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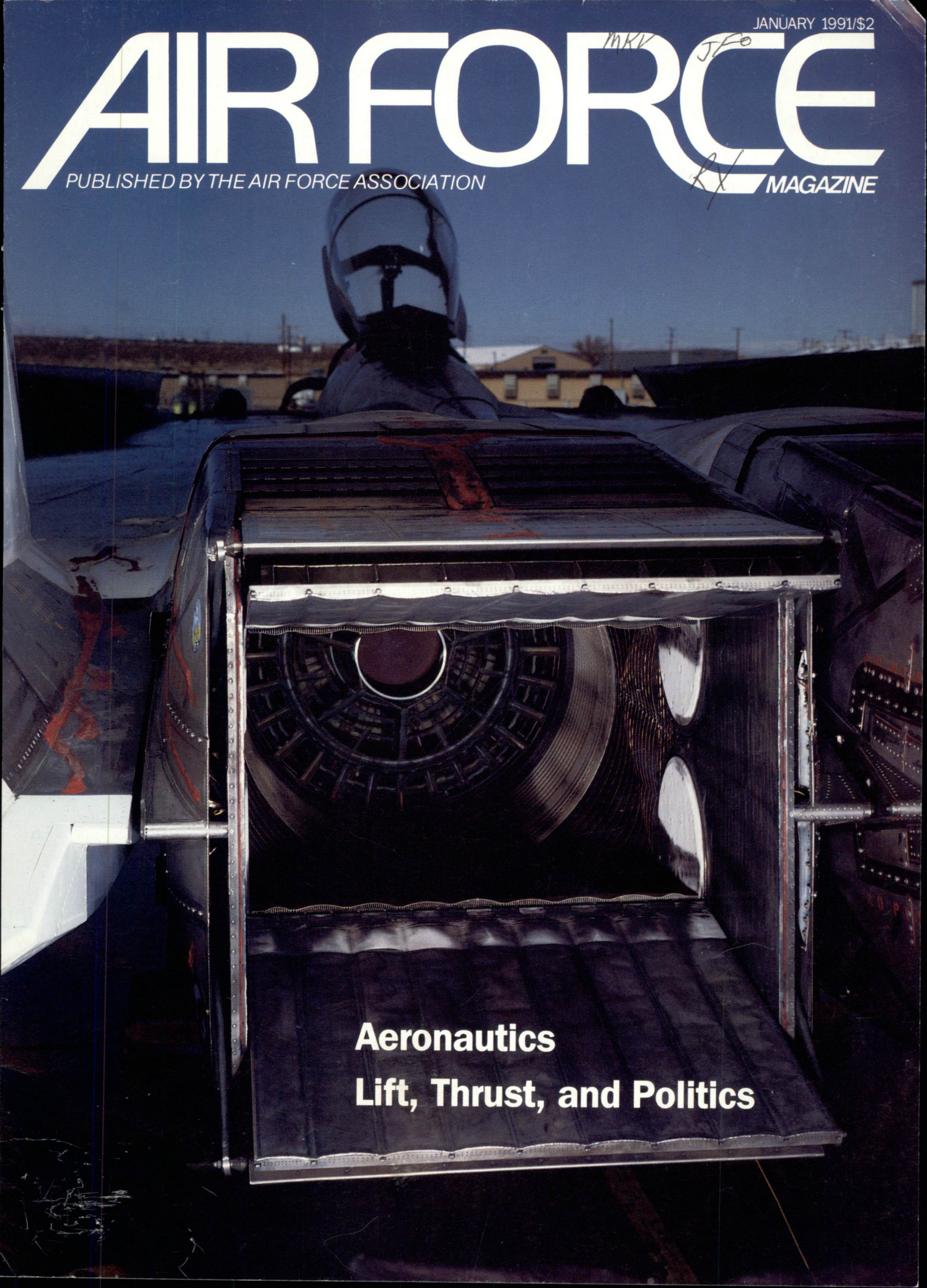
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JANUARY 1991/\$2

AIR FORCE

PUBLISHED BY THE AIR FORCE ASSOCIATION

MAGAZINE



Aeronautics
Lift, Thrust, and Politics

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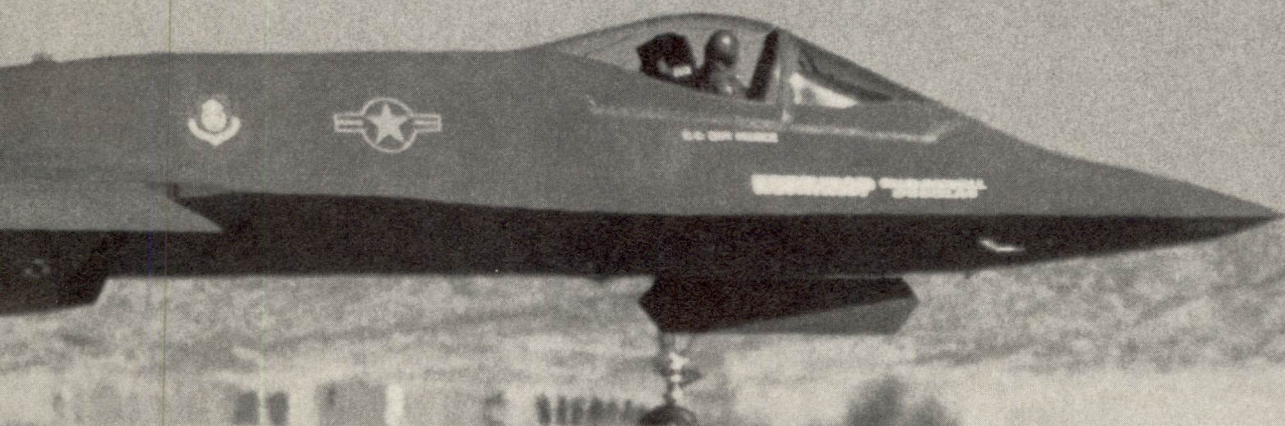
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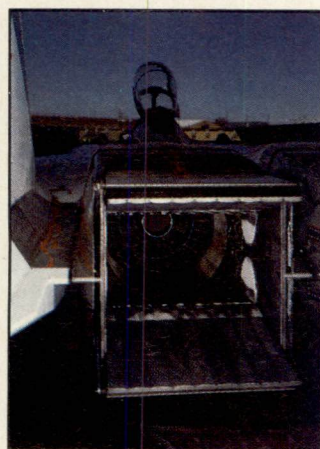
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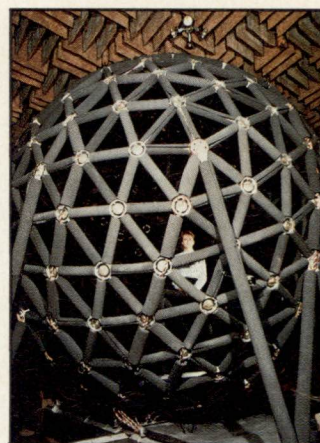
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About the cover: This month's cover shows a two-dimensional, vectored-thrust nozzle on the F-15/Eagle STOL Maneuvering Technology Demonstrator. For more on the possible applications of vectored thrust, see p. 54. Photo by Anand Singhal/Arms Communications.

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By John T. Correll, Editor in Chief

The Indictment of Airpower

THE AIR FORCE, a separate service since 1947, is still answering basic questions about its legitimacy and effectiveness. In the past year, the indictment of airpower has been strident.

The military reform analyst Dr. Jeffrey Record ticked off a whole laundry list of accusations in "Into the Wild Blue Yonder: Should We Abolish the Air Force?" in the Spring 1990 issue of the Heritage Foundation *Policy Review*. Since then, other critics have picked up the theme.

Surveying Persian Gulf strategy options in the *National Journal*, David C. Morrison sneers at the Air Force's performance in three wars and wonders why "this history of costly failure does not deter airpower advocates." In a September column, strategist Harry G. Summers warns against "the fanciful notion that a war can be won quickly and decisively by the use of airpower alone."

Summing up for the prosecution in the Baltimore *Sun* October 5, Dr. Record charges that "the history of Air Force claims for what airpower can do has been one of inflated expectations followed by postwar alibis."

This might be shrugged off as media speculation except that it corresponds with a certain chariness about airpower that seems to be developing among some in Congress and elsewhere in government. Ignoring it would be a mistake.

The main allegation is that *airpower is not decisive*. What exactly is this supposed to mean? That the Air Force did not win all by itself in World War II, Korea, and Vietnam, or merely that its contribution was marginal?

If the criterion is single-handed victory, then no arm of service is decisive in modern warfare. If the definition is something else, the commentator-critics have not made a convincing case. In support of their point, whatever it is, they dig up again the tired old theory that the strategic bombardment of Germany in World War II was irrelevant.

Among those who repudiated that notion was Albert Speer, Hitler's Minister of War Production. He said the

bombing was tantamount to an additional front, destroying nine percent of his total production capacity and tying up 900,000 troops, 10,000 pieces of artillery, a third of the optics industry, and half of the electronics industry. To that add damage done directly to German forces, logistics, and railroads.

Would you rather fight an enemy on the ground before or after the Air Force hits him from the air?

Dr. Record tells us that "Germany's decision to capitulate came only with its conquest on the ground." Well, yes, but it took a combined arms effort to put Allied armies on the Oder and the Elbe. The Normandy invasion, for example, would have gone much harder had not a three-month air campaign almost completely neutralized the Luftwaffe before D-Day.

It is outrageous to claim, as Dr. Record and others do, that subsequent wars, especially Vietnam, demonstrated a failure of airpower. Vietnam did not prove much of anything about war except that politicians make poor generals.

In measuring decisiveness, the commentators might ask themselves two questions: Would the absence of airpower tend to make a difference in modern warfare, and would they prefer to fight an enemy on the ground before or after the Air Force hits him from the air?

The second allegation is that *airpower has been oversold*. There is some truth to that, particularly if one uses seventy years of hindsight to punch holes in Giulio Douhet's *Command of the Air*, published in 1921. Douhet and other early thinkers did promise too much, but their vision was closer to reality than that of their

traditionalist contemporaries who said military airpower was no more than a novelty.

Some advocates of airpower overstate their case on occasion, but the same is true of those promoting sea-power, land power, and any other social, political, economic, or military concept you can name. Even analysts and newspaper columnists have been known to push a point to excess.

The real issues are whether today's Air Force leaders claim airpower can win alone and if they promise more than they can deliver. In the estimation of this magazine, which has followed the subject more closely than most, the Air Force has *not* made such claims.

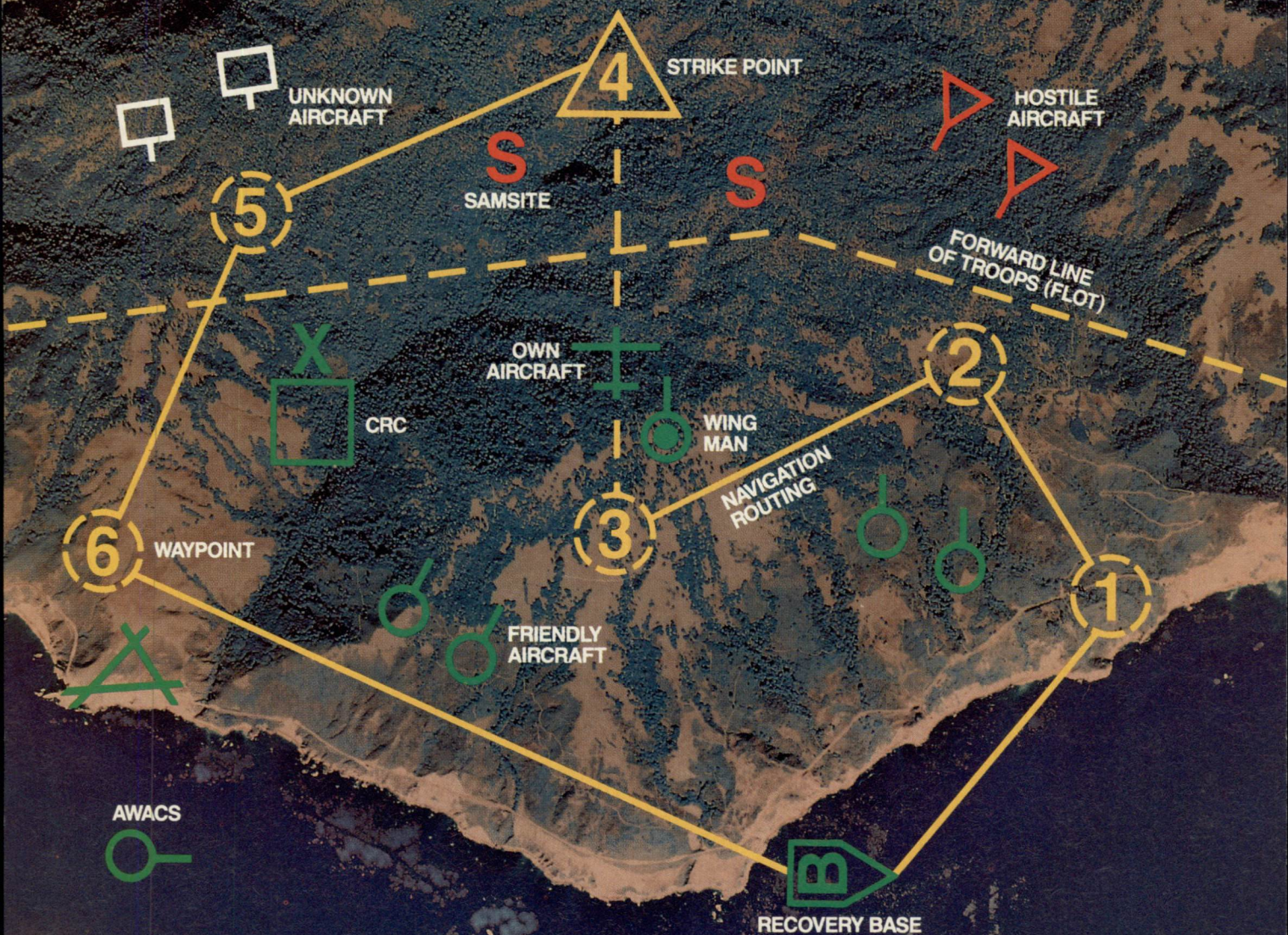
Dr. Record, analyzing the Persian Gulf problem in August, found airpower "the single most important comparative military advantage we have over Iraq." In a later epistle, he describes airpower as "absolutely indispensable to military power as a whole. Airpower may not be able to win wars by itself, but try winning one without it." That is approximately what the US Air Force has been saying all along.

No one seriously questions the value of airlift or the advantage of air superiority over a battlefield. The importance of speed, range, and flexibility in military strategy should be obvious. These qualities are intensified in airpower. Projecting force over long distances is useful not only in fighting wars but also in deterring them.

The other combat arms have important qualities, too. Talking with this magazine in August, for example, Gen. Michael J. Dugan, former Air Force Chief of Staff, cited persistence as a special strength of armies and recognized the mobility of naval forces but added that nothing beats airpower when you need to "deliver a big punch between the eyes."

It is pointless to argue about single-dimension strategies or whether individual services are "decisive" in isolation. Wars are not fought that way. The longer you look at the rambling indictment of airpower, the less sense it makes. ■

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Letters

Ends and Means

Even for the pages of *Air Force Magazine*, Col. Dennis Drew's statements are too strong [see "We Are an Aerospace Nation," November 1990 issue, p. 32]. They have the air of salesmanship rather than of well-argued advocacy. If the military profession has learned anything from the Mahans and the Douhets, it is that no one factor or theory is decisive above all others. Aerospace power is no exception. It is but one element of a broad palette comprising (to borrow a phrase) the "correlation of forces" over which the US must always be vigilant to ensure the security of our national interests.

Colonel Drew makes valid points about the capabilities of aerospace power that should not be overlooked. However, it is national interests and objectives that are the keystone of military power—indeed, of national power—not airpower, as he argues.

Very few of our stated national interests and objectives are closely associated with our status as the predominant aerospace power in the world. Colonel Drew is trapped by the age-old "ends vs. means dilemma." One must never forget that national security objectives (ends) drive the choice of means (possibly aerospace power) to determine what element of national power may be decisive in any given situation. It is quite conceivable that there are situations where the employment of airpower may be the least attractive policy option. In that case, even though we may be the predominant aerospace power, our strength is negated.

The search for simply stated, bold prescriptions for the complexities of the world has gone on through recorded history. I'm afraid Colonel Drew has not brought that quest to its conclusion.

Maj. C. J. Krisinger, USAF
US Naval War College
Middletown, R. I.

Missing MAC

"Back to the Future" [see October 1990 issue, p. 32] was seriously flawed. In reporting USAF's new

"Global Reach, Global Power" strategy, you concentrated almost exclusively on what the Air Force normally concentrates on: TAC and SAC, to the detriment of MAC.

MAC was dealt with only indirectly, most visibly by the two pictures of C-5s in Saudi Arabia. This obvious snub to the 90,000 very able men and women of MAC simply showed not only how your article was superficial and grossly lacking, but also how TAC and SAC run the Air Force, sometimes putting their priorities—like the ATF and B-2—ahead of our real national defense priorities—like the C-17.

Operation Desert Shield proved once again the critical role of airlift. Does it always take a conflict to prove what everyone has been saying for years—that we need more strategic airlift rather than "glamor" weapons that cost more than their weight in gold?

A few interesting facts illustrate the importance of MAC:

- During the defense drawdown, TAC will lose eleven fighter wings while MAC will lose zero strategic airlift squadrons.

- MAC was in Saudi Arabia first, not TAC. The 438th MAW Airlift Control Squadron received elements of the 1st Tactical Fighter Wing.

- More than seventy-five percent of all military operations since Vietnam have included MAC.

- There are more pilots with combat time in MAC than in either TAC or SAC.

A little more research and soul-

searching would have precluded the need for this letter, just as a little common sense would have prevented the shortage of airlift and sealift we are experiencing in the current Persian Gulf crisis.

Capt. Philip A. Bossert, Jr.,
USAF
McGuire AFB, N. J.

Havoc with the Facts

"Aviation Cadets" by Bruce Callander in the November 1990 issue [see p. 98] was interesting but played havoc with the facts about the Aviation Cadet program between World War I and World War II.

I have a roster of all the Flying School classes from September 1922 to February 1933, after which it was no longer printed. There were many more cadets than officers in most of the classes, except some of the October classes, and the March Field classes in 1927, 1928, and March 1929 were solely cadets, no officers.

The worst error was the statement, "The Army let a few cadets enter, but the standards were so high that few qualified and most who did washed out." Lindbergh was not just one of a handful, but one of many pilots who became great leaders both in and out of the military. Another was Curt LeMay. The aviation industry was, and still is, loaded with former cadets. The percentage of graduates was about the same for officers and cadets, and the percentage of cadets who became general officers was comparable, showing clearly that the cadets were of good caliber, many being college graduates before being accepted as cadets.

There was not enough room for all graduates to remain in the Army, due to congressional limitations, but the overflow is one of the main reasons that the US has always had such an outstanding aviation industry, in which former cadets have played such an important part.

C. R. Bullock
San Antonio, Tex.

Ubiquitous Jiminy

Unit pride and morale notwith-

Do you have a comment about a current issue? Write to "Letters," *Air Force Magazine*, 1501 Lee Highway, Arlington, VA 22209-1198. Letters should be concise, timely, and preferably typed. We cannot acknowledge receipt of letters. We reserve the right to condense letters as necessary. Unsigned letters are not acceptable. Photographs cannot be used or returned.—THE EDITORS

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Executive Editor
Robert S. Dudney

Senior Editor
James W. Canan

Aeronautics Editor
Jeffrey P. Rhodes

Associate Editor
Colleen A. Nash

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Brian Green
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Advertising Director
Charles E. Cruze
1501 Lee Highway
Arlington, Va. 22209-1198
Tel: 703/247-5800
Telex: 44-0487 COURTESY
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Director of Marketing Services
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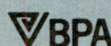
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Letters

standing, "Patches" by Jeffrey P. Rhodes in the October 1990 issue reminds me that unit patches can bring a measure of good luck and fortune to many, not just to those who wear them.

While serving as a forward air controller (FAC) flying O-1s in the 23d Tactical Air Support Squadron at Nakhon Phanom Royal Thai AB in 1966, I wrote the Disney studios to see if they would help us design a unit insignia. Since we were called "Operation Cricket," I suggested a design incorporating Jiminy Cricket in a pose symbolizing our mission: visual reconnaissance and airborne control of fighter strikes over the Ho Chi Minh Trail network.

A few weeks later and to my surprise, I received a beautiful artist's rendering of Jiminy Cricket floating through the air grasping his open umbrella and excitedly pointing at the ground. The umbrella's handle was a stylized walkie-talkie. Disney's design was right on target, an excellent rendition of our mission and a perfect symbol for FACs. We were also given permission to reproduce the design for the sum of \$1, "prepaid."

Although I thought our squadron had one of the most unusual patches ever in the Air Force, it seems Jiminy Cricket has had tours of duty with other units. I'm struck by how much the design made for the 3d Mobile Aerial Port Squadron at Pope AFB in 1959 is like ours. Disney's magical cricket has served us, the Air Force, and who knows how many others well.

Lt. Col. John C. Taylor,
USAF (Ret.)
Puyallup, Wash.

Whose History?

"Patches" was outstanding. However, I wish to correct the inaccurate statement made concerning the 91st Strategic Missile Wing. Although the 91st does trace its lineage back to the 91st Strategic Reconnaissance Group, its history goes back even further, to April 15, 1942, when the 91st Bombardment Group (H) was activated at Harding Field, La.

"The Ragged Irregulars" established several claims to fame while operating from Bassingbourn, England, from October 1942 to June 1945. These include suffering the highest losses of all Eighth Air Force bomb groups, being the first group to attack a target in the Ruhr (Hamm, January 4, 1943), leading the August 17, 1943, Schweinfurt mission, being the first Eighth Air Force bomb group to complete 100 missions, and having

the first Eighth Air Force B-17 crew to complete twenty-five missions (the crew of *Memphis Belle*).

The bomb group was redeployed to the US in June 1945 and then inactivated November 7, 1945. It was activated again in 1947 as the 91st Strategic Reconnaissance Group, only to be inactivated again in the late 1950s. The 91st again came to life for the Vietnam War as a B-52 wing flying sorties over Vietnam. In 1968, the 91st became the 91st Strategic Missile Wing at Minot AFB, N. D.

Capt. Michael J. Petersen,
USAF
Offutt AFB, Neb.

• *It depends on whom you talk to. According to the USAF Reference Series's Lineage and Honors History, the 91st SMW has no connection with the earlier bomb group. The wing's unit history, however, states, "In 1954, Air Force headquarters agreed to bestow, or loan, the histories of World War II groups to identically numbered wings, [allowing] the 91st SMW to keep alive the history of the 91st Bombardment Group."*—THE EDITORS

Flying at Ellsworth

"Patches" was quite enjoyable—both from the perspective of an aviation history enthusiast and that of a member of a new organization submitting a patch design through the AFHRC at Maxwell.

On p. 68, your caption claims that "the 25th Strategic Training Squadron [is] the only flying unit directly assigned to Strategic Air Command's Strategic Warfare Center at Ellsworth AFB, S. D." That's just not true.

The Strategic Weapons School was activated on October 1, 1989, and assigned (like the 25th STS) to the 99th Strategic Weapons Wing. Though we didn't exist "on paper" until that date, the initial cadre began arriving as early as December 1988 to begin writing the curriculum. One of our early tasks was to create a school insignia, and Mr. Godwin and his office were most helpful to us in getting our patch design approved. . . .

All our flying is done on "borrowed" airframes, since the 99th Strategic Weapons Wing doesn't own any. The support of all nine operational B-52 wings has been crucial to getting us airborne and keeping us there.

As you can see, the 25th Strategic Training Squadron has some partners in the flying training business here at Ellsworth. In addition to mentioning the Strategic Weapons School, I would be remiss if I failed to mention

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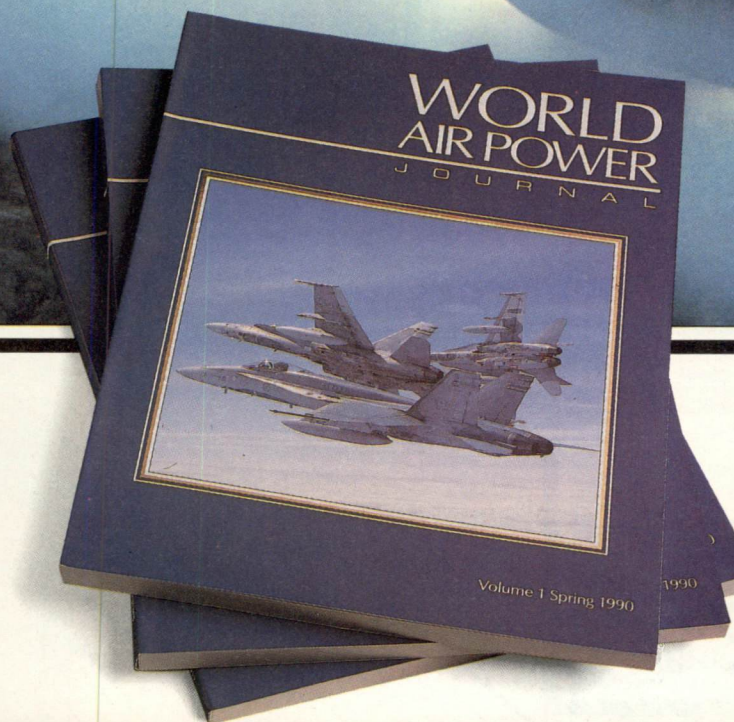


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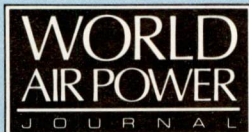
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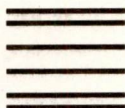
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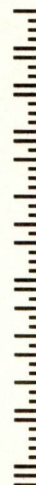
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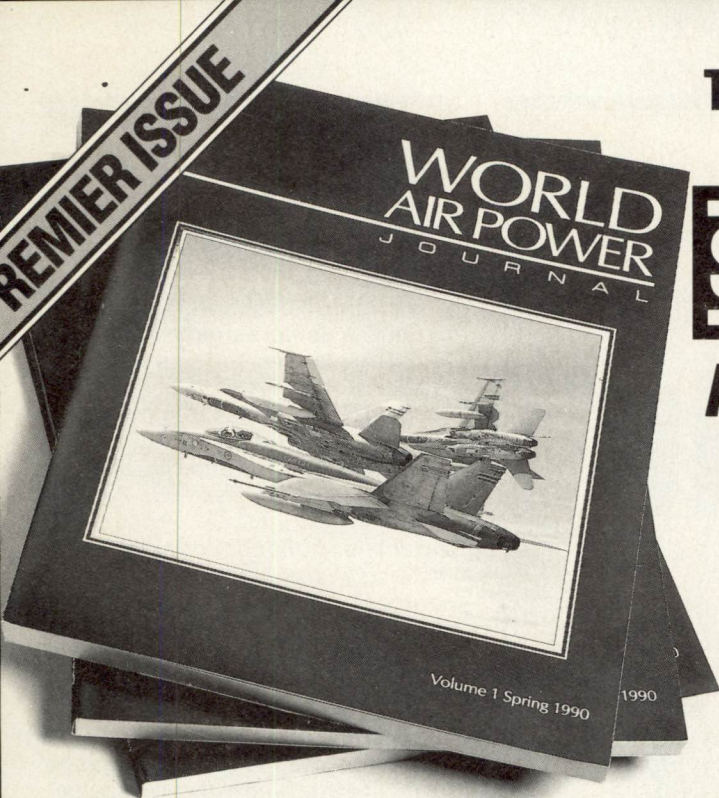
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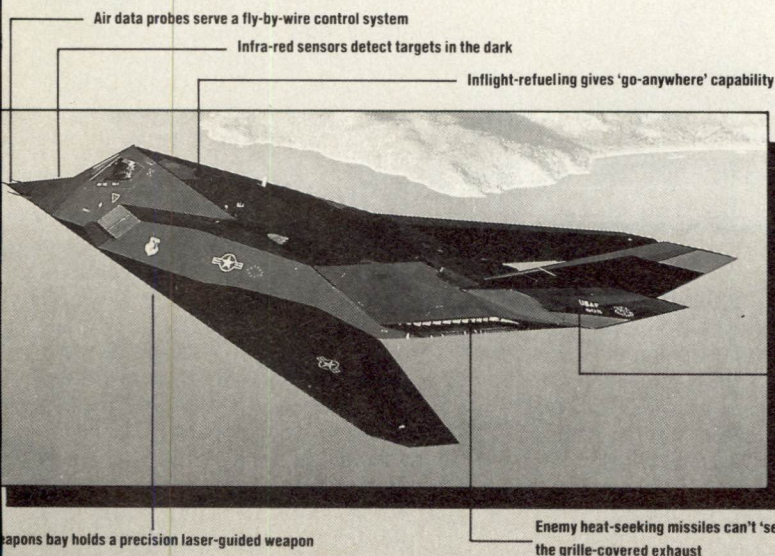
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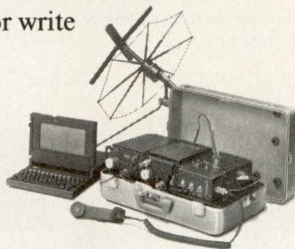
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Maj. Brian C. Rogers,
USAF
Ellsworth AFB, S. D.

Mistaken Identity

We would certainly like to take

credit for the great-looking cadets pictured with Secretary Rice on p. 59 of the November 1990 issue. However, they are Senior ROTC cadets (college level) and not Junior ROTC cadets (high school level).

Dr. Ken Daly
Chief, Junior Program Division
Maxwell AFB, Ala.

Going Bats

I have just read "The Bat Bombers" by C. V. Glines [see *October 1990 issue*, p. 88]. This would have been a riv-

Letters

eting, great article for *Audubon* magazine and was worthy of the information and pages taken up for the reader's information. But some questions remain:

Two million spent on this project? In 1943? A dental surgeon from Irwin, Pa.? Three armed services involved? President Roosevelt OK'd it?

Come on, *AIR FORCE Magazine*, help us believe in your credibility.

Florence M. McCabe
Doylestown, Pa.

• *Outlandish though they may seem, the facts in the article are backed by sources as diverse as Edgewood Arsenal, the National Speleological Society, and the National Archives.*—THE EDITORS

Turning Inward

I have enjoyed *AIR FORCE Magazine* for most of my twenty-two-year career, but the September issue was even more special than most. Its theme, "The Way It Was," captured the essence of our profession. I sincerely hope that its message was not lost on a generation more at home with a computer than with colleagues.

In recent years it has been increasingly difficult to get people to participate in a variety of social activities that in the not-too-distant past were part of our Air Force heritage. Hangar flying "war stories," Friday "happy hour" camaraderie, and even squadron picnics seem to have fallen victim to an inward-oriented attitude.

I fear that many of the traditions that give our profession its special flavor are being lost. Worse, a generation that could have built on these traditions is now content to abandon them in favor of isolation.

Lt. Col. Doug Schott,
USAF
Rapid City, S. D.

Wrong Year

In the November Anniversaries section of "Aerospace World," the date listed for the first flight of the B-58 is incorrect. First flight was on November 11, 1956, not 1955. I was newly assigned to the B-58 Weapon System Program Office (WSPO) at the time, but unfortunately I did not witness this historic occasion.

Your excellent magazine is my main contact with events in the present-day Air Force, since I am now living in a predominantly Navy city. Keep up the good work.

Lt. Col. Hans J. Petermann,
USAF (Ret.)
San Diego, Calif.



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The Pampa 2000 is a team effort from LTV and Fabrica Militar de Aviones (FMA) of Argentina. LTV has more than 70 years' experience in

aviation, making history with aircraft like the F4U Corsair and the A-7 Corsair II. FMA has been building military aircraft for more than 60 years. Since 1988, the Pampa has proven itself with a flawless record in the Argentine Air Force. Together, LTV and FMA are making the Pampa 2000 a world-class JPATS contender.

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Washington Watch

By James W. Canan, Senior Editor

The Future Is Stealth

In the Air Force's view, modification might make existing airplanes faster and more maneuverable, but it cannot make them stealthy enough to get the job done.



The Air Force is staking its future on stealth and is determined not to turn back. USAF's commitment to stealth is central to its plans and ambitions for new bombers and

fighters and is the cause of much of the controversy surrounding its programs for building those planes.

When the Air Force says it cannot do without the B-2 bomber and the Advanced Tactical Fighter, it is really saying, in effect, that it cannot do without stealth. In the final analysis, stealth is what sets those airplanes apart from bombers and fighters now in the force. There are other differences between the present and future generations of aircraft, but none so profound and lasting.

With the B-2 and the ATF, the Air Force claims, it will be able to do the jobs that the nation expects of it well into the twenty-first century. Without them, it claims, it will not.

Much as the Air Force swears by its top-of-the-line B-1B bomber and F-15 fighter, it insists that time is fast running out on them. It sees them as still useful in the years ahead, but in decreasingly demanding roles.

Their only major drawback, where the future is concerned, is that they are not stealthy or, in the case of the B-1B, not stealthy enough. That is drawback enough. Although they can be upgraded in all other respects, there is no way to make them sufficiently stealthy, and so they just won't hack it.

To the Air Force, it's as simple as that. In recent years, many Air Force leaders have said as much, if not quite so baldly.

Taken together, the low-observable technologies that make a plane or a missile stealthy are widely acclaimed as the most revolutionary military aeronautics technologies since the jet engine and the swept wing. Those technologies reduce the radar, infrared, visual, and noise signatures of aircraft and missiles and make them hard to detect and even harder to track and destroy.

Critics of Air Force programs for stealthy flying machines have no quarrel with stealth itself. Their quarrel is with the need for the prowess, pegged to stealth, that the Air Force claims those planes must possess.

The critics suspect that Air Force performance requirements for the planes are overblown and that the Air Force should be able to upgrade existing planes to do the necessary missions for a long time to come, even though those planes cannot be made stealthy.

Not a chance, counters the Air Force.

The B-2, USAF maintains, will be the only bomber able to penetrate the increasingly formidable air defenses of the Soviet Union, which are expected to remain in place, cold war or no cold war, and of many other potential adversaries around the world. Abandoning the B-2 would be tantamount to giving up on the bomber leg of the time-honored triad of strategic weapons, the Air Force claims.

A political decision to do that very thing is always possible, particularly at a time of tighter defense budgets and of seemingly diminishing strategic threats. The nation's future needs for the triad, for manned penetrating bombers in general, and for the B-2 in particular are open to question in some political and military circles, if not in the Air Force, and are fair game for debate.

No Argument

Such is clearly not the case with the ATF. It is on much firmer ground with respect to its mission. There would seem to be no argument, political or military, about the need for air superiority in all tactical arenas and for

fighters capable of gaining and maintaining it. When is the last time anyone advocated conceding control of the air?

As to air superiority, only the ATF will do, the Air Force insists. Why? The short answer: stealth.

The ATF is expected to improve on existing Air Force fighters in all important respects, but by an unbridgeable margin in only one respect—its stealthiness. Contemporary fighters can be upgraded with new avionics and engines, for example, to rival the ATF in speed and maneuverability. But they cannot be made stealthy, an attribute that will distinguish the ATF.

The Air Force cites computer gaming of air-war scenarios in support of its case for the ATF. The computer models show that the relatively new Soviet-built MiG-29 "Flanker" and Su-27 "Fulcrum" fighters might be a match for the F-15 in air-to-air combat but would be convincingly outclassed and overmatched by the ATF.

By replacing the F-15 with the ATF, "we would go from rough parity with the Flanker and Fulcrum to a dramatic increase in exchange ratios—to five to one in our favor, on the low side, to twelve to one or fifteen to one on the high side," declares Lt. Gen. John E. Jaquish, principal deputy to the Assistant Secretary of the Air Force for Acquisition.

He cites two main reasons for this: "signature and sustained speed."

"The ATF's avionics and maneuverability will be better than the F-15's, but they are not the cause of the dramatic increase that we see in exchange ratios. What causes that is the ATF's combination of stealth and supercruise," General Jaquish says.

Supercruise—exceeding Mach 1 without using afterburners—is a capability unique to the ATF, but not necessarily so. Supercruise can be built into existing airplanes that lack it. Stealth, on the other hand, cannot be.

Engines built for the ATF by Pratt & Whitney and General Electric have demonstrated supercruise propulsion in both the Northrop/McDonnell Douglas and Lockheed/Boeing/Gen-

eral Dynamics ATF prototypes. Production versions of those engines could be retrofitted into existing fighters, enabling them to go supersonic without lighting the fires.

"We could move the F-15s beyond parity [with the Soviet fighters], but not to the revolutionary extent of the ATF, and any new advantage could be quickly countered. With supercruise, their kill ratios would improve, to two to one or maybe three to one, but not into the ten-to-one bracket."

To come anywhere near matching the ATF in that regard, the F-15 would need stealth, General Jaquish stresses.

Will Air Force fighters really need to be all that capable? There is suspicion in some quarters that the ATF may be overqualified for the tasks it would undertake in the post-cold war world, and that there may be no need for it, or no urgency about bringing it along.

Capitol Hill is the seedbed of the growing skepticism about the ATF program.

Congress sent mixed signals on the ATF this year. It appropriated \$200 million for the Air Force to move the program into full-scale development, but its defense authorization bill, expressing reservations about the program, defers FSD beyond Fiscal 1991, which will end next September 30. [See "Scorecard From the Budget Wars," p. 64.]

The bill also authorizes \$100 million for the Air Force to put by in case it decides to develop the F-15XX, an enhanced air-superiority variant of the fighter.

The Air Force did not request that funding and sees no point in developing the F-15XX. It studied the F-15XX proposal in 1988 as part of its normal requirement-setting process, and again last year as part of the Pentagon's Major Aircraft Review (MAR), and concluded that the fighter, while more capable than any F-15 type yet built, would fall far short of the Air Force's requirement for the ATF.

Not the Point

That is not the point, argue members of Congress who question the need for the ATF.

Prominent among them is Sen. William Cohen (R-Me.), an influential member of the Senate Armed Services Committee. Speaking for a substantial number of like-minded colleagues on the committee, he told the Senate late last year that the Air Force should "not hold the F-15 or the F-15XX up against the ATF to see whether it meets its performance criteria."

misquoting
"We know what the outcome will be if that is the case," he said. "We are saying perhaps the ATF performance requirements are incorrect."

What the Air Force should do, Senator Cohen claims, is to "take a look at . . . whether we can modernize the F-15 and the F-16" to serve the purpose "in an environment that is less hostile" than the one—featuring a full-blown Soviet threat—that was anticipated back when the ATF requirements were defined and delineated.

The Air Force argues that the environment will not be less hostile and that it cannot, in consequence, compromise on its requirement for the ATF. It warns that first-class fighter aircraft are making their appearances in air forces of nations all around the world and that the US can ill afford to let many of those nations get the jump



on air superiority. Twelve of them now fly the MiG-29, which, according to USAF, would give the F-15 all it could handle.

Secretary of the Air Force Donald B. Rice makes the point. He asserts that "no major conflict since the advent of airpower has been won without control of the air," and he takes note of "a trend over the last twenty years" that could spell trouble for the United States in that regard.

"Our fighter inventory has declined slightly," Dr. Rice says, "but that's not true elsewhere." In nations outside NATO and the Warsaw Pact, and excluding China, "we have seen a fifty percent increase in the numbers of fighter aircraft deployed from 1970 to 1990."

For example, "Libya's air force grew from seven aircraft to 500, and Iraq increased its inventory by 117 percent," he says. He also claims that fighters everywhere are more capable as well as more numerous.

"In Iraq, we're facing MiG-29s and Su-24s, and there's every reason to believe nations like Iraq will continue upgrading," says the Air Force Secretary.

Nations intent on upgrading can look forward to a growing supply of "advanced fighters in various stages of development," including "the European Fighter Aircraft, the Swedish Gripen, the French Rafale, and the Taiwanese Indigenous Defense Fight-

er," says Dr. Rice. "All could compete on the global market. And don't forget the Soviets. They need hard currency and are hawking Fulcrum brochures from Tripoli to Tehran, from Cuba to Algeria. They're not about to be left behind in the fighter business."

The Air Force Secretary asks, "Why put ourselves in a position of trying to seize control of the air from an opponent in the Third World equipped with more advanced aircraft than our own? It's an unacceptable position."

The Air Force is convinced that the only way to avoid getting into that position is to field stealthy fighters, particularly ATFs. Only they will be able to win the day against the growing numbers of increasingly formidable weapons that future fighters will come up against, the Air Force maintains.

At the Air Force Association's National Convention in Washington, D. C., last fall, Gen. Ronald W. Yates, commander of Air Force Systems Command, discussed the global proliferation of potent air defense systems. He called attention to "the very capable, very mobile systems that the Soviets built and that the Iraqis have, along with a number of other Third World countries."

In the Defense Department's MAR of last year, the US intelligence community made a point of those highly sophisticated defenses. The MAR pointed out that even though "we may not be nose-to-nose with the Soviets, that does not lessen our need for the ATF and the B-2," says General Jaquish.

The MAR "clearly demonstrated our need" for the ATF and clinched the case at the highest levels of the Department of Defense, the General claims.

None Too Soon

The review also made it clear that the ATF will come on the scene none too soon, he says. The Soviet fighters that the ATF was conceived to counter have long since been deployed. Now come their presumably much more capable successors, under the generic names of Air-Superiority Fighter (ASF) and Counter-Air Fighter (CAF), which are said to be well along in development.

"Our justification for the ATF was not the emergence of the ASF and the CAF. It was the development of the Flanker and Fulcrum, which are roughly equal to the F-15 and the F-16," explains General Jaquish.

Secretary of Defense Richard Cheney spoke out strongly for the ATF in delivering the results of the MAR to

Congress. He said the study convinced him that the ATF will be crucial to the Air Force's ability to control the air in future tactical scenarios, a superiority that it must assert in order to carry out other missions.

In the MAR, the Defense Department "specifically analyzed alternatives to the ATF, including the F-15XX and several variations of the F-16, in terms of reducing signatures and upgrading engines and avionics," General Jaquish says. DoD concluded that "it would be just as expensive to do that as it would be to build the ATF" and that all of the upgraded fighters would be "woefully inadequate in terms of doing the [ATF's] mission." Even with slightly better kill ratios, they would suffer unacceptable attrition and would not be able to sustain air superiority over the long haul, he claims.

The answer, again, is stealth. It helps aircraft to kill as well as to avoid being killed.

"Stealth's defensive contributions are widely understood, but one of the big things people don't realize is that stealth provides tremendous leverage on the offensive side of the equation," General Jaquish declares.

"In air-to-air combat, stealth makes it possible for your sensors to find the enemy and for you to bring your weapons to bear on him before his avionics can tell him you're there.

"In the case of the ATF, its combination of stealth and supercruise, together with radar that is also stealthy and with AMRAAMs [advanced medium-range air-to-air missiles], will enable it to get in there, find the enemy, target him, shoot at him in multiples [of missiles], and pull away before ever being seen."

At the rollout of an ATF prototype in 1990, Maj. Gen. Joseph W. Ralston, USAF's director of tactical requirements, emphasized the significance of stealth on the offense. He said stealth had not been "a survivability issue" in ATF design.

"The real interest in low observables is to be able to see the other guy before he sees you and to get an offensive advantage," General Ralston declared.

Stealth's contribution to survivability of aircraft against surface-to-air threats is also significant. Says General Jaquish: "In air-to-ground operations, stealth dramatically reduces the threat from air defenses—by more than fifty percent under ordinary circumstances. When stealth is coupled with speed, such as supercruise in the ATF, there's a synergistic effect

that reduces the threat in excess of ninety percent."

The Air Force used stealthy F-117As sparingly in Panama in Operation Just Cause at the close of 1989 and deployed them in much larger numbers to Saudi Arabia in Operation Desert Shield last summer. Their job is to attack high-value, heavily defended targets on land. Stealth is their key to lethality and survivability, in equal measure.

General Jaquish notes that the maiden flight of the F-117 took place nearly ten years ago, in 1981, during full-scale development of the aircraft. "We'd been working stealth even prior to that, so we're not exactly Johnny-come-latelies in our understanding of it. We know how it works and what it will do."

On the Lookout

The Air Force is always on the lookout for fatal flaws in stealth and for realistic ways to foil stealthy aircraft. It says it has yet to find any. Now and then, it is confronted with accusatory claims that this or that radar has caught a glimpse of a stealthy flying machine somewhere in the sky. In response, USAF notes that it has never claimed that stealth makes airplanes invisible to radar and to other sensors, only that stealth makes them impossible, or virtually impossible, to track and kill.

Stealth has many applications that may not immediately meet the eye. It is a major means of electronic combat, for example. Air Force officials make the case that passive avoidance of electronic detection is as vital to EC as is the active jamming of enemy radars.

The Air Force is preparing to bring stealth to tactical land-attack missions in a big way in years to come. If all goes as planned, the vehicle for this will be an Air Force variant of the stealthy A-12 attack plane developed by the Navy.

There are signs that, as a general rule, the Air Force is moving toward greater reliance on stealth and less on jamming to enable attack aircraft to penetrate enemy air defenses. There is also reason to believe that this course will prove more cost-effective, as well as more militarily effective, in the long run.

Once stealth pervades the tactical force, more aircraft can be devoted to the attack, and fewer to their support, than is now the case. As it lowers the defense-to-offense ratio of aircraft, the Air Force should also be able to devise new tactics to make its stealthy

attack planes even deadlier than before.

Stealth also has a synergistic effect on aircraft not equipped with it. Notes General Jaquish, "One of the major contributions of stealth is that when we have an ATF and a B-2 and an A-12 doing their stuff, we introduce a level of chaos in the [enemy's] command and control system throughout the battle. And that takes a lot of the heat off our nonstealthy aircraft."

"So the presence of the B-2 and the ATF will enhance the ability of the B-1B and the F-15 to do their missions and will make it easier for all our airplanes to penetrate air defenses," General Jaquish claims.

The advent of the ATF "will not mean that the F-15s will fall off the face of the Earth," he says. They will still have plenty to do, and they will be around a while. Their production is scheduled to end in 1992, but they will remain USAF's air-superiority mainstays for many years until the ATF comes along.

If the ATF program stays on schedule—no sure thing—it will be about eleven years before two squadrons of the stealthy fighters are operational. USAF's rule of thumb is that two wings of a fighter must be operational before it can be said to provide true combat capability. In the case of the ATF, that won't happen until the year 2005 under the best of circumstances.

The ATF program is admittedly pricey, but this is no time to jettison it for that reason, in the opinion of Air Force officials. They claim that the long-term cost-effectiveness of the ATF will far surpass that of any upgraded fighter now in service.

Each F-15E currently coming off the production line costs \$35 million. The projected flyaway cost of each ATF, adjusted in terms of the buying power of today's dollars, is \$43 million, assuming a full run of 750 aircraft. The MAR concluded that the unit flyaway cost of an F-15XX, featuring new engines and avionics, would be roughly the same as that of the ATF and would be spent on an airplane far less capable.

"There is a notion that stealth is driving up the cost of the ATF. That is absolutely, categorically not true," says General Jaquish.

He declares, "We have worked on stealth and counterstealth equally hard. We understand stealth—its strengths and its weaknesses. There are no show-stoppers."

"Stealth is here to stay. It offers us military leverage that will be the key to our future weapon systems." ■

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The Chart Page

Edited by Colleen A. Nash, Associate Editor

A Comparison of Deployed Technology

Key

- US superior ■
- US/USSR equal ■
- USSR superior ■
- Soviet position improving ➤

The Pentagon says that in spite of the USSR's increasing economic difficulties, it continues to produce technologically advanced weapon systems. This relative comparison of technology levels in deployed military systems shows the overall average standing. The US has superior technology levels in most deployed systems, but, as the arrows indicate, this is changing significantly in the USSR's favor in several areas.

Strategic

- | | |
|-----------|-----------------------------|
| ICBMs ■ | SAMs ■ |
| SSBNs ■ | Ballistic missile defense ■ |
| SLBMs ➤ | Antisatellite ■ |
| Bombers ■ | Cruise missiles ■ |

Tactical

Land Forces

- | | |
|----------------------------|----------------------------|
| SAMs (including naval) ➤ | Antitank guided missiles ➤ |
| Tanks ➤ | Attack helicopters ➤ |
| Artillery ■ | Chemical warfare ■ |
| Infantry combat vehicles ■ | Biological warfare ■ |

Air Forces

- | | |
|---|----------------------------|
| Fighter/attack and interceptor aircraft ➤ | Air-to-surface munitions ➤ |
| Air-to-air missiles ➤ | Airlift aircraft ➤ |

Naval Forces

- | | |
|----------------------|-------------------------|
| SSNs ➤ | Surface combatants ■ |
| Torpedoes ■ | Naval cruise missiles ➤ |
| Sea-based aircraft ■ | Mines ■ |

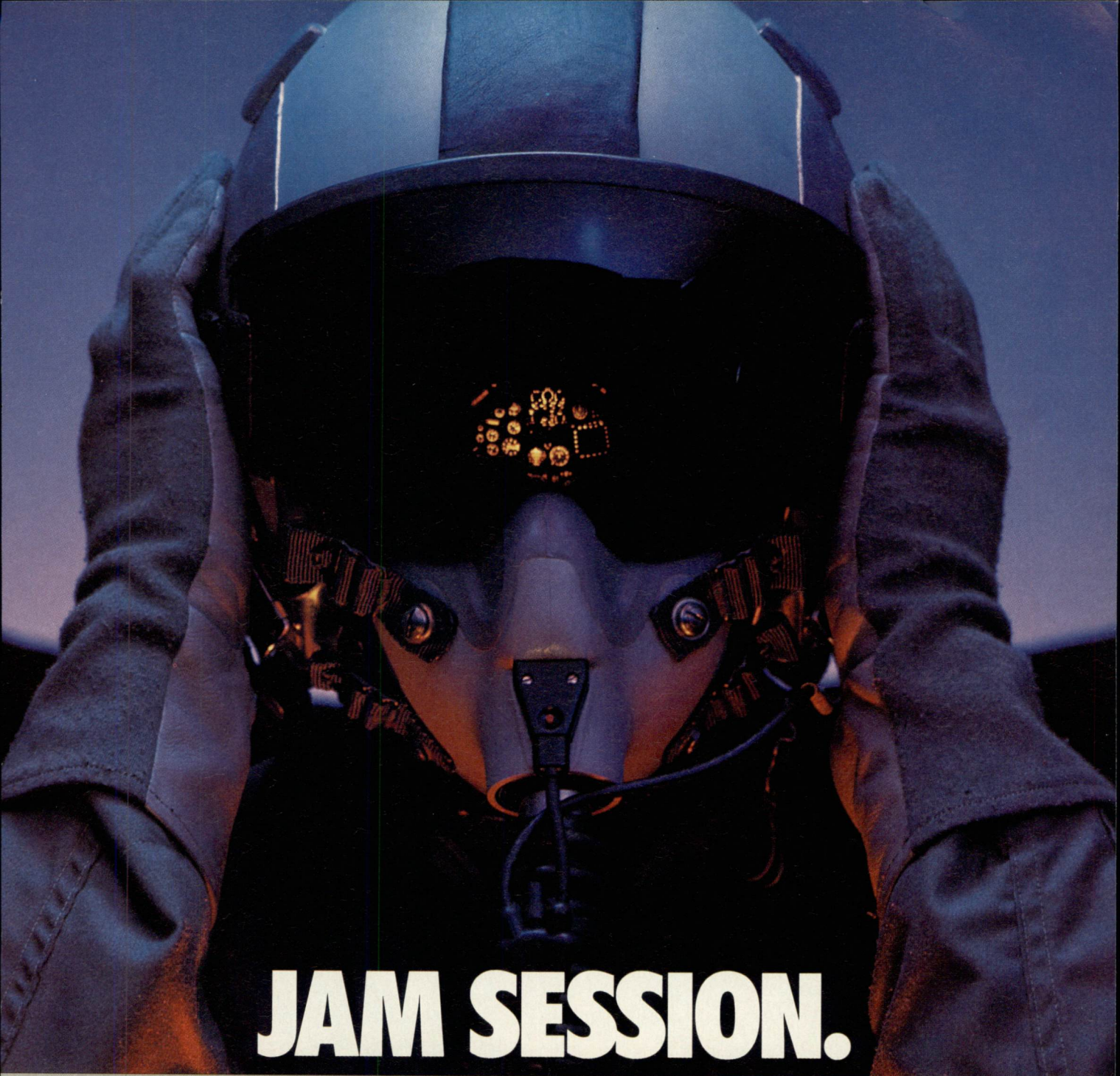
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| Communications ➤ | Early warning ■ |
| ECM/ECCM ➤ | Surveillance and reconnaissance ➤ |

Training Simulators

- Training simulators ■

Source: US Department of Defense, *Soviet Military Power 1990*, September 1990.



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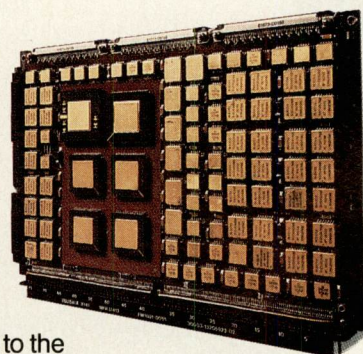
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 **CONTROL DATA**

Aerospace World

By Jeffrey P. Rhodes, Aeronautics Editor

★ Flight-testing of the two competing Advanced Tactical Fighter designs swung into high gear in late October as both teams flew the second example of their prototypes. The end of the demonstration/validation phase is now in sight; Air Force Systems Command's Aeronautical Systems Division (ASD) released the final ATF request for proposal November 2.

The second Northrop/McDonnell Douglas YF-23A (serial number 86-801) flew first, with Northrop test pilot Jim Sandberg making a forty-four-minute flight on October 26. The plane, powered by two General Electric YF120-GE-100 engines, reached an altitude of 15,000 feet and a calibrated speed of 240 knots during the flight, which was made from the Air Force Flight Test Center at Edwards AFB, Calif.

The first flight was marred slightly by a landing gear problem. Mr. Sandberg retracted the landing gear, but on the first effort to lower the gear, only the nose wheel extended. The pilot recycled the gear, and on the second try, both the mains and nose wheel came down and locked into place.

The first YF-23, powered by two Pratt & Whitney YF119-PW-100 engines, was flown to a supercruise (i.e., without afterburner) speed of Mach 1.43 at 42,000 feet on November 14. The plane had earlier hit an instantaneous speed of Mach 1.7 during flutter tests.

As of November 15, the two YF-23 prototypes had been flown by five pilots (including Air Force Maj. Ron Johnston and Con Thueson) twenty-two times for a total of thirty-three hours.

The P&W-powered Lockheed/Boeing/General Dynamics YF-22A (civil-registered N22YX) was flown for the first time on October 30. Lockheed test pilot Thomas Morgenfeld reached a speed of 240 knots and an altitude of 10,000 feet during the fourteen-minute flight from Palmdale, Calif. (where the airplane was built), to Edwards. The flight had been delayed for several days because the on-board auxiliary power unit had to be replaced.

Air Force Maj. Mark Shackelford, the first military pilot to fly the prototype, made the GE-powered YF-22's tenth and eleventh flights on October 25 and 26. Major Shackelford accomplished the type's first air refueling on the eleventh sortie, taking on 5,000 pounds of fuel from a KC-135. The aircraft was flown twice on October 31, with the afternoon sortie lasting 2.9 hours.

On November 3, an important milestone was reached as Lockheed test pilot Dave Ferguson flew the number one YF-22 to a supercruise speed of Mach 1.58 at 40,000 feet. He logged twenty-two minutes of supersonic flight in two supercruise demonstrations during the 1.2-hour flight. As of November 15, the two YF-22s had been flown nineteen times for slightly more than nineteen hours.

Both YF120-powered prototypes suffered hydraulic leaks. As a result, the YF-22 had to make a single-engine landing and one YF-23 flight was shortened. After consultation with the Air Force, General Electric removed a

temperature gauge from both sets of engines. The gauge had been chafing against the gaskets on the hydraulic lines, causing them to leak. The gauge was deemed redundant, and its removal solved the problem.

ASD issued two requests for proposals for full-scale development of the ATF. One is for development of the integrated weapon system, and the other is for engine development. The RFPs contain the requirements the Air Force seeks for its ATF, as well as the Navy's requirements for the Naval ATF, or NATF. Two draft RFPs had been issued earlier, which allowed the competitors the opportunity to respond and make suggestions.

The Air Force says that one contractor will build all the ATF engines, since the planned buy of 750 aircraft makes it uneconomical to qualify a second source and have yearly engine competitions, as was done for the F-15 and F-16.

★ Two of the most successful modification and modernization programs



A Boeing KC-135R crew pulls its aircraft up under another tanker during a recent high-altitude sortie. The KC-135R modification effort and the KC-135E upgrade, two of the Air Force's most successful modernization efforts, are being performed by Boeing Military Airplanes at its facility in Wichita, Kan.

in Air Force history are the conversions of Boeing KC-135A tankers into KC-135Es and KC-135Rs. Boeing Military Airplanes produces the reengine kits and does the installation work for both of these programs at its huge facility in Wichita, Kan.

The KC-135R effort is the more complex, involving changes to the plane's powerplant and structure. The KC-135A was first flown in 1956, and the decision to upgrade the aircraft's performance with a new engine and to further reduce overall maintenance and operation costs with other modifications was announced in 1980. After four years of development work, the first KC-135R was delivered to Strategic Air Command in 1984.

The General Electric/SNECMA CFM56 engine (designated F108-CF-100) was chosen to power the KC-135R. This 22,000-pound-thrust engine allows the R model to take off with more fuel and carry it farther. The KC-135R burns twenty-seven percent less fuel than the KC-135A, so the modification allows two R models to do the work of three KC-135As. The modified tankers are far quieter and can operate from shorter runways.

At the company's modification facility, the engines (which are government-furnished equipment) are first hung on an overhead monorail. After hydraulic and electrical connections are made, the nacelle, strut, and fairing are built up around the engine. The monorail holds seven engines; one powerplant starts on the line, and one built-up engine and nacelle come off, every ten hours.

Nearby, the aircraft's vertical stabilizer (removed when the tanker arrives) lies flat so a new rudder control and hydraulic wiring can be added. The area of the fin is also increased as part of the modification effort.

Boeing Military's modification hangar holds five KC-135s. One aircraft comes in and one goes out at roughly five-day intervals. In addition to re-hanging the fin and attaching the new engines, the aircraft are further modified with a reinforced wing structure and floor and strengthened landing gear, including a new antiskid system. A second auxiliary power unit is added, and the water injection system equipment is deleted. A new electrical system is installed, and autopilot modifications are also made.

Nearly 230 aircraft (of the 634 KC-135s still in service) have been brought up to the R-model standard and have been delivered. Boeing Military Airplanes recently received a \$23.5 million ASD contract for forty

SSgt. Lorenzo Galvan, a loadmaster with the Air Force Reserve's 433d Military Airlift Wing at Kelly AFB, Tex., receives the Airman's Medal from Chief of AFRES Maj. Gen. Roger P. Scheer. Sergeant Galvan was recognized for his efforts after the crash of a C-5A at Ramstein AB, West Germany, in August.



installation kits for FY 1991. With options, installations over a five-year period could total 166 to 211 additional tankers. The reengine kits are covered under a separate contract.

The second major modification program is the KC-135E upgrade for Air National Guard and Air Force Reserve tankers. This effort takes overhauled Pratt & Whitney JT3D engines from 707 jetliners and puts them on the KC-135s. Though not as complete as the R-model modification, this upgrade is accomplished at less cost and much faster. The last of 186 tankers to be brought to the E-model standard is scheduled to be delivered this summer.

Boeing has also prepared a proposal to the French Air Force to install wingtip pods (much like those on the US Air Force's KC-10s) on its eleven KC-135FRs. This will allow the tankers to refuel up to three aircraft at a time. One possible future effort for the Air Force's KC-135s is a complete modernization of the plane's avionics to further improve maintainability. The avionics modification would also eliminate the navigator's position.

★ **ELECTED**—Randy "Duke" Cunningham, who, along with radar inter-

cept officer Willie Driscoll, was the first US ace of the Vietnam War, was **elected to the House of Representatives** from California on November 6. The retired Navy commander, a Republican, defeated incumbent Rep. Jim Bates (D-Calif.) by a slim 982-vote margin. Representative Cunningham will serve the San Diego area. He is one of five Navy and Air Force aircrew members to record five or more victories in Vietnam.

★ **HONORS**—SSgt. Lorenzo Galvan, the lone surviving aircrew member of the C-5A transport that crashed at Ramstein AB, West Germany, on August 29, **received the Airman's Medal** from Chief of the Air Force Reserve Maj. Gen. Roger Scheer in ceremonies held at Robins AFB, Ga., on October 30. Sergeant Galvan, one of four people aboard the C-5 to survive the crash, was recognized for his efforts in trying to save other crew members and assisting passengers despite his own injuries. Sergeant Galvan is a loadmaster with the Reserve's 433d Military Airlift Wing at Kelly AFB, Tex. The Airman's Medal is awarded for actions involving voluntary risk of life under conditions other than those of combat.

The **Air Force Academy football team claimed the Commander in Chief's Trophy** for the second straight year with a 15-3 win over Army at West Point, N. Y., on November 10. The Falcons have won the trophy three out of the last four years and six times overall. The Academy last recorded back-to-back championships in 1982-83, the last time any of the three academies playing Division 1-A football claimed the trophy in consecutive years. The Commander in Chief's Trophy is awarded to the academy with the best record against the other service schools on the gridiron. Air Force beat Navy 24-7 on October 6.

The **Thunderbird Theater** at Lackland AFB, Tex., was **renamed the Bob Hope Performing Arts Center** in ceremonies on October 28. The performing arts center is the Air Force's permanent tribute to Mr. Hope in recognition of his nearly fifty years of entertaining service members around the world. A monument to Mr. Hope was also unveiled in the theater's plaza as part of the ceremony.

★ **PURCHASES**— Air Force Systems Command's Aeronautical Systems Division awarded **Boeing Advanced Systems Co.** a \$33 million "urgent and compelling" contract on October 26 for **5,300 Protective Integrated Hood/Masks (PIHMs)** for aircrews supporting Operation Desert Shield. The PIHM will be used USAF-wide to replace the MBU-13P chemical mask now worn by aircrew members. The PIHM is equipped with an intercom system, an air-filter canister, an oxygen mask and hood that fit under the aircrew member's helmet, and a blower unit that provides a continuous flow of filtered air for wear in and out of the cockpit. Boeing was under contract for development of the PIHM, but events in the Persian Gulf justified the need to bypass competitive bidding and award the production contract.

Grumman received a \$523.1 million contract from Air Force Systems Command's Electronic Systems Division (ESD) on November 2 for the **third E-8A Joint Surveillance and Target Attack Radar System (Joint STARS) aircraft**. Two E-8s are now being tested at the company's facility in Melbourne, Fla., and the third aircraft will serve as the preproduction example. The Air Force plans to acquire twenty-two production E-8As.

The **Texas Instruments/Westinghouse** joint venture received a \$7.4 million follow-on contract on October 30 for continued development of **technologies that will aid in the manufacture of active-element, electronically scanned, phased-array radar**

transmit/receive modules. The contract was awarded by ASD's Wright Research and Development Center's MANTECH directorate. The goal of this program is to bring down the cost of the modules to approximately \$400 each. [For more on the T/R modules and the MANTECH program, see "The Blocks That Built the ATF," p. 30.]

Northrop received a \$55 million ASD contract in late October to **convert the B-2A Stealth bomber to operate on JP-8 aviation fuel**. Boeing Military Airplanes, already one of the primary subcontractors on the B-2, will handle the conversion. The modifications will include removal of the pressurization system needed for JP-4 fuel and changes in the fuel management and measurement system. The modifications will take nearly two years to design and implement. JP-8 has a higher flashpoint than JP-4 and is similar to the Jet-A fuel used

on airliners. It also includes additives that dissipate static electricity and lower the freezing point of the fuel.

Beech Aircraft received a \$17.9 million Oklahoma City Air Logistics Center contract in late October to provide **worldwide logistics support** for the Air Force's fleet of forty **C-12F operational support aircraft**. The contract runs through 1991, and work will be performed by Beech Aerospace Services, Inc., a wholly owned subsidiary. The C-12Fs, a military version of the Super King Air corporate aircraft, are stationed at locations in the US, Europe, and the Far East.

Unisys received a \$452.3 million ESD contract on October 24 to build forty **AN/FPS-124 short-range, unattended radars for the North Warning System**. The FPS-124 is designed to fill gaps left between the long-range AN/FPS-117 NWS radars that are al-

Anniversaries

- **January 18, 1911:** Eugene Ely, flying a Curtiss pusher, makes the first landing on a ship. He touches down on a 119-foot-long wooden platform on the stern of the cruiser USS *Pennsylvania*, riding at anchor in San Francisco Bay.

- **January 21, 1911:** The first Army message to be transmitted from the air via radio is sent by Lt. Paul Beck from a Wright biplane at Selfridge Field, Mich., using a radiotelegraphic transmitter of his own design. The message is received at a ground station 1.5 miles away.

- **January 5, 1916:** The 1st Company of the 2d Aero Squadron sails from San Francisco, Calif., headed for the Philippines. Once in operation, it becomes the first Aviation Section unit to serve outside the US.

- **January 29, 1926:** Lt. John Macready (a pilot on the first nonstop transcontinental flight in 1923) sets an unofficial US altitude record of 38,704 feet in the experimental Engineering Division XCO-5 over Dayton, Ohio.

- **January 21, 1946:** President Harry S. Truman asks for the unification of the armed forces in his State of the Union address.

- **January 26, 1946:** The Army announces that the Army Air Forces has created the 1st Experimental Guided Missile Group at Eglin AFB, Fla., to develop and test this new type of weapon.

- **January 31, 1961:** America's first space voyager, a chimpanzee named Ham, is launched atop a Redstone booster from Cape Canaveral, Fla., in a test of the Mercury manned capsule.

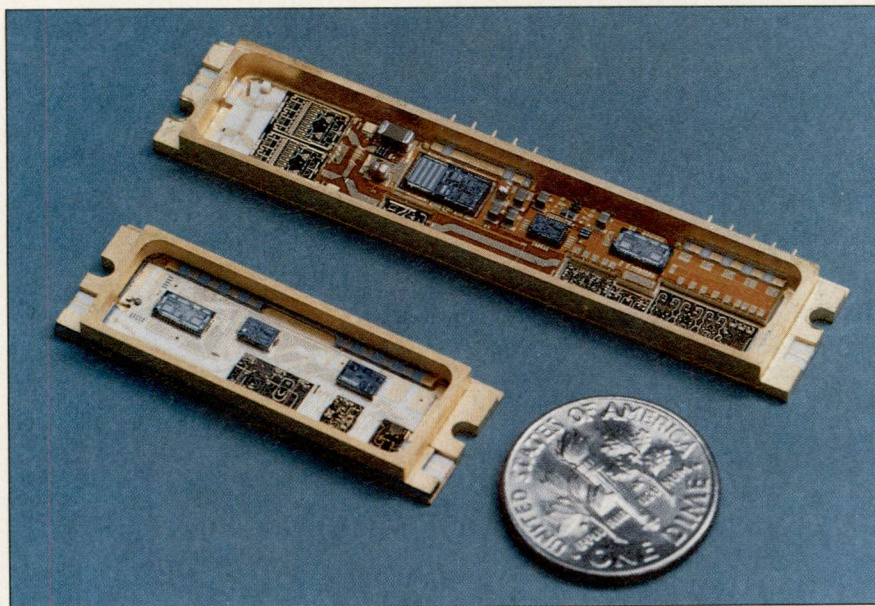
- **January 6, 1966:** The first Lockheed SR-71 "Blackbird" high-altitude, high-speed reconnaissance aircraft (serial number 64-17957) is delivered to the 4200th Strategic Reconnaissance Wing (later the 9th SRW) at Beale AFB, Calif.

- **January 17, 1966:** A B-52 loaded with four hydrogen bombs collides with a KC-135 while refueling near Palomares, Spain. Seven of the eleven crew members involved are killed. Three of the four weapons are quickly recovered. The fourth, which had fallen into the Mediterranean Sea, is not recovered until early spring.

- **January 23, 1966:** The newly renamed Military Airlift Command (as of January 1) completes Operation Blue Light, the airlift of the Army's 3d Brigade, 25th Infantry Division, from Hawaii to Pleiku, South Vietnam, to offset the buildup of Communist forces there. The airlift began on December 23, 1965, and its 231 C-141 sorties moved approximately 3,000 troops and 4,700 tons of equipment.

- **January 20, 1981:** Two Air Force C-9A Nightingales are flown from Algeria to Rhein-Main AB, West Germany, carrying fifty-two Americans who had been held hostage in Iran for 444 days. On January 27, the Americans are repatriated aboard a VC-137 Stratoliner.

- **January 28, 1986:** The nation watches in horror as the space shuttle *Challenger* explodes seventy-three seconds into flight on the twenty-fifth shuttle mission, 51-L. Dick Scobee, Navy Cmdr. Michael Smith, Air Force Lt. Col. Ellison Onizuka, Gregory Jarvis, Dr. Judith Resnick, Dr. Ronald McNair, and schoolteacher Christa McAuliffe are killed. The manned spaceflight effort would be halted until 1988.



The Texas Instruments/Westinghouse joint venture has received a contract to continue developing technologies to aid in the manufacture of individual radar transmit/receive modules such as these, used in active-element phased-array aircraft radars. The goal is to reduce the price to approximately \$400 each.

ready deployed. The radar pairs are designed to detect and track low-flying aircraft and cruise missiles approaching the US and Canada. The FPS-124 can track up to 200 targets and is designed to automatically monitor its performance, isolate faults, switch to redundant components, and then notify the remote maintenance facility. The company will build thirty-seven new sets and upgrade three preproduction models.

The **Center for Aviation Systems Reliability**, a collaboration between Iowa State University and Northwestern University, was established on October 29 under a \$3 million Federal Aviation Administration grant. The center's researchers will work on developing new technologies that will give aircraft inspectors a closer look at the condition of airframes, engines, and other structures. The technicians will also seek to apply existing technologies to improve aircraft safety and inspection. The center will be located at ISU's campus in Ames, Iowa.

★ **DELIVERIES**—General Electric delivered the 6,000th T700 series engine to the Army in ceremonies on October 18. The 1,940-shp-class T700 series is used to power the Sikorsky UH/SH/MH-60 Black Hawk/Seahawk/Pave Hawk family as well as the McDonnell Douglas AH-64 Apache, Kamman SH-2G Sea Sprite, and Bell AH-1W Cobra for the US military. Since en-

tering service in 1978, the T700 series has accumulated nearly 6,000,000 flight hours and has an engine-caused shop visit rate averaging one per 5,000 hours. The milestone engine, a T700-GE-701C, will be installed in an Army UH-60.

Senior Staff Changes

RETIREMENTS: M/G Fredric F. Doppelt; L/G Robert P. McCoy; M/G Alan G. Sharp.

CHANGES: B/G George K. Anderson, Jr., from Dir., Medical Inspection, Hq. AFISC, Nor- ton AFB, Calif., to Cmdr., HSD, AFSC, Brooks AFB, Tex., replacing retired M/G Fredric F. Doppelt . . . M/G Lester P. Brown, Jr., from Cmdr., 24th AD, TAC, Griffiss AFB, N. Y., to Cmdr., USAF Air Defense Weapons Ctr., TAC (which will become the 25th AD, TAC), Tyndall AFB, Fla., replacing retiring M/G Richard M. Pascoe . . . M/G William P. Hallin, from Cmdr., AFLC Log. Ops. Ctr., and Ass't DCS/Sys. & Req., Hq. AFLC, Wright-Patterson AFB, Ohio, to DCS/Material Mgmt. and Ass't to the Cmdr., AFLC, for R&M, Hq. AFLC, Wright-Patterson AFB, Ohio, replacing M/G Michael D. Pavich . . . M/G Arlen D. Jameson, from Cmdr., Strategic Missile Ctr., SAC, Vandenberg AFB, Calif., to C/S, Hq. SAC, and Dep. Vice Dir., JSTPS, Offutt AFB, Neb., replacing retiring M/G Donald L. Marks . . . M/G Michael D. Pavich, from DCS/Material Mgmt. and Ass't to the Cmdr., AFLC, for R&M, Hq. AFLC, Wright-Patterson AFB, Ohio, to Cmdr., Sacramento ALC, AFLC, McClellan AFB, Calif., replacing M/G (L/G selectee) Trevor A. Hammond.

AFRES RETIREMENT: M/G Jack L. Lively.

AFRES CHANGE: B/G Robert A. McIntosh, from Cmdr., 10th AF, AFRES, Bergstrom, AFB, Tex., to Vice Cmdr., Hq. AFRES, Robins AFB, Ga., replacing retired M/G Alan G. Sharp.

SENIOR ENLISTED ADVISOR (SEA) CHANGE: CMSgt. Ronald D. Allison, to SEA, Hq. AFCC, Scott AFB, Ill., replacing CMSgt. Walter D. McLain.

SENIOR EXECUTIVE SERVICE (SES) CHANGE: Dr. Chine I. Chang, from Chief Scientist, Naval Air Systems Cmd., Washington, D. C., to Dir., Aerospace Sciences, Air Force Office of Scientific Research, Bolling AFB, D. C., replacing retired Dr. Michael Salkind. ■

Litton delivered the first of four system modules for Air Force Logistics Command's new Reliability and Maintainability Information System (REMIS) on November 5. REMIS will replace multiple data systems currently used to analyze and report on weapon systems field data. Use of one system, connected to an on-line central database, is expected to produce significant savings over the old multiple systems. The first module monitors and reports the count, status, and use of items in the weapon system inventory. The second module will access reliability and maintainability data. The third will offer configuration status accounting information, and the fourth will access all information regarding open mission capability incidents. The modules are scheduled to be operational by 1993.

★ **MILESTONES**—Col. (Dr.) Thomas C. Cook, believed to be the Air Force's last World War II combat veteran still serving, retired November 9. Most recently the chief of the medical consultant branch at USAF's Military Personnel Center's Directorate of Medical Service Officer Programs at Randolph AFB, Tex., Dr. Cook enlisted as an aviation cadet in 1943. He saw action as a B-24 navigator in Europe and transferred to reserve status in 1948. He returned to active duty in 1976.

The Air National Guard's **108th Tactical Fighter Wing** at McGuire AFB, N. J., set a **single-day F-4 sortie generation record** on November 3. The wing's crews flew 127 sorties in just under eleven hours. For the day, the unit's fully mission capable rate "fell" to 99.2 percent because of a single ground abort. The 108th's weapons specialists loaded more than 750 practice bombs on the sixteen F-4Es used in the surge.

The **first captive-carry test** of the tactical version of the Boeing AGM-131B short-range attack missile (**SRAM-T**) was **successful**. During the November 5 test at the Air Force Flight Test Center at Edwards AFB, Calif., the fourteen-foot-long missile, carried on an F-15E, was subjected to a full range of aerodynamic and structural loads, including aircraft speeds in excess of Mach 1. The test round was mounted on a prototype pylon adapter (built by McDonnell Douglas) that provides the missile with vertical fin clearance of the pylon and adequate spacing to route the umbilical cable. The missile, pylon, and pylon adapter were instrumented to gather data. SRAM-T is the tactical version of the AGM-131A SRAM II supersonic, nuclear-tipped, air-to-ground missile that will equip the B-1B and B-2 bomber fleets.

The battleship **USS Iowa (BB-61)** was **decommissioned** for the second time in its forty-seven-year career on October 26 as a cost-cutting move. The ship, which took President Franklin D. Roosevelt to the Tehran conference in 1943 and suffered a tragic turret explosion in 1989, will be mothballed at the Norfolk (Va.) Naval Shipyard and towed to Philadelphia, Pa., this spring, where it will join the inactive fleet. **USS New Jersey (BB-62)** is also being mothballed, but **USS Missouri (BB-63)** and **USS Wisconsin (BB-64)** will continue in active service.

★ **NEWS NOTES**—As part of an organizational restructuring to cut costs, **Air Force Logistics Command** began operating its five air logistics centers through "product" and "service" directorates on October 31. Each ALC consists of a three-tier structure. The first level includes the center commander's special staff. The second level includes the major service directorates (contracting, financial management, human resources, inspector general, environmental management, communications, and computer systems) and an air base group. The third level is the product management directorates. Each product directorate will be as in-



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dependent as possible and will have the personnel necessary to perform the full spectrum of activities to support specific aircraft, weapons, or systems. This change will eliminate AFLC headquarters involvement in specific program management and will cut several other layers of management.

Construction of the Department of Defense's largest telescope began with ground-breaking ceremonies at Kirtland AFB, N. M., on October 23

for the special mechanical support building. The 3.5-meter telescope at Kirtland's Starfire Optical Range will allow scientists at the Weapons Laboratory to track basketball-sized objects 1,000 miles from Earth. The telescope, to be the fifth largest in the US and the twelfth largest in the world, will also be used for ground-based optical research in atmospheric compensation, advanced imaging and acquisition, and pointing and tracking. Its primary mirror is being fabricated

An Advanced Development Electronic Warfare System will help Military Airlift Aircraft survive in territory that may have been penetrated by enemy fighters or Surface-to-Air-Missiles (SAMs). The demonstration system is being developed by the team of Hughes Aircraft Company and Tracor for the Air Force Wright Research and Development Center. It includes a Warning, Awareness and Avoidance Subsystem consisting of RF receivers, approaching missile detectors, processors and displays, all integrated by Hughes, with the Chaff and Flare Dispensers and Active Countermeasures made by Tracor.

A laser system acquired, tracked, and destroyed a supersonic target in a test for the Strategic Defense Initiative Organization and the U.S. Navy. The laser system used a Hughes-built collection of mirrors, sensors, and alignment and stabilization equipment, called a Sea Lite Beam Director. Sea Lite is designed to acquire and track a supersonic Vandal missile, focus an external, high-energy laser beam at a point on the moving target, and hold the beam at the same position long enough to disable the missile. The test was the conclusion of a two-year effort to validate the use of a high energy laser system against targets in flight.

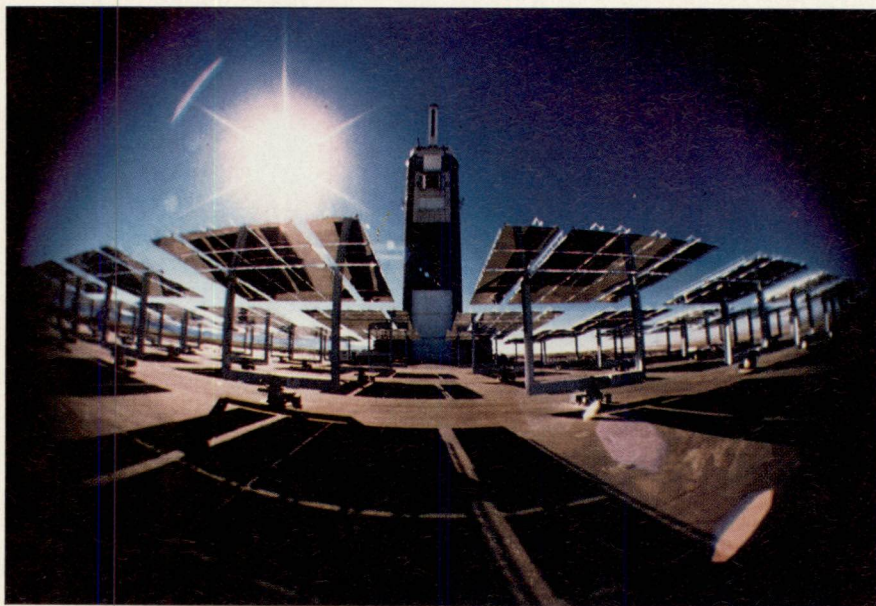
A rocket engine less than an inch long and weighing only 3.5 grams (about a tenth of an ounce) will control a space intercept vehicle. The engine was designed for the Lightweight Exo-Atmospheric Projectile (LEAP), a state-of-the-art intercept device under development by Hughes for the U.S. Army. The miniature LEAP rocket produces one pound of thrust by expelling hot gas, produced in a gas generator, in small pulses less than a millisecond in duration. The projectile also includes a long-range imaging infrared seeker and a 4.2 million-instructions-per-second computer that weighs less than an ounce. The LEAP vehicle, which has no warhead, is the smallest and lightest-weight intercept technology being developed for defensive applications.

More than 20 nations protect their sovereign airspace with command, control and communications systems produced by Hughes, the world's most experienced developer of automated air defense systems. The systems are comprised of air defense radars, computers, displays, communications and other electronic subsystems. Target information is transmitted through data links to data processing centers, where computers automatically track and report the aircraft's speed, altitude, and course. The systems are tailored to the requirements of each country based on geography, military equipment, and size and structure of military forces. Nations equipped with Hughes systems include Japan, Switzerland, the U.S., Spain, Canada, Malaysia and European NATO members Belgium, Denmark, Greece, Italy, the Netherlands, Norway, Turkey, the United Kingdom, and West Germany.

A new packaging technology offers the highest circuit interconnect density per unit volume in applications ranging from digital to microwave. Developed by Hughes, the technology, called low-temperature cofired ceramic packaging, places buried interconnects, such as low frequency signal traces and RF stripline, in laminated ceramic material. Buried passive elements, such as resistors and capacitors, can also be incorporated into this monolithic package structure. High packaging density is also achieved by placing devices into cavities and interconnecting within the cavity walls. This new technology offers significant weight and size reductions in several applications, especially active radar antennas.

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

HUGHES



A new wind tunnel, sponsored by the Air Force, has been installed at the Sandia National Laboratory at Kirtland AFB, N. M. Using the 220 sun-tracking heliostats of the National Solar Thermal Test Facility (shown here) and airflows of up to 240 miles per hour, the tunnel (in the tower, center) can simulate the irradiating effects of nuclear thermal flash on aircraft materials.

by the University of Arizona's Stewart Observatory Mirror Laboratory and will be installed in 1992. The telescope will be cooled by chilled water produced by melting ice in a half-million-gallon tank.

The assembly tooling surrounding the **first production McDonnell Douglas C-17A airlifter** was removed on October 24, and the aircraft is now

standing on its own landing gear. This C-17, the second built at the Douglas plant in Long Beach, Calif., will be used in the type's ground and flight-test program at Edwards AFB. The C-17A is one of four production aircraft that will be involved in the test program. They will eventually join Military Airlift Command's operational C-17 fleet.

The **second test in the Air Force's Car Assembly Launch Test Program**, which will validate equipment for use in the Peacekeeper rail-garrison effort, **was successfully carried out** on October 26 at the Rocky Mountain Railcar Co. test center at Hudson, Colo. A 200,000-pound test vehicle simulating an LGM-118A Peacekeeper intercontinental ballistic missile was ejected from the engineering model of the rail-garrison missile launch car during the test (which employed the cold-launch technique used with the Peacekeeper ICBM) to provide engineering data to verify that the car and the railbed can withstand launch loads. The first live launch is scheduled for 1992 from Vandenberg AFB, Calif. Westinghouse is working under a \$167 million contract to provide systems definition, design, development, and test of the Peacekeeper rail-garrison missile launch cars.

Two aircraft now serving as outdoor displays at the Air Force Museum at Wright-Patterson AFB, Ohio, **recently provided valuable assistance for Operation Desert Shield.** Engineers designing sunshades for operational Fairchild A-10s and McDonnell Douglas F-15s in Saudi Arabia went to the museum to take measurements from the YA-10A and the "Streak Eagle" F-15A that were retired several years ago. This saved the expense and time it would have taken to go to an operational base and take the measurements there. The museum currently has approximately 22,000 items of Air Force historical property on loan to other museums in the US and abroad. Another 6,000 are displayed at its site near Dayton, and 14,000 more are in storage across Wright Field from the museum building. Among the museum's assets are about 1,800 aircraft—about 1,400 on loan, 200 exhibited at the museum, and another 200 stored.

★ **DIED—Robert N. Thorn**, an engineer who designed more than a dozen nuclear warhead types, of unreported causes on October 25 in Los Alamos, N. M. He was sixty-six. He joined the Los Alamos National Laboratory in 1953 and became head of the lab's thermonuclear weapons physics and design group in 1962. He became head of the lab's theoretical design division in 1971 and was deputy director of the lab from 1979 to 1985. Dr. Thorn also served on advisory groups to the CIA, Defense Intelligence Agency, and Air Force before retiring in 1989. ■

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Fielding the new fighter took ten years' worth of custom technology.

The Blocks That Built the ATF

By Jeffrey P. Rhodes, Aeronautics Editor

WHEN the Air Force announced requirements for the Advanced Tactical Fighter, it became clear that building it was not for the faint of heart. The airplane had to be fast, stealthy, agile, supportable, and affordable. In short, it had to embody what seemed to be mutually exclusive design factors.

Insiders, however, knew the requirements were not quite so daunting as they appeared. By the time contracts were awarded in 1986, Wright Research and Development Center, based at Wright-Patterson AFB, Ohio, had gone far in developing technologies needed to make the ATF a reality.

"We have been linked very closely with the ATF [System Program Office, or SPO] from very early in the program," says Dr. Gary Denman, deputy director of WRDC, the laboratory component of Air Force Systems Command's Aeronautical Systems Division. "We go back to the beginning of concept definition in the early 1980s."

Adds Dick Matson, one of WRDC's radio systems engineers, "We did the right set of experiments for the SPO to allow them to make

the necessary tradeoffs. We are not always this successful."

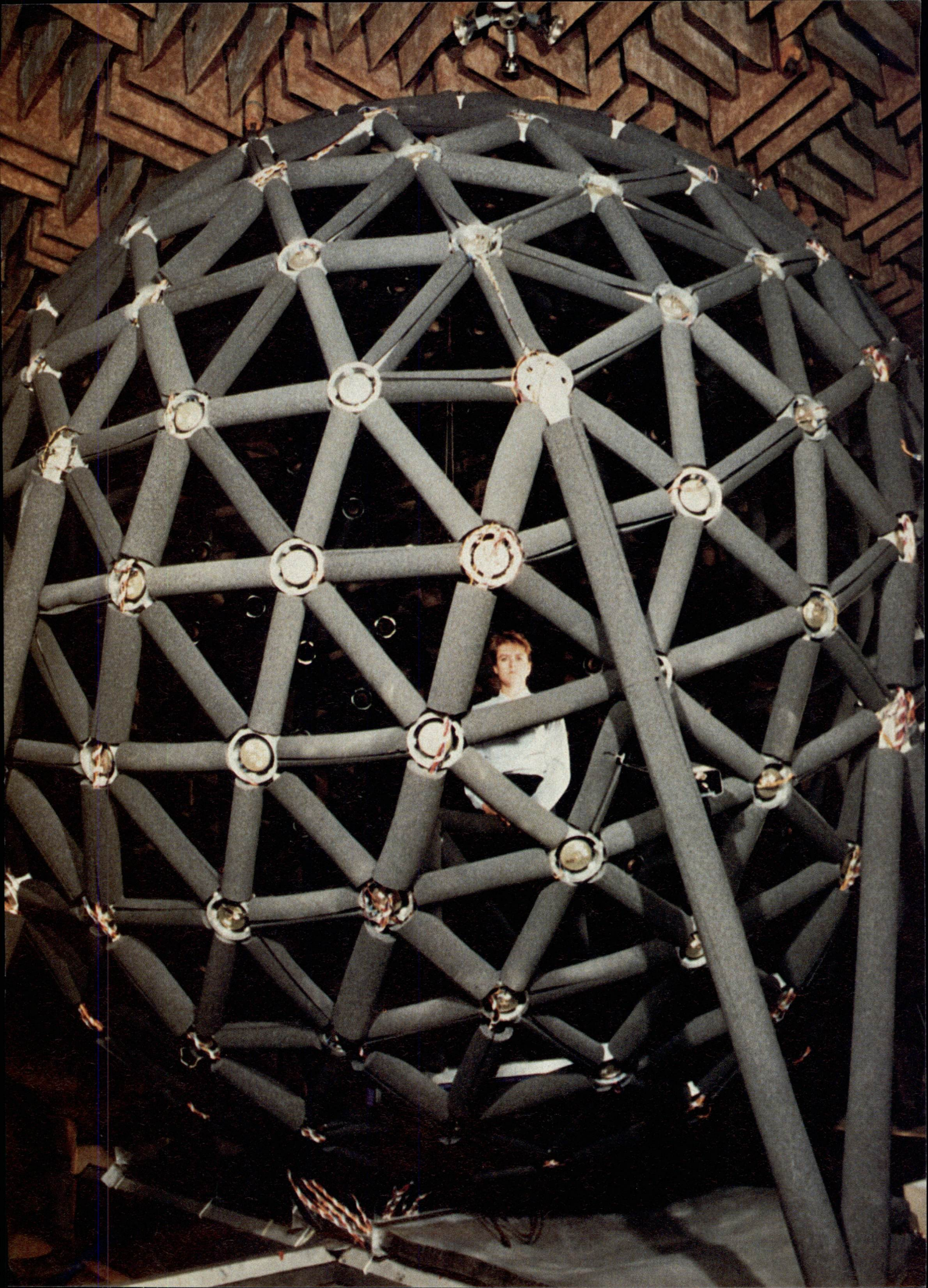
From active-element, phased-array radar to exotic materials, from integrated avionics using VHSIC chips to low-aspect-ratio engine compressors, WRDC has left an unmistakable imprint on the ATF. Its influence is apparent in both prototype ATF airframes—the Lockheed/Boeing/General Dynamics YF-22 and Northrop/McDonnell Douglas YF-23—and the Pratt & Whitney and General Electric demonstrator engines.

Now WRDC scientists and engineers are turning to new challenges. Much WRDC work focuses on efforts to modify and keep current what the Air Force already has on the ramp. The laboratories also are working on a number of major projects, some of which will see results in a few years and some that won't come to fruition until after the turn of the century.

WRDC has not completely cleared the decks of ATF work. The first huge challenge for WRDC was developing and validating many futuristic technologies. That part of the effort is now largely complete. The

One of the promising technologies being developed for the ATF's successors is 3-D sound.

This fourteen-foot-diameter aluminum sphere at the Wright Research and Development Center at Wright-Patterson AFB, Ohio (soon to be the Wright Laboratory) contains 272 loudspeakers spaced at regular intervals for sound localization research. Lt. Denise West, a lab audiologist, is inside.



next big hurdle will be to bring to maturity all of these recently developed technologies and, in the process, bring down costs to affordable levels.

Up Front

The ATF technologies were not produced overnight. For example, the effort to develop active-element, phased-array radar for use in an aircraft actually began in 1964. In 1983, the Air Force launched its Ultra Reliable Radar (URR) program, the aim of which was to build a solid-state array using gallium arsenide devices in its active circuits.

The work took five years but was, in the end, a success. Technicians came up with a practical way to produce a radar with 2,000 individual transmit/receive antenna modules. Westinghouse, Texas Instruments, and IBM all produced portions of the X-band, multimode radar, which boasts much-improved range compared to current radars. It is also far more reliable—the expected mean time between failures for the entire array comes to 2,000 hours, and for each T/R module an astounding 8,000 hours.

Up to now, aircraft radars were based on one traveling wave tube; it either works or doesn't work. By contrast, a phased-array radar allows for graceful degradation—that is, the system fails slowly, one ele-

ment at a time. On the URR, up to five percent of the modules can fail before significant reduction in radar capability occurs.

"Reliability was good; performance was very good," recalls Marvin Spector, director of WRDC's Avionics Laboratory. "We were generating power at the aperture, not behind it as on current radars." However, Mr. Spector concedes that "cost was a problem." In fact, the early 400-pound URR demonstrator cost \$55 million.

Cost per module is still a great concern. However, engineering work and testing have continued, with beneficial results. T/R modules that will go on production ATFs come in two packages, each of which is half the size of the experimental URR modules. These new modules offer greater power and more functions.

"VHSIC [very-high-speed integrated circuit] was the number one priority around here for a long time," says Robert Werner, the Air Force VHSIC program manager. "It is a complex program—we had to get the basic processing technology, figure out design aspects, and do packaging and testing."

VHSIC chips offer three main advantages over conventional integrated circuits: dramatic increases in both processing speed and power and smaller size. One chip does the

work of hundreds of thousands of transistors. A "super chip," now under development, will be 1.5 inches square and do the work of four million transistors.

VHSIC chips offer high reliability and are hardened against severe radiation environments. Each chip comes with a diagnostics capability. In fact, fifteen to twenty percent of the circuitry of each chip is dedicated to self-test functions. This allows maintainers to determine whether a problem stems from failure of one chip or of an entire circuit board.

These microchips are exceedingly complex. Each contains thousands of mechanical interconnections, none longer than one quarter of an inch and each at least 100 times narrower than a human hair. If all the connections in one tiny chip were placed end to end, they would extend about twenty-four feet.

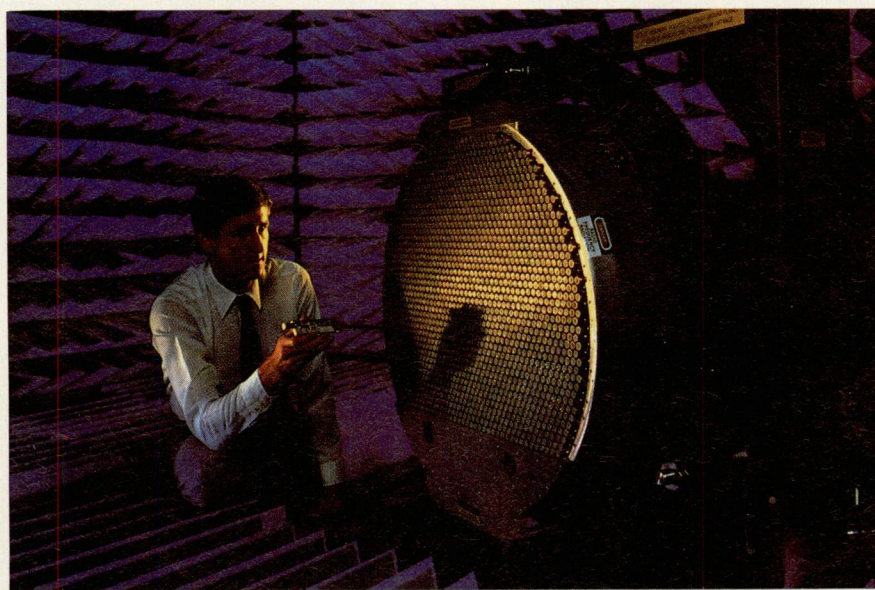
High-quality manufacturing of such devices, at economical prices, obviously poses an immense challenge.

Sensing and the Single Box

"VHSIC had to be in place for us to do anything we did on the ATF," notes Mr. Spector. "VHSIC led to common modules and shared resources. The avionics lab's role was to create an environment where common module technology could be explored."

Today's avionics systems support many functions, the most important of which are radar, electronic warfare, communications, navigation, identification of friendly and enemy aircraft, and fire control. In the current generation of avionics, each of these functional-area systems relies on circuitry contained in an individual "black box." This kind of system organization works, but it is inefficient and expensive.

In the early 1980s, WRDC set as a basic goal development of a new and better way of managing avionics functions, a goal that was demonstrated in the course of its Pave Pillar program. Under the Pave Pillar concept, avionics designers would dispense with many and varied "black boxes" and put all functions into one big box, which would use higher-level software to sort out the differences in signals and functions. This type of avionics "architecture" will be used in the ATF.



The Ultra Reliable Radar program developed a practical way to produce an aircraft radar with 2,000 individual transmit/receive antenna modules. The X-band, multimode radar has great range and reliability, but each module (such as the one held by this engineer) costs several thousand dollars. A manufacturing technology program is making progress toward reducing the cost per module to approximately \$400.

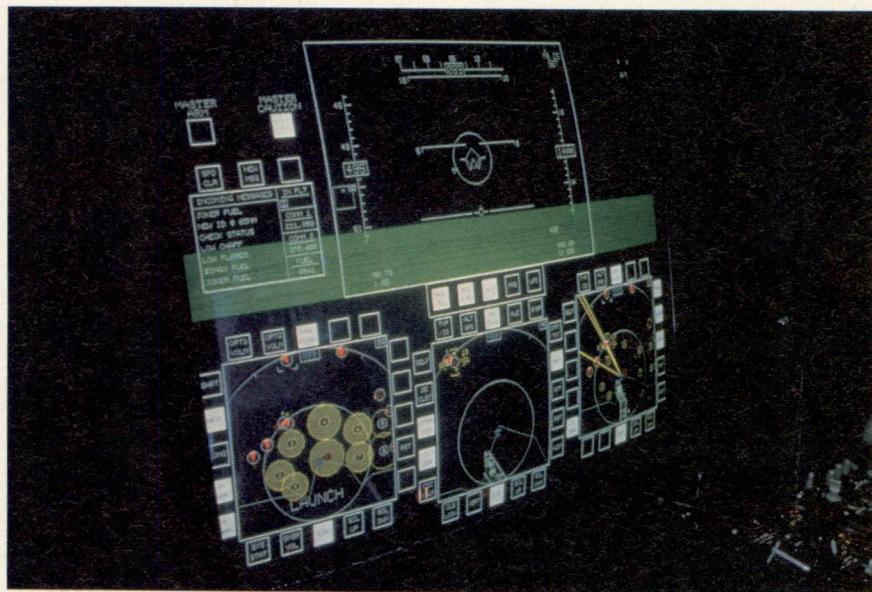
The Pave Pillar-style architecture is flexible and fault-tolerant. It is based on a family of common modules that can be used in multiple applications or packaged as a unit to form an avionics upgrade. It uses high-speed data buses and a common signal processor, both based on VHSIC-type chips. The system runs on Ada, the Pentagon's common computer language.

Each module has a self-test function that will allow maintainers to know when it has failed. Module replacement will be as easy as opening the box, sliding out one module, and sliding in a new one.

Ease of repair is a key reason for development of this type of system. With the self-test feature, flight-line mechanics will only replace modules. If a circuit board fails a test, it will be sent to the depot. No modules will be fixed in an intermediate shop. Thus the Air Force eliminates an entire level of maintenance and saves money.

Size and weight requirements were also factors. Communications, navigation, and identification (CNI) equipment in an F-16, for example, takes up eight cubic feet and weighs 585 pounds. In contrast, production CNI equipment on the ATF will take up roughly four cubic feet and weigh under 320 pounds.

"Integration of functions such as CNI, electronic warfare, and the ra-



Research into flat panel displays for the cockpit has been under way for nearly eighteen years. This laboratory test article shows a "glass cockpit" display. While active-matrix, color liquid crystal multifunction displays are being introduced and promise great benefits, they can't be produced in large sizes, they sometimes need a warm-up period, and they will require a large investment in production facilities.

dar was difficult," says Mr. Spector. "We designed the system so it would work, would be easy to upgrade, and would be less difficult to get into production. But mainly we designed it to get the pilot the right information when he needs it."

How the pilot will see the gathered information is also being addressed in the labs. "Cathode-ray tubes [CRTs] are heavy, they are huge, they need lots of power, they

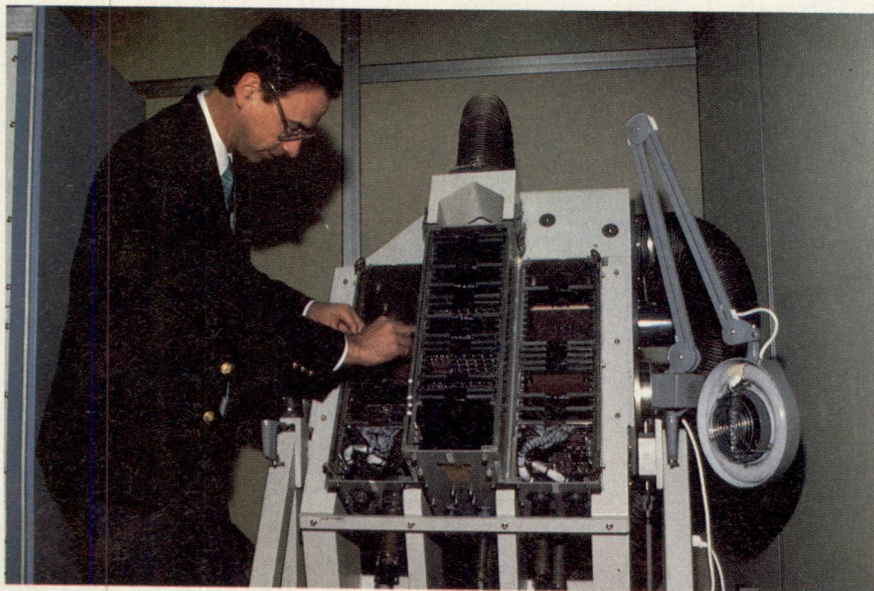
have poor reliability, and they have poor sunlight readability," says Bob Michaels, a displays engineer in WRDC's cockpit integration directorate. "But they are what we use now."

That, however, is about to change. Research into "flat-panel" displays began in 1973. Technology is now coming out of the laboratory in the form of active-matrix, color liquid crystal displays. LCDs are everything CRTs are not—lightweight, operable on small amounts of power, reliable, small (one inch deep), and readable in harsh glare. The YF-22 was the first aircraft to use LCDs as multifunction displays.

The LCDs have some drawbacks. At present, they cannot be produced in large sizes. The LCDs need a short warm-up period in cold weather, something an alert fighter can ill afford. Finally, LCD manufacturers would have to build large, expensive "clean rooms"—pristine production facilities—to carry out the task.

The Rest of the Airplane

When an airplane is ready to go into production, a common remark is, "It's time to cut aluminum." There won't be much aluminum to cut when the ATF gets to the factory floor, at least not the aluminum currently used in airplanes. The production ATF is most likely to make



Dale Van Cleve pulls a module from the common signal processor test rig at WRDC's avionics laboratory. Research into very-high-speed integrated circuits led to the successful Pave Pillar avionics architecture program. Common modules and sophisticated software allow primary avionics functions to reside in a few signal processors, rather than giving each function its own "black box."

extensive use of aluminum alloys and new-generation composites, both of which are products of WRDC efforts.

Several metals projects hold great promise for use on the ATF. An aluminum-lithium alloy offers substantial weight savings for such structures as fuselage frames. Elevated-temperature aluminum will be able to withstand up to 600 degrees Fahrenheit (standard-grade aluminum starts to melt at 350 degrees) and could replace titanium in keel beams and the engine area.

Thermoset composite materials have been in wide use in the aerospace industry for roughly seven years, but their replacement could already be on the way. "Thermoplastic materials will find a niche on the ATF," says Dr. Charlie Browning, the structural materials branch chief. "All of the companies have an interest in thermoplastics."

Thermoplastic composites offer three main advantages over thermosets. First, their cost of manufacturing has the potential to be far lower. Thermoplastics can be pressure-formed, so there is no need for an autoclave. Unlike the raw materials used in thermosets, those used in thermoplastics don't need to be refrigerated.

Second, thermoplastics stand up well to drilling and can be reheated

and reformed, making for ease of assembly.

Finally, thermoplastics are inherently sturdy, offer better reliability and maintainability than thermosets, and can better survive crashes.

If they are perfected, thermoplastics would offer great advantages. However, it is unknown whether they will actually work on an airplane. The Materials Laboratory is running a pilot program with each ATF contractor team in an effort to find out. The first task was to build a secondary piece, such as an engine access or landing gear door, from thermoplastic composites. The second phase will be to manufacture a primary structure, such as a bulkhead or other part in the center section of the fuselage.

Building a Better Powerplant

When it comes to the ATF's technologies, WRDC officials point with pride to their work in the area of powerplants. "The biggest contribution we have made to the ATF is in the area of engines," states Dr. Denman.

Both ATF demonstrator engines propelled the prototypes to supersonic flight without afterburner—supercruise—and one major contributing factor was the radically new compressor design.

The low-aspect-ratio compressor

blades on the ATF engines are short and fat, just the opposite of blades on current engines. The amount of work each blade does is increased by using lower-aspect blades so that the number of compressor stages can be reduced. The engine's overall length can also be shortened.

Increasing the blade chord increases circumferential spacing between blades, so fewer blades and parts are needed. The remaining blades tend to be hefty and rugged and thus are much better able to work in the presence of sand, the bane of fighter engine performance and longevity. This type of blade costs less and offers better resistance to birdstrikes.

A second new design feature was the addition to the blades of an aerodynamic sweep. Much like a propfan, the sweep slows the rotation of the blades' tips, further increasing the efficiency of the compressor.

"Low-aspect-ratio compressor blades were inspired by a lot of things, not the least of which was what we saw in some foreign technology," notes Dr. Arthur Wennerstrom, chief of the compressor research group and the pioneer of this new type of compressor. "A lot of evidence said that short blades were the way to go."

A final major technology pioneered for the ATF was thrust-vectoring nozzles. The current F-15 STOL/Maneuvering Technology Demonstrator program proved the concept of in-flight thrust-vectoring and reversing, with dramatic results. These nozzles are of the first generation, while the nozzles on the YF-22 represent the second generation. A third generation, lighter and of improved design, could be used on production ATFs. [For more details on thrust-vectoring, see "A Nudge in a Better Direction," p. 54.]

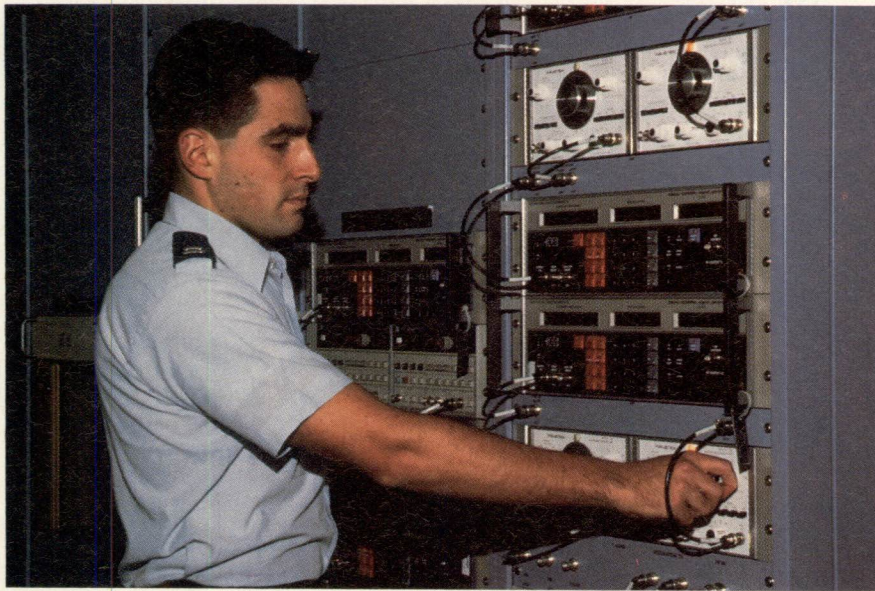
Addressing Costs

Astounding though they may be, the technologies developed for the ATF will become little more than abandoned demonstrations unless ways to reduce their cost can be found. To this end, WRDC's Manufacturing Technology (MANTECH) directorate oversees many programs designed to bring technology from the laboratories to the factory floor.

Each T/R module for the ATF ra-

A technician at Lockheed's Composite Development Center in Burbank, Calif., tests the relative strength of a thermoplastic-resin composite with laser holography. Production ATFs may make extensive use of thermoplastic composites, which offer many advantages over the thermoset composites that have been widely used for years.





The avionics laboratory's "avionics wind tunnel"—the Electromagnetic System Simulator—can create an entire flight environment, complete with electronic warfare, communications, and sensor inputs. This allows the laboratory engineers to test equipment in a "real" situation before actual flight tests are performed.

dar costs approximately \$7,000. Now under way are two projects (with a Texas Instruments–Westinghouse team and with Hughes) to explore whether processes used to make computer chips for automobiles will work with gallium arsenide. The hope is to reduce module costs to \$400 or less each, an event that would virtually guarantee use of phased-array radar in the ATF.

A single piece of dust during manufacture will ruin a VHSIC chip. Instead of making the chips in a clean room, say WRDC researchers, why not put the clean room inside the machinery? They see great promise in this "factory in a bottle" concept, which calls for fabricating chips in a near vacuum.

Another VHSIC innovation is the VHSIC Hardware Description Language. VHDL has been called DoD's gift to industry because it standardizes descriptions of the function and design of the chips. Nothing is lost between manufacturers; any company can take the description and reproduce the circuits.

An innovation in the manufacturing area is the Integrally Bladed Rotor. At present, rotor blades are mechanically attached to a disc. The IBR is an isothermal forging with blades attached metallurgically to a disk. The IBR process produces a component with fewer parts, less weight, and no attachments.

Since the program was established in 1947, the MANTECH operation has produced a number of notable successes. MANTECH has invested \$1.3 billion in various projects and has had a return ratio greater than ten to one.

WRDC and the ATF SPO are also taking an early look at problems and processes that can affect the performance of the ATF in the field. For example, say engineers, it is one thing to establish battle-damage repair techniques to fix the ATF's composite structures. It is quite another to make repairs that will also maintain the airplane's stealthiness. Exploration of techniques to do this is under way.

In another area, live-fire testing on composite F-16 and F/A-18 parts is providing an estimate of the kind of damage known threats may cause to the ATF.

The Future Begins Today

Even as engineers work to complete the ATF mission, they are embarking on the search for new technologies that may underpin the ATF's successor. "Our time line is expanding," notes Col. Dick Borowski, director of the Flight Dynamics Laboratory. "We are not focusing as much on specific programs like the ATF anymore. We are a little past that. We are looking at new missions and long-term technologies."

These efforts focus on both the near and far terms. Some of the near-term programs:

- **Self-repairing flight controls.** The Air Force has conducted one successful demonstration of this technology. Plans call for a second demonstration to take place this year. No special sensor or hardware is needed; the control reconfiguration system and on-board maintenance diagnostics use the existing flight-control software.

- **Fluids.** A noncombustible hydraulic fluid won't be ready in time for use on the ATF. However, a low-cost, nontoxic, environmentally safe dielectric coolant will be tested on a B-1B this year.

- **Three-dimensional sound.** Fitted with a headset-mounted localizer, pilots will not only be able to hear the radar warning receiver go off, they will also be able to determine from which thirty-degree section of the sky the enemy missile is approaching. This system will also aid in communications.

Further down the road are these technologies:

- **Displays.** By 1996, a full-color tactical display will have a limited capability "electronic backseater"—the Pilot's Associate. By 2005, a full panorama display will boast window inserts, a helmet-mounted display, and a fully mature Pilot's Associate. By 2020, the virtual world will be displayed. The pilot will have no out-of-the-window capability because of the predicted severe laser threat.

- **ICAAS.** The Integrated Control and Avionics for Air Superiority program is to develop an effective, real-time, knowledge-based, decision-aiding system for air combat. This system will allow even a single-seat fighter to attack and survive when outnumbered four to one.

- **Metal matrix composites.** Materials such as silicon carbide-reinforced titanium and ceramic-coated titanium have an endless supply of potential applications. The problem now is getting the materials to bond to one another.

- **IHPTET.** The three-phased Integrated High-Performance Turbine Engine Technology Initiative hopes to bring about a 100 percent improvement in aircraft engine performance in fifteen years. The baseline for the program is the ATF engine. ■



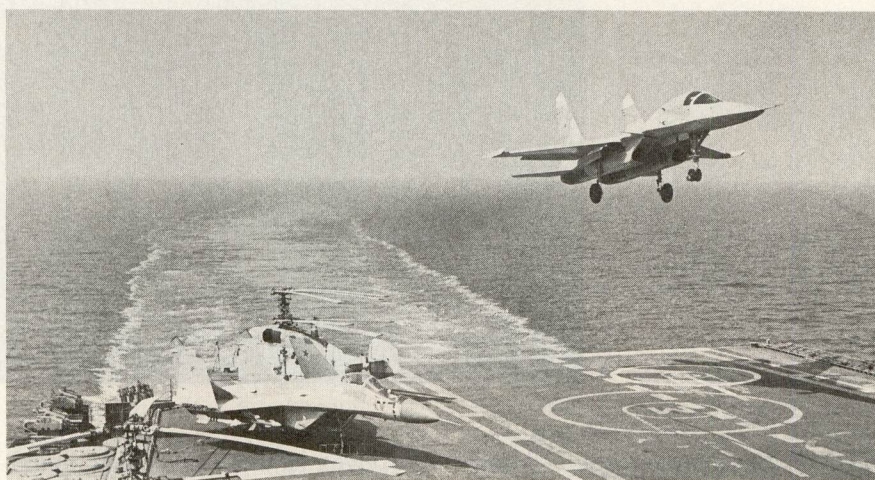
The MiG-29s of Fighter Wing 3 of the East German Air Force are now equipping the new 5th Luftwaffe Division. Twelve air forces now fly the MiG-29, whose radar capability impressed NATO pilots in simulated air combat last year.

awaits a second production contract for 110 aircraft to add to thirty already on order. Taiwan has launched initial production of 256 of its Ching-Kuo Indigenous Defensive Fighter. Italy and Brazil are coproducing the AMX close air support, battlefield interdiction, and reconnaissance aircraft, which has a secondary counterair role.

Trends in Cost-Effectiveness

Two major trends are evident in the export market. Faced with ever-rising costs, Jordan and Malaysia abandoned plans to buy Tornados. Instead, Malaysia joined the growing number of smaller nations re-equipping with the highly cost-effective two-seat Series 100 and single-seat Series 200 combat versions of the British Aerospace Hawk, which started life as the RAF's standard advanced trainer. At the same time, F/A-18 orders from South Korea and Switzerland, which had seemed firm, came in for reevaluation.

At a time when it is not unusual for the development life of an airplane to last twenty or more years, air forces are trying to make best use of limited funding by upgrading proven designs. An example is Japan's FSX program, which aims to produce a superadvanced offspring of the F-16C. It is to use a Japanese-designed all-composites wing, a more powerful turbofan, ventral canards, and state-of-the-art avionics, plus air-to-air and air-to-surface missiles of domestic manufacture. The FSX is a warning sign that Asian aerospace industries might well threaten those in North America and Europe.



The Soviet aircraft carrier Tbilisi, during an August 1990 test voyage in the Black Sea, received a surprise visit from this side-by-side two-seat trainer version of the Su-27, known to NATO as "Flanker-D" and described by Sukhoi as a deck landing trainer.

The practice of making the good better is nowhere more evident than in the USSR. While it presses on with research into stealth technology, Moscow is putting greater effort into what it refers to as the "asymmetric reply" of improving air defense systems to cope with the emerging generation of stealth bombers and fighters. At the same time, it is building on the excellence of its current combat aircraft by developing their potential.

At the Moscow air show last fall, Mikoyan's general designer, Rostislav Belyakov, referred to his latest fighter, now under test. It is based on the aerodynamically stable airframe of the MiG-29 but, he said, is "different in every other respect." Like many current NATO aircraft, notably the F-16, it will include features to reduce its radar signature without being a specifically stealth

design. Field performance, avionics, and fuel efficiency will all show improvement. New materials will be used. In this respect, it is worth remembering that the MiG-29 made extensive use of carbonfiber composites in secondary structures and aluminum-lithium alloy in production components while the West was still experimenting with these materials.

More is known about Su-27 development for the 1990s. Many predict this year's Paris Air Show will see a new type of "Flanker" with "glass" cockpit and flight-refueling probe. The single-seat naval version known to NATO as "Flanker-D," with folding wings, all-moving canards, and deck hook, was photographed recently on the 67,000-ton Soviet carrier *Tbilisi*. It had what appears to be a reconnaissance pod between its engine intake ducts. An all-new,

two-seat model completed deck trials, with side-by-side seating in a front fuselage somewhat reminiscent of that in the SR-71. The radar has gone, and deletion of the usual underwing weapon pylons supported Sukhoi's description of it as a deck landing trainer. A similar configuration could be used in a formidable attack and/or reconnaissance version of the Su-27 with large space in the new cockpit fairing for role equipment, or for extra fuel if the current standard internal fuel capacity for a 2,500-mile range were considered inadequate.

NASP on the Horizon

It is good to be told that the US has settled on the design of the projected X-30 National Aerospace Plane (NASP), as the first step on a long road to the future transatmospheric vehicle (TAV). The currently approved NASP concept is for a lifting body between 150 and 200 feet long, weighing 250,000–300,000 pounds, with a crew of two, and powered by a single small rocket motor and up to five scramjets. The program envisages a start on two flight prototypes in 1993, first flight in 1997, and achievement of single-stage-to-orbit operations by 1999. The flight profile would enable an operational TAV, flying at up to Mach 25, to drop out of orbit to photograph or attack a specific target on the ground or at sea, and then return to orbit afterward. Such a vehicle was under discussion at Air Force Systems Command at least ten years ago. It is beginning to look practicable.

Today there are many examples of growing East-West cooperation. Civilian airline operators within what once was the Eastern Bloc, including Aeroflot, are buying Western airliners. Chiefs of staff and senior officers of NATO and ASEAN air forces have flown in the Su-27 and MiG-29. The Polish Air Force is evaluating the F-16, F/A-18, and JAS 39 Gripen, but without any immediate plans to purchase.

Perhaps to dampen the clamor for payment of peace dividends, defense ministers are making cuts they may later regret. The RAF, for example, is reducing its Tornado interdiction squadrons from twelve to seven, using some of the surplus aircraft to reequip its two Buccaneer



Another four-nation program is the NATO "Helicopter for the '90s," designated NH 90. France, Germany, the Netherlands, and Italy are collaborating to develop this ship-based, antisubmarine warfare helicopter.

maritime strike squadrons. Four RAF Phantom ADF squadrons also will go.

France had been expected to reduce deliveries of Atlantique 2 maritime patrol aircraft from five to three a year and delay introduction into service of the French Air Force's Rafale and the Navy's nuclear-powered carrier. That plan is being revised as a result of the Persian Gulf crisis. To pay for the Rafale program, 1991 procurement of Mirage 2000 fighters will now be cut from twenty-eight to twenty-four. In its program to replace Jaguars, Mirage IIIs, and Mirage 5s, France will upgrade forty-one (rather than fifty-five) Mirage F1s this year. Only Japan, an economic superpower, continues to have no difficulty financing the growth and upgrading of its Self-Defense Forces.

Think International

As Europe's Economic Community progresses steadily toward the "single market" after 1992, collaborative and inter-EC programs proliferate. In addition to the four-nation EFA, France and Germany are developing the Tiger antitank helicopter; the same nations, plus the Netherlands and Italy, are collaborating on the NATO "Helicopter for the '90s" program. It calls for a tactical transport, search-and-rescue, surface attack, and ship-based ASW

helicopter. Italy and the UK are well-advanced on the much larger EH 101 for naval, military, and commercial multirole missions. Production of the Tornado continues in Germany, Italy, and the UK. Plans call for the five-nation European Future Large Aircraft Group four-turboprop transport to replace the C-130 Hercules and Transall C-160. These plans look purposeful but long-term, with a first flight in 2000. Work is under way on a variety of important civil programs, ranging from the ATR 42/72 short-haul transports to the Eurofar thirty-passenger civil tilt-rotor transport and additions to the Airbus family.

Fewer and fewer aircraft are one-nation products. British Aerospace works with McDonnell Douglas to develop ever-better Harriers, with night attack variants now adding immensely to the unrivaled V/STOL capability of this combat aircraft. MBB of Germany has collaborated with Rockwell to build the X-31A Enhanced Fighter Maneuverability research prototypes that point the way to more agile and formidable fighters of the future. Grob of Germany has fitted E-Systems equipment and a Garrett engine into an airframe of its own design. Result: the D-500, a high-flying, LO, multi-purpose aircraft that is likely to perform sigint and surveillance duties for German and other air forces. ■

John W. R. Taylor, a longtime Contributing Editor to AIR FORCE Magazine, is editor emeritus of Jane's All the World's Aircraft and a Fellow of both the Royal Aeronautical Society and the Royal Historical Society. Mr. Taylor compiles or edits for us the galleries of aerospace weapons that appear in various issues throughout the year.

Simulator for Electronic Combat Training (SECT)

Program to generate documentation that accurately defines the Electronic Warfare Officer Training (EWOT) requirements needed for today's advanced technology. **Contractor:** JWK Int'l. **Status:** Requirements analysis.

Special Operations Forces Aircrew Training System

Development and production of a total aircrew training and mission-rehearsal system for MC-130H/E, AC-130H/U, MH-53J, HC-130H/P/N, MH-60G, and V-22 crew members. **Contractor:** Loral. **Status:** Development, acquisition.

Standard DoD Simulator Digital Database (Project 2851)

Triservice-sponsored and -approved program to develop database standards, production capability, and central library to support training and mission-rehearsal systems for all services. **Contractor:** Planning Research Corp. **Status:** Development.

USAFE Low-Altitude Training System (LATS) Requirements Analysis

Program to examine and analyze current USAFE LATS program. **Contractor:** JWK Int'l. **Status:** Requirements analysis.

WRDC Aeropropulsion Laboratory

Advanced Turbine Engine Gas Generator

Program to assess new core engine components, advanced structures, and material technologies in a true, large-thrust-class engine environment. **Contractors:** Allison, GE, P&W. **Status:** Advanced development.

Air-Breathing Missile Propulsion

Program to develop and demonstrate "wooden round" propulsion concepts for air-to-air and air-to-ground missile applications. **Contractors:** Atlantic Research, Hercules, UTC's Chemical Systems Division. **Status:** In-house research, exploratory and advanced development.

Aircraft Power

Program to develop noncombustible hydraulic system, power electronics, advanced battery, and highly reliable electrical power systems for current and future airplanes. **Contractors:** Many. **Status:** In-house 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. Emphasis is on endothermic and other high-heat-sink fuels. **Contractors:** Many. **Status:** In-house research, exploratory and advanced development.

Combustion

Program to provide experimental data and advanced design codes for turbine engine and ramjet combustors. Extensive application of optical diagnostic techniques and computer modeling. **Contractors:** SRI, U. of Dayton Research Institute. **Status:** Research, exploratory development.

High-Speed Propulsion

Technology program to develop an Air Force capability for manned and unmanned flight at very high speeds using air-breathing propulsion and logistically attractive fuels. **Contractors:** Many. **Status:** Exploratory development.

Hypersonics

Program to develop the technology of air-breathing propulsion, using hydrocarbon-based storable fuels, to the highest achievable flight speed. This includes turboramjet, air turbo rocket, scramjet, and new concepts. **Contractors:** UTRC, CSD, and others. **Status:** Research, exploratory development.

Integrated High-Performance Turbine Engine Technology Initiative

National program to develop and demonstrate revolutionary advances in turbine engine technology that will double current propulsion capability. **Contractors:** Many. **Status:** In-house research, exploratory and advanced development.

Joint Expendable Turbine Engine Concepts

Interservice program to develop demonstrator engines to help define future technology requirements for small, unmanned, limited-life vehicles. **Contractors:** Allison, Garrett, Teledyne, Williams. **Status:** Advanced development.

Joint Technology Demonstrator Engine

Interservice program to develop large-thrust-class demonstrator engines combining advanced high-pressure cores from ATEGG with advanced low-

pressure and adaptive components. **Contractors:** Garrett, GE, P&W. **Status:** Advanced development.

Joint Turbine Advanced Gas Generator

Interservice program to assess new core engine components, advanced structures, and material technologies in a true, small- to medium-thrust-class engine environment. **Contractor:** None. **Status:** Advanced development.

Plasma Physics

Program to investigate the fundamental properties of plasmas for application to thin film deposition, high-power switches, and advanced lasers. **Contractors:** SRI Int'l, U. of Chicago, Wright State U. **Status:** Research, exploratory development.

Spacecraft Power Technology

Program to provide evolutionary and revolutionary improvements in spacecraft power systems and thermal management technologies while reducing weight and volume and improving survivability. **Contractors:** Many. **Status:** In-house research, exploratory and advanced development.

Special-Purpose Power

Initiative to provide pulsed power and energy storage technology for special-purpose loads such as high-power microwaves, electromagnetic launchers, and accelerator systems. **Contractors:** Many. **Status:** In-house research, exploratory and advanced development.

Survivable Solar Power System

Initiative to design, fabricate, and test a survivable solar power and energy storage system for use in space. **Contractors:** TRW, Boeing, Martin Marietta, Lockheed. **Status:** Advanced development.

WRDC Avionics Laboratory

Advanced Avionics Reconfiguration Technology

Development and application of neural computing methods for RF threat alert. Addresses parametric and intrapulse information domains as well as information correction. **Contractors:** Booz-Allen Hamilton, Georgia Tech Research Institute. **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

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:** Honeywell. **Status:** Development.

Automatic Radar Air-to-Ground Target Identification Program

Two-phased effort to design, build, and demonstrate an all-weather target identification of ground-mobile targets using synthetic aperture radar imagery, model-based vision techniques, and massively parallel computing engines. **Contractor:** Martin Marietta. **Status:** Development.

Automatic Radar Target Identification

Three-phased effort to produce and demonstrate an air-to-air identification system using one-dimensional radar signatures. **Contractor:** GD. **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.

Concealed Target Detection Technology Program

Two-phased program to develop and demonstrate airborne radar technology required to detect strategic and tactical targets concealed by foliage and/or camouflage. **Contractor:** None. **Status:** Concept definition.

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:** Flight testing.

Digital EW Receiver

Development of a wideband EW receiver in which the baseband frequency is digitized, thus allowing all subsequent receiver functions to be performed in the digital domain. **Contractor:** TBD. **Status:** Development.

Electronic Combat Multifunction Radar Technology

Program to develop ECCM technology for robust airborne radar performance in post-1995 threat environments. Uses wide, tunable bandwidth and adaptive waveforms. **Contractors:** Hughes, Raytheon. **Status:** Development.

Embedded Computer Resources Support Improvement Program

Development of software support technologies to reduce costs, improve turnaround capability, and provide software supportability. New technology insertion for support of current, new, and retrofit weapons platforms. **Contractors:** In-house, TRW, Westinghouse, JFTaylor, Hughes, Analytic Sciences Corp. **Status:** Development.

High-Power Countermeasures

Definition, development, and flight testing of a long-range standoff jamming capability. Elements include very high effective radiated power and fast-switching, narrow-beamwidth, multiple-beam jamming. **Contractor:** Raytheon. **Status:** Completed preliminary flight testing.

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 Communication, Navigation, and Identification (CNI) functions. **Contractor:** TRW. **Status:** Development.

Integrated Electronic Warfare Analysis and Modeling

Program to analyze, evaluate, and model RF/EO/IR countermeasures concepts and EW advanced development prototype hardware. **Contractor:** SAIC. **Status:** Development.

Intra-Flight Data Link

Develop and demonstrate a covert, jam-resistant, secure LPI wideband common avionics situational awareness data link for intra- and inter-flight sharing of multisensor information. **Contractors:** Northrop, Hazeltine, Unisys/TRW. **Status:** Studies, development.

Laser Warning

Program to analyze, develop, and test technology for threat warning of hostile laser systems. Emphasis on robust, low-cost, reliable techniques and designs. **Contractor:** None. **Status:** Ongoing in-house project.

Low Probability of Intercept Radio Brassboard

Development and demonstration of the feasibility of a cost-effective, multi-mode, LPI/antijam, secure airborne radio system. **Contractor:** QualComm. **Status:** Development.

Modular Avionics Maintenance Technology

Development and demonstration of an integrated diagnostics concept to address maintenance issues in JIAWG-type avionics. **Contractor:** None. **Status:** Development.

Multifunction CNI/EW Antenna System

Joint USAF-Navy development of broadband (2MHz-6GHz) antenna system to service CNI/EW functions. **Contractor:** TRW. **Status:** Development.

Multiple Target Attack Program

Program to develop and demonstrate fire-control techniques for maneuvering attack of multiple targets in a single pass using advanced avionics and weapons. **Contractors:** MD, Hughes, Martin Marietta. **Status:** Man-in-the-loop simulation.

Passive Expendables Analysis Measurements

Design, develop, and test passive or partially passive expendable/decoy ECM techniques for tactical and strategic applications. **Contractor:** None. **Status:** Ongoing in-house project.

Pave Pace

Design and demonstration of key elements to enhance avionics architecture for the twenty-first century. Exploits potential of emerging technologies in parallel processing, opto-electronics, and artificial intelligence. **Contractors:** Boeing, Lockheed, McDonnell Aircraft. **Status:** Design.

Real-Time Artificial Intelligence System

Joint USAF-Army-NASA program to develop and demonstrate a modular computing system for real-time processing of artificial intelligence/expert systems applications for aiding aircrews. **Contractor:** IBM. **Status:** Development.

Resonant Fiber-Optic Gyro

Program to develop and demonstrate feasibility of an inertial grade resonant fiber-optic gyro. **Contractor:** Charles Stark Draper Laboratory. **Status:** Development.

Silent Attack Warning System

Development of hardware to demonstrate a state-of-the-art infrared detection system for missile and aircraft warning. **Contractors:** GE, Loral, TI. **Status:** Development.

Strategic Targeting Laser Radar (LADAR) Technology

Development and demonstration of critical technologies and components needed to produce a CO₂ laser radar (LADAR) sensor that can permit manned bombers to recognize and attack relocatable targets. **Contractors:** Hughes, Rockwell. **Status:** Development.

Superconductivity Application for EW

Evaluation of superconductivity application concepts and resulting payoffs in electronic combat/electronic warfare systems. **Contractors:** TRW, SRI Int'l. **Status:** Studies.

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. **Contractors:** Loral, Hughes. **Status:** Development.

WRDC Electronics Technology Laboratory

Device Research

In-house program of III-V semiconductor technology research. Includes material growth and characterization integrated with device design, fabrication, evaluation, and modeling. **Contractor:** None. **Status:** Ongoing.

Microwave/Millimeter Wave Monolithic Integrated Circuits

DARPA/triservice program to develop affordable gallium arsenide MIMICs for advanced DoD systems. Emphasizes MIMIC development areas such as computer-aided design, chip fabrication, testing procedures, packaging, and manufacturing. **Contractors:** Phase I: Hughes/GE. Phase III: AT&T, Varian, Gateway Modeling, M/A-COM. **Status:** Continuing.

Strategic Defense Initiative

Multitechnology program involving the development of advanced microwave and electro-optical devices for spaceborne imaging radar and surveillance applications. **Contractors:** Many. **Status:** Development.

WRDC Flight Dynamics Laboratory

Advanced Fighter Technology Integration F-16

Program to develop, integrate, and flight-demonstrate 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, head-steerable FLIR, integrated night vision helmet, automatic target hand-off system, and Pave Penny. **Contractor:** GD. **Status:** Aircraft modification, flight tests February 1991, final reports December 1991.

Aircraft Windshield System Development

Integration of emerging technologies into operationally acceptable transparency systems compatible with evolving military missions. **Contractor:** In-house. **Status:** Continuing.

Airframe Propulsion Integration

Technology development program for advanced fighters and high-speed flight vehicles. Advanced multifunction exhaust nozzles and highly survivable inlets. **Contractors:** MD, Lockheed, GD. **Status:** Continuing in-house exploratory and advanced development.

Carbon-Carbon 2-D Exhaust Nozzle Structures

Program to develop the technologies required to design and manufacture

into night vision.

MARTIN MARIETTA

Masterminding

Tomorrow's

Technologies

They wait for the ships and aircraft to return—this time carrying goods for them.

The Cargo Cults

By C. V. Glines

AFTER World War II, veterans returning from the Pacific all had stories to tell, not only about the war, but also about experiences with other cultures. There were tales of mysterious customs, strange lifestyles, and curious ceremonies. Of all the experiences, however, few were like the encounters with a number of bizarre—to Americans, at least—religious groups: the cargo cults.

“Cargoism” was, and is, a widespread religious movement among natives of the islands of Melanesia in the South Pacific. The theology and practice of the cult centers on the worship of cargo.

In simplest terms, followers of cargoism believe in the imminence of a new age of blessing which, they believe, will be heralded and fulfilled by the arrival of special cargo sent to them by supernatural powers. This belief existed long before the appearance in the Pacific of Western troops.

Western sociologists specializing in Melanesian religions say all the cargo cults are based on a curious mixture of native and Christian beliefs and rituals. The cultists believe their deities will send them ready-made goods just like those used by the military forces that came from far away. In their estimation, the goods will come from heaven, thought by some to be in Australia or, alternatively, in the sky immediately above it.

Those who hold to the latter view of paradise believe that Heaven is joined to Earth by a ladder, down which ancestral spirits carry the goods, packed in crates addressed to specific individuals. They expect that the precious cargo will come to them by ship, airplane, or truck, depending on where they live.



In both the 1970s and the 1940s, Westerners drew a crowd in certain areas of the Pacific, where the indigenous people saw them as heralds of a new age. The airmen pictured above needed the cargo for themselves, but islanders believed that next time, the gods would provide goods for cultists. The crowd at right listens as chants to ensure the return of the cargo are played back on an anthropologist's tape recorder.



In order to ensure the return of cargo, the cultists imitate the behavior they saw the last time it arrived in bulk in their corner of the world. If the cargo does not appear, the cultists believe that it is because they have not performed the rituals correctly. Here, cultists from Vanuatu take part in close order drill, complete with "rifles" and a "drill sergeant."



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The Millennium at Hand

When soldiers and airmen from the United States and other allied countries arrived in the islands with huge war cargoes, it was for the worshipers proof that those who followed the beliefs of a cargo cult were to be rewarded for their faith. Though the natives did not benefit directly from the appearance on their islands of those types of cargo, the cultists believed that their predictions were confirmed and that the cargo-millennium was at hand. A time of plenty had arrived. There was no longer a need to work. Money was unnecessary. Crops could be, and were, neglected. Pigs were randomly

slaughtered for feasts. It was a time to celebrate, and the cultists lived it up.

Things didn't turn out as the cultists expected, but few lost the faith. When goods fail to appear, as in the post-war period, the followers usually assume it is because they have not yet performed the correct ritual, because foreigners have schemed against them, or because the cultists have neglected the gods.

Although the worship of cargo is basic, there are slight variations in theology among the approximately seventy cargo cults that are known to have existed. There are fewer now, and those remaining seem to be waning in re-

The US has a special place in the hearts of the cultists who believe in John Frum, the king of America, whose return will not only bring a time of unprecedented wealth, but will also rid the islanders of the demanding ways of foreigners, especially Europeans. Anthropologists speculate that the affection for America is based on the generosity of US troops stationed on Vanuatu during World War II.



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ligious fervor. However, world religion scholars say interest fluctuates and is revived by forceful, persuasive leaders who appear from time to time.

Typically, all cargo cults begin when someone claims that, through a dream or vision, supernatural powers have told him or her that a messiah and the ancestors or spirits of the dead will soon return bringing huge supplies of manufactured goods. Their arrival will usher in a wonderful new era when the believers will have their identity, dignity, and honor restored. Inequality, suffering, and death will cease. The riches of those they think have so far monopolized wealth and defrauded them of their share will then belong to the cultists.

The cargo cult members do not know how the goods of foreigners are made. They believe that the arrival of cargo must be stimulated by some kind of religious ritual,

Worshipping George V

In Papua New Guinea, cargo cults are numerous. The first to be discovered were the Baigona, reported by researchers in 1912, and the Vailala, first described by sociologists in 1919. Researchers found that cultists often were seized by mass hysteria that led to violent shaking fits and ecstatic trances. The Marching Rule movement is popular in the Solomon Islands. Another cult worships a faded portrait of King George V of England, declaring that it is the picture of Ihova, also known as God.

Some cult members believe they must imitate the foreigners. They even drill with wooden rifles and hold flag-raising ceremonies. They adopt Western dress and imitate Western behavior. They have built wharves, storehouses, airfields, "radio masts," and lookout towers in anticipation of the arrival of good fortune. Cult leaders



The island women also take part in rituals designed to bring back the cargo. The fervor of the cults waxes and wanes but persists, despite efforts by missionaries to quash it. The cults are seen as harmful because cultists have been known to squander money and slaughter livestock profligately, in the belief that all their needs would be taken care of by the return of the cargo.

because the gods will respond only to correctly performed ceremonies. Cult leaders and sometimes whole native communities demonstrate that they have received news about the coming of cargo by falling into ecstatic states.

Typical of cargo dogma is a belief adopted by three groups in Vanuatu (formerly the New Hebrides). They worship a god named John Frum, king of America, who is said to have arrived in the islands before the appearance there of Christian missionaries in the mid-1800s. John Frum also is expected to return.

The cultists embrace the deity of Frum because he promised them a life untroubled by economic strife and the demanding ways of foreigners, especially Europeans. Although Frum hasn't shown up, Frum followers saw great significance in the arrival of cargo-rich foreign troops on the island Tana in the New Hebrides during World War II. Cargo cult believers on other islands of Melanesia were likewise convinced that the cargoes they saw being unloaded were heaven-sent and that a god or messiah would soon follow.

make contact with the deities by using "wireless telephones," often nothing more than wooden posts or carved totem poles.

Cargo is expected to appear in local cemeteries, on altars, or in other places they consider holy and where the deity is expected to emerge. Cultists of Vanuatu have not lost faith in the long-absent John Frum; believers still await his return.

If someone tells you that he has seen natives of the South Pacific building airstrips and piers to prepare for the return of vast cargoes, don't pass it off as just another tall war story. There are still hundreds of cargo cultists out there, patiently awaiting the day when their lookouts will spot a great armada on the horizon and a string of giant aircraft lined up on final approach to their airstrips. ■

C. V. Glines is a regular contributor to this magazine. A retired Air Force colonel, he is a free-lance writer and the author of many books. His most recent article for AIR FORCE Magazine was "The Visions of Hector Bywater," which appeared in the December 1990 issue.

By John L. Frisbee, Contributing Editor

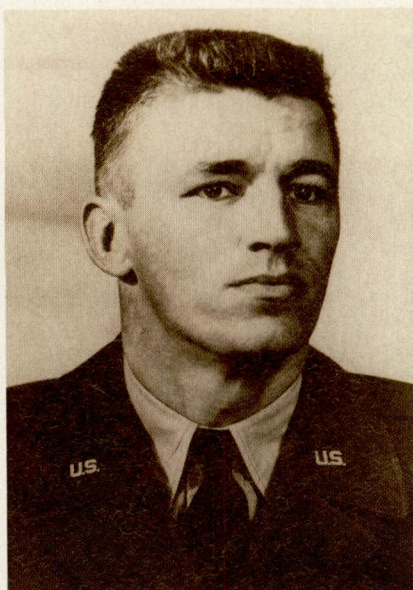
Sacrifice at Sniper Ridge

Every gun destroyed would save American lives as Chinese Communist masses surged toward Sniper Ridge.

THE "Valor" series has told the stories of several Air Force men who made conscious and unequivocal decisions to sacrifice their lives for some moral or martial imperative that to them was more valued than life itself. Precisely what inspired such acts of heroism will never be known. Among such men was Maj. Charles Loring, one of only four airmen to be awarded the Medal of Honor during the Korean War. All those awards were posthumous.

Charles Loring was no neophyte when he joined the 8th Fighter-Bomber Wing in Korea in June 1952. On completing flying training in February 1943, he had spent several months with the 36th Fighter Squadron patrolling the Caribbean in P-39s and P-40s. The squadron then returned to the States, converted to P-47s, and was sent to the European Theater in the spring of 1944. From its base at Kingsnorth, England, the squadron, part of Ninth Air Force, primarily flew interdiction missions in preparation for Allied landings in Normandy on June 6, 1944. A month after D-Day, the 36th moved to a series of bases on the Continent, flying close support and interdiction, paving the way for ground forces in their drive toward Germany.

On every mission, the fighter-bombers faced ground fire ranging from heavy anti-aircraft artillery to rifles. Loss rates for Ninth Air Force fighter-bombers were high compared to the escort groups of Eighth Air Force. Early in his tour, Lieutenant Loring was wounded on a close support mission, but soon he was out of the hospital and back to the war. On his fifty-fifth mission, December 24, 1944, during the Battle of the Bulge, Loring's luck ran out. Hit by ground fire, he crash-landed in Belgium and spent the next four months as a POW.



Today Loring AFB in Maine commemorates the extraordinary heroism of this honored son.

Charles Loring decided to make the Air Force a career. He spent six years in nonflying positions, including two years as an instructor at the Army Information School at Carlisle Barracks, Pa. Then the Korean War broke out. Loring, now a major, requested assignment to a combat unit and waited impatiently for two years until his request was granted.

When Major Loring reported to the 8th Fighter-Bomber Wing, it had been in combat for two years, first with F-51s, then in F-80s. Initially he was assigned to Headquarters and Headquarters Squadron in charge of training and indoctrinating replacement pilots. But Loring had come to Korea to fight. A month later he began flying combat missions and was made a

squadron operations officer. The combat environment was in most ways a replay of his World War II experience, except that now he was flying a jet fighter. Ground fire was there as always, but the chance of escape or evasion if shot down in an Oriental land was practically nil. The prospect of becoming a POW of the Chinese was not attractive.

The Chinese Communists had, as we know, entered the war with massive forces in December 1950, driving United Nations troops back to positions near the Demarcation Line. For the next eighteen months fighting was sporadic, interrupted or slowed by fruitless peace negotiations. During the late summer and fall of 1952, the war heated up. With enormous sacrifice of their troops, the Communists recaptured Triangle Hill in early November and were threatening US ground forces at Sniper Ridge.

On the morning of November 22, 1952, Major Loring, on his fifty-first mission, led a flight of four F-80s in a close support strike against enemy formations in North Korea. He was directed by an airborne controller to dive-bomb gun emplacements that were pinning down UN forces near Sniper Ridge. Ground fire, as usual, was heavy.

After locating his target, Loring rolled into his bomb run. Enemy fire concentrated on his F-80. Other members of his flight saw Loring's plane take severe hits. They expected he would pull out of his dive and attempt to reach friendly territory. Instead, he continued the attack, altering his course some forty-five degrees in a deliberate, controlled maneuver and dove directly into active enemy gun positions, destroying them at the cost of his own life. There was no indication that Loring had been mortally wounded when his aircraft was hit or that it could not have been flown to safety. What impelled Major Loring's calculated act of self-sacrifice that "exemplified valor of the highest degree"? No one could say.

Today Loring AFB in Maine commemorates the extraordinary heroism of this honored son. ■

WORLD AIR POWER JOURNAL

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rs: Ken Daly (Junior Col. Roy A. Davis (Senior McRaney (Communication Turner (Medical), Capt. II (Civil Air Patrol).

nal President Oliver R. appointed the following Directors to serve one Trustees: Earl D. Clark, Gibson, Martin H. Haraitos, James M. McCoy, Lapp, William W. Spruance, A. A. Stearn, and Kenneth

EF news, SSgt. Michael named an AEF Scott As tireless efforts in aeron. AFA's **Heart of the**



Hills (Tex.) Chapter President Edward Fox and Vice President for Aerospace Education Fred Eubanks presented the award to the local recruiter.

Homage to "The Few"

Proudly taking their name, "The Few," from Winston Churchill's historic remarks about how much the grateful nation owed them, Britain's RAF veterans, though today even fewer in number, retain a fierce pride in their brave accomplishments of a half-century ago. That pride was on display as the RAF celebrated the fiftieth anniversary of the Battle of Britain last year, and AFA representatives were on hand to join in honoring the thwarting of Hitler's Operation Sea Lion.

Dorothy Brierton Wadsley, a World War II WAAF veteran, New York State AFA vice president, charter member of AFA, and former president of the **Gen. Daniel "Chappie" James Memorial (N. Y.) Chapter**, led the delegation. She went to Britain laden with honors for veterans of the Battle and seeking even stronger ties with British counterparts in the Royal Air Force Association (RAFA).

Ms. Wadsley, along with Beresford Sealy, secretary-treasurer of the James Chapter, presented gifts to



New York State AFA Vice President Dorothy Brierton Wadsley presents a plaque to Air Chief Marshal Sir Christopher Foxley-Norris, RAF (Ret.), during ceremonies commemorating the fiftieth anniversary of the Battle of Britain. Ms. Wadsley's visit helped strengthen AFA's ties with its British counterpart, the Royal Air Force Association.

Mark Tompkins, secretary-general of RAFA; Norma Bearblock, RAFA liaison officer; Jackie Evans, an RAF wing commander; and Air Chief Marshal Sir Christopher Foxley-Norris, RAF (Ret.), chairman of the Battle of Britain Fighter Association. The 180,000-strong force of women who served alongside the RAF in the Battle of Britain and afterward were not forgotten. Josephine Robins-Fairclough, a recipient of the Medal of Valor, and Sadie Younger, of Fighter Command Headquarters, received commemorative gifts from the New York delegation.

Among the gifts given by the New Yorkers were several high-quality briefcases containing autographed pictures of Gen. Jimmy Doolittle, copies of "High Flight," an inspirational message from Mrs. Ira Eaker, and several reprints of *Air Force Magazine* articles of special interest to veterans of the Battle of Britain.

Ms. Wadsley terms it a "privilege" to have been involved in the festivities surrounding the anniversary of such a storied chapter in aviation history, which many US citizens (who were soon to be soldiers, sailors, Marines, and airmen) found so inspirational fifty years ago.

Chapter News

Not everyone could make it to Britain for the festivities, but some who could not wanted to take note of the anniversary just the same. The **Tacoma (Wash.) Chapter** did so by combining its recognition of the Battle of Britain with its forty-third annual celebration of the Air Force's birthday, held at McChord AFB, Wash. Highlights of the Birthday Ball included the presentation of two checks by Chapter President Rainer Willingham. The first, for \$2,000, went to Col. Rodney Chiapusio, commander of the 62d Combat Support Group at McChord, for the base's youth activities program. The second, for \$1,500, went to Ronald I. Powell, president of the McChord Air Museum, in support of museum activities.

National Vice President (Northwest Region) Alwyn T. Lloyd was on hand to present an Exceptional Service Award to Jack Gamble, chapter vice president for communications, and Medals of Merit to Eugene Nuss and Jack Sandstrom, former presidents of the Tacoma Chapter.

New chapter officers were installed, including President Joseph E. Tucker, First Vice President Thomas H. Swarner, Second Vice President Richard A. Seiber, and Secretary Robert L. Hol-



"Hurry up and wait," a time-honored tenet of military life, has been made a little easier to bear for veterans patronizing the VA Outpatient Clinic in Tulsa, Okla., thanks to a worthwhile effort by the Tulsa Chapter. Chapter President Harry Burt and Vice President for Veteran Affairs Jim Carl (pictured here with Dr. Laura Goldberg, director of the clinic) led the effort that placed three new television sets in the clinic's waiting rooms.

lister. Mr. Powell was installed as treasurer.

Guests responded enthusiastically to a fine presentation on a hot topic, Operation Desert Shield. Lt. Col. Julian Allen, commander of the 8th Military Airlift Squadron, spoke of MAC's excellent efforts during the events of last summer. Maj. Russel G. Frasz and Capt. R. Tracy Mead, participants in the tremendous airlift that made Desert Shield possible, were also on hand to mingle with the guests, who evinced a high level of curiosity about the operation. Other distinguished attendees included Washington State President and Mrs. Ted Wright and Adm. and Mrs. James S. Russell, USN (Ret.). The Admiral, a strong supporter of AFA, has been inducted into the National Museum of Naval Aviation Hall of Honor.

An earlier operation that saw a major contribution by MAC, Just Cause, was the topic of a speech by Col. Daryl L. Bottjer, director of current operations for MAC, to a meeting of the **Everett R. Cook (Tenn.) Chapter**. The Colonel talked about MAC's role in deployment, operations, evacuation of casualties, and the eventual transport of captured Gen. Manuel Noriega to the US. Chapter President William Freeman welcomed the Colonel and other distinguished guests, including former National Vice President (South Central Region) Everett E. Stevenson.

Kentucky State AFA President James R. Jenkins, former president of the **Lexington (Ky.) Chapter**, took the opportunity on a recent trip to Washington, D. C., to escort teacher Sue Darnell, this year's winner of AEF's



At the Dacotah Chapter's symposium on the "Guard and Reserve in the Nineties" were (from left): Bob Johnson, then Dacotah Chapter president; Bob Jamison, then South Dakota AFA vice president; Hon. George S. Mickelson, Governor of South Dakota; Joyce Hazeltine, South Dakota Secretary of State; Maj. Gen. Alexander P. Macdonald, ANG, North Dakota Adjutant General; Maj. Gen. Roger P. Scheer, Chief, AFRES; and John Kittelson, AFA national vice president (North Central Region).

Christa McAuliffe Memorial Award, through the halls of Congress. They were able to meet with Kentucky congressmen from both sides of the aisle, Republican Larry Hopkins of Lexington, a member of the Armed Services Committee, and Democrat Carroll Hubbard of Mayfield.

In other dealings with the legislative branch, **Colorado Springs/Lance Sijan (Colo.) Chapter** members got a chance to talk with Rep. Joel Hefley (R-Colo.) at a luncheon meeting. Frank R. Wisneski, chapter president at the time, reports that Representative Hefley, a member of the Readiness Subcommittee of the Armed Services Committee, is well positioned to keep his AFA constituents informed on matters of great concern to them. Also at the luncheon were Gen. Donald Kutyna, Commander in Chief of NORAD and US Space Command, and Gen. Jim Hartinger, USAF (Ret.), former CINCNORAD and the first commander of Air Force Space Command.

President Louis Maddalone of the **Lloyd Schloen-Empire (N. Y.) Chapter** was proud to honor the memory of the late Col. James Kehoe at a recent meeting. He presented a plaque to Mrs. Kehoe as a token of appreciation for her husband's efforts as one of the chapter's founders.

The **Gus Grissom (Ind.) Chapter** held a successful meeting in Lafayette, Ind. It was a Boilermaker reunion of sorts as the meeting was addressed by Purdue University graduate Col. Dan McGrath, USAF (Ret.), now a Nor-

throp executive. He was able to impart much valuable information on the B-2 Stealth bomber program from an insider's perspective. Henry Yang, dean of Purdue's school of engineering, donated some Purdue memorabilia and wrote a special letter of recognition of the Colonel's achievements. Chapter President "Buck" Hudgens, Chapter Vice President for Aerospace Education James Wagner (also of Purdue), and Chapter Treasurer Don James, a former U-2 pilot, thanked Colonel McGrath for his presentation.

Sgt. Brian L. Klein did not find out until after he won the prestigious Commandant's Award of the Lowry Noncommissioned Officers Leadership School, Lowry AFB, Colo., that his achievement had a special poignancy for his family. Sergeant Klein, administrative assistant to the 3415th Air Base Group's deputy commander, had been unaware that his father, MSgt. Russell L. Klein, who was later killed in Vietnam while serving as a flight engineer on a C-7A that was shot down, had won the same award while stationed at Mountain Home AFB, Idaho, in 1962. It made for an emotional moment when Sergeant Klein received his plaque and citation from Bob Cardenas, then-president of the **Mile High (Colo.) Chapter**, sponsors of the award.

Have AFA News?

Contributions to "AFA/AEF Report" should be sent to Dave Noerr, AFA National Headquarters, 1501 Lee Highway, Arlington, VA 22209-1198. ■

Bulletin Board

Orders are being taken for a history of the **301st Bomb Group/Wing**, a 15th Air Force B-17 combat group, to cover the period from 1942 to 1979. **Contact:** Erwin H. Eckert, 14215 Hunter Hill, San Antonio, TX 78217.

Seeking information and photos of any and all **Air Force planes**, from 1907 to the present. **Contact:** Thomas Murphy, 59 E. Browning Rd., Spruce Mason Apartments, Apt. 525F, Bellmawr, NJ 08031.

Seeking contact with anyone who knew **Irma Jack Medley**, who was in the 12th Observation Squadron, 2d Division, Air Corps, stationed at Fort Sam Houston in San Antonio, Tex., in 1927. Also seeking people who knew **Robert Grayson**, who was born in 1918 or 1919 in Indiana and was at Fort Bliss, Tex., in 1941. **Contact:** Penelope Giacoletti, P. O. Box 276, Morenci, AZ 85540.

Seeking contact with veterans who served in the **461st Bomb Group** in Italy between 1943 and

1945. **Contact:** Edward Chan, P. O. Box 117, New Hyde Park, NY 11040.

Seeking contact with anyone who knew **Lt. John M. "Woody" Woodward**, a B-17 pilot with the 65th Squadron, 43d Bomb Group, who was shot down on June 13, 1943. **Contact:** John M. Woodward, 209 Parkview, Luling, TX 78648.

For a book on **USAFE Fighter and Reconnaissance units from 1946 to 1956**, I would like to borrow photos or slides of aircraft from the following units: 10th and 66th Tactical Reconnaissance Wings; 20th, 48th, 81st, and 406th Fighter/Bomber Wings; and 31st and 55th Fighter Groups. **Contact:** MSgt. David W. Menard, USAF (Ret.), 5224 Longford Rd., Dayton, OH 45424-2547.

Seeking models of the **C-124 Globemaster** and the **KB-50** refueling aircraft. **Contact:** MSgt. Richard J. Gronowski, USAF (Ret.), 140 N. Garfield Ave., Traverse City, MI 49684.

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Bulletin Board

Seeking **RAF Sculthorpe yearbooks** from 1955 to the present. Also seeking any Tornado base magazines from the 47th Bomb Wing. **Contact:** Herbert Foster, 58 Hammerton St., Pudsey, West Yorkshire LS28 7DD, England.

Seeking reminiscences, photographs, names, nose art, and other items relating to **USAF, Vietnamese Air Force, and USN Skyraider** pilots or ground crews. **Contact:** Dan Medeiros, 5605 Valhalla Dr., Carmichael, CA 95608.

Seeking contact with anyone who knew **SSgt. John Louis Scala**, who was a gunner on a B-17E with the 16th Reconnaissance Squadron, 68th Reconnaissance Group, at Foch Field, Tunisia, when he was killed in a crash December 6, 1943. He also served with the 358th Bomb Squadron, 303d Bomb Group, and is buried at Lorraine, France. **Contact:** Tony Scala, 64 Sunnymead, West Green, Crawley, West Sussex RH11 7DZ, England.

Seeking members of the **453d Bomb Group** who served in England during World War II and are not already members of the 453d Bomb Group Association. **Contact:** Wib Clingan, 8729 Samoline, Downey, CA 90240.

Seeking contact with members of the **59th Air Base Depot Group** (later NAMA) at RAF Burtonwood, England, who had dependents attending the American high school at Burtonwood during the 1950s. **Contact:** Veda Rae Richards Hobbs, 9009C Contee Rd., Laurel, MD 20708.

For books on these subjects, seeking information on the **Eagle Squadrons, the Battle of Britain, and B-17 Bomb Groups**. **Contact:** Raymond Heward, 16 The Moorlands, Colereton, Leicestershire LE6 4GG, England.

Seeking photographs or slides of **Air Defense Command F-102 Delta Daggers**, especially from the 5th, 27th, 84th, and 456th Fighter Interceptor Squadrons. **Contact:** Thomas G. Izbrand, 2540 W. Maryland #274, Phoenix, AZ 85017.

Seeking contact with people who knew **Maj. Alton C. Williams**, who was in the 774th Troop Carrier Squadron in Vietnam in 1967. Especially seeking contact with members of his crew: Lt. Toby Skinner, copilot; Lt. Pete Daly, navigator; SSgt. Art Doyle, flight engineer; and A2C Dave Bloss, loadmaster. **Contact:** David C. Williams, 223Y Brookhollow Dr., Abilene, TX 79605.

Seeking members of my crew from **301st Bomb Group**, 353d Bomb Squadron, 15th Air Force, who served in Foggia, Italy, during World War II. Also seeking **William Mackey**, who trained with the squadron at MacDill Field, Fla., but didn't deploy to Europe. **Contact:** P. M. Gahagan, 2660 N. 66th St., Wauwatosa, WI 53213.

Seeking contact with the **USAF lieutenant colonel from Jamestown, R. I.**, who responded to my request for information on my father, saying he knew a Walter Y. Lucas. **Contact:** P. Slatcher, 51 Woolmer Rd., The Meadows, Nottingham NG2 2FA, England.

Seeking contact with a US glider pilot named **Boyne** who tried to contact his father's relatives in London during World War II. **Contact:** Irene (Boyne) Moore, 25 Westbrook Dr., Macclesfield, Cheshire SK10 3AQ, England.

Seeking contact with as many NCOs as possible who were at **RAF Brize Norton**, England, between 1953 and 1954, for a publication called *The Flying Times*, including a "where they are now" feature on you. **Contact:** CMSgt. Jim Bailey, (Ret.), 2 Sunbury Ln., Battersea, London SW11 3NP, England.

Seeking contact with other **patch collectors** and information on any patch clubs. **Contact:** Jerry Cecil, 4627 Ave. De Las Flores, Yorba Linda, CA 92686.

Seeking a book, **History of the 445th Bomb Group**, by Ralph J. Bursic. **Contact:** MSgt. Robert H. Murray, USAF (Ret.), 11165 Cochise Cir., Dewey, AZ 86327.

Seeking information on **W. G. Ehart**, a B-17 crew member with the 413th Bomb Squadron, 96th Bombardment Group, 8th Air Force, in England between 1942 and 1945. **Contact:** Jan P. Reifenberg, P. O. Box 1805, Rosamond, CA 93560.

Collector seeks photos or negatives of **nose art** on F/B-111s, B-1Bs, B-52s, KC-10s, and KC-135s. Also seeking any F-4 memorabilia. **Contact:** Randy P. Walker, 412 S. W. 46th St., Oklahoma City, OK 73109-7418.

Seeking color or black-and-white **photos** of military aircraft, personnel, equipment, markings, and camouflage. **Contact:** Sait Yorukel, 600 Evler, Akincilar Sk. 26, 10220 Bandirma, Turkey.

Collector seeks **USAF patches**. Will trade French Air Force patches. **Contact:** J. C. Cechetti, 53, Rue du Cormier, 41200 Romorantin, France.

Seeking contact with people who knew the **crew of B-24 #41-23711** of the 328th Bomb Squadron, 93d Bomb Group, 8th Air Force, which was shot down October 1, 1943, two months after participating in the raid on Ploesti. I am especially seeking the following 93d Bomb Group veterans: SSgts. Naum "Curly" Diltz, Kermit Morris, Charles Bates, and Robert O. Bocek; 2d Lieutenant McQuinn (the plane's former copilot); and Maj. Roy G. Martin. **Contact:** Gregg Jones, 2400 Riverfront Dr., #2232, Little Rock, AR 72202.

Seeking the whereabouts of **Lowell Janke and Elias Coury**, who were with the 18th Composite Squadron at Andrews Field (Great Saling), Essex, England, in 1943-44. **Contact:** G. Inglis, 2013 Collins Blvd., Gulfport, MS 39507.

Seeking information on USAF unconventional warfare and special operations activities in Southeast Asia between 1963 and 1975. I would especially like information on the following aircraft and units: **Duck Hook C-123s** of the 1st Flight Detachment; **Combat Spear C-130 Combat Talons** of the 15th, 90th, and 1st Special Operations Squadrons; **Green Hornet UH-1s** and **Pony Express CH-3s** of the 20th Special Operations Squadron; and **Knife CH-53Cs** of the 21st Special Operations Squadron. **Contact:** Maj. Bernard V. Moore II, 1683A Strickland Ct., Gunter AFB, AL 36115.

Seeking information on **Capt. Harry L. "Larry" Golding**, a base commander in Greenland from 1942 to 1943 who later served in India. **Contact:** Richard E. Golding, 125 West Parrish Rd., Sequim, WA 98392.

Seeking photos, recollections, and unit histories of **Army Air Fields in Florida** during World War II. **Contact:** Walter E. Houghton, Broward County Aviation Dept., 1400 Lee Wagener Blvd., Fort Lauderdale, FL 33315.

For a history of the 25th Bomb Group, I am seeking the whereabouts of personnel involved in secret **OSS missions called "Redstocking"** in England during World War II. **Contact:** Norman Malayney, 519 Semple St., Pittsburgh, PA 15213-4315.

Seeking the whereabouts of **William Walker**, who was stationed in Thailand from 1972 to 1976

and lived with Somret Phetsena in the village of Korat. **Contact:** Montan Phetsena, 7270 Heather Rd., Macungie, PA 18062.

Collector of military aviation **flight gear** seeks contact with other collectors to trade items from World War II to present. **Contact:** Jeffrey D. Guidry, 114 Oak Leaf Dr., Slidell, LA 70461.

Seeking information on a **swastika-like insignia** used by the 55th Pursuit Squadron, 20th Fighter Group, in the late 1920s or early 1930s. The insignia was changed when Hitler came to power. **Contact:** Dick D. Cato, 2602 Woodridge, Abilene, TX 79605.

Seeking the whereabouts of USAAF Night Fighter personnel, especially **John G. Smith, Edward "Ted" Collegan, and Hardin E. Ross** of the 425th Night Fighter Squadron. **Contact:** A. E. "Bud" Anderson, 8885 Plumas Cir., D-1116, Huntington Beach, CA 92646.

Seeking the whereabouts of former students who attended **Ramey High School**, on Ramey AFB, Puerto Rico, between 1955 and 1975. **Contact:** Glenn & Cindy Greenwood, 1424 Corona Dr., Austin, TX 78723.

Patch collector would like to trade or purchase **USAF patches and pilot scarves**. Also seeking memorabilia relating to the FB-111, the 509th and 380th Bomb Wings, and Pease AFB, N. H. **Contact:** MSgt. Jordan Murphy, CAP, 10 Farm Pond Ln., Hollis, NH 03049.

Seeking the whereabouts of **Pfc. Robert Brown**, who served with the 817th Engineer Aviation Battalion, Company C, based at RAF Chelveston, England, in 1952-53. **Contact:** John Stiles, 48 Squirrel Rise, Marlow Bottom, Bucks, England.

Seeking contact with members of the **652d Bomb Squadron, Weather Reconnaissance**, who were stationed at RAF Watton or RAF Alconbury, England, in 1944-45. **Contact:** R. J. Hunt, 1487 Lupine Dr., Santa Rosa, CA 95401-3936.

Seeking contact with veterans who took part in the **April 16, 1944, "Black Sunday" raid on Hollandia** by these units: 3d, 22d, 43d, 312th, 345th, and 417th Bomb Groups; 8th and 475th Fighter Groups; and 26th Photoreconnaissance Squadron. **Contact:** Col. Russell L. Sturzebecker, USAF (Ret.), 503 Owen Rd., Westchester, PA 19380.

Seeking information on **2d Lt. Richard M. Merrill**, a B-24 navigator with the 777th Bomb Squadron, 464th Bombardment Group, 15th Air Force, at Pantanella AAB, Italy, who was killed October 17, 1944 in Vienna, Austria. **Contact:** K. Reading, P. O. Box 1689, Pendleton, OR 97801.

If you need information on an individual, unit, or aircraft, or if you want to collect, donate, or trade USAF-related items, write to "Bulletin Board," *AIR FORCE Magazine*, 1501 Lee Highway, Arlington, VA 22209-1198. Letters should be brief and typewritten. We cannot acknowledge receipt of letters to "Bulletin Board." We reserve the right to condense letters as necessary. Unsigned letters are not acceptable. Photographs cannot be used or returned.—THE EDITORS

Seeking information on two World War II bombers, **Spirit of Autauga County, Ala.**, and **Pride of Autauga**, which were purchased with war bonds by the citizens of Autauga County. **Contact:** Elizabeth Boone Aiken, 410 Cary Dr., Auburn, AL 36830.

For a book, seeking contact with anyone who was on the **low-level mission to Ploesti on August 1, 1943**, or who worked on the aircraft that flew that mission. **Contact:** Michael Hill, 1405 8th St. S. W., Minot, ND 58701.

Seeking contact with members of the **366th and 367th Air Service Squadrons** of the 96th Air Service Group who served in Italy during World War II. **Contact:** Edmund Wilkinson, 6425 Gaelic Glen Dr., Oklahoma City, OK 73142.

Seeking historical data, photos, anecdotes, and memorabilia relating to the **12th Tactical Reconnaissance Squadron**. **Contact:** 1st Lt. Walter L. Jablow, 12th TRS/DO, Bergstrom AFB, TX 78743.

A memorial fund has been established for the families of **MSgt. Samuel M. Gardner, SSgt. Marc H. Cleymann, and SSgt. Rande J. Hulec**, who were killed when their Air Weather Service C-5 crashed last August en route to Saudi Arabia to take part in Operation Desert Shield. **Contact:** Air Weather Association Memorial Fund, 5301 Reservation Rd., Placerville, CA 95667.

Historian seeks oral histories, correspondence, anecdotes, and reminiscences relating to the training, test and evaluation, deployment, and deactivation of the **Ground-Launched Cruise Missile (GLCM)** at any operational, test, or training location. **Contact:** David Ramagos, 235 Thames Dr., Colorado Springs, CO 80906.

For an alumni book, the public affairs staff of the **207th AFROTC Cadet Wing** is seeking addresses, photos, and job descriptions of all graduates of Detachment 207 and Detachment 206. **Contact:** C/3C Sean P. Brady, 207th AFROTC Cadet Wing, Parks College of St. Louis University, Cahokia, IL 62206-1998.

Seeking information on **Walter "Wally" Holstead**, who was with the 513th Troop Carrier Group, stationed at Kaingwan AB, China, and was killed in late January or early February 1946 near Hankow (now Wuhan), China. **Contact:** Robert M. Kirkpatrick, 3562 Artesian St., Riverside, CA 92503.

Seeking information on and a copy of a photo that was taken on **September 22, 1944**, by a member of the **15th Air Force near Termoli, Italy**. The photo shows a group of people who had been in a crash landing of an aircraft, including the pilot and his wife, a General Naday, a Colonel Howie (a South African, wearing civilian clothes), and possibly another member of the

flight crew. **Contact:** Philip Markham, 85 Avenue Rd., Ottawa, Ontario K1S 0P1, Canada.

Seeking the whereabouts of **Marion O. Wilson, Selma McDougale, Maxie B. Seale, Ronnie McCulloch, and Corwin Giese**, who were assigned to the Palace Hotel, Southport, England, during World War II. **Contact:** R. C. Harris, Jr., 4813 Burton SE, Albuquerque, NM 87108-3419.

Seeking contact with anyone who knew **Henry Schreier**, a tail gunner on **Snow White**, a B-24 of the 98th Bomb Group, in Italy, who was later a POW in Germany. **Contact:** Margaret L. Cawood, Confederate Air Force, 1419 Quamasia, McAllen, TX 78504.

For a biography, seeking information on **Antoine de Saint-Exupéry**, who was part of a French group attached to the American 23d Photoreconnaissance Squadron, flying P-38 Lightnings on reconnaissance missions from North Africa to Sardinia in 1943. **Contact:** Stacy Schiff, 125 Cedar St., Apt. 4S, New York, NY 10006.

For a history of **Air Refueling Units**, seeking contact with members who served with the 11th, 77th, 100th, 311th, 334th, 335th, 336th, 497th, 499th, 500th, 4045th, 4050th, 4060th, 4061st, 4108th, 4397th, or 4505th Air Refueling Wings. **Contact:** SSgt. Mike L. Lambert, 4000 E. Dunham St., Wichita, KS 67210.

Unit Reunions

Bataan and Corregidor

Members of the American Defenders of Bataan and Corregidor will hold their national convention May 2-5, 1991, at the Airport Hilton Hotel in Memphis, Tenn. **Contact:** John Crago, 615 Lehmeyer St., Huntington, IN 46750.

Foster/Aloe Fields

Military and civilian personnel stationed at Foster and Aloe Fields (Matagorda Gunnery Range/Matagorda Peninsula), Tex., during the 1940s and 1950s will hold their fiftieth-anniversary reunion in June 1991. **Contacts:** Paul A. Kneblick, 601 Cambridge, Rte. 6, Victoria, TX 77901. Phone: (512) 575-5840 or (512) 575-7560 (Helen K. Welch).

2d Bombardment Group

Members of the 2d Bomb Group will hold a reunion September 12-15, 1991, at the Stouffer Hotel in Dayton, Ohio. **Contact:** Kemp F. Martin, 8433 Katy Freeway, Suite 102, Houston, TX 77024. Phone: (713) 467-5435.

6th Bomb Group

Members of the 6th Bomb Group (Very Heavy) stationed on Tinian in 1945 will hold a reunion May 30-June 2, 1991, in Newton, Mass. **Contact:** Newell W. Penniman, Jr., 6 Porter Ln., South Hamilton, MA 01982. Phone: (508) 468-2806.

9th Service Squadron

Members of the 9th Service Squadron, 321st Service Group, 13th Air Force, will hold a reunion in June 1991 in Hot Springs, Ark. Please send a postcard for additional information. **Contact:** MSgt. Laurence F. Mirick, USAF (Ret.), 14 Grasswood Ln., Rockland, MA 02370-2834. Phone: (617) 878-3934.

33d Tactical Fighter Wing

Veterans of the 33d Fighter Group/33d Tactical Fighter Wing will hold their fiftieth-anniversary reunion April 3-5, 1991, in Fort Walton Beach, Fla. **Contacts:** Lt. Col. Ibbie Beatty, USAF (Ret.),

18 Sherwood Rd., N. W., Fort Walton Beach, FL 32547-1635. Phone: (904) 862-8891. Lt. Col. William Jones, USAF (Ret.), 25 Country Club Rd., Shalimar, FL 32579. Phone: (904) 651-5859. Clay McCutchan, 33d TFW/HO, Eglin AFB, FL 32542. Phone: (904) 882-4885.

Readers wishing to submit reunion notices to "Unit Reunions" should mail their notices well in advance of the event to "Unit Reunions," AIR FORCE Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Please designate the unit holding the reunion, time, location, and a contact for more information.

53d Weather Recon Squadron

The 53d Weather Reconnaissance Squadron and Weather Detachment "Hurricane Hunters" will hold a reunion February 22-24, 1991, in Biloxi, Miss. **Contact:** Lt. Col. James L. Donnelly, USAF, 53d WRS/CC, Keesler AFB, MS 39534-5000. Phone: (601) 377-2377.

307th Bomb Group/Wing

Members of the 307th Bomb Group and Wing who served between 1947 and 1954 will hold a reunion May 16-19, 1991, in Dayton, Ohio. **Contact:** Harold K. Sams, 4100 Tonawanda Trail, Dayton, OH 45430. Phone: (513) 429-0639.

404th Fighter Group

Members of the 404th Fighter Group, which included the 506th, 507th, and 508th Fighter Squadrons, will hold a reunion June 20-23, 1991, in Abilene, Tex. **Contact:** John S. Freeman, 404 S. West St., Box 508, Kempton, IN 46049. Phone: (317) 947-5231.

450th Bomb Group

The 450th Bomb Group "Cottontails" will have a return trip to Manduria, Italy, for a memorial dedication on April 8-16, 1991. **Contact:** Col. Robert H. Gernand, USAF (Ret.), 1054 San Remo Rd., St. Augustine, FL 32086. Phone: (904) 797-7348.

4135th SW/39th BW

The 4135th Strategic Wing and the 39th Bomb Wing will hold a reunion March 8-10, 1991, at the Elks Lodge, Greenwood Motel, in Fort Walton Beach, Fla. **Contact:** Rex Nevill, 123 Sortir St., Fort Walton Beach, FL 32548. Phone: (904) 862-2819 or (904) 897-2312.

Retired USAF Musicians

Seeking names and addresses of retired US Air Force musicians for a roster for future reunions and to plan a 1992 reunion. **Contact:** Louis C. Kriebel, 1521 East Boulevard., Maitland, FL 32751.

Pilot Class 52-A

For the purpose of planning a reunion in 1992, I would like to hear from Pilot Class 52-A. **Contact:** Stan Nelson, 2012 W. 49th Terrace, Shawnee Mission, KS 66205. Phone: (913) 362-1325.

314th Tactical Airlift Wing

I would like to hear from members of the 314th Tactical Airlift Wing stationed at Ching Chuan Kang (CCK) AB, Taiwan, in 1967 and 1968 who would be interested in holding a reunion in May 1991. **Contact:** John Powell, 210 Southland Station Dr., #41, Warner Robins, GA 31088.

367th Air Service Squadron

I am trying to locate members of the 367th Air Service Squadron and the 96th Air Service Group who served in Italy during World War II and who would be interested in holding a reunion. **Contact:** Edmund Wilkinson, 6425 Gaelic Glen Dr., Oklahoma City, OK 73142. Phone: (405) 722-2153.

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Member's Attained Age*	Member	Spouse	Each Child
under 50	\$25.27	\$54.15	\$17.97
50-54	37.76	59.03	17.97
55-59	55.35	63.18	17.97
60-64	66.13	79.66	17.97

For Military Retirees and Dependents QUARTERLY PREMIUM SCHEDULE In-Patient and Out-Patient Benefits

Member's Attained Age*	Member	Spouse	Each Child
Under 50	\$39.00	\$79.32	\$40.84
50-54	51.25	87.34	40.84
55-59	70.85	115.33	40.84
60-64	89.00	132.80	40.84

*Note: Premium amounts increase with the member's attained age.

For Dependents of Active Duty Personnel ANNUAL PREMIUM SCHEDULE

In-Patient Benefits Only			
	Member	Spouse	Each Child
All Ages	None	\$12.89	\$7.72
In-Patient and Out-Patient Benefits			
	Member	Spouse	Each Child
All Ages	None	\$51.52	\$38.61

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Group Policy GMG-FC70
Mutual of Omaha Insurance Co.
Home Office: Omaha, Nebraska

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Rank _____ Last _____ First _____ Middle _____

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Number and Street _____ City _____ State _____ Zip Code _____

Date of Birth _____ Current Age _____ Height _____ Weight _____ S.S.N. _____
Month/Day/Year

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PLAN & TYPE OF COVERAGE REQUESTED

Plan Requested (check one) ☐ AFA CHAMPLUS® PLAN I (for military retirees & dependents) ☐ AFA CHAMPLUS® PLAN II (for dependents of active-duty personnel)

Coverage Requested (check one) ☐ Inpatient Benefits Only ☐ Inpatient and Outpatient Benefits

Person(s) to be insured (check one) ☐ Member Only ☐ Member & Children ☐ Spouse Only ☐ Spouse & Children ☐ Member & Spouse ☐ Member, Spouse & Children

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All premiums are based on the attained age of the AFA member applying for this coverage. Plan I premium payments are normally paid on a quarterly basis, but, if desired, they may be made on either a semi-annual (multiply by 2), or annual (multiply for 4) basis.

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Quarterly (annual) premium for spouse (based on members' age) \$ _____

Quarterly (annual) premium for _____ children @ \$ _____ \$ _____

Total premium enclosed \$ _____

If this application requests coverage for your spouse and/or eligible children, please complete the following information for each person for whom you are requesting coverage.

Names of Insured Dependents Relationship to Member Date of Birth (Month/Day/Year)

(To list additional dependents, please use a separate sheet.)

In applying for this coverage, I understand and agree that (a) coverage shall become effective on the last day of the calendar month during which my application together with the proper amount is mailed to AFA, (b) only hospital confinements (both inpatient and outpatient) or other CHAMPUS-approved services commencing after the effective date of insurance are covered and (c) any conditions for which I or my eligible dependents received medical treatment or advice or have taken prescribed drugs or medicine within 12 months prior to the effective date of this insurance coverage will not be covered until the expiration of 12 consecutive months of insurance coverage without medical treatment or advice or having taken prescribed drugs or medicine for such conditions. I also understand and agree that all such preexisting conditions will be covered after this insurance has been in effect for 24 consecutive months.

Date _____, 19____ (Member's Signature)

Form 6173GH App.

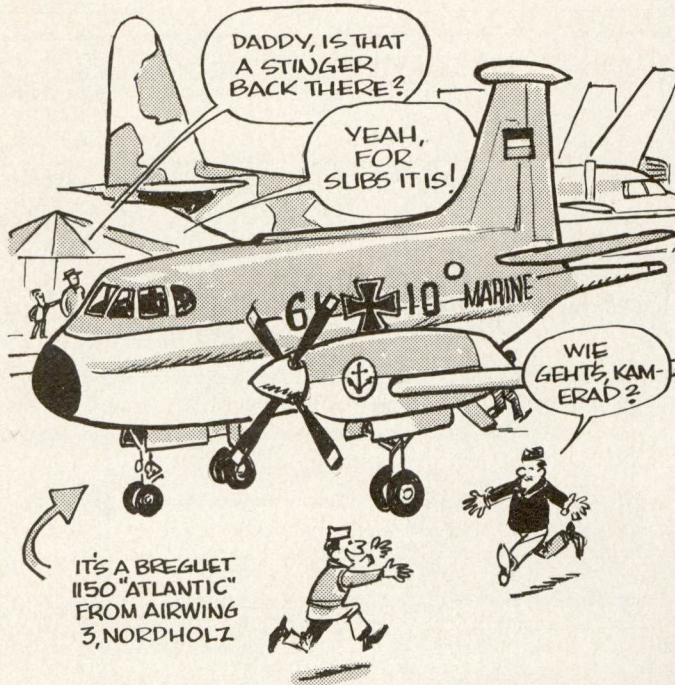
Application must be accompanied by a check or money order. Send remittance to:
Air Force Association, Insurance Division, 1501 Lee Highway, Arlington, VA 22209-1198



Bob Stevens'

"There I was..."

OVER A HALF-MILLION FOLKS PACK THE RAMP FOR TWO DAYS. ONE STRANGE BIRD ON DISPLAY CAME FROM GERMANY-



...AT RICHARDS-GEBAUR AFB, KANSAS CITY, FOR "OPERATION HANDSHAKE"-THE ANNUAL AIRSHOW EXTRAVAGANZA PLANNED AND DIRECTED ENTIRELY BY AIR RESERVE UNITS. THIS IS ONE OF THE TOP SHOWS IN THE NATION AND RECEIVES 110% SUPPORT FROM KC. BOOSTERS-



YANKEE INGENUITY AT ITS BEST-303 TFS PERSONNEL HAWKED MEMENTOS OF LAST SUMMER'S DEPLOYMENT-



ONE OF THE HIGHLIGHTS WAS 4 PASSES BY THE USAF'S F-117 STEALTH FIGHTER!

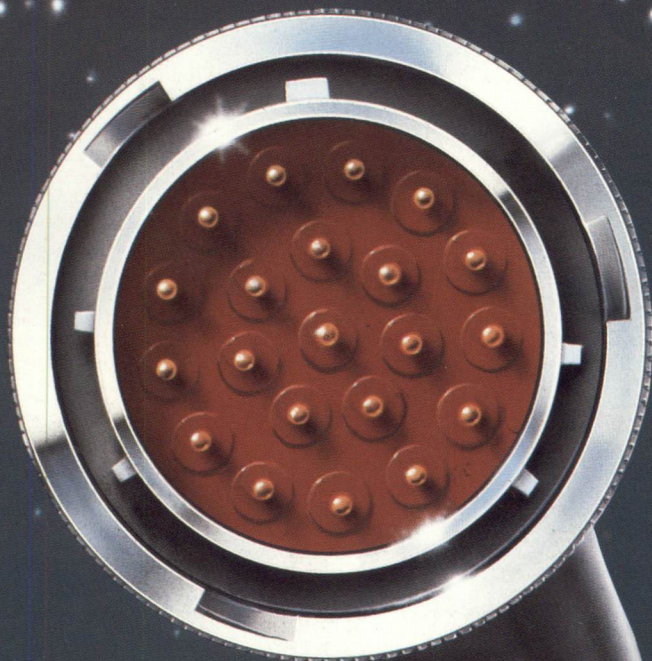


AND, OF COURSE, THE THUNDERBIRDS WOUND UP THE DAY WITH A PRECISION PERFORMANCE (IT WAS THEIR "FLAT" ROUTINE DUE TO LOW CLOUDS THE FINAL DAY).



Bob Stevens
(ON LOCATION)

Plug-in to the future with Pentastar



Automatic Test Equipment

Pentastar, a new name for Chrysler Military-Public Electronic Systems, is a prime defense contractor with over 35 years of experience. Our Mil-Spec automatic test equipment supports all types of systems, from missiles to armored vehicles.

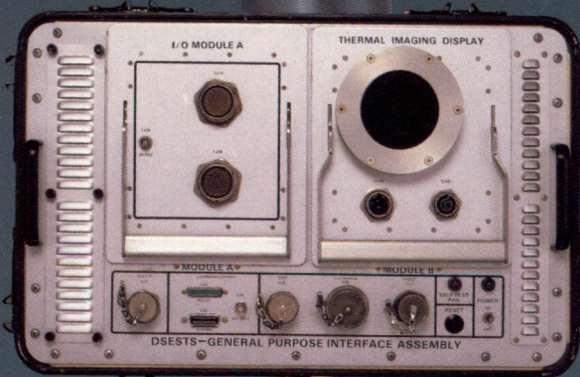
We design and build the Direct Support Electrical System Test Sets (DSESTS) for the M1 tank and the M2/3 Bradley infantry fighting vehicle. Pentastar also has experience in vehicle electronics, power bus management systems and electrical interface units.

Our test system knowledge gives Pentastar the capability to meet your most stringent ATE requirements, today and tomorrow.

Test Program Sets

Our capabilities in digital and analog processing, RF, lasers and electro-optics technologies helps us design the vital link between standard Mil-Spec ATE systems and units under test. Pentastar's test program sets are known for their easy-to-use designs, rugged flexibility and low life cycle costs.

Our test equipment works because we understand modern weapon systems and their operational environment. All of which is why more and more customers are plugging into our capability.



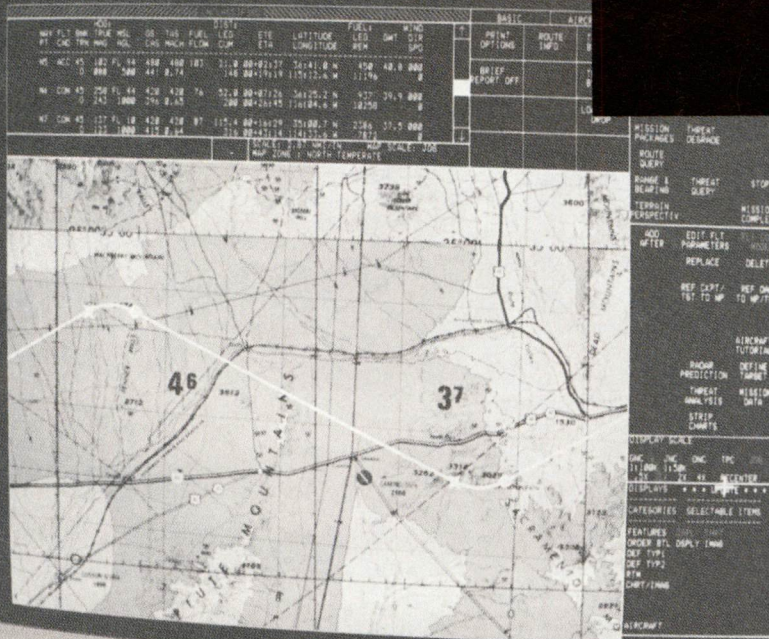
Pentastar Electronics Inc.
A Chrysler Company
P.O. Box 1929
Huntsville, AL 35807-0929
Telephone: 205-895-2209
FAX: 205-895-2039



PENTASTAR
ELECTRONICS INC.
A CHRYSLER COMPANY

Light years ahead in capability

A close-up, low-angle shot of a pilot's helmet and oxygen mask, looking out over a clear blue sky. Two fighter jets are visible in the distance, flying in formation.



Mission Support System (MSS) upgrades and enhancements from the McDonnell Douglas Missile Systems Company (MDMSC) provide planning packages with highly sophisticated, proven products behind them. And unparalleled experience.

country mission planning systems commonly available today, ours have established a reputation for in-depth planning analysis using standard data bases supplied by the U.S. government. And they work. In fact, they're proving themselves right now in the harshest environments on earth, delivering as promised.

Maximum capability combined with maximum experience means minimum program risk. And a choice that can help Air Force decision makers rest easy.

Far more advanced than the simple cross-

MCDONNELL DOUGLAS
A company of leaders.

**Office of
Aeronautics,
Exploration and
Technology**

NASA AERONAUTICS

**Presentation to
Dr. Eugene Wong
and
Dr. William D. Phillips
Office of Science and Technology Policy**

**Dr. Robert Rosen
Deputy Associate Administrator
September 12, 1990**

NACA
1915

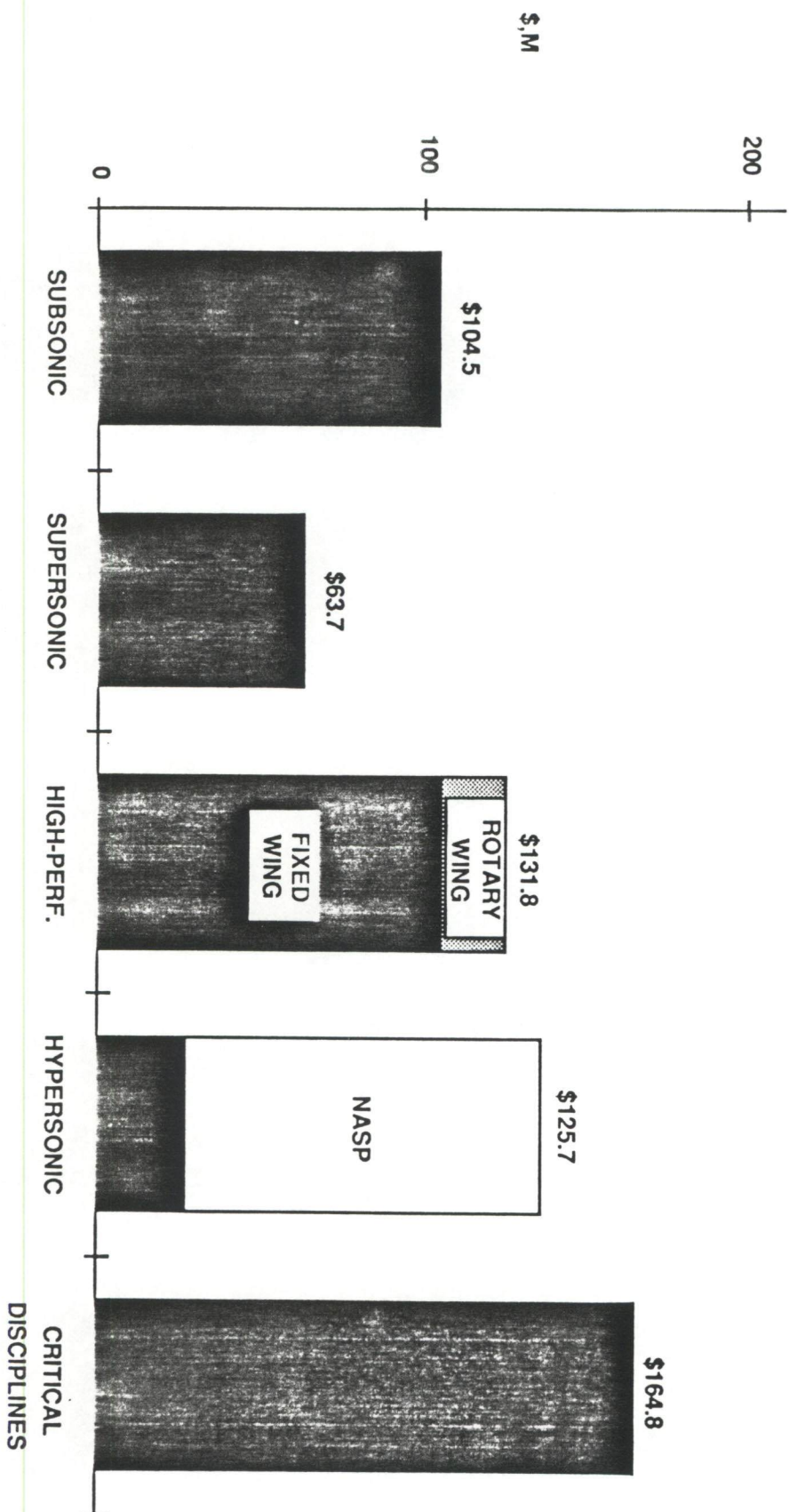
AERONAUTICS CHARTER

NASA
1990

- Preserve the role of the United States as a leader in aeronautical science and technology, and the application thereof
- Improve the usefulness, performance, speed, safety, and efficiency of aeronautical vehicles, both civil and military
- Supervise and direct the scientific study of the problems of flight, with a view to their practical solution
- Ensure the timely provision of a proven technology base for a safe, efficient, and environmentally compatible air transportation system

Seventy-five year tradition of advanced aeronautical research and technology enhancing our economic competitiveness, national security, and air transportation infrastructure

FY 1991 AERONAUTICS INVESTMENT



NASA AERONAUTICS

BENEFITS TO NATION

- **NATIONAL SECURITY**
- **ECONOMIC STRENGTH**
- **EFFICIENT TRANSPORTATION**
- **HIGH TECHNOLOGY INDUSTRIAL BASE**
- **NATIONAL PRESTIGE**

BENEFITS TO NASA

- **DIRECT R&T CONTRIBUTIONS TO SPACE**
- **FACILITIES CRITICAL TO ENTIRE AGENCY MISSION**
- **MODEL FOR COOPERATION WITH INDUSTRY AND OTHER GOVERNMENT AGENCIES**

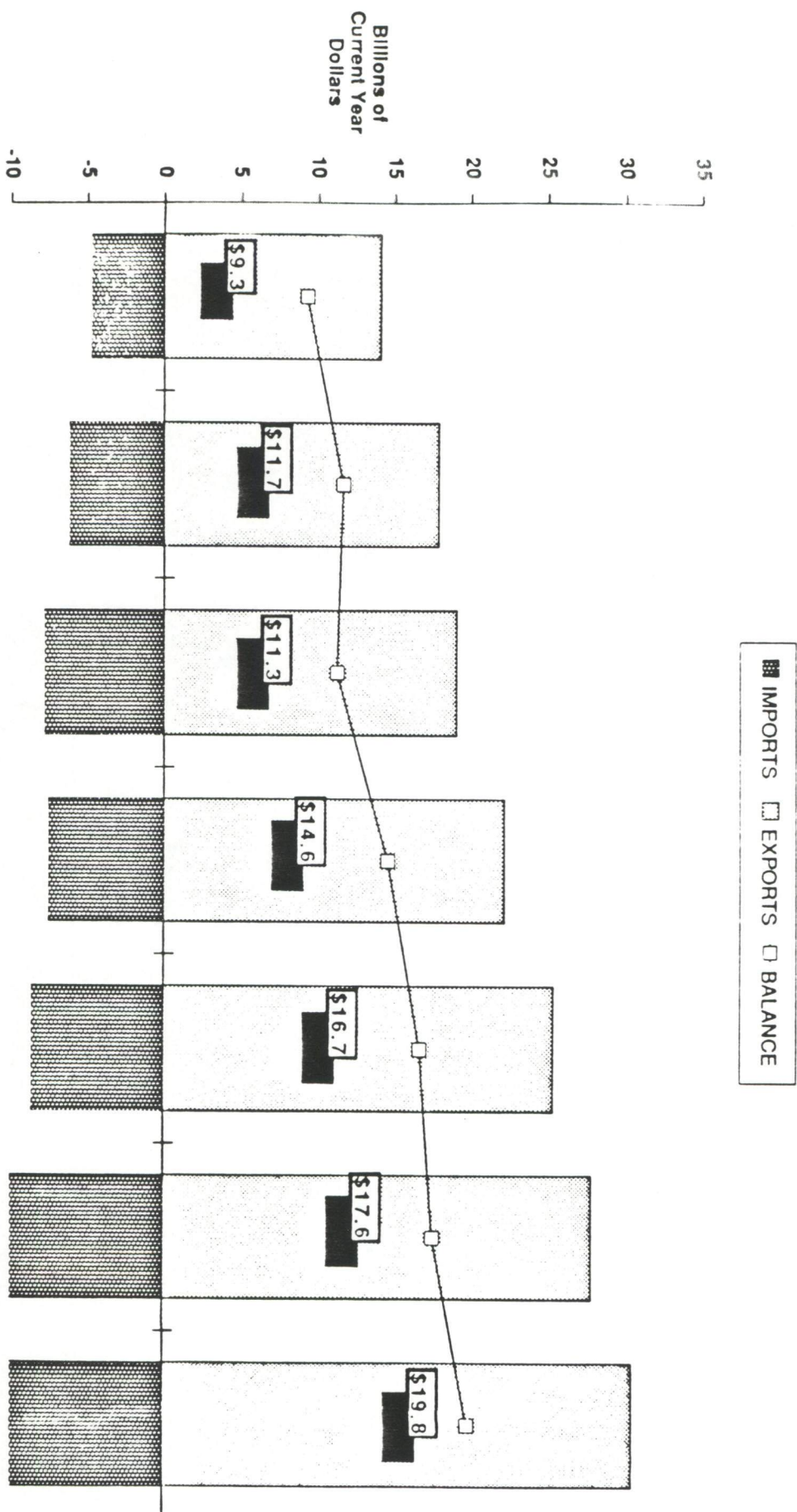
NATIONAL/INTERNATIONAL PERSPECTIVE

U.S. AVIATION LEADERSHIP

THE STAKES ARE HIGH

- **SIGNIFICANT CONTRIBUTOR TO NATIONAL ECONOMY**
 - SALES EXCEED \$90 BILLION
 - \$19 BILLION POSITIVE BALANCE OF TRADE
 - 1 MILLION EMPLOYEES
- **PROVIDES VITAL DOMESTIC AND INTERNATIONAL TRANSPORTATION INFRASTRUCTURE**
- **CRITICAL FOR NATIONAL DEFENSE**
 - ONE THIRD OF THE DOD BUDGET FOR DEVELOPMENT, PROCUREMENT AND OPERATION OF AERONAUTICAL SYSTEMS

U. S. TRADE IN AVIATION

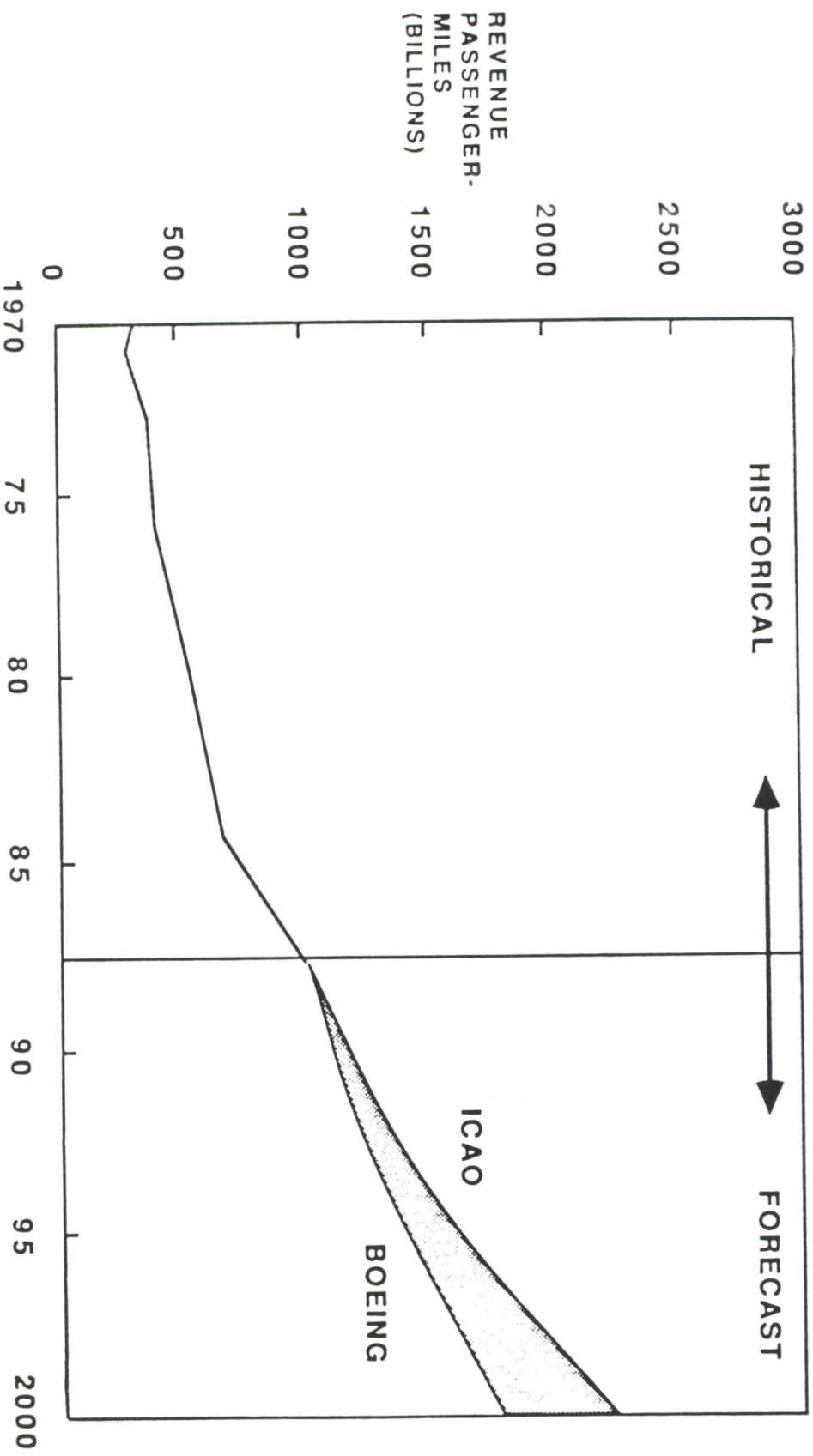


source: U.S. Dept of Commerce "1990 U.S. Industrial Outlook"

Calendar Year

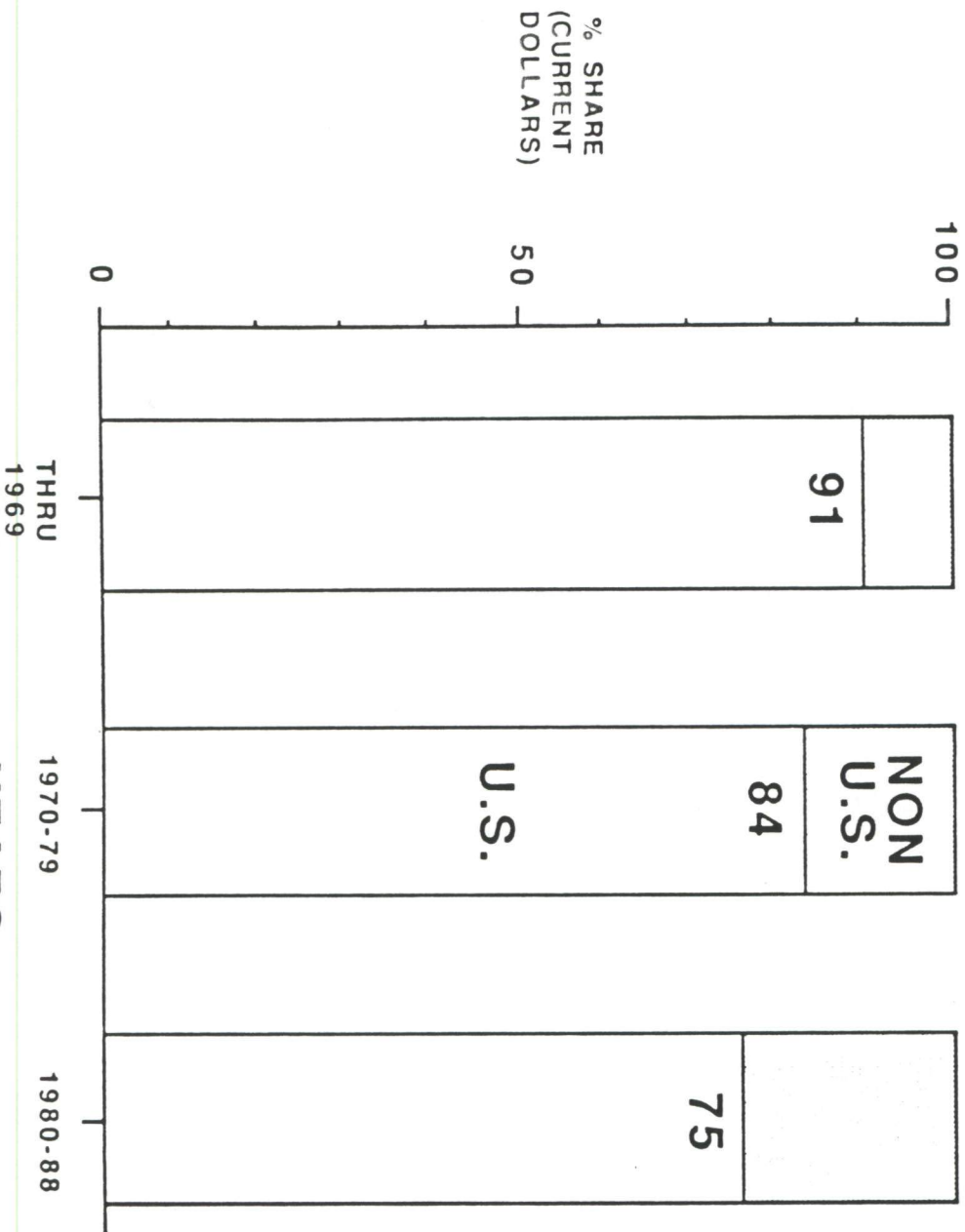
K/190.021

WORLD REVENUE PASSENGER-MILES



SOURCE: 1988 BOEING CURRENT MARKET OUTLOOK
& ICAO FORECAST

MARKET SHARES - JET TRANSPORT ORDERS



Source: Boeing Commercial Airplanes

HIGH-SPEED CIVIL TRANSPORT FOREIGN COMPETITION

~~OAEI~~

JAPAN

• MITI

- \$120M MATERIALS DEVELOPMENT PROGRAM
- \$195M PROPULSION RESEARCH PROGRAM (BIDDERS INCLUDE: G.E., P&W, ROLLS, SNECMA)
- \$145M DEFINITION OF TEST FACILITIES
- \$5B ESTIMATED FACILITIES CONSTRUCTION BUDGET

EUROPE

• BRITISH AEROSPACE/AEROSPATIALE

- JOINT STUDY AGREEMENT (MAY 10, 1990)
- 5-YEAR FEASIBILITY STUDY
- \$34M STUDY BUDGET - PHASE I

interavia

Volume 11

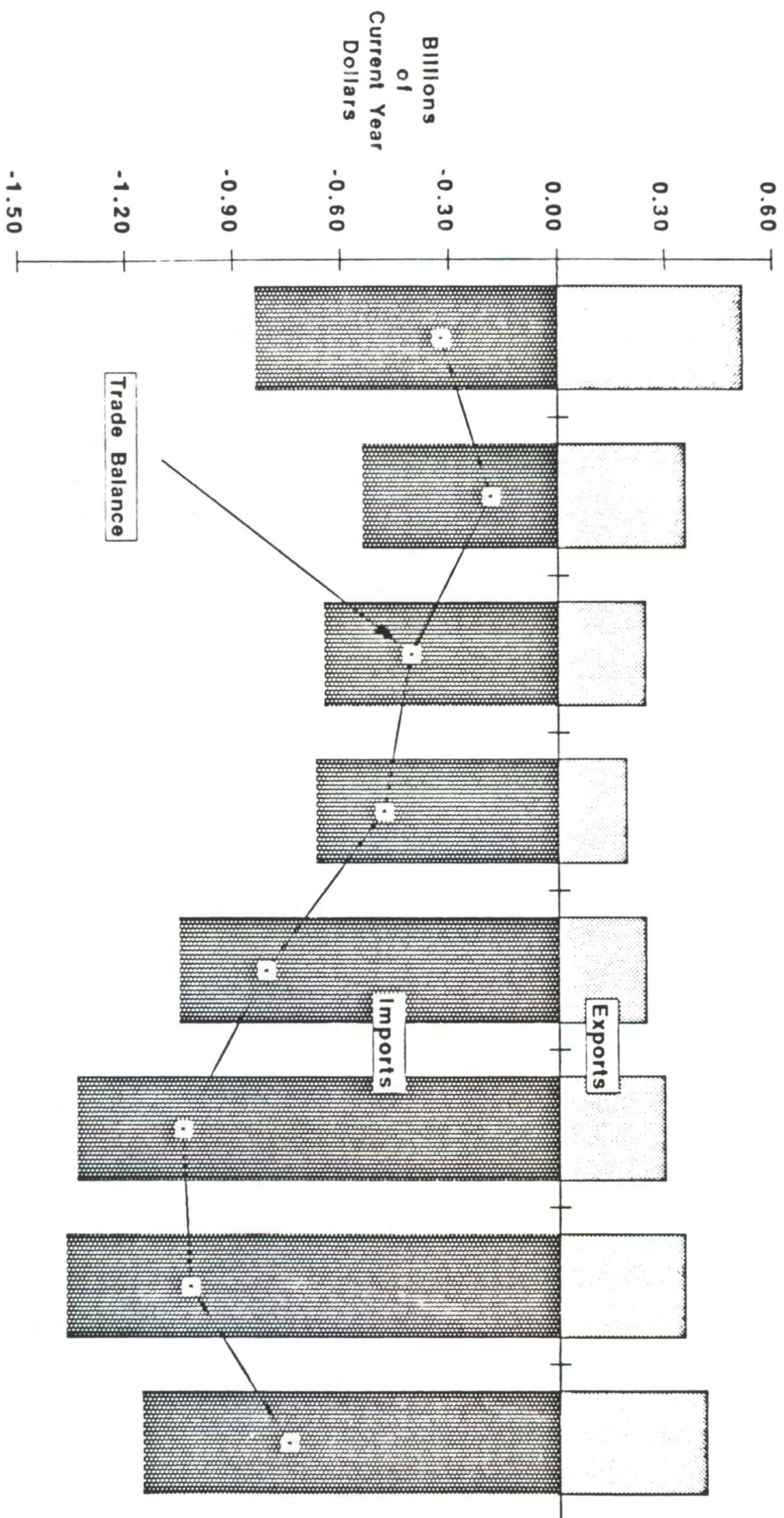
7/1988

Month 1



**Soviets
steal the show**

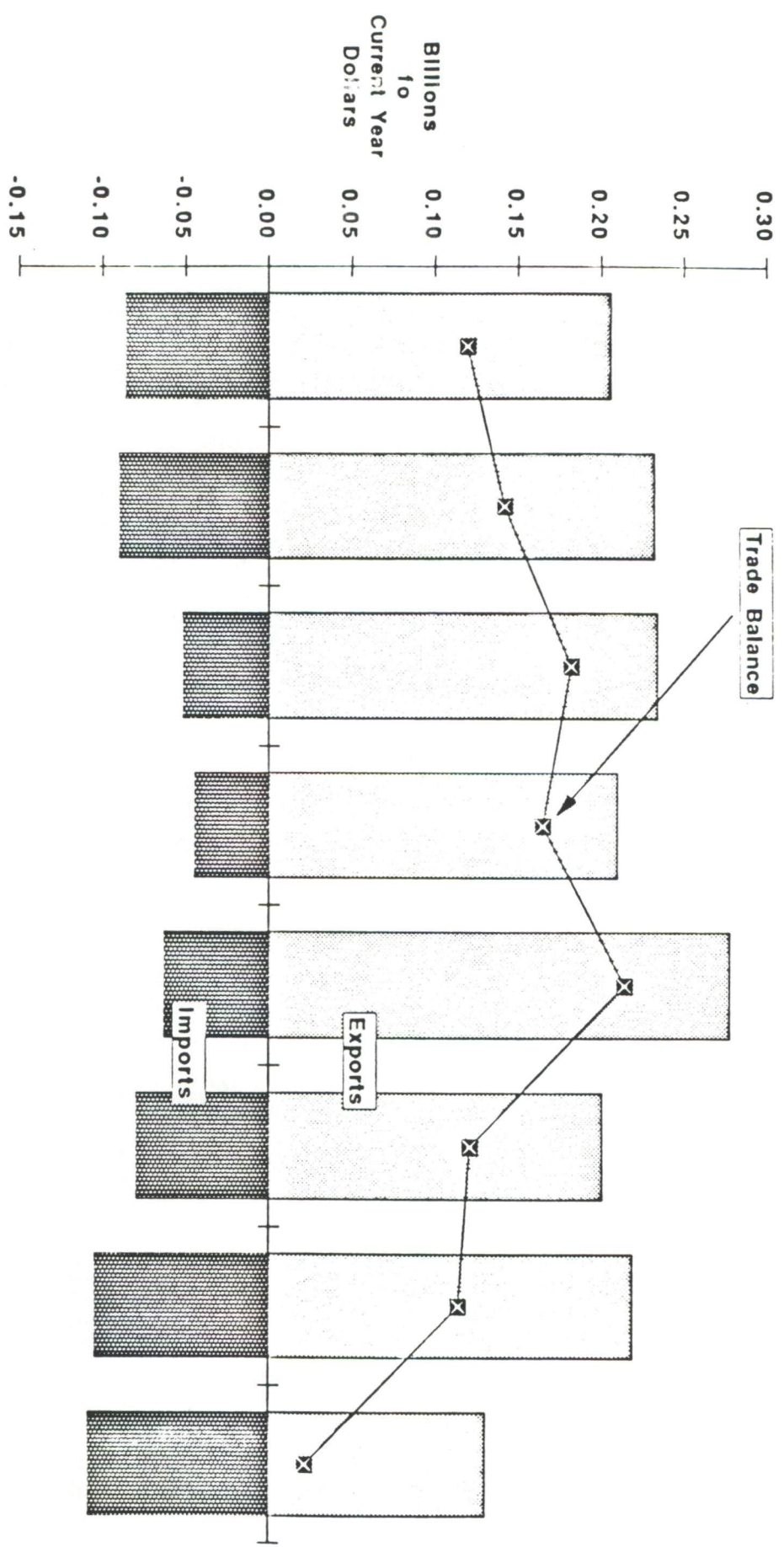
U.S. TRADE IN GENERAL AVIATION



source: U.S. Dept of Commerce Statistics

K/190.016

U.S. TRADE IN CIVIL HELICOPTERS

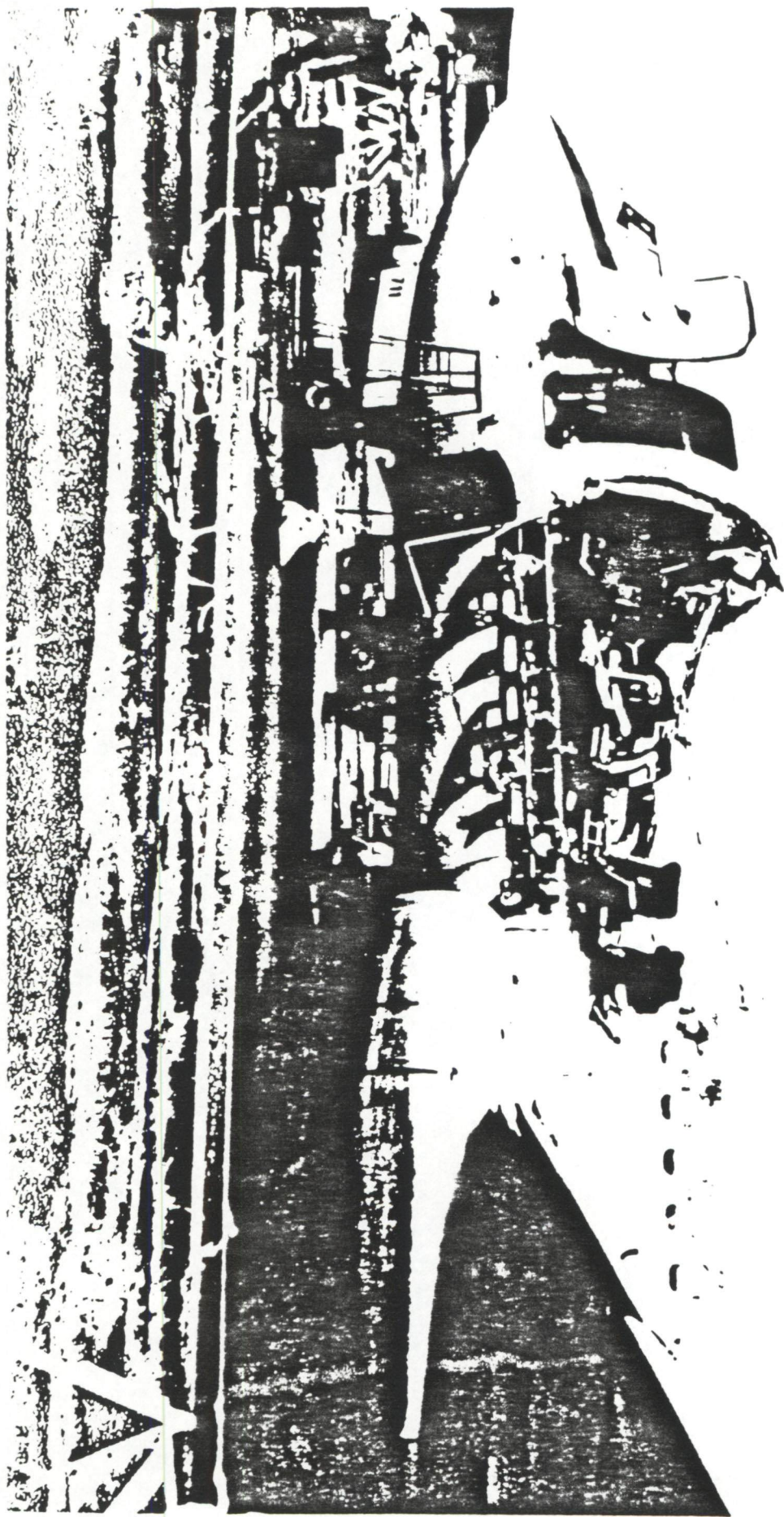


source: U.S. Dept of Commerce Statistics

— 9457 —



1997



CURRENT AERONAUTICS ENVIRONMENT

- U.S. share of global markets has declined in the face of serious foreign competition
 - U.S. technological leadership is eroding
 - Foreign efforts accelerating
- U.S. aviation system is approaching saturation
 - Growth will create increasing strain
- Military-related aeronautical R&T uncertain as DoD budgets decline

**MAJOR NATIONAL ISSUES EXIST WHICH
REQUIRE HIGH LEVEL ATTENTION**

CURRENT AERONAUTICS ENVIRONMENT

SUFFICIENT NATIONAL ISSUES EXIST THAT IT IS APPROPRIATE TO REINSTITUTE THE AERONAUTICS POLICY REVIEW PANEL

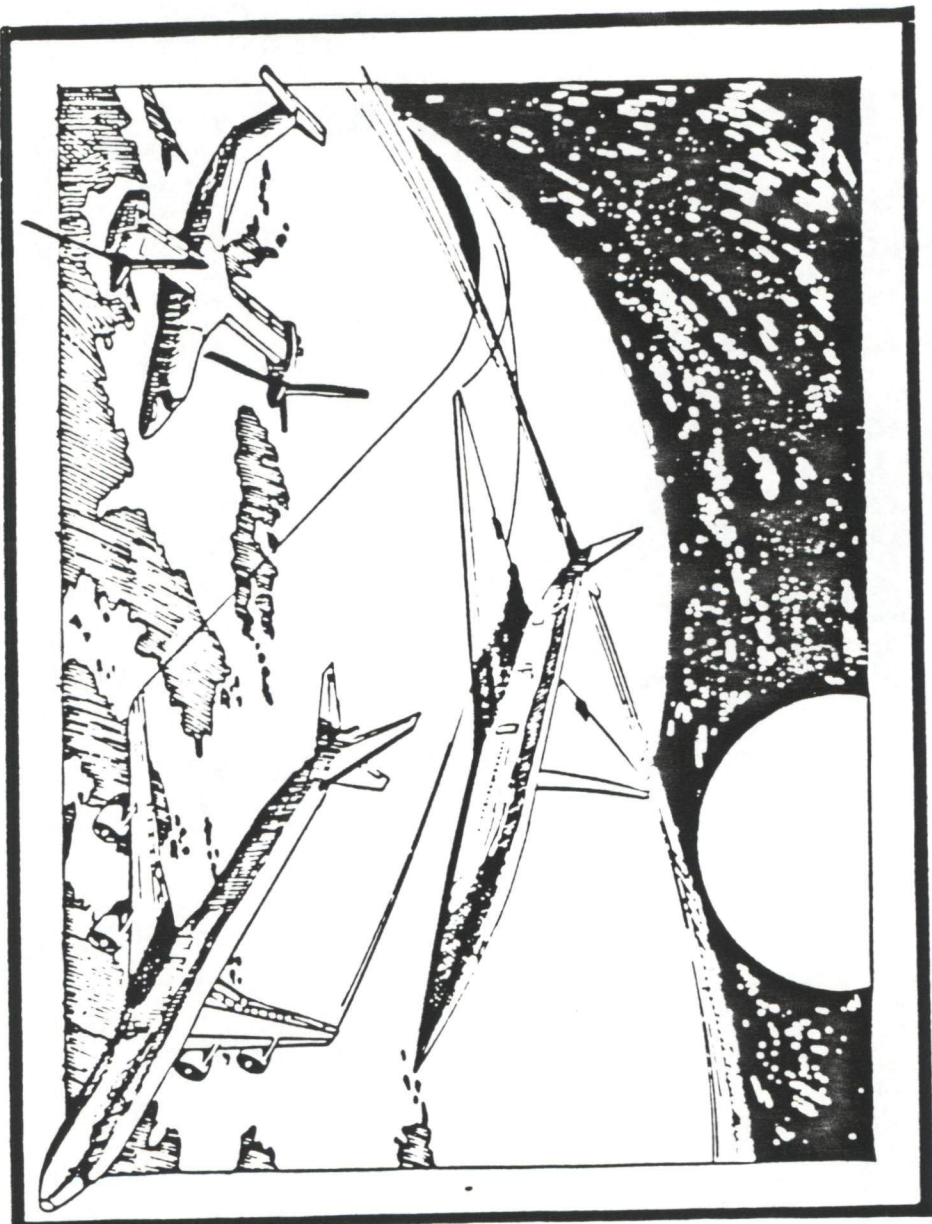
- **IMPLICATIONS OF MAJOR REDUCTION IN DEFENSE SPENDING**
- **U.S. LEADERSHIP IN GLOBAL AIR TRAFFIC CONTROL**
- **ROLE AND IMPORTANCE OF GOVERNMENT RESEARCH IN COMPETITIVENESS**
- **INDUSTRIAL TEAMING FOR NEW AIRCRAFT DEVELOPMENT**
- **NATIONAL APPROACH TO TILTROTOR TECHNOLOGY**

ROLE OF TECHNOLOGY IN COMPETITIVENESS

WHILE TECHNOLOGY LEADERSHIP WON'T GUARANTEE
A SUCCESSFUL AERONAUTICS INDUSTRY, TECHNOLOGY
IS NECESSARY TO ALLOW PARTICIPATION IN A GLOBAL
MARKETPLACE

CIVIL AERONAUTICS TECHNOLOGY DEVELOPMENT AND VALIDATION PLAN

OAEF



Office of
Aeronautics and
Space
Technology

MARCH 1988

CIVIL AERONAUTICS TECHNOLOGY DEVELOPMENT AND VALIDATION PLAN

"NASA IS DIRECTED TO PREPARE A MULTI-YEAR TECHNOLOGY DEVELOPMENT AND VALIDATION PLAN THAT WILL HELP THE UNITED STATES RETAIN ITS LEADERSHIP IN AERONAUTICS RESEARCH AND TECHNOLOGY AND COMPETE IN THE INTERNATIONAL MARKETPLACE FOR FUTURE CIVIL AIRCRAFT. THIS PLAN SHALL BE PREPARED IN COOPERATION WITH PRIVATE INDUSTRY AND SHALL BE DESIGNED TO ASSURE CONTINUED U.S. LEADERSHIP IN FUTURE CIVIL AIRCRAFT MARKETS."

NASA AUTHORIZATION ACT, 1988

SENATE COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION

JUNE 24, 1987

AERONAUTICS TECHNOLOGY NEEDS

ADVANCED TRANSPORTATION HIGH PERFORMANCE AIRCRAFT

HIGH-SPEED RESEARCH (1.7B) ENVIRONMENTAL RESEARCH S.S. LAMINAR FLOW VARIABLE CYCLE ENGINES SUPERSONIC THROUGHFLOW PROP CONFIGURATION INTEGRATION HIGH TEMP COMPOSITES ADV METALLICS & STRUCTURAL CONCEPTS FLY-BY-LIGHT CONTROLS LOW VISABILITY COCKPIT	TILTROTOR & COMMUTER (373M) TILTROTOR DOWNLOAD ALLEVIATION NOISE & VIBRATION REDUCTION AUTOMATED CONTROLS ADV. STRUCTURAL DESIGN CONCEPTS COMMUTER PROP ADV. MATERIALS PRES. COMPOSITE FUSELAGE TECH. VALIDATION ADV. WING & ROTOR TECH. VALIDATION	SUBSONIC RESEARCH (1.6B) ULTRA HIGH BYPASS PROPULSION DRAW REDUCTION FLY-BY-LIGHT CONTROLS CORE ENGINE TECH HIGH-LIFT SYSTEMS HIGH-ASPECT-RATIO WINGS ADV. COMPOSITE WING & FUSELAGE STRUCTURE AIRFRAME/PROP INTEGRATION POWER-BY-WIRE	NEXT GENERATION FIGHTER (325M) HIGH ANGLE-OF-ATTACK STOVL PROPULSION CONCEPTS STOVL INTEG. CONTROLS PROPULSION INDUCED AERODYNAMIC PREDICTIONS STOVL INLETS & NOZZLES AEROACOUSTICS/ AEROTHERMAL LOADS
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AERONAUTICAL RESEARCH AND TECHNOLOGY

~~DAET~~

CAPITAL DEVELOPMENT PLAN 1989 - 1993

- DIRECTED BY NASA FY 1989 AUTHORIZATION LAW (PL100-685)
- MULTI-YEAR BUDGET PLAN SUBMITTED THROUGH OMB
- OUTLINED HIGH PRIORITY AERONAUTICAL TECHNOLOGY INITIATIVES

AERONAUTICS RESEARCH AND TECHNOLOGY

CAPITAL DEVELOPMENT PLAN

(Budget Authority in Millions of Dollars)

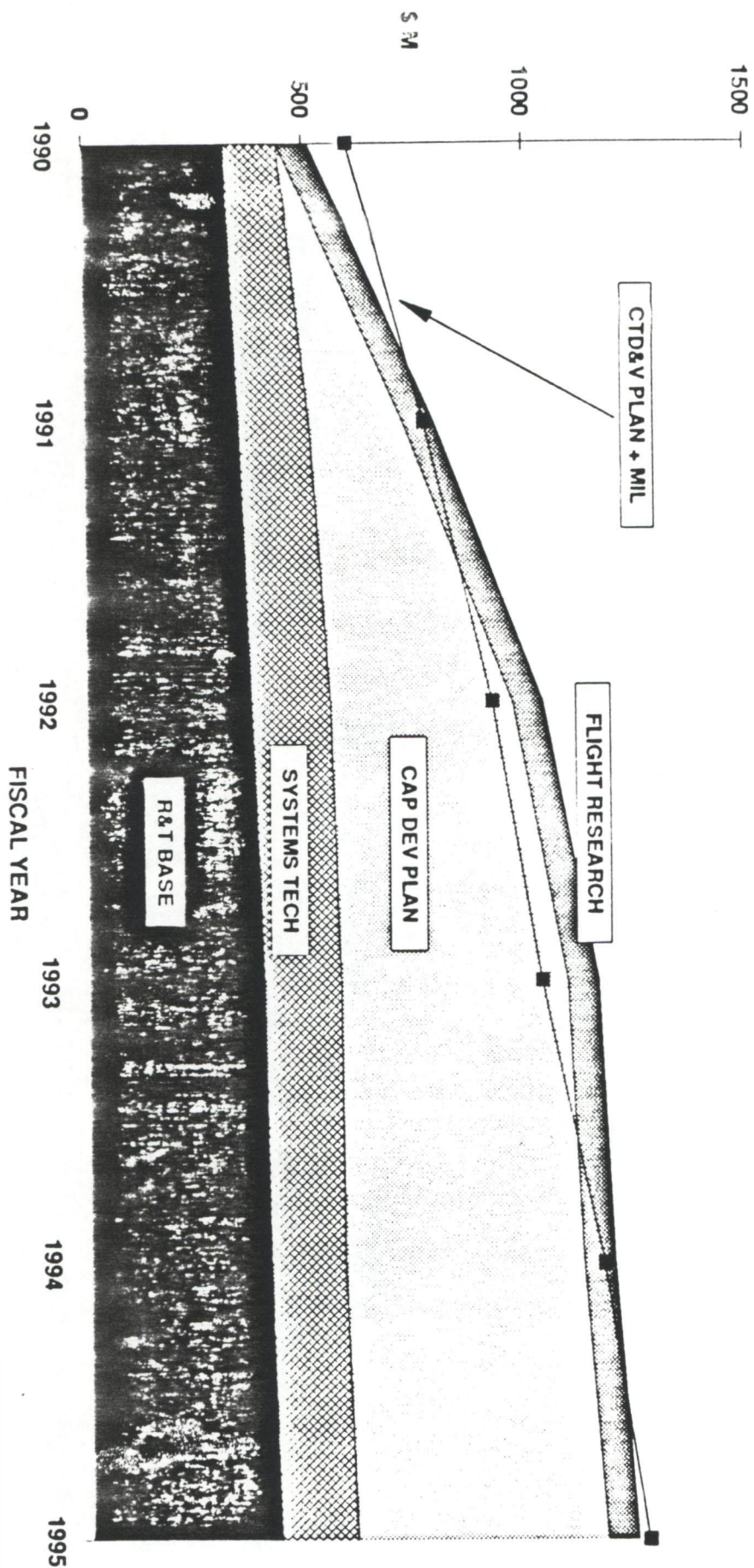
	FY 1989	FY 1990	FY 1991	FY1992	FY 1993	Total
Research and Development Appropriation	-----	-----	-----	-----	-----	-----
Current Program	404	463	502	531	542	2,442
Candidate Initiatives						
Subsonic Technology			20	20	20	60
Supersonic STOVL Technology			20	25	30	75
High Speed Rotorcraft			10	30	35	75
R&T Base Augmentation			30	60	60	150
Advanced Fiber Technology			25	25	25	75
High Performance Computing Initiative			20	35	50	105
High-Speed Research				50	75	125
Advanced Cockpits/Flight Management				15	20	35
Flight Research				5	8	13
Advanced High Temperature Materials Tech.					20	20
Composite Structures					25	25
Hypersonic R&T					20	20
Subsonic Core Engine Technology					20	20
Total Funding	404	463	627	796	950	3,240
Construction of Facilities Appropriation						
Current Program	53	71	57	48	27	256
Candidate Initiatives						
Total Facilities	53	71	88	150	118	480

AERONAUTICS ADVISORY COMMITTEE

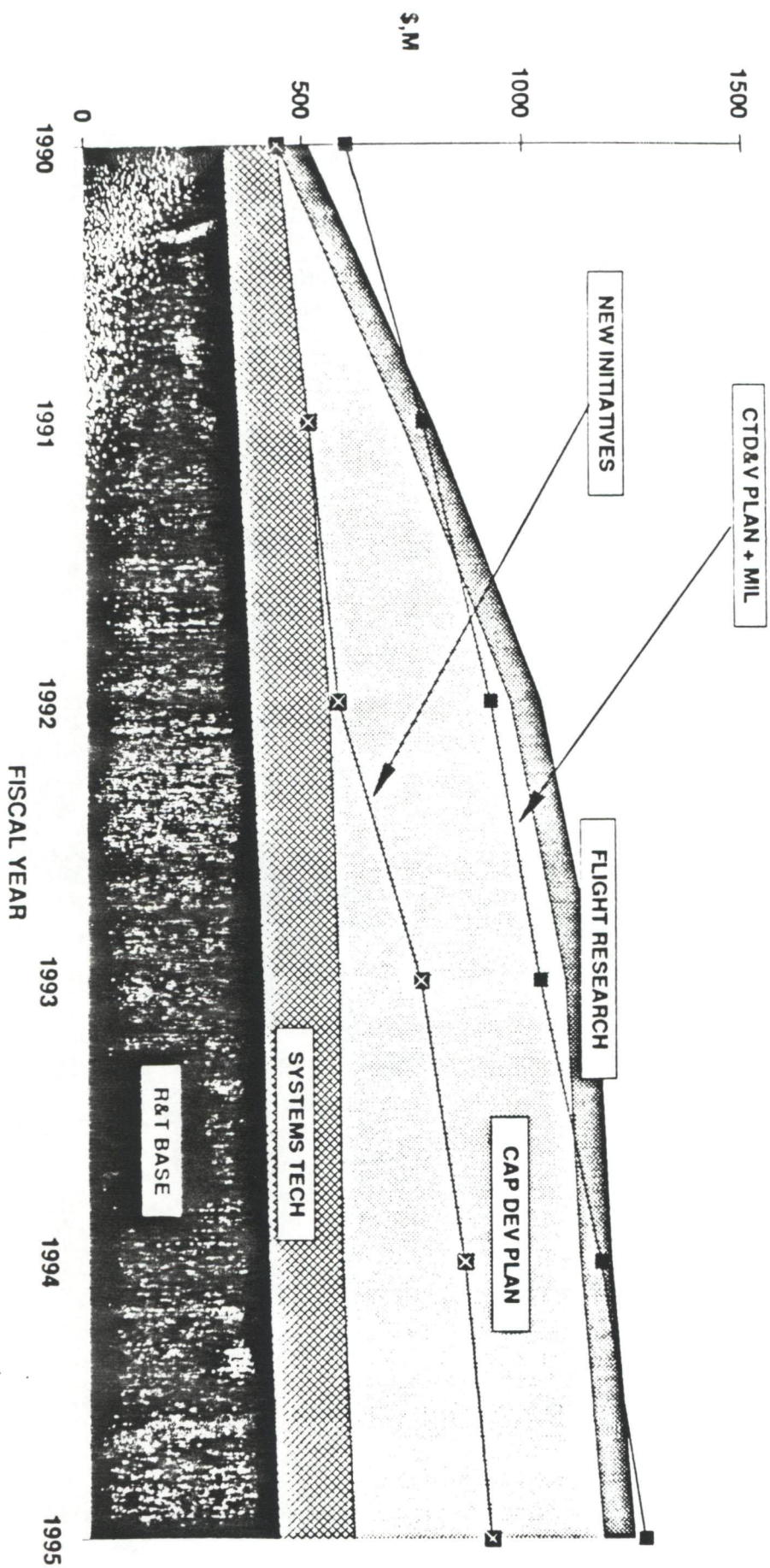
**AD HOC TEAM FOR FLIGHT RESEARCH AND TECHNOLOGY
1989**

- CITES SERIOUS EROSION OF CAPABILITY
- NEGATIVE IMPACT ON NATIONAL STRENGTH IN AERONAUTICS
- RECOMMENDED MINIMUM AUGMENTATION FOR REVITALIZATION
OF \$70M/YEAR
- FINDINGS ENDORSED BY NRC AERONAUTICS AND SPACE
ENGINEERING BOARD

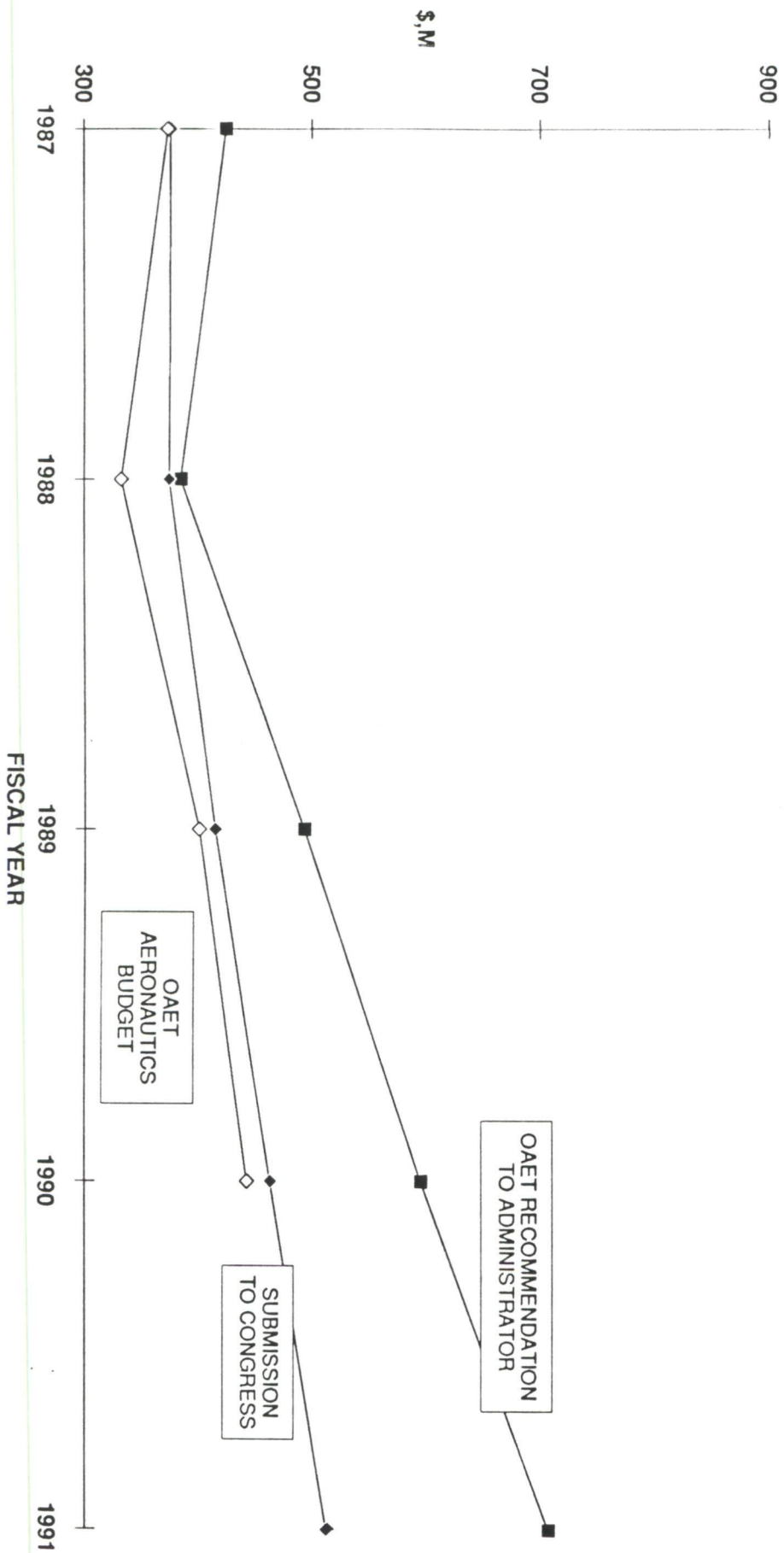
NASA AERONAUTICS R&D



NASA AERONAUTICS R&D



OAET AERONAUTICS R&D BUDGET HISTORY



AFRONAUTICS FY 1991 R&D PREVIEW BUDGET

	FY 1990	FY1991	FY1992	FY1993	FY1994	FY 1995
<u>FY90 PROGRAM RUNOUT</u>	<u>462.8</u>	<u>501.9</u>	<u>531.4</u>	<u>542.4</u>	<u>545.5</u>	<u>567.3</u>
<u>FY 1991 BASELINE ADJUSTMENT</u>		<u>53.0</u>	<u>56.2</u>	<u>59.6</u>	<u>63.2</u>	<u>67.0</u>
<u>FACILITY MAINTENANCE & ADP</u>		53.0	56.2	59.6	63.2	67.0
<u>FY1991 ADDITIONS</u>		<u>130.0</u>	<u>154.8</u>	<u>224.9</u>	<u>270.3</u>	<u>296.1</u>
ADV. SUBSONIC TECHNOLOGY		60.0	78.0	136.2	169.6	198.2
NXT GEN. MEAS. & EXPER VALID		30.0	31.8	33.7	35.7	37.9
ADVANCED FIBER DEVELOPMENT		20.0	20.0	25.0	40.0	40.0
SUPERSONIC STOVL		20.0	25.0	30.0	25.0	20.0
<u>FY1992 ADDITIONS</u>			<u>70.0</u>	<u>100.0</u>	<u>125.0</u>	<u>145.0</u>
HIGH-SPEED ROTORCRAFT			20.0	25.0	25.0	20.0
HIGH-SPEED RESEARCH (Phase II)			50.0	75.0	100.0	125.0
<u>FY1993 AUGMENTATIONS</u>				<u>30.0</u>	<u>31.8</u>	<u>33.7</u>
HYPERSONICS R&T				30.0	31.8	33.7
<u>TOTAL</u>	<u>462.8</u>	<u>604.9</u>	<u>612.4</u>	<u>856.9</u>	<u>1035.8</u>	<u>1189.1</u>
<u>SPECIAL ISSUE</u>		<u>22.0</u>	<u>37.0</u>	<u>53.0</u>	<u>63.0</u>	<u>55.0</u>
HIGH PERF. COMPUTING		22.0	37.0	53.0	63.0	55.0

0497

ADVANCED SUBSONIC TECHNOLOGY (\$,M)

	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>BTC</u>	<u>TOTAL</u>
AERODYNAMICS - VISCOUS DRAG REDUCTION - TILTROTOR AERODYNAMIC ANALYSIS - HIGH-LIFT SYSTEMS TECHNOLOGY - INDUCED DRAG REDUCTION	21.0	22.9	24.9	27.9	29.6	50.0	176.3
SAFETY - SEVERE WEATHER - AGING AIRCRAFT	10.0	10.6	11.2	11.8	12.6	27.3	83.5
FLIGHT SYSTEMS - FLY-BY-LIGHT/POWER-BY-WIRE - ADV. COCKPIT/FLIGHT MANAGEMENT	27.0	32.5	33.1	38.8	45.0	57.0	233.4
PROPULSION - HIGH-TEMP. ENGINE MATERIALS - HIGH-EFFICIENCY CORE ENGINE - TILTROTOR NOISE & VIBRATION RED.	2.0	12.0	42.0	51.0	61.0	167.0	335.0
COMPOSITES VERIFICATION - PRIMARY WING STRUCTURE - PRESSURIZED FUSELAGE - WING/FUSELAGE INTERSECTION - INTEGRATED COMPOSITES DATABASE	-	-	25.0	40.0	50.0	70.0	185.0
TOTAL	60.0	78.0	136.2	169.5	198.2	371.3	1013.2

AERONAUTICS R&T

FY 1990 PREVIEW BUDGET

(\$,M)

~~OAFET~~

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>		
<u>FY 1989 PROGRAM RUNOUT</u>			327.4	414.2	431.5	455.9	469.3	482.1	493.2

FY 1990 ADDITIONS (IN PRIORITY ORDER)

- BASELINE ADJUSTMENTS

	<u>6.4</u>	<u>4.2</u>	<u>4.4</u>	<u>2.3</u>	<u>2.5</u>
NEW LARC CHARGING ALGORITHMS	2.0	2.1	2.2	2.3	2.5
ROTARY ENGINE	2.0	2.1	2.2	-	-
REVITALIZATION PROGRAM ADJUST.	2.4	-	-	-	-

- FY 1990 AUGMENTATIONS

	<u>158.0</u>	<u>282.0</u>	<u>385.0</u>	<u>438.0</u>	<u>416.0</u>
SUBSONIC TRANSPORT TECH. DEVEL.	60.0	90.0	129.0	176.0	184.0
HIGH-PERFORMANCE AIRCRAFT TECH. DEVEL.	23.0	32.0	37.0	30.0	23.0
HIGH-SPEED CIVIL TRANSPORT TECH. DEVEL.	40.0	104.0	147.0	154.0	144.0
TILTROTOR/COMMUTER TECHNOLOGY DEVEL.	15.0	21.0	22.0	18.0	20.0
HIGH-PERFORMANCE COMPUTING INITIATIVE	20.0	35.0	50.0	60.0	45.0

TOTAL FY 1990 BUDGET..... 595.9 742.1 858.7 922.4 911.7

AERONAUTICS R&T FY 1990 CONGRESSIONAL BUDGET (\$,M)

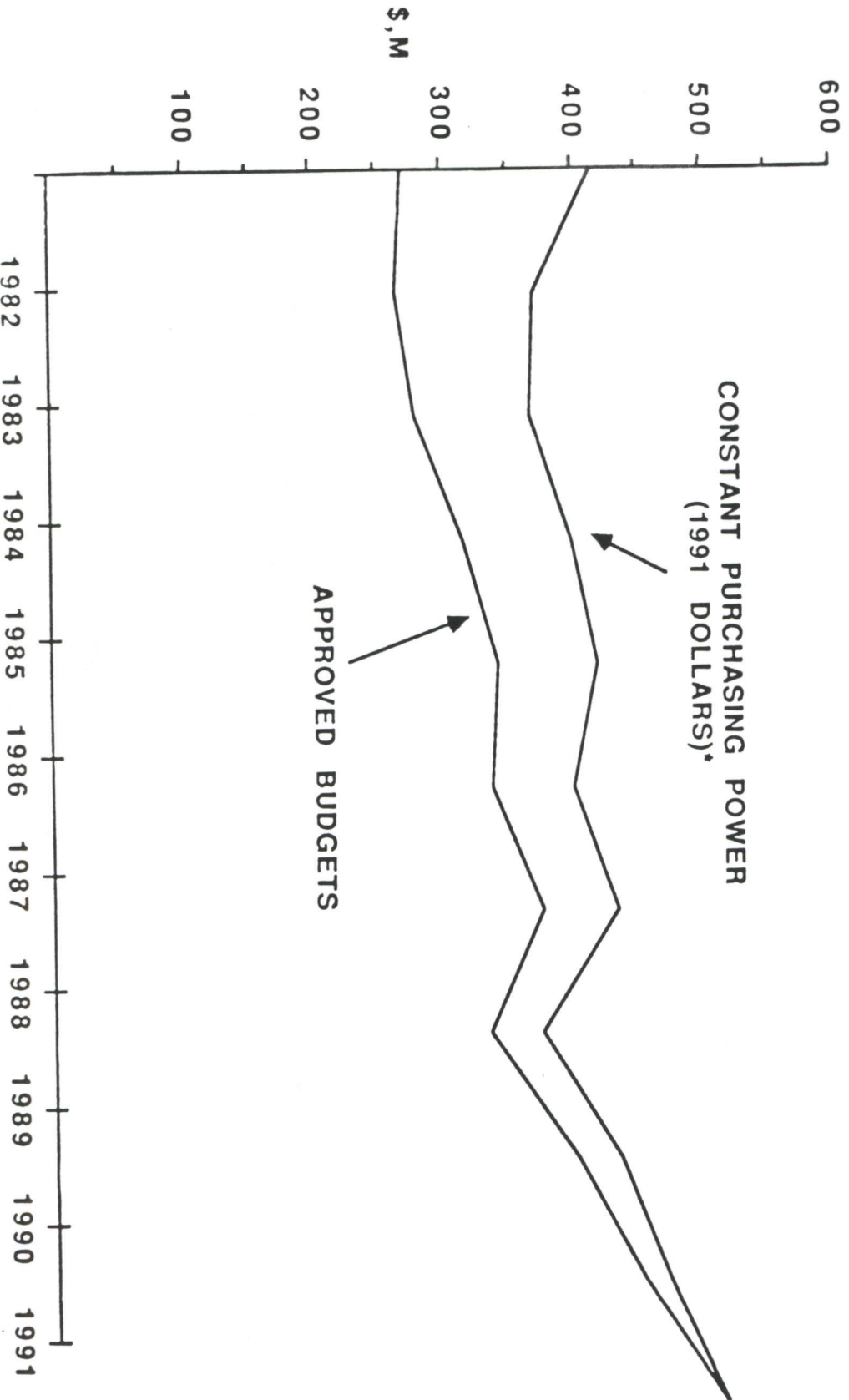
GAET

	<u>1990</u>
<u>FY 1989 PROGRAM RUNOUT</u>	431.5
● <u>PROGRAM ADJUSTMENTS</u>	<u>6.3</u>
WIND TUNNEL REVITALIZATION PROGRAM REALIGNMENT FROM CoF	(+2.4)
HIGH-PERFORMANCE AIRCRAFT RESEARCH	(+8.0)
ACADEMIC PROGRAM (CONSOLIDATION)	(-6.1)
HIGH PERFORMANCE COMPUTING	(+2.0)
● <u>FY 1990 AUGMENTATIONS</u>	<u>25.0</u>
HIGH-SPEED RESEARCH	(25.0)
TOTAL FY 1990 BUDGET.....	462.8

AERONAUTICS R&T PROGRAM EFFECTS OF INFLATION

OASD

(1982 - 1991)

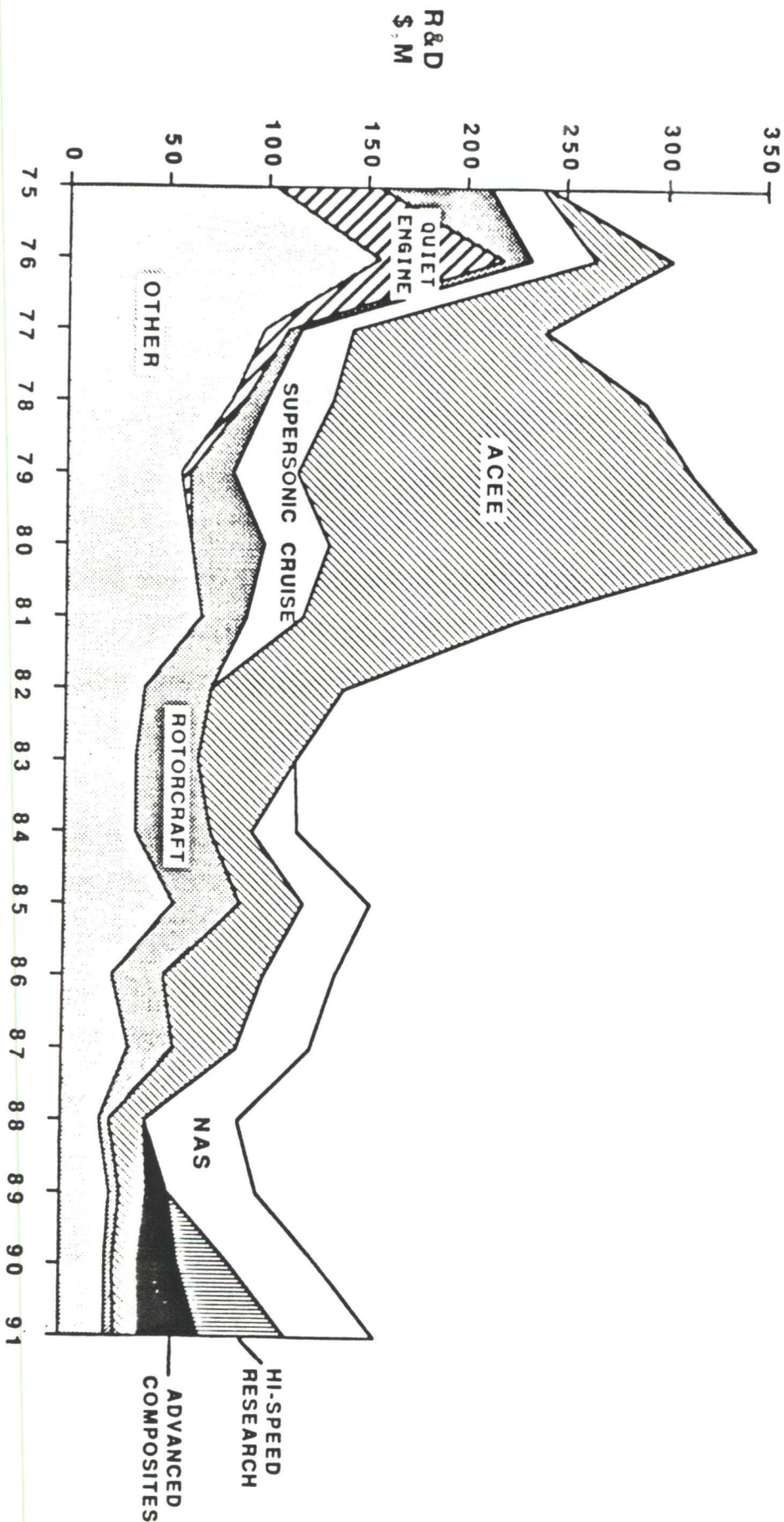


* GNP PRICE INDEX

NASA AERONAUTICS SYSTEMS TECHNOLOGY FUNDING

OAEJ

(In Constant 1991 Dollars)



OAEI

**FY 1992 BUDGET
AERONAUTICS R&T
(\$,M)**

	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>
<u>FY 1991 PROGRAM RUNOUT</u>	<u>512.0</u>	<u>554.5</u>	<u>575.1</u>	<u>580.2</u>	<u>604.1</u>	<u>543.7</u>
<u>PROGRAM ADJUSTMENT</u>						
- HIGH SPEED RESEARCH - ENABLING PROPULSION MATERIALS		+16.5	+39.8	+58.5	+50.0	+40.0
<u>FY 1992 AUGMENTATION</u>						
- ADVANCED SUBSONIC TECHNOLOGY		+15.0	+45.0	+72.4	+87.3	+88.9
<u>TOTAL FY 1992 BUDGET</u>		<u>586.0</u>	<u>659.9</u>	<u>711.1</u>	<u>741.4</u>	<u>672.6</u>

CONCLUSIONS

- HIGH LEVEL ATTENTION NEEDED ON IMPORTANT NATIONAL NEEDS IN AERONAUTICS
- HIGH PRIORITY AERONAUTICS TECHNOLOGY OPPORTUNITIES ARE CONSTRAINED BY BUDGET LEVELS
- NATIONAL PLANS TO MAINTAIN U.S. LEADERSHIP ARE DEFINED
- STRONG SUPPORT FOR APPROPRIATE LEVEL OF INVESTMENT IS NEEDED

Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01. Report	Consolidated Trip Report: NASA Tour of Soviet Aeronautical Facilities (16 pp.)	6/1/90	(b)(1)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: O'Neil, John F., Files
Subseries: Government Organization Files
WHORM Cat.:
File Location: NASA - Aeronautics Policy [4 of 4]

Date Closed: 5/27/2010	OA/ID Number: 62098-002
FOIA/SYS Case #: 2005-0336-F	Appeal Case #:
Re-review Case #:	Appeal Disposition:
P-2/P-5 Review Case #:	Disposition Date:
AR Case #:	MR Case #:
AR Disposition:	MR Disposition:
AR Disposition Date:	MR Disposition Date:

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
P-3 Release would violate a Federal statute [(a)(3) of the PRA]
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [(a)(5) of the PRA]
P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
(b)(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
(b)(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
(b)(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

**Office of
Aeronautics,
Exploration and
Technology**

NASA-SOVIET AERONAUTICAL DISCUSSIONS

**PRESENTATION TO
DR. ALLAN BROMLEY
ASSISTANT TO THE PRESIDENT FOR SCIENCE AND TECHNOLOGY**

**Dr. Robert Rosen
Deputy Associate Administrator
December 20, 1990**

1990 NASA-SOVIET AERONAUTICAL ACTIVITIES SUMMARY

~~OAEI~~

- IN JUNE, A SENIOR NASA DELEGATION WENT TO THE SOVIET UNION TO:
 - Tour Soviet aeronautical facilities
 - Ascertain the state of Soviet aeronautical research
- WE FOUND THAT THE SOVIET RESEARCH CAPABILITY IS IMPRESSIVE
- IN OCTOBER, NASA INVITED THE SOVIETS TO THE U.S. TO:
 - Tour NASA aeronautical facilities
 - Discuss areas of potential mutual interest
- NASA BELIEVES IT BENEFICIAL TO DEFINE AREAS FOR COOPERATION

1990 NASA TOUR OF SOVIET AERONAUTICAL FACILITIES

OAET

DELEGATION MEMBERS:

NASA HEADQUARTERS

Dr. Robert Rosen, OAET Deputy Associate Administrator
Martin Stein, Director for Institutions
John McCarthy, Deputy Director for Aeronautics
Jennifer Clapp, Chief, International Program Policy Office
Lavonne Parker, International Affairs Officer

LANGLEY RESEARCH CENTER

Richard Petersen, Director
Dennis Bushnell, Associate Chief, Fluid Mechanics Division
Dr. James Starnes, Assistant Chief, Structural Mechanics Division

LEWIS RESEARCH CENTER

Dr. John Klineberg, Director
Neal Saunders, Director of Aeronautics

AMES RESEARCH CENTER

Dr. Dale Compton, Director
Dr. James Arnold, Chief, Thermosciences Division
Kenneth Szalai, Chief, DFRF Research Engineering Division

Natalie Latter (Interpreter)

1990 NASA TOUR OF SOVIET AERONAUTICAL FACILITIES

~~SECRET~~

ITINERARY:

MAY 28 a.m.	Met with Dep. Minister of Aviation Industry (V. Chuiko)
p.m.	Toured Central Institute of Aviation Motors (TSIAM)
May 29	Toured Central Aero-Hydrodynamics Institute (TSAGI)
May 30	Toured TSIAM/Turaevo
May 31 a.m.	Toured All-Union Institute of Aviation Materials (VIAM)
p.m.	Toured Flight Research Institute (LII)
June 1	Met with Minister of Aviation Industry (A. Systov)

1990 NASA TOUR OF SOVIET AERONAUTICAL FACILITIES

~~OAET~~

IMPRESSIONS:

- MAJOR FACILITIES INSPECTED WERE IMPRESSIVE
 - Extensive capability
 - Well-maintained
 - Analog (vs. digital) equipment
- NO MAJOR TECHNICAL SURPRISES
 - Good quality research
 - Only a limited view however
- SOVIETS ATTEMPTED TO BE OPEN
- SOVIETS VERY INTERESTED IN COOPERATION OF ANY KIND
 - Wanted to visit NASA's Aero. Research Centers in October

1990 SOVIET TOUR OF NASA AERONAUTICAL FACILITIES

DELEGATION MEMBERS:

Victor Chuiko, Deputy Minister of Aviation Industry (Head)

Alexander Batkov, Department Head, Ministry of Aviation Industry

German Zagainov, Director, Central Aero-Hydrodynamic Inst. (TsAGI)

Donat Ogorodnikov, Director, Central Inst. of Aviation Motors (TsIAM)

Vladimir Raschupkin, Department Head, TsIAM

1990 SOVIET TOUR OF NASA AERONAUTICAL FACILITIES

ITINERARY:

Oct. 17	Toured Ames/Dryden Flight Research Facility
Oct. 18-19	Toured Ames Research Center
Oct. 22-23	Toured Langley Research Center
Oct. 23-24	Toured Lewis Research Center
Oct. 25	Held discussions at NASA Headquarters

1990 SOVIET TOUR OF NASA AERONAUTICAL FACILITIES

GAET

AREAS OF MUTUAL INTEREST:

- **TRANSITION AND TURBULENCE**
- **TURBINE DISK LIFE PREDICTION**
- **CHEMICALLY REACTING FLOWS**
- **AIRCREW HUMAN FACTORS AND AVIATION SAFETY**
- **THERMAL PROTECTION SYSTEM MATERIALS**
- **ANISOTROPIC ANALYSIS OF COMPOSITE STRUCTURES**

Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
02. Memorandum	To: Karl Erb From: Michelle Van Cleave Re: National Defense Section of FY92 R&D Budget Presentation (8 pp.)		(b)(1)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: O'Neil, John F., Files
Subseries: Government Organization Files
WHORM Cat.:
File Location: NASA - Aeronautics Policy [4 of 4]

Date Closed:	5/27/2010	OA/ID Number:	62098-002
FOIA/SYS Case #:	2005-0336-F	Appeal Case #:	
Re-review Case #:		Appeal Disposition:	
P-2/P-5 Review Case #:		Disposition Date:	
AR Case #:		MR Case #:	
AR Disposition:		MR Disposition:	
AR Disposition Date:		MR Disposition Date:	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
P-3 Release would violate a Federal statute [(a)(3) of the PRA]
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [(a)(5) of the PRA]
P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
(b)(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
(b)(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
(b)(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

DRAFT

OFFICE OF SCIENCE AND TECHNOLOGY POLICY

CHARTER

AERONAUTICAL POLICY REVIEW COMMITTEE

1. Committee's Official Designation:

Aeronautical Policy Review Committee (APRC)

2. Objectives and Scope of Activities and Duties:

The purpose of the Aeronautical Policy Review Committee is to review for the Director, Office of Science and Technology Policy (OSTP), the implementation of national aeronautical research and technology policy. The Committee will address the National Aeronautical R&D Goals proposed by the Committee in 1985, 1987, and 1988, and to consider implementation strategies thereof, in concert with the goals and technical objectives of the National Aeronautics and Space Administration, the Department of Defense, and Federal Aviation Administration, and the aeronautical industry.

The Committee shall advise on specific aeronautical issues assigned by the Director, OSTP, and keep him informed of changing perspectives in the aeronautics community.

The Committee shall report annually the results of this review to the Director, OSTP.

3. Duration:

The Committee will terminate on January 21, 1993, unless sooner extended.

4. Official to Whom the Council Reports:

The Aeronautical Policy Review Committee will report to the Director, OSTP.

5. Agency Responsible for Providing Necessary Support for this Council:

Office of Science and Technology Policy.

6. Description of Duties:

The duties of the Committee are solely advisory and are stated in paragraph 2 above.

DRAFT

7. Costs:

The estimated annual operating cost of the Committee is ____.

8. Estimated Number and Frequency of Meetings:

The Aeronautical Policy Review Committee shall meet semiannually and at such other times as may be called by the Chairman.

9. Subgroups:

Subgroups may be formed to conduct studies on specific issues assigned by the Director, OSTP.

10. Members:

Committee members shall be appointed by the Director, OSTP. That appointment shall be subject to review every 365 days unless terminated earlier. The Committee shall consist of no more than 17 members. The Director, OSTP, shall appoint a Chairman and Vice Chairman from the members of the Committee.

The Committee shall utilize additional technical experts as needed to constitute its panels and study groups. These technical experts shall be appointed by the Director, OSTP, and shall be for the duration of the panel upon which the expert serves, or 365 days, whichever is sooner, unless terminated earlier by the Director.

This Charter for the Advisory Committee named above is hereby approved on:

Date: _____

Barbara Ann Ferguson
Committee Management Officer

Date filed: _____

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY

WASHINGTON, D.C. 20506

November 5, 1991

Dear Brad;

I wish to thank you for the assistance you've provided me over the past year concerning aeronautics policy generally and aeronautics priorities for 1990's specifically. Much of your advice and expertise is reflected in the numerous aeronautics issue papers I've produced for OSTP all of which will hopefully contribute to reestablishing the Aeronautics Policy Review Committee.

From a personal standpoint I strongly encourage the AIAA to continue playing a major role in defining our country's future aeronautics agenda and in particular exploring the most productive balance of aeronautics R&D as between industry, government, and academia. In that vein I personally support your efforts to convene a symposia on the impact of legislation on our country's competitiveness in aeronautics.

Stay in touch and good luck with law school.

Rich E. Gininger

Public Policy Symposia
Legislative Impact on Aeronautical Competitiveness

Purpose: The House of Representatives Subcommittee on Technology and Competitiveness was recently formed with oversight of the NASA Aeronautics R&T budget. The Subcommittee is interested in developing a better understanding of the impact of legislation on our competitiveness in aeronautics. The Subcommittee acknowledges that aeronautics contributes a significant positive trade balance and has a positive effect on the US economy in general.

Audience: Members of the Technology and Competitiveness Subcommittee, Technology and Competitiveness Staff, other Members of the House of Representatives, and other Congressional staff. The audience also includes representatives from the Legislative Offices of many aeronautics manufacturers, airlines, and others.

Agenda:

Civil Aeronautics and the Economy: An Overview

Four panelists from industry will present an analysis of the economic impact of civil aeronautics. The panelists will describe market projections for civil aircraft sales, the economic effects on the domestic economy, including employment and revenue generation. Panelists will also discuss the impact of civil aeronautics sales on the balance-of-trade. The impact of the trade balance on job and revenue creation will be discussed. Panelists will also examine economic predictions for the size of the civil aeronautics market in the year 2005. The analytical methodologies used will be briefly described.

The Civil Aeronautics Industry in the Year 2005: A Projection

Four panelists will examine trends in technology development, market expansion, and other factors to develop a vision of the civil aeronautics industry in the year 2005. Panelists will address the impact of new products such as a High-Speed Civil Transport, a Civil Tilt-Rotor, and other new technologies on the industry in the year 2005. Opportunities and limitations set by the aeronautics infrastructure projected for the year 2005 will also be discussed, including: capacity limitations, facilities to support Civil Tilt-Rotor, and the air-ground transportation interface.

The Internationalization of the Aeronautics Industry: Competition and Cooperation

Four panelists will provide an overview of the growth of the international aeronautics industry and the size of the international competition. Panelists will give special attention to European and Japanese activities and will project the likely impact of the international marketplace on the industry through the year 2005. The panel will also identify current modes of competition and cooperation in aeronautics. Topics will include the Civil Aircraft Agreement and the General Agreement on Tariffs and Trade.

Investing in the Future: Implications of the World Financial Outlook

Four panelists will examine the relationship between private investment in aeronautics and the ability and interest of the financial markets to support this activity. Investment mechanisms will be examined for their ability to: support basic competitiveness, invest in infrastructure modernization and expansion, and finance industrial expansion to meet future market demands. Private mechanisms will be contrasted with those mechanisms used by governmental agencies in other nations.

Cooperative Consortia: Balancing Anti-Trust and Competitiveness

Four panelists will discuss the implications for R&D and production consortia and their underlying rationales and potential economic and market impacts. Discussion will also examine existing Anti-Trust considerations and their applicability to the aeronautics R&D and/or production consortia under discussion. Discussions will examine existing consortia such as SEMATECH and the NASP teaming arrangement.

Implications of Legislative Actions: Deregulation—A Case Study

Airline deregulation had a significant impact on the civil aeronautics market. Reduced fares and restructured airline service served to stimulate air travel, and consequently, demand for civil aircraft. At the same time, numerous smaller airlines have been absorbed into so-called "mega-carriers" and other established airlines have been forced out of business. A four member panel will examine these issues as a case study of the impact of Congressional legislation on the aeronautics industry.

Government Policy and Competitiveness: Constructing a Dialogue

Four panelists will discuss the various opportunities for government investment and key enabling policies in the areas of environmental regulation (emissions and noise) financial regulation, airline regulations, and infrastructure improvements.

Gene Wong
11/27/91

Reasons for Reactivating the Aeronautical Policy Review Committee

Introduction

There are signs that the U.S. aerospace companies are unable to make individually the investment in research and development that will be necessary to keep the U.S. the leading nation in aeronautics in the 21st Century. There are at least three causes for the investment deficiency and these are briefly stated below.

Impact of Reduced Defense Spending

The commercial and defense segments of the aeronautical industry have always be mutually dependent. The very large investment needed for product development and the severe fluctuations in market demand have made a large revenue base essential to providing the necessary investments for research and development. In light of the projected reductions in defense procurement the revenue stream for the aeronautics industry may be inadequate to support the required R&D investment. In order to ensure that critical R&D efforts continue, a strategy that coordinates the federal and private investments will be necessary.

Escalating Cost of R&D

The cost of cutting edge technology development escalates at a rate faster than inflation. This is certainly true in aeronautics, where the development of a new generation of aircraft requires major advances in materials, engines, and design methodology. Given the research progress of the recent past, these advances are distinctly possible, but their development into production stage technologies will require large investments. The spectrum of activities that spans research to production is very wide, and involve roles that are both pre-competitive and competitive. How to coordinate public and private investments to gain the greatest leverage without preempting free-market forces is a challenging task.

Increased Foreign Competition

Pressure from foreign competition is a new reality for the American aeronautics industry. The success of Airbus Industries in gaining a large share of the world civil aviation market was stunning. Projection of a high growth rate in the Pacific routes renders it almost inevitable that Japan and the Pacific Rim nations will target the aeronautics industry as a major area for investment in the next century. Initiatives for such investments are beginning. Examples include the recently announced sale of a large minority position in Douglas Aircraft Division of McDonnell Douglas, the FSX deal with Japan, and the MITI consortium in supersonic engine development. Implications of the foreign competition on R&D strategy is not clear. It may well be that joint international efforts in funding major R&D projects are inevitable and desirable. It is an issue that needs early consideration.

Objectives of APRC

Under the circumstances, there is a need for a broad review of the current R&D policies of the U.S. Government with the following objectives:

- a. A projection and prioritization of the major R&D requirements for the next decade.**
- b. An identification of the likely sources of funding for the required R&D, and appropriate means for optimizing the investment.**
- c. A determination of the appropriate respective roles for government, industry, and academia in carrying out the required R&D functions.**
- d. Finding ways to more tightly couple the R&D functions to their ultimate application in product development.**

RICK E. YANNUZZI
WHITE HOUSE OFFICE OF SCIENCE AND TECHNOLOGY POLICY
REMARKS PREPARED FOR DELIVERY
AIAA ANNUAL MEETING
CRYSTAL CITY, VIRGINIA
APRIL 30, 1991

Ladies and Gentlemen:

I have been asked this afternoon to discuss aeronautics issues that affect the AIAA, and to offer insights into the policy process that the President's Science Advisor, Dr. Bromley, has established in the White House Office of Science and Technology Policy to help formulate and coordinate aerospace policy at the Federal level.

Among those of you in the aerospace community who have been OSTP watchers it is well known that the office has had a long-term interest in aerospace issues. Through the 1980's probably the two most visible signs of this interest were the Aeronautics Policy Review Committee and the National Aerospace Plane. Under Dr. Bromley's tenure OSTP's involvement in aerospace issues has continued. This interest has been stimulated by Dr. Bromley's membership on the National Space Council and his chairmanship of the interagency council that developed the Global Change Research Program of which NASA's Earth Observing System is a critical element.

But from a broader perspective OSTP's increasing involvement in

aeronautics and astronautics reflects both their ultimate importance to the security of the US, and the tremendous contribution they make to our economy. And, because of his position as Assistant to the President for Science and Technology, Dr. Bromley has unique responsibilities in both areas.

AEROSPACE AND NATIONAL SECURITY

The timing of this conference provides an excellent opportunity to reflect on the importance of aerospace to our national security, and to strongly endorse the steps being taken to maintain our preeminence in aerospace defense systems for the future. No two events better reflect the contributions of aerospace to our national defense, both past and future, than Desert Storm and the awarding last week of the contract to build the Air Force's Advanced Tactical Fighter.

Throughout the Persian Gulf War the world watched in amazement as US military forces launched thousands of air attacks against Iraqi military targets with devastating effectiveness and yet suffered astonishingly few losses. This remarkable achievement is a tribute to the detailed planning and precise execution of an air campaign that involved thousands of disciplined and well-trained service men and women.

However, as was obvious to anyone watching the progress of the Gulf

war on CNN the effectiveness of our forces relied heavily on the qualitative superiority of the weapons that were employed throughout the air campaign. The importance of these weapons to the overall success of the war cannot be overstated. Their performance not only met or exceeded expectations, but in doing so they became powerful political symbols as was witnessed with the rapid deployment of the Patriot missile to Israel.

The media clearly developed favorites among the US weapons used in the Gulf, but only when these systems are viewed in their totality can the American people gain an appreciation of what the last two decades of investment in defense research and development have produced. Probably among the most critical but most easily overlooked array of defense systems used in the war was our constellation of space reconnaissance, communication, and navigation satellites. They were quite literally the eyes, ears, and compass of our Persian Gulf forces.

The performance of these and many other US weapons during the war is a direct result of decisions made in years past to harness American technical ingenuity and creativity, and develop military systems of unparalleled capabilities and quality. Costly though some were, these systems have saved the lives of many US servicemen as well as countless numbers of civilians. As the US enters the 1990's our military forces must maintain the qualitative

superiority that was so much in evidence throughout the Gulf war.

It is in recognition of the importance of technology to national security that Dr. Bromley has strongly advocated that basic and applied research in defense technologies continue to be well funded even during a period of overall decline in the defense budget. His support of a strong defense R&D base reflects a belief best expressed in a Defense Science Board report that stated "The effectiveness of our strategy of deterrence depends upon our ability to maintain technological superiority and our adversaries belief in that ability. When our ability is questioned, our deterrent is diminished and the threat of war increases."

THE ADVANCED TACTICAL FIGHTER

Symbolic of this country's commitment to equip our future military forces with technologically superior weapon systems was the announcement last week of the winner of the Advanced Tactical Fighter competition. As the size of our air forces contract in the 1990's it is essential that in any future conflict we possess aircraft capable of quickly achieving and maintaining air superiority.

The global air environment of the 21st century will undoubtedly see many countries with advanced fighter aircraft similar to our frontline aircraft used in the Gulf War. While the Gulf

performance of the F-15, F-16 and other aircraft were impressive, one must recognize that they reflect technologies that are over 20 years old. The latest generation of Soviet fighters as well as those being developed elsewhere in the world match and in some cases exceed the capabilities of many of our current fighters. Moreover, because of the rapid proliferation of low observable technologies worldwide many of these aircraft are likely to eventually incorporate some level of signature reduction.

In order to ensure that in any future conflict we can repeat the performance of our air forces in the Gulf war, it is essential that we take the next quantum leap in fighter technology. The ATF's combination of stealth, agility, speed, and advanced avionics ensures that our future pilots will be equipped with aircraft of unquestioned superiority well into the next century.

THE NATIONAL AEROSPACE PLANE

Another example of this country's commitment to maintain our preeminence in aerospace is the X-30 National Aerospace Plane, a research vehicle that represents the growing convergence of aeronautics and astronautics technologies. As many of you know the NASP is closely associated with OSTP because of the transatmospheric goal established by the OSTP chartered Aeronautics Policy Review Committee in 1985. And, I think it would be fair to say that in the intervening six years the office's view of the

importance of the program has grown significantly.

This is partly because the NASP program embodies several critical policy objectives that are consistent with Dr. Bromley's emphasis on the "T" in OSTP. First, the NASP is fundamentally a precompetitive R&D program to advance critical generic technologies that promise broad application in both the defense and commercial realms. Second, the program is comprehensive in scope. By that I mean it does not merely stop at technology development -- otherwise know as Phase 2 -- but extends into technology validation and flight testing.

In order for the US to reap the benefits of Phase 2 and establish clear dominance in hypersonic vehicle design we must validate the technology through flight testing. The flight test program will have the net effect of elevating the discoveries that occur in Phase 2 to a risk-acceptable level of readiness. At the conclusion of the X-30 test program industry will then have the opportunity to exploit these proven technologies for product application and production.

The NASP is a sterling example of government-industry cooperation that strengthens and preserves US leadership in an area that is under increasing challenge particularly in many of the technologies underlying aeronautics. The unique teaming arrangement among the five prime contractors is structured to ensure that in the future

the US aerospace industry will have at least five companies competent in air-breathing hypersonic vehicle design and development.

The government-industry relationship is also distinctive in that government laboratories and research centers have responsibility for explicit pieces of work on the programs main development path. This transfer of government technology and expertise to industry symbolizes the type of cooperation that OSTP hopes to foster more of in the future. Clearly, OSTP is very excited about the teaming arrangement, but I should note that this novel approach is not without its critics. Some have been concerned that the teaming arrangement would work as a disincentive to creativity because competition is removed. That is something we will want to watch and evaluate carefully. But if the NASP teaming arrangement proves the critics wrong we hope that industry take notice of the lessons learned from the program and apply them to other precompetitive R&D projects.

Overall, OSTP remains a dedicated supporter of the NASP program. In his role as both a member of the Space Council and as an honorary member of the NASP Steering Group, Dr. Bromley has and will continue to stress the importance of the program. We are confident that with his backing combined with the solid support expressed by NASA and DoD at Congressional NASP hearings last month we will see the X-30 flying before the year 2000.

US TECHNOLOGY POLICY AND THE AEROSPACE INDUSTRY

I would like to turn my attention now to the central theme of today's session of the AIAA annual meeting -- that of aeronautics - - and more to the point, summarize for you those policy initiatives that OSTP has undertaken which will affect the aeronautics community.

Let me begin by saying that OSTP is keenly aware of the importance of a healthy aeronautics industry to both our country's economic vitality and our national security. We closely monitor the domestic and international competitive pressures you face and are especially proud of the fact that yours is one of the few US industries that retains a substantial positive trade balance.

From OSTP's vantage point we see a diverse, vigorous, and robust industry founded on a strong enduring partnership among the Federal government, industry, and academia. These relationships have been key to our nations preeminence in civil and military aviation. However, the synergy between excellence in aeronautics and national prestige has not gone unnoticed elsewhere in the world.

Europe in particular already poses a significant competitive challenge to our large civil transport industry. In less than ten years our market share has dropped from over 90 percent to 70

percent. Over that same period the industrial supplier base has decreased by hundreds of small to mid-size firms. More recently I was surprised to read in a Department of Commerce newsletter that in 1990 the US became for the first time a net importer of aircraft gas turbine engines! Other portions of civil aviation such as general aviation and rotocraft have fared even worse. Of equal concern is that both Europe and Japan are targeting and making large investments in future markets such as the high-speed civil transport market.

The overall picture we see then is of a domestic aviation industry undergoing major change. On the home front the reductions in military spending will likely lead to a significant restructuring of the industry. Internationally, long-term competitive pressures will grow to an extent that one of our industry's few areas of comparative advantage will be the proficiency of its technology. It is therefore in the national interest that we maintain that technological edge.

In this context, the historical role that NASA has played in aeronautics research and technology validation is especially vital to ensuring continued US leadership in aviation. Therefore, I strongly support such NASA initiatives as their High-Speed Research Program which seeks to develop the technologies that will make supersonic commercial air travel both environmentally safe and economical. But I also feel that NASA as well as other Federal

agencies have a broader responsibility to advance those critical technologies upon which many sectors of our economy depend.

Symbolic of the importance which OSTP and other Federal Agencies and departments place in these critical technologies is a government-industry report which the President transmitted to Congress last week. The National Critical Technologies Report identifies 22 technologies that are of crucial importance to our economy and national security. The technologies fall into six broad categories one of which includes aeronautics. The specific areas cited as critical to maintain our leadership in aeronautics are: propulsion, aviation materials and structures, aerodynamics, avionics and systems integration, human factors engineering, aircraft manufacturing, and aeronautical test facilities.

However, of equal significance to the aeronautics community is that of the remaining five categories, three -- materials, manufacturing, and information and communication -- are also clearly of vital importance to aeronautics. The Critical Technologies List therefore demonstrates that not only is the aeronautics field uniquely recognized for its importance but, that many of the technologies it is dependent on and a stimulus for, are given equal status.

Now that these technologies have been selected OSTP will be giving careful thought to how they can be successfully developed and

deployed. The government strategies that will evolve will not be geared toward developing technologies for commercial products or processes. Instead, what I think the government can do is leverage its combined resources to advance these generic technologies in a way that will prove beneficial to our national security and many different sectors of the economy.

THE HPCC INITIATIVE AND AERONAUTICS

Illustrative of this approach is the Administrations recently announced High Performance Computing and Communications initiative. The initiative was developed under the auspices of the Federal Coordinating Council for Science, Engineering, and Technology which Dr. Bromley chairs. The overall goals of this initiative are set forth in what are called "grand challenges", problems of important scientific and social value whose solution could be advanced by applying high performance computing techniques and resources. Among the grand challenges identified by the program are problems in both aeronautics and astronautics.

The initiative represents a full integration of high performance computing and communication programs in a number of Federal agencies including NASA. The program proposes to increase funding 30% in FY 1992 to \$638 million of which \$72 million are NASA funds. Where appropriate, projects will be performed on a cost-shared basis with industry.

The Administration program is but one example of the emphasis that Dr. Bromley has placed on the technology component of OSTP. Similar initiatives in other critical technologies are planned and many of these will have a direct bearing on the aerospace community.

AERONAUTICS POLICY IN THE EXECUTIVE BRANCH

Within OSTP the institutional structure that will shape these future initiatives reflects Dr. Bromley's emphasis on collegiality. Because OSTP is a relatively small office the responsibilities for many areas of science and technology are shared among the senior staff. In that way the unique resources and expertise of each office directorate are utilized.

Currently, there are three members of the senior OSTP staff with substantive responsibilities in aerospace. They are the Associate Director for Industrial Technology, Dr. Phillips; the Assistant Director for National Security Affairs, Ms. Van Cleave; and, the Associate Director for Physical and Engineering Sciences, Dr. Wong. Collectively, these individuals are reviewing whether the office should reestablish in Fiscal Year 1992 an aeronautics advisory committee to examine the future challenges faced by our country's aeronautics R&D establishment.

A useful starting place for studying the future health of the US aeronautics community are the so called "Bird books" that were issued by the Aeronautics Policy Review Committee during the Reagan administration. The original recommendations from these reports established national goals in three areas, and then provided an eight-point action plan for the development of aeronautics technology for the next ten to twenty years. As I've noted earlier, several of the Committee goals, such as the NASP and the High Speed Civil Transport Program, are now being actively pursued. In fact, the same reports have also been adopted as critical long-range planning guides by other nations. So, in a town where advisory committees appear and disappear without a trace the Aeronautics Policy Review Committee stands out as one with a commendable record of achievement.

In light of the Committee's success and the long-range action plan it provided, the aeronautics community may wish to consider two criteria in determining whether the plan requires significant midcourse adjustment. The first examines whether any new issues have arisen that broadly affect the aeronautics community but were not addressed by the Aeronautics Committee. The second looks at whether the Committee's action plan has assumed a greater sense of urgency because of changed circumstances.

Judging by the numerous interactions OSTP has had with a broad cross section of the aeronautics community, it appears that many

of the issues they cite as important had in fact already been extensively examined by the Aeronautics Committee. Hence, as regards the first criterion, changes to the Committee's action plan seem unnecessary. However, an analysis based on the second criterion may lead to different results.

In my view, the repercussions of two events are dramatically affecting the environment in which the US aeronautics community exists. When the Aeronautics Committee last met these events were either not foreseen or, were recognized but not fully appreciated. The first was the unforeseen collapse of the Warsaw Pact and the impact of the geopolitical revolutions in East Europe and the Soviet Union on the Defense budget. During the latter half of the 1980's there was general recognition that the Defense budget had plateaued but few either predicted or were prepared for the steep decline that in large measure resulted from the events in Europe.

The importance of this sudden drop in defense spending to the entire aeronautics community rests on the interdependence of military and civil aeronautics. To illustrate this point, the decreased spending on military aircraft and missiles means that the Pentagon will be spending less on programs that validate aeronautics technologies with commercial applications -- a classic example being the V-22 Osprey. In addition, because the allocation of internal research and development (IRAD) funds are based on total sales, industry R&D investments will likely decrease.

Moreover, as the industry rapidly adjusts to the changed business environment pressures will increase on some US companies to enter into agreements with foreign firms that may not be in our long-term national interest. So in effect, this accelerated pace of change has altered many of the assumptions that underly the Aeronautic Committee's national aeronautics strategy. In essence to achieve the Committee's national goals, the time horizon for implementing it's action plan has contracted to a degree that was not anticipated four years ago.

The second event I spoke of is the rapid emergence of the European Community as a distinct economic entity in 1992. The Aeronautics Committee certainly recognized the broad challenge that the EC posed. But, few people anticipated the speed with which the European aerospace industry has consolidated into a handful of large and diverse companies. Aside from the obvious competitive pressures this trend poses there is the additional factor of the EC as an emerging regulatory body in the civil aviation sector. The inevitable result is they will not only become more active in setting safety standards but, more importantly, their role in developing the framework for the next generation global airspace system will also grow, perhaps at the expense of the FAA.

In sum then, from my vantage point the impact on the US aeronautics community of the sudden collapse of the cold war and the rapid emergence of the EC provides ample basis for reexamining the action

plan set forth by the Aeronautics Policy Review Committee. As OSTP continues its deliberations on the need to reestablish an aeronautics advisory committee I encourage those of you here today to work with the AIAA to bring the challenges you face into sharper focus.

Thank you.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

November 16, 1989

Memo To: D. Allen Bromley
From: Ron York *R*
Subject: Aerospace Policy

Summary: The purpose of this memo is to provide you with background information regarding the visit by AIA (Aerospace Industries Association) representatives on your calendar for Monday 11/20 to invite you to participate in their Aeronautical Policy Forum. I wish to strongly encourage you to express your support for their initiative because of the symbiotic relationship between the AIA Key Technologies Program and OSTP's Aeronautical Policy Advisory Board.

Background: In the midst of the on-going debate over the Federal government selectively supporting specific technologies or industries, it may be especially important to re-examine the unique cooperation that has existed between the government agencies, industry and our universities working in the aeronautical arena. If found to be sound, as evidenced by its contributions toward our nation's security and economic goals, it may serve as a model for appropriate policy and mechanisms for other industries.

In any case, aeronautical policy should continue to be a vital interest to OSTP. The aeronautics industry persists as this nation's largest contributor to a favorable balance of trade and the key to our defensive strategies. Although still healthy, our aero industry is also under intensive attack from foreign competition; worldwide market share has been eroding at about 1% per year. Competition is coming from all sides, including even third tier countries like Israel, Brazil and Indonesia. Japan is clearly positioning itself to be a major player in both military and commercial markets. Aeronautical industries in many countries enjoy substantial support from their governments for both technology development and commercialization.

OSTP's Aeronautical Policy Review Board (hereafter, the "Board") has served a very key role in keeping the importance of a strong aeronautical industry in front of the leaders of government, and in recommending goals and actions needed to keep our domestic aeronautical industry in the lead into the next century. This guidance has been instrumental in maximizing the value received for these immense federal budget outlays in aeronautical technology and systems.

A rough chronological outline of the principal milestones in OSTP's aero policy actions is included as Appendix A. The Board has consistently pointed out that we must continue to aggressively invest in ever-advancing aeronautical technology, as this is the basis for both our military superiority and commercial success.

This focus on technology is the bridge to the AIA Key Technologies Program. A very light summary of the Key Technologies Program is included in appendix B, but they will explain this more thoroughly during their visit. Although initiated independently by the AIA, there is a very strong coupling between their program and the recommendations of the Board. This is a natural outcome of a high degree of overlapping membership and is also evidence of a strong consensus having been developed. I view the AIA's Key Technology program as being in direct support of goals defined by OSTP's Board.

The AIA Key Technologies Program is an outstanding example of an industry-led, but cooperative, consensus-building approach toward a "technology policy." This process closely parallels the consensus approach which I believe you have stated is one of the key strengths of the U.S. basic science program. For this process to be complete, the "consensus voice" must be heard and endorsed by government.

OSTP participation in the AIA forum is vital for both the success of their aeronautical policy initiatives and our own.

Visitors: We will be visited by Don Fuqua, President of AIA; Tom Faught, Executive Director, NCAT; and Dick Hartke, Director of Technology Programs. I'm sure you're already acquainted with Don from his years of leadership on the House Science and Technology committee. Resumes of our three guests are included in Appendix C.

Talking Points:

Solicit their views:

On the top one or two key threats of international competition.

On the process they have used to define Key Technologies.

On the relationship between the AIA Key Technologies Program and OSTP's Aeronautical Policy Advisory Board. (The relative roles of government and industry.)

Knowing that your busy schedule will probably not allow you to attend the entire session on Tuesday, 11/11, you might:

Make a token appearance and strongly endorse their process;

Send a representative, who will back-brief you;

and plan to participate personally in future sessions.

[Note, this session is planned as a historical briefing for new members of the Forum]

Aeronautical Issues, Policy & Technology Studies

I. OSTP Activities

A. 1982: First Aeronautical Research & Technology Policy issued.

- 1) Authority: OSTP
- 2) Chairman: Victor Reis, Asst. Dir, OSTP
- 3) Composition: Interagency Steering & Working groups: OMB, DARPA, FAA, NASA, OSTP, DOC, DOD, & CEA; plus Eugene Covert (MIT) and John Steiner (Boeing) as observers.
- 4) Summary

The context of this study was in a period when severe questions were being raised as to whether it was still appropriate to be making huge federal investments in an area that some people believed to be a mature technology, and whether our government aeronautic research agencies were properly structured. (e.g. There was talk of shutting NASA-Lewis Research Center down.)

The committee's findings and recommendations were that large gains in aeronautical technology and systems were forthcoming, that continued strong advancements were essential for the national security and for continued success of the U.S. civil aeronautical industry, and that that continuing major federal investments were both appropriate and necessary. Further, the committee agreed that the current government structure and agency roles (NASA vs. DOD) and use of facilities should be maintained.

B. 1983: Aeronautical Policy Review Committee chartered

- 1) Authority: OSTP, G.A. Keyworth, II
- 2) Chairman: John Steiner
- 3) Composition: Approx. 1/3 Gov't and 2/3 Industry, plus one University participant.

C. 1983: First report

The committee recommended that the technology horizons for both military and non-military were too short and should be extended to ten years or more.

D. 1985: "National Aeronautical Goals" (Bird Book I)

Observing that international competition had narrowed the technical margins enjoyed by the U.S. that are essential to preserving both the military and civil competitive edge, the report stated that "U.S. national aeronautical policy now stipulates that the nation cannot and will not allow

leadership erosion."

The report called for government and industry cooperation toward aggressive technological goals with potential for broad future applications. Goals were delineated in 3 flight regimes: Subsonic, supersonic and Transatmospheric.

This initiated the NASA-Industry supersonic study program and aided in securing funding for the X-30 program.

E. 1987: "National Aeronautical Goals; Agenda for Achievement" (Bird Book II)

This report noted that the strength of the international competition and the national effort required to preserve American competitiveness were still largely underestimated.

The committee reaffirmed goal statements for each of the three flight regimes, then proceeded to identify eight elements of an Action Plan:

- 1) Increase innovative industry R&D efforts given the certainty of intensifying global competition and the importance of new technology for U.S. competitiveness.
- 2) Aggressively pursue the National Aero-Space Plane program, assuring maturation of critical technologies leading to an experimental airplane.
- 3) Develop fundamental technology, design, and business foundation for a long-range, supersonic transport in preparation for a potential U.S. industry initiative.
- 4) Expand domestic research and development collaboration by creating an environment that reflects the new era of global competition.
- 5) Encourage government aeronautical research in long-term emerging technology areas which promise high payoffs.
Receiving specific mention were:
 - a) Composites
 - b) Numerical Simulation
 - c) Propulsion
 - d) Laminar Flow
 - e) National Facilities
- 6) Strengthen American universities for basic research and science education through enhanced government and aerospace industry support and cooperation.
- 7) Improve the development and integration of advanced design, processing and computer-integrated manufacturing technologies to transform emerging R&D results into affordable U.S. products.
- 8) Enhance the safety and capacity of the National Airspace System through advanced automation and electronics technology and new vehicle concepts, including vertical and short takeoff and landing aircraft.

F. 1988: "Report of the Aeronautical Policy Review Committee"

The committee was chartered to perform an assessment of progress against the goals/action plans of prior reports and to clarify certain areas. Progress was noted in some areas (e.g. Propfans & NASP), but continued erosion of U.S. technological and commercial leads by international competition was even more evident.

1) Specific recommendations were provided in 10 areas:

- a) Stimulation of U.S. R&D
- b) Domestic and international consortia
- c) Engineering education
- d) The X-30 Aero-Space Plane Technology Demonstrator
- e) National Facilities
- f) High-Speed Civil Transport
- g) Recovery of Global Market Share in Vertical Takeoff and Landing Aircraft
- h) Revitalization of the General Aviation Industry
- i) Stimulation of Favorable Trade Balance
- j) Global Air Traffic Control

The committee identified global air traffic control as the most pressing issue and called for a Presidential Commission to develop a national strategy and implementation plan.

2) Technology Status

The report included a fairly detailed summary of the status of several key discipline areas and defined specific technical visions for these efforts:

- a) Aerodynamics
- b) Propulsion
- c) Structures and materials
- d) Systems Management
- e) Processing and Manufacturing Technology
- f) Overall Status

AIA Key Technologies for the 1990's

The AIA has initiated a national cooperative effort to advance the technologies needed to ensure the competitiveness of the U.S. Aerospace industry in the 21st century.

1) Key Technologies Roadmaps & Development Plans

The overall objective is to get a consolidated and coordinated national plan for each key technology, including resources, facilities, programs and goals. Roadmaps have been developed by teams in the following areas and detailed technology development plans are in the process of being constructed.

- a) Advanced composites
- b) Very large scale integrated circuits
- c) Advanced Software
- d) Propulsion systems
 - > Airbreathing
 - > Rocket
- e) Advanced sensors
- f) Optical information processing
- g) Artificial Intelligence
- h) Ultrareliable electronic systems

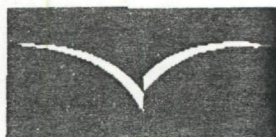
2) Aerospace Technology Policy Forum

The policy forum is comprised of very senior policy levels from government, industry and universities. The forum has three functions:

- a) To provide oversight and guidance to the Key Technologies program
- b) To identify impediments to the implementation plans and address the needed policy, regulatory or legislative changes
- c) To facilitate cooperative efforts

3) National Center for Advanced Technologies (NCAT)

NCAT was created by AIA as a non-profit research & educational foundation to promote a better understanding of the importance of advanced technology. NCAT provides coordination between the Policy Forum and the Roadmap Teams.



**Aerospace
Industries
Association**



Don Fuqua
President

DON FUQUA

Don Fuqua is President and General Manager of the Aerospace Industries Association of America, Inc. (AIA). He assumed the position on January 1, 1987, and serves as a leading spokesman for the U.S. aerospace industry.

Mr. Fuqua is a member of the AIA Board of Governors and oversees the activities of nine AIA councils, services and offices that serve the Association's membership.

Before joining AIA, Mr. Fuqua served 12 terms as a U.S. Congressman, representing Florida's Second Congressional District. He was elected Chairman of the House Science and Technology Committee in 1979, after serving on the Committee since joining Congress in 1963. He gained firsthand knowledge of the U.S. space program as a member of the subcommittee overseeing the program in its formative years and as Chairman of the Subcommittee on Space Science and Applications from 1971 to 1981.

Mr. Fuqua also served as chairman of the Science and Technology Committee's Subcommittee on Energy Development and Applications and as ranking majority member of the House Committee on Government Operations.

As Chairman of the Science and Technology Committee, Mr. Fuqua personally inspected and reviewed research projects throughout the nation. He delved into fields as far ranging as the development of competitive aircraft of the future, the application of space technology to the needs of the elderly and disabled, the design of more fuel-efficient autos, the development of liquefied coal, and the protection of the environment from hazards as common as water weeds and as advanced as nuclear waste. The Committee has direct authorization and oversight responsibility for most of the nation's government-funded civilian research, development and demonstration programs.

Prior to his election to Congress, Mr. Fuqua served from 1958 - 62 as an elected member of the Florida House of Representatives from Calhoun County.

Mr. Fuqua was born in Jacksonville, Florida in 1933. He received a B.S. degree in agricultural economics in 1957 from the University of Florida. He served in the U.S. Army from 1953-55.

-2-

Awards:

Robert H. Goddard Memorial Trophy, 1984
Jack Swigert Memorial Trophy, 1985
National Aeronautics and Space Administration Distinguished Public Service Medal, 1986
National Science Foundation Distinguished Public Service Award, 1986
Knight Commander's Cross of the Order of Merit, Federal Republic of Germany, 1987
The Order of the Rising Sun, Gold and Silver Star, His Majesty the Emperor of Japan, 1987
Rotary National Award for Space Achievement, 1988

AIA Positions:

Chairman, Key Technologies for the 1990s Aerospace Technology Policy Forum
Chairman, Board of Trustees, National Center for Advanced Technologies
Member, Council of Defense and Space Industry Associations
Member, International Coordinating Council of Aerospace Industries Associations
Member, White House Science Advisor's Joint High Level Advisory Panel of the U.S.-Japan Agreement on Cooperation in Research and Development in Science and Technology

Boards:

Founding Board Member, Challenger Center for Space Science Education
Chairman, Air & Space Heritage Council
Member, USO World Board of Governors
Member, Board of Advisors, Rotary National Award for Space Leadership
Member, Board of Governors, National Space Society

Honorary Doctorate Degrees:

University of Notre Dame, 1982
Florida Institute of Technology, 1982
Florida State University, 1986
Florida A&M University, 1986

Memberships:

Honorary Member, American Institute of Aeronautics and Astronautics
Member, National Aeronautic Association

April 1989

THOMAS F. FAUGHT, JR.

Executive Director
National Center for Advanced Technologies

Thomas F. Faught, Jr. is the Executive Director of the National Center for Advanced Technologies, a foundation established by some fifty major companies within the U.S. aerospace industry to plan and oversee the development of several key technologies for the twenty-first century. Mr. Faught manages this Washington, D.C.-based organization, a position he assumed in July, 1989.

From 1987 to mid-1989, Mr. Faught was the Assistant Secretary of the Navy. He was responsible for planning and directing Navy-wide research and development. This scientific and technical activity involved 53,000 people and an annual budget of approximately \$10 billion.

Before his appointment as Assistant Secretary of the Navy by President Reagan, Mr. Faught was President and Chief Executive Officer of Dravo Corporation, a billion dollar NYSE company. This company was engaged in process engineering, factory automation, natural resource development, project planning and management and industrial facilities construction as well as manufacturing materials handling systems and equipment. Before becoming Dravo's CEO in 1983, he served the company as President and Chief Operating Officer, Chief Administrative Officer and Chief Financial Officer, as well as being a member of the Board of Directors. Mr. Faught joined Dravo in mid-1974.

His earlier industrial career was with Gould, Inc. as the senior corporate planning and development officer; the F. & M. Schaefer Corporation where he was executive vice president, chief financial officer and a member of the board; Booz, Allen & Hamilton, a management consulting firm where he was responsible for industrial products, market planning, organization development, executive placement and corporate acquisition activities; and the Ford Motor Company in manufacturing supervision and process engineering management. He has extensive international experience, including living and working abroad for several years.

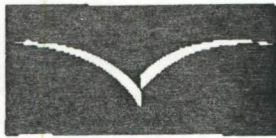
In 1986, partly as a result of the turn around success with Dravo, he was named the Nation's Chief Outstanding Executive Officer by Financial World and the Wall Street Transcript.

Born in Salem, Oregon, Mr. Faught is a graduate of Oregon State University (BS Degree) and Harvard Business School (MBA). He completed additional graduate work at the Massachusetts Institute of Technology in nuclear energy development for industrial application.

He has been a member of the Board of Trustees of Carnegie Mellon University (CMU), the Presbyterian University Hospital, and WQED (Pittsburgh's Public Broadcasting and Television) and The Duquesne Club (Pittsburgh). He also was Vice Chairman of CMU's Research and Technology Committee. In 1984, Faught was appointed by President Reagan to the Advisory Board of the Export-Import Bank, where he became Chairman of the Board in 1986. Earlier he was Vice Chairman of a Presidential Task Force aimed at encouraging the development of private enterprise in Third World Countries.

Mr. Faught served in the U.S. Marine Corps as an enlisted man and as an officer. He is married to the former Lynda Clancy and they have two sons, ages three and five. He also has two sons and two daughters from a previous marriage.

October, 1989



**Aerospace
Industries
Association**

November 13, 1989



RICHARD H. HARTKE

Richard Hartke assumed the position of Director, Technology Programs, with Aerospace Industries Association in December, 1985. He is responsible for AIA's **Key Technologies for the 1990s** program and its implementation, as well as cooperative R&D projects and other related technology matters.

Before coming to AIA, Mr. Hartke spent 25 years in the Air Force, mostly in research and development (R&D) assignments. His last assignment was Vice Commander, U.S. Air Force Office of Scientific Research, which manages Air Force basic research programs, issuing grants and contracts to universities, industry and AF laboratories. Mr. Hartke also served as the U.S. Air Force member on the Hermann Study group which, in 1982, reviewed all DoD laboratories for the Under Secretary of Defense for Research & Engineering. In previous assignments, Mr. Hartke worked on the White House staff of the Office of Science and Technology Policy, where he was extensively involved with the IR&D program and Government laboratories and participated in policy studies on technology utilization and industrial innovation.

Early in his military career, Mr. Hartke was a maintenance officer with the Strategic Air Command; an aerospace engineer in Dayton, Ohio; a research associate at Lawrence Livermore Laboratory in California; and a program element monitor at the Pentagon.

Mr. Hartke received a Bachelor of Science degree in Aeronautical Engineering from Purdue University in 1956; a Masters degree in Aeronautical Engineering from the Air Force Institute of Technology in 1962; and a second Masters degree in Business Administration from George Washington University in 1968.

Married and the father of 6 children, Mr. Hartke is a part-time farmer and antique clock repairman.

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EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY

WASHINGTON, D.C. 20506

October 2, 1991

MEMORANDUM FOR MICHELLE VAN CLEAVE

FROM: RICK E. YANNUZZI *REY*

SUBJECT: CANDIDATES FOR THE AERONAUTICS COMMITTEE

Attached is a list of candidates for membership on the Aeronautics Policy Review Committee (APRC). It is drawn from recommendations provided by: the American Institute of Aeronautics and Astronautics, former members of the APRC, former Science Advisor Bill Graham, and Dr. Cecil Rosen, Director of Aeronautics, NASA. It also includes current members of the National Research Council Committee on Aeronautical Technologies, and the NASA Advisory Committee on Aeronautics.

The first list I have provided contains the membership of the last APRC which met in 1988. For purposes of continuity I'd recommend that the new committee include one or two members from the last APRC. In my opinion the two most notable candidates would be Dr. Covert and Dr. Cashen. Dr. Covert is one of the premiere aerodynamicists in academia having written several college textbooks on aerodynamics and propulsion that are widely used. In addition he was formerly the Chairman of the Department of Aeronautics and Astronautics at MIT and is currently the Chairman of the National Research Council's Committee on Aeronautical Technologies. Dr. Cashen is the Chief Scientist for the Northrop Corporation and is credited with being the designer of the B-2 stealth bomber. He was also the Deputy Chairman of the last APRC.

Beyond the above recommendations I would urge that the makeup of the committee include a cross section of the aeronautics community from industry, government, and academia. A suggested aeronautics community profile for the committee might include representatives from the following organizations:

GOVERNMENT

1. National Aeronautics and Space Administration. Probably from the Office of Aeronautics and Space Technology.
2. Federal Aviation Administration, Dept. of Transportation.
3. Defense Advanced Research Projects Agency
4. Office of the Secretary of the Air Force
5. Department of Commerce. Probably the DAS for Aerospace.

INDUSTRY

1. Representative(s) from the military fixed wing aircraft sector.
2. Representative(s) from the rotary wing aircraft sector.
3. Representative(s) from the civilian commercial aircraft and general aviation manufacturing sectors of the industry.
4. Representative(s) from the aircraft engine sector.
5. Representative(s) from the avionics industry.
6. Representative(s) from the commercial airline industry.

ACADEMIA

1. Representative from a major research university with extensive contacts with industry and most importantly the principal NASA aeronautics R&D centers -- NASA Langley, Lewis, and Ames.

In addition to the above aeronautics community profile the inclusion of an individual with a strong understanding of the national and international business side of the aircraft industry would add a unique and important degree of depth that is often lacking in such review committees. Someone from either academia or the business investment community would be ideal.

AERONAUTICS POLICY REVIEW COMMITTEE

MEMBERSHIP (1988)

John Steiner (Chairman)	(206) 454-5108
VP, Corporate Product Development (Ret.) The Boeing Company	(206) 453-8602
Dr. William Ballhaus, Jr. Associate Administrator for Aeronautics and Space Technology NASA Washington, D.C.,	(202) 453-2693
Dr. John Cashen (Deputy Chairman)	(213) 948-8985
V.P. and Chief Scientist, Advanced Projects Northrop B-2 Division Pico Rivera, Ca. 90660	(213) 948-8068 FAX
Dr. Raymond Colladay Director, DARPA Arlington, Va.	(703) 614-3007
Professor Eugene Covert Professor, Department of Aeronautics and Astronautics, MIT Cambridge, Ma.	(617) 253-2604 (617) 253-0051 FAX
J. Roger Fleming Sr. V.P., Technical Services Air Transport Services Washington D.C.	(202) 626-4021
Bastian (Buz) Hello Sr. V.P., Government Relations Rockwell International Corp., Arlington, Va.	(703) 553-6625
Russell Hopps V.P. Engineering (Ret.) Lockheed Corp.	(805) 488-6625
Charles Husick Executive V.P., Operations Advanced Technology and Research, Inc. St. Petersburg, Fl.	(813) 867-3549
James Krebs	(617) 631-4149 or,

V.P. & General Manager (Ret.) General Electric Company	(505) 988-3413
Walter Luffsey Director, Advanced Aviation Systems Federal Aviation Administration Washington D.C.	(202) 267-8876
Robert Lynn Senior V.P., Research & Engineering Bell Helicopter Textron Ft. Worth, Tx.	(817) 280-2624
Dr. Bernard Paiewonsky Deputy for Advanced Technology, Office of the Assistant Secretary of Air Force for Acquisition The Pentagon	(202) 697-8331
Fred Randall Deputy Assistant Secretary for Aeronautics Dept. of Commerce Washington D.C.	(202) 377-8228
Hershel Sams V.P., Engineering Technology (Ret.) McDonnell Aircraft Company St. Petersburg, Fl.	(813) 367-1418
John Swihart V.P., International Affairs (Ret.) The Boeing Company Seattle, Wa.	(206) 544-4767

POSSIBLE CANDIDATES FOR THE NEW APRC

GOVERNMENT

- ✓ 1. Richard ("Pete") Petersen
Associate Administrator for Aeronautics and Space Technology
Former Director of NASA Langley
NASA Hqs
2. Donald Engen, Adm. USN (Ret.)
Former Administrator, FAA
President
Aircraft Owners and Pilot's Association
(301) 695-2375
3. Lawrence B. Ryan
DAS for Aerospace
Dept. of Commerce
(202) 377-1872
*TRADE DEVEL. DIV.
ASSIS. SEC. TIM McBRIDE*
- ✓ 4. Ray Siewart
Deputy Director for Research and Advanced Technology, DUSD
Dept. of Defense
(703)695-5036
- ✓ 5. Dr. Vic Reis
Director, DARPA
(703)614-3007
- ✓ 6. John Welch, Jr.
Assis. Secretary for Acquisition
Office of the Secretary of the Air Force
(703)697-6361
- ✓ 7. Federal Aviation Administration
Martin Pozesky, Assoc. Administrator for Engr. and Devel.
(202) 267-8183
Anthony Boderick, Assoc. Administrator for Regulation & Cert.
(202) 267-3131

INDUSTRY

Military Fixed Wing Sector

- ✓ 1. Dr. John Cashen
V.P. and Chief Scientist

Northrop Corporation
(Former Deputy Chairman of the APRC)
(213) 948-8985

2. Sherm Mullen
V.P. Lockheed "Skunk Works"
(Designer of the F-117)
Lockheed Corp.
(818)847-6666
3. Ben Rich
V.P. Lockheed "Skunk Works" (Ret.)
Lockheed Corporation
(818)847-6666
4. Hershel Sams
V.P. Engineering Technology (Ret.)
McDonnell Aircraft Company
4342 Holland Dr.
St. Petersburg, Fl. 33706
(813) 367-1418
- ✓ 5. Lt. Gen. James A. Abrahamson
Hughes Aircraft
(Former Director, SDIO)
(213) 568-6600
6. Gen. Jack Chain (USAF Ret.)
(Former Commander in Chief of the SAC)
Executive V.P. for Operations
Burlington Northern Inc.
2900 Continental Plaza
777 Main St.
Ft. Worth, Tx 76102-5384
(817) 878-3171

Rotary Wing Aircraft Sector

1. Edward Carter
Sikorsky (Ret.)
(Member, NRC Aeronautical Technologies Committee)
(203) 259-9935
2. Kenneth Grina
Boeing Helicopters (Ret.)
(Member, NRC Aeronautical Technologies Committee)
(215) 566-5295

Commercial Aircraft and General Aviation Sectors

- ✓ 1. Phil Condit
V.P. & 777 Program Manager
Boeing Commercial Aircraft Company
Chairman, NASA Aeronautics Advisory Committee

(Clearly being groomed to be Boeings next CEO)
(206) 237-7774

2. T. Wilson
CEO Boeing Corporation (Ret.)
The Boeing Company
Mail Stop 10-50
PO Box 3707
3. Sanford McDonnell
Chairman, McDonnell Douglas Corp. (Ret.)
(314) 232-2233
4. Roger Schaufele
V.P. Engineering (Ret.)
Douglas Aircraft
(213)593-2465
5. Harvey Nay
V.P. of Engineering
Piper Aircraft Corporation
(Member of the NRC Aeronautical Technologies Committee)
(407) 567-4361

Aircraft Engine Sector

1. William A. Kerr
V.P. Product Development and Manufacturing
Pratt & Whitney, Hartford, Ct.
2. Brian Rowe
Senior V.P. Engineering
Aircraft Engine Group, GE
(513)243-2000
3. Dr. M.C. Steele
Senior Chief Engineer
Garrett Engine Division
Phoenix, Az.
(602) 231-2355
- ✓ 4. Dr. Maurice Shank
Pratt & Whitney (Ret.)
(Member of the NRC Committee on Aeronautical Technologies)
Bellvue, Wa.
(206) 462-0828
5. Dr. Ronald York
Director, Advanced Engine Products
Allison
(317) 230-4446

Avionics Sector

1. Dr. John Warner
V.P., Engineering
Boeing Commercial Airplane Company
Seattle, Wa.
(Chairman, NRC Panel on Avionics and Control)
(206) 234-9661

Commercial Airline Industry

1. Julian May
V.P. Engineering
Delta Airlines
2. Al A. Checchi
President of Northwest Airlines
5101 NW Drive
St. Paul MN. 55111
(612) 726-2111

ACADEMIC EXPERTS

1. Roland Schmitt
President, Rennselear Polytechnic Institute
(Former V.P. of G.E.)
(513) 276-6211
- ✓ 2. Dr. Eugene Covert
Professor, Dept. of Aeronautics and Astronautics, MIT
Chairman, NRC Committee on Aeronautical Technologies
(617) 253-2604

WALL STREET EXPERTS

- ✓ 1. Wolfgang Demisch
Director of Research
UBS Securities, NY, NY
(212) 230-4292
2. William Deatherage
V.P. Research
Dean Whitter, NY, NY
(212) 392-3590

AERONAUTICAL PIONEERS

- ✓ 1. Burt Rutan
Pres. Scaled Composites Inc.
(Designer and builder of the Voyager -- the first aircraft to
circle the globe nonstop and unrefueled.)
(805) 824-4541
- ✓ 2. Scott Crossfield
Staff member of House S&T Committee

(Former test pilot)
(202) 225-8103

INDUSTRY ASSOCIATIONS

1. Don Fuqua
President, Aerospace Industries Association
1250 I St. NW
Suite 1100
Washington D.C. 20005
(202) 371-8400
2. Richard Iverson
President, American Electronics Association
1225 I St NW
Suite 950
Washington D.C. 20005
(202) 682-9100

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Palmdale, California 93550

		DATE 12/11/90	TIME
TO (NAME): RICK YANNUZZI	COMPANY, CITY, STATE OSTP, WASHINGTON, D.C.	FAX PHONE NO. (202) 395-3719	
FROM (NAME): JOHN CASHEN	DEPT/ZONE TODD/AP	PHONE NO. (213) 948-8985	

MESSAGE:

Rick -
Attached is Committee membership list. I will
locate missing numbers & forward to you.

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William F. Ballhaus, Jr.
Martin Marietta
Orlando, FA

Raymond S. Colladay
Director
Defense Advanced Research Projects
Agency
(703) 694-3007

Eugene E. Covert
Department Head, Aeronautics &
Astronautics
Massachusetts Institute of Technology
(617) 253-2604

J. Roger Fleming
Sr. Vice President, Technical Services
Air Transport Association
1709 New York Avenue N>W>
Washington, D.C. 20006
(202) 626-4201

Bastian Buz Hello
Retired, Sr. Vice President, Government
Relations, Rockwell International Corp.
President, AIAA

Russell L. Hopps
618 Island View Circle
Port Hueneme, California 93041
(805) 488-4125

Charles (Chuck) B. Husick
Executive Vice President, Operations
Advanced Technology & Research, Inc.
4973 60th Avenue S.
St. Petersburg, Florida 33715
(813) 867-3549

James N. Krebs
Summer Address
84 Harbor Avenue
Marblehead, Massachusetts 01945
(617) 631-4149
Winter Address
234 West San Mateo
Santa Fe, New Mexico 87501
(505) 988-3413

Walter Luffsey
Director, Advanced Aviation Systems
Design Team
Federal Aviation Administration
800 Independence Avenue S.W.
Washington, D.C. 20591
(202) 267-8876

Robert R. Lynn
Senior Vice President, Research &
Engineering
Bell Helicopter Textron
P.O. Box 482
Fort Worth, Texas 76101
(817) 280-2624

Bernard Paiewonsky
Deputy for Advanced Technology
Office of the Assistant Secretary of
the Air Force for Acquisition

Hershel Sams
Vice President, Engineering Technology
McDonnell Aircraft Company
P.O. Box 516
St. Louis, Missouri 63166
(314) 232-3031
Home Address (for Fed. Ex.)
39 Lake Top Court
St. Charles, Missouri 63301

John M. Swihart
President, AIAA