expense of the coherence of the Atlantic alliance." The danger, he said, is that the Europeans will create "a monopoly cartel that will exclude the US defense industry and basically rend asunder our joint ability to address the collective threat."

Should this happen, he said, the US Congress, already quick to accuse the European NATO partners of not adequately sharing the burden of their own defense with the US, would likely tell them, "Okay, you're on your own" and vote to

withdraw US troops from the continent.

Tougher After 1992

Dr. Schneider noted that "the defense sector is likely to be the last" to be enfolded in the EC economic integration targeted for 1992. Even so, he said, "the increasing consolidation of the European aerospace industry makes it important for American companies to develop some sort of technique for having a place in Europe, whether by way of strategic alliances with [European] companies, joint ventures, teaming arrangements, or direct investment.

"It is likely that the companies that are there [in Europe] before 1992 will have an easier time of it than companies that try to get in after 1992."

Dr. Schneider described "the core philosophy of a customs union, which is what the European Community will be," as "having a common set of barriers to those who are not members of the customs union."

He declared, "It is fair to say that 1992 is going to be an important Rubicon."

On a positive note, Dr. Schneider predicted that Western European companies will continue to seek access to the US defense market and that US companies would do well to accept them as partners in that market. This, he said, would foster a climate of reciprocal "equal opportunity" for US companies to enter into joint ventures, strategic alliances, and teaming arrangements in the Western European market.

Technology-transfer rules of all transatlantic parties "can be made compatible" to bring this off, Dr. Schneider opined.

Mr. Kloske took note of the trend toward transatlantic direct investment by American and Western European industrial sectors, with each wanting to buy into the other. He said that the American companies want to do so "because of 1992," the European companies "in spite of 1992."

The number of foreign companies seeking to buy into American companies "is continuing to grow," and this "has the Pentagon and the [Capitol] Hill nervous," Mr. Kloske said.

He also saw a bright side. He said the US military services are more disposed than ever to join in "cooperative programs" across the Atlantic. A big reason, he said, is that their individual budgets are being squeezed, and they are drawn to the Defense Department's pool of funds available to them for just such transatlantic programs, funds that support the 1985 Nunn Amendment for fostering US-European collaboration in weapons development and production.

"I think we'll see a gradual ramping up of [transatlantic] cooperation in the area of components and subsystems," Mr. Kloske said. He expressed doubt that such cooperation will come to pass "in the area of [weapons] platforms, because that may be too politicized and too complicated."

Mr. Campobasso was specific about some platforms in making his point that the US industry is "getting phased out more and more" in Western European military and commercial aerospace development and production. As outstanding examples of this, he cited Airbus Industrie's Airbus airliner program on the commercial side and the four-nation Eurofighter consortium's European Fighter Aircraft (EFA) program on the military side. *(For more on EFA, see p. 70.)*

What Radar for Eurofighter?

At the time of the symposium, it was still considered possible that the Eurofighter consortium would decide to incorporate advanced US radar technology in the EFA. Under existing US technology-transfer policy, however, Washington would almost certainly forbid any outside-Europe exports of the EFA if it were to embody that technology.

Mr. Campobasso said he was told by one EFA partner in Europe that the consortium would get around this by developing its own indigenous radar for export models of the fighter. These models would then compete with the US General Dynamics F-16 Agile Falcon and the McDonnell Douglas Hornet 2000, a variant of the F/A-18, in Third World markets.

Such ploys aimed at finessing US technology-transfer restrictions are harmful to US industry, Mr. Campobasso claimed, adding:

"We've got to have cooperative development and production programs. With a unified Europe staring us in the face in 1992, it's going to be all one economy over there. Everyone says, 'That's commercial. Don't worry about defense.' But I say—and believe me—we should worry about it."

The Rockwell International executive also stressed that the US is "no longer the keeper of all first-line technology" and that the Western Europeans "have developed a lot of technologies that we would love to have."

The symposium panelists agreed that it makes little sense for the US to withhold from world markets

Dr. Schneider predicted that Western European companies will continue to seek access to the US defense market and that US companies would do well to accept them as partners in that market.

technologies that are available elsewhere, in any case. Mr. Campobasso said that such "foreign availability" is not presently taken into consideration by US export licensing officials in determining the exportability of a technology, adding, "I think it must be considered. This is one of the things we really have to push for."

Like all the panelists, Mr. Campobasso expressed the conviction that "if we have a unique technology that is critical to national defense, we should export it to no one." But US policy for determining whether a technology is critical "is dated," he said, adding:

"It belongs in the era of the 1950s and 1960s when we were preeminent in technology, when we had all the answers, and when we didn't have to sell, we just took orders. Everyone came to us, and they'd buy if we wanted to sell. When we denied an export, they had no place else to go.

"Those days are gone. . . . In many cases, when we deny an export of a defense article today, we're just diverting the source of procurement to another country."

Mr. Garry agreed, declaring that "technology is evolving on an international plane and is not just a birthright of the United States." He also cautioned that "technology transfer is increasingly a two-way street," contrary to "the presumption that technology flow is only outbound from the United States," and that continued high-handedness in the tech-transfer arena could come back to haunt Washington.

The US technology effort remains "colossal," and the US should remain preeminent in military technology for some time, Mr. Garry said.

"The dilemma we face as the world's technology leader," the General Electric executive declared, "is to transfer to our less technologically dominant partners the information they need to carry out that part of their business that is related to our own—and yet, at the same time, not be so generous that we seriously reduce or lose our national advantage. . . . "

Enter Markets Early

In light of the fierce competition that is "leaving us white-knuckled" in an expanding market, it is increasingly imperative that US companies "enter markets early and respond quickly to changing demands," Mr. Garry said. This means, he added, that the government "must minimize restrictions on the flow of information" from US industry overseas and must "allow only the most critical technology to be controlled in the West-West [US-European] arena."

US policy is "schizophrenic" in "promoting the flow of technology but keeping it from the enemy." Too often, Washington "tends to lump all foreigners together," whether NATO or Soviet.

Mr. Greinke claimed that US policy is "schizophrenic" in the matter of "promoting the flow of technology but keeping it from the enemy." Too often, he said, Washington "tends to lump all foreigners together, whether they're from a NATO country or the Soviet Union."

He asserted: "We still see a lot of what I call 'technological arrogance' by the systems people in our military organizations as well as in our industry. A lot of this comes from the fact that they just haven't been around to see the technology that's available overseas."

But the scene is not entirely negative, Mr. Greinke said. He noted that the US has instituted a great many cooperative programs with friendly nations in recent years to share advanced technologies all around. He cited Korea, Japan, Egypt, Israel, Britain, France, West Germany, Australia, Canada, and Pakistan among a score or more of nations with which the US exchanges research and engineering data, scientists, and engineers.

The former high-ranking Pentagon technology official declared that "technologies overseas are advancing rapidly on their own" and that "there has been a lot of cooperation on cutting-edge technologies that's been approved by the US government, and in which many of our industry people are involved as well."

The paradox, he said, is that in many instances, such cooperative endeavors are countervailed by US refusal to export high-tech products to the selfsame countries. "We'll have to resolve these opposing issues better in the future, because they're causing our industry far more trouble than they should."

Mr. Greinke also said that more attention should be paid to the pros and cons of offset arrangements, under which foreign nations agree to buy US defense products in return for various kinds of sweeteners.

"More and more of our foreign military sales programs are not just sales, they're offset programs," he said, "and there's technology transfer involved because they [the buyers] don't just want to be metal-benders, they want high technology in that offset. So we have to figure out some way to do that but still protect the competitive edge of the

US industrial base. I don't see a clear answer."

No one else at the symposium seemed to see one either. Mr. Urban described offsets as "an emotional, controversial issue" and "where the term 'can of worms' comes from."

He explained that offsets offered to prospective buyers of a company's wares can take many forms. So-called direct offsets can be coproduction, technology transfer, and licensing, all having to do with the product sold and bought in the principal deal. Offsets can also be "indirect," or unrelated to the prime product, in such forms as marketing assistance, barter, and "countertrade."

Mr. Kloske described the Pentagon as "split" on the pros and cons of offsets and as needing "inputs from industry before the government moves on what is a potentially explosive issue."

The Demands for Offsets

Mr. Urban told the symposium that about 1,000 US companies are involved in offset deals overseas, that "about 100 countries are asking for offsets," and that such deals "are on the increase in terms of demands and percentages" of total dollar value of primary contracts.

Emphasizing that offsets "are international business arrangements, not subsidies," Mr. Urban said that US companies must ask themselves, "Can we afford to live with this or should we walk away from it?" when customers' demands for offsets become overly burdensome.

Mr. Hoehn was more blunt. He called offsets "a serious and growing problem," as seen on Capitol Hill. What it comes down to "in most cases," the Senate staffer said, "is a matter of our allies holding a gun to the head of our industry."

He warned that unless the Administration moves to "do something about" offsets, perhaps through new rules governing their scope and the conditions under which they can be offered, Congress may be forced to take draconian measures to bring offsets to a stop—in ways that "might be the least thoughtful" and that "might make the situation worse than it is."

Mr. Hall noted that the US government is of a mixed mind in the matter of offsets. He described DoD's view as "pretty much hands-off" except to monitor technology transfers that may be involved. Elsewhere in the government, in such arenas as the Treasury Department, the Commerce Department, and the office of the US Trade Representative, the view is that offsets are "a distortion of trade," cost jobs in the US, and deplete the US industrial base, he said, adding that such sentiments are prevalent on Capitol Hill, especially among members of Congress representing the so-called Rust Belt.

Mr. Hall emphasized that US industry is not crazy about indulging in offsets but accepts the need to offer them to customers as "an element of competition" in the global market. Industry by and large does not see offsets as costing US jobs or weakening the US industrial base, he said.

He acknowledged, however, that "perhaps the time has come for the government to reenter the arena of trading in defense products" and devise a policy that would treat such trading on the same level as foreign policy.

From the floor as a member of the symposium audience and then from the podium in summing up for AL-ESA, General Fish raised the question of what can be done about the offsets situation.

Mr. Kloske recommended that the next administration "review US and allied offset policy to determine what adjustments need to be made." He described the Pentagon as "split" on the pros and cons of offsets and as needing "inputs from industry before the government moves on what is a potentially explosive issue," one that he said could actually threaten the Atlantic Alliance.

Dr. Schneider said that "market forces have driven people to compete on the basis of offsets" but that "nobody believes they are a good way of doing business." He raised the possibility of future agreements among NATO nations "not to request offsets" as part of cooperative weapons programs. But he predicted that "offsets will still be an accepted way of doing business in the developing countries."

In discussing the problem of allocation of resources for security assistance programs, Mr. Eisenhour, Mr. Bauerlein, Dr. Gaffney, and Mr. Schuerch agreed that there is much room for improvement of relations between the executive and legislative branches in the matter and that the new Administration and the new Congress should move to cement such relations.

Still, the panelists said, not much can be done by way of getting additional funds for security assistance at a time of austerity in the defense budget and in overseas grants and loans as well.

"It is unlikely that we will see large shifts up or down in the military assistance pot," Mr. Bauerlein said. "We are looking at a couple of years of creative thinking ahead, of trying to make up for some of the gap that's been created by our declining resource base." ■

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TEXAS INSTRUMENTS

In the beginning, the mechanics knew as little about fixing airplanes as the pilots did about flying them. Nevertheless, those eight "aviation mechanicians" of 1909 went at the task with an attitude that still persists eighty years later.

The Knuckle-Busters

BY BRUCE D. CALLANDER

Soon after the Air Force broke from the Army in 1947 and went into business for itself, the Pentagon came out with a set of specialty knowledge tests (SKTs) for technical as well as clerical skills.

Some senior aircraft mechanics snickered. Written exams might be all right for clerks, they said, but a good mechanic could tell you what ailed an engine just by listening to it, and then could fix it with his pen knife, if he had to. You couldn't measure that kind of knowledge with pencil-and-paper tests.

The Air Force lost some grizzled old "knuckle-busters" in the process, but the SKTs became a permanent institution. It was time. Engines and aircraft systems were getting too complicated to trust to instinct. The old-timers indeed might have been able to diagnose an engine by its sound, but future ground crews would shut out the roar with earplugs and study the blips on monitors.

The old breed of wrench-benders may have gone the way of wire wheels and wooden props, but even in an era of computerized systems and exotic building materials, their legacy remains.

In the beginning, of course, all aircraft mechanics were civilians. The first worthy of the name probably were the Wright brothers. They made their own airframes and engines and fussed over both like mother hens. When they brought their machine to Washington to show it to the Army in 1908, a young lieutenant named Benjamin Foulois told them he had read a lot about flying. Wilbur Wright told him to forget the books and get acquainted with the machine itself. Foulois put on his coveralls, grabbed some tools, and followed Wright's advice. Remembered as a pilot and later as Chief of the Air Corps, Foulois probably was also the Air Force's first airplane mechanic.

By 1909, the Army had bought one flying machine, and the Wrights had taught three officers to fly it. Foulois was the only one still on aviation duty and the least trained of the trio, but after less than an hour's instruction, he was sent to Fort Sam Houston in Texas with orders to take plenty of spare parts and to teach himself to fly. He was given a voucher for $150 (to maintain the machine for a year) and eight enlisted men to help.

The old breed of wrench-benders may have gone the way of wire wheels and wooden props, but their legacy remains. At right: KC-135 crew chief at work at K. I. Sawyer AFB, Mich.

—Staff photo by Guy Aceto

Four of the soldiers had some experience with aviation. They had served briefly on the ground crew of the Army's first dirigible. The four—Sgts. Herbert Marcus and Steven Idzorek and Cpls. Vernon Burge and Glen Modale—would later be among the first men officially rated as "aviation mechanicians." At Fort Sam, however, they learned their skills largely on the job under Foulois and Oliver G. Simmons, the Army's first civilian airplane mechanic.

Help from the Blacksmith

With the help of the post blacksmith, tailor, and plumber, the embryonic air force kept its machine flying and even made some improvements. Simmons and Modale got rid of the Wrights's cumbersome catapult and monorail launching system by adapting the wheels of a cultivator into a tricycle landing gear. The post saddlery shop fitted the machine with a seat belt so Foulois wouldn't be thrown out on rough landings.

As best it could, the crew modernized the plane by incorporating changes that the Wrights were making in their newer models. When his $150 maintenance allowance ran out, Foulois dug into his own pocket to pay for repairs. Even so, by 1911, the plane was in bad shape. While Congress debated the possibility of replacing it, publisher Robert J. Collier bought a new Wright Type B and lent it to the Army.

When the new machine arrived, so did one of the Wrights' own pilots, Phillip O. Parmalee. It was to become common practice for both the Wrights and pioneer aircraft designer and builder Glenn Curtiss to provide a "company man" with each new machine, to teach the pilots how to fly it and help the ground crews maintain it. In effect, these were the first manufacturers' representatives.

By now, eighteen young officers had volunteered for flight training, and the Army decided it was time to set up a permanent school. All flying was halted at Fort Sam, and, in the summer of 1911, planes, pilots, students, and enlisted mechanics were sent to College Park, Md. Oliver Simmons had resigned in order to work for Robert Collier, and the Army hired Henry S. Molineau to replace him. Molineau would be the only civilian mechanic at the school for the next two years. By June 1911, however, he had fifteen enlisted men to help him, and by that November the number had risen to thirty-nine.

That same year, the Army adopted the pilot test used by the civilian Aero Club of America. The main requirement was completion of three closed-circuit flights of five kilometers each. There still was no specific test for mechanics, and their training was still obtained largely on the job.

Still, the death toll among pilots mounted. Of the forty-eight officers detailed to aviation since 1908, eleven had died in crashes by the end of 1913. Outdated planes, inadequate maintenance, and pilot inexperience were blamed. The following year, Grover Loening, who had been engineer and general manager for the Wrights, was made aeronautical engineer of the Signal Service and sent to San Diego to overhaul the Army's aging planes.

The earliest mechanics were jacks-of-all-trades. World War II greatly increased the demand for skilled craftsmen. Here, a P-51 is tuned up.

The Toll Mounts

When the weather turned bad at College Park, the Army opened a winter school at Augusta, Ga., and included ground school classes for pilots in telegraphy, gasoline engines, and airplane structures. Even this much formal training might not have been scheduled if the weather had not turned sour in Augusta too. In any case, the training took place in the classroom and did not include the hands-on experience pilots really needed. Their scant knowledge of airframes and engines cost the Army both men and machines.

But change was coming. By 1912, the Army opened another flying school in San Diego, where civilian instructors taught not only flying but also repair of planes and engines.

While Loening's extensive modifications made the planes more airworthy, his department did little actual repair work. To fill the gap, Cpl. A. D. Smith and other enlisted men set up a repair shop and began to overhaul fuselages and wing sections that had previously been sent back to the factory for repair. As the shop grew, it developed separate departments. Mechanics who had been jacks-of-all-trades began to specialize. Corporal Smith and Pvt. Gordon Smith repaired fabrics and fuselages. A private named Kuhn was in charge of woodwork, and a civilian named Semeniouk made metal fittings. Maintenance training expanded, too.

In January 1914, the Army adopted tough new criteria for aviator ratings, including a test on engine operation and repair. The requirement applied not to mechanics but to pilots. Foulois, sent to San Diego as a troubleshooter, put the student officers in coveralls and, just as the Wrights had told him, told the students to go into the shops and learn something about their planes. That June, Secretary of War Lindley M. Garrison recommended that aviation officers be sent to airplane factories and that none be licensed until they had mastered the principles of construction.

By then, too, the Army finally had seen the need to develop a corps of skilled mechanics. Earlier, most enlisted men detailed to aviation had been raw recruits who spent as much time putting up new buildings as doing technical work. In the autumn of 1914, the San Diego school asked that only line Army men with an aptitude for mechanics be sent there. The Army transferred forty-four such men. That December, it adopted the examination for the rating of aviation mechanician. Among the first to pass were Marcus, Idzorek, Modale, and Burge—four of Foulois's original crew of eight. By then, Burge was a pilot and Marcus was in flight training. Both would be commissioned in World War I.

A few months before the US entered the war, the Army had sketched plans to build up to thirteen squadrons of twelve planes each by the end of the year. Since planes were expected to wear out in three months of wartime conditions, each squadron would use up forty-eight per year. The life of an engine was figured at about 300 hours, and several engines, costing about $50 per horsepower, would be needed for each plane. By that prewar estimate, five trained men would be needed for each machine.

The Plan Meets Reality

In fact, the United States faced World War I with less of everything. The Army had acquired 224 planes since 1909, but few were still in commission. All those remaining were trainers, and most of them were obsolete. It had 131 aviation officers, including recalled reservists and retirees. Of these, fifty-six were pilots and fifty-one were student pilots. There were just over 1,000 enlisted men.

When the US finally declared war, there was no lack of eager volunteers for the glamorous new field of aviation, but trained resources were in short supply. Both pilots and mechanics were sent overseas with minimal training to learn on the job from the French and British. Shortages of parts and tools were epidemic. Mechanics turned bronze shafting into bearings and used wood from packing crates to patch fuselages.

An added problem was the fact that French planes and motors were not standardized, so parts from one often did not fit another. Spruce, the preferred wood for fuselages, became scarce, and fir was substituted. Doped cotton replaced linen for wing and fuselage covering.

The US had no combat aircraft of its own design, but it produced parts for foreign planes and shipped them to Europe for assembly. Since few male mechanics could be spared from the combat units, more than 400 women were recruited to work in the assembly plants.

By war's end, the Army had built a sizable force, but it demobilized quickly when the Armistice was signed. The Air Service launched a running public-relations effort to educate the public to the potential of airpower. Lts. John Macready and Oakley Kelly flew coast-to-coast nonstop in May 1923 in an Army T-2 transport. The following year, four Douglas World Cruisers started out to circle the earth; two made it. Army pilots such as Lt. James Doolittle snatched speed records from foreign flyers. In 1929, Maj. Carl Spaatz and a crew of four kept the *Question Mark* aloft over Los Angeles for almost a week with aerial refueling. In a less subtle demonstration of aviation's possibilities, Brig. Gen. William Mitchell showed the Navy what bombers could do to a collection of captured German vessels and obsolete US battleships.

The heroes of this "Golden Age of Aviation" were the pilots. But behind the flyers were ground crews of overworked, underpaid enlisted men who kept the planes flying as they had done through the first years of flying. When the Army was drafted to fly the mail, ground crewmen shared the pilots' hardships, often sleeping in hangars and repairing the planes in cold, stormy weather with inadequate tools.

When the Air Corps was established in 1926, enlisted strength was authorized to increase from 8,342 to 14,582, but funds were so limited that the buildup had to be spread over five years. The country entered World War II with shortages of everything, including skilled mechanics.

Mechanics in the Big War

When the newly created Army Air Forces finally began to expand in 1941, growth was phenomenal. Strength increased from barely 150,000 to more than 2,000,000 within two years. Flight schools sprouted all over the country, and technical training expanded to match. By now, the Army was training mechanics not only for ground crews but also as members of flight crews on its larger bombers. The B-24 had a flight engineer to troubleshoot fuel, electrical, and hydraulic systems. He was the ranking enlisted man on the crew and, in addition to being a mechanic, served as a turret gunner.

The flight engineer's position gained importance late in the war, when the B-29 went into action in the Pacific. From a separate crew position, the engineer monitored the plane's systems and even controlled engine settings for the pilot. This trend reached its peak in the postwar B-36. Its crew of fifteen included flight engineers who ran the equivalent of a ship's engine room. Some futurists speculated that the next generation of bombers would be the aerial equivalents of naval vessels. They pictured aircraft commanders as simply giving orders from the "bridge" while specialists did the steering, manned the guns, operated the engines, and maintained the systems.

As it turned out, the B-36 was to be the last of the big-crew bombers. The sleek new jets had no cavernous hulls through which a mechanic could roam with wrench and screwdriver to fix an ailing component. Nor was there the need. Technology had produced black boxes that could monitor the systems, detect trouble, and even correct minor malfunctions. Such electronic trou-

bleshooters weighed less than human mechanics.

Flight engineers still serve on some transports, but technological advances are breathing down their necks as well. In the C-17, the flight engineer will be eliminated on most flights. Even on older transports, electronic devices now monitor subsystems, diagnose malfunctions, and even advise the pilots on the best power settings.

Ever-Increasing Specialization

If the days of the flying mechanic seem numbered, however, the era of ground maintenance is healthy and growing. Its history is one of ever-increasing specialization. It began in those days before World War I when the largely self-taught enlisted men began to concentrate on specific types of work: some on fixing engines, some on repairing airframes, some on mending fabrics. By World War II, the specialists included armorers, metalworkers, instrument repairmen, and the forerunners of today's avionics technicians.

Today, the charts of airman specialty codes are as cluttered as a plane's circuit boards. Ben Foulois's crewmen would recognize the engine mechanic and the airframe repair specialist, but they would be amazed to find whole armies of airmen specializing in such fields as life-support systems, metals processing, electrical systems, pneudraulics, egress, and fuels. They would be even more baffled to find airmen whose sole job is to maintain the ground support equipment used to test the systems that keep the planes flying.

The proliferation of specialties has changed even the structure of the maintenance operation. Through World War II, each plane usually had its own ground crew chief and a handful of mechanics. Armorers, instrument repairmen, and a few other specialists were consolidated at squadron or group levels. In the postwar demobilization, this approach no longer seemed cost-effective. Much maintenance was consolidated at base levels, and neither flight crews nor ground crews "owned" individual aircraft. Sprawling shops and depots did much of the work that had been done on the line. Maintenance specialties were divided and subdivided into increasingly narrower skills.

Recently there has been an effort to reverse this trend, to combine similar specialties and bring maintenance closer to unit level, particularly in such highly mobile commands as TAC. Such moves would not only provide more versatile maintenance personnel, some officials argue, but would help recapture the unit spirit that existed when air and ground crews had a common interest in individual aircraft.

It's unlikely that the Air Force will ever recapture the mood of a World War II flight line, much less the kind of learning experience Foulois and his eight troops received at San Antonio. Still, the challenge of fixing the machines and keeping them going remains much the same. The spirit of today's jet mechanic echoes that of his professional forebears in more ways than one might expect.

The similarity came through in a recent interview with SSgt. John M. Davis at Chanute AFB, Ill. Now a jet engine maintenance instructor at Chanute's technical training center, Davis spent seven years on the line at Edwards AFB, Calif., and later at Tyndall AFB, Fla. He was asked what was the worst aircraft he ever worked on.

"I guess it was the F-4," he said. "When I first started working on it, I hated it. Then I made up my mind that this thing was trying to kick my butt, and I was going to win. Then it was a challenge. I ended up actually enjoying working on F-4s. Every time I got a new job, it was 'All right. I haven't done this. It's time to try it and see who's going to win here.' I was going to win."

In different words and in a far different time, one of Foulois's eight soldiers might have said much the same thing about the cantankerous Wright machine that struggled skyward from the parade ground at Fort Sam. ■

—Staff photo by Guy Aceto

USAF may never again recapture the mood of the World War II flight line, but the spirit of today's jet mechanic echoes that of his professional forebears.

A World War II B-24 bombardier, Bruce D. Callander was recalled to active duty during the Korean War. Between tours of active duty, he earned a B.A. in journalism at the University of Michigan. In 1952, he joined Air Force Times, *becoming Editor in 1972. Mr. Callander has written many articles for* Air Force *Magazine, including "Apprentices With a Difference" and "It Isn't Over 'Til It's Over" in the December '88 issue.*

Viewpoint

The Mistakes of Vietnam

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

There were plenty of bunglers and incompetents, but they didn't lose the war. Our failure was one of national policy.

America's most perplexing war continues to fascinate, even as it fades into history. The Black Wall, more funerary than traditional as a war memorial, attracts a steady procession of viewers drawn there by a variety of emotions. The conduct of that war continues to be a subject of speculation and controversy. How did the United States, a full-fledged superpower, fail so miserably?

A number of recent books explore that question. In *A Bright Shining Lie: John Paul Vann and America in Vietnam* (published by Random House), Neil Sheehan, a journalist who covered Vietnam for a number of years, has used the device of biography; his subject is John Paul Vann, a celebrated, if controversial, figure during the peak of our Vietnam commitment. Sheehan sets forth in detail Vann's military exploits and his deeply flawed personal life, but underlying it all is a critique of the war. Vann's theories were at odds with the search-and-destroy strategy. He favored pacification zones and a strengthening of South Vietnam's army. Some senior US Army officers began to share his views, but by then Washington had lost its nerve and was no longer concerned with winning, just with seeking an escape hatch.

Actually, our political leaders had never really been interested in winning. Military victory involved too many risks—hence, the shackles placed on airpower and Washington's fantasy of a neutral Laos.

Another recent book is a more straightforward account of the war. Phillip Davidson, a retired Army lieutenant general, was a MACV intelligence chief, and he has written a scholarly history of the conflict from a ground officer's point of view. His book is titled *Vietnam War: The History 1946–1975,* and the publisher is Presidio Press. Davidson concludes, correctly, that the Viet Cong were defeated, with Tet the final victory in the counterinsurgency. Thereafter, it was North Vietnam that we were up against.

It is at least possible, if not likely, that President Bush may have to use the military somewhere in the next few years. With that in mind, the incoming horde of political appointees ought to take the time for a look back. Vietnam, by general agreement, was a fouled-up war, and while all the fouling was by no means the work of politically appointed transients, they made a major contribution to the mess. Just to keep the record straight, the military, including the Air Force, had its share of bunglers and incompetents in high places.

These bunglers and incompetents, however, had little effect on the war's outcome, for the overriding cause of our Vietnam debacle was one of national policy. The failure began with the tentative, more or less *ad hoc,* introduction of US forces into Vietnam. Service politics then played an inevitable role in determining the force mix, but the overall mission remained obscure. High officials—men like Averell Harriman, Henry Cabot Lodge, Jr., Roger Hilsman, and John Galbraith, to name but a few—made profound decisions on the fate of a land about which they had little or no firsthand knowledge.

In retrospect, an incident in 1962 was a clear omen of the shambles to come. Mr. Harriman, then an Assistant Secretary of State, had convened a Southeast Asia Chiefs of Mission conference at Baguio, a cool retreat in the mountains of northern Luzon. Two disaffected South Vietnamese pilots picked that moment to bomb the presidential palace in Saigon, after which they defected to Cambodia. [At the time, General Milton was Commander of PACAF's Thirteenth Air Force—THE EDITORS.] Out of curiosity, I ordered two RF-101s, which happened to be in South Vietnam at the time, to take a few pictures. When he learned about this, Mr. Harriman became quite excited and, after viewing the photos, concluded that the attack had been an attempt on President Diem's life. By some sort of extrapolation, Mr. Harriman further concluded that the bombing was proof Diem was unpopular and should be removed. On that day, the wheels were set in motion for the subsequent coup against Diem and the political chaos that followed.

Thoughtful military men like Adm. U. S. G. Sharp and Gen. Bruce Palmer have written persuasively about the strategic flaws in the Vietnam adventure. During his years as Commander in Chief, Pacific, Admiral Sharp, although a black-shoe sailor, was a steadfast advocate of the proper use of airpower. A lot of us believe, as did Admiral Sharp, that airpower could have been decisive, at least in gaining a more honorable settlement, but all that is in the past and beside the point, except insofar as it contains a lesson for future military ventures.

The first and most important lesson we should have learned is that we should only take on the things we can do. In Vietnam, we could have mined the ports and cut the rail lines and thus reduced Hanoi's logistics to a trickle.

President Bush has serious force-structure decisions ahead of him, dictated by inevitable cuts in the defense budget. If he decides to maintain readiness, as we can hope he will, other things will have to go. Clearly, we must maintain strong, credible, strategic nuclear forces, even if they never have to perform, for then they will have justified their existence. What is left over will dictate what we can do in the way of contingency operations.

In that connection, there is more at stake in Central America than there ever was in Southeast Asia, and ample opportunity to repeat our mistakes. ■

Air Force Logistics Command—which worked 360,000 procurements last year—is holding itself and its contractors to tougher standards.

AFLC Raises the Procurement Standard

BY GEN. ALFRED G. HANSEN, USAF
COMMANDER, AIR FORCE LOGISTICS COMMAND

Air Force Logistics Command is setting the standard for acquisition excellence by taking innovative and effective procurement actions across the spectrum in contracting and manufacturing. This kind of effort is necessary because the nature of our business inherently sets the stage for such problems as the "horror stories" about overpriced spare parts of the early 1980s.

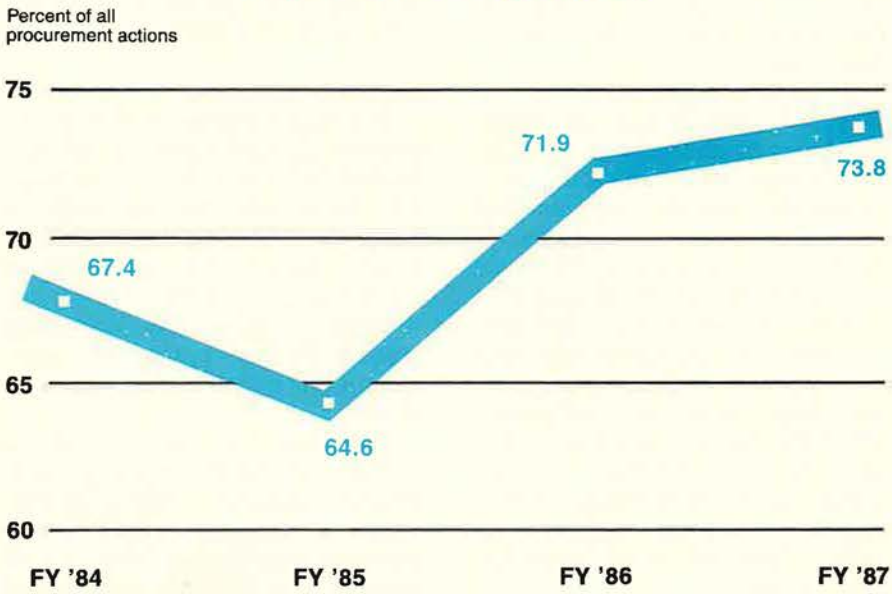
In support of the Air Force inventory, we in AFLC spend most of our money on small-buy/high-value items. In the early 1980s, as a result of manpower and budget cuts, we had to put our first priority on such contracts and assign our most experienced people to them.

The result: Many of the high-volume/lower-cost items were not given adequate attention. This, coupled with waning competition, culminated in those sensationalized parts-pricing "horror stories."

To deal with these problems, we moved in the 1980s to exploit the inherent strengths of free-enterprise economics. We improved our requirements process to give ourselves more time to buy smarter. We instituted new pricing techniques to give us a better handle on how much what we buy should cost.

We also took on the proprietary

More Purchases Open to Bid



Source: Air Force Logistics Command.

Stimulated by the "Creeping Capitalism" legislation of the mid-1980s, the Air Force has opened up more of its procurements to competitive bidding. Last year, AFLC conducted seventy-four percent of its contract actions on a competitive basis, an all-time high, finding 5,449 new sources for the products it needs.

data problem by working closely with our defense contractors. In many cases, they released their data rights to the government, often at no charge. In other cases, we obtained the data through reverse engineering.

All in all, we built a healthier relationship with our defense industrial base and assured fair prices by improving competition and opening the channels of communication. We set the stage for the many actions and initiatives that are in place today.

The number of suppliers is up, competition rates have skyrocketed, and the dollars saved are mounting.

Last year, AFLC had more than 4,000 procurement specialists working about 360,000 actions worth well over $10 billion. Better than forty-two percent of these contract dollars were awarded on the basis of competition. Seventy-four percent of the actions were competed, an all-time high. Last year alone, 5,449 new sources for parts manufacture were developed, and another 15,662 items were coded for first-time competition. The result is that our total acquisition savings exceeded $551 million, and many millions more were recovered through voluntary refunds from vendors, zero overpricing actions, and reverse engineering.

Building from these successes, we have now expanded our efforts through many additional procurement initiatives. Some of the more innovative and interesting include efforts to wage war on delinquencies, simplify the acquisition process, enhance competition for performance, set up an AFLC insurance program, contract for improved reliability and maintainability (R&M), and exploit multiple-year contracting.

War on Delinquencies

AFLC has experienced a serious problem with contractors failing to meet their delivery dates. At the beginning of 1988, AFLC's contractors averaged only a fifty-four percent on-time delivery rate for hardware, with a range from forty-six percent to sixty-two percent. Our "War on Delinquencies" started this year to improve deliveries.

First, we're focusing on our database deficiencies, because you can't identify problems without the right people having the right information at the right time. Since data management problems can't be solved overnight, we're working a near-term fix with additional management emphasis and some system improvements; in the long term, we'll be looking to our Contracting Data Management System (CDMS) as an effective, permanent solution.

Second, we're improving communications with the Defense Contract Administration Services (DCAS) and the Air Force Plant Representative Offices (AFPRO). Our goal is to have more timely and accurate information on a contractor who seems to be getting into trouble so we can begin our efforts to help, find alternative sources, or pursue workarounds.

Third, we intend to get a problem contractor's attention with alert notices and, when warranted, by withholding progress payments, using liquidated damages and incentives provisions—and ultimately, by termination, suspension, or debarment. If the contractor is a sole-source supplier, we'll pursue breaking out the procurement for competition and developing new sources.

Besides focusing on contractor delinquencies, we're also making a substantial effort to simplify the acquisition process. Buying for the government today is no simple matter. The process is ponderous and time-consuming. Just consider some typical time standards for our buying cycles: seventy-five days for advertising, 220 days for source

selection, seventy days for noncompetitive small purchase, and 180 days for definition of unpriced contract actions.

Acquisition regulations have proliferated, often faster than implementation policies can be formulated. Currently, acquisition is controlled by Federal Acquisition Regulations (FAR), FAR Supplements, Air Force Regulations, Federal Information Resources Management Regulations, and various policies.

Socioeconomic legislation comes into play, often with substantial impact. For example, laws that protect small businesses add time. Laws that protect minorities add complexity. Laws that protect the environment add costs, and laws that protect labor add to our manpower requirements.

The intent of most such legislation is good, but the cumulative effect often is not. Frequently, legislation is contradictory, and sometimes it is irreconcilable. In many cases, the negative synergism of several laws taken together can thwart our best efforts to spend the taxpayer's money wisely.

Our procurement and legal people actively evaluate pending congressional actions for their impact on AFLC's acquisition process, and new legislative agenda items are developed as appropriate.

Factors in the Award

The acquisition process does not adequately distinguish good performers from not-so-good performers. To remedy this, an initiative was begun. The objective of this initiative, often called "Blue-Ribbon Contracting," is to award contracts to vendors who provide the greatest value to the government, with price and other factors taken into account.

This initiative gives contracting officers the means of paying a premium to contractors whose quality, past performance, and delivery rates are outstanding. They can be awarded contracts even when their bids are not the lowest, if the contracting officer determines that their bids represent the best overall value.

We have shared this concept with all DoD agencies, and both the Navy and Army have adopted it.

We not only have to identify and reward good performers, but also must protect ourselves from those contractors who are "not so good" —particularly when new suppliers and critical items are involved. Any time an award for critical items may go to a first-time producer, and there could be a break in the logistics supply pipeline if that producer does not furnish the product on time, we let two contracts.

The first contract, which is for the minimum quantity needed to determine production capability, goes to the first-time producer. The second, which is for a minimum quantity essential to avoid a break in supply, goes to a proven source. This second contract represents our insurance policy. We also put options into both contracts to ensure that the entire quantity can be obtained, no matter what happens with the first-time producer.

In a period of scarce resources, the defense-business environment is tough and competitive. We want to use this toughness and competitiveness to best advantage by emphasizing quality. We will do business with companies with the best R&M track records—in effect, making a contractor's market share proportional to the reliability and maintainability of his products.

This initiative gives contractors incentives to produce more reliable and maintainable products using state-of-the-art technologies. Criteria for competition include such things as maintenance costs throughout the service life of the product and improved performance warranties.

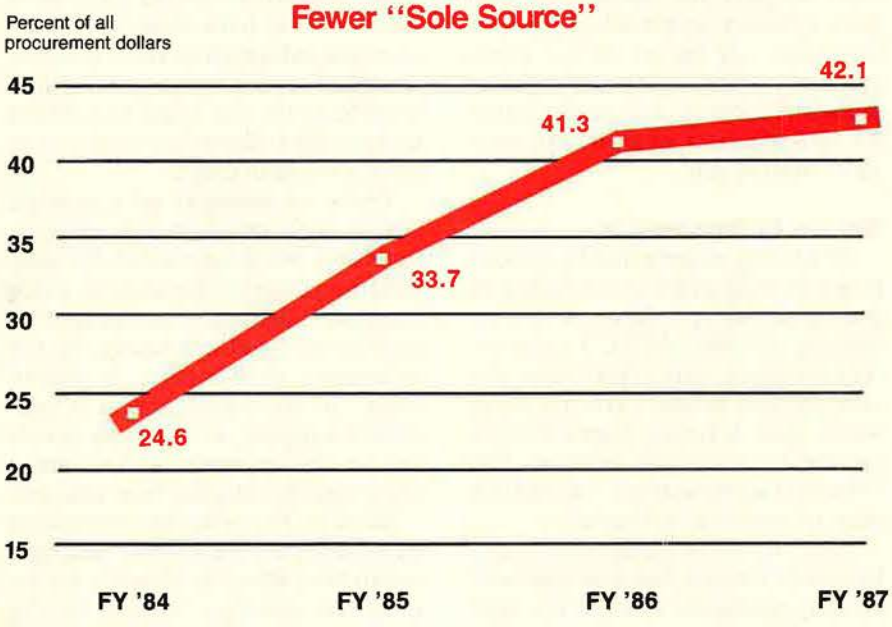
Our goal is to establish minimum R&M levels, but not to limit R&M levels by the way we write specifications. Reliability and maintainability specifications should not represent goals, but rather should establish baselines. The sky is the limit on R&M, and we want those companies that can climb the highest to get our business.

Multiple-Year Contracting

Contracting for more than one year at a time makes sense for both government and industry. Multiple-year cycles allow contractors to plan ahead, establish a stable and skilled work force, and buy larger amounts of required material at a time. It spreads their overhead across more items and, in the end, significantly reduces their prices to the government.

To identify outyear requirements

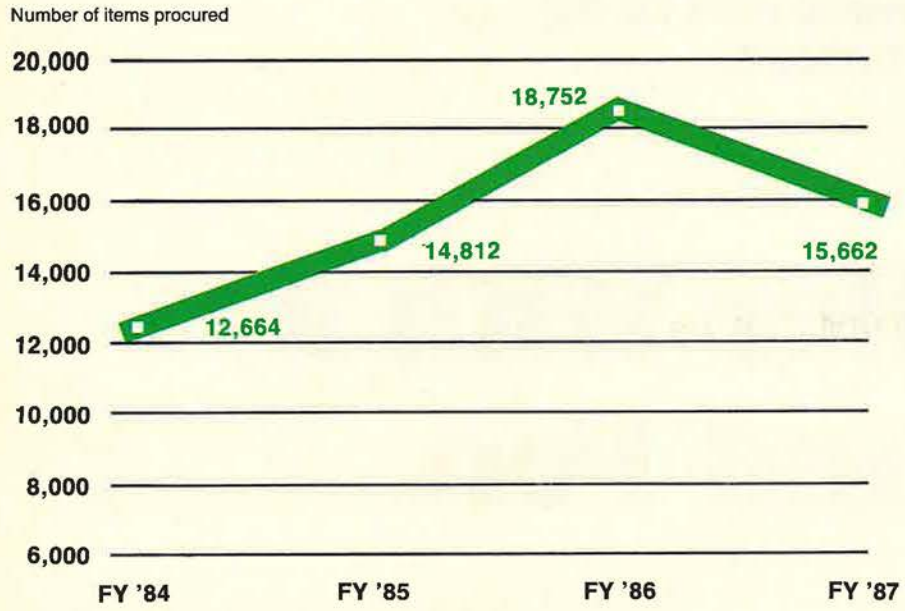
More Dollars in Competitive Transactions, Fewer "Sole Source"



Source: Air Force Logistics Command.

Since most AFLC procurements are for relatively small amounts of money, it is important to look at the share of the dollars—as well as of the contract actions—spent in competitive transactions. AFLC has raised that level to forty-two percent of the total value of its annual procurements. While pleased with this trend, AFLC continues to focus on value and quality, not competition for competition's sake.

New Items in Competition



Source: Air Force Logistics Command.

Between FY '84 and FY '87, of the items previously bought sole-source, AFLC put 61,890 out for competitive bid. The breakout peaked in FY '86, when 18,752 new items were identified for first-time competition.

and increase the use of multiple-year contracting, AFLC has established goals for its centers and has institutionalized a multiple-year contracting program command-wide.

Multiple-year contracting should not be confused with multiyear contracting. Multiple-year contracting involves a whole class of contracts and techniques; it includes multiyear contracting, which typically lets us buy three years' worth of supplies at one time. Multiple-year also includes requirements and indefinite delivery contracts (prearranged agreements that allow a quick-response ordering), quantity discounts (which lets the government select the procurement quantity that serves it best), and options (to buy additional quantities on an existing contract).

There are, of course, many other procurement initiatives—some 126 in our contracting and manufacturing community alone—covering a whole range of acquisition activities. Among them are efforts to modernize our data-management systems, improve program execution, deal with support requirements for old technology, streamline procurement arrangements for engines, provide improved warranties, or enhance programmed depot maintenance contracts. We have initiatives that deal with acquisition plans, justification and approvals, fixed-price redeterminable contracts, price-increase certifications, pricing work load, specifications and standards, and competitive technical services. The number of procurement initiatives currently ongoing in this command reflects the complexity of the acquisition process and the importance we place on buying the most combat capability possible for every dollar.

Looking Ahead

With new and ever more complex weapon systems coming into the Air Force inventory, the logistics challenge will be even greater, but the resources available to meet the challenge will be limited. AFLC, therefore, will continue its push for acquisition excellence.

Many of the conditions that set us up in the 1970s for the parts-pricing problems of the 1980s are starting to reappear. Defense budgets are getting smaller. Some economists expect inflation to rise. We're also seeing significant defense manpower cuts, and certainly the costs of supporting both new and old technologies continue to be a strain.

But things are different now. For example, there's a much better appreciation for logistics on the part of the combat commanders. Unlike the 1970s, when *numbers* of systems were the focus, today's commanders are more concerned about *supportable* and *available* weapons.

We also have a much healthier acquisition environment today. Numbers of suppliers are up, competition is keen, and we're further along the learning curve than we were just a few years ago.

The importance of having adequate numbers of skilled procurement specialists cannot be overstated, and we do have some real concerns in this area. Fewer people working the acquisition problem usually means longer administrative lead times, and that has a direct negative impact on Air Force mission-capable rates. In addition, fewer people also means less supervision of lower-cost contracts, and that always carries with it the potential for unpleasant surprises.

New technology is coming on line to help us manage our resources better. Maintaining visible and accessible data on the hundreds of thousands of contract actions and the billions of dollars spent each year is no simple matter, even with modern computers and integrated databases.

We're also committed to strengthening the vital partnership between Air Force Logistics Command and America's defense industry. That means we have to make an extra effort to work together—to keep open the channels of communication, to be sensitive to one another's needs, and to exploit fully the potential benefits of free-enterprise economics and American ingenuity. I have no doubt that AFLC and industry, working together as a team, will continue to find new and better ways to provide combat strength through logistics. ■

Gen. Alfred G. Hansen, Commander of Air Force Logistics Command since June 1987, served in 1985–87 as director of logistics, J-4, Organization of the Joint Chiefs of Staff. His earlier assignments included logistics and maintenance engineering commands and fighter operations.

It all began a quarter century ago this month, when Bob Stevens sent us his first "There I Was..." cartoon.

Storyteller With a Brush and Pen

BY JEFFREY P. RHODES
AERONAUTICS EDITOR

IT ALL began with a letter in September 1963. Bob Stevens, then Lt. Col. Robert M. Stevens, USAF, wrote to Jack Loosbrock, then Editor of AIR FORCE Magazine. Saying he had "reams of material," Colonel Stevens wondered if the magazine would be interested in running some of his cartoon reminiscences as either a one-time piece of "spot" art or as a regular feature.

The rest, as they say, is history. Twenty-five years ago this month, "There I Was . . ."—Bob Stevens's look at the lighter side of the flying business—premiered. Three hundred and two pages later (two episodes were double-page spreads), the AIR FORCE staff has long conceded that the one-page feature at the back of each issue is the first thing most readers turn to each month.

The "There I Was . . ." drawings have an air of authority about them because Stevens really was there. He soloed before Pearl Harbor, was commissioned in 1943, and flew F-5s (photoreconnaissance P-38s) and P-51s in the Pacific during the war. After a short postwar stint as a commercial pilot, he rejoined the Air Force and flew F-80s, reverted to P-47s, then switched to F-86s. In 1950, he set an unofficial world speed record of 711.75 mph in an F-86A. He ended his career as an Atlas missile squadron commander and retired from the Air Force in 1964, six months after "There I Was . . ." started.

A man at home in the cockpit is Bob Stevens, shown here about a dozen years ago on a visit to Luke AFB, Ariz., as he gathered material for more of his "There I Was . . ." cartoons.

"The stuff that actually happened to me filled up the first ten years," said Stevens, who lives with his wife Barb in southern California. "From then on, I've had to depend on people telling me what's going on. The truth is actually funnier than the stuff you can imagine."

Sometimes, though, real-life inspirations haven't come. Stevens has then relied on his lively imagination, which was fostered at an early age by his mother, who let him draw on the backs of her rolls of shelf paper.

He became known as a cartoonist while in the military. "I'll make up a story out of the clear blue—the B-29 in the Pacific that made an approach to an aircraft carrier with its gear down, or the Jeep that went over the cliff on Ie Shima—and several people will write and say, 'Hey, I was on that carrier,' or 'I was there when that happened!' That's either an incredible coincidence or there are a lot of bull shippers [his actual

words] out there. Somehow, the stories become fact."

More has changed over the past quarter-century than Stevens's sources of inspiration. Both his style of drawing and his point of view have undergone some alteration.

Compared to the early drawings (some of which can be seen in this month's "There I Was . . ." retrospective), Stevens's style today is much cleaner and crisper. Part of this change can be attributed to the specially treated paper he now uses, which makes shading easier, and part of it is Stevens's shift to the "less-is-often-more" school of detailing.

"I think I stage the drawings a little better now," said Stevens. "Now I use lighting and angles more to break up the monotony of a flat [cartoon] panel.

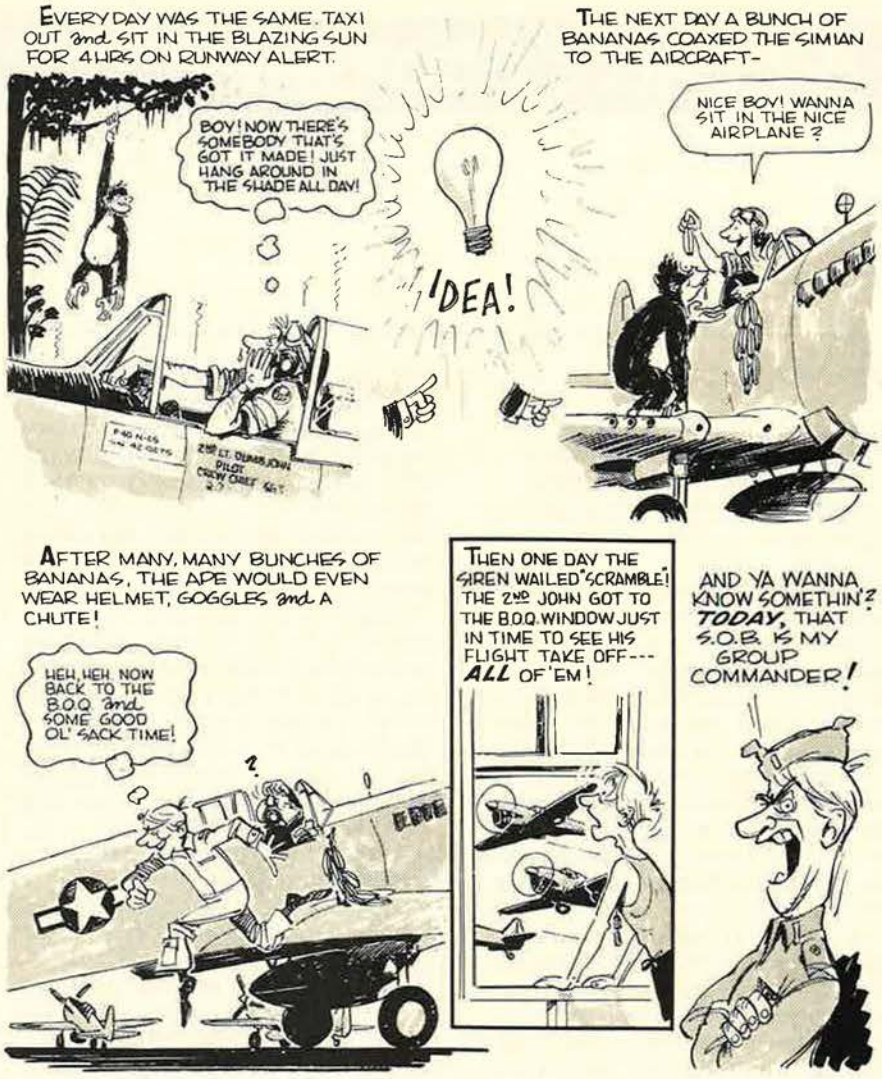
"Also, I think that as you get older, there's a natural tendency to understate rather than overstate," noted the cartoonist, who also draws for *Professional Pilot* and *Private Pilot* magazines. "I now try for more subtlety, rather than the pie-in-the-face types of gags."

Stevens's all-time favorite episode uses both subtlety and slapstick, though. The first three panels of the April 1975 "There I Was . . ." show a bored P-40 pilot coaxing a monkey to the aircraft with a bunch of bananas (which *could* have happened, after all). The final two panels are the "gotcha," as can be seen in the illustration.

"I use that one in talks, and it still brings as much laughter as anything," noted Stevens.

"Keeping up with the technical aspects of aviation has been an awesome task," said the Iowa-born Stevens. "Twenty-five years is an eternity in the flying business. I've covered the evolution of things from the "coffee grinder" radios I knew in the P-40 to the HUD [head-up display] in today's tactical fighters that tells a pilot how much fuel he has left." Stevens's reference morgue has quadrupled in size over the years, and he says that it's still not big enough.

The only change in the "There I Was . . ." audience is that it has grown steadily since 1964. "I want to continue to draw for a spectrum of people," noted Stevens, whose



Here's cartoonist Stevens's own all-time favorite. It first ran in the April '75 issue of* AIR FORCE *Magazine and had its origin in the Panama Canal Zone during World War II where a bunch of bored P-39 and P-40 jocks stood sub alert.

editorial cartoons were syndicated by the Copley News Service for many years. "In fact, almost a quarter of the guys who started with me in my flying class [43-E] attended our last reunion—that's 1,000 men.

"The Vietnam vets have taken the spotlight lately," Stevens added, "but the Korean War element is starting to show itself. Korea was a hard, miserable war with heavy casualties in a short time. It seems like they always fight a war in the world's most unpleasant place."

Stevens owned a Mooney 201, and over the years, he got permission to land the little plane at military bases while on assignment for this magazine. Although he now no longer flies, his most memorable moment as a cartoonist came while flying his plane on a trip to McClellan AFB, Calif., several years ago.

Air traffic controllers at McClellan had to hold a C-5 on the runway to let Stevens and his Mooney take off. Otherwise, the huge transport's jetwash would have blown the Mooney into San Pablo Bay. "When the controller told the C-5 to 'hold for the Mooney,' the pilots had to stand up in their seats to see us," Stevens gleefully recalled.

There have been many other highlights during Bob Stevens's drawing career, but he takes it all in stride. "I'm just a storyteller with a brush and a pen. I owe the Air Force a lot—I was treated well both on duty and after I got out. The only way I can repay that is through humor." ■

Airman's Bookshelf

Life of "Tooey" Spaatz

Master of Airpower: General Carl A. Spaatz, by David R. Mets. Presidio Press, Novato, Calif., 1988. 405 pages with bibliography and index. $18.95.

The life and times of Carl A. "Tooey" Spaatz and the institutional evolution of the US Air Force are irrevocably intertwined. His career began in the earliest days of military aviation, continued through two world wars, and culminated in his being chosen in 1947 as the first Chief of Staff of the newly independent Air Force. Despite his administrative, organizational, and combat genius, Spaatz remains one of the least known and least understood flyers of his era.

Born in Pennsylvania in 1891, Spaatz graduated from West Point in 1914. His academic record was mediocre, and his personal conduct worse. He tried to resign two weeks after he arrived; he was charged with illegal possession of liquor on the post; and he "gambled" on the annual Army-Navy football game. He graduated in the lower half of his class. In fact, on the day of his graduation, he was still marching off demerits.

After graduation and flight school, Spaatz served with the 1st Aero Squadron in the 1916 punitive expedition against Pancho Villa. Known even then as a bold and daring pilot, he constantly pestered Gen. John J. Pershing to go for an airplane ride with him. Finally, in exasperation, "Black Jack" said, "Young man, when I want to fly, I'll order you to take me up"—which he never did. Nevertheless, Spaatz always seemed to consider his duty as a young maverick pilot in the wilds along the Mexican border as the most exciting and happiest days of his career.

In 1917, Spaatz was ordered to France, where he commanded a training school for fighter pilots. While he lost a reputation for clowning, he gained another one: as a top pilot and superb leader.

After Spaatz shot down three German planes, Col. Billy Mitchell personally recommended him for the Distinguished Flying Cross. Of equal importance, Spaatz learned well not only the new, revolutionary doctrine associated with fighter planes and their tactical use but also the theory and philosophy of what became known as strategic bombing.

Spaatz quickly climbed the career ladder in the postwar 1920s. He served as commander on the Air Service's only pursuit squadron and wrote manuals on pursuit, attack, observation, and bombardment for his mentor, Billy Mitchell. He was assigned to the Army's Training and War Plans Division in Washington, D. C., where for four years he headed the Tactical Units Branch.

Having become a master in the pursuit/fighter plane world, Spaatz in the 1930s changed his career pattern. He took command of the 7th Bombardment Group in San Diego just when evolving technology began producing big bombers with large-load and long-range capabilities.

During that decade, he was a prime advocate of the new strategic doctrine that argued that huge, daylight bombers could locate and destroy the enemy's crucial industrial and military resources. With the introduction of the B-17 in the late 1930s, Spaatz had the plane he needed for the realization of his theories.

He spent 1939 to 1941 on the staff of Gen. "Hap" Arnold, head of the Army Air Corps. His mission was simple yet mind-boggling; after twenty years of peace and low budgets, he was to get the Air Corps ready for war.

After Pearl Harbor, Spaatz was immediately named Commanding General of the Eighth Air Force in England and master of the primary strategic offensive against Germany.

Throughout the first two years of US involvement in the war, official AAF doctrine and policy fluctuated from the strategic to the tactical and back to the strategic. Spaatz, however, never wavered in his belief that the Allies had first to establish absolute air superiority over the Nazis and then to "bomb them back to the Stone Age," as his then-subordinate Curtis LeMay later argued. As Lt. Gen. Ira Eaker said after the war, Spaatz often took the unpopular course, "but he believed it was right and would not compromise."

By 1944, Spaatz had become General Eisenhower's right-hand man and his chief air advisor. He had personally created and implemented a true strategic bombing doctrine, had achieved virtual air superiority over Europe, and had been instrumental in ensuring the success of the D-Day landings in France. The young rebel, the nonconformist of West Point, had never changed, and the military world increasingly leaned toward his innovative and creative notions—because they yielded concrete, verifiable, and definitive results.

In 1945, Spaatz was at his career peak. His theories—with regard to both bombers and fighters—were vindicated by the total destruction of the German warfighting capability.

After V-E Day, he was sent to the Pacific; however, he had only been there for a couple of weeks before the atomic bomb ended World War II. He didn't make the decision to drop the bomb—but he made sure it was delivered on time.

With the war's end, Spaatz devoted the rest of his career to the establishment of the AAF as an independent arm of the military. Knowing well the value of public relations, he and "Hap" Arnold both worked long and hard toward the development of the Air Forces League—which ultimately became the Air Force Association. Shortly thereafter, largely through his persuasive arguments, the Air Force was established as a third, equal partner with the Army and Navy.

"Tooey" Spaatz, first Air Force Chief of Staff, died in 1974. A colorful character to the press, he was really a quiet, humble person to those who knew him best. He was probably more aware than any of his contemporaries of both doctrine and public relations. A pragmatist, as Mr. Mets says, he had "an unerring sense of what would work."

A massive history of World War II

and a fine biography of one of its foremost commanders, *Master of Airpower* is required reading for those who know, or would like to know, the way things were in the Air Force of yesterday.

—Reviewed by Dr. William J. Teague. Dr. Teague lectures on American Government at the University of Texas at Dallas and is a regular book reviewer for AIR FORCE *Magazine.*

LeMay and the B-29

Superfortress—The B-29 and American Air Power, by Gen. Curtis E. LeMay and Bill Yenne. McGraw-Hill Book Co., New York, N. Y., 1988. 222 pages with appendix. $18.95.

American airpower in the Pacific theater in World War II was dominated by two forces. One was the B-29—the right tool at the right time. The other was a superb military tactician, in the person of Gen. Curtis E. LeMay. The fusing of these two elements led to the ultimate defeat of the Japanese empire.

Readers now have a chance to read of the complete development of the B-29, as told by the man who was entrusted with its employment in the Pacific. LeMay opens by going through the turbulent beginnings of the Army Air Corps and the tribulations of its "patron saint," Brig. Gen. William Mitchell, who believed in the concept of strategic airpower. The B-29 would prove the validity of that idea.

However, the road that led to the Superfortress was not an easy one. It fell to one of General Mitchell's followers, Gen. H. H. "Hap" Arnold, to travel down that road—taking chances, cutting corners, and ordering the airplane into production even before the prototype was completed.

It also took the likes of Claire Egtvedt and engineers at Boeing, building on the successes of the B-17, to produce a truly strategic bomber. It would take the efforts of such men as test pilot Eddie Allen (who lost his life during testing) to make sure the B-29 would be the superb aerial bombing platform that it became. Finally, it would take a superb aerial strategist like General LeMay to employ the weapon to its full potential.

General LeMay takes us behind the scenes during the building of the aircraft and provides some interesting and little-known facts about the Superfortress. For instance, the aircraft had just over nine times the wing area of a Piper Cub, but, we're told, could lift more than *ninety* times the weight.

Of course, no recounting of this airplane's history would be complete without the background of the two atomic bomb missions flown. As commander of the XXI Bomber Command, General LeMay gives us a frank personal insight into both the decision to use the weapon and the mission profiles flown.

The book closes with an appendix bristling with facts and figures on the B-29 program. This fascinating volume should be a welcome addition to any airman's library.

—Reviewed by Capt. Ron Lovas, USAF. Captain Lovas is Chief of Public Affairs for the 323d Flying Training Wing at Mather AFB, Calif. He is a former Contributing Editor to this magazine under the Air Force's Education With Industry program.

New Books In Brief

Jane's World Combat Aircraft, edited by Michael J. H. Taylor. This work could have almost been titled "The Best of *Jane's All The World's Aircraft,*" for it condenses the 1,500,000-word *Jane's* and deals solely with combat aircraft. Unlike other books, this one does not limit itself to fighters and bombers, but also includes helicopters, reconnaissance, dual-role trainers, and special-duty types. Unlike *Jane's,* this volume also includes information about aircraft variants that are no longer in production, such as F-15As.

Detailed specifications are listed for the basic (or predominant) version of each type, as well as a complete development history of each aircraft. The information is accurate and current (up to early 1988), and this makes for a very complete, very useful reference work. Jane's Information Group, Inc., Alexandria, Va., 1988. 416 pages with photos, three-view line drawings, and index. $75 hardbound.

The World Atlas of Warfare—Military Innovations That Changed the Course of History, by Richard Holmes. More than just an almanac of weapons and wars, this volume describes how the science of warfare has evolved since the dawn of recorded time. Full of color illustrations, maps, charts, and photographs, *The World Atlas of Warfare* focuses on the turning points in warfare, ranging from the chariots used in the battle of Kadesh (circa 1286 B. C.), through trench development in World War I, to the AirLand Battle doctrine of today. Also included are brief biographies of famous military leaders, discussions of support systems, and chronologies of the major eras in warfare. As a reference, this book is first-rate. It is also an interesting read. Viking Studio Books, New York, N. Y., 1988. 304 pages with photographs, maps, charts, and index. $40.

The National Air and Space Museum (Second Edition), by C. D. B. Bryan. This second edition of the definitive aviation coffee-table book is as compelling as the first. Bryan has revised the book to include the five major galleries that have been changed since the Museum opened in 1976—Early Flight, Golden Age of Flight, Jet Aviation, Looking at Earth, and Stars—as well as new exhibits in old galleries, such as the *Double Eagle II* and *Voyager.* As in the first volume, the photos (almost all in full color splashed over the pages) are the real stars of the book. Printed on high-quality stock, this book, like its predecessor, is destined to become a treasured heirloom. Henry N. Abrams, Inc., New York, N. Y., 1988. 504 pages with photographs, chronology, bibliography, technical appendix, and index. $60.

—Reviewed by Jeffrey P. Rhodes, Aeronautics Editor.

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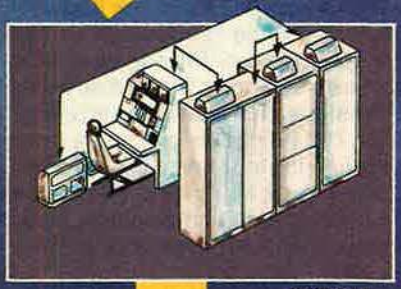

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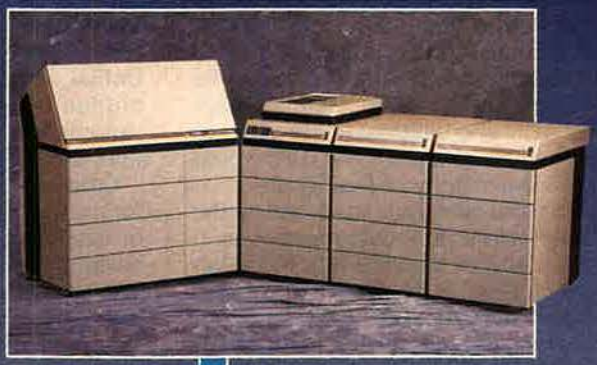

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A Thyng of Valor

Harrison Thyng's unique career pitted him against fighter pilots of five nations.

BY JOHN L. FRISBEE

FROM July 1939 to September 1945, the Army Air Forces trained 193,440 pilots. About 36,000 became fighter pilots, but of that number only 697 achieved the honored status of ace during World War II. Many of those aces flew again in the Korean War. Six of them shot down five or more enemy jets to form the elite circle of Air Force prop and jet aces. One of the six was Harry Thyng, a member of Flying School Class 40-A, whose career was studded with distinctions.

In the late spring of 1942, the 31st Fighter Group arrived in the UK to be equipped with Spitfires. Seven of its senior officers were detached to an RAF fighter group to gain operational experience. Among them was Maj. Harrison Thyng, commander of the 309th Squadron. On July 26, 1942, the 31st pilots flew on an RAF fighter sweep over northern France to become, according to several sources, the first AAF fighter pilots to see combat in Europe. Three weeks later, Thyng was awarded the Silver Star for protecting one of his pilots downed in the Channel while Thyng himself was under attack by enemy fighters.

Early in November 1942, the 31st Group moved to Gibraltar to support the November 8 Allied invasion of North Africa *(see November '88 "Valor")*. On D-day of Operation Torch, Thyng led his squadron to a field in Algeria. There, American aircraft in the landing pattern were under attack by Vichy French Dewoitine 520 fighters. The 309th pilots downed three of the four Dewoitines, one of them falling to Harry Thyng's guns for his first confirmed victory.

During that cold, wet North African winter, the 309th moved frequently from one improvised strip to another, living under primitive conditions and averaging three missions a day in support of ground operations and against the cream of the Luftwaffe and the Italian Air Force. On one mission, Thyng crash-landed his battle-damaged Spitfire behind enemy lines, suffering a back injury. Armed only with a pistol, he fought his way through an Arab patrol to the sanctuary of a friendly tank.

Another day, while Thyng was on the tail of an Me-109, a British antiaircraft unit, wishing to be helpful, opened fire on the enemy plane but shot down Thyng's Spitfire. After his rough parachute landing, apologetic Brits put the bruised pilot in a jeep for return to his squadron. On the way, the jeep driver went over an embankment. Thyng was thrown out, breaking his ankle.

The next morning, as he hobbled to operations with his ankle in a cast, he was met by his crew chief, standing beside a Spitfire, "borrowed" during the night from another squadron, with Thyng's name painted on the nose. The crew chief had rigged a sling on the rudder bar "so we won't have to miss a mission." Years later, in February 1975, retired Brig. Gen. Harrison Thyng wrote about that crew chief in one of the most engaging stories AIR FORCE Magazine has ever published.

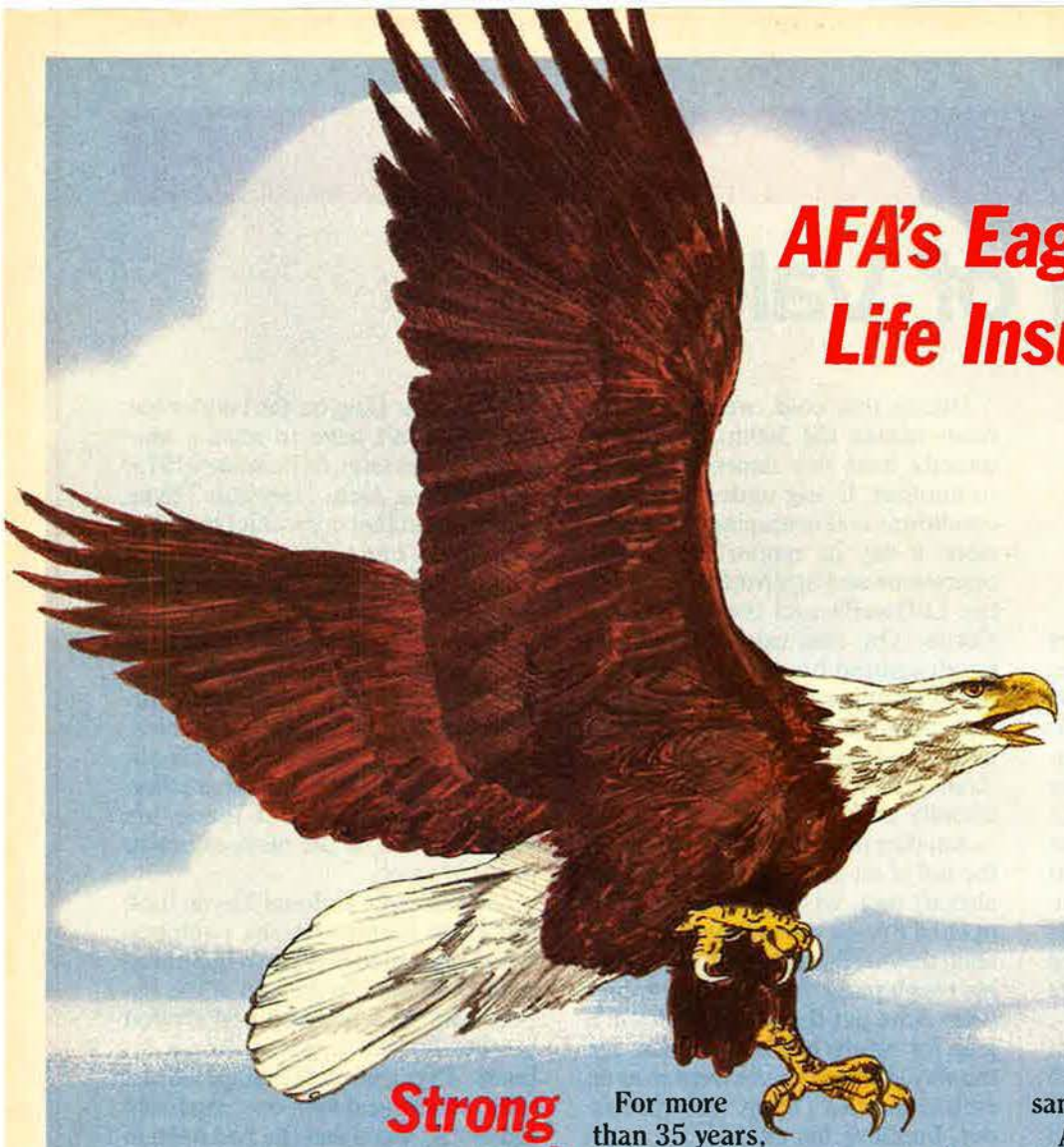
Colonel Thyng waves from the cockpit of his F-86 Sabrejet after his first victory over a MiG-15 in the Korean War.

Harry Thyng ended his tour in England and North Africa with 162 combat missions, five enemy aircraft confirmed, several probables, and an Oak Leaf Cluster for his Silver Star. He was cited for inspirational leadership that made his squadron one of the most effective in the theater.

In May 1945, Colonel Thyng took the 413th Fighter Group, equipped with long-range P-47Ns to Ie Shima, near Okinawa. To the end of the Pacific war, they bombed and strafed targets in the Japanese home islands. Thyng is unofficially credited with shooting down one Japanese fighter. At war's end, he had been in combat with pilots of four nations—France, Germany, Italy, and Japan. That string was to be extended to five while he commanded the 4th Fighter Interceptor Wing in Korea, going against MiG pilots of the Chinese People's Republic.

While leading the Wing from November 1951 to October 1952, Colonel Thyng flew 114 combat missions, shot down five MiGs, and was awarded a third Silver Star. But his combat career was not yet over. In 1966, on a special assignment in Vietnam to test air-to-air missiles, he flew several missions as a brigadier general, retiring later that year with a total of 650 combat hours in three wars.

Harry Thyng ran for the US Senate in his home state of New Hampshire, losing by a narrow margin. He served as president of a junior college and as president of the American Fighter Aces Association. General Thyng died in 1983, honored as a superb leader in peace and in war. ■



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By John R. "Doc" McCauslin, CHIEF, FIELD ORGANIZATION DIVISION

In the Field

The **Abilene (Tex.) Chapter** recently hosted a POW Appreciation Dinner at the Dyess AFB NCO Open Mess, where nearly 100 chapter members honored local former POWs and their spouses. Former President of Texas State AFA John Russell introduced AFA Life Member and guest speaker Col. John E. Stavast, USAF (Ret.), who related experiences from his five and a half years as a POW in Vietnam.

The **John W. Demilly, Jr., Chapter** in Homestead, Fla., took first place for its float in the Homestead parade. The spirited, colorful float carried replicas of the Statue of Liberty and Old Glory flags. Chapter members distributed candy along the parade route. Also, the Demilly Chapter folks sponsored nearly 100 members of the Military Affairs Committee at a US Customs Service Drug Interdiction Team presentation on the topic of drug-carrying aircraft and methods to deter drug addiction in Florida.

The **Golden Gate (Calif.) Chapter** cosponsored the Annual Battle of Britain Service of Remembrance at the Presidio of San Francisco's Chapel and a luncheon at the NCO Open Mess. Recalling experiences of American Eagle Squadrons and exiled Polish airmen during the Battle of Britain were Robert Reynolds, Secretary of the Royal Air Force Association, and Maj. Gen. C. W. "Red" McColpin, USAF (Ret.). After both men addressed the large gathering, Mr. Reynolds presented the Golden Gate Chapter with a painting of American Eagle Spitfires in appreciation for cooperative efforts between the chapter and the RAF Association.

The **Wright Memorial (Ohio) Chapter** celebrated the forty-first anniversary of the Air Force with a large, formal awards banquet at Wright-Patterson AFB, Ohio. Awards were presented to Lt. Col. Charles J. Rigano, Outstanding Senior Military; Capt. Thomas E. Saner, Outstanding Company Grade Officer; MSgt. David R. Murray, Outstanding NCO; Col. Gordon S. Walbroehl, Outstanding Reserve Officer; MSgt. Fran A. Valensi, Outstanding Reserve NCO; Ellen R.

At an awards banquet held at the USAF Senior NCO Academy at Gunter AFB, Ala., AFA National President Jack C. Price (left) presents SMSgt. George J. Matta, Jr., with the National Security Affairs/Force Employment Award. Sergeant Matta, who accepted the award for Class 88-E, is a member of the Command and Control Systems Office, Tinker AFB, Okla.

Lt. Gen. Elwood "Pete" Quesada, USAF (Ret.), first Commander of Tactical Air Command, recently visited the Jerry Waterman (Fla.) Chapter and spoke on his experiences as a pioneer aviator, including the famed Question Mark *refueling mission. Shown, left to right, are Brig. Gen. James Jamerson, Commander, 56th Tactical Training Wing, MacDill AFB, Fla.; Brig. Gen. Robert Beyers, USAF (Ret.), immediate past Chapter President; General Quesada; Marion Chadwick, Chapter President; and Roy P. Whitton, Florida State AFA President.*

Brig. Gen. Walter Kross (left), Vice Commander, Air Force Military Personnel Center, Randolph AFB, Tex., presents a POW Medal to Alamo (Tex.) Chapter President Paul D. Straw, in honor of Mr. Straw's imprisonment in Stalag Luft I in 1944-45. Applications for POW Medals and further information can be obtained from AFA National Vice Presidents, State Presidents, and Directors or from AFA Headquarters, Field Organization.

AFA Chairman of the Board Sam E. Keith, Jr. (right), accepts a special presentation from Michael Fedorchak, then Gen. David C. Jones (N. D.) Chapter President, during the AFA National Convention.

LaGrone, Outstanding Civilian Manager; and Kay H. Veal, Outstanding Civilian Technician. Scholarships were presented to Ohio State University ROTC cadets Kim Corner and Christina Stanchi. Chapter President William Schaff introduced Lt. Gen. John M. Loh, Commander of Aeronautical Systems Division (ASD), as the guest speaker. The General spoke on positive military aspects of 1988, the need for an informed public, and requirements for maintaining a strong national defense.

The **Richard I. Bong (Minn.) Chapter** held its quarterly meeting in Duluth with a very special guest speaker—Gen. John Vessey, USA (Ret.). General Vessey, a Life Member of AFA, spoke of his efforts regarding the POW/MIA mission assigned by the President of the US. The former Chairman of the Joint Chiefs of Staff also spoke of the strength of America's defense, the efficiency of our forces, major contributions of the ANG and Reserve, the importance of immediate utilization of space, and cooperative efforts among nations for a lasting peace. Also attending this function were Minnesota State AFA President Maj. Gen. Doyle Larson, USAF (Ret.), past Chapter President John R. Hed, and newly elected Chapter President Curtis Jones.

The **Major General Charles I. Bennett, Jr. (Calif.), Chapter** enthusiastically accepted a Barry Goldwater Fellowship from Gen. Jimmy Doolittle, USAF (Ret.). General Doolittle asked that the fellowship, which is in the form of a photograph of a Hualapi Indian, be retained in his name at the Castle Air Museum. A capacity crowd was on hand for the evening as Hal Strack, then President of California State AFA, and Chapter President Aaron Page presided over the festivities.

AFA National Headquarters was the scene of an intense two-and-a-half-day orientation for AFA National Vice Presidents, State Presidents, and newly elected Directors. Chairman of the Board Sam E. Keith, Jr., and National President Jack C. Price presided over the sessions, which addressed the responsibilities and operation of AFA at chapter, regional, and national levels.

Anheuser-Busch, Inc. and AFA's Nation's Capital (D. C.) Chapter recently raised $24,350 in scholarship funds for the Aerospace Education Foundation by cosponsoring a Charities Golf Outing. Tom Moore (left), Anheuser-Busch's Director of Military Sales, and Denny Sharon (far right), then Nation's Capital Chapter President, present the check to AFA Executive Director Chuck Donnelly and Director of Meetings and Conference Services Rosemary Pacenta.

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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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(919) 936-9361

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New Chapters

Recently chartered as AFA's newest chapter, the **Durham-Chapel Hill (N. C.) Chapter** is the seventh new chapter in the Southeast Region in less than a year. Frederick W. Knops, Jr., was installed as Chapter President by AFA National Vice President for the Southeast Region James "Red" Smith and by Robert Newman, North Carolina State AFA President.

The **Roanoke Valley (N. C.) Chapter** also recently received its charter from "Red" Smith, Bob Newman, and North Carolina State AFA Vice President John White. The guest speaker for the event was Lt. Col. William Daws, Jr., a native of Roanoke Rapids and the Deputy Commander for the 4th Supply Group at nearby Seymour Johnson AFB, N. C. Colonel Daws's address centered on the history and mission of Seymour Johnson AFB. Among the many dignitaries in attendance were Harry Branch, Chairman of the Halifax County Commissioners, and three local mayors: Lloyd Andrews of Roanoke Rapids, Johnny Draper of Weldon, and Benjamin Tripp of Halifax.

Commemorations

The **POW Medal** recently authorized by Congress is now available "to recognize the honorable service of United States military personnel who were taken captive in World Wars I and II, Korea, and/or Vietnam." AFA Headquarters has distributed application forms for the medal to all National Vice Presidents, State Presidents, and newly elected Directors. Members, former POWs, their representatives, or next of kin are encouraged to contact the Field Organization Division (800-727-3337) for additional forms or additional information.

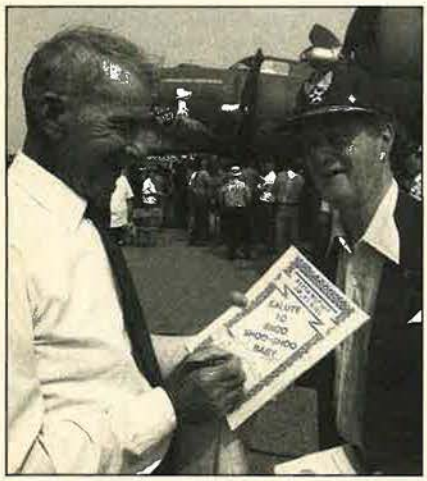
Continuing his active participation in and support of AFA, Lt. Gen. E. G. Shuler (right), Commander, Eighth Air Force, Barksdale AFB, La., completes his Change of Chapter Affiliation Request as Doyle Blasingame, President of the Ark-La-Tex Chapter, based in Shreveport, La., looks on. General Shuler has been a Life Member of AFA since 1962.

The long-awaited **postage stamp** commemorating the AAF's wartime leader and AFA's founding father, General of the Air Force **H. H. "Hap" Arnold,** was issued on November 5 in his home town of Gladwyne, Pa. AFA designed a special collector's envelope for the occasion. Five thousand envelopes were stamped and canceled in Gladwyne and are on sale for $3 each, $2 of which benefits AFA's Aerospace Education Foundation.

Members wishing to order these first-day covers should write to the Air Force Association, Communications Department, 1501 Lee Highway, Arlington, Va., 22209-1198. For each envelope desired, please enclose $3. Checks should be made payable to the Air Force Association.

AFA Advisors

AFA has formed a new **Civilian Personnel Council** so that the Association can broaden its support for USAF's large civilian work force. The Council, with Tony Kausal (AFSC/CR), Chairman, and Pat Schittulli (USAF/



Joe Dougherty (left), President of the Brandywine (Del.) Chapter, gets the autograph of Bob Langford, copilot of the famous World War II B-17G Shoo Shoo Baby, *during its rollout at Dover AFB. (See "Aerospace World," November '88 issue, p. 30.)*

When Col. Donald L. Peterson arrived at Cannon AFB, N. M., to take over as Commander of the 27th Tactical Fighter Wing, the Llano Estacado (N. M.) Chapter honored the Colonel and his wife at its general membership meeting. Left to right are Col. David E. Benson, Commander, 27th Combat Support Group; Louis Evers, President, New Mexico State AFA; Mrs. Gayle Peterson; Colonel Peterson; Mrs. Nancy Crawford; Ollie Crawford, AFA National Vice President, Southwest Region; and James Cook, President, Llano Estacado Chapter.

AFA National Secretary Tom McKee accepts a membership application from Mary Kavanaugh (left) as her daughter, Doris Vallone, then President of the High Point (N. J.) Chapter, watches. Mrs. Kavanaugh became a member during AFA's National Convention in Washington.

DPC), advisor, will report directly to AFA National President Jack Price. Major concerns will be issues affecting the 230,000 Air Force civilians who develop and repair new aircraft and provide spare parts. Council members named by Mr. Price are Al Perez (Liaison, USAF/DPCE); Gary D. Carter (MAC/DPC); James A. Mattice (ASD/XR); Michael A. Aimone (AFCC/DE); Dennis Dillinger (AFCMPC/DPCML); Leonard Casaus (Hq. AFCMD); Dr. Allen Schnell (AFSC/CA); Dr. Paul W. Brower (Hq. USAF/SCMMB); and Marty Maust (SAF/ACBMC).

CMSgt. Deborah S. Canjar has been named by National President Jack Price to be **Chairman of the AFA Enlisted Council** for 1988–89. Chief Canjar replaces CMSgt. Norman T. Parnes, who has been reassigned to Hq. AFMPC as the Assistant for Chief Master Sergeant Matters.

Prior to his move, Chief Parnes was Senior Enlisted Advisor for the Defense Intelligence Agency at Bolling AFB, D. C.

Recently selected **senior enlisted advisors** are CMSgt. Freiler R. Burton, 1606th Air Base Wing, Kirtland AFB, N. M.; CMSgt. Richard R. Cantera, 67th Tactical Recon Wing, Bergstrom AFB, Tex.; CMSgt. Earl W. Irwin, Defense Intelligence Agency, Bolling AFB, D. C.; CMSgt. Joseph S. Jones, 86th Tactical Fighter Wing, Ramstein AB, Germany; and CMSgt. John Sipes, Chanute Technical Training Center, Chanute AFB, Ill.

Contributions to "Intercom" should be sent to J. R. "Doc" McCauslin, AFA Headquarters, 1501 Lee Highway, Arlington, Va. 22209-1198. ■

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Unit Reunions

Bataan and Corregidor
The American Defenders of Bataan and Corregidor will hold their national convention on April 30–May 7, 1989, at the Holiday Inn (Waterside) in Norfolk, Va. **Contact:** Austin Patrizio, 414 Richmond Pl., Leonia, N. J. 07605. John Crago, 615 Lehmeyer St., Huntington, Ind. 46750.

La Junta AAF Flyers
The Chamber of Commerce of La Junta, Colo., is planning to host a reunion in 1989 for flyers who trained at the La Junta Army Airfield during World War II. **Contact:** Chamber of Commerce, P. O. Box 408, La Junta, Colo. 81050.

Nagoya/Komaki AB Ass'n
Personnel who served at Nagoya AB and Komaki Airdrome, Japan, from 1946 through 1959 will hold a reunion on June 8–11, 1989, in San Antonio, Tex. **Contact:** CMSgt. Richard L. Goff, USAF (Ret.), 206 Lemonwood Ave., Universal City, Tex. 78148. Phone: (512) 658-1579.

Wright Field Aircraft Laboratory
Aircraft Laboratory personnel (1939–60) at Wright Field, Ohio, will hold a reunion on April 12–13, 1989, at Wright-Patterson AFB, Ohio. **Contact:** Richard F. Hoener, 3901 LeFevre Dr., Kettering, Ohio 45429.

1st Wartime Info. Security Squadron
The Dallas, Tex., Detachment 11, 1st Wartime Information Security Squadron of the National Postal and Travelers Censorship Organization will hold a reunion on March 11, 1989, in Dallas, Tex. **Contact:** Col. Connie Eckard, USAFR, 10190 Vistadale Dr., Dallas, Tex. 75238-1637. Phone: (214) 553-8235.

11th Bomb Group Ass'n
The 11th Bomb Group will hold a reunion on August 2–6, 1989, in Portland, Ore. **Contact:** Robert E. May, P. O. Box 637, Seffner, Fla. 33584. Phone: (813) 681-3544.

15th Air Depot Group
The 15th Air Depot Group will hold a reunion on September 21–23, 1989, at the El Tropicano Hotel in San Antonio, Tex. **Contact:** Joe B. Mitchell, Sr., 4706 E. Cambray Dr., San Antonio, Tex. 78229. Phone: (512) 694-0309.

20th Air Depot Repair Squadron
Members of the 20th Air Depot Repair Squadron who served in New Orleans, La., North Africa, and Italy will hold a reunion on August 25–26, 1989, at the Radisson Inn in Dayton, Ohio. **Contact:** Scott C. Ide, Jr., 195 Patrice Terrrace, Williamsville, N. Y. 14221. Phone: (716) 634-2197.

20th Tactical Reconnaissance Squadron
The 20th Tactical Reconnaissance Squadron will hold a reunion on May 18–20, 1989 in Destin, Fla. **Contact:** Stanley A. Gawlik, 661 Woodland Dr., Tallmadge, Ohio 44278. Phone: (216) 633-5750.

21st Weather Squadron
Members of the 21st Weather Squadron, 40th Mobile Communications Squadron, are planning to hold a reunion in September 1989 in Colorado Springs, Colo. **Contact:** Irvin J. Kirch, 34 W. Hoss Rd., Indianapolis, Ind. 46217. Phone: (317) 786-6858.

Class 41-B
Members of Class 41-B who trained at the Southeast Training Command in Montgomery, Ala., will hold a reunion on April 27–29, 1989, at the Embassy Suites Hotel in Atlanta, Ga. **Contact:** Col. W. S. Fellows, USAF (Ret.), 415 Sassafras Rd., Roswell, Ga. 30076. Phone: (404) 993-0860.

Class 42-D
Members of Class 42-D (Oxnard, Calif.) will hold a reunion on April 22–24, 1989, in Stockton, Calif. **Contact:** Lt. Col. Jack Lacey, USA (Ret.), 3720 S. Monitor Circle, Stockton, Calif. 95209.

Class 49-A
Former cadets, student officers, and instructors of Class 49-A will hold their fortieth-anniversary reunion on March 10–12, 1989, in Mesa, Ariz. **Contact:** Col. Jack M. Smith, USAF (Ret.), 436 Lakeview Dr., Lindale, Tex. 75771. Phone: (214) 882-9772.

69th Fighter Squadron
The 69th Fighter Squadron (World War II) will hold a reunion on May 12–15, 1989, in San Antonio, Tex. **Contact:** George E. Mayer, 7445 Thomas Ave. South, Richfield, Minn. 55423. Phone: (612) 866-6073.

80th Fighter Group
The 80th Fighter Group reunion, which was scheduled in September 1988, was canceled because of Hurricane Gilbert. It has been rescheduled for March 9–11, 1989, at the Marriott Hotel in Corpus Christi, Tex. **Contact:** Col. Charles D. Schaeffer, USAF (Ret.), 4430 Eisenhauer Rd., San Antonio, Tex. 78218. Phone: (512) 655-1654.

99th Bomb Group
The 99th Bomb Group (Northwest Chapter) will hold a reunion on May 19–20, 1989, in Spokane, Wash. **Contact:** C. D. Boggs, 250 E. Woodland Dr., Shelton, Wash. 98584. Phone: (206) 426-4371.

376th Heavy Bomb Group Ass'n
The 376th Heavy Bomb Group (World War II), Ninth Air Force, will hold a reunion in conjunction with the B-24's fiftieth anniversary celebration on May 17–22, 1989, in Fort Worth, Tex. **Contact:** Bob James, 204 Summit Dr., Keaton, Ohio 43326.

438th Troop Carrier Group
The 438th Troop Carrier Group (World War II) will hold a reunion on May 27–29, 1989, in St. Louis, Mo. **Contact:** Ronald H. Worrell, 419 S. 4th St., DeKalb, Ill. 60115. Phone: (815) 756-6582.

456th Bomb Group Ass'n
Members of the 456th Bomb Group (World War II) who served in Italy will hold a reunion in conjunction with the B-24's fiftieth anniversary celebration on May 17–22, 1989, at the Hilton Hotel in Fort Worth, Tex. **Contact:** James F. Watkins, 11415 Minor Dr., Kansas City, Mo. 64114-5436. Phone: (816) 942-5594.

556th/6091st Recon Squadrons
Members of the 556th/6091st Reconnaissance Squadrons who served at Yokota AB, Japan, from 1953 through 1972 will hold a reunion on April 28–30, 1989, at The Sands in Las Vegas, Nev. **Contact:** Lt. Col. William T. "Terry" Wilson, USAF (Ret.), 2980 Stanford Lane, El Dorado Hills, Calif. 95630. Phone: (916) 933-2898.

7499th Composite Squadron
The 7499th Composite Squadron and associated squadrons will hold a reunion on May 12–14, 1989, in Colorado Springs, Colo. **Contact:** Col. Dick Barrett, USAF (Ret.), 7331 Oakmont Dr., Santa Rosa, Calif. 95409.

Class 60-D
For the purpose of organizing a reunion in 1989, we would like to hear from members of Class 60-D.

Please contact one of the addresses below.

Maurice J. Saroni
31 Los Pinos Vista
Tucson, Ariz. 85704
or
Richard L. Rice
5901 N. Camino Hombre De Oro
Tucson, Ariz. 85718
Phone: (602) 297-2971 (Saroni)
(602) 299-3064 (Rice)

306th Fighter-Control Squadron
For the purpose of organizing a reunion, I would like to hear from members of the 306th Fighter-Control Squadron, which was organized at Bradley Field, Conn., and operated in England, France, and Germany.

Also, I would like to hear from controllers who trained at AAFSAT in Orlando, Fla., in 1943 and went on to serve in various outfits in Europe and the Pacific.

Please contact the address below.
Maj. James D. Tilford, Jr., USAF (Ret.)
9012 Country View Ct.
Mobile, Ala. 36695-9604
Phone: (205) 633-3741

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, a time and location, and a contact for more information.

Bob Stevens'

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WORLD WAR II - THERE HAVE BEEN PLENTY OF "WAR STORIES" FOR MY CONTEMPORARIES.

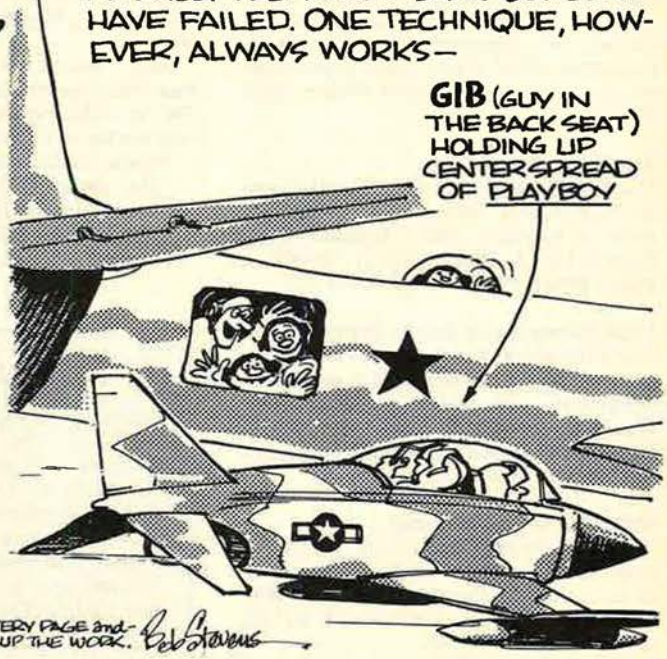
KOREA - "THE FORGOTTEN WAR". THE ONLY ONE THE U.S. DOESN'T YET HAVE A MEMORIAL FOR.

VIETNAM - THIS UGLY WAR SPANNED ABOUT 60% OF "THERE I WAS..."

OVER 'NAM THE TINY O-1 SPOTTER PILOTS CARRIED ON THEIR OWN LITTLE WAR-

CURRENT TIMES - "GLASNOST" and "PERESTROIKA" ARE NEW WORDS TO THREE GENERATIONS OF FLYERS.

MORE RECENTLY, ATTEMPTS BY U.S. FIGHTER PILOTS TO HAND SIGNAL INTERCEPTED SOVIET "BEAR" BOMBERS HAVE FAILED. ONE TECHNIQUE, HOWEVER, ALWAYS WORKS—



I HAVE ENJOYED DOING EVERY PAGE and GOD WILLING - WILL KEEP UP THE WORK. Bob Stevens

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