

August 1998/\$3

AIR FORCE

PUBLISHED BY THE AIR FORCE ASSOCIATION

MAGAZINE



Space Almanac Issue

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August 1998, Vol. 81, No. 8

- 4 Letters
- 10 Valor
- 11 Aerospace World
- 16 Senior Staff Changes
- 18 Index to Advertisers
- 58 Industrial Associates
- 71 Flashback
- 89 This Is AFA
- 95 State Contacts
- 96 AFA/AEF National Report
- 102 Unit Reunions
- 103 Bulletin Board
- 104 Pieces of History



About the cover: Seven thousand light-years away, a star is born, as seen through the eyes of the Hubble Space Telescope. See "Space Almanac," p. 22. Photo courtesy of NASA.

2 Editorial: Destiny in Space

By John T. Correll

When our interests in space are challenged—and they will be—the nation will expect its armed forces to be ready.

22 Space Almanac

Compiled by Tamar A. Mehuron
Facts, figures, agency and system profiles, budget data, and other information about US and international space programs.

50 The F-22 Out Front

By John A. Tirpak

This fighter is built to handle any competition for the next quarter-century.

59 The Views of the Force

By Bruce D. Callander

The latest poll finds a great many Air Force members thinking about leaving service.

64 Expeditionary Nerve Center

By Robert Wall

All that AEF commanders need is the right information, at the right time, to help attack the right targets, in the right way.

68 In the Sandbox

By Otto Kreisher

Desert deployments are a big reason why the Air Force is losing some of its best people.

72 Nuclear Adjustments

By James Kitfield

Seven years after the end of the Cold War, the questions continue about nuclear policies and strategies.



76

76 From Ravens to Prowlers

In June the Air Force bid farewell to its last Raven and ushered in a new age of jointness.

82 Airpower at Khe Sanh

By Walter J. Boyne

The North Vietnamese thought it was Dien Bien Phu all over again. They thought wrong.

90 Congressional Veterans' Affairs Establishment

Compiled by Chanel Sartor

Photochart of Capitol Hill's veterans' affairs panel members.

92 AFA Nominees for 1998-99

Candidates for national offices and the Board of Directors.

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By John T. Correll, Editor in Chief

Destiny in Space

IN the early evening of May 19, the Galaxy IV satellite, in orbit high above Kansas, suddenly lost its bearings and began to roll aimlessly in space. Among other consequences, 35 million personal pagers in the United States went dead. Many self-service gasoline pumps refused to take credit cards. Some television outlets were left with nothing to televise until another satellite could be moved into position.

The loss of Galaxy IV, one of about 250 commercial satellites currently operational, drew our attention to the ever-increasing linkage between everyday life and systems in space. It also reminded us of how fragile and vulnerable those systems are. Early reports of hacker sabotage turned out to be wrong. Galaxy IV's problem was technical, a processor that failed to switch on. It could have been the work of a hacker or an adversary, though, and next time it may be.

What we have seen so far is the first wave of a massive migration of civil, commercial, and military functions into space. Most of the 1,500 new satellites going up in the next five years will be commercial ones. The space industry is growing at a rate of 20 percent a year.

US Space Command predicts that our dependence on space capabilities in the 21st century will rival our dependence on electricity and oil in the 19th and 20th centuries.

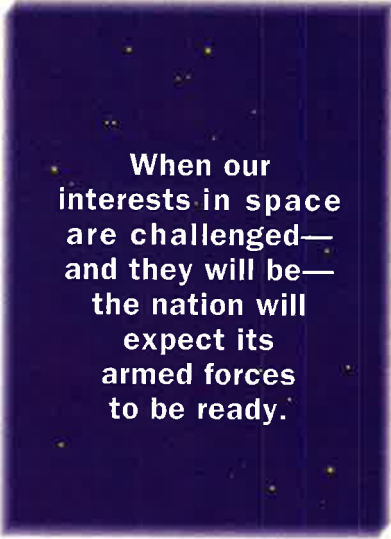
Space is fast becoming an area of vital national interest. When the nation's interests in space are challenged—and, sooner or later, they will be—the nation will expect its armed forces to be ready.

Unfortunately, the commercial surge in space is not matched by preparations for the defense of space. According to the Office of Management and Budget, defense spending on space activities fell by 52 percent between 1989 and 1995.

The main constraints, however, are political. We are nominally committed to space control, the ability of the United States and its allies to reach space and operate freely there while denying those capabilities to

an adversary. In actuality, our commitment is hedged by a host of policies, treaties, and agreements that restrict military operations in space.

Space Command is effectively limited to information, surveillance, reconnaissance, communications, and other support missions. It has neither the means nor the charter for offensive operations to directly de-



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fend our interests in space. The very notion of weapons in space is contrary to national policy.

In January, 43 retired generals and admirals wrote to President Clinton saying that the United States must dominate space in wartime and that we must have "such crucial capabilities as space-based missile defenses" and be able to "neutralize hostile spacecraft in time of war."

Pressed by members of Congress and others, the Administration has restated its commitment to space control, but our national policy has not changed.

The defense of space is further complicated by differences in civil and military priorities. Space is a booming market with strong commercial interests that center on trade, exports, and the open availability of technology. It is difficult to withhold capabilities from that market, espe-

cially if they are of great value to civil users.

High-resolution imagery from satellites has already gone commercial. So has the Navstar Global Positioning System, which was developed by the US Air Force. It is now standard equipment for fishermen and hikers. Soon, rescue squads will begin using it to find cellular phone users in distress. GPS is also in use by China to improve the accuracy of its weapons.

Earlier this year, the Defense Intelligence Agency warned Congress that US military dominance in space is eroding. Space Command forecasts that by 2020, if not sooner, "adversaries will share the high ground of space with the United States and its allies."

Gen. Howell M. Estes III, commander in chief of US Space Command and commander of Air Force Space Command, believes that "some day in the not so distant future, space will have evolved to the point where the movement of terrestrial forces will be accomplished only at the pleasure of space forces, much the same way that the movement of land and sea forces today can only be accomplished at the pleasure of air forces."

In a new long-range plan published in April, US Space Command says we should begin contingency preparations now in case "our civilian leadership [should] later decide that the application of force from space is in our national interest." That proposal is eminently sensible.

It is beyond question that critical elements of our destiny lie in space. We can no more isolate ourselves from interests there than we can from our interests in Europe or Asia.

Nor is there any real doubt—no matter how discomfiting the reality of it may be for our political leaders to accept—that, when push comes to shove, we will have no choice but to defend our vital interests in space.

If we expect the armed forces to be ready when that time comes, we had better begin making some changes now in our national policies and plans. ■



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Talking Design

Maj. Mike Spehar's letter in the July issue [*"Letters," p. 4*] conveyed a feeling shared by a number of Air Force people who have spoken to me [about the Air Force Memorial]. Spehar writes that, while the view from above is a "very striking star design," the view from the side "seems to be far less impressive." He is also concerned that the memorial leadership was not "more sensitive" to the requirement for a "more human connection." These are all well-made points and ample evidence of his feeling for our Air Force and concern for its memorial.

[Retired] Lt. Gen. Bob Springer and the Air Force Memorial Foundation Board of Trustees brought me aboard the foundation staff in October 1997. Since that time, I would guess that I have heard from more than 25 Air Force people who have shared thoughts similar to the major's. In fact, as I reviewed the drawings, I, too, was concerned with the view from the side. Those concerns were quickly set aside, however, when I was able to view the three-dimensional model. Illustrations limited to the flat page simply do not convey the same sense of air and space incorporated into the memorial's design by the architect.

Like Spehar, many airmen have suggested that the memorial should look like an airplane. The question, of course, is what kind of airplane. Remember that our memorial purposely avoids focus on a particular battle, war, or era. We want to evoke the "idea" of the Air Force, its predecessors, and successors—the "idea" of operating in air and space—the "idea" of three-dimensional mobility and maneuver. By representing the idea of the Air Force rather than a particular aircraft, we hope to maintain the relevance of the memorial through the next millennium.

Another concern that crops up occasionally is described as the lack of a human representation. Over hundreds of years, we have grown accustomed to military memorials designed to honor the sacrifice of

soldiers, sailors, or Marines. While plenty of airmen have experienced sacrifice, we must remember that the Air Force is simply different from its sister services. Everyone in the Army soldiers together on the ground. Everyone in the Navy goes to sea together. And Marines carefully cultivate the focus on the basic Marine. As a result, a statue of a soldier can represent the entire Army, a sailor the entire Navy, and so forth. The evocative power of the "Lone Sailor" near the Navy Memorial or the USMC War Memorial commemorating the raising of the flag on Iwo Jima cannot be denied. The heroism and sacrifice of soldiers, sailors, and Marines have earned deep and lasting respect from us all.

In the Air Force, we all work to create serious military effects for the enemy while exposing only a handful of Americans to enemy fires. If we were to honor only that handful, or only their sacrifice, we would have overlooked the majority of our Air Force members. The nature of our Air Force has produced a wide variety of highly specialized competencies which combine to provide America with unchallenged superiority in air and space operations. Somehow, our memorial has to embrace all those specialties in an inclusive and respectful way.

It is the "idea" of the Air Force that unites all airmen—the idea of exploiting the mediums of air and space—of cultivating and maintaining sufficient competence in those mediums to enable success not only

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in air and space but on land and at sea as well. It is a powerful idea, yet difficult to express. Ours is the youngest of the nation's armed services, but it brings fundamentally important capabilities to commanders in chief. It continues to evolve, to reach for distant horizons, even distant galaxies. Our memorial is envisioned as a salute to all those who have served, and those who will serve, to bring the "idea" of the Air Force to reality for the American people.

I am hopeful that Spehar and others will find these thoughts helpful in their consideration of the worthiness of the memorial design. Naturally, it would be impossible to meet every airman's expectation exactly, as those expectations will have grown from our different Air Force experiences. It is our fervent hope that the memorial's evocation of the "idea" of the Air Force will serve to embrace the experiences of all airmen, of all times. In that way, it will be an appropriate place for the "soul" of our Air Force to reside for as long as America needs an Air Force.

Maj. Gen. Charles Link,
USAF (Ret.)
President, AFMF
Arlington, Va.

Blind Spot

John T. Correll's "Long Range Blind Spot" [*June, p. 3*] skirts the obvious underfunding of our defense. It may not be politically correct to say so, but we need a defense budget twice the current amount. With defense spending at its lowest level in over 50 years, and countries such as India and Pakistan arming for nuclear war, let alone perennial threats with China, Russia, North Korea, Iran, and Iraq, the President and Congress are sadly leading us down the road once traveled by Neville Chamberlain.

George Washington once said, "To be prepared for war is one of the most effectual means of preserving peace." If we are serious about preparing for war to preserve peace, rather than maintaining our armed forces for an endless series of various and sundry UN peacekeeping

missions, the President and Congress would spend the money needed to build a fleet of new long-range bombers (more B-2s), to build a defense against long-range ballistic missiles, and improve our airlift capacity.

James H. Hughes
Englewood, Colo.

The arguments put forth in the editorial are very compelling and timely. There are, however, two considerations missing. We have seen most recently an emphasis on the use of sanctions aimed at persuading other nations to take actions or desist from actions, as desired by the United States. And when "national interest" concerns are great enough, supplementing the sanctions in some cases has seen the deployment of US military forces. The US "presence" has been felt and US forces have been placed at risk.

"Presence" was at one time a very key element in Strategic Air Command's deterrent posture. Recall [Capt. James G.] Gallagher's [1949] round-the-world flight. Recall deployments on alert in England, Labrador, Alaska, Guam, and on SAC bases in the US. Even the SAC competitions emphasized "presence."

This brings us to the present day. The B-52 demonstrated its presence in the Gulf War. [B-52s dropped] 32 percent of the bomb tonnage [while being] 4 percent of the force. Overall the bomber forces delivered 44 percent of the bomb tonnage while being only 7 percent of the force. Identification as long-range weapons of specific destruction, the second consideration missing in the editorial, [was] demonstrated under circumstances where their effectiveness was proven.

To emphasize the need for long-range bomber forces now and in the future attention should be given to "presence" and to the fact that they are long-range weapons of specific destruction. There are risks involved. The dollar value of these aircraft is so high that any single loss stings, but they represent the very best of our abilities to influence hostile actions being taken by other nations very far away.

Eino E. Jenstrom
Arlington, Va.

A Powerful Force

The situation in which the Air Force is currently involved is cause for alarm for all career personnel, officer, enlisted, and retired alike, not to mention the American public. The force structure positions taken by the White House, DoD, the Secretary of the Air Force, and, unfortunately, the [USAF]

Chief of Staff are unbelievable in light of the existing world strategic conditions and resulting pressures on the Air Force operational units.

It is no wonder that retention and morale are prime issues. The positions stated by Generals Hawley, Jumper, Myers, Habiger, and Kross clearly show the depth of the problem that now exists. [See "To Provide for a Powerful Force," June, p. 20.] The charted course for the future is continuing decline. Is no one listening? Where are the leaders who will put the needs of the service before career protection in our current troubled political environment? Is the position of Secretary or Chief of a hollow force worth being an integral part of the demise of our national defense?

I speak for many of my associates watching the decline of a once proud, capable force with rudderless direction, in a world filled with burgeoning threats.

Col. W.H. Norris,
USAF (Ret.)
Albuquerque, N.M.

Khobar Towers

In "Khobar Towers" [June, p. 41] Rebecca Grant, after identifying the 58th Fighter Squadron, dismisses the other unit that suffered severe losses as "a rescue squadron from Patrick AFB, Fla." This inconsistency gives the article a lazy and unresearched appearance. The failure of John T. Correll and his staff to correct this oversight prior to the June issue going to press is unfortunate. It gives the impression that the Air Force Association gives little importance to non-fighter operational units.

The 71st Rescue Squadron is the only active duty HC-130 rescue unit in the Air Force. The editors of *Air Force Magazine* know this; after all, they publish the "USAF Almanac." They should not be so quick to dismiss a unit which has given more support to [theater commands] than any other single unit in the last five years. The 71st Rescue Squadron is the epitome of USAF's core values, especially "Service Before Self." They certainly deserve more than a passing reference.

Mark E. Harrison
Madison, Ala.

Berlin Airlift

Congratulations on the fine article "The Berlin Airlift," [June, p. 50]. Overlooked, however, is the civilian airlines' contribution to this historic airlift, especially that of one headed by one of my predecessors as AFA's national president and chairman of the board, C.R. Smith.

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Letters

Early in World War II, Smith was personally picked by Gen. H.H. "Hap" Arnold to help direct the tremendous airlift challenge. Having started as a colonel and ascending to major general during World War II, Smith quickly rose to the occasion when the Berlin blockade began. He offered up the resources of the subsidiary to his American Airlines, American Overseas Airlines. AOA already had been granted the first postwar service for German nationals between Berlin and Frankfurt.

On the same day the Russian blockade became effective, June 26, 1948, American Overseas Airlines contributed their own DC-3 and DC-4 aircraft in support of the effort. Their civilian flight crews, support personnel, and offices were collocated at Rhein-Main and Tempelhof ABs.

Throughout this period, Smith also ensured that his charter operations to transport military [personnel] and [their] dependents were sold at a reduced rate but with normal onboard service. With the heavy return of immediate postwar tourist demand, Smith remained constant in forsaking valuable civilian revenue to satisfy the military needs. Throughout this period only one flight was canceled in spite of extremely poor winter conditions and restrictions on the use of Rhein-Main.

When Russia finally lifted the blockade, Smith's American Overseas Airlines had transported 28,546 passengers, [flown] 7,850,150 passenger miles, [and] carried 12,800,000 pounds of cargo on 2,000 flights between Frankfurt and Berlin.

Maj. Gen. Joe L. Shosid,
USAF (Ret.)
Fort Worth, Texas

The article on the Berlin Airlift was most interesting. But I am afraid Bill L. Cooley could not have seen "four Russian MiG-15s trying to force a C-54 to land." The prototype MiG-15 did not fly until the summer of 1949, and the first units became operational with them about one year later! He might have seen some of the Yak-9s trying things (this incident is not mentioned in any of the books on the airlift I have read), but he sure didn't see any MiG-15s!

MSgt. David W. Menard,
USAF (Ret.)
Huber Heights, Ohio

Thank you for publishing "The Berlin Airlift." Those of us [who] were there knew we were on the edge of World War III. The Russians inter-

preted our friendship as weakness and tried to use it to their advantage. Stewart M. Powell has done our nation a great favor by exposing one of the most difficult challenges that our nation faced since World War II.

Brig. Gen. Harold F. Knowles,
USAF (Ret.)
Spring Branch, Texas

The Young Tigers and Their Friends

I was given a great deal of assistance in "The Young Tigers and Their Friends" article [*June, p. 74*] by Maj. Vernon B. Byrd, USAF (Ret.), who provided source material in his fine book *Passing Gas: The History of Inflight Refueling* and who was kind enough to check my manuscript for errors. I would appreciate it if you could publish this letter in acknowledgment of his help.

Col. Walter J. Boyne,
USAF (Ret.)
Ashburn, Va.

It was enjoyable reading Walter Boyne's article on tanker support in SEA, having participated in the "Yankee Team" efforts out of Da Nang, [South Vietnam,] in 1964.

However, there is one gross error. The four tankers which supported the eight F-100s which struck Laos on June 9 were Pacific Air Forces KB-50Js from Yokota AB, Japan, not Strategic Air Command KC-135s based at Clark AB, Philippines. Some of the younger pilots who flew the mission had been trained only on KC-135s and had never seen a KB-50J. Despite major differences in speed, altitude, and techniques, the mission went off without any refueling glitches, a demonstration of the skill of all concerned.

I was a squadron pilot and the mobility officer for the 615th TFS, which deployed from England AFB, La., on June 4 for a normal rotation to Clark AB. About two days later we redeployed to Da Nang and were the first US fighter squadron in Vietnam. Following the initial strike on June 9, the 615th flew almost daily armed recce escort missions (Yankee Team) over Laos.

Yankee Team missions generally consisted of six F-100s from Da Nang, three RF-101Cs from Saigon, and three KB-50Js from Yokota, all joining up over Laos for refueling. Each RF-101 would head out on his individual Ho Chi Minh Trail recce route, escorted by two F-100s. The unarmed "One-Oh-Wonders" knew exactly where all the AA guns were and had been getting shot at for several years.

However, the rules of engagement allowed us to attack the gun positions only if we were fired upon first, which happened occasionally. The US Navy was also part of the Yankee Team effort, operating from carriers in the Gulf of Tonkin.

Lt. Col. Donald R. Morrison,
USAFR (Ret.)
Incline Village, Nev.

[The Young Tigers] have finally gotten some of the recognition they deserve.

I flew F-4Cs out of Ubon, Thailand, with the 433d. It was late 1966. We had just completed a low level strike mission near Hanoi. Checking my fuel, [I knew] we could never make Da Nang with the 1,500 pounds showing on the gauge. As we climbed out above Hainan Island the gauge showed 1,000, then 800 pounds and, [with consumption] at about 6,000 pounds per hour, it was time to get serious. I called our controlling agency, asking for gas. After breaking through the customary confusion the voice of an angel responded. "Hey, Hotshot 2, where are you and how much do you need?" "I'm just south of Hainan at 26,000 feet, and I'll take anything you can give me!" "Well, we're about 120 miles from you, headin' your way." [At] 500 pounds.

In my rearview mirror I could see my GIB, Lt. Jim Whitehurst, looking over my shoulder, eyes big as saucers. "Jim, try to find them on the radar." "I'm trying." "Try harder!" [At] 400 pounds.

"Hey, Hotshot 2, I think we have a contact at about 45 miles dead ahead." "Keep comin', I'm lookin'." "Hotshot, we're about 30 miles." [At] 300 pounds. "Hey, guys, I've got a visual; keep coming, I'll call your turn!" "There he is on radar, Jim. Lock on." "Got him!" "OK, guys, I've got you at nine miles. Turn port as tight as you can." [At] 200 pounds. "Boom, hang it out there and I'll hit it!" "You got it, Hotshot." [At] 100 pounds. "Boomer, start pumping as soon as I hit the boom." "Rog." "Contact. You're taking fuel, Hotshot." "Another save, guys."

After the adrenalin subsided a bit, I asked where I could find them so I could treat them to the biggest steak in Thailand. Their reply: "If the boss finds out we came up after you, we're dead—your thanks will do."

The memory of that mission has never left me though I have seldom spoken about it. The last time I saw the fuel gauge, it read 100 pounds and we were about half a mile from the hookup. All I'm sure of is that those J79s were still churning.

I don't know if I was the first, the 50th, or the 500th save. I do know

that I am among those many friends of the Tigers. [They are] truly the unsung heroes of Vietnam.

Lt. Col. Ron Gawlitta,
USAF (Ret.)
Phoenix, Ariz.

Walt Boyne brought back old memories with his excellent article. I [was] the first wing safety officer for the 4258th Strat Wing at U Tapao AB, [Thailand]. I well remember the problem of going "over the fence" without authorization, which you weren't going to get anyway—but necessity usually in war leads to doing what has to be done. I was one of the wing [instructor pilots] who flew the first sortie with new crews to help them acclimate to the mission.

I knew both Al Lewis and John Casteel. They both were outstanding [aircraft commanders] and had super crews. Interestingly, at first the Navy denied that Casteel had really done anything extraordinary—claiming that their airplanes were neither dangerously low on fuel or in any danger. Apparently the crews involved had a different view, and Casteel's crew was recognized for its achievement.

Small point: Having flown the old tank from 1959 to 1967, I recall the max takeoff weight as being just a little over 297,000 pounds. At U Tapao we normally didn't get near that weight, and from Takhli that figure was beyond anyone's fondest hopes. I suspect that gross weights for an R model may have snuck into the article.

Col. Charlie Rose,
USAF (Ret.)
Burkburnett, Texas

I had the privilege of serving in Strategic Air Command for 25 of my 30 years in the Air Force. Of that 25 years about 22 of them [were] in the air refueling business. I was on the KC-97 for 13 years, then went to the KC-135. [The Young Tigers] article brought back a lot of good memories.

I still have one of the Young Tiger patches. I was the maintenance supervisor on several tanker task forces to SEA. We were a very close group. The maintenance people (crew chiefs/assistant crew chiefs) would help each other out to get the mission off on time. They were from different bases in the states, didn't know each other, but all had a common bond, to get all the tankers off [at] the scheduled time.

CMSgt. Donald W. Grannan,
USAF (Ret.)
Fort Worth, Texas

I was assigned to "Lion Control" at Ubon. The Tactical Air Control Sys-

tem was an exciting part of the war over the North. We hooked up more F-105s and F-4s than I can now remember. We even refueled the SR-71 a couple of times. The timing is blurry in my memory, but it seems that there was an F-105 with a fuel leak from ground fire that was about to flame out when a KC-135 went into Laos briefly and got him enough fuel to get back to Korat, [Thailand].

Great article about Young Tiger. It brings back memories, some good, some bad, about the air war over North Vietnam. Col. Robin Olds and Col. Daniel James provided much excitement with the 8th TFW. Too bad Olds never got that fifth MiG.

MSgt. Jimmy W. Creekmore,
USAF (Ret.)
Newsome, Texas

POW Update

I thought it would be interesting, and it is certainly significant for readers, to know who the three Vietnamese were [who] were pictured with Gen. Mike Ryan and myself in the item "AFA at Vietnam POWs' 25th Reunion" [p. 84] in the July issue. These men spent, even to all of us former POWs, an unbelievable number of years as prisoners of the North Vietnamese. From left to right, A Sam Trinh, captured July 13, 1963, and released March 27, 1983; Thai Kien Nguyen, captured Sept. 21, 1967, and released Sept. 24, 1984; and Son Van Ha, captured June 6, 1967, and released Feb. 3, 1989.

When anyone asks me if people could still be alive over there, there is your answer. The other interesting thing to me was, these men could not believe that we Americans would fight for them so their country could be free of communism. It made us very proud.

Gene Smith
AFA Chairman of the Board
West Point, Miss.

Remembering Zuckert

I remember Gene Zuckert—and so should every Air Reservist. The Army Air Forces Reserve and then the Air Force Reserve flounder[ed from] 1946 to 1948. Nobody wanted them or knew they existed. Then a veteran Naval Reservist came on board, looked around at the cobbled together organization, loose "training," and nonexistent or inadequate facilities, and started making a difference.

By the time he became Secretary of the Air Force, the Reserves had an organization, the start of training, and were sharing facilities with the Naval Reservists or Army. And we were no longer sending attendance and train-

ing reports to "Fort Crook"! A belated thanks, Mr. Secretary.

Col. Frank W. Ward,
USAFR (Ret.)
Battle Creek, Mich.

From the May Almanac

[In] the "USAF Leaders Through the Years" section [p. 62] notably missing is General of the Air Force "Hap" Arnold. I guess it's fair to leave him out—he only saw to it that there is an Air Force.

Ernest C. Guerri
Melbourne, Fla.

■ *The section beginning on p. 62 only includes USAF leaders. Gen. of the Army Henry H. "Hap" Arnold is listed on p. 34 in "The Nation's Air Arm and Its Early Leaders" section at the start of the Almanac. It includes the explanation that Congress changed his title to General of the Air Force on May 7, 1949.—THE EDITORS*

As an ex-pilot in the Army Air Corps [during] World War II, I look forward to your magazine. I wonder, though, why you left out the glider pilot and the bombardier wings on p. 59? We had them, you know.

Jack H. Hodges
Vero Beach, Fla.

■ *The wings and badges are ones in current use. We'll insert the word "current" in the explanation to avoid confusion.—THE EDITORS*

The list of aces with kills in World War II and "a later war" is missing a name, that of Rudy Augarten. Augarten flew P-47s in Europe and shot down two -109s. He went to Israel to fight in the 1948 War of Independence and shot down four Egyptian aircraft, thereby accumulating six kills. The [American Fighter Aces Association] recognizes his tally in the latest edition of their book. Unless by "later war," you mean only those conflicts in which USAF pilots officially participated I would think that Augarten qualifies for inclusion.

Peter B. Mersky
Norfolk, Va.

There appears to be at least one major omission from [the "Guide to Aces"]: The mention of those AAF or USN fighter pilots who were encouraged by President Franklin D. Roosevelt to become members of the American Volunteer Group, "The Flying Tigers." After Japan's attack on Pearl Harbor, many of these pilots became members of the AAF. In par-

ticular, Col. David Lee "Tex" Hill was originally a naval aviator who resigned his commission and joined the AVG, where he scored 14 victories. At the beginning of World War II, Hill took a commission in the AAF and scored 6.5 more victories, giving him a total of 18.5 victories against the Japanese. I am quite certain there are other Flying Tigers who took up commissions in the AAF and who scored enough victories to be listed in the "Guide to Aces." This is a piece of aviation history that [should] not be lost on present and future generations.

Thomas R. McDade
Houston

■ *We do indeed mean only US conflicts and count only victories by members of US units. Thus, neither of these aviators would appear in these listings.—THE EDITORS.*

I refer to p. 73 [where] you credit Robin Olds with a total of 16 victories. The official history of the 479th Group in which Olds served during World War II credits him with 24-0-2 victories before the end of that conflict. What he earned elsewhere I do not know. I served as an A-2 in the 479th and believe that history to be correct.

Lt. Col. Edward T. Barnard,
USAF (Ret.)
North Branford, Conn.

■ *The information in the Aces section comes from the Air Force Historical Research Agency. We check with them every year to ensure there have not been any changes in this historical data.—THE EDITORS*

I have been an Air Force employee for 29 years and for the last 10 years have been very proud to be the executive director of the 300-person Air Force Cataloging and Standardization Center, located in Battle Creek, Mich. We are a specialized center under Air Force Materiel Command, and our mission is to "maintain logistics data and provide information services in cooperation with our customers and suppliers."

We assist system/item managers during provisioning, support the engineers' and equipment specialists' changing of requirements (manufacturers, cost, technology upgrades, etc.) during the life of the item, respond to over 900 weekly requests for item-level information from retail customers, and assure proper information for item disposal.

I noticed that our center, that was established in 1976, was missing from both the AFMC list of units as well as the AFMC organizational chart. CASC is the last active duty Air Force [unit] in Michigan. Because of USAF initiatives over the last 15 years, DoD selected Battle Creek to be the location for DoD to centralize and consolidate all cataloging. By the end of Fiscal 1998 our current Air Force organization will become part of the Defense Logistics Agency's new Defense Logistics Information Service organization in Battle Creek. However, today we remain a very proud and respected USAF and AFMC organization.

E. Glenn Holmwall
Executive Director
AFCASC
Battle Creek, Mich.

MK are the tail markings of the C-130s belonging to the 440th AW, General Mitchell IAP/ARS (Milwaukee). It's a Reserve unit. While you have other Reserve and Guard units listed on p. 54 of your 1998 Almanac issue, MK and the 440th are not on this list. Why not?

Thomas C. Taskonis
Racine, Wis.

■ *We only list active tail codes. It is our understanding that the Reserve airlift units are now following the practice of Air Mobility Command airlift units—that is, not using tail codes.—THE EDITORS*

I [discovered] an error on p. 101. The 199th Fighter Squadron does not belong to the 176th Wing, nor is it based in Alaska. The 199th FS belongs to the 154th Wing, Hawaii Air National Guard, and it is based at Hickam AFB, Hawaii.

Maj. Brett Wyrick
Hickam AFB, Hawaii

■ *We received the information as listed from the Air National Guard, but upon checking with the unit, we find you are correct.—THE EDITORS*

He's Air Force

[In the] June issue, p. 89, Jacques Klein was incorrectly referred to as a retired Army general! [He is] Air Force Reserve Maj. Gen. Jacques Klein.

Col. Thomas F. Royals,
USAF (Ret.)
Henrico, N.C.

Blackbird Rising

I was disappointed that your 1998 USAF Almanac did not show, as of

Sept. 30, 1997, the two SR-71s that belong to the 9th Reconnaissance Wing at Beale AFB, Calif. They have provided seven US Presidents, the CIA, NSA, DIA, and the rest of the intelligence, surveillance, and reconnaissance community with over three decades of operational flying. I would have thought they were worthy of some credit by the Air Force leadership.

The SR-71s were brought back in 1995 because Congress realized, from Desert Storm debriefings and other sensitive sources, that there was a definite void in US ability to gather timely intelligence on Third World rogue nations. They knew the SR-71 is the only manned platform that can gather intelligence anywhere in the world, day or night, rain or shine, over a high threat area. They also knew that, without use of SR-71 intelligence gathering assets, it wouldn't be long before many nations had nuclear capabilities and delivery vehicles like we are seeing in India and Pakistan today.

[I] and many other former SR-71 crews don't believe the conspicuous absence of the SR-71s from your 1998 USAF Almanac was merely an oversight by the Air Force leadership.

Col. Richard H. Graham,
USAF (Ret.)
Plano, Texas

■ *The SR-71 flew its last operational mission on Oct. 10, 1997, shortly after President Clinton's line-item veto of SR-71 funding in the new budget. It apparently was a slightly premature cut from the aircraft list by Air Force folks who supply this data, and, thus, it did not make the 1998 Almanac issue.*—THE EDITORS

USAF Weapons Notes

On p. 147 [May] you show a picture of an MC-130P. The aircraft you are showing is an MC-130E [Combat Talon I]. I have been working with the MC-130E or its variants since 1967. I am currently a Lockheed Martin instructor pilot for the MC-130E mission qualification course and simulator program at Hurlburt Field, Fla.

Maj. Russell B.G. Darden,
USAF (Ret.)
Fort Walton Beach, Fla.

■ *We misidentified the photo.*—THE EDITORS

Under "Tactical Missiles and Weapons" [p. 158], GBU-28 first flight is listed as "not available." I can tell you with 100 percent certainty, the first flight occurred Feb. 24, 1991, just three days before two were dropped by [an] F-111F on Iraq the last day of



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[Desert Storm]. I am certain because I was the GBU-28 program manager at that time.

After the flight, test film was immediately flown back to Eglin [AFB, Fla.], where I met with Seek Eagle engineers later that day. The film showed the GBU-28 separated safely and [it] was approved for F-111F employment. Two days later, a rocket-sled test was conducted at Holloman AFB, [N.M.] and even earlier in the day,

two GBU-28 weapons departed Eglin AFB aboard a C-141 for a special delivery to the 48th Tactical Fighter Wing at Taif, Saudi Arabia.

Ironically, had we delivered the bombs according to the schedule agreed to with TAC, these bombs would not have been used. Instead, we were one day early and became part of an extraordinary history.

Lt. Col. Dick Wright,
Reston, Va.

By John L. Frisbee, Contributing Editor

A Gift of Life

Over the Gulf of Tonkin, Capt. Steve Bennett made a fateful decision to save the life of his back-seater.

By 1969 public and congressional support for US involvement in Vietnam had dwindled to a point where withdrawal of our 543,400 troops was inevitable. The US had suffered more than 200,000 combat and related casualties. Several attempts to negotiate a cease-fire with North Vietnam had failed. Withdrawal began in July 1969, the ground fighting being turned over as rapidly as possible to South Vietnam. The South's air force, VNAF, had been expanded but was still not highly capable by the end of 1972 and needed much help from USAF and Navy aviation.

Emboldened by the decline of US support, North Vietnam launched its March 1972 Easter offensive. The main thrust was in I Corps area, where some 30,000 North Vietnamese troops supported by tanks and artillery were massed along the DMZ. They rapidly overran the South Vietnamese Army's (ARVN) 3d Division, capturing Quang Tri. In May the ARVN counterattacked, moving back toward Quang Tri along SAM-7 Alley where shoulder-held, heat-seeking anti-aircraft weapons were taking a heavy toll on low-and-slow US and VNAF aircraft.

On June 29, Capt. Steven L. Bennett of the 20th Tactical Air Support Squadron at Da Nang, the pilot of an OV-10 forward air control aircraft, had been marking targets for friendly forces. In his backseat was Marine Corps Capt. Mike Brown, calling targets for the guns of Navy ships in the Gulf of Tonkin. Bennett had been in Vietnam for less than three months. Brown, a company commander stationed in Texas, had volunteered for Vietnam duty and was versed in laying fire for Navy guns that had a flatter trajectory than those of the Army.

The OV-10 was an excellent FAC aircraft with good range and visibil-

ity, two engines, an ejection system, and four 7.62 mm machine guns. It had one weakness, well-known to all its crews. Because of its structure it could not be ditched successfully. No pilot had ever survived an OV-10 ditching.

This day they had been on station for about three hours. It was dusk. They were ready to return to Da Nang, about 25 miles to the south, but learned that their replacement had been delayed. No problem. They had plenty of fuel remaining. Then came an emergency call. Several hundred North Vietnamese troops were attacking a South Vietnamese platoon that desperately needed help. There were no fighters that could arrive in time, and Navy gunfire couldn't be called in without threatening the friendlies. If the platoon was to be saved, Steve Bennett would have to do it, striking at low altitude where his OV-10 would be a prime target for SAM-7s and AA guns.

Four passes forced the North Vietnamese to back off, but Bennett wanted to be sure. One more pass should do it. On that pass a SAM-7 caught them from behind, blowing up one engine, damaging the left landing gear that dropped to an extended position, wounding Brown slightly, and setting the aircraft afire. Bennett could not jettison his reserve fuel and rockets over the area held by the South Vietnamese. He headed for the gulf where the fuel and ordnance could be dropped safely. They were down to 600 feet, but the OV-10 still was flyable. Then an escorting aircraft warned Bennett that he had better punch out before his plane exploded.

The two men were preparing to eject when Brown looked over his shoulder and saw that his parachute had been destroyed by the hit they had taken. Bennett had a good chute, but he knew he could not eject and leave Brown in the aircraft with no pilot. There was a good chance that Brown, in the backseat, could survive a ditching, find his way out of the wreckage, and be picked up by a rescue chopper. There was no



chance that Bennett, in the front seat, could survive. Many times during the war a pilot had risked his life to save another. Bennett was prepared to give his life to save Mike Brown.

With damaged landing gear dangling, the OV-10 hit the water with a heavy impact, flipped over on its back, nose down, and began to sink. Brown managed to escape from the rear cockpit and swim to the surface. Pulling himself along the fuselage, he was unable to reach the nose of the aircraft before it sank, taking Bennett with it. Brown was picked up by a rescue chopper. Bennett's body was recovered the next day.

For his act of supreme self-sacrifice, Capt. Steven L. Bennett was awarded the Medal of Honor posthumously. His was the last act of extraordinary gallantry to be awarded the nation's highest decoration for valor in the Vietnam War. At the ultimate cost to himself, Steve Bennett had given Capt. Mike Brown the greatest of all gifts, the gift of life. On Aug. 8, 1974, the medal was presented by Vice President Gerald Ford to Bennett's widow, Linda, and his daughter, Angela.

In an unprecedented tribute, on Nov. 20, 1997, a US Navy-chartered commercial sealift ship was renamed *Capt. Steven L. Bennett*. ■

Aerospace World

By Peter Grier

Many Units Depart Persian Gulf

The Air Force moved scores of aircraft, thousands of troops, and hundreds of tons of cargo out of Southwest Asia and back to the United States.

The forces had deployed to the region last fall and winter in response to Iraqi leader Saddam Hussein's denial of access for United Nations weapons inspectors. Renewed Iraqi compliance with UN requests moved US officials to order units back to home base in the early weeks of June.

"We sent them over because Saddam wasn't complying with the inspection team," said Maj. Ben Beeson, AMC contingencies deputy division chief. "The problem has been fixed, and the politicians have decided we can bring our forces home."

The operation was planned as part of the effort to reduce the overall US troop levels in Southwest Asia from about 37,000 to between 17,000 and 20,000. More than 100 Air Combat Command aircraft are included in the force reduction.

AMC Swings Into Gulf Action

About 600 AMC personnel deployed overseas to help carry out the Gulf redeployment operation. They ranged from crew chiefs to loadmasters, personnel specialists, and chaplains.

Thirty tanker aircraft, including units from McConnell AFB, Kan., McGuire AFB, N.J., and Selfridge ANGB, Mich., supported the redeployment. Officials predicted the tankers would fly nearly 100 refueling missions before all the US bomber and fighter aircraft made their way home.

Tankers refueled six F-117 stealth fighters 27 times as they flew from the Kuwaiti region to the East Coast of the US, for instance. The tankers—both KC-135s and KC-10s—provided a continuous escort for the F-117s.

Among the dozens of airlifters involved in the redeployment were eight C-17s from the 437th Airlift Wing at Charleston AFB, S.C.

Lajes Field, Azores, was a crucial staging base for the C-17s. Efficient support staff at Lajes ensured that



USAF photo by TSgt. Joe Beia

AMC maintainer SSgt. Lionel Furtado on temporary duty at Moron AB, Spain, checks the oil on a KC-135, this one on its way to provide en route refueling for F-117s returning to the US from Southwest Asia.

crews were quickly shuttled to beds for needed rest, while an experienced fuels distribution staff, almost all Portuguese nationals, cut layover times.

Fighter aircraft also moved through Lajes. In the period June 4–5, 36 F-15s and F-16s returned home through a base sometimes referred to as "The Crossroads of the Atlantic."

NATO Aircraft Stage Determined Falcon

On June 15, 85 aircraft from 13 NATO nations took to the skies in the Balkans to carry out Operation Determined Falcon, a show of force meant to contain violence in Kosovo.

"This is a very vivid demonstration of the North Atlantic Treaty Organization's ability to rapidly project power in the region," said USAF Lt. Gen. Michael C. Short, commander of Allied Air Forces Southern Europe.

The operation involved NATO jets patrolling Yugoslavia's borders with Albania and Macedonia. Twenty-two fighters, including 12 US F-16s, two Portuguese F-16s, and eight Spanish EF-18s, kicked off the exercise by departing Aviano AB, Italy, at 8 a.m.

local time and flying over the Adriatic Sea toward the southern Balkans.

This initial flight was joined by fighters from Belgium, Denmark, France, Germany, Greece, Italy, Holland, Norway, Turkey, and the UK. Departure points were 15 bases in six European countries. The 5th Allied Tactical Air Force Combined Air Operations Center at Vicenza, Italy, was responsible for running the show.

"This is a new look at NATO," said Short. "Now you have an organization that is postured to respond out of the region and out of area."

According to NATO headquarters, the jets flew over the airspace of Macedonia and Albania, then edged to within 10 miles of the Yugoslav border.

Since late February, Yugoslavia's strongman president, Slobodan Milosevic, has been running a military assault in an effort to crush ethnic Albanian fighters who are seeking independence for Kosovo, a province of Serbia, Yugoslavia's dominant republic.

While NATO nations do not support Kosovo independence, they have been appalled by Milosevic's brutality. At

Nerve Gas Story Backs Up on CNN and *Time*

"Valley of Death" started out to be a big scoop for CNN's April Oliver and Peter Arnett, but their journalistic glory—such as it was—did not last long. In less than a month, their sensational story had been exposed as untrue.

The way producer Oliver and reporter Arnett told it, a US Special Forces commando unit pushed deep into Laos in 1970 on a mission to kill American GIs who had defected to the enemy. In the course of the mission, Operation Tailwind, CNN said, US Special Forces troopers not only killed 15 or 20 defectors but also wiped out everyone else in a village of 100 people, including the women and children. The "hatchet force" commandos were supported by Air Force A-1 Skyraider aircraft, which dropped deadly sarin nerve gas on the village and on North Vietnamese and Laotian forces.

These accusations were broadcast June 7 in a segment titled "Valley of Death" on the premiere of "NewsStand: CNN & *Time*," a new TV magazine show brought forth jointly by the network and the magazine. The telecast featured Oliver and Arnett, who also shared a byline in the print version of the story, "Did the US Drop Nerve Gas?" in the June 15 issue of *Time*.

The wild story soon began to fall apart.

There really was an Operation Tailwind, but its purpose was to aid anti-communist guerrillas. The "village" was a North Vietnamese military base camp. Pressed by a large North Vietnamese force, the US troops were pulled out by helicopters. The withdrawal was supported by Air Force A-1s dropping tear gas, not nerve gas. Art Bishop, one of the A-1 pilots, had shown Oliver his journal written in 1970 at the end of the mission, recording that it was tear gas that had been used.

The officer who planned the mission said that if the US troops themselves had been as exposed to nerve gas as CNN and *Time* reported, "They would have been dead or in the hospital." An Army medic who was on the mission—and who had experienced exposure to tear gas before—confirmed that the substance used was tear gas.

Eugene McCarley, who led the raid as an Army captain, and others who took part in Operation Tailwind said that when Oliver in-

terviewed them, she demonstrated little interest in what had actually happened.

Maj. Gen. Perry Smith, USAF (Ret.), CNN's military analyst, resigned in protest on June 14 when CNN refused to retract the story.

The star witness for "Valley of Death" was Lt. Robert Van Buskirk, a platoon leader who supposedly had killed two GI defectors himself and called in the nerve gas strike. However, Van Buskirk subsequently told *Newsweek* that he had "repressed" his memory of the operation during a vision he had on Easter morning in 1974. At the time, he was in a German jail on charges (later dropped) of gun-running. Twenty-four years later, he suddenly "recovered" that memory during a five-hour interview with Oliver.

Van Buskirk, now a prison minister in North Carolina, then drifted further from the story CNN said he had told. Interviewed by the *Washington Times*, he said he never confirmed CNN's claims that US forces used sarin nerve gas and targeted a camp holding American defectors. Also, he said, "I didn't see any civilians."

Jay Graves, said by CNN and *Time* to be the "recon-team leader" who supposedly checked out the village before the strike and saw American "roundeyes" through a special field telescope, made a public statement declaring that he had no part in Operation Tailwind and that his comments had been "twisted" by CNN and *Time*.

With the story coming unstuck at all seams, CNN hired Floyd Abrams, a New York lawyer who specializes in news media matters, to investigate. He soon reported that "CNN's conclusion that United States troops used nerve gas during the Vietnamese conflict on a mission in Laos designed to kill American defectors is insupportable," and that those responsible for the program had "ignored or minimized" information that did not agree with conclusions they had already reached.

The Abrams report went to some length in acknowledging the misrepresentation of comment by Adm. Thomas Moorer, former Chairman of the Joint Chiefs of Staff. CNN misconstrued his remarks to indicate he had validated the nerve gas story. A friend of Moorer's told

The Weekly Standard that "the admiral got mixed up. He's 87 years old; he's in a nursing home; they interrogated him for hours."

On July 2, CNN news group chairman Tom Johnson retracted the story and apologized to viewers, to his colleagues at *Time*, and to the US military personnel involved in Operation Tailwind.

Concurrently, CNN fired Oliver and another producer but gave Arnett only a reprimand, explaining that "it was mainly a case of him being flown in to read a script." Arnett professed shock to hear that his job might be in question, declaring that he had "contributed not one comma" to the story and that his byline had been tacked on to Oliver's in *Time* for "marketing reasons."

However, Oliver—who continued to claim the story was true and said CNN's retraction of it was prompted by "an organized attack full of untruths and brutal slander"—said Arnett did more than read a script. She said Arnett had conducted a number of the interviews, including sessions with Van Buskirk and Graves, among others.

This was not the first time Arnett has been wrong in reports about the armed forces. In 1965, when he was working for the Associated Press, Arnett picked up and repeated a false allegation by Radio Hanoi that the US Army was using poison gas in Vietnam. Reporting from Baghdad for CNN in 1991, he broadcast and later defended Saddam Hussein's claim that the United States had bombed a "baby milk plant," which turned out to be a biological weapons factory.

Veterans groups and others have bombarded CNN, calling for Arnett's dismissal, but the network decided on July 9 that the reprimand was punishment enough and that Arnett could stay.

Arnett lamented that he had been "trashed on a daily basis in the right wing media" and that his reputation had "taken a major hit around the world."

He said he accepted CNN's retraction of the story but that he was still not certain the allegations in "Valley of Death" were untrue.

CNN has created a watchdog position to track the accuracy of its reporting.

—John T. Correll

least 250 people had been killed in the fighting through early June.

The Albanian capital of Tirana shook with the roar of fighters during the middle of the exercise. Many residents of the poverty-stricken nation expressed support for the airplanes, which they felt demonstrated world support for their embattled ethnic brothers. Others simply marveled at the overflights, as they had never seen jets before.

House OKs FEHBP Pilot Program

The House of Representatives has approved legislation that would establish a test program allowing military retirees to participate in the Federal Employees Health Benefits Program.

The proposal, a longtime priority of military organizations, was included as an amendment to the defense authorization bill. It was sponsored by Reps. Jim Moran (D-Va.), J.C. Watts (R-Okla.), and Mac Thornberry (R-Texas).

Under the bill, some 70,000 Medicare-eligible military retirees and their families would be able to enroll in an FEHBP pilot program at six to 10 sites around the country. The aim of



The second Tier III Minus DarkStar Unmanned Aerial Vehicle successfully completed its first flight at Edwards AFB, Calif., in June. The Lockheed Martin UAV performed a fully automated 46-minute flight, reaching 5,000 feet.

the effort would be to gauge the feasibility of extending FEHBP coverage to retirees living in a number of different locations and situations. At least one of the test sites would be

located near a Military Treatment Facility, under the amendment. Another would be near a facility currently engaged in the Medicare Subvention pilot project. A third would be located in an area far from any MTF.

A House-Senate conference will complete action on the defense bill later this summer.

The Battle of Arlington Ridge

ARLINGTON, VA., July 6—A federal judge has dismissed "with prejudice" a lawsuit brought by Rep. Gerald B.H. Solomon (R-N.Y.) and the "Friends of Iwo Jima" in their attempt to stop construction of the Air Force Memorial on Arlington Ridge, overlooking the Potomac River.

Judge Albert V. Bryan Jr., who handed down the decision in eastern Virginia District Court in Alexandria, Va., June 15, rendered summary judgment in favor of the Air Force Memorial Foundation and three oversight groups—the National Park Service, the US Commission of Fine Arts, and the National Capital Planning Commission—declaring that "there is no genuine issue for trial."

The Air Force Memorial project began in 1992 and has followed meticulously all of the rules prescribed by the Commemorative Works Act of 1986. Although the project had been reported prominently in the *Washington Post* and elsewhere, no objection was raised until April 1997 when a neighborhood group, the Friends of Iwo Jima, was formed. The stated complaint was that the Air Force Memorial would "encroach" on the Marine Corps Memorial, which occupies eight of the 25 acres on Arlington Ridge.

The protest was soon joined by Marine veterans, including Solomon. In addition to the lawsuit in which he joined the Friends group, Solomon introduced three pieces of legislation, one of them since withdrawn, seeking to block construction of the Air Force Memorial.

Judge Bryan noted the litany of complaints (including a claim that the National Capital Planning Commission had not properly followed Robert's Rules of Order) and found all of them immaterial, with one possible exception. There could be some question, he said, about adequacy of public notice for a National Capital Planning Commission meeting in 1995 when the Arlington Ridge site was approved. Nevertheless, he added, the court could not take seriously any assertion that the plaintiffs in the lawsuit were unaware of the site selection. He also pointed out that they then waited for more than two-and-a-half years before bringing their grievance to court.

The Air Force Memorial Foundation and the oversight groups had "substantially complied with all relevant statutes and internal procedures," he said, and their actions "were reasonable under the circumstances."

USAF Outlines "Body Art" Policy

Want to wear a silver stud in the side of your nose or metal rings in the skin above your eyebrows? Then you had better not be a member of the US Air Force.

A new Air Force policy on personal decoration released in early June prohibits most body piercing—a popular practice among today's young people in which rings, studs, straps, or other pieces of metal are inserted in holes punched through various body parts.

The only exceptions to the policy are that women may wear small, conservative earrings, and all Air Force personnel may wear piercing items that do not show while in uniform.

The policy is in force at all times while personnel are in uniform or when they are wearing civilian clothing on a base or any location under military control.

"We've recognized the increasing popularity of body art and have adjusted personal appearance policy to set appropriate guidelines for such practices," said Lt. Col. Whit Taylor, chief of the Air Force Quality of Life Office.

At the same time, the Air Force issued its first formal rules on tattoo-

ing and "branding," in which designs are literally burned into skin.

Tattoos and brands which express racist, sexist, or obscene sentiments are banned. No such mark can cover more than one-fourth of an exposed body limb or be visible over the collarbone in an open-neck uniform, according to the new policy.

USAF Pushes Gun for JSF

The US Air Force still wants a gun mounted on the Joint Strike Fighter, despite the demurs of other services that will also buy the aircraft.

"The Air Force position now is we support a gun in the aircraft," said Harry C. Disbrow Jr., USAF's deputy director of operational requirements, at an American Helicopter Society convention in Washington on May 21.

Air Force officials have yet to decide exactly what kind of gun they want. The F-15's 20 mm weapon probably would not be powerful enough to meet all mission requirements, they said. The A-10's 30 mm gun would likely be too heavy. A compromise caseless 25 mm version is possible.

The Navy, for its part, considers the gun an option. Rear Adm. Dennis V. McGinn, director of Navy air warfare, noted at the same forum that the cost of individual items on service wish lists, such as the gun, needs to be thoroughly explored before proceeding.

The Marine Corps believes a gun would be useful for some JSF missions but not others. Marine officials are particularly concerned about adding unnecessary weight to their short takeoff/vertical landing JSF variant, said Lt. Gen. Terrence R. Dake, head of Marine Corps aviation.

JSF Engine Completes First Test

On June 11, the first model of Pratt & Whitney's F119-derived engine for Lockheed Martin's version of the Joint Strike Fighter successfully completed an initial test run at Pratt & Whitney's facilities in West Palm Beach, Fla.

The test marked a major step forward for the JSF Concept Demonstration Program, which began in November 1996.

"This engine run is another positive milestone in our program to demonstrate Joint Strike Fighter technologies with the X-35 demonstrator aircraft," said Frank Cappuccio, Lockheed Martin's vice president and program director for the JSF.

The JSF 119-PW-611 engine is a derivative of the F119 power plant for the F-22 Raptor. Among the modifications made to the basic model for

Vets Lose VA Disability for Smoking-Related Illness

Veterans are outraged that Congress has voted to deny VA disability benefits to veterans afflicted with smoking-related ailments.

They are especially livid that, in doing so, lawmakers declared that any veteran who smoked on active duty could be considered to have engaged in "willful misconduct," just as if they had abused alcohol or drugs while in uniform.

Such a comparison is grossly unfair, vet spokesmen say, especially considering the fact that the US military long encouraged the use of tobacco, via such methods as inclusion of cigarettes in combat rations.

"Given the government's complicity in tobacco use among veterans, VA's self-righteous hypocrisy and the government's ulterior motive for enacting this legislation [become] all the more reprehensible," said David Gorman, executive director of the Disabled American Veterans.

The Air Force Association took a strong stand against the measure. AFA National President Doyle E. Larson sent letters to all senators on the Veterans' Affairs Committee to protest the "willful misconduct" label and ask for a correction.

The benefits change was contained in this year's highway bill, which was passed by Congress in May and signed into law by President Clinton on June 9. The move would save the government an estimated \$17 billion over five years—notional funds which lawmakers used to partially offset the budget-busting nature of the massive transportation legislation.

Any veteran who develops heart disease, lung cancer, or any other illness connected to tobacco consumed while on active duty will no longer be eligible for VA disability payments, under Sec. 8202 of the highway bill, H.R. 2400. Nor will the survivors of vets who die from service-incurred smoking be eligible for death benefits. The only exception to the prohibition: vets who applied for and won a VA disability claim for smoking-related problems before the bill was passed.

While majorities of both the House and Senate approved the change, it originated as a freestanding proposal by the Clinton Administration. Testifying before Congress earlier this year as acting VA secretary, Togo D. West Jr. said three considerations prompted the proposal.

First, said West, tobacco use is an individual's choice, not a requirement of military service.

Second, providing benefits in such cases "exceeds Americans' sense of the government's obligations to veterans and, as a result, threatens to undermine public support for VA programs," he said.

Third, the ban would save Uncle Sam lots of money and help prevent claims processing delays for all VA claimants. West estimated savings of \$17 billion based on not processing 357,000 smoking-related disability payment claims over the next five years.

Veterans organizations dispute all of Secretary West's claims. They are particularly angry about the attempt to distance the military from responsibility for smoking habits.

"Smoking was not only fully approved of by the armed services, it was encouraged and facilitated by the military on a level probably unparalleled anywhere else in our society," said DAV's Gorman.

Free cigarettes were long included in C-rations, for instance. Tobacco products were sold at deep discounts in military exchanges. Troops were often encouraged to smoke during breaks in training or combat situations.

A June 5 memo drafted by Dr. Kenneth W. Kizer, the VA's undersecretary for health, concluded that considering the history of the US military and tobacco it will be difficult to label vets with a smoking history as guilty of "willful misconduct," as the highway bill requires.

To do so would require a conclusion "that the individual was exposed to a consistent message about the impropriety and health hazard of tobacco use from both the government and society at large," wrote Kizer.

Vet leaders hope to overturn the change by flooding Capitol Hill with protests from the nation's 26 million former members of the military. When Senate leaders tried to pass a bill to correct technical flaws in the highway legislation in the first week in June, they were stymied by Sen. John D. Rockefeller IV (D-W.Va.), who tried to insert an amendment restoring veterans' tobacco-related benefit eligibility.

Lockheed Martin JSF purposes are a larger fan and an axisymmetric exhaust nozzle.

Different JSF variants will, in turn, have their own engine model. The power plant will be coupled with a shaft-driven lift fan system to augment vertical thrust for the short takeoff/vertical landing JSF configuration

that Lockheed Martin is developing for the Marine Corps and the UK's Royal Navy, for instance.

Some 200 hours of risk reduction testing undertaken by Lockheed Martin in 1995 and 1996 have already successfully demonstrated the shaft-driven lift fan concept, said contractor officials.

USAF Pushes Airborne Laser

The Air Force moved quickly to try to convince senators that the Senate Armed Services Committee made a mistake when it cut \$97 million from the budget of the Airborne Laser theater missile defense system.

In a May letter to Sen. Pete Domenici (R-N.M.), Gen. Michael E. Ryan, Air Force Chief of Staff, stated that the move would derail the Administration's plans for a crucial mission: theater missile defense. The Air Force's Space Based Laser program is not a replacement for ABL, said Ryan, as some lawmakers appear to believe. SBL will address strategic National Missile Defense needs and will not reach operational maturity until 15 years after possible ABL deployment.

USAF Tests Anti-Missile Laser

On June 3, a team of contractors working on a laser intended to shoot down ballistic missiles in flight successfully completed a "first light" test of an important laser module in USAF's Airborne Laser program.

Team ABL—Boeing, TRW, and Lockheed Martin—conducted the test of the Flight-weighted Laser Module at TRW's Capistrano Test Site near San Clemente, Calif. The experiment was conducted under the auspices of a \$1.1 billion program definition and risk reduction contract awarded in November 1996 by USAF's ABL System Program Office, Kirtland AFB, N.M.

The FLM, a chemical oxygen iodine laser with multihundred-kilowatt power, is a foundation technology for the ABL system. It was run successfully at increasing levels of power several times through the first week of June, said Air Force officials.

Based on this test and tests last year that showed the ABL system could track a missile in flight, USAF officials gave a "green light" June 26 to begin finalizing the system's design.

If all goes as planned, the first test firing of the actual ABL, designated Attack Laser aircraft, will take place in 2002.

Last ICBM Leaves Grand Forks

The last of 150 Intercontinental Ballistic Missiles assigned to the 321st Missile Group was removed from North Dakota soil June 3. With the departure of its last Minuteman III, the 321st moved one step closer to a July 2 inactivation ceremony after standing guard in the high northern plains of America for more than three decades.

"For 34 years, we have had ICBMs out here in the fields of eastern North Dakota," said Col. Edward Rausch, group commander, during the June ceremony. "They stood as a deter-



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TACTICAL MISSILE WARHEADS

Joseph Carleone, Aerojet, editor

1993, 745 pp, Hardcover • ISBN 1-56347-067-5 • List Price: \$109.95 • Order #: V-155(106)

TACTICAL MISSILE PROPULSION

G.E. Jensen, United Technologies Corporation, and David W. Netzer, Naval Postgraduate School, editors

1996, 529 pp, Hardcover • ISBN 1-56347-118-3 • List Price: \$104.95 • Order #: V-170(106)

TEST AND EVALUATION OF THE TACTICAL MISSILE

E. J. Eichblatt Jr., Pacific Missile Test Center, editor

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Members of the 321st Missile Group pulled their final Minuteman III from its silo June 3, signaling the end to 34 years of ICBMs at Grand Forks AFB, N.D. The Group itself deactivated in July.

rent to any adversary in the world that might consider challenging the peace and freedom that we enjoy. These missiles did their job."

Some 120 of the 321st's ICBMs have been transferred from Grand Forks AFB, N.D., to Malmstrom AFB, Mont. Thirty have been shipped to a depot in Utah for use in test launches.

The transfer was mandated as part of the 1995 Base Realignment and Closure Commission.

Guard, Reserve Get Green Cards

On June 20, the Pentagon began honoring a pledge made by Secretary of Defense William S. Cohen last year that ID cards for all active duty, Guard, and Reserve US military service members will be one color—green.

The move away from red cards for reservists is meant to eliminate barriers, both structural and cultural, between the components of the Total Force, according to defense officials.

Senior Staff Changes

RETIREMENTS: Brig. Gen. Ruben A. **Cubero**, Lt. Gen. Brett M. **Dula**, Gen. Eugene E. **Habiger**, Lt. Gen. George K. **Muellner**.

NOMINATIONS: To be **General:** Patrick K. **Gamble**.

To be **Lieutenant General:** Marvin R. **Esmond**, Thomas J. **Keck**.

CHANGES: Brig. Gen. John D. **Becker**, from IG, AMC, Scott AFB, Ill., to Cmdr., 305th AMW, AMC, McGuire AFB, N.J. ... Brig. Gen. Franklin J. **Blaisdell**, from Cmdr., 21st SW, AFSPC, Peterson AFB, Colo., to Cmdt., AFSC, NDU, Norfolk, Va. ... Maj. Gen. Robert J. **Boots**, from Vice Cmdr., 15th AF, AMC, Travis AFB, Calif., to Chief, Office of Defense Cooperation to Turkey, USEUCOM, Ankara, Turkey ... Brig. Gen. (sel.) Marion E. **Callender Jr.**, from C/S, USSTRATCOM, Offutt AFB, Neb., to Dep. US Mil. Rep. to NATO Mil. Cmte., Brussels, Belgium ... Maj. Gen. (sel.) Bruce A. **Carlson**, from Mission Area Dir., Global Power, Asst. SECAF for Acq., Pentagon, to Dir., Operational Rqmts., DCS, Air & Space Ops., USAF, Pentagon ... Maj. Gen. Robert S. **Dickman**, from DoD Space Architect, USD for Acq. & Tech., OSD, Pentagon, to Dir., Plans & Analysis, Asst. SECAF for Space, Pentagon ... Lt. Gen. Roger G. **DeKok**, from Cmdr., SMC, AFMC, Los Angeles AFB, Calif., to DCS, P&P, USAF, Pentagon ... Brig. Gen. Jerry M. **Drennan**, from Cmdt., ACSC, AU, AETC, Maxwell AFB, Ala., to Cmdr., 21st SW, AFSPC, Peterson AFB, Colo. ... Lt. Gen. (sel.) Marvin R. **Esmond**, from Cmdr., Air Warfare Center, ACC, Nellis AFB, Nev., to DCS, Air & Space Ops., USAF, Pentagon ... Gen. (sel.) Patrick K. **Gamble**, from DCS, Air & Space Ops., USAF, Pentagon, to Cmdr., PACAF, Hickam AFB, Hawaii ... Lt. Gen. (sel.) Walter S. **Hogle Jr.**, from Dir., P&P, AMC, Scott AFB, Ill., to Vice Cmdr., AMC, Scott AFB, Ill.

Maj. Gen. Raymond P. **Huot**, from Chief, Office of Defense Cooperation to Turkey, USEUCOM, Ankara, Turkey, to Mission Area Dir., Global Power, Asst. SECAF for Acq., Pentagon ... Lt. Gen. (sel.) Thomas J. **Keck**, from Vice Cmdr., 12th AF, ACC, Davis-Monthan AFB, Ariz., to Vice Cmdr., ACC, Langley AFB, Va. ... Maj. Gen. Ronald E. **Keys**, from Cmdr., AF Doctrine Ctr., Maxwell AFB, Ala., to Dir., Ops., USEUCOM, Stuttgart-Vaihingen, Germany ... Maj. Gen. Timothy A. **Kinnan**, from Cmdt., AWC, and Vice Cmdr., AU, Maxwell AFB, Ala., to Cmdr., AF Doctrine Ctr., Maxwell AFB, Ala. ... Brig. Gen. (sel.) Jeffrey B. **Kohler**, from

Cmdr., 100th ARW, USAFE, RAF Mildenhall, UK, to Asst. Dep. Under SECAF (Intl. Affairs), OSAF, Pentagon.

Brig. Gen. William R. **Looney III**, from Cmdt., AFSC, NDU, Norfolk, Va., to Cmdr., Space Warfare Ctr., AFSPC, Schriever AFB, Colo. ... Brig. Gen. (sel.) Stephen P. **Luebbert**, from Chief, Command & Control Div., USEUCOM, Stuttgart-Vaihingen, Germany, to Vice Cmdr., Oklahoma City ALC, AFMC, Tinker AFB, Okla. ... Lt. Gen. (sel.) Gregory S. **Martin**, from Dir., Operational Rqmts., DCS, Air & Space Ops., USAF, Pentagon, to PDASECAF for Acq., Pentagon ... Brig. Gen. Maurice L. **McFann Jr.**, from Cmdr., E-3A Component, NATO Airborne Early Warning Force, NATO, Geilenkirchen, Germany, to Cmdr., 552d ACW, ACC, Tinker AFB, Okla. ... Brig. Gen. John W. **Meincke**, from Vice Dir., Defense Info. Sys. Agency, Arlington, Va., to Dir., C⁴, USCENTCOM, MacDill AFB, Fla. ... Maj. Gen. William F. **Moore**, from Dir., Spec. Prgms., USD for Acq. & Tech., OSD, Pentagon, to Dep. Dir., Defense Threat Reduction Agency, OSD, Alexandria, Va.

Maj. Gen. (sel.) Glen W. **Moorhead III**, from Cmdr., Space Warfare Ctr., AFSPC, Schriever AFB, Colo., to Cmdr., Air Warfare Ctr., ACC, Nellis AFB, Nev. ... Brig. Gen. James W. **Morehouse**, from Cmdr., 552d ACW, ACC, Tinker AFB, Okla., to Dep. Cmdr., Jt. Warfighting Ctr., USACOM, Ft. Monroe, Va. ... Brig. Gen. Robert M. **Murdock**, from Dep. US Mil. Rep. to the NATO Mil. Cmte., Brussels, Belgium, to Vice Cmdr., San Antonio ALC, AFMC, Kelly AFB, Texas ... Gen. Richard B. **Myers**, from Cmdr., PACAF, Hickam AFB, Hawaii, to CINC, NORAD and USSPACECOM, and Cmdr., AFSPC, Peterson AFB, Colo. ... Brig. Gen. Craig P. **Rasmussen**, from Cmdr., 305th AMW, AMC, McGuire AFB, N.J., to Vice Cmdr., 15th AF, AMC, Travis AFB, Calif. ... Gen. (sel.) Charles T. **Robertson Jr.**, from Cmdr., 15th AF, AMC, Travis AFB, Calif., to CINC, USTRANSCOM, and Cmdr., AMC, Scott AFB, Ill. ... Brig. Gen. (sel.) John W. **Rosa Jr.**, from IG, PACAF, Hickam AFB, Hawaii, to Cmdt., ACSC, AU, AETC, Maxwell AFB, Ala. ... Lt. Gen. John B. **Sams Jr.**, from Vice Cmdr., AMC, Scott AFB, Ill., to Cmdr., 15th AF, AMC, Travis AFB, Calif. ... Maj. Gen. Lance L. **Smith**, from Vice Cmdr., 7th AF, PACAF, Osan AB, South Korea, to Cmdt., AWC, Maxwell AFB, Ala.

SENIOR ENLISTED ADVISOR RETIREMENT: CMSgt. Edwin B. **Brown**.

Acting Assistant Secretary of Defense for Reserve Affairs Charles L. Cragin handed out the first green cards at a joint reserve promotion and reenlistment ceremony at Ft. Dix, N.J., on June 20. The changeover is to be fully implemented over five years.

Though ID card color is changing, there will be no associated changes to current service benefits, privileges, or entitlements, unless a change in status occurs, noted officials. Some 1.5 million members of the Selected Reserve, the Individual Ready Reserve, and the active Standby Reserve will eventually receive new cards.

Air Guard Faces Aging Issues

The first of the Air National Guard's older F-16s face grounding next year due to age, and ANG leaders have to decide what, if anything, they are going to do about it.

Choices range from a mini-Service Life Extension Program, through a mid-life update, to purchase of new aircraft. The SLEP, while the cheapest option, would simply keep the current force up and running, without adding capability, ANG officials note. The update would cost more money—and purchase of all new aircraft would cost the most money of all.

The last of ANG's F-16As are now scheduled for removal from service by 2005.

Tricare Dental Fees Rise

The monthly premium for the Tricare Active Duty Family Member Dental Plan will go up slightly Aug. 1, 1998. The premium increase will be reflected in July 1998 leave and earnings statements.

Cost of a single enrollment, currently \$7.64 a month, will increase to \$8.09. Cost of a family enrollment, now \$19.09, will reach \$20. This amount, which is deducted from active duty members' paychecks, represents 40 percent of the total cost of the dental plan. The other 60 percent is paid for directly by the government.

Dental program contractor United Concordia Companies, Inc., proposed the premium increases to cover expected increases in costs. Government contracting officials subsequently accepted the hikes.

Reapers Named Best Air Superiority Unit

The "Grim Reapers," officially known as the 493d Fighter Squadron, RAF Lakenheath, UK, received the Hughes Trophy June 12 for winning the title of best air defense/air superiority fighter squadron in the US Air Force for 1997.

The F-15C Eagle squadron picked

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up its award at a ceremony in Cambridge, UK. It marks the first time in 10 years that a US Air Forces in Europe unit has won the coveted title. "This award reflects a lot of hard work and dedication from the entire 493d Fighter Squadron team," said Lt. Col. Mark Barrett, 493d FS commander.

All Air Force air defense/air superiority squadrons, from the National Guard to Air Combat Command, compete for the Hughes Trophy annually. Units are graded on operational performance, organizational readiness inspection results, training exercise participation, unit achievements and awards, individual achievements and awards, and unit incentive programs.

Among the reasons for the 493d's winning effort was its 288 combat sorties flown over northern Iraq in support of Operation Northern Watch. The squadron also completed eight deployments to contingencies and exercises around the world, from Canada's Maple Flag to African Eagle in Morocco.

The Hughes Trophy is sponsored by Raytheon Systems Corp.

New Chocks Save Money, Maybe Engines

The 93d Air Control Wing at Robins AFB, Ga., is the first unit in the Air Force to receive a set of large aircraft composite wheel chocks for a six-month test.

The YF-22 Raptor at Edwards AFB, Calif., is testing a similar type of chock but in a smaller version, said Lee R. Sink, logistics program manager at Air Combat Command, Langley AFB, Va.

The new chocks should last five to



The second F-22 Raptor, USAF's new air superiority fighter, flew for the first time June 29, 11 days ahead of schedule. Lockheed Martin officials said they were able to substantially reduce the labor hours using lessons learned from assembly of Raptor 01.

10 times longer than their traditional wooden counterparts, according to Sink. Wooden chocks become sodden from rain and snow and deteriorate in only nine to 18 months. They have to be painted often to keep them from falling apart even faster.

The composite chocks, made from recycled plastic, are about 20 pounds lighter than wood. They are also unlikely to become a potential source of Foreign Object Damage.

Trading Eagles

Over the next six months, the 33d Fighter Wing, Eglin AFB, Fla., will

swap 42 F-15Cs with the 3d Wing, Elmendorf AFB, Alaska.

The reason for the trade is to simplify logistics by standardizing the engine type at each base. The 33d FW will be giving up airplanes powered by F100-PW-220 engines and receiving aircraft outfitted with F100-PW-100 power plants in return.

"The -220 is the newer engine and has more sophisticated electrical components than the -100s we will receive," said SMSgt. Randy Duty, the 33d FW propulsion flight production superintendent. "But having only one type of engine will greatly simplify the maintenance process."

Deployment will also become easier and cheaper. The transfer is scheduled to be completed by Nov. 24.

News Notes

■ Three Air National Guard pararescuemen saved an Italian sailor from a 55-foot sailboat 1,000 miles east of Bermuda June 5. After parachuting 3,500 feet, the three Guardsmen—MSgt. Steven Arrigotti and SSgts. Kenneth Smith and Jeff Baker, all from the 106th Rescue Wing, Francis S. Gabreski IAP, N.Y.—found the sailor suffering from internal bleeding. They stabilized the patient and transferred him to a nearby supertanker.

■ Lt. Col. Scott Schroeder, an instructor pilot with the 560th Fighter Training Squadron from Randolph AFB, Texas, won the gold medal at the International Skeet World Cup Competition in Atlanta May 16-17. The US earned an Olympic skeet

Index to Advertisers

AIAA	15
Benchmade Knife	17
Boeing	Cover IV
Breitling	3
British Aerospace	9
Dell Computers	20-21
GEC Marconi Hazeltine	Cover II
Hertz	19
Mitchell Lang	102
Motorola SSTG	27
Rockwell Collins	49
Spectrum Astro	43
TRW	57
TRW Space & Electronics Group	37
USAA	Cover III
AFA Convention	67
AFA Wearables	102
Video Biography on Legends of Airpower	101
Video on the History of USAF	100

shooting slot at the 2000 Olympics in Australia by virtue of Schroeder's performance.

■ A bomb threat temporarily grounded an Air Force C-141 May 29. The plane, carrying 14 crew members and 79 Air Force Reservists, took off from NAS Fort Worth JRB at Carswell Field, Texas, en route to Harrisburg, Pa., but was forced to land at Scott AFB, Ill., after the Texas base received a phoned-in bomb threat. The threat turned out to be a false alarm.

■ The Jan. 7 midair collision of two F-16s at Hill AFB, Utah, was caused by pilot error, according to an Air Force accident investigation report. The two pilots—who both survived—“failed to use proper ‘see and avoid’ techniques to ensure a clear flight path while entering and leaving” a practice engagement, according to the report.

■ An assistant staff judge advocate from F.E. Warren AFB, Wyo., is the sole Air Force winner of the American Bar Association's 1998 Legal Assistance for Military Personnel Distinguished Service Award. Capt. Aaron E. Kornblum earned the award for significant contributions to the civil legal assistance of service members and their families.

■ On June 3, Maj. Lee J. Archambault, assistant operations officer for the 39th Flight Test Squadron at Eglin AFB, Fla., moved a big step closer to the fulfillment of a long-held dream when NASA informed him of his selection to the astronaut candidate class of 1998. Archambault, along with 24 other military and civilian selectees, will arrive at the Johnson Space Center, Houston, in mid-August to begin one year of training and evaluation.

■ On June 15, two Air Force Reserve aircrews from the 446th Airlift Wing, McChord AFB, Wash., guided rescuers to a private pilot downed in a remote Oregon forest. The crews first relayed distress calls from 68-year-old Patricia Burrell, of Bend, Ore., to air traffic controllers. After Burrell crash-landed her Cessna on a narrow road, the Air Force crews searched for her and circled the area in their C-141s until help arrived.

■ Robert L. Jones, a former Army veteran with assignments in infantry, airborne, ranger, and special forces units, is the new deputy assistant secretary of defense for prisoners of war/missing personnel affairs. Jones, 54, was sworn into office May 10. He also served as a ground liaison officer with the Air Force's 50th Tactical Fighter Wing and flew some 200 hours in F-4 aircraft.

■ A Defense Department-wide survey has found that 47.5 percent of all US military installations have only one fitness center and that 22 percent of all fitness facilities are rated in poor condition. The survey was conducted under the auspices of “Operation Be Fit,” a DoD initiative to place renewed emphasis on the physical fitness of the entire military community.

■ On May 29, Air Force Space Command turned over control of its weather satellites to the National Oceanic and Atmospheric Administration, as directed by President Clinton in 1994. The merger creates the most technologically advanced weather sensing system in the world and promises major savings for the Air Force in the future, officials said.

■ The Army's new AH-64D Apache Longbow helicopter debuted in a demonstration conducted at Ft. Hood, Texas, on June 12. The craft's sophisticated radar and electronics are intended to feed real-time target data to commanders and other attack units in its immediate area.

■ The Defense Advanced Research Projects Agency is developing an Unmanned Aerial Vehicle helicopter that is intended to be able to stay aloft for more than 24 hours, according to *Jane's Defence Weekly*. ■

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- ATI Rage Pro Turbo 2X AGP Video Controller with 4MB (Upgradeable to 8MB) 100MHz SGRAM
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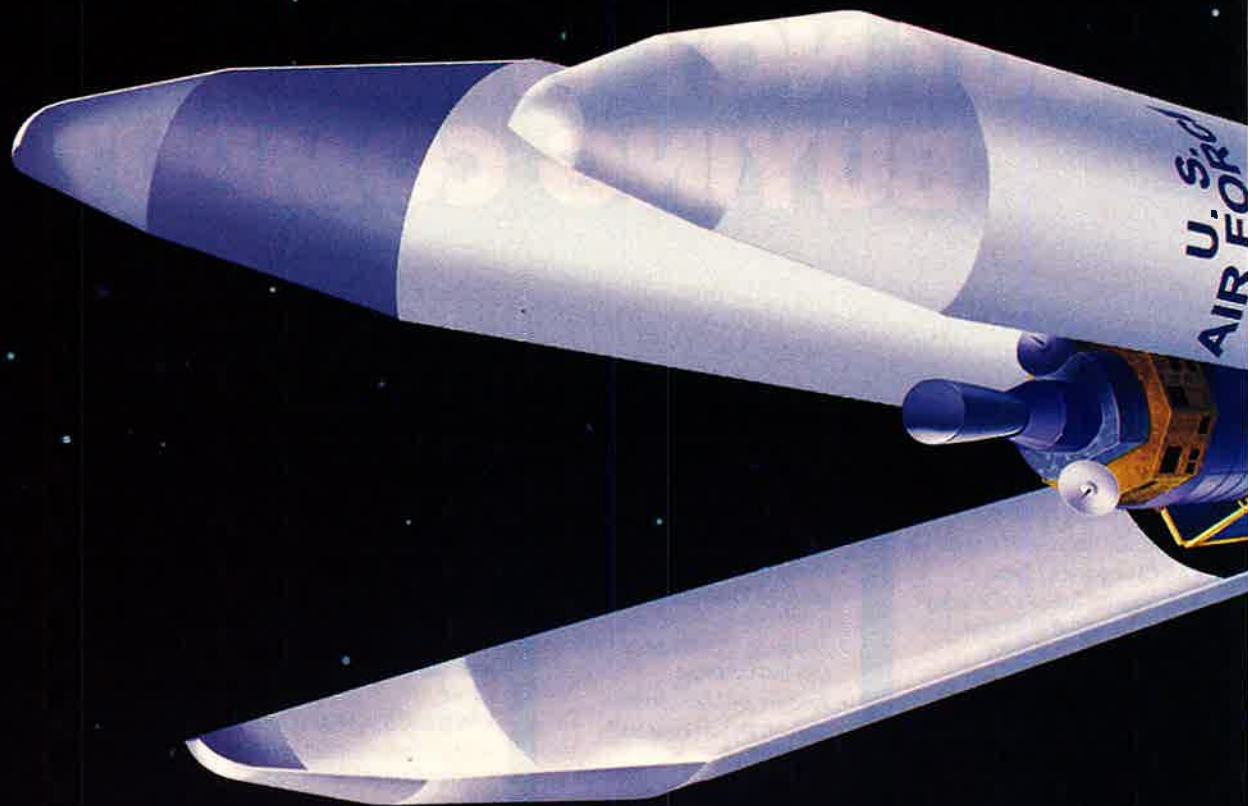
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Space Almanac



On the following pages appears a variety of information and statistical material about space—particularly military activity in space. This almanac was compiled by the staff of *Air Force Magazine*, with assistance and information from Dr. R.W. Sturdevant, Air Force Space Com-

mand History Office; Tina Thompson, editor of *TRW Space Log*; Phillip S. Clark, Molniya Space Consultancy, Whitton, UK; Joseph J. Burger, Space Analysis and Research, Inc.; and Air Force Space Command Public Affairs Office.

Figures that appear in this section will not always agree because of different cutoff dates, rounding, or different methods of reporting. The information is intended to illustrate trends in space activity.



Compiled by Tamar A. Mehuron, Associate Editor

A Boeing Delta IV Heavy lifts a satellite into Geosynchronous Transfer Orbit. The Delta IV Heavy is capable of lifting 33,000 pounds into GTO. Boeing is developing the Delta IV family of rockets in response to the US Air Force Evolved Expendable Launch Vehicle program.

The Year in Space

July 1–17, 1997 Shuttle *Columbia* (STS-94), with crew of seven astronauts, completes record 33-project science mission—fire, plant, crystal, and metal studies—cut short in April because of fuel cell problems.

July 4 Mars Pathfinder lands on surface of Red Planet and, next day, the lander is officially renamed *Carl Sagan Memorial Station* in honor of renowned astronomer who died in December 1996.

July 5 Sojourner rover rolls down stationary lander's ramp onto Martian soil, becoming first mobile, semiautonomous, robotic vehicle to traverse another planet's surface.

July 23 After failed attempt in January 1997, USAF successfully launches first Navstar GPS Block IIR satellite on Delta II booster from Cape Canaveral AS, Fla.

Aug. 5 Air Force Research Lab in its Warfighter-1 hyperspectral sensor demonstration departs from decades of tradition with dedicated intelligence satellites using agency-specific hardware and awards first satellite-imaging contract based on commercial technology to Orbital Sciences.

Aug. 7–19 Shuttle *Discovery* (STS-85) performs environmental study using Cryogenic Infrared Spectrometers and Telescopes for the Atmosphere—Shuttle Pallet Satellite-2 to measure trace gases that deplete ozone layer.

Aug. 22 Mir crew—two Russians and an American—repairs damage caused by collision of cargo ship with Spektr module June 25 and restores much of station's power-generating capacity.

Aug. 22 First successful launch of two-stage Lockheed Martin Launch Vehicle, subsequently renamed Athena I, places NASA's Lewis communications satellite in orbit.

Aug. 25 USAF launches NASA Advanced Composition Explorer to provide real-time data on solar disturbances to National Oceanic and Atmospheric Administration (NOAA) Space Environment Center in Boulder, Colo.

Aug. 27 Proton K rocket from Baikonur, Kazakhstan, launches PanAmSat Corp.'s PAS-5 communications satellite, first commercial spacecraft to use xenon ion propulsion, toward geosynchronous orbit.

Sept. 1 Air Force Reserve Command acknowledges increasing importance of military space operations by activating its first space group and a space operations squadron—the 310th and 8th, respectively.

Sept. 1 Although too late for John Blaha, who missed the 1996 presidential election because he was aboard Mir, democracy enters the Space Age with Texas law permitting registered voters flying in space to cast ballots via electronic mail.

Sept. 3 Boeing, working under USAF contract, unveils prototype of reusable space vehicle designed for military reconnaissance and quick deployment of small satellites.

Sept. 9 James W. Benson announces plan for his Colorado-based SpaceDev, Inc., to become first private organization to land spacecraft—Near Earth Asteroid Prospector—on asteroid to collect and

sell data, as well as stake commercial mining claim.

Sept. 11 Global Surveyor arrives at Mars and swings into initial orbit to map planet's atmosphere and surface from physical, chemical, meteorological, and, perhaps, biological perspectives.

Sept. 25–Oct. 6 Amidst congressional questions about whether US presence should continue aboard accident-prone, 11-year-old Russian space station, shuttle *Atlantis* (STS-86) carries astronaut David A. Wolf to Mir and picks up his colleague C. Michael Foale.

Oct. 4 In celebration of 40th anniversary of Sputnik 1 launch, Progress-M 36 cargo freighter carries Sputnik 40/RS-17 from Baikonur to Mir, where cosmonauts will hand-deploy the scale-model satellite Nov. 3.

Oct. 15 USAF Titan IVB Centaur launches plutonium-powered Cassini, with European Space Agency (ESA) Huygens probe and Italian Space Agency high-gain antenna, toward rendezvous with Saturn in July 2004.

Oct. 17 Mid-Infrared Advanced Chemical Laser sends beam 260 miles into space from White Sands Missile Range, N.M., and hits USAF's aging Miniature Sensor Technology Integration III satellite, marking first time US has fired a high-powered laser at an orbiting spacecraft.

Oct. 22 Space Test Experiment Platform (STEP) 4, launched via Pegasus XL booster, fails to deploy successfully, signaling end—with only one successful mission in five attempts (STEP 0–STEP 4)—of USAF Space Test Program experiments designed to evaluate standardized, flexible systems for future spacecraft using new generation of TRW-built, low-cost, lightweight satellites.

Oct. 30 First successful launch to orbit of Ariane 5 rocket from Kourou, French Guiana, carries two instrument platforms to measure launcher performance, as well as several experiments by young graduate trainees.

Nov. 2 Brazil's first space booster, 15 years in development by that nation's Air Force Space Research Institute, is destroyed 65 seconds after liftoff from Alcântara Launch Center.

Nov. 4 NASA's Solar and Heliospheric Observatory spacecraft detects first major flare—X flare—of new 11-year solar cycle.

Nov. 5 First outdoor test of laser-boosted "lightcraft" at White Sands Missile Range uses 10-kilowatt pulse-beam laser to boost vehicle to altitude of 50 feet.

Nov. 6 Astronomers using NASA's Rossi X-Ray Timing Explorer (RXTE) spacecraft report observing space-time distortion by a black hole, the first evidence to support prediction made in 1918 using Einstein's theory of relativity.

Nov. 12 Launch of Orbital Sciences' Cakrawarta-1, or Indostar-1, satellite marks first time outside vendor—Princeton Satellite Systems—supplied whole set of attitude control algorithms and their software implementation to spacecraft manufacturer for geosynchronous satellite.

Nov. 14 Representatives from NASA,

USAF, and industry break ground for X-33 RLV launch facility at Edwards AFB, Calif.

Nov. 19–Dec. 5 Shuttle *Columbia* (STS-87) tests sodium-sulfur batteries weighing one-third less than current nickel-hydrogen cells and promising to reduce launch costs by as much as \$4 million per flight, as well as a free-flying robotic camera intended for use during assembly of International Space Station.

December Virginia Commercial Spaceflight Authority receives license to operate commercial spaceport in US at NASA's Wallops Flight Facility, Va.

Dec. 16 Galileo Europa Mission begins with first of eight consecutive flybys of Jupiter's moon Europa and captures amazingly detailed images of its surface, which appears to be relatively young ice as thick as 1 kilometer in places.

Dec. 23 Orbcomm passes major milestone in its "Countdown to Global Service" with launch of eight LEO satellites via Pegasus XL from Wallops Flight Facility.

Dec. 24 Colorado-based EarthWatch's EarlyBird 1, first commercial satellite capable of intelligence-quality—3-meter resolution—imaging is successfully launched from Svobodny via Russian Start-1 booster, but ground controllers lose contact with spacecraft Dec. 28.

Dec. 25 Russia's Proton booster grounded after premature cutoff of fourth-stage engine leaves AsiaSat 3 spacecraft short of planned geostationary orbit. The booster will not return to service until April 1998 with the launch of seven Iridium satellites.

Jan. 6, 1998 First launch from Spaceport Florida Authority's Commercial Launch Complex 46 at Cape Canaveral AS and first operational use of Lockheed Martin's three-stage Athena II sends NASA's Lunar Prospector spacecraft toward moon.

Jan. 15 According to Ballistic Missile Defense Organization, a small piece of unidentified orbital debris destroys expended third stage of modified Minuteman II during test flight that involves Raytheon-built warhead tracking sensor—Exoatmospheric Kill Vehicle sensor—over Kwajalein Atoll in the Pacific.

Jan. 16 NASA Administrator Daniel S. Goldin announces that Sen. John Glenn (D-Ohio), at age 77, will return to space in October 1998 as payload specialist on STS-95 to assist with research on the aging process.

Jan. 22–31 Shuttle *Endeavour* (STS-89) carries Andrew S.W. Thomas to Mir to replace Wolf, making Thomas the seventh and last American to inhabit the Russian space station.

Jan. 29 Senior officials from US, Russia, and 13 other nations sign new agreement to cooperate in building International Space Station.

Feb. 10 Upgraded Taurus vehicle, making first use of USAF-designed payload isolator system—a ring of shock absorbers that replace bolts traditionally used to fasten satellite to launch vehicle—launches US Navy's GeoSat Follow-On oceanographic satellite and two Orbcomm telecommunications satellites.

Feb. 14 Deployment of Globalstar's \$2.6 billion, 48-satellite constellation for telecommunications begins with launch of first four spacecraft on Boeing's new Delta II/7420 booster.

Feb. 17 Voyager 1, launched from Kennedy Space Center, Fla., Sept. 5, 1977, becomes most distant human-made object in space at 6.5 billion miles from Earth.

Feb. 24 USAF awards Boeing a four-year contract to design and build experimental Solar Orbit Transfer Vehicle to demonstrate radically cheaper means of boosting payloads into high orbits.

Feb. 25 Pegasus XL launches two small satellites: Student Nitric Oxide Explorer (SNOE), developed by University of Colorado at Boulder, to study how nitric oxide layer at approximately 70 miles altitude causes drag on satellites and the space shuttle; and Teledesic Corp.'s experimental T1 satellite—designed, built, and launched in less than one year—enters orbit to conduct tests for fielding a \$9 billion, 288-satellite fleet offering "Internet in the sky" services as early as 2002.

March 5 NASA announces that a neutron spectrometer aboard its Lunar Prospector, launched Jan. 6, has found "significant quantities of water-ice at both lunar poles."

March 5 First Lady Hillary Rodham Clinton announces that USAF Lt. Col. Eileen Collins, already first female shuttle pilot, will become first woman to command a US spaceflight—*Columbia* (STS-93).

March 12 NASA's X-38 lifting body, the crew-return "lifeboat" for International Space Station, completes first unpiloted flight test after being released from beneath wing of B-52 approximately 23,000 feet over the Mojave Desert in Calif.

March 16 Navy's eighth Ultrahigh frequency Follow-on (UFO) Satellite, first DoD communications spacecraft to carry three distinct payloads in three spectra—including package for new Global Broadcast Service (GBS)—enters orbit atop Atlas II launched from Cape Canaveral AS.

April 1 Pegasus XL from Vandenberg AFB, Calif., launches NASA's Transition

Region and Coronal Explorer (TRACE) spacecraft to collect data on shape and behavior of upper solar atmosphere, which affects satellite communications and Earth's climate.

April 3 Spin-2 satellite, sponsored jointly by Aerial Images, Inc., of Raleigh, N.C., and Sovinform Sputnik, a branch of Russian Space Agency, lands at Baikonur after 45-day mission to obtain 2-meter-resolution images of southeastern US.

April 7 ESA announces that its Infrared Space Observatory (ISO), after orbiting Earth for over two years, has detected water vapor in the atmosphere of Titan, Saturn's largest moon, and elsewhere in universe.

April 17 Ulysses, joint NASA-ESA solar probe launched in 1990, completes first orbit of sun having delivered reams of data about solar wind and sun's magnetic field.

April 17-May 3 Shuttle *Columbia* (STS-90) NeuroLab mission, seeking to unlock mysteries of brain and nervous system, uses more than 2,000 animals—rodents, fish, snails, and crickets—to perform several space firsts: direct nerve recordings, joint recording of sleep and breathing, embalming of animals, and surgery on animals meant to survive.

April 28 Ariane 4 from Guiana Space Center, Kourou, launches first Egyptian satellite, NileSat 101, for Egyptian Radio and Television Union.

April 30 Pentagon awards Boeing a three-year, \$1.6 billion contract to design, develop, and test variety of components for National Missile Defense system.

May 13 NOAA-K meteorological satellite, launched via Titan II from Vandenberg AFB, includes first flight of Advanced Microwave Sounding Unit to peer through cloud cover for better monitoring of hurricanes and other severe storms.

May 14 NASA announces Hubble Space Telescope has provided unprecedented multiple views of "galactic cannibalism"—massive black hole at center of nearby giant galaxy that is feeding on smaller galaxy.

May 19 Due to failure of its attitude con-

trol processors, PanAmSat's Galaxy IV spacecraft begins tumbling and leaves approximately 90 percent of America's 35 million pager customers without service.

May 20 NASA announces that combination of data gathered from Rossi X-Ray Timing Explorer and Advanced Satellite for Cosmology and Astrophysics confirms existence of "magnetars," a special class of neutron stars with magnetic fields one thousand trillion times stronger than Earth's.

May 28 NASA announces Hubble Space Telescope has provided first image of possible planet orbiting another star.

May 29 In first ever transfer of an operational military space system to a civilian agency, Air Force hands control of Defense Meteorological Satellite Program (DMSP) spacecraft to NOAA per 1994 White House directive to merge US military and civilian weather satellite programs.

June 1 Pentagon merges high-level management of classified and unclassified satellite systems under newly established Deputy Assistant Secretary of Defense for Command, Control, Communications, Intelligence, Surveillance, and Reconnaissance (C³ISR) and Space Systems.

June 2-12 Shuttle *Discovery* (STS-91), using super-lightweight external tank for first time, completes ninth docking mission with Mir and retrieves astronaut Thomas, thereby ending 812 days of continuous US presence in space.

June 17 Hughes, completing first commercial mission to the moon, uses dual lunar flybys to maneuver AsiaSat 3 (now designated HGS-1), left in unusable, highly elliptical orbit after Dec. 25, 1997, launch anomaly, into usable, geosynchronous orbit.

June 17 National Reconnaissance Office lifts veil of secrecy surrounding first US signals intelligence satellite, Galactic Radiation and Background Experiment (GRAB), launched June 22, 1960.

Recent Space Issues and Developments

■ Advanced technology launchers

The nation continues its efforts to develop new, lower cost launch vehicles. The Air Force announced in November 1997 that it would award two development contracts for its Evolved Expendable Launch Vehicle (EELV) rather than select a single contractor. In September 1998, USAF expects to award contracts for development and initial launch services to both Boeing and Lockheed Martin. Each contractor has been working the 17-month pre-engineering and manufacturing development phase of the program. EELV is aimed at evolving current launcher systems into a common core family of medium- and heavy-lift boosters with launch costs 25 to 50 percent lower than today's rockets. The first medium launch is scheduled for

Fiscal 2002, and the first heavy launch is scheduled for Fiscal 2003. In addition, several US companies, with some USAF support, are planning reusable or inexpensive disposable boosters for smaller satellites. Some of these private boosters are scheduled for launch later this year.

■ Commercial remote sensing

This year, two commercial companies operating high-resolution, remote-sensing satellite systems are expected to begin selling data to DoD, as well as many commercial and international customers. EarthWatch, Inc., orbited its first satellite, capable of providing imagery with 3-meter resolution, Dec. 24, 1997. It failed four days later. Space Imaging, Inc., their leading competitor, plans to launch Ikonos 1,

capable of 1-meter imagery, this year. EarthWatch will orbit QuickBird 1, an 82-centimeter system in 1998. Ikonos 2 and QuickBird 2 will be launched within the next eight months. Other companies will follow suit in the next few years. The images will be useful for a variety of tactical defense missions and for mapping. The companies also expect to sell imagery to commercial and civil users to help agricultural production, urban planning, transportation planning, and many other endeavors.

■ Communications

The LEO multisatellite communications system presents a need for DoD access. One of the methods is to use individual access devices. But a more efficient method is working through a gateway facility. The companies, with

the support of DoD, are looking into a mobile gateway that can be transported to any crisis area. This has the additional capability for high level security in the communicators using the constellation. In another area, USAF last year awarded a \$59.2 million contract to develop and produce an engineering prototype for DoD's next generation satellite communications system. This advanced extremely high frequency system will include onboard processing capabilities 10 times that of the current Milstar system. Procurement is expected in 2001, with deployment in 2006.

■ Space Based Laser (SBL)

With the spread of weapons of mass destruction and missile technology, the US and its allies are increasingly in danger of ballistic missile attack from many countries. The Patriot missile system is of some help in a theater role, as will be USAF's Airborne Laser system. To supplement them, the Ballistic Missile Defense Organization, USAF, TRW, and Boeing are working on the SBL Readiness Demonstrator program. The SBL could add a third tier to theater defense, and it would be available to defend a theater commander in minutes, rather than the days or weeks required by conventional missile defense batteries. Using the Alpha Laser, the plan is to intercept the boosters when they clear the Earth's atmosphere, as the laser cannot penetrate to the ground.

■ Space Debris

The number of objects cataloged by US Space Command in the last two years was in excess of 1,500. The potential for major explosions of payloads or rocket bodies, like the explosion of the Pegasus fourth stage launched in May 1994 that resulted in over 680 new pieces in space, is increasing with all the new payloads being launched. Sometimes there are as many as 12 payloads per launch. Because of this, NASA and DoD have established an Orbital Debris Working Group. The first meeting was held in January 1998. Co-chairmen of the working group are Col. James Brechwald of Air Force Space Command and Nicholas Johnson of NASA. The focus will be on collection and interpretation of orbital debris space surveillance data to better define the current near-Earth environment. They also discussed plans and techniques for evaluating the threat of the 1998 Leonid Meteor Stream/Storm.

■ Unified Command Plan (UCP) for US Space Command

The UCP, which was signed into law in January 1998, states that unless otherwise directed by the Secretary of Defense, USCINCSpace will serve as the single point of contact for military space operational matters, to include communications. USCINCSpace must coordinate with other appropriate CINCs when undertaking any military activities with other nations or unilaterally in the area of responsibility of another CINC. USSPACECOM will also work with other US government, commercial, and international agencies on military space operations issues, as well as provide space expertise to other CINCs to plan, implement, and

US Space Funding				
(Millions of current dollars)				
FY	NASA	DoD	Other	Total
1959	\$ 261	\$ 490	\$ 34	\$ 785
1960	462	561	43	1,066
1961	926	814	69	1,809
1962	1,797	1,298	200	3,295
1963	3,626	1,550	259	5,435
1964	5,016	1,599	216	6,831
1965	5,138	1,574	244	6,956
1966	5,065	1,689	217	6,971
1967	4,830	1,664	216	6,710
1968	4,430	1,922	177	6,529
1969	3,822	2,013	141	5,976
1970	3,547	1,678	115	5,340
1971	3,101	1,512	127	4,740
1972	3,071	1,407	97	4,575
1973	3,093	1,623	109	4,825
1974	2,759	1,766	116	4,641
1975	2,915	1,892	106	4,913
1976	4,074	2,443	143	6,660
1977	3,440	2,412	131	5,983
1978	3,623	2,738	157	6,518
1979	4,030	3,036	177	7,243
1980	4,680	3,848	233	8,761
1981	4,992	4,828	233	10,053
1982	5,528	6,679	311	12,518
1983	6,328	9,019	325	15,672
1984	6,858	10,195	392	17,445
1985	6,925	12,768	580	20,273
1986	7,165	14,126	473	21,764
1987	9,809	16,287	462	26,558
1988	8,322	17,679	737	26,738
1989	10,097	17,906	560	28,563
1990	11,460	15,616	512	27,588
1991	13,046	14,181	697	27,924
1992	13,199	15,023	769	28,991
1993	13,064	14,106	698	27,868
1994	13,022	13,166	601	26,789
1995	12,543	10,644	629	23,816
1996	12,569	11,514	750	24,833
1997	12,457	11,727	727	24,911
Total	241,090	254,993	12,783	508,866

Figures are expressed in current dollars and are rounded. NASA totals represent space activities only. "Other" category includes the Departments of Energy, Commerce, Agriculture, Interior, and Transportation; the National Science Foundation; the Environmental Protection Agency; and other agencies. (Note: NSF recalculated its space expenditures since 1980, making them significantly higher than reported in previous years.) Fiscal 1997 figures are preliminary.

assess security assistance. The command will develop space campaign planning as part of the joint planning process for the National Military Strategy. It will also be the focal point for countering the proliferation of weapons of mass destruction in space.

■ Vision for 2020

The two principal themes of the US Space Command Vision are dominating the space medium and integrating spacepower throughout military operations. To transform the vision into capabilities, the command has adopted four operational concepts: Control of

Space, Global Engagement, Full Force Integration, and Global Partnerships. US Space Command's end-to-end planning system uses Joint Vision 2010, the National Security Space Master Plan, and the US Space Command Vision as overarching guidance. Annually the command assesses current and future space requirements, capabilities, and shortfalls in its support of warfighters. With its vision, USSPACECOM expects to extend the time horizons from the Future Years Defense Plan to 2020.

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Proposals and Prospects

Launcher Concepts

■ Astroliner

The Astroliner from Kelly Space & Technology is a manned Single-Stage-To-Orbit (SSTO) vehicle that will deliver satellites into LEO. It will be towed by a 747 aircraft to 20,000 feet and released. (The towing concept was tested successfully six times between Dec. 20, 1997, and Feb. 6, 1998, using a QF-106 and C-141.) The Astroliner's internal motors will then be fired. When in space, the cargo doors will be opened and the satellite and its booster will be released. The Astroliner will coast up to about 95 nautical miles before it starts its reentry and comes in for a normal airplane-like landing. It can be launched from any airfield of 10,000 feet in length. From Kennedy Space Center, Fla., it can place an 8,800-pound package into a 28.5°, 100-nautical mile orbit. Suborbital test flights are planned for mid-2001, with orbital flights later that year or early 2002. The number to be built will depend on the need for launch services.

■ Atlas III

The Atlas IIIA and IIIB are the new names for Lockheed Martin's Atlas IIAR and IIARC. The Atlas III reduces the number of engines and staging events and requires 15,000 fewer parts. Using the Centaur upper stage, the Atlas IIIA can lift 8,940 pounds to GTO. The first flight is expected in December 1998. The Atlas IIIB will use a stretched dual-engine Centaur upper stage and be capable of lifting 9,920 pounds to GTO.

■ BA-1

Beal Aerospace Technologies announced June 16 that it would move directly to development of its commercially financed BA-2 Ariane 5-class ELV, bypassing the smaller BA-1 it had intended to build first. The BA-1 was projected to lift about 5,800 pounds to GTO, while the BA-2 will transport payloads weighing more than 11,000 pounds to GTO. The Texas corporation plans to launch the three-stage BA-2 from the UK dependency of Anguilla in the Leeward Islands. The actual launch site will be on Sombrero island (18.5° north), on which Beal has a 98-year lease. The first launches are planned for late 1999.

■ Delta IV

The Boeing EELV program is a multiyear US Air Force effort to reduce launch costs by up to 50 percent. The three variants that will be available in the next century are the Small (4,800 pounds to GTO), Medium (10,000 pounds to GTO), and the Heavy (33,000 pounds to GTO).

■ Intrepid I and II

Universal Space Lines plans to build two Intrepid ELVs that will be launched from Kodiak Island in the Gulf of Alaska. The simplicity of the design makes them very cost-effective. It is estimated that as few as 10 people will be needed for a launch.

Intrepid I will probably be capable of launching 1,000 pounds to LEO polar orbit. Intrepid II will probably be capable of lofting 5,000 pounds to a similar orbit. Current plans call for operations beginning 1999-2000.

■ K-1

Kistler Aerospace's K-1 two-stage RLV is scheduled for its first launch in late 1998. Because the US government has not approved launch from Nevada, where Kistler is working to establish a test facility, the first launch will be out of Woomera, Australia. Kistler plans to build five launchers using Russian NK-33 and NK-43 rocket motors. Each will be used 100 times, as both stages will be returned to Earth using parachutes and air bags. Launching due east from the Nevada site, the K-1 can place 3,400 pounds into a 650-mile orbit. A nine-day turnaround is planned.

■ MLV-D, MLV-A, HLV-L, and HLV-G

The Lockheed Martin concept for the EELV calls for a family of four vehicles featuring a number of common elements. Those elements include the company's 12.5-diameter, structurally stable Common Core Booster, a common propulsion system featuring the RD-180 engine, and standard commercial payload adapters and avionics. The four vehicles are the MLV-D (8,575 pounds to LEO; 4,060 pounds to GTO), MLV-A (16,100 pounds to LEO; 8,500 pounds to GTO), HLV-L (41,000 pounds to LEO), and HLV-G (13,500 pounds to GEO).

■ Roton

Rotary Rocket Co.'s Roton is an inexpensive, piloted, fully reusable SSTO space vehicle. It is unique in that it is designed to return to Earth with a fully loaded cargo bay. Although initially intended for the LEO telecommunications markets, the piloted return capability will appeal to the space manufacturing industry. Rotary Rocket says it can deliver 7,000 pounds to a 200-mile circular orbit from their Mojave, Calif., launch site. The first flight tests are planned for the spring-summer of 1999 and will be suborbital. The first flights to orbit will be in late 1999 or early 2000 and probably carry either developmental or microgravity payloads that will be brought back to Mojave after a one or two orbit flight. Three to five Rotons are to be built initially and production is expected to continue as the market builds. Each Roton is designed to make at least 100 flights. A one- to two-day turnaround is expected.

■ Sea Launch

Sea Launch Co. is a partnership among Boeing, Kvaerner Maritime a.s. of Norway, RSC Energia of Moscow, and KB Yuzhnoye/PO Yuzhmash in Ukraine. The assembly and command ship and the launch platform have both passed their sea trials. From their home port of Long Beach, Calif., the first launch of the Galaxy XI satellite is scheduled for October 1998. Launching on the equator

at 154° west longitude near Christmas Island, the Zenit launcher can place an 11,000-pound payload into GTO. Sea Launch has 17 additional launches purchased.

■ VentureStar

If Lockheed Martin's X-33 (see below) technology proves to be promising, a full-scale RLV will be built. Technology development will continue through 1999 when, if the concept seems viable, vehicle development will take place. The planned VentureStar will be capable of lifting 24,250 pounds to the International Space Station. The cost per pound to orbit is expected to be a small fraction of the current costs of more than \$10,000 per pound. The first flight is planned for the beginning of 2004.

■ X-33

The Lockheed Martin X-33 is a 53 percent-scale working model of the VentureStar RLV. The X-33 will take off vertically from Edwards AFB, Calif., and land horizontally on 15 planned missions. The short missions (14 minutes) will climb to 31 miles and land at Michael Army Air Field, Utah. The long missions (24 minutes) will climb to 47 miles and land at Malmstrom AFB, Mont. Flights are scheduled to begin mid-1999. If the X-33 technology works, it will be transferred to the VentureStar vehicle that is planned to go into space.

■ X-34

The X-34 is Orbital Sciences' RLV technology demonstrator built under contract to NASA. The X-34 will be carried to altitude by an L-1011. When released it will reach speeds of Mach 8 and an altitude of 41 nautical miles. It will then return to its launch base. The technology learned will be used in the VentureStar program or to build a usable follow-on. A 24-hour turnaround on a surge basis is planned.

Satellite Concepts

■ Combined weather satellites

Civil and military weather LEO polar satellites are being merged into a single system. The number of satellites will be reduced from four to three, with savings now estimated at \$560 million through 1999. DoD and NOAA are coordinating the purchase of the remaining satellites. NOAA, DoD, and NASA are maintaining a tri-agency office for the National Polar-Orbiting Operational Environmental Satellite System, which took responsibility for DMSP in May. Operational control at the primary site in Suitland, Md., began May 29, 1998, with the backup site at Schriever AFB, Colo. The first NPOESS satellite is now scheduled for launch in 2007.

■ Milstar II

The last four Milstar satellites will have a higher data-rate capability added to respond to a shift in emphasis since the

end of the Cold War from mostly strategic users to a more tactical use. The medium-data-rate payload takes advantage of current technology and includes two Nulling Spot Beam Antennas that give the satellite an antijam capability. The launch dates for the satellites are January and December 1999, November 2000, and October 2001.

■ **Space Based Infrared System (SBIRS)**

Advanced infrared sensing satellites to replace the Defense Satellite Program satellites and perform the four space surveillance missions of missile warning, theater and National Missile Defense, battlespace characterization, and technical intelligence. The SBIRS architecture will deploy a combination of GEO, highly elliptical orbit, and LEO satellite constellations to detect and track advanced missile threats that will not be detected by currently fielded DSP surveillance satellites. SBIRS high constellation will include four GEO satellites and two sensor payloads hosted on highly elliptical orbit satellites. The SBIRS high component, now in the Engineering and Manufacturing Development phase, provides a near-term capability in all four infrared mission

areas (first launch in 2001). The SBIRS low constellation of 20 or more LEO satellites further enhances the SBIRS high and provides the unique capability to track ballistic missiles after booster burnout, significantly enhancing our nation's ability to target enemy warheads in midflight for intercept and destruction. The SBIRS low component is currently in program definition and risk reduction phase, with two contractor teams scheduled to launch demonstration satellites in 1999. An SBIRS low EMD milestone decision is planned in Fiscal 2000 with first operational satellite launch projected for Fiscal 2004. SBIRS low was formerly known as the Space and Missile Tracking System and, prior to that, as Brilliant Eyes.

■ **Small satellites**

The National Reconnaissance Office decided in 1996 to move to a smaller class of satellites than the very large spacecraft that had supported its intelligence-gathering mission in the past, after pressure from Congress and an independent advisory panel. Details of the new satellites and design changes to current satellites to downsize them remain classified, but one indication of a drop in satellite size was a decision to switch some NRO payloads from the

large Titan IV to Atlas-class launchers in the next decade. The NRO study, completed in 1997, provided intelligence leaders and the Secretary of Defense with options on how to proceed with NRO's adoption of small satellites. The Air Force Research Lab's Space Vehicles Directorate at Kirtland AFB, N.M., is a leader in the development of advanced technology for small satellites. It is involved in the Space Test Experiment Platform series of satellites, having successfully launched the STEP/Technology for Autonomous Operational Survivability satellite, which has passed its fourth anniversary. Additionally, the directorate is developing the Clementine 2 microsatellite's mother ship, which will be launched later this year. There is also a new, inexpensive series of spacecraft known as MightySat, the first of which is to be launched in September 1998. The Kirtland operation also has a program called the Integrated Space Technology Demonstration, which supports the integration and demonstration of technologies critical to the warfighter. It is also involved in NASA's Lewis (failed) and Clark (canceled) and New Millennium small-satellite projects.

Major Military Space Commands

	Personnel	Budget, FY 1999	Activities
Unified Command US Space Command Peterson AFB, Colo.	851	\$18.0 million	Responsible for placing DoD satellites into orbit and operating them; supports unified commands with space-based communications, weather, intelligence information, navigation, and ballistic missile attack warning; enforces space superiority through protection, prevention, negation, and surveillance; ensures freedom of access to and operations in space and denies same to adversaries; applies force from or through space; plans for and executes strategic ballistic missile defense operations; supports NORAD by providing missile warning and space surveillance information; advocates the space and missile warning requirements of the other unified commands.
Service Command Air Force Space Command Peterson AFB, Colo.	37,797	\$1.7 billion	Operates military space systems, ground-based missile-warning radars and sensors, missile-warning satellites, national launch centers, and ranges; tracks space debris; operates and maintains the USAF ICBM force (a component of US Strategic Command). Budget includes funding for 11,326 contractor personnel and operations and maintenance for seven bases and 50 worldwide sites.
Naval Space Command Dahlgren, Va.	521	\$79.7 million	Operates assigned space systems for surveillance and warning; provides spacecraft telemetry and on-orbit engineering; develops space plans, programs, concepts, and doctrine; advocates naval warfighting requirements in the joint arena. Budget includes funding for nearly 100 contractor personnel and operations and maintenance of headquarters, component commands, and field sites.
Army Space Command Colorado Springs, Colo.	625	\$51.0 million	Manages joint tactical use of DSCS through the 1st Satellite Control Battalion; operates the Army Space Support Teams and Army Space Support Cell; operates the Joint Tactical Ground Stations; operates the Army National Missile Defense Element; manages the Army Astronaut Program.

Major Military Satellite Systems

Global Positioning System (GPS)

Constellation of 24 satellites used by military and civilians to determine a precise location anywhere on Earth. A small receiver takes signals from four GPS satellites and calculates a position. The satellites transmit a highly precise signal to authorized users, permitting accurate navigation to within 16 meters. DoD has deployed more than 110,000 GPS receivers to US government and allied users, with terminals becoming much more widely available since the 1991 Persian Gulf War. Civilians use a commercial version of the terminals, with a degraded signal with an accuracy to 100 meters. Receivers are priced as low as \$200. The less accurate signal prevents adversaries from using GPS for precision weapons targeting. Civilian users are working to obtain a much better signal through auxiliary equipment, known as differential GPS, that corrects the degradation. DoD has become increasingly concerned about enemy use of GPS during a conflict and has begun an effort called NAVWAR (navigation warfare) to protect its advantage while preventing adversary use of GPS. GPS III is an overarching requirements process to develop a document that encompasses civil, military, scientific, and commercial use of GPS. It is also referred to as positioning, navigation, and timing. The current constellation is 25 operational Block II/IIA series and one test-and-checkout satellite. The GPS office has procured 21 Block IIR replenishment satellites. GPS IIR-2 was destroyed in the January 1997 Delta rocket explosion. GPS IIR-3 was launched July 23, 1997. No IIR satellites are scheduled for launch in 1998. One is scheduled for February 1999 and a second in September 1999.

Defense Satellite Communications System (DSCS)

Constellation of five primary spacecraft in geostationary orbit provides voice, data, digital, and television transmissions between major military terminals and National Command Authorities. Secure voice and high-data-rate communications, operating in superhigh frequency, primarily for high-capacity fixed users. Four DSCS satellites remain to be launched in 1999–2003. Launches are scheduled for July 1999, July 2000, May 2002, and May 2003. The Air Force has funded a program that will allow more tactical users access on DSCS. The Pentagon is developing the architecture to replace the capacity in the next decade.

Milstar

The first two Milstars of an intended constellation of four that would provide coverage between 65° north and 65° south latitude are in orbit. The first \$1 billion Milstar was launched Feb. 7, 1994, and the second Nov. 5, 1995. Originally conceived as a communications system that could survive a nuclear conflict and connect Na-

tional Command Authorities to commanders of ships, aircraft, and missiles during war, the system's design and application have been altered in the aftermath of the Cold War. Milstar currently serves tactical forces as well as strategic, and the last four Milstars (Milstar IIs) will include medium-data-rate payloads able to transmit larger volumes of data up to 1.45 mbps. The four are scheduled for launch between January 1999 and October 2001. All satellites have low-data-rate payloads providing communications at five bps to 2.4 kbps. The system can handle a data stream equal to 50,000 fax pages an hour and 1,000 simultaneous users. The satellites are designed to be jam-proof and use sophisticated techniques to provide secure communications.

Defense Support Program (DSP)

Infrared detectors aboard these satellites have provided early warning of ballistic missile attack to NORAD since the 1970s. During Operation Desert Storm, operators at Space Command used DSP data to provide warnings of Scud attacks to theater commanders, though DSP was not designed to spot and track smaller missiles. Information on procurement situation, number of satellites launched, and number to be launched is classified. DoD intends to replace the system with a new spacecraft, the Space Based Infrared System (SBIRS), designed to spot and track the smaller, faster-burning theater missiles that have proliferated in recent years. It will be fielded in three increments: Increment 1, Fiscal 1999; Increment 2, Fiscal 2002; and Increment 3, Fiscal 2006.

Defense Meteorological Satellite Program (DMSP)

Weather satellites, whose flight operations were transferred from the military to NOAA in May 1998, operate in LEO to collect and disseminate global weather information directly to the warfighter and government agencies. Operating in a two-satellite constellation, each spacecraft collects high-resolution cloud imagery (visible and infrared) from a 1,800-mile-wide area beneath it. Satellites collect other specialized data, such as atmospheric temperature and moisture, snow cover, precipitation intensity and area, and oceanographic and solar-geophysical information for DoD air, sea, land, and space operations. Five satellites remain to be launched (USAF launched its last April 4, 1997). Joint satellites will be procured with NOAA for the follow-on system, with the first to be launched in the 2007–10 time frame. It will be called the National Polar-Orbiting Operational Environmental Satellite System (NPOESS).

Fleet Satellite Communications (FLTSATCOM)

Constellation of four satellites operated by USN, USAF, and the presidential command network. A secure link among the three, providing ultrahigh frequency (UHF)

communications. Satellites carry 23 channels for communications with naval forces, nuclear forces, and National Command Authorities. The last two FLTSATCOM satellites (Flights 7 and 8) carry extremely high frequency (EHF) payloads. In operation since 1978 in geostationary orbit, with a minimum of four satellites needed for worldwide coverage.

UHF Follow-On (UFO) Satellites

New generation of satellites providing UHF communications to replace FLTSATCOM satellites. UFO satellites have 39 channels—compared to the FLTSATCOM's 23—are bigger, and have higher power. Compatible with the same terminals used by the earlier systems. UFO-4 was first in the series to include an EHF communications payload with enhanced antijam telemetry, command, broadcast, and fleet interconnectivity. EHF channels provide an additional 11 channels. Ten UFO satellites were ordered; eight have been launched and are operational.

Global Broadcast System (GBS)

GBS is projected to be a high-speed, one-way broadcast communications system that provides high-volume information worldwide directly to theater warfighters. GBS will provide data to large populations of dispersed users with small, mobile receiver terminals. These terminals will allow data to be disseminated directly to lower-echelon forces, providing current weather, intelligence, news, imagery, and other mission-essential information. GBS will be implemented in three phases. Phase 1 will consist of leased commercial transponders. Phase 2 will consist of GBS packages aboard three UFO satellites. Phase 3 will be an objective system consisting of military assets, a commercial leased system, or a combination of the two.

Dark and Spooky

An undisclosed number and type of intelligence satellites are operated by intelligence agencies in cooperation with the military. The missions and, especially, the capabilities are closely guarded secrets. Using a page from the Soviet book on naming satellites, the US government started in the 1980s calling all government satellites "USA" with a sequential number. This allowed them to keep secret the names of satellites which monitor the Earth with radar, optical sensors, and electronic intercept capability. Most of the names of satellites, like White Cloud (ocean reconnaissance), Aquacade (electronic ferret), and Trumpet (Sigint) are secret and cannot be confirmed by the Intelligence Community. However, the move to declassify space systems has begun, leading to the release of selected information on some systems. Pictures of the Lacrosse radar imaging satellite have been released without details on the system. Details of the Keyhole optical imaging systems in the Corona program have been released.

Major US Civilian Satellites in Military Use

Advanced Communications Technology Satellite (ACTS)

NASA's ACTS was launched in 1993 on the space shuttle to demonstrate Ka-band communications and onboard switching equipment. Military use of the technology demonstration satellite included communications service to US Army troops deployed to Haiti in 1994.

Geostationary Operational Environmental Satellite (GOES)

NOAA operates GOES-8 and GOES-9. GOES-7 provides backup. Satellites hover at 22,300 miles altitude over the equator, monitoring storms and tracking their movements for short-term forecasting. Satellites are a new design that has improved spatial resolution and full-time operational soundings of the atmosphere.

Globalstar

Globalstar L.P. filed an FCC application in June 1991 for the \$2 billion Globalstar mobile communications system of 48 satellites plus eight satellites as backups. Two Delta II ELVs have launched eight satellites through May 1998. The system has been used for communications links already and will continue to be expanded with three launches of SL-16 Zenit launchers out of Tyuratam, Kazakhstan, with 12 satellites each in 1998. The three final launches will also be from Tyuratam on SL-04 Soyuz launchers with four satellites each, during the first half of 1999. Globalstar has looked into a deployable mobile gateway that would permit more terminals in a given area and allow DoD to add security controls.

International Telecommunications Satellite Organization (Intelsat)

Established in 1964 to own and operate a global constellation of communications satellites. Has 143 members and 21 operational satellites. Intelsat is in the process of restructuring into an intergovernmental treaty organization, which will continue to provide basic global satellite connectivity, and a commercial spin-off called New Skies, which has been given seven satellites for competitive services like broadcasting and data networking. The restructuring was approved in May 1998. US signatory to Intelsat is Comsat Corp. The US military uses the system for routine communications and to distribute the Armed Forces Radio and TV Services network and used it to set up a Very Small Aperture Terminal data network for field commanders in Bosnia in 1996.

International Mobile Satellite Organization (IMSO)

Formerly called International Maritime Satellite (Inmarsat) Organization. They have retained the Inmarsat name for their satellites. Established in 1979 to own and operate satellites for mobile communications. Has 79 member-coun-

tries. IMSO is 10.5 percent owner of ICO Global Communications, which was spun off as a separate company in 1995 to develop a satellite system for global mobile telephone services. IMSO operates seven satellites, including the first three of the third-generation Inmarsat 3 series and one Inmarsat 2 satellite. Another three satellites serve as orbital spares. The spacecraft are sometimes used by military forces for peacetime mobile communications services. Inmarsat is prohibited by convention from being used for military purposes. Briefcase- and laptop-sized satellite telephone terminals are used to communicate through the satellites. Inmarsat use in Somalia and Bosnia included the transmission of medical data and supply orders.

Iridium

Motorola announced its Iridium mobile communications system plan in June 1990. Iridium, Inc., was incorporated in June 1991 to own and operate the 66-satellite (plus spaceborne spares) system. The system applications are for voice, fax, and data transmission worldwide using satellite-to-satellite or satellite-to-ground interfaces. The system was started with the launch of five satellites on a Delta II out of Vandenberg AFB on May 5, 1997. During the past year 21 satellites were launched from Tyuratam on three Russian SL-12 Proton launchers; six (plus two test loads) were launched from Taiyuan, China, on four Long March-2C boosters; 45 have been launched on nine Delta IIs from Vandenberg AFB. The system is being checked out and will be operational in September 1998. DoD will have 2,000 people using

the system, with a potential for as many as 120,000 users.

Landsat

US government's civilian remote sensing satellite system. Used in polar orbit since 1972. Carries a multispectral scanner able to operate at a resolution of 30 meters and provide imagery that can be computer enhanced to show deforestation, expanding deserts, crop blight, and other phenomena. Space Imaging EOSAT operates the aging Landsat 5. The government plans to launch a Landsat 7 satellite in 1998. Military use of Landsat imagery has included mapping and planning for tactical operations.

NOAA-12, NOAA-14, and NOAA-15

Three polar orbit satellites for long-term forecasting of weather, operated by NOAA. The satellites fly in a 450-nautical mile orbit, carrying visible and infrared radiometry imaging sensors and ultraviolet sensors to map ozone levels in the atmosphere. Provide weather updates for all areas of the world every six hours to civil and military users. NOAA-15 (formerly NOAA-K) was launched May 13, 1998, and will replace NOAA-12. Launch of NOAA-L is planned for 1999.

Orbcomm

Orbcomm Global L.P.'s first two satellites were launched in April 1995, and commercial service in the US and Canada began in February 1996. Orbcomm is a joint venture between Orbital Sciences and Teleglobe of Canada. Orbcomm's satellite constellation will comprise 28 satellites, with an additional

Worldwide Launches by Site, 1957-97

Launch Site	Nation	Launches
Plesetsk	Russia	1,445
White Sands Missile Range, N.M.	US	1,105
Tyuratam/Baikonur	Kazakhstan	1,019
Vandenberg AFB, Calif.	US	527
Cape Canaveral AS, Fla.	US	524
Poker Flat Research Range, Alaska	US	274
JFK Space Center, Fla.	US	107
Kapustin Yar	Russia	83
Kourou	French Guiana	102
Tanegashima	Japan	29
Shuang Cheng-tzu/Jiuquan	China	23
Wallops Flight Facility, Va.	US	24
Uchinoura	Japan	22
Xichang	China	23
Indian Ocean Platform	Kenya	9
Sriharikota	India	8
Edwards AFB, Calif.	US	5
Hammaguir	Algeria	4
Taiyuan	China	4
Yavne	Israel	3
Woomera	Australia	2
Svobodny	Russia	2
Gando AFB, Canary Islands	Spain	1
Total		5,345

eight satellites to serve as ground spares or to be launched at a later date. Twelve were launched by early May 1998, with two more Pegasus XL launches of eight satellites each this year that will complete the constellation. Orbcomm worked with DoD in 1995 and 1996 to demonstrate the potential military use of the commercial system under the Joint Interoperability Warfighter Program. Today, DoD still possesses more than 100 Orbcomm units.

Orion Network Systems

Orion provides commercial satellite-based, rooftop-to-rooftop communications in support of the US Army Trojan program via its own satellite as part of the GE American Communications team. In addition, Orion provides communications through wholesalers to other DoD agency locations in the US and Europe. Rooftop-to-rooftop support is also provided to selected State Department overseas locations. Orion con-

tinues its support for the troops deployed to Bosnia via leased capacity to the Defense Information Systems Agency. Future plans include the launch and operation of two additional satellites covering the Asia-Pacific region, Latin America, the Middle East, and parts of Russia and Africa.

Satellite Pour l'Observation de la Terre (SPOT)

Remote sensing satellite system developed by the French space agency, CNES. Owned and operated by a commercial firm, SPOT Image S.A. of Toulouse. Two satellites produce images with resolution as fine as 10 meters and can be used for stereoscopic viewing for three-dimensional terrain modeling. SPOT 3 failed Nov. 17, 1996, and SPOT 1 was reactivated to augment SPOT 2. SPOT 4 was launched March 24, 1998. SPOT 5 is scheduled for launch in 2002. DoD is a large customer, purchasing the images for mission-planning systems,

terrain analysis, mapping, and humanitarian missions.

Tracking and Data Relay Satellite System (TDRSS)

NASA operates six TDRSS satellites to form a global network that allows low Earth orbiting spacecraft, such as the space shuttle, to communicate with a control center without an elaborate network of ground stations. The geostationary TDRSS, with its ground station at White Sands, N.M., allows mission control in Houston to maintain nearly constant contact with the shuttle. Other satellites using TDRSS include the Hubble Space Telescope, Compton Gamma Ray Observatory, Earth Radiation Budget Satellite, and military satellites. TDRSS satellites have been used since 1983. Three next generation satellites are being built for use with the shuttle, the space station, and other satellites. Hughes is the contractor for TDRS H, I, and J. The first will be launched in July 1999.

Current US Launchers



Delta II



Space Shuttle



Titan II

Athena I and II

Lockheed Martin's Athena I and II launch vehicles (formerly LMLV-1 and LMLV-2) provide access to space for small to medium class spacecraft. The Athena II launched the Lunar Prospector Jan. 6, 1998. The Athena I is capable of lifting 1,750 pounds to LEO. The Athena II increases that lift to 4,350 pounds to LEO. Both Athenas can be launched from Cape Canaveral AS and Vandenberg AFB.

Atlas I

The Atlas I, built by Lockheed Martin, is a two-stage commercial launcher using the Centaur booster as the upper stage.

It is now also used to launch GOES satellites for NASA, the X-ray Astronomy Satellite for the Italian Space Agency, and three UHF satellites for the US Navy. The four versions can lift from 5,000 to 8,000 pounds into LEO of 100 nautical miles out of Cape Canaveral AS. The Atlas I can additionally lift 5,235 pounds to GTO.

Atlas II

A modified version of Lockheed Martin's Atlas I, the Atlas II carries DSCS satellites and NASA and commercial payloads. No failures have occurred with Atlas II since first launch Dec. 7, 1991. The range of payloads Atlas II through

IIAS can lift into GTO from Cape Canaveral AS is 6,193 to 8,197 pounds and 12,144 to 15,895 pounds to a polar LEO from Vandenberg AFB. The Atlas IIAR and Atlas IIARC have been renamed Atlas IIIA and IIIB, respectively. They are listed in the "Proposals and Prospects" section.

Delta II

Boeing's medium launcher, in operation since 1989. Payloads include Global Positioning System and other DoD, scientific, and commercial communications satellites. Launches from both Cape Canaveral AS and Vandenberg AFB. Available in two- and three-stage



Pegasus, mounted under an L-1011

configurations. It can lift 4,120 pounds to GTO or 7,000 pounds into a 448-nautical mile sun synchronous orbit. Has successfully launched 27 GPS satellites for USAF. Delta IIs have launched most of the Iridium satellites and all of the GlobalStar units to date. Before the end of 1998 they will also have launched Deep Space 1 and the Landsat 7 Earth Resource satellite.

Delta III

Boeing's Delta II carries twice the payload of the Delta II. It can loft 8,400 pounds to GTO and 18,280 pounds to LEO. The first launch this summer is with the Galaxy X communications satellite. There are six more confirmed launches before the end of the century.

Titan II

Modified ICBM. Lockheed Martin has modified 14 missiles; seven have been launched successfully, with the latest transporting the NOAA-15. Puts 4,200 pounds into polar LEO. The Air Force used it for DMSP launches. Titan II is launched from Vandenberg AFB. It launched the Clementine 1 mission to the moon and places NOAA satellites into orbit. In the 1960s, NASA used Titan II for the manned Gemini flights.

Titan IV

Lockheed Martin's heavy-lift launcher, adapted from an ICBM as an expendable

launch system. First launch in 1989. Due to be phased out in 2003. Carried DSP, Milstar, and DoD classified satellites and NASA's Cassini to Saturn. With Centaur G-prime upper stages, lifts 10,200 pounds to GEO, 39,000 pounds to LEO, and 32,000 pounds into polar LEO. Titan IVB, with upgraded solid rocket motors that provide 25 percent better performance, had its first launch Feb. 23, 1997. The Air Force has contracted for 40 Titan IVs; 24 (with one failure) have been launched as of May 1998. Lockheed Martin will complete production of all Titan IVs by 1999 but will continue to launch them until all have been expended.

Pegasus

Orbital Sciences' three- or four-stage winged small launcher, dropped from an L-1011, the Pegasus and Pegasus XL can carry payloads of 440 to 615 pounds to a 250-nautical mile polar orbit. The Pegasus launchers have flown 21 missions with two failures. The fourth stage, a Star 27 booster, can give a satellite an Earth escape capability. Three launches are scheduled for the remainder of 1998.

Space Shuttle

Manned space transportation system operated by United Space Alliance, a venture between Lockheed Martin and Boeing, under contract to NASA.



Titan IV

Launched from Kennedy Space Center, lifts 46,000 pounds to 160-nautical mile, 28.5°-inclined orbit. The delta-winged orbiters have flown 31 missions since its first use April 12, 1981. There was one failure. The shuttle carries scientific and military payloads and experiments and will be used to assemble the International Space Station starting in 1999.

Taurus

Orbital Sciences' ground-launched, four-stage rocket with some Pegasus commonality. The Taurus family can launch from Cape Canaveral AS into a 216-nautical mile orbit from 2,684 to 3,850 pounds to LEO; or from 1,125 to 1,472 pounds to GTO. From Vandenberg AFB, they can launch 2,024 to 2,904 pounds into a sun synchronous LEO. Two launches have taken place to date. A classified payload and the STEX satellite are scheduled for mid- to late 1998.

Russian Space Activity

Russian Launches, 1997

	Launches	Spacecraft
Communications	4	9
Photoreconnaissance	3	3
Unmanned space station resupply	4	4
Navigation	2	2
Military ocean surveillance	1	1
Manned flight	2	2
Science	1	1
Commercial	7	20
Remote Sensing	1	1
Early Warning	3	3
Total	28	46

Russian Launch Site Activity, 1997

Spacecraft	Number of launches
Baikonur Cosmodrome, Tyuratam, Kazakhstan	
Proton-K	9
Soyuz-U	7
Tsyklon-M	1
Total	17

Plesetsk Cosmodrome, Plesetsk, Russia	
Tsyklon-3	1
Kosmos-3M	2
Soyuz-U	3
Molniya-M	3
Total	9

Svobodny Cosmodrome, Siberia, Russia	
Start-1	2
Total	2

(Maiden launch from Svobodny was March 4, 1997.)

Russian Operational Spacecraft, 1997

Mission	Type	Number	
Communications	Kosmos (Strela-3)	20	
	Gonets-D	6	
	Raduga/Raduga-1	7	
	Gorizont	9	
	Molniya-1	4	
	Molniya-3	4	
	Kosmos (Geizer)	2	
	Luch/Luch-1	2	
	Ekran-M	1	
	Ekspress	2	
	Gals	2	
	Radio Rosto	1	
	Kupon	1	
	Navigation	Kosmos GLONASS	20
		Kosmos (military)	6
Meteorology	Kosmos (civil)	4	
	Meteor-2	1	
	Meteor-3	2	
Early warning	Elektro (GOMS)	1	
	Kosmos (Oko)	6	
Electronic intelligence	Kosmos (Prognoz)	2	
	Kosmos (Tselina-2)	3	
Photoreconnaissance	Kosmos (EORSAT)	2	
	Kosmos (Orlets-1)	1*	

	Kosmos (Yantar-4K class)	1
	Kosmos (Arkon-1)	1
Remote sensing	Okean-O	2
	Resurs-01	1
	Sich	1
	Resurs-F1M	1*
Geodesy	Kosmos (Etalon)	2
	Kosmos (GEO-IK)	1
Radar calibration	Kosmos (Romb)	1
Space station activity	Mir	1
	Kvant-1	1
	Kvant-2	1
	Kristall	1
	Spektr	1
	Priroda	1
	Soyuz TM	1
	Progress M	1
	Foton	1*
	Coronas-I	1
Scientific activity	Granat	1
	Interball	2
	MAGION 4 (Czech satellite)	2

Older spacecraft sometimes are placed in orbital standby mode.

*Number of spacecraft launched during 1997 but not in orbit at the end of the year.

Comparison of US and Russian Space Activity

Military vs. Civilian Launches

Year	Military		Year	Civilian	
	US	Russia		US	Russia
1957	0	0	1978	8	60
1958	0	0	1979	4	60
1959	6	0	1980	5	64
1960	10	0	1981	5	59
1961	19	0	1982	6	68
1962	31	5	1983	7	58
1963	26	7	1984	12	63
1964	32	15	1985	6	64
1965	28	25	1986	3	63
1966	32	27	1987	6	62
1967	24	46	1988	6	53
1968	20	49	1989	13	42
1969	16	51	1990	13	45
1970	15	55	1991	9	30
1971	10	60	1992	12	32
1972	11	53	1993	13	26
1973	8	58	1994	12	26
1974	6	52	1995	9	15
1975	7	60	1996	11	8
1976	7	74	1997	9	10
1977	9	69	Total	486	1,614

Year	Military		Year	Civilian	
	US	Russia		US	Russia
1957	0	2	1978	24	28
1958	7	1	1979	12	27
1959	5	3	1980	8	25
1960	6	3	1981	13	39
1961	10	6	1982	12	33
1962	21	15	1983	15	40
1963	12	10	1984	10	34
1964	25	15	1985	11	34
1965	35	23	1986	3	28
1966	41	17	1987	2	33
1967	34	20	1988	6	37
1968	25	25	1989	5	32
1969	24	19	1990	14	30
1970	14	26	1991	9	29
1971	22	23	1992	16	22
1972	20	21	1993	10	21
1973	15	28	1994	14	22
1974	18	29	1995	18	17
1975	21	29	1996	22	17
1976	19	25	1997	28	18
1977	15	29	Total	641	935

Manned Spaceflights

Year	US		Russia	
	Flights	Persons	Flights	Persons
1961	2	2	2	2
1962	3	3	2	2
1963	1	1	2	2
1964	0	0	1	3
1965	5	10	1	2
1966	5	10	0	0
1967	0	0	1	1
1968	2	6	1	1
1969	4	12	5	11
1970	1	3	1	2
1971	2	6	2	6
1972	2	6	0	0
1973	3	9	2	4
1974	0	0	3	6
1975	1	3	4	8
1976	0	0	3	6
1977	0	0	3	6
1978	0	0	5	10
1979	0	0	2	4
1980	0	0	6	13
1981	2	4	3	6
1982	3	8	3	8
1983	4	20	2	5
1984	5	28	3	9
1985	9	58	2	5
1986	1	7	1	2
1987	0	0	3	8
1988	2	10	3	9
1989	5	25	1	2
1990	6	32	3	7
1991	6	35	2	6
1992	8	53	2	6
1993	7	42	2	5
1994	7	42	3	8
1995	7	42	2	6
1996	7	43	2	5
1997	8	53	2	5
Total	118	573	85	191

Payloads by Mission, 1957-97

Category	US	Russia
Platforms	0	492
Earth orbital science	226	211
Automated lunar, planetary	59	86
Moon	25	34
Mercury	1	0
Venus	8	33
Mars	11	19
Outer planets	5	0
Interplanetary space	9	0
Applications	490	509
Communications	355	294
Weather	101	74
Geodesy	20	34
Earth resources	12	97
Materials processing	2	10
Piloted activities	157	243
Earth orbital	107	90
Earth orbital (related)	13	145
Lunar	20	0
Lunar (related)	17	8
Launch vehicle tests	11	22
General engineering tests	57	4
Reconnaissance	430	1,088
Photographic	249	798
Electronic intelligence	94	131
Ocean electronic intelligence	39	83
Early warning	48	76
Minor military operations	44	161
Navigation	84	213
Theater communication	0	535
Weapons-related activities	2	56
Fractional orbital bombardment	0	18
Antisatellite targets	2	18
Antisatellite interceptors	0	20
Other military	18	1
Other civilian	3	2
Total	1,581	3,623

Military Functions in Space

Communications

Provide communications from National Command Authorities to Joint Force Commander. Provide communications from JFC to squadron-level commanders. Permit transfer of imagery and situational awareness to tactical operations. Permit rapid transmission of JFC intent, ground force observations, and adaptive planning.

Environmental/Remote Sensing

Use space systems to create topographical, hydrographic, and geological maps and charts and to develop systems of topographic measurement.

Space Environment/Meteorological Support

NOAA took over flight operations of DMSP weather satellites from the Air Force in May 1998. The Air Force operates ground-based systems and directs NOAA on the operations of space-based systems to provide solar/geophysical support to the warfighter. The weather systems provide data on worldwide and local weather systems affecting combat operations.

Missile Defense

Employ space assets to identify, acquire,

track, and destroy ballistic and cruise missiles launched against forward deployed US forces, allied forces, or US territory.

Navigation

Operate GPS network and certain smaller Navy systems. Enable commanders to determine precise locations of friendly and enemy forces and targets. Permit accurate, timely rendezvous of combat forces. Map minefields and other obstacles.

On-Orbit Support

Track and control satellites, operate their payloads, and disseminate data from them.

Reconnaissance and Surveillance

Identify possible global threats and surveillance of specific activity that might be threatening to US or allied military forces or US territory. Reduce effectiveness of camouflage and decoys. Identify "centers of gravity" in enemy forces. Accurately characterize electronic emissions.

Space Control

Control and exploit space using offensive and defensive measures to ensure that friendly forces can use space capabili-

ties, while denying their use to the enemy. This mission is assigned to USCINCSpace in the Unified Command Plan.

Spacelift

Prepare satellite and booster, joining the two. Conduct checkout prior to launch, carry out launch, and conduct on-orbit checkout.

Strategic Early Warning

Operate satellites to give national leaders early warning of all possible strategic events, including launch of ICBMs. Identify launch locations and impact areas. Cue area and point defense systems.

Tactical Warning/Attack Assessment

Discharge the NORAD mission calling for use of all sensors to detect and characterize an attack on US or Canadian territory. US Space Command carries out similar tactical warning in other theaters.

Force Application

US Space Command is identifying potential future roles, missions, and systems which, if authorized by civilian leadership for development and deployment, could attack terrestrial targets from space in support of national defense.

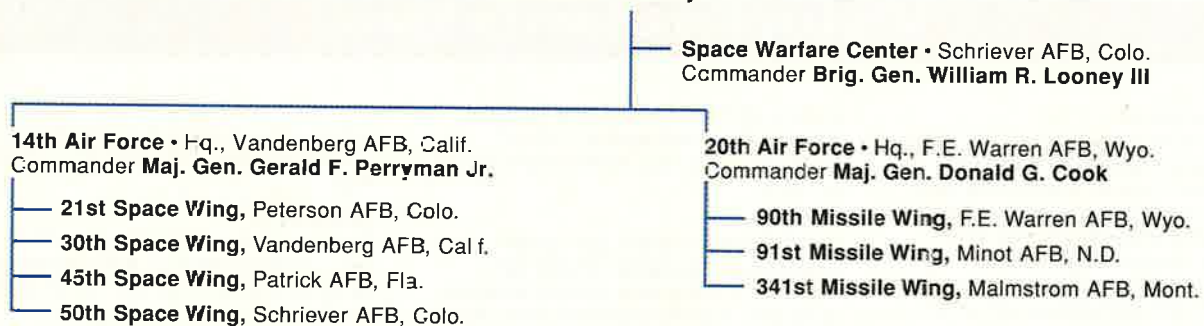


Gen. James V. Hartinger, here with Gen. Jerome F. O'Malley (left) and Edward C. Aldridge Jr., became the first commander of Air Force Space Command, upon its establishment Sept. 1, 1982, at Peterson AFB, Colo.

Air Force Space Command Headquarters, Peterson AFB, Colo.

(As of July 1, 1998)

Commander
Gen. Richard B. Myers*



*Confirmed by Senate June 25, 1998; assumes position upon retirement of Gen. Howe I M. Estes III.

Air Force Space Acquisition Organizations

Air Force Materiel Command • Wright-Patterson AFB, Ohio
Commander **Gen. George T. Babbitt Jr.**

Space and Missile Systems Center • Los Angeles AFB, Calif.
Commander **Lt. Gen. Roger G. DeKok***

- Defense Meteorological Satellite SPO¹
- Launch Programs SPO
- Advanced Systems SPO
- Satellite and Launch Control SPO
- Navstar Global Positioning System JPO²
- Space & Missile Test & Evaluation Directorate, Kirtland AFB, N.M.

Air Force Program Executive Office • Pentagon
Air Force Acquisition Executive (Vacant)

Program Executive Officer for Space Programs
Brent R. Collins

- MILSATCOM
- Launch Systems
- Space Based Infrared System
- Evolved Expendable Launch Vehicle
- ICBM/National Missile Defense

*DeKok nominated June 18, 1998, to be DCS, Plans & Programs, USAF, Pentagon.

¹System Program Office ²Joint Program Office



Preparing Today. . .

While Americans enjoy peace at home, somewhere in the world armed conflict destroys a family.

Seemingly daily, rogue nations threaten their neighbors' tranquility. Their missile weapons are growing in range and lethality.

The Space-Based Laser Readiness Demonstrator (SBLRD) Program will ensure our nation's preparedness. TRW and Boeing, already building the airborne laser, are again united as Team SBL. We are working together with the Air Force and BMDO to develop a successful program, to make SBLRD a meaningful prelude to readiness.

To Protect Tomorrow



Major US Agencies in Space

National Imagery and Mapping Agency (NIMA)

Headquarters: Bethesda, Md.
Established: Oct. 1, 1996
Director (acting): Army Maj. Gen. James C. King

Mission, Purpose, Operations

Provide timely, relevant, and accurate imagery intelligence and geospatial information to support national security objectives. This DoD-chartered combat support agency is also a member of the Intelligence Community and has been assigned, by statute, important national-level support responsibilities.

Structure

Three principal directorates: Operations, Systems and Technology, and Corporate Affairs.

Major facilities in Virginia, Maryland, Washington, D.C., and Missouri, with the NIMA College located at Ft. Belvoir, Va. Also, customer support teams and technical representatives stationed around the world at major customer locations.

Personnel: Classified

Central Intelligence Agency (CIA) Office of Development and Engineering

Headquarters: Washington, D.C.
Established: 1973
Director: Dennis Fitzgerald

Mission, Purpose, Operations

Develop systems from requirements definition through design, testing, and evaluation to operations. Works with systems not available commercially. Disciplines include laser communications, digital imagery processing, real-time data collection and processing, electro-optics, advanced signal collection, artificial intelligence, advanced antenna design, mass data storage and retrieval, and large systems modeling and simulations. Work includes new concepts and systems upgrades.

Structure: Classified

Personnel: Classified

National Aeronautics and Space Administration (NASA)

Headquarters: Washington, D.C.
Established: 1958

Administrator: Daniel S. Goldin

Mission, Purpose, Operations

Explore and develop space for human enterprise, increase knowledge about Earth and space, and conduct research in space and aeronautics. Operate the space shuttle and lead an international program to build a permanently occupied space station, which will be launched starting in 1998. Launch satellites for space science, Earth observations, and a broad range of technology Research and Development. Conduct aeronautical R&D.

Structure

Ten centers around the US: Johnson Space Center, Houston; Marshall Space Flight Center, Huntsville, Ala.; Kennedy Space Center, Fla.; Lewis Research

Center, Cleveland; Langley Research Center, Hampton, Va.; Ames Research Center, Mountain View, Calif.; Dryden Flight Research Center, Edwards AFB, Calif.; Stennis Space Center, Bay St. Louis, Miss.; Jet Propulsion Laboratory, Pasadena, Calif.; and Goddard Space Flight Center, Greenbelt, Md.

Personnel

Civilians 18,500
Contractors 166,000

National Oceanic and Atmospheric Administration (NOAA)

Headquarters: Washington, D.C.
Established: Oct. 3, 1970
Administrator and Undersecretary for Oceans and Atmosphere: Dr. D. James Baker

Mission, Purpose, Operations

Provide satellite observations of the global environment by operating a national system of satellites. Explore, map, and chart the global ocean and its resources and describe, monitor, and predict conditions in the atmosphere, ocean, and space environment. Its National Environmental Satellite, Data, and Information Service processes vast quantities of satellite images and data. Its prime customer is NOAA's National Weather Service, which uses satellite information in creating forecasts.

Structure

National Environmental Satellite, Data, and Information Service
National Weather Service
National Ocean Service
National Marine Fisheries Service
Office of Oceanic and Atmospheric Research
NOAA Corps
Office of Sustainable Development and Intergovernmental Affairs
Coastal Ocean Program

Personnel

National Environmental Satellite, Data, and Information Service 839
Other NOAA employees 11,055
Total 11,894

National Reconnaissance Office (NRO)

Headquarters: Chantilly, Va.
Established: September 1961
Director: Keith R. Hall

Mission, Purpose, Operations

Design, build, and operate reconnaissance satellites to support global information superiority for the US. It has operated hundreds of satellites during its nearly 37-year history. Responsible for innovative technology; systems engineering; development, acquisition, and operation of space reconnaissance systems; and related intelligence activities. Supports monitoring of arms control agreements, military operations and exercises, natural disasters, environmental issues, and worldwide events of interest to the US.

Structure

NRO is a DoD agency, funded through part of the National Foreign Intelligence Program, known as the National Reconnaissance Program. Both the Secretary of Defense and Director of Central Intelligence have approval of the program. Four offices and four directorates report up to the level of the director. Offices are management services and operations, plans and analysis, space launch, and operational support. Directorates are signals intelligence systems acquisition and operations, communications systems acquisition and operations, imagery systems acquisition and operations, and advanced systems and technology.

Personnel

Staffed by CIA (37 percent), USAF (51 percent), Navy (7 percent), Army (1 percent), and National Security Agency (4 percent), both military and civilian employees. Exact personnel numbers are classified.

National Security Agency (NSA)

Headquarters: Ft. Meade, Md.
Established: 1952
Director: Lt. Gen. Kenneth A. Minihan, USAF

Mission, Purpose, Operations

Protect US communications and produce foreign intelligence information. Supply leadership, products, and services to protect classified and unclassified information from interception, unauthorized access, and technical intelligence threats. In the foreign signals intelligence area, the central point for collecting and processing activities conducted by the US government, with authority to produce signals intelligence in accord with objectives, requirements, and priorities established by the CIA director with the advice of the National Foreign Intelligence Board.

Structure

Established by a presidential directive in 1952 as a separate agency within DoD under the direction, authority, and control of the Secretary of Defense, who serves as the executive agent of the US government for the production of communications intelligence information. The Central Security Service was established in 1972 by a presidential memorandum to provide a more unified cryptological organization within DoD. The NSA director also serves as chief of the CSS and controls the signals intelligence activities of the military services.

Personnel: Classified

Other Agencies

The White House Office of Science and Technology Policy; Defense Advanced Research Projects Agency; Ballistic Missile Defense Organization; US Space Command and the component commands of the Air Force, Navy, and Army; NORAD; and the FAA's Office of Commercial Space Transportation.

Other Spacefaring Nations

For eight years after Sputnik went into orbit in October 1957, the two superpowers alone were able to launch spacecraft. France broke the monopoly in 1965, establishing an independent capability. China, India, Japan, and Israel also have hurled satellites into space using indigenously built rockets. European capabilities are embodied in the European Space Agency (ESA), currently a group of 14 nations.

China launched its first satellite in 1970 and has had at least 50 satellites on orbit. China also launches science and military reconnaissance satellites and has made commercial launches for other nations. Its primary launch site is near Jiuquan, in northern China; a newer site is near Xichang, in southeastern China, and a third is at Taiyuan. The launch program relies on the Long March series of rockets, one version of which has a cryogenic upper stage. Chinese astronauts were in training in the 1970s, but the country has indefinitely deferred manned spaceflight.

ESA was formed in 1975 for civilian activities only. It has 14 members: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, and the UK. A major activity is development of the Ariane rocket. France led development of the booster, which is launched from Kourou, French Guiana. Arianespace, a private company, markets

Ariane and manages launches. France, Italy, and Germany all have strong programs.

India launched its first satellite, Rohini 1, into orbit in July 1980. The Indian Space Research Organization operates an offshore Sriharikota Island launch site in the Bay of Bengal. India's booster program includes the Satellite Launch Vehicle, Augmented Satellite Launch Vehicle, and Polar Satellite Launch Vehicle. The latter is capable of placing spacecraft into polar orbit. India is particularly interested in remote sensing for resource, weather, and reconnaissance purposes. An Indian cosmonaut flew on a Soviet Soyuz mission in 1984.

Israel launched its first test satellite, Ofeq 1, into orbit September 1988 and has had two more successful flights since then. Launched from the Palmachim missile range in the Negev Desert, satellites in the Ofeq series are thought to be dedicated to military purposes. Ofeq is seen as a step toward creation of a military satellite reconnaissance system. The prime booster is Shavit, possibly based on the Jericho 2 missile.

Japan put its first satellite into orbit in 1970 and has made at least 51 successful satellite launches. Communications, remote sensing, weather, and scientific satellites are on orbit. Japan's satellite program is run by the National Space Development Agency and the Institute of Space and Astro-

Year	France	China	Japan	Europe	India	Israel
1965	1					
1966	1					
1967	2					
1968						
1969						
1970	2	1	1			
1971	1	1	2			
1972			1			
1973						
1974			1			
1975	3	3	2			
1976		2	1			
1977			2			
1978		1	3			
1979			2	1		
1980			2		1	
1981		1	3	2	1	
1982		1	1			
1983		1	3	2	1	
1984		3	3	4		
1985		1	2	3		
1986		2	2	2		
1987		2	3	2		
1988		4	2	7		1
1989			2	7		
1990		5	3	5		1
1991		1	2	8		
1992		4	1	7	1	
1993		1	1	7		
1994		5	2	6	2	
1995		2	1	11		1
1996		3	1	10	1	
1997		6	2	12	1	
Total	10	50	51	96	8	3

nautical Science. Main launch sites are Kagoshima, on Kyushu, southwest of Tokyo, and Tanegashima, an island south of Kyushu. The Mu series of launch vehicles is used to orbit scientific satellites and toss spacecraft into deep

space. N-1 and N-2 rockets were based on the US Delta. The H-series is replacing the N-1 and N-2 boosters. The H-2 booster was first launched in 1994.

Spacefarers

(As of end of 1997)

Nation	Persons	Nation	Persons
Afghanistan	1	Mexico	1
Austria	1	Mongolia	1
Belgium	1	Netherlands	1
Bulgaria	2	Poland	1
Canada	6	Romania	1
Cuba	1	Russia	86
Czechoslovakia	1	Saudi Arabia	1
France	7	Switzerland	1
Germany	8	Syria	1
Hungary	1	Ukraine	1
India	1	United Kingdom	1
Italy	3	United States	233
Japan	5	Vietnam	1
Total		Total	368

Payloads in Orbit

(As of end of 1997)

Launcher/operator	Objects	Launcher/operator	Objects
Argentina	3	Luxembourg	7
Australia	6	Malaysia	2
Brazil	6	Mexico	5
Canada	17	NATO	8
China	24	Norway	2
Czechoslovakia	3	Philippines	1
ESA	35	Portugal	1
France	30	Russia	1,364
France/Germany	2	Saudi Arabia	6
Germany	15	South Korea	4
India	17	Spain	5
Indonesia	9	Sweden	6
Israel	2	Thailand	3
Italy	7	Turkey	2
ITSO ¹	54	United Kingdom	24
Japan	63	United States	778
Total		Total	2,511

¹International Telecommunications Satellite Organization

■ **AXAF, \$92.2 million.** Space science. The Advanced X-Ray Astrophysics Facility spacecraft to study the composition and nature of galaxies, stellar objects, and interstellar phenomena. Scheduled for launch aboard the space shuttle in 1998 but schedule under review.

■ **Cassini, \$8.8 million.** Space science. Spacecraft mission to Saturn. Seeks data on formation of solar system and on how the building blocks needed for the chemical evolution of life are formed elsewhere in the universe. Launched in October 1997. Scheduled to arrive in Saturnian system in 2004.

■ **Discovery, \$126.5 million.** Space science. Lunar Prospector launched in January 1998. In March, its instruments detected significant amounts of water-ice in the shaded polar regions. The Stardust mission, scheduled for launch in February 1999, is designed to gather dust samples from the comet Wild-2 and return the samples to Earth for analysis. Discovery is intended as NASA's low-cost planetary exploration program. NASA's next two Discovery missions are: Genesis, which will collect samples of charged particles in the solar wind and return to Earth laboratories for study; and the Comet Nucleus Tour (Contour), which will intercept and collect data on three comets. Launch for Genesis is January 2001, and launch for Contour is June 2002.

■ **Earth Observing System, \$659.1 million.** Earth Science Enterprise (formerly Mission to Planet Earth) environmental project. Series of satellites to document global climatic change and observe environmental processes. Scheduled launches start in 1998.

■ **Explorer, \$114.3 million.** Space science. Four missions and spacecraft development. Study of X-ray sources, solar corona, and organic compounds in interstellar clouds. Scheduled launches each year from 1997 to 2000.

■ **Galileo, \$30.0 million.** Space science, planetary exploration. Funds to support operations of mission to explore Jupiter and its moons.

NASA Spending on Major Space Missions

FY 1999 Proposal, Current Dollars

Project Office	Millions
Human spaceflight	\$5,511.0
Space science	2,058.4
Earth science	1,372.0
Aeronautics	1,305.0
Mission communication services	380.0
Life and microgravity sciences	242.0
Safety and mission assurance	35.6
Total	\$10,904.0

The Golden Age of NASA

Name
Duration
Cost
Distinction
Highlight
Number of flights
Key events

Project Mercury
Nov. 3, 1958–May 16, 1963
\$392.1 million (cost figures are in then-year dollars)
First US manned spaceflight program
Astronauts are launched into space and returned safely to Earth
Six
May 5, 1961 Lt. Cmdr. Alan B. Shepard Jr. makes first US manned flight, a 15-minute suborbital trip.
Feb. 20, 1962 Lt. Col. John H. Glenn Jr. becomes first American to orbit Earth.
May 15, 1963 Maj. L. Gordon Cooper Jr. begins flight of 22 orbits in 34 hours.

Name
Duration
Cost
Distinction
Highlight
Number of flights
Key events

Project Gemini
Jan. 15, 1962–Nov. 15, 1966
\$1.3 billion
First program to explore docking, long-duration flight, rendezvous, space walks, and guided reentry
Dockings and rendezvous techniques practiced in preparation for Project Apollo 10
June 3–7, 1965 Flight in which Maj. Edward H. White II makes first space walk.
Aug. 21–29, 1965 Cooper and Lt. Cmdr. Charles "Pete" Conrad Jr. withstand weightlessness.
March 16, 1966 Neil A. Armstrong and Maj. David R. Scott execute the first space docking.
Sept. 15, 1966 Conrad and Richard F. Gordon Jr. make first successful automatic, computer-steered reentry.

Name
Duration
Cost
Distinction
Highlights
Number of flights
Key events

Project Apollo
July 25, 1960–Dec. 19, 1972
\$24 billion
Space program that put humans on the moon
Neil Armstrong steps onto lunar surface. Twelve astronauts spend 160 hours on the moon.
11
May 28, 1964 First Apollo command module is launched into orbit aboard a Saturn 1 rocket.
Jan. 27, 1967 Lt. Col. Virgil I. "Gus" Grissom, Lt. Cmdr. Roger B. Chaffee, and White die in a command module fire in ground test.
Oct. 11–22, 1968 First manned Apollo flight proves "moonworthiness" of spacecraft.
Dec. 21–27, 1968 First manned flight to moon and first lunar orbit.
July 16–24, 1969 Apollo 11 takes Armstrong, Col. Edwin E. "Buzz" Aldrin Jr., and Lt. Col. Michael Collins to the moon and back.
Armstrong and Aldrin make first and second moon walks.
Dec. 7–19, 1972 Final Apollo lunar flight produces sixth manned moon landing.

■ **Mars Surveyor, \$164.0 million.** Space science. Launch of the Mars Global Surveyor orbiter occurred in November 1996. It arrived in September 1997. Development of spacecraft for new Mars exploration strategy. Mapping, in situ climate and soil measurements, and eventual goal to return rock samples from Mars. Follow-on orbiter launch is planned for December 1998, and the first lander launch is scheduled for January 1999.

■ **New Millennium Spacecraft, \$90.0 million.** Space science. Flight-technology demonstration to produce new microspacecraft with reduced weight and life-cycle costs. Funding increase to spur deep-space mission technology and development. Deep Space 1 mission will test several new technologies during its flight. Launch is scheduled for October 1998.

■ **Relativity (Gravity Probe B), \$37.6 million.** Space science. Major test of Einstein's general theory of relativity. Development of a gravity probe. Launch is scheduled for March 2000.

■ **Space shuttle, \$3.1 billion.** Spaceflight. Program emphasizes continuing improvement of safety margins, fulfillment of the flight manifest, reduction of costs, and launch of nine flights for Fiscal 1999 and nine in Fiscal 2000.

■ **International Space Station, \$2.3 billion.** Spaceflight. International manned space facility. Ultimate capacity for seven persons. Crew capability for three persons to be available with delivery of Soyuz crew transfer vehicle in

Upcoming Shuttle Flights

FY 1999 Proposal

Month/Year	Mission	Name
10/1998	STS-95	Discovery
12/1998	STS-88	Endeavour
1/1999	STS-93	Columbia
5/1999	STS-96	Atlantis
6/1999	STS-92	Discovery
8/1999	STS-97	Endeavour
9/1999	STS-99	Atlantis

Fiscal 1999. Efficiencies gained through design changes and participation of the Russians in an international partnership.

■ **US/Russian Cooperative Program.** (Funding ended in Fiscal 1997, but activities still ongoing.) Spaceflight. Program provides for contract with

Russian Space Agency for services and hardware and joint activities with Russia on the Mir. The ninth and final joint shuttle—Mir mission took place in June 1998.

■ **Other space operations, \$526.6 million.** Space science. Operation of

Hubble Space Telescope, the AXAF program, the Compton Gamma Ray Observatory, and the International Solar Terrestrial Physics program. Support of planetary missions includes Galileo, NEAR, Mars Surveyor, Cassini, Lunar Prospector, and Stardust.

US Space Launch Sites

Orbital Sites

Cape Canaveral AS, Fla.

Located 28.5° N, 80° W. One of two primary US space launch sites. Handles piloted, lunar, and planetary launches and launches of satellites into geostationary orbit. First US satellite in space, first manned spaceflight, and first flight of a reusable spacecraft all originated here. Scene of more than 3,000 launches since 1950. Tract covers more than 15,000 acres. Cape Canaveral also provides range operations for NASA's shuttle, military, civil, and commercial space launches, and military ballistic missile tests.

John F. Kennedy Space Center, Fla.

Located 28° N, 80° W. NASA's primary launch base for the space shuttle. Occupies 140,000 acres of land and water on Merritt Island, adjacent coastal strand, and the Indian and Banana Rivers and Mosquito Lagoon surrounding the center. NASA holdings include 84,031 acres. The Merritt Island location was better suited than nearby Cape Canaveral to serve as a launch site for the Apollo program's 363-foot-tall Saturn V, the largest rocket ever built. With the 1972 completion of the Apollo lunar landing program, KSC's Complex 39 was used to launch four Skylab missions and for the Apollo spacecraft for the Apollo-Soyuz Test Project. In the mid- to late 1970s, the Kennedy facilities were modified to accommodate the space shuttle program.

Vandenberg AFB, Calif.

Located 35° N, 121° W. Second of two primary US launch sites. Used for satellites (mostly weather, remote sensing, navigation, communications, and reconnaissance) that must go into polar orbits. Provides basic support for R&D tests for DoD, USAF, and NASA space, ballistic missile, and aeronautical systems. Furnishes facilities and essential services to more than 60 aerospace contractors on base. Base covers 98,400 acres. Originally Army's Camp Cooke, taken over by the Air Force June 7, 1957.

Wallops Flight Facility, Va.

Located 38° N, 76° W. Founded in 1945 on Wallops Island, Va. One of the oldest launch sites in the world. First research rocket launched July 4, 1945. Resumed orbital launches in 1995 with the EER Systems Conestoga rocket. From 1961 to 1985, 21 satellites were placed in orbit from Wallops using the Scout vehicle. Wallops currently serves as the East

Coast launch site for Orbital Sciences' Pegasus missions. Additional small launch vehicles are expected to be launched from Wallops with the establishment of the Virginia Space Flight Center. Site for launches of NASA's suborbital sounding rockets and the like. Conducts about 15 suborbital launches per year. Covers 6,166 acres on Virginia's eastern shore.

Spaceport Florida Facility

Located 28.5° N, 80° W. New commercial launch site at Cape Canaveral AS. Designed to meet growing demand for private-sector access to space and to tap underutilized military launch sites. Operated by the Spaceport Florida Authority, a state agency. Launch Complex 46 launchpad has been converted to handle small to medium commercial launch vehicles, boosting satellites into equatorial orbit. The Navy originally used LC-46 to support land-based testing of the Trident II fleet ballistic missile program. The Naval Ordnance Test Unit will maintain launch capability for future programs. Lockheed Martin launched NASA's Lunar Prospector Jan. 6, 1998, aboard their Athena II. Expected to handle up to 12 launches per year.

California Spaceport

Located 34.33° N, 120.37° W. Designed to handle polar and near-polar LEO launches, the California Spaceport is a commercial launch facility at Vandenberg AFB. Spaceport Systems International, a limited partnership formed by ITT Federal Services Corp. and California Commercial Spaceport, Inc., is to build and operate the facility. The spaceport will provide both commercial launch and payload processing capability. Payload processing is operational. Construction of the launch duct was completed in early 1997, with design plans ongoing for launchpad completion. The launchpad will have an initial rate of 15 launches per year.

Alaska Spaceport

Located 57.5° N, 153° W. Designed for polar and near-polar launches, the dual-use commercial launch facility is sited on 3,100 acres at Kodiak Island, Alaska. With funding secured by the Alaska Aerospace Development Corp., Alaska's spaceport authority, construction for the Kodiak Launch Complex is scheduled for completion by June 1999. KLC's initial operational capability is September 1998 for AADC's first scheduled launch by the Air Force. There will be an eventual

capacity for nine launches per year. KLC will launch payloads up to 8,000 pounds into polar LEO, primarily communications, remote sensing, and scientific satellites. The site has the capacity for a total of three launchpads. With its large launch corridor, the spaceport would provide an additional backup launch capability for both polar satellites and for DoD's ICBM launches at Vandenberg AFB.

Virginia Space Flight Center

Located 38° N, 76° W. NASA and the Commonwealth of Virginia reached an agreement in March 1997 for the establishment of a Virginia Spaceport on the south end of Wallops Island. Construction of the commercial launch facility began in 1998. The flight center can currently accommodate some small ELVs using up to a Castor 120 power plant at the EER Systems launch tower located on the island, in addition to payload processing. When fully operational, the flight center is expected to be able to handle launch vehicles up to the Athena III.

Suborbital Sites

Poker Flat Research Range, Alaska

Located 65° N, 147° W. Owned by the University of Alaska. Established 1968. Operated by the Geophysical Institute under contract to NASA's Goddard Space Flight Center, Wallops Flight Facility. Only US launch facility currently in polar region. World's largest land-based range. Payload recovery and observatories in flight zone extending north 600 kilometers to coast and over Arctic Ocean. Conducts launches primarily to investigate aurora borealis and other middle- to upper-atmosphere phenomena. Site of more than 274 military and civilian launches.

White Sands Missile Range, N.M.

Located 32° N, 106° W. Established July 9, 1945, as White Sands Proving Ground. Site of July 16, 1945, Trinity shot, world's first test of atomic bomb, and of postwar test and experimental flights with captured German V-2 rockets. Scene of Feb. 24, 1949, launch of Bumper rocket, whose second stage achieved altitude of 244 miles—becoming the first man-made object in space. Now used for launches of suborbital sounding rockets. New Mexico is in the process of establishing a spaceport adjacent to White Sands for commercial orbital launches.

Space Firsts

Feb. 24, 1949 Project Bumper, the first fully successful two-stage rocket-launch into space, reaches a record altitude of 244 miles.

July 24, 1950 Bumper-WAC becomes first missile launched from Cape Canaveral, Fla.

Sept. 20, 1956 US Jupiter C rocket achieves record first flight, reaching an altitude of 682 miles and landing 3,400 miles from Cape Canaveral.

Aug. 21, 1957 First successful launch of Soviet R7 rocket, which six weeks later will loft Sputnik into orbit.

Oct. 4 USSR launches Sputnik 1, the first man-made satellite, into Earth orbit.

Nov. 3 First animal in orbit, a dog, is carried aloft by Soviet Sputnik 2.

Dec. 6 First US attempt to orbit satellite fails when Vanguard rocket loses thrust and explodes.

Dec. 17 First successful Atlas booster launch.

Jan. 31, 1958 Explorer 1, first US satellite, launched.

May 15 USSR launches first automatic scientific lab aboard Sputnik 3, proving satellites can have important military uses.

Dec. 18 Project Score spacecraft conducts first US active communication from space.

Feb. 28, 1959 Discoverer 1 becomes first satellite launched from Vandenberg AFB, Calif.

June 9 First engineer group arrives at Cape Canaveral to prepare Atlas booster carrying first Mercury capsule.

Aug. 7 Explorer 6 spacecraft transmits first television pictures from space.

Sept. 12 Soviet Union launches Luna 2, which two days later becomes first man-made object to strike the moon.

April 1, 1960 TIROS 1 becomes first US weather satellite to go aloft.

April 13 Transit 1B becomes first US navigation satellite in space.

May 24 Atlas D/Agema A booster places MIDAS II, first early warning satellite, in orbit.

June 22 US performs first successful launch of multiple independently instrumented satellites by a single rocket.

Aug. 11 Capsule ejected from Discoverer 13 parachutes into Pacific Ocean and becomes first orbital payload ever recovered.

Aug. 12 First passive communications carried via Echo 1 satellite.

Aug. 19 Capsule containing first satellite photographs of Soviet Union ejected

from Discoverer 14 becomes first orbital payload recovered in midair by C-119 Flying Boxcar.

Jan. 31, 1961 Preparing for manned spaceflight, US launches a Mercury capsule carrying the chimpanzee Ham on a suborbital trajectory.

Feb. 16 Explorer 9 becomes first satellite launched from Wallops Island, Va.

April 12 Soviet cosmonaut Yuri Gagarin pilots Vostok 1 through nearly one orbit to become first human in space.

May 5 Lt. Cmdr. Alan B. Shepard Jr., aboard Freedom 7 Mercury capsule, becomes first American in space, climbing to 116.5 miles during suborbital flight lasting 15 minutes, 28 seconds.

Oct. 27 First flight of Saturn rocket marks beginning of more than 11 years of Apollo launches.

Feb. 20, 1962 Project Mercury astronaut Lt. Col. John H. Glenn Jr., aboard the Friendship 7 capsule, completes the first US manned orbital flight.

July 17 Air Force Capt. Robert M. White earns astronaut wings when he reaches altitude of nearly 60 miles in rocket-powered X-15, the first aircraft to be flown to the lower edge of space, considered to be 50 miles.

Dec. 14 Mariner 2 passes Venus at a distance of 21,600 miles, becoming the first space probe to encounter another planet.

June 16, 1963 Valentina Tereshkova of USSR pilots Vostok 6 to become first woman in space.

July 26 Hughes Corp.'s Syncom 2 (prototype of EarlyBird communications satellite) orbits and "parks" over the Atlantic to become world's first geosynchronous satellite.

Oct. 17 Vela Hotel satellite performs first space-based detection of a nuclear explosion.

July 28, 1964 First close-up lunar pictures provided by Ranger 7 spacecraft.

Aug. 14 First Atlas/Agema D standard launch vehicle successfully fired from Vandenberg AFB.

March 18, 1965 First space walk conducted by Alexei Leonov of Soviet Voskhod 2.

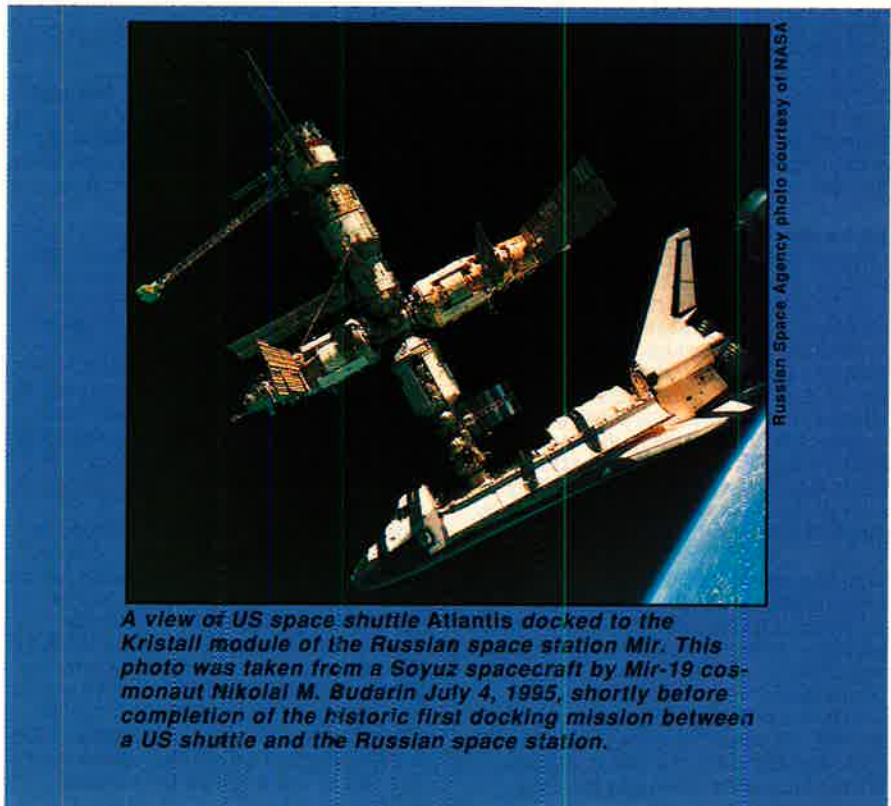
March 23 Gemini 3 astronauts Maj. Virgil I. "Gus" Grissom and Lt. Cmdr. John W. Young complete world's first piloted orbital maneuver.

June 4 Gemini 4 astronaut Maj. Edward H. White performs first American space walk.

July 14 Mariner provides the first close-up pictures of Mars.

Aug. 21 Gemini 5 launched as first manned spacecraft using fuel cells for electrical power rather than batteries.

March 16, 1966 Gemini 8 astronauts Neil A. Armstrong and Maj. David R.



Q: What's the Fastest, Most Affordable Way to Get Your Next Generation Technology Demonstrated in Space?

A: The AFRL's MightySat.

MightySat II.5

Launch Date - June 2004

MightySat II.4

Launch Date - March 2003

MightySat II.3

Launch Date - August 2003

MightySat II.2

Launch Date - February 2002

MightySat II.1

Launch Date - January 2000

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Contact Howard Parks, Director of Program Development



Scott perform first manual docking in space with Agena rocket stage.

June 2 Surveyor 1 is first US spacecraft to land softly on the moon. It analyzes soil content and transmits surface images to Earth.

Jan. 25, 1967 Soviet Cosmos 139 antisatellite weapon carries out first fractional orbit bombardment.

Jan. 27 First deaths of US space program occur in flash fire in Apollo 1 command module, killing astronauts Grissom, White, and Lt. Cmdr. Roger B. Chaffee.

Sept. 8 Surveyor 5 conducts first chemical analysis of lunar soil.

Oct. 20, 1968 Soviet Cosmos 248 and Cosmos 249 spacecraft carry out first co-orbital antisatellite test.

Dec. 21–27 Apollo 8 becomes first manned spacecraft to escape Earth's gravity and enter lunar orbit. First live lunar television broadcast.

March 3–13, 1969 Apollo 9 crew members Col. James A. McDivitt, Col. David R. Scott, and Russell L. Schweickart conduct first test of lunar module in Earth orbit.

July 20 Apollo 11 puts first human, Neil A. Armstrong, on the moon.

Nov. 14–24 US Apollo 12 mission deploys first major scientific experiments on the moon and completes first acquisition of samples from an earlier spacecraft—Surveyor 3.

Feb. 11, 1970 Japan launches first satellite, Osumi, from Kagoshima Space Center using Lambda 4S solid-fuel rocket.

Jan. 31, 1971 Apollo 14 launched; its astronauts will complete first manned landing on lunar highlands.

April 19 First space station, Salyut 1, goes aloft.

June 6 USSR's Soyuz 11 performs first successful docking with Salyut space station.

Oct. 28 First British satellite, Prospero, launched into orbit on Black Arrow rocket.

Nov. 2 Titan IIC launches first Defense Satellite Communications System (DSCS) Phase II satellites into GEO.

April 16–27, 1972 Apollo 16 astronauts Capt. John Young, Lt. Cmdr. Thomas K. Mattingly II, and Lt. Col. Charles M. Duke Jr. are first to use the moon as an astronomical laboratory.

July 23 US launches first Earth Resources Technology Satellite (ERTS A), later renamed Landsat 1.

Dec. 3, 1973 Pioneer 10 becomes first space probe to come within reach of Jupiter.

July 15, 1975 US Apollo and Soviet Soyuz 19 perform first international docking of spacecraft in space.

July 20, 1976 NASA's Viking 1 performs first soft landing on Mars and begins capturing images of Red Planet's surface, with Viking 2 doing the same on Sept. 3.

Aug. 12, 1977 Space shuttle *Enterprise* performs first free flight after release from a Boeing 747 at 22,800 feet.

Feb. 22, 1978 Atlas booster carries first Global Positioning System (GPS) Block I satellite into orbit.

Dec. 13 Successful launch of two DSCS II satellites puts a full four-satellite constellation at users' disposal for first time.

July 18, 1980 India places its first satellite, Rohini 1, into orbit using its own SLV-3 launcher.

April 12–14, 1981 First orbital flight of shuttle *Columbia* (STS-1) and first landing from orbit of reusable spacecraft.

Dec. 20, 1982 First Defense Meteorological Satellite Program (DMSP) Block 5D-2 satellite launched.

June 13, 1983 Pioneer 10 becomes first spacecraft to leave solar system.

June 18 Space shuttle *Challenger* crew member Sally K. Ride becomes first American woman in space.

Sept. 11, 1985 International Cometary Explorer becomes first man-made object to encounter a comet (Giacobini–Zinner).

Sept. 13 First US antisatellite intercept test destroys Solwind scientific satellite by air-launched weapon.

Oct. 3, 1985 First launch of *Atlantis* (STS-51J) results in first launch of pair of DSCS III satellites from space shuttle using Inertial Upper Stage.

Jan. 28, 1986 In the first shuttle mishap, *Challenger* explodes after liftoff, killing seven astronauts.

Feb. 22 France launches first *Satellite Pour l'Observation de la Terre* (SPOT) for remote sensing.

Aug. 12 First launch of Japanese H-I rocket puts Experimental Geodetic Satellite into circular orbit.

May 15, 1987 USSR stages first flight of its Energia heavy launcher, designed to lift 100 tons into Low Earth Orbit.

Nov. 15, 1988 USSR makes first launch of 30-ton shuttle *Buran* using Energia rocket.

Feb. 14, 1989 Launch of first Block II GPS satellite begins an operational constellation.

Jan. 17, 1991 What the Air Force calls "the first space war," Operation Desert Storm, opens with air attacks.

Oct. 29 Galileo swings within 10,000 miles of Gaspia, snapping first close-up images of an asteroid.

May 13, 1992 The first trio of space-walking astronauts, working from the shuttle *Endeavour*, rescues Intelsat 6 from useless low orbit.

Jan. 13, 1993 USAF Maj. Susan Helms, flying aboard *Endeavour*, becomes first US military woman in space.

July 19 Launch of a DSCS Phase III satellite into GEO provides the first full five-satellite DSCS III constellation.

Dec. 2–13 USAF Col. Richard O. Covey pilots shuttle *Endeavour* on successful \$674 million mission to repair \$2 billion Hubble Space Telescope, a mission for which the crew wins the 1993 Collier Trophy.

Jan. 25, 1994 Launch of the 500-pound unpiloted Clementine spacecraft marks the first post-Apollo US lunar mission.

Feb. 7 First Titan IV–Centaur booster launches first Milstar Block I satellite into orbit.

March 13 First launch of Taurus booster (from Vandenberg AFB) places two military satellites in orbit.

June 29 First visit of a US space shuttle to a space station, the Russian Mir.

Nov. 5 Ulysses, first probe to explore the sun's environment at high latitudes, completes a pass over the sun's southern pole and reveals that solar wind's velocity at high latitudes (i.e., about two million mph) is nearly twice its velocity at lower latitudes.

Feb. 6, 1995 Shuttle *Discovery* (STS-63) and space station Mir perform first US–Russian space rendezvous in 20 years, with Air Force Lt. Col. Eileen M. Collins coincidentally becoming first woman to pilot a US spaceship.

March 14 US astronaut Norman E. Thagard becomes first American to accompany Russian cosmonauts aboard Soyuz TM-21 spacecraft and, two days later, becomes first American to inhabit space station Mir.

June 29 *Atlantis* (STS-71) docks with Mir, the first docking of a US spacecraft and a Russian space station.

March 8, 1996 First successful launch of Pegasus XL rocket from beneath modified L-1011 aircraft sends Air Force Radiation Experiment–II satellite into polar orbit.

June 27 Galileo captures first close-up images of Jupiter's moon Ganymede.

April 21, 1997 Celestis, Inc., of Houston performs first space "burial" when Pegasus rocket launched from L-1011 off coast of northwest Africa carries cremated remains of "Star Trek" creator Gene Roddenberry, LSD guru Timothy Leary, and 22 other space enthusiasts into orbit 300 miles above Earth.

April 29 US astronaut Jerry Linenger and Russian cosmonaut Vasily Tsibliev complete five-hour space walk outside Mir, the first such joint excursion in space history.

June 27 In first flyby of "dark, primitive main-belt" type asteroid, NASA's Near-Earth Asteroid Rendezvous spacecraft passes 253 Mathilde.

Space Leaders

(As of July 1, 1998)

Commanders in Chief, US Space Command

Gen. Robert T. Herres Sept. 23, 1985–Feb. 6, 1987
 Gen. John L. Piotrowski Feb. 6, 1987–March 29, 1990
 Gen. Donald J. Kutyna March 29–June 30, 1992

Commanders, Air Force Space Command

Gen. James V. Hartinger Sept. 1, 1982–July 30, 1984
 Gen. Robert T. Herres July 30, 1984–Oct. 1, 1986
 Maj. Gen. Maurice C. Padden Oct. 1, 1986–Oct. 29, 1987
 Lt. Gen. Donald J. Kutyna Oct. 29, 1987–March 29, 1990
 Lt. Gen. Thomas S. Moorman Jr. March 29, 1990–March 23, 1992

Commanders in Chief, US Space Command, and Commanders, Air Force Space Command

Gen. Donald J. Kutyna March 23, 1992–June 30, 1992
 Gen. Charles A. Horner June 30, 1992–Sept. 13, 1994
 Gen. Joseph W. Ashy Sept. 13, 1994–Aug. 26, 1996
 Gen. Howell M. Estes III Aug. 26, 1996–(Oct. 1, 1998)*
 Gen. Richard B. Myers (Oct. 1, 1998)–

*Announced retirement date.

Directors, NASA

T. Keith Glennan Aug. 19, 1958–Jan. 20, 1961
 James E. Webb Feb. 14, 1961–Oct. 7, 1968
 Thomas O. Paine March 21, 1969–Sept. 15, 1970
 James C. Fletcher April 27, 1971–May 1, 1977
 Robert A. Frosch June 21, 1977–Jan. 20, 1981
 James M. Beggs July 10, 1981–Dec. 4, 1985
 James C. Fletcher May 12, 1986–April 8, 1989
 Richard H. Truly May 14, 1989–March 31, 1992
 Daniel S. Goldin April 1, 1992–

Directors, National Reconnaissance Office

Joseph V. Charyk Sept. 6, 1961–March 1, 1963
 Brockway McMillan March 1, 1963–Oct. 1, 1965
 Alexander H. Flax Oct. 1, 1965–March 11, 1969
 John L. McLucas March 17, 1969–Dec. 20, 1973
 James W. Plummer Dec. 21, 1973–June 28, 1976
 Thomas C. Reed Aug. 9, 1976–April 7, 1977
 Hans Mark Aug. 3, 1977–Oct. 8, 1979
 Robert J. Hermann Oct. 8, 1979–Aug. 2, 1981
 Edward C. Aldridge Jr. Aug. 3, 1981–Dec. 16, 1988
 Martin C. Faga Sept. 26, 1989–March 5, 1993
 Jeffrey K. Harris May 19, 1994–Feb. 26, 1996
 Keith R. Hall (acting) Feb. 27, 1996–March 27, 1997
 Keith R. Hall March 28, 1997–

Space and Missile Badges



Space/Missile Badge



Astronaut Pilot*

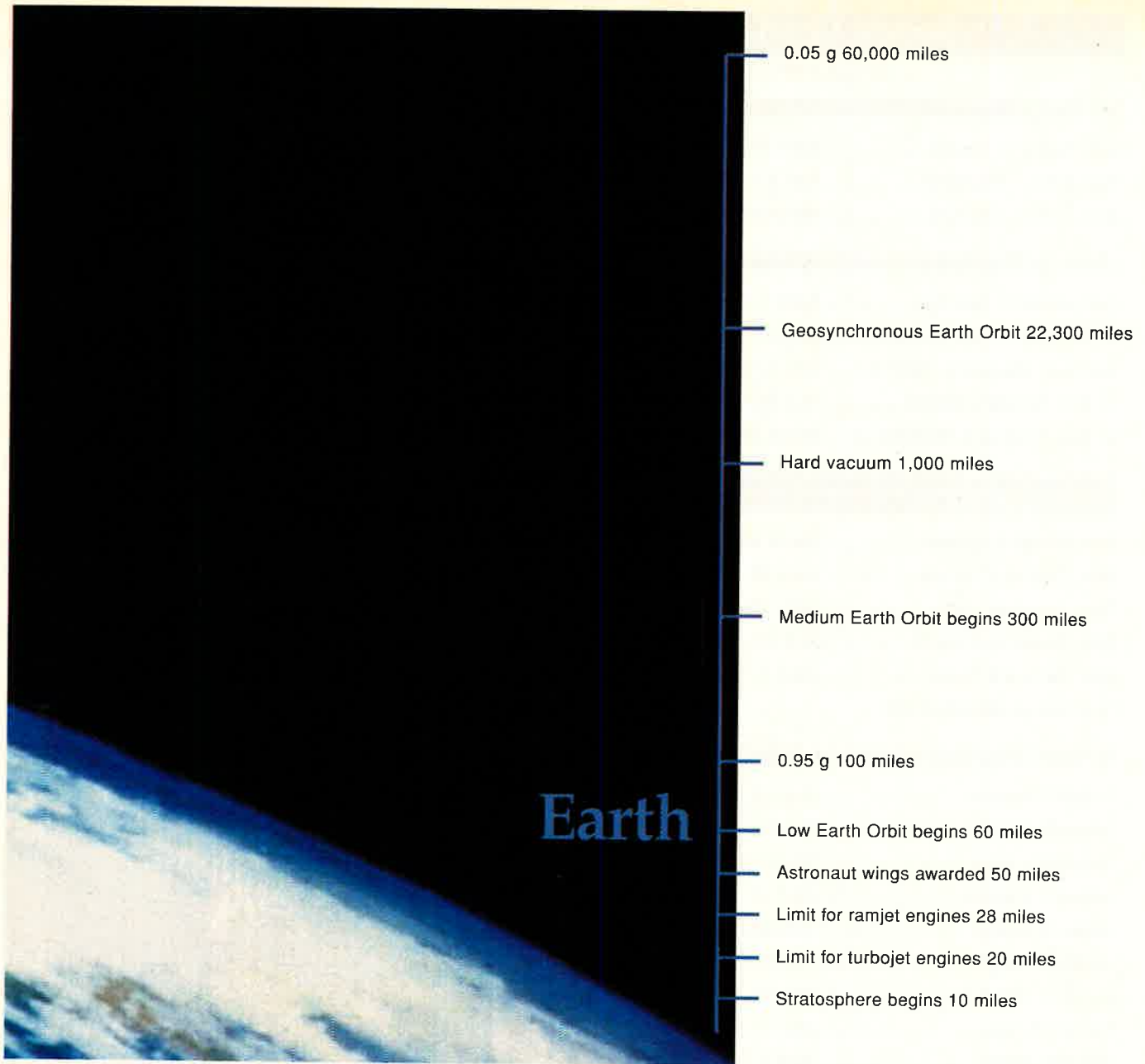


Missile Badge



Missile Badge with Operations Designator

*The astronaut designator indicates a USAF rated officer qualified to perform duties in space (50 miles and up) and who has completed at least one operational mission. Pilot wings are used here only to illustrate the position of the designator on the wings.



Space Terms

Aerospace. A physical region made up of Earth's atmosphere and the space beyond.

Aerospace plane. A reusable spacecraft able to operate effectively in both the atmosphere and space. Also known as a "transatmospheric vehicle" or, more currently, "spaceplane."

Apogee. The point of greatest distance from Earth (or the moon, a planet, etc.) achieved by a body in elliptical orbit. Usually expressed as distance from Earth's surface.

Atmosphere. Earth's enveloping sphere of air.

Boost phase. Powered flight of a

ballistic missile—i.e., before the rocket burns out.

Burn. The process in which rocket engines consume fuel or other propellant.

Circumterrestrial space. "Inner space" or the atmospheric region that extends from 60 miles to about 50,000 miles from Earth's surface.

Constellation. A formation of satellites orbiting for a specific combined purpose.

Deep space. All space beyond the Earth-moon system, or from about 480,000 miles altitude outward.

Eccentric orbit. An extremely elongated elliptical orbit.

Ecliptic plane. The plane defined by the circle on the celestial sphere traced by the path of the sun.

Elliptical orbit. Any noncircular, closed spaceflight path.

Exosphere. The upper limits of Earth's atmosphere, ranging from about 300 miles altitude to about 2,000 miles altitude.

Expendable Launch Vehicle (ELV). A launch vehicle that cannot be reused after one flight.

Ferret. A satellite whose primary function is to gather electronic intelligence, such as microwave, radar, radio, and voice emissions.

Geostationary Earth orbit. A geosynchronous orbit with 0° inclination in which the spacecraft circles Earth 22,300 miles above the equator and appears from Earth to be standing still.

Geosynchronous Earth Orbit (GEO). An orbit at 22,300 miles that is synchronized with Earth's rotation. If a satellite in GEO is not at 0° inclination, its ground path describes a figure eight as it travels around Earth.

Geosynchronous Transfer Orbit (GTO). An orbit that originates with the parking orbit and then reaches apogee at the GEO.

Ground track. An imaginary line on Earth's surface that traces the course of another imaginary line between Earth's center and an orbiting satellite.

High Earth Orbit (HEO). Flight path above geosynchronous altitude (22,300 to 60,000 miles from Earth's surface).

High-resolution imagery. Detailed representations of actual objects that satellites produce electronically or optically on displays, film, or other visual devices.

Inertial Upper Stage (IUS). A two-stage solid-rocket motor used to propel heavy satellites into mission orbit.

Ionosphere. A region of electrically charged thin air layers that begins about 30 miles above Earth's atmosphere.

Low Earth Orbit (LEO). Flight path between Earth's atmosphere and the bottom of the Van Allen belts, i.e., from about 60 to 300 miles altitude.

Magnetosphere. A region dominated by Earth's magnetic field, which traps charged particles, including those in the Van Allen belts. It begins in the upper atmosphere, where it overlaps the ionosphere, and extends several thousand miles farther into space.

Medium Earth Orbit (MEO). Flight path between LEO, which ends at about 300 miles altitude, and GEO, which is at an average altitude of 22,300 miles.

Mesosphere. A region of the atmosphere about 30 to 50 miles above Earth's surface.

Orbital decay. A condition in which spacecraft lose orbital altitude and orbital energy because of aerodynamic drag and other physical forces.

Orbital inclination. Angle of flight path in space relative to the equator of a planetary body. Equatorial paths are 0° for flights headed east, 180° for those headed west.

Outer space. Space that extends from about 50,000 miles above Earth's surface to a distance of about 480,000 miles.

Parking orbit. Flight path in which spacecraft go into LEO, circle the globe in a waiting posture, and then transfer payload to a final, higher orbit.

Payload. Any spacecraft's crew or cargo; the mission element supported by the spacecraft.

Perigee. The point of minimum altitude above Earth (or the moon, a planet, etc.) maintained by a body in elliptical orbit.

Period. The amount of time a spacecraft requires to go through one complete orbit.

Polar orbit. Earth orbit with a 90° inclination. Spacecraft on this path could pass over every spot on Earth as Earth rotates under the satellite's orbit (see orbital inclination).

Remote imaging. Images of Earth generated from a spacecraft that provide data for mapping, construction, agriculture, oil and gas exploration, news media services, and the like.

Reusable Launch Vehicle (RLV). A launch vehicle that can be reused after flight.

Rocket. An aerospace vehicle that carries its own fuel and oxidizer and can operate outside Earth's atmosphere.

Semisynchronous orbit. An orbit set at an altitude of 12,834 miles. Satellites in this orbit revolve around Earth in exactly 12 hours.

Single-Stage-To-Orbit (SSTO) system. A reusable single-stage rocket that can take off and land repeatedly and is able to boost payloads into orbit.

Stratosphere. That section of atmosphere about 10 to 30 miles above Earth's surface.

Sun synchronous orbit. An orbit inclined about 98° to the equator and at LEO altitude. At this inclination and altitude, a satellite's orbital plane always maintains the same relative orientation to the sun.

Thermosphere. The thin atmosphere about 50 to 300 miles above Earth's surface. It experiences dramatically increased levels of heat compared to the lower layers.

Transfer. Any maneuver that changes a spacecraft orbit.

Transponder. A radar or radio set that, upon receiving a designated signal, emits a radio signal of its own.

Troposphere. The region of the atmosphere from Earth's surface to about 10 miles above the equator and five miles above the poles. This is where most clouds, wind, rain, and other weather occurs.

Van Allen belts. Zones of intense radiation trapped in Earth's magnetosphere that could damage unshielded spacecraft.

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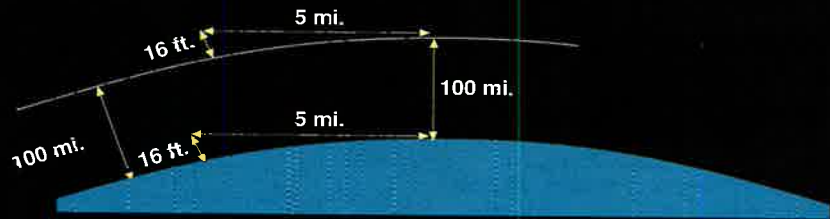
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Orbits

Orbits result from the mutual attraction of any two bodies with a force proportional to the product of their individual masses and inversely proportional to the square of the distance between them. The curvature of the Earth, on average, drops 16 feet below the horizontal over a distance of about five miles. A spacecraft circling above would "fall" that same amount over the same distance. It travels five miles in one second if gravitational pull equals one g. Therefore, spacecraft velocity of five miles per second (18,000 mph) produces perpetual orbit at sea level, unless the spacecraft's flight is upset by perturbations, such as solar wind or mechanical anomalies.



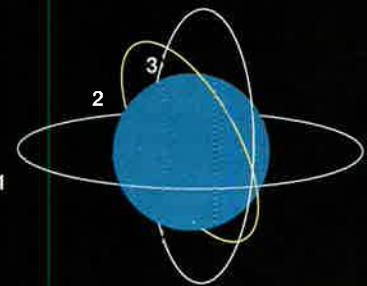
Orbital Altitude

- LEO Low Earth Orbit
- MEO Medium Earth Orbit
- GEO Geosynchronous Earth Orbit
- HEO High Earth Orbit

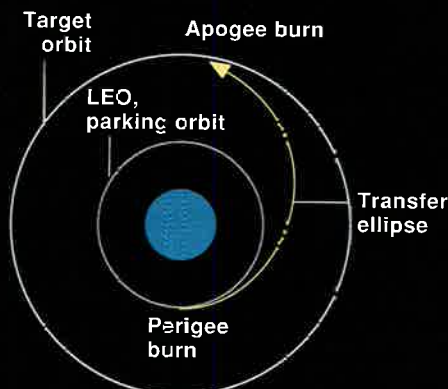
Orbital Inclinations

- 1 Equatorial
- 2 Sun synchronous
- 3 Polar

HEO 22,300–60,000 mi.



Geosynchronous Transfer Orbit



It is common procedure to pick an initial "parking" orbit, usually at LEO, then boost payloads to higher altitude. Engines are fired first (at perigee) to reach the apogee of an elliptical transfer orbit and then are fired again to put the spacecraft into a circular orbit at that higher altitude.

Illustrations are not drawn to scale.



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command and control platforms worldwide. Small wonder. Our Collins Link 16 Class 2/2H terminals have the longest range of any data link (up to 500 nautical miles). Best of all, they're available now. So stop waiting. Take the upper hand today. Discover data links so powerful they link you to the future. Call 319.295.5100.

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for the next
quarter-century.**

The F-22 Out Front

By John A. Tirpak, Senior Editor

EVERYTHING that fighter pilots, tacticians, and engineers learned about air combat in the last 50 years has been distilled into the F-22 Raptor, the Air Force's fighter for the 21st century. The lessons learned the hard way in Korea, Vietnam, and places like the Bekaa Valley of Lebanon—the pricelessness of superior situational awareness and agility, shooting before being seen, fooling or eluding ground threats, reliability, “speed is life”—have been translated into about 34,000 pounds of titanium, aluminum, and wonder materials that fly like a dream.

Superfast and maneuverable, stealthy, and providing its pilot with instantly comprehensible information about everything going on around him, the F-22 incorporates so many fighter “firsts” that it will be the benchmark of air combat power for at least a quarter-century.

Almost every year since the program's inception, however, the F-22 has been hounded by budget-cutters in Congress and the Pentagon who question the Air Force's need for such a powerful fighter. Especially now, with defense budgets at near-historic postwar lows, critics hold the Raptor up as a prime example of an expensive program that doesn't know the Cold War is over, a case of technological overkill for the fighter threats that may pop up in the coming decade.

The F-22 program has been cut, delayed, or restructured so many times in the last seven years that most observers have lost count. Originally pegged at a buy of 750 airplanes, the planned inventory slipped to 650, then 600, then 442, and now, with the Quadrennial Defense Review, 339—slightly more than three wing's worth. As the buy has descended, unit cost has climbed, and some members of Congress worry that the F-22 may price itself out of existence. As Sen. John Glenn (D-Ohio) recently remarked in a Senate





Armed Services Committee hearing, “We must be vigilant that the program not go the way of previous programs” such as the B-2, “where the sticker shock overwhelms the capability improvements.”

To underline the point, Congress has imposed a \$40.9 billion program cost cap on the F-22, much as was done with the B-1B and B-2 programs. If the project exceeds the cap, the Air Force must fund the overage from other accounts.

With the reduced buy, the Pentagon also cut the peak production rate of the F-22 from 48 per year to 36 a year, reduced the engine buy from 1,027 to 777, and cut the initial production batch from 70 to 58 aircraft.

Far From Overkill

Air Force leaders do not see the F-22 as overkill. Far from it. Instead, they see the airplane as simply having the power to deliver what the nation has come to expect—total control of the air in any armed conflict involving US forces. Rather than an answer to the new generation of highly capable and even somewhat stealthy fighters now coming into service around the world—such as the Russian Su-37, French Rafale, and EF2000—the Raptor is designed to counter the airplanes and missiles that will come *after* them.

“We are not building the F-22 for the threats we face in 2000 or 2005,” asserted Maj. Gen. (sel.) Bruce A. Carlson, director of operational re-

quirements, USAF’s Deputy Chief of Staff for Air and Space Operations. “We are building it for the threats we will face in 2020,” when large numbers of F-22s will be in the force.

Carlson noted that the F-15—USAF’s current top air superiority fighter—was designed in the 1960s, tested and produced in the 1970s, upgraded in the 1980s, and finally did battle on behalf of the US in the Gulf War of 1991. There it racked up an impressive tally of 29 air-to-air kills with no losses, against state-of-the-art MiG-29s and other capable fighters. Likewise, the F-22 will have to be able to dominate the battlespace well into its middle-age years.

“We don’t have the resources for building a new fighter every five to 10 years,” Carlson said. “We don’t want to come back” from a battle in 2010 “with our tail between our legs and say, ‘Well, we just didn’t want to spend the money on a real capable fighter’ ” back in the 1990s.

“The F-15 dominated during its lifetime, and the F-22 ... is being designed to do the same thing,” he added.

There is no point in building a “match” for today’s best potential enemy fighters, Carlson said. The Air Force needs an airplane that can defeat large numbers of enemy airplanes swiftly and overwhelmingly.

Parity Has Arrived

“The question is, are there planes out there right now that can threaten

us? And the answer is, yes,” Carlson said. “With the F-15, we’re at parity right now” with the Russian Flanker family of airplanes, which have unneringly good acceleration, range, radar power, and agility.

“Put a good missile on that plane, and it becomes a hell of a threat to most of our aircraft and the F-15,” he continued. Moreover, “the Flanker has been licensed to other countries,” so they will show up in more and more places. As for the MiG-29, he said, “They’re everywhere. [Russia is] selling them cheap.” As time passes, better fighters are showing up in many places where the US might get into a fight, and there’s “no telling” who the Eurofighter or Rafale “may be sold to.”

The USAF emphasis on expeditionary operations will make it more difficult for the F-15 to dominate as time goes on and the new threat airplanes multiply in number.

“When I go to war, I’m an expeditionary force,” Carlson said. Because of worldwide commitments, perhaps “I can only take a wing and a half” of F-22s to a hot spot. Since even a fairly small air force can afford “to buy two wings’ worth” of topline fighters that can match the F-15, the air battle could be a draw, with disastrous consequences for an American ground force at the end of a long supply line from the continental US.

“If you’re at parity, you’re not going to win big, and you’re not going to guarantee air dominance to the theater commander, so you can land troops ... and equipment on the shore,” Carlson said. “We don’t want to lose to some third-rate air force just because they happen to live close to the fight and can throw a few wings of good airplanes at us,” he asserted.

The F-22 is not only needed in order to be able to win in an expeditionary mode where it will likely be outnumbered. The F-15 is now out of production and getting old. Its age and associated problems—airframe stress, corrosion, water intrusion, and so forth—will only get worse as time goes on.

“We don’t have much option but to replace the F-15s,” according to Gen. Michael E. Ryan, Air Force Chief of Staff.

The F-15 has numerous “geriatric” problems, Ryan said, and given that “we have to keep them” for at

F-22 Team photo



The Raptor promises to be the benchmark for air combat power. An impressive, sleek fighter aircraft from any angle, this one shows the thrust vectoring nozzles that help give the F-22 extreme maneuverability.



that what we have is quality capability," Ryan noted.

If 1.5 wings of F-22s looks to be insufficient, Ryan said the Air Force might convert some of the youngest F-15E strike airplanes to an air superiority role to supply the missing fourth wing. The airplanes would not be "first-in" types, leaving that mission to the stealthy F-22, but could be "pylon airplanes" patrolling the airspace after enemy fighters and air defenses had been largely suppressed.

In addition, Ryan observed that the F-22 production line need not shut down at 339 airplanes, especially if world events dictate a larger force. Ryan observed that the F-117 and F-15E strike airplanes will need replacement before the F-22 line

least another decade as the F-22 is tested, refined, and produced, "it worries you."

The average age of fighters in the Air Force is creeping toward 20 years, Ryan noted.

"We've never had an average age in our fighter fleet of 20 years, and ... we'll get there before we turn it around," he said. "That's going into territory we haven't been in before."

If the F-22 is further delayed, it would pose enormous problems for the Air Force, Ryan said.

"Fighter aircraft are built for a certain number of [service] hours on the airframe. And after that, we have to do almost a remanufacture of the airplane to put it back in flying condition because of the stress and strain of the fighter maneuvers," he explained. The Air Force has not budgeted a remanufacturing effort for the F-15 because it would be highly expensive and do nothing to increase its capability to meet modern threats, particularly those posed by ground defenses and surface-to-air missiles.

"We screw around with the [F-22] program anymore and cut [it], ... and unit costs go up significantly," Ryan said. "Economically, it doesn't make any sense to take it down any lower."

Rising Risk

The Air Force has been criticized by some members of Congress who pointed out that the service backed away from its previous insistence that four wings—442 airplanes—was absolutely the lowest number with which it could accomplish the mis-



At Fort Worth, Texas, the main fuselage (in top photo) and one of the two Sidewinder bays (above) undergo assembly. Final assembly takes place in Georgia. Any more delays in the F-22 program will pose enormous problems, say USAF leaders.

sion of fighting two near-simultaneous Major Theater Wars. In the Quadrennial Defense Review the Air Force acceded to a program cut to only 339 airplanes, or about three wings.

Ryan acknowledged that "the risk goes up" with the smaller buy but that the proposal was based on scenarios revolving around a US operation in Southwest Asia at the same time it was involved in one in North-east Asia.

"We have force-sized ourselves on those two regional contingencies, and then our hedge against the unknown on force size is making sure

closes, and the Raptor, modified for a broader ground attack capability, might be the best solution to replacing them.

Gen. Richard E. Hawley, commander of Air Combat Command, told reporters in Washington recently that the F-22, built for punishing air combat and stealth "equal to or even better than" that of the F-117, "might make it a natural" to replace that airplane. And, just as the F-15E retains all of the dogfighting prowess of the F-15C, the dedicated strike version of the F-22 could augment the air superiority force at need.

"Just as the F-15 turned out to be

How a Stealth Aircraft Avoids Detection

Widely misunderstood as either some sort of spray-on treatment or built-in cloaking device, stealth is a wide variety of technologies and tactics used to prevent detection by the enemy. Since surveillance methods use many parts of the electromagnetic spectrum, different techniques are needed to address each one.

Radar. Radar works by sending out pulses of energy: If those pulses strike an object, such as an airplane, they bounce back, creating an echo which the antenna can detect. A computer notes where the echo is from moment to moment and creates a track on the operator's display. The shaping of a stealth aircraft reduces radar echo by deflecting some of the radar energy away in a different direction. The pilot will approach enemy radars from different angles, depending on their frequencies, to best exploit this deflective capability. Special materials in the structure and surface of the airplane, as well as its paint, can further absorb radar energy or even change its frequency so that the echo is even more diminished. While the echo is almost never completely eliminated, it can be attenuated to the point where the radar operator can't tell whether he is seeing an airplane or a small bird or even an insect. Thus the enemy has greatly reduced warning of a stealth airplane's approach. This effect can be multiplied by flying low to the ground and hiding in the clutter that appears on radar screens, as trees and terrain reflect back "noise."

Infrared. Heat-seeking missiles and Infrared Search-and-Track devices look for the hot exhaust of an airplane's engines. Stealth aircraft reduce the heat of their exhaust by mixing it with cold ambient air and dissipating it over a wide, flat area. Special ceramics in the engine exhaust—similar to those used to protect the space shuttle from re-entry temperatures—can further reduce an airplane's heat signature by capturing heat and converting it into a soft glow. These mea-

a great basic airplane to turn into an interdicator, and we converted that into the F-15E for a relatively small engineering and manufacturing development investment, the F-22, too, may turn out to be a great platform, just because of its basic air superiority design," said Hawley. "It tends to lend itself well to that interdiction mission, with minor modification."

Miniature Munitions

Moreover, munitions technology



This view of the intakes shows how much the engine fan blades are shielded from radar reflection. It is one of the many characteristics that contribute to the F-22's stealth capability.

sures can be enough to prevent an IR missile orIRST device from locking on to a stealth airplane's tail. Furthermore, the irregular paint job on the F-22 is more than just camouflage: It gives an imaging infrared missile a harder time finding a distinct "picture" of the airplane's edges, further hampering lock-on.

Visual. Stealth aircraft aren't physically invisible. However, flying them at night and painting them with dull gray paint makes them hard to see with the naked eye. In addition, stealth airplanes tend to have a low, flat silhouette that makes them even harder to see, especially head-on.

Aural. To remain most stealthy, an airplane must fly below supersonic speed to prevent forming a sonic boom that would announce its presence. The F-22 will likely go supersonic only after turning on radars

and revealing itself in other ways, like the explosion of targets behind it.

Electromagnetic. Maintaining radio silence has long been a means of avoiding detection; now it also refers to radars or any other electronic devices that create electromagnetic emissions that would betray the presence of an airplane. When an onboard radar must sometimes be used for navigation or to illuminate a target, the radar on aircraft such as the B-2 or F-22 can rapidly hop from one frequency to another in random fashion, so that an enemy can't lock on to its radar. The F-22's radar beam is also sophisticated enough to be very narrow, betraying its position in only one small slice of the sky. Much effort has been put into eliminating the radar sidelobes, or electronic noise at the edges of the radar beam. This makes the F-22's radar one of the low probability of intercept varieties.

is advancing rapidly, and all indications are that, within a decade or less, a 1,000- or 500-pound bomb will be able to pack as much punch as the 2,000-pound bombs of today.

The F-22 was designed to be able to carry two 1,000-pound Joint Direct Attack Munitions, but the "small smart bomb" research initiative may mean that it could carry as many as four—or even eight—bombs with as much destructive power, Hawley observed. Such a development would

make it unnecessary for F-22s to undergo much modification to make it a workhorse strike airplane.

The ACC chief explained, "Those miniature munitions ... are ideally suited to stealthy platforms, because it allows you to put more weapons in that internal weapons bay, which you have to do—anything that carries a weapon externally is not stealthy, by definition—so it allows you to carry more weapons internally, cover more targets, more aim points within the

target set. So those developments will ... determine the shape of that future interdictor and whether or not the F-22 will have to have significant modifications or just minor mods."

He went on to note, "Some people say you could get as many as eight bombs in the F-22 bomb bay pretty much as it's currently configured. That's a pretty good payload, if you can get the right punch out of those miniature munitions, and the lab work indicates we will."

He also believes that the Air Force will need to replace its F-15s, F-117s, and F-15Es on "a one-to-one" basis, "as long as our force structure requirements stay the way they are now for the next decade or so." The F-15, he noted, is "one of the most heavily tasked airplanes" in the Air Force. "We're drawing down lots of things, but the F-15 is not one of them."

Also affecting the eventual buy will be the changing nature of the threat. The F-15E, he said, "could fall victim ... to a threat more robust than it can handle."

Carlson noted that "there will be two more QDRs before we even field the first wing of F-22s," leaving plenty of time to make a decision as to what the final buy should be, and Ryan observed that additional airplanes were tacked onto the F-4, F-15, and F-16 buys, so "historically," the precedent exists for more F-22s. The problem that is bigger than the ulti-



Staff photo by Guy Aceto

One of the most heavily tasked aircraft in the Air Force, the F-15E, shown here on deployment with an Air Expeditionary Force, is among the fighter aircraft that will need replacement.

mate buy is "getting the program going" in the first place, he said.

The Raptor has now been in flight test at Edwards AFB, Calif., for several months; a second flying model was to join the test program by August. Delays in getting the first airplane ready for test—coupled with freakishly high winds and bad flying weather at Edwards, attributed to "El Nino"—has delayed the test program.

Those problems have been of a practical, production-line nature and do not concern the soundness of the design or the technology underlying it, Carlson said.

"There really is nothing more to invent" for the F-22 to perform as expected, he observed. The items that have delayed delivery of the initial test airplanes have had to do with welding, castings, and, literally, keeping certain items glued together. The fixes are all in place and production continues, but the glitches delayed the initial clutch of test flights.

The General Accounting Office cautioned Congress that more flight test data should be obtained before proceeding with major contracting milestones that would commit USAF to funding large-scale F-22 production. It suggested delaying that go-ahead by 10 months to allow more test flying to be done to increase program confidence. It noted that previous aircraft types racked up more flying before getting the production go-ahead than the F-22 will.

Desirable but Expendable

The Air Force agrees that more testing is desirable but argues that the program shouldn't be further delayed to acquire it. If something gravely wrong with the F-22 is discovered in testing, terminating the program would cost \$600 million. Delaying the program by 10 months to acquire more flight test data, however, would require significant renegotiation of the contract and restructuring of the production process—with a whopping price tag of \$2.75 billion.

Pentagon acquisition and technology chief Jacques S. Gansler de-

F-22 Team photo



The Eagle and the Raptor: The F-15 (upper right) could not be modified to handle the tasks planned for the Raptor (lower left), and attempts to do so would cost almost as much as the F-22's program.



In the superfast, stealthy, and maneuverable F-22, USAF leaders see an airplane with the power to deliver what the nation expects—total control of the air in any armed conflict involving the US.

clined to functionally postpone the program but did build new reviews into it that will verify performance and cost of the F-22 program before large sums are laid out.

Carlson noted that the F-22 was designed—and is being tested—in a way very different from that of earlier fighters.

“We would be criticized if we structured the F-22 flight test program as we did for [earlier] fighters,” Carlson said. “Years ago, you did testing because you had to. ... There was no other way to find out what the airplane would do.” Today, computer modeling and simulation have become so effective that large amounts of flight testing that used to be essential may now be considered redundant.

“Flight testing ... in 1998 is not the same as it was in 1978,” Carlson noted. “We’re able to validate ... parameters through computer models.” Things that previously could be discovered “only by flying the airplane” can now be found—and corrected—before the airplane is even built.

“Today, you flight-test to validate the computer prediction,” Carlson said. If performance matches the computer models at certain key points of the envelope, it’s a safe bet that the points in between match up as well.

The expense of flight testing is such that “we would be criticized if we built a flight test program of the size of the F-15’s,” he added.

Thus far, Lockheed Martin and Air Force test pilots have found that the F-22 simulations have remarkable “fidelity”—that is, they very closely match the actual performance of the aircraft as demonstrated in test flights.

The Air Force has run more than 43,000 hours of wind tunnel tests on the F-22 and its prototype, the YF-22. More than 2,100 hours of aerodynamics and propulsion simulation have been run on a Cray supercomputer, and over 365,000 test flight hours have been accumulated on components. The radar, for example, has been flying on a test aircraft for several years and more recently has flown with a nosecone identical to that of the F-22.

“Confident”

The test points obtained so far “all point to the fact that we’re very confident ... that the airplane will fly the way we thought it would,” Carlson said. “The guys that’ve flown it say it handles just exactly like the VISTA” or Variable stability In-flight Simulator Test Aircraft, an F-16 modified with the computer control laws of the F-22.

Moreover, test flight programs have consistently shown that any major problems with a fighter typically show up in the first 200 hours of testing. The Air Force will have at least that much, and possibly as much as 400 hours, before it must make its next large commitment of money for production.

The service has also struck an agreement with Lockheed Martin and the company’s subcontractors to hold to a firm price on the first few batches of F-22s, even as the contractors continue to seek ways to pare weight and cost from the project.

Carlson reported that restructuring the flight test program “bought back” some of the nine months of delay caused by the manufacturing glitches for the first airplanes. This has been applied to the software and avionics development effort as “program reserve,” meaning that there are nearly eight months of time to fix any problems or delays that emerge in the electronics or software of the F-22.

The alternatives to building the F-22 are unappetizing. The F-15 simply could not be modified to take on the tasks planned for the Raptor, and modifying it as much as possible—still to a far lower standard—would cost almost as much as the F-22 program as it now stands.

Some have discussed using the in-development Joint Strike Fighter as a possible F-22 alternative, but Carlson asserted that the JSF, “no matter what you do to it, is not going to give you what we have in the F-22. ... My hope is that there will never be a comparable airplane to the F-22. You’d always like to win 11—nothing and have the other guy go home beat-up and sorry he took you on.”

There were no deals struck with the Pentagon in the QDR that the F-22 wouldn’t be cut any further, Ryan reported.

“I don’t think we have any kind of promise from anybody,” Ryan said. “If it continues to perform the way it’s performing right now, if costs come in the way they’re supposed to come in, ... there’s no reason to go after it. It’s a good program. It’s one this nation needs.”

He was asked whether the Air Force might reach a point at which the size of the F-22 buy is too low to make the program worthwhile. Ryan said, “I don’t think that number’s there, quite honestly. You must have the best capability to provide you air superiority. All the services agree on that. I mean, the last thing in the world we want to have is our military forces subjected to what we did to the Iraqis.” ■

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The latest poll finds a great many Air Force members thinking about leaving service.

The Views of the Force

By Bruce D. Callander

General Well Being

	% Officer			% Enlisted		% Civilian	
	Jr.	Field	Pilot	1st term	2d term	Jr.	Sr.
USAF is a good place to work	81	83	71	69	68	83	81
USAF provides good quality of life	76	77	67	66	60	76	75
Family supportive of career	71	78	59	63	60	82	83
How well USAF informs	47	54	40	45	41	51	49

MANY Air Force members are working harder, spending more time away from home, and thinking more seriously than ever about quitting. Those are among the more disturbing conclusions to be found in USAF's latest Chief of Staff Survey, results of which were published late this spring.

The poll, perhaps the most ambitious the service has performed, was conducted last fall. It not only probed standard quality-of-life matters but also asked members to comment on the organizational climate of their units. This second section of the survey asked respondents to rate their organizations on leadership, resources, teamwork, and overall performance.

As with other recent surveys, this one was directed at the entire active force. Officers, enlisted members, and civilian employees were invited to answer computer-based questionnaires. More than 200,000 persons (almost 40 percent of the population) responded.

On the bright side, most members agreed that the Air Force is a good place to work and provides a good quality of life. Most also said that their families are supportive of their careers. However, the responses of enlisted members and pilots on these points were generally less positive than those of nonrated officers and civilians.

Fewer than half the respondents agreed that the Air Force keeps them well enough informed. Pilots and second term airmen showed the most negative perceptions of the information flow.

The most discouraging findings, however, came in responses to questions about members' career intentions. Only 64 percent of officers and 58 percent of airmen say they intend to stay until retirement. Compared with the results in the previous two surveys, this represented a drop of 10 percentage points for officers and six for enlisted.

About 77 percent of civilian members said they planned to stay, but

Career Intent—Three-Year Trend

Intent	Officer			Enlisted			Civilian		
	1995	1996	1997	1995	1996	1997	1995	1996	1997
Stay	74	72	64	64	62	58	81	84	77
Undecided	12	13	13	16	17	15	11	10	14
Go	14	15	23	20	21	27	8	6	9

All that AEF commanders need is the right information, at the right time, to help attack the right targets, in the right way.

Expeditionary Nerve Center

By Robert Wall

IN September, about 100 military personnel will “deploy” to Southwest Asia as command-and-control element of a massive 1,000-sortie-per-day air campaign. The effort will be undertaken in defense of an American ally that has been “attacked” by a rogue state, and the task will be to swiftly and decisively halt the heavily armed invading force.

That’s the scenario USAF will use as the basis of EFX 98, first in a new breed of Air Force warfighting experiments. EFX 98 will be the opening act of the Expeditionary Force Experiment series that the Air Force approved last year when it established Air and Space Command and Control Agency under Air Combat Command.

The setting is Southwest Asia in or around the year 2005. However, all of the action will take place within the continental United States, unfolding during the period Sept. 14–26. The Eglin AFB/Hurlburt Field complex in northern Florida will represent the territory of a threatened ally. Langley AFB, Va., will serve as a rear air operations hub. The mobile command element will deploy to Florida and direct operations of assets from around the United States. The forward element will stay in constant contact with the larger element at Langley.

The postulated threat is a nine-division force in a state adjacent to the American ally. The aggressor will use 2.5 of the nine divisions as the initial invasion force. The Air Force, in response, will deploy an AEF to break down and then halt that invasion.

With each annual exercise, the Air Force will explore new technologies, procedures, and requirements that affect its operations and systems. EFX is the service’s way of dealing with a critical DoD-wide issue: how to harness the Revolution in Military Affairs and advances in information technology to improve the way the US armed forces fight wars.

The EFX series differs greatly from traditional exercises conducted in the past. In Green Flag exercises, for example, the Air Force hones the tactics and procedures of existing command, control, and intelligence assets. EFX, on the other hand, is experimental and therefore serves a different purpose. It looks at the new, unproven, and futuristic.

The impact will be felt mostly on the operational Air Force of tomorrow, not that of today.

EFX will have some common themes. These include live-fly missions, simulations, and insertions of advanced technologies in a specified and controlled war environment. The overarching goal is to integrate emerging capabilities with existing ones in an Air Expeditionary Force concept, said the Air Force in an EFX paper.

EFX 98, for its part, will focus on command and control, viewed as the brains of any major air campaign. The Air Force presents the EFX 98 hypothesis this way: If command centers and platforms are connected to a robust “global area network” that moves information rapidly and efficiently, then a rapid halt of an invading force can be achieved sooner, with less risk to friendly forces.

Right, Right, Right, Right

The object is to incorporate improved command-and-control systems and procedures into a given Air Expeditionary Force. Maj. Gen. John W. Hawley, the ASC²A commander who oversees EFX 98, said, “It is about providing commanders the right information, at the right time, so they attack just the right targets, in the right way, at the right time. No more, and no less.”

For Gen. Michael E. Ryan, Air Force Chief of Staff, the entire EFX initiative is part of an effort to become an expeditionary aerospace force that can decisively halt an enemy early in a conflict.

“Part of the expeditionary mode is the ability to command and control whatever forces you have forward,” said Ryan. “Part of that is to get the show on the road quickly.”

EFX 98 will focus sharply on the crucial first 15 days of the war and include the demands of the critical logistics buildup that is often overlooked when campaigns are simulated.

The live-fly portion of EFX 98 will include a variety of combat and special operations aircraft—F-15 and F-16 fighters, B-1B and B-2 bombers, AC-130 gunships, MC-130 Combat Talons, and an MH-53 special operations helicopter. Also playing a critical role will be reconnaissance assets such as E-3 AWACS, E-8 Joint STARS, and RC-135 Rivet Joint aircraft, which will provide data on the air, ground, and signals environments, respectively and in combination.

These assets will generate up to 60 actual combat and combat-support sorties per day. In addition, as-

sets at Hurlburt will generate upwards of 900 simulated sorties per day, bringing the total to about 1,000 daily sorties.

In the final weeks before EFX 98, USAF is conducting a series of workups to try to ensure the experiment runs smoothly. Three so-called "spirals" will take place before EFX 98 begins. Each covers an increasingly large part of the experiment, culminating in a large dry run scheduled to run from late August through early September.

During each spiral, the Air Force is able to work through the kinks that arise when someone puts together a very large command-and-control architecture. The goal is to eliminate any technical hiccups that later could bedevil the experiment.

Shrinking the "Brain"

One key element in September will be experimentation with a small, 100-person Joint Air Operations Center. Plans call for the unit to be "forward deployed" on the Eglin range complex, hard by the "theater of conflict" in this simulated war.

This is a major departure from the Air Force norm. In late 1990, the Joint Air Operations Center responsible for activity in Operation Desert Shield required more than 1,500 people. Getting all the troops and materiel in place cost \$4 million, took two weeks, and required 25 C-17-sized aircraft loads. A lean JAOC with only 100 people would cost \$200,000, deploy in a day, and take only one or two C-17s for transport.

What's the significance of conducting an air war with a forward deployed element of only 100 people? The obvious operational benefit is being able to put bombs on target much earlier and stifle the aggressor's ground offensive before it can be fully unleashed.

Moreover, Hawley pointed out, a small JAOC is much more flexible. "We don't really know where we have to fight next," he said, so the ability to deploy at a moment's notice anywhere in the world is increasingly important.

Hawley further noted that, with the smaller unit, "95 percent fewer people are at risk on the front lines—with no change in capability." That's particularly important given the lack of a robust theater missile defense system to protect those troops.

In EFX 98, all staff will be joint-service, the better to make the forward JAOC establishment realistic. Also, an element of the Army's 82d Airborne Division will be air-dropped into the Florida range from C-17s to secure an area where the operations center can be set up. As would be the case in a regular operation, the Army paratroopers will then go on to other missions, and USAF security forces will come in to protect the JAOC.

Air Force officials said they are able to reduce the size of the forward ops center because they also are establishing a rearward JAOC comprising about 300 people. This larger unit exists to provide critical support and depth to the personnel deployed to the theater. Hawley said the rear JAOC is a "1-800 Help Desk" for the forward deployed commander and staff. The two centers will stay in constant touch by using the military's global communications channels.

The rear JAOC can call on subject matter experts located anywhere in the world and then funnel their input to the forward center. For example, the rear JAOC might lean heavily on experts at Air Mobility Command, Scott AFB, Ill., to help deal with theater transportation difficulties. One key advantage of operating through this distributed network is that subject matter experts are left in their familiar environments to work most efficiently with the best tools of the trade.

All communications will take place over a global area network connecting different facilities and information databases in the US and overseas. One of the main means of providing data to forward deployed forces will be the Global Broadcast System. Unlike other communications "pipes," GBS is relatively rich in bandwidth. The system already is in use today, supporting military forces in Bosnia.

Situational Awareness

A second major USAF initiative focuses on improving the situational awareness of the Joint Forces Air Component Commander—usually the top Air Force official on scene.

Heretofore, JFACCs have had to wait to get into a theater before they could begin to put together all the intelligence needed to get a clear picture of the battlefield. But that

time delay wastes critical hours, possibly days, during which air operations may not be running at their optimum.

If the exercise unfolds as planned, the JFACC will be kept in constant touch with developments in the combat zone. Plans call for connecting the rear and forward JAOCs and JFACC's transport aircraft via the global area network that links all the dispersed Air Force elements.

The most critical aspect may be keeping the JFACC in touch with theater forces while he is en route to theater, since the combat theater changes by the minute.

"With a better, faster, and constant flow of information, the JFACC will make better and more timely decisions which will, in turn, shorten conflicts," Hawley said.

The initiative also seeks to keep the air component commander fully connected even when he is on the move in the combat zone. By keeping the JFACC fully informed at all times, he can more rapidly react to changes, swiftly directing attacks or counterattacks.

Fast reaction is a dominant theme that invariably crops up in the 30 or so initiatives the Air Force will be looking at during EFX 98. In the past, air campaigns have been slowed by the need for detailed, lengthy target planning before missions could be flown. EFX 98 hopes to show that this no longer is the case.

Heavy bombers that take off from the US or from forward bases such as Guam or Diego Garcia will be launched much faster and sent on their way with incomplete mission plans. All the planning activity that used to be done before an aircraft launched will now take place while the bombers are en route to targets. Flight crews will either conduct their own planning using onboard tools that provide access to time-critical battlefield intelligence or they will receive mission plans from the JAOC as they approach the combat zone. USAF has already done much work toward this end under various Real-Time Information to the Cockpit efforts.

Smaller Footprint

The numerous EFX 98 initiatives will try to find answers to a host of other questions. One concerns how to reduce the on-ground footprint of

EFX 98 Initiatives*

As of mid-summer, the Air Force was listing 30 major initiatives in its EFX 98 plan.

- AWACS airborne C² and real-time common operational picture
- AWACS broadcast intelligence
- Remote location in-transit viewer
- Dynamic information gateway management system
- Joint targeting workstation
- Defensive information warfare
- Joint STARS assured satellite communications connectivity
- Expeditionary operations center en route concept
- Track II
- Collaborative virtual work space
- B-1B data link
- Master battle planner
- Air tasking order viewer
- Sensor box "look forward"
- Sensor box integration into the Air Operations Center
- Wireless broadband system
- Link 16 to situational-awareness data link
- Steel Rattler
- Joint total asset visibility
- Tactical automated security system
- Joint Tactical Information Distribution System satellite communications connectivity
- Tactical data exploitation/automatic target recognition
- Joint Forces Air Component Commander en route information system
- Lightweight long-range information and communications system
- Agile combat support improved logistics C² capability
- Theater Battle Management core systems version 1.0 as EFX infrastructure
- Near Real-Time Intelligence in Cockpit multimission advanced tactical terminal
- Common object framework/Special Operations Forces planning and rehearsal system
- Global Broadcast System
- Distributed mission rehearsal and analysis

* List subject to change

an AEF, while another focuses on the issue of speeding up the deployment of such a force.

Though the operational initiatives are new, some of them depend on technologies that are considered relatively mature. Some have been proposed and are being conducted by different USAF or Defense Department organizations, including the National Reconnaissance Office, while others are under study in some areas of industry.

The success of EFX 98 isn't going to be measured by how the simulated campaign turns out but by how much insight has been gained from the different initiatives. Reviewers are going to examine each initiative and decide whether the system or tactic should be integrated into the combat force, further developed, shelved for a while, or simply discarded. The Air Force hopes that, with early user involvement in the development of technologies, it will be able to identify systems with true operational promise and also what changes might be needed as a system enters the regular acquisition path.

EFX 98 operators will encounter at least one self-induced challenge: attacks on computers throughout the exercise. The Air Force does not want to fall into the trap of assuming that all systems will operate in a benign environment.

"We'll be aggressively testing our ability to protect our information systems," Hawley said.

How exactly the systems will be challenged is closely guarded, but different forms of hacking will be employed. USAF operators know that the only way to get robust command-and-control systems is to have good system design up front. Hawley said EFX 98 will show whether that in fact was accomplished.

USAF is putting \$40 million in the first edition of EFX. Hawley said it's a worthwhile investment. "If we learn something from this experiment that allows us to make just one better budget decision, we'll likely save the American taxpayers the cost of this experiment and much, much more."

Another payoff from the investment is the creation of "leave behind" capabilities. USAF estimates that \$16 million, or some 40 percent of the total investment, will go to equipment that will be available long after the completion of EFX 98. For example, the service will have acquired hardware at Langley for a rear JAOC, as well as the hardware package for a small forward ops center that could be used to support any Air Expeditionary Force deployment.

Budget pressures already have taken their toll. Some EFX technology initiatives had to be dropped from the experiment due to lack of funds. One of those is a promising experiment using an Unmanned Aerial Vehicle for the Suppression of Enemy Air Defenses. The UAV would carry a

payload capable of detecting and providing targeting information on enemy radars, jamming those radars, and acting as a fighter or bomber decoy. That experiment will now take place as a stand-alone effort early next year.

Air Force Edge

No one is certain that the EFX plan can be executed in the current budget situation. Perhaps more than other services, the Air Force has a chance to succeed in its effort to capture the benefits of the information revolution. For one thing, it has a long history of developing these type of force multipliers, most notably in the Tactical Exploitation of National Capabilities program. TENCAP for years has enabled warfighters to derive benefits from technology investments made for intelligence gathering purposes. Secondly, USAF systems operate at a higher level of technical sophistication, so integrating new technology should be technically and culturally easier for the Air Force than it will be for the other services.

The Air Force already has specified a couple of objectives for future EFXs.

In EFX 99, which will run for about 12 days next summer, the service wants to take a closer look at space operations. One of the goals of next year's experiment, USAF says, will be a "more thorough integration of space-based capabilities and space-derived information with expanded live scenario elements to highlight the important role of aerospace, mobility, and agile combat support" to fulfill warfighting needs.

It will take place in July 1999. ■

Robert Wall is the Pentagon reporter for Aerospace Daily, a Washington-based defense and commercial aviation periodical. Wall's most recent article for Air Force Magazine, "The B-2 Proves a Point," appeared in the July 1998 issue.

AFA 1998 National Convention

Marriott Wardman Park Hotel
(formerly the Sheraton Washington Hotel)
Washington, D.C., Sept. 14-16, 1998

Theme: Aerospace Power—The International Dimension

Opening Ceremonies: keynote address by a national leader. Performance by the chorale of the Randolph-Macon Academy, the only coeducational all AFJROTC cadet school in the nation

Aerospace Education Foundation Luncheon featuring the 1998 AEF contest-winning AFJROTC unit; Doolittle, Eaker, and Goldwater Fellowships; awards for excellence in education

Business Sessions: national elections, adoption of AFA Statement of Policy

Awards: membership awards, national awards to Air Force, government, and AFA leaders and outstanding Air Force crews

Annual Reception in exhibit halls

Salute to the 12 Outstanding Airmen of the Air Force; address by USAF Vice Chief of Staff Gen. Ralph E. Eberhart; Toastmaster: CMSAF Eric W. Benken

International Airpower Luncheon: Sept. 15. A congressional speaker has been invited

International Airpower Symposium: AFA will host a special international airpower symposium on Sept. 16. During the past few years, the international community has been faced with contingencies in Iraq, Rwanda, Korea, Liberia, Bosnia, and a host of other countries. Air operations are crucial in providing a rapid response to stabilize and resolve problems from humanitarian relief to conflict. World-renowned leaders will offer new perspectives on the strategic use of air operations to help resolve crises. Invited speakers include: members of Congress, Secretary of the Air Force, Vice Chairman of JCS, Chief of Staff of the Air Force, and Air Chiefs from the new NATO members. Building on the success of the 1997 International Symposium held at the AFA Air Force Fifty Celebration in Las Vegas, this 1998 symposium continues the AFA tradition of *Assuring America's Aerospace Excellence*.

Air Force Anniversary Dinner: an evening of entertainment and fellowship in honor of the 51st anniversary of the US Air Force and presentation of AFA's top three awards to an outstanding industrial, civilian, and military leader

Aerospace Technology Exposition with more than 52,000 square feet of technology displayed by companies from all over the world. Exhibit halls open Monday, Tuesday, and Wednesday

Attention Industrial Associates: Exhibit space at AFA's Aerospace Technology Exposition is still available. Please call Pat Teevan at 703-247-5836 for information

Headquarters Hotel: Marriott Wardman Park Hotel (formerly the Sheraton Washington Hotel) 202-328-2000. Also, free housing service is available to match requests with vacancies at several area hotels: Washington DC Accommodations 800-554-2220

For further information call the AFA Fax Reply Service at 800-232-3563 or check the AFA Website at www.afa.org

Individual Tickets:

Tuesday Luncheon	\$75 each
Annual Reception	\$85 each
Outstanding Airmen Dinner and Reception	\$140 each
Anniversary Dinner	\$185 each
International Airpower Symposium	\$225 each*

*Includes all sessions, continental breakfast, sandwich lunch in exhibit halls, and reception.
Note: Add \$10 to each ticket request postmarked after Aug. 30, 1998.

Recognized during this convention will be the:

- ★ **25th Anniversary of the return of the POWs from Vietnam**
- ★ **50th Anniversary of the US Air Force Reserve**
- ★ **50th Anniversary of the Berlin Airlift**
- ★ **75th Anniversary of the first nonstop flight across America, which paved the way for commercial aviation**

Desert deployments are a big reason why the Air Force is losing some of its best people.

In the Sandbox

MAJ. Ralph Phillips is the kind of officer that the Air Force dearly wants to keep. The combat-tested F-16 pilot loves to fly, loves the Air Force, and declares unabashedly: "I have a very strong desire to serve my country."

However, the 36-year-old Air Force Academy graduate and Desert Storm veteran is leaving active duty after 14 years. He says he is being driven out of the service by a combination of factors that have overwhelmed his once-strong intention to make a career in the Air Force.

When Phillips, who is with the 27th Fighter Wing at Cannon AFB, N.M., is pressed to itemize the reasons for leaving the Air Force, he answers, "higher optempo" and "spending more time away from my family."

Then, he adds, "If that desert deployment wasn't there, it wouldn't be a problem."

When he says "desert deployment," everybody knows what Phillips means. He refers to long and frequent rotations to Saudi Arabia, Kuwait, and other Persian Gulf zones that take Air Force personnel away from their families as well as the training and education that are vital to maintaining a professional edge.

Such deployments have become an unpleasant and unavoidable fact of life for the combat air forces in the 1990s.

"It [the decision to leave] is mostly due to the impact on my family life," explains Phillips. "What I'm doing to my family, the cost to them, doesn't make it worth my selfish desire to serve." Phillips called leaving USAF "the toughest decision I've ever made in my life."

Sand in the Gears

As demonstrated in the case of Phillips, desert duty is fueling one

of USAF's most serious problems—the exodus of skilled, experienced pilots from the service. No single factor is driving this retention problem. However, senior Air Force officials and pilots agree that a major cause is the explosion in operating tempo, particularly the frequent deployments to Southwest Asia—commonly referred to as the "Sandbox."

It appears that too much time in the Sandbox has worn to the bone not only Air Force pilots but also support personnel.

Air Force leaders note that since the end of the Cold War they have reduced the total force by one-third and their overseas bases by two-thirds. However, operating tempo has soared 400 percent, fueled by a flurry of contingency missions. While these have included Bosnia, Africa, and several other world hot spots, the bulk of the deployments have been to Southwest Asia.

"Southwest Asia is the No. 1 irritant, the one thing pushing guys out of the Air Force," argues Lt. Col. Kurt Dittmer, commander of the 34th Fighter Squadron at Hill AFB, Utah. Dittmer said six of his most experienced F-16 pilots are leaving the Air Force this year, mainly because of frequent family separations—especially those caused by "that desert deployment."

Dittmer warned, "We're going to get to the point where we'll have only young guys left."

Unfortunately for the Air Force, Phillips and the Hill pilots are not isolated cases. The service is suffering such a rapid exodus of experienced pilots that it expects to have a shortage of nearly 800 by the end of 1998 and a deficit of more than 2,300 pilots by 2002, if the trend continues.

This flood was barely a trickle last year and was hardly a drip the year

By Otto Kreisher

before. The 1998 separation rate for pilots at the end of their service commitments is up 80 percent over that of 1997. "That's an alarming signal," said Lt. Col. Russell Franz, a rated-officer programs specialist at the Air Force Personnel Center, Randolph AFB, Texas.

Though less severe at the moment, a similarly disturbing trend is starting to show up among Air Force enlisted personnel, particularly Air Combat Command fighter aircraft crew chiefs. In that group, second-term retention is around 35 percent. "There won't be anyone left in the F-16 community in a few years," a Fighting Falcon pilot now at the Air Command and Staff College at Maxwell AFB, Ala., said recently.

Navy and Marine Corps officials also are concerned about increasing resignations among their fixed-wing pilots, although the situation is not yet as acute as that now facing the Air Force. In the Navy, the "take rate" for the pilot bonus falls well below requirements for carrier-based fighter, anti-submarine, and electronic warfare pilots. The Marines also are losing too many of their fixed-wing pilots, with particular shortages in the AV-8Bs and KC-130s.

Coming Home

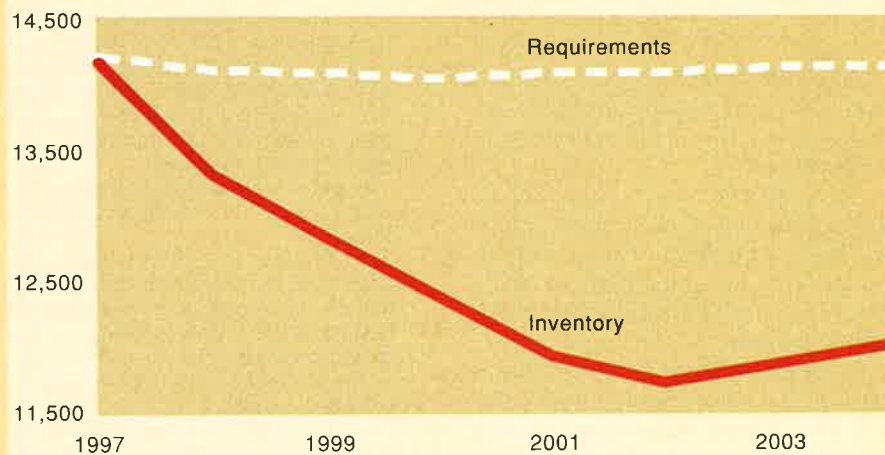
The Clinton Administration in early summer implicitly recognized the Sandbox factor when it approved the Pentagon's request to bring home from Southwest Asia many of the bomber and fighter aircraft it had deployed to the region in February after Iraqi President Saddam Hussein failed to comply with United Nations resolutions regarding weapons inspections.

The force reduction operation will bring home more than 2,500 people and 100 aircraft from Air Combat Command, as well as troops from the other services.

A forward deployed Air Expeditionary Force in Bahrain left the region in early June. DoD reverted to its policy of sending AEFs for periodic visits, rather than for extended deployments.

To explain the move, DoD spokesman Kenneth Bacon said, "The President approved these redeployments because they allow us to protect our interest in the Gulf while reducing the wear and tear on the forces."

Pilot Inventory vs. Requirements



The exodus of skilled pilots not only threatens future combat readiness but represents the loss of an enormous investment. The Air Force estimates it has invested \$5.9 million to train the average pilot by the ninth year, when most are eligible to leave active duty.

The situation, needless to say, has the full attention of Air Force leaders, Pentagon officials, and even some members of Congress, who are working to counter the combination of factors behind the dangerous erosion of experienced pilots.

"It's not their fault they are leaving," Gen. Michael E. Ryan, Air Force Chief of Staff, told reporters recently. "Maybe it's our fault."

Several pilots emphasized that going to the desert didn't bother them nearly as much as what they did when they arrived and how they were forced to live while they were there.

"The very first time I went to Dhahran [Saudi Arabia], I thoroughly enjoyed it," said Capt. Lou Foley, an F-16 pilot from Shaw AFB, S.C., referring to the major Saudi city and associated air base in that country's eastern province. The Gulf War had ended recently and "there was a sense of purpose," he said.

"Each time I go back, I find it less and less stimulating," Foley said. "The flying is boring" and there is nothing to do while on the ground because the deployed units now are "stuck at Prince Sultan" AB, literally in the middle of the desert.

This fall, Foley is leaving the Air Force after serving in uniform for nine years.

Similar comments come from a veteran A-10 pilot who flew numerous combat missions during Desert Storm and has since 1991 gone back several times on temporary deployments.

"Saudi isn't fun," the A-10 pilot said. "To most [Saudi nationals], we are hired guns saving our stake in the oil reserves. The Saudis considered us as [members of a] lower society and had a [condescending] attitude while I was there. ... I just couldn't believe their arrogance and hypocrisy."

According to this pilot, things were better when the main provisional wing was deployed in Dhahran. The Air Force moved the entire wing to Prince Sultan, near the desert town of Al Kharj, after the June 1996 terrorist bombing of the Khobar Towers housing complex. It is an outpost with heavy security and scant amenities.

"Where's the End?"

Pilot retention has generated the most headaches. However, the frequent trips to the Sandbox since the war also appear to be grating on Air Force enlisted personnel.

"I think the troops look at the desert and say, 'Hey, it's been seven years [since the end of the Gulf War]; where is the end to this?'" said Eric W. Benken, Chief Master Sergeant of the Air Force.

Benken noted that many airmen go to the desert several times and then get an unaccompanied tour to Korea. "After a while, that begins to take a toll," he said.

Gen. Richard E. Hawley, commander of Air Combat Command at Langley AFB, Va., has been one of the most senior voices calling for a redeployment of Air Force units back from Southwest Asia to the United States. He agreed that conditions can be improved for the units deploying to the desert.

Permanent housing is replacing the air-conditioned tents most personnel have occupied at Prince Sultan, he said, but he added that the No. 1 need is improved training for those pilots deployed to the area.

As Hawley puts it, "Enforcing a no-fly zone involves a lot of takeoffs and landings, refueling, and a lot of left turns."

Hawley said he wants to make the desert deployments "more like Red Flag," the highly realistic series of training exercises held at Nellis AFB, Nev. He would hold at least one such exercise or combined strike training mission during each deployment.

The ACC commander also is trying to reduce the length of the deployments to the Gulf from 90 days to 45 days.

Hawley said he had pushed the Pentagon for a decision to bring back the additional air units sent to the Gulf. With the "demonstrated ability of airpower to respond quickly to a crisis," Hawley said, "we don't have to have our forces deployed on a continuous basis to forward areas to get our job done. In the time it takes to prepare the political ground, we can be there."

Enforcing the no-fly zone over Iraq does not require a considerable number of aircraft and crews, Hawley said. He added, though, that the leaders of US Central Command frequently call for additional forces. "I would like to see the size of that force reduced to the level that can be sustained without stress on the force," Hawley said.

Accentuating the push from the negative factors are the powerful pulls of a booming economy and the airlines' enormous appetite for trained pilots.

Because of the expansion of air service and the forced retirement of now-older pilots who left the mili-

The Mixed Record of Higher Pay

Of all the initiatives to keep experienced military pilots in uniform, boosting compensation rates near the top.

Congress has approved a major increase in the pilot bonus, raising from \$12,000 to \$22,000 the additional amount paid each year to a pilot signing up for five more years after the end of his service commitment. And to help the senior pilots coming off the bonus, the aviation career incentive pay was increased from \$620 to \$840 a month.

Because some pilots balked at the five-year commitment, the Air Force began offering \$6,000 for a one-year extension, \$9,000 for two years, and \$12,000 for three.

As of May, 81 USAF pilots had taken one of the shorter extensions. The combination of the 81 and the 139 who signed up for a new five-year commitment still comes to only 40 percent of the 537 pilots offered a bonus.

Most of the resigning pilots said more pay was nice, but it was not enough to overcome their other concerns.

The bonus was "not a factor at all," said Capt. Chuck Cook, of the 34th Fighter Squadron at Hill AFB, Utah. The recently married Cook said, "If they offered me a million dollars, it's still going to require the time" away from his wife.

Lt. Col. Russell Franz at AFPC noted, however, that when the higher bonus was offered retroactively to pilots who had decided to leave last year, 42 changed their minds and decided to stay in.

tary in the Vietnam era, the major airlines will hire 3,854 pilots this year—more than all the pilots who are eligible to leave the services. That demand is expected to remain high for years.

"Comfort Level"

The availability of an airline job was cited as a factor in the decision to leave active duty by Phillips and four other resigning pilots interviewed for this story.

"The fact that the airlines are hiring did help to convince me," said Capt. Chuck Cook, one of Dittmer's pilots. Cook will be leaving this summer because he did not think he could give the necessary time to the job after getting married. Said Cook, "If the airlines weren't hiring, if the economy wasn't good, I think I'd stick with the Air Force. It gave me kind of a comfort level."

Although most military pilots going to the airlines will take a pay cut for the first several years, Air Force officials acknowledge that after five or six years they will be earning more than if they had stayed in.

The Air Force knows that the real answer to keeping more of its pilots is to reduce the pace of operations and the time away from home.

In a survey of resigning pilots, the top two reasons for leaving were optempo, cited by 19 percent, and

quality-of-life concerns, named by 14 percent.

"They're very closely related," Franz said. "Optempo is the primary driver. And as a result of the increased optempo, we're seeing some dissatisfaction in the quality-of-life area."

To address that, Air Force leaders have sought to reduce non-contingency deployments by cutting back on exercises and inspections and even curtailing their most cherished training exercises and contests.

They also skipped some planned Operational Readiness Inspections by giving air mobility units credit for short-notice, real-world contingencies, which tested the same capabilities.

Ironically, some of the pilots interviewed complained about losing valuable training exercises, like Red Flag.

"Those are the kind of deployments that are actually fun, that make me like the job," Phillips said.

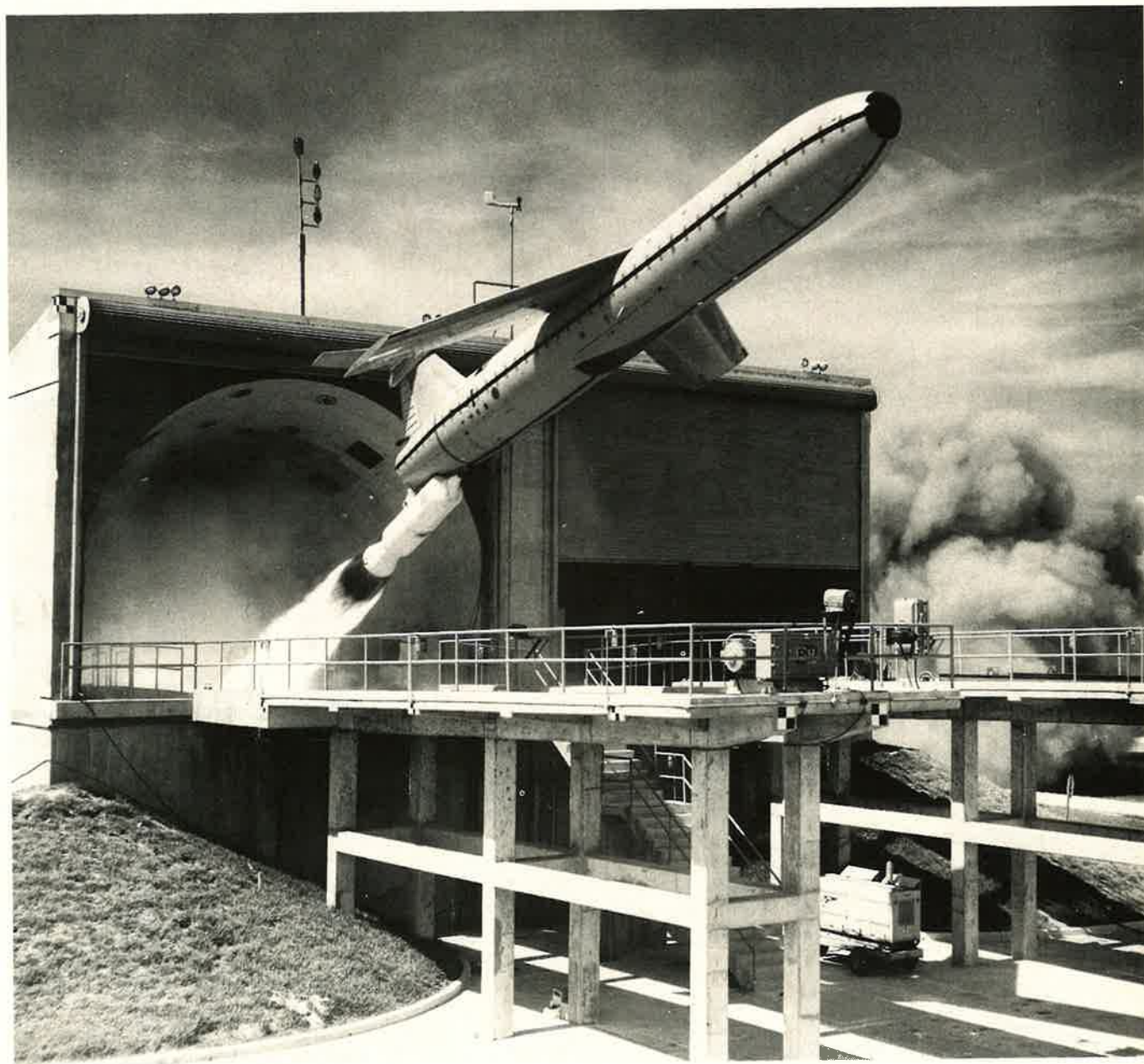
Dittmer agreed, noting that he turned down a chance to take his squadron to a Maple Flag exercise with the Canadians that "I wanted to do badly," but he had been hit with several contingency assignments and had to cut one of the few things under his control to reduce the load on his pilots.

"The short-notice tasking is what kills my program," he said.

But there may be limits to how much the Air Force can reduce the demand on its personnel. "We are an expeditionary Air Force," Ryan declared. "That's what the nation wants of us." ■

Otto Kreisher is the national security reporter for Copley News Service, based in Washington, D.C. His most recent article for Air Force Magazine, "The Base Closure Flap," appeared in the July 1998 issue.

Mace



Developed in 1954, the Mace, like its predecessor, the Matador, was a tactical surface-launched missile designed to destroy ground targets. The Mace could be launched from a mobile trailer or bomb-proof shelter. It was propelled by a solid-fuel booster rocket that fell away following takeoff and was then powered up to speeds of 650 mph by a J33 engine. The first version created, known

as Mace A, used a terrain identification system, called ATRAN (Automatic Terrain Recognition And Navigation), to correct the missile flight path if deviation was detected. It was first deployed to USAF forces in Europe in 1959 and remained in service until the mid-1960s. The As then became target drones, due to their resemblance to manned aircraft. The second version, Mace B (above),

was developed in 1964 and employed an inertial guidance system. It had twice the range of the A. The Mace B remained operational in Europe and the Pacific until the early 1970s.

Seven years after the end of the Cold War, the questions continue about nuclear policies and strategies.

Nuclear Adjustments

By James Kitfield

THE thunderclap of underground nuclear tests and the escalating arms race between India and Pakistan have raised anew the specter of nuclear war in a world which had come to view it as something of an obsolete and diminishing danger. The emergence of two new nuclear-weapon states has focused renewed attention on the United States' own nuclear posture and forces, forgotten players in the debate of recent years on US defense and deterrence.

"Because the Cold War ended in such an ambiguous manner, it has been hard to make our message heard," remarked Gen. Eugene E. Habiger, commander in chief of US Strategic Command, Offutt AFB, Neb. "Our message is that we still need to be around."

Habiger said that the end of the Cold War marked a sharp departure from the tradition of conflicts be-

tween great nations—that is, the Cold War ended with the loser still in possession of a massive arsenal of front-line weapons and with those weapons on high alert and aimed at the victor. This was significant, said Habiger, because “only one threat can bring us to our knees; and that is the nuclear threat.”

Despite numerous unresolved concerns about the future of democratic Russia and the possible emergence of new nuclear armed states, the wind down of the Cold War did lead the United States to promptly make dramatic changes in the size, shape, and posture of its own nuclear forces.

Since 1989, the stockpile of nuclear warheads has declined by about half. The number of US tactical weapons has dropped to about one-tenth of its Cold War level. The US has removed all nuclear weapons aboard surface warships and from the arsenals of US land forces, taken all Air Force strategic bombers off alert, stood down all USAF Minuteman II ICBMs (the last was removed from its silo in 1995 as part of the START I accord), and cut back the size of its fleet of strategic missile-firing submarines. No ICBMs are presently targeted at Russia.

SAC and Son of SAC

Those dramatic steps are reflected in the fortunes of USSTRATCOM, the quasi-successor to USAF's Strategic Air Command, which in 1992 was reorganized out of existence and its forces dispersed to several different commands. (Whereas SAC was an Air Force major command with operational control over forces, personnel, bases, and weapons, USSTRATCOM is a multiservice unified command lacking operational control over combat systems until they are formally “chopped” for a specific purpose.)

During the 1990s, personnel strength of combat forces earmarked for use by USSTRATCOM has declined by some 50 percent from the SAC level. The base structure has dropped by 60 percent. Strategic offensive forces—the old SAC's bombers and missiles plus the Navy's strategic submarines—have been cut 45 percent over the same period and will fall another 15 percent under START II provisions approved by Washington (but not yet by Moscow).

Spending on US strategic forces has declined from 7 percent of total defense expenditures in 1991 to less than 3 percent of today's greatly diminished Pentagon budget.

Even as nuclear forces continue on a steadily declining glide path, US officials have attempted to counter the impression that the United States is going out of the nuclear business.

“Now that the Cold War is over, the role of nuclear deterrence has been reduced, but the need for deterrence in today's world is still critical,” said Edward L. Warner III, assistant secretary of defense for strategy and threat reduction, in a recent appearance before the Senate Armed Services Committee.

Warner said that it is critical to maintain functional nuclear weapons as one of a broad range of possible responses to an enemy's use or threatened use of weapons of mass destruction against US interests and as an important “disincentive” to nuclear, biological, and chemical weapons proliferation. They also provide a hedge against the emergence of hostile nuclear powers, he said.

In addition, senior Administration and Air Force officials have taken issue with a number of apostate Cold War warriors who, in their retirement years, have begun arguing that the United States and other nations could and should move much faster toward total elimination of nuclear weapons. The most notable example of this latter-day abolitionist group is retired Air Force Gen. Lee Butler, the last SAC commander and first USSTRATCOM commander in chief who retired from active duty in 1994. Since that time, he has delivered numerous attacks on the “immorality” and “obscenity” of nuclear deterrence.

“The issues of nuclear force posture and nuclear deterrence continue to be debated by individuals and groups who question the need for nuclear weapons in today's world and, in some cases, call for the complete elimination of these weapons,” said Warner in his Senate testimony. “However, we are not yet at the point where we can eliminate our nuclear weapons. For the foreseeable future, we will continue to need a reliable and flexible nuclear deterrent ... capable of inflicting a devastating retaliatory response.”

The reason for maintaining a strong nuclear force once was summed up in this fashion by former Secretary of Defense James Schlesinger: “It is in the interest of all the nations that desire stability for the United States to continue to have a deterrent sufficiently impressive to deter weapons use by other states. The game of flagellating the United States in disarmament conferences is one to which many diplomats from the Third World became habituated during the Cold War. It is time to end that game. It is also time to curb the tendency to satisfy these demands by rummaging through our own nuclear deterrent to see what we can throw overboard without doing too much damage.”

Loosened Grip?

In the nearly seven years since the collapse of the Soviet Union, there have been credible reports of an alarming loosening of Russia's grip on its own nuclear forces, leading a number of commentators to argue for a new, interim approach to supplement arms control agreements that take many years to negotiate and carry out. These advocates call for both the United States and Russia to begin taking their nuclear forces off alert and thereby eliminate the potential for either side to launch thousands of nuclear weapons in a matter of minutes, as they could today.

“The United States and Russia continue to operate their strategic forces in a hair-trigger posture that is wildly out of step with the end of the Cold War,” said Bruce G. Blair, of the Brookings Institution in Washington.

In an article published in *Scientific American*, Blair and several of his colleagues catalogued rapid decay in Russia's huge nuclear arsenal. Citing CIA data, they reported that critical electronic devices and computers controlling Russian nuclear arms frequently switch to a combat mode for no apparent reason.

The most troubling incident—by far—occurred on Jan. 25, 1995. Russian radar operators mistook the launch of a Norwegian weather satellite for a possible Western missile attack.

After 15 tense minutes the Russian command system eventually determined that the rocket was not a threat.

Given the apparent deterioration

in Russia's nuclear infrastructure, Blair and others argue that the two sides cannot wait for START negotiations and should immediately take a host of "de-alerting" measures. These proposals include removing the warheads from all of the Air Force's Peacekeeper ICBMs that will be retired under START II; immobilizing all Minuteman III ICBMs; removing the warheads on the eight Trident submarines that will likely be retired under the START III framework; putting lower-yield warheads on the remaining Trident submarines; having these underwater boats patrol further from the Russian mainland; and keeping the submarines on lower alert status. Blair also proposes reciprocal measures for the Russians.

The proponents of de-alerting aren't cutting much ice in official Washington. Most de-alerting measures would lengthen the reaction time and reduce the flexibility of US nuclear forces, a fact that leads many experts strenuously to oppose the idea.

"De-alerting undermines deterrence by reducing both the survivability [of US nuclear forces] and the ability [of nuclear forces] to respond in a timely manner," said Kathleen C. Bailey, a senior fellow at Lawrence Livermore National Laboratory, in an appearance before the Senate Armed Services Committee.

De-alerting nuclear forces would create greater incentives for one side to launch a pre-emptive strike on warhead storage sites, she said, especially in times of tension. The act of hurriedly putting those forces back on alert during a crisis could also be seen as destabilizing and lead to cutting corners on matters affecting safety. Finally, said Bailey, the de-alerting measures are inherently difficult to verify and are taken on a largely unilateral basis, circumventing the arms control process.

"Efforts to de-alert our nuclear forces should be strongly resisted," said Bailey. "De-alerting has a severe impact on force readiness and stability, as well as a host of other problems. If we have concerns about [Russia's command, control, and communications] problems, we should address them by other means, not be reducing nuclear readiness, survivability, and safety."

Some officials have also ques-

tioned reports that have depicted the Russian nuclear command-and-control system crumbling at the foundations. For instance, Habiger last year became the first non-Soviet official to visit a Russian nuclear command center and weapons storage site. He left feeling encouraged by the visits.

"The thing that impressed me," said the USSTRATCOM chief, "was the fact that any individual in that chain [of command] can ... disable the launch sequence. They are concerned about the control of the nuclear weapons. ... I saw nothing that would give me pause or concern."

Character, Not Numbers

Habiger added that he has a little problem with those advocating de-alerting, "because we are on the right glide path—it is stable, rational, and verifiable. During the Cold War, each side had about 5,000 nuclear weapons on alert staring each other in the face. We have about 2,300 today. With START III, I predict we will have less than 700 weapons on alert. ... As we draw down our nuclear forces, the character of our remaining forces will be more important than the actual number of warheads."

Even so, the Defense Department has created a De-alerting Scoping Group to continue to study the idea. Possible measures being considered, officials reported, include the de-alerting of the Peacekeepers by removing their launch keys and the establishment of a direct Moscow-Washington link for rapid data exchange on missile launches. Assuming the Russian Duma ratifies START II, those measures and others will likely be the subject of intense negotiations on a follow-on START III treaty.

De-alerting has become a factor in the START II treaty. Under an agreement that Clinton and Yeltsin reached last year in Helsinki, Russia has been given several extra years—until the end of 2007—to reduce its nuclear arsenal to the roughly 3,000 warheads stipulated in the treaty. They must, however deactivate or de-alert multiple warhead missiles covered under START II by the original deactivation date of 2003.

When negotiators turn to a follow-on START III agreement, de-alerting does figure to be on the

If we have concerns about [Russia's command, control, and communications] problems, we should address them by other means, not be reducing nuclear readiness, survivability, and safety."

agenda, said Robert Bell, senior director of the White House's National Security Council staff for defense and arms control. "We've agreed in principle to have a very thorough discussion with the Russians as part of START III on how to go about deactivating those weapons covered by START II."

Bell added that the Administration wished to avoid doing anything that would cause the Duma to believe that Washington was de-alerting its weapons unilaterally. He added that the Administration will also have to convince a clearly skeptical Congress that any de-alerting measures are sound.

With a START III treaty already on the horizon and a START IV treaty in the preliminary talk stage, a number of lawmakers and defense experts are arguing that it is time to pause and take stock.

Under START I, which went into force in 1994, the United States and Russia are moving to 6,000 deployed strategic nuclear weapons. Since the treaty was signed in 1991, the superpowers have destroyed more than 750 missile silos, 32 ballistic missile submarines,

and almost 300 heavy bombers. That amounts to more than 50 percent of the required warhead reduction under START I.

START II will limit each nation to 3,000–3,500 deployed warheads and eliminate multiple warheads on ICBMs. Under START's protocol, the number of US SSBNs will decline by 2007 from 18 to 14; each Minuteman III ICBM missile will be fitted with only one rather than three warheads; the 50 Peacekeepers will be removed and dismantled; and the cruise-missile capacity of the B-52 fleet will be reduced.

Preliminary talks indicate that a START III treaty would further reduce strategic arsenals to 2,000–2,500 warheads.

80 Percent Down

Once all three START treaties are implemented, the United States and Russia will have reduced their strategic arsenals by roughly 80 percent from Cold War levels and eliminated all multiple-warhead ICBMs.

As discussed by experts, a START IV Treaty would likely shift from bilateral agreements between the United States and Russia to a multilateral forum encompassing other declared nuclear states. "In my view START IV will take much longer [to negotiate,] because ... it is clear that the Russians will want to bring in the British, the French, and the Chinese," said Habiger. "When you go from bilateral to multilateral negotiations of this type, it is going to take a long, long time."

Habiger spoke before India and Pakistan detonated a total of 11 nuclear tests under the deserts of the Indian subcontinent. The question is whether to include them as well as other closet proliferators such as Israel and North Korea.

With the US already having made such significant reductions, a number of officials argue that the endgame of the nuclear arms control process should still leave Washington with sufficient nuclear forces to deter increasingly dangerous threats.

"Given that existing and emerging nuclear, chemical, and biological threats require an effective US

nuclear deterrent, I would urge caution in making further deep reductions in our nuclear forces," said Bailey of Lawrence Livermore.

She explained, "Russia is increasing its reliance on nuclear deterrence and improving its arsenal and delivery system. The relative threat presented by the Chinese arsenal is increasing. India is an emerging secondary nuclear power; North Korea secretly separated plutonium for nuclear weapons and still retains that fissile material, thus remaining in non-compliance with the Nuclear Non-Proliferation Treaty. And, in addition to those nuclear threats, there are chemical and biological weapons programs worldwide."

Because the United States has renounced chemical and biological weapons, deterring those threats in particular may put a premium on nuclear weapons. "The continuing proliferation of chemical and biological weapons can only increase our need for nuclear deterrence. The United States has given up these capabilities and has thus given up the option of deterring chemical and biological threats with like capabilities," said Keith B. Payne, president of the National Institute for Public Policy at Georgetown University, at a Senate Armed Services subcommittee hearing. "Consequently, nuclear disarmament would be dangerous and counterproductive for the United States, potentially increasing the prospects for catastrophe."

In his Senate testimony, Warner pointed out that the Administration has recently promulgated a new policy directive on the actual employment of nuclear weapons. In November 1997, he said, President Clinton signed the document, which is classified. Though US nuclear plans have been updated through the years via changes to subordinate documents and specific presidential decisions, the new directive "takes account of the changes in our policy and force posture brought on by the end of the Cold War," said Warner.

The directive, according to Warner, indicates that the US must maintain a response capability to inflict "unacceptable damage" against those

assets a potential enemy values most. It also posits that the United States must continue to plan a range of options to ensure that the US can respond to aggression in a manner appropriate to the provocation, rather than being left with an "all-or-nothing" response. The news in the document, however, concerns the postulated length of a nuclear conflict. "The new guidance eliminates previous Cold War rhetoric including references to 'winning a protracted nuclear war,'" said Warner.

Bell, one of the drafters of the new guidance, explained the change in this way: "It's different in that we make no pretext that there's going to be some effort to acquire forces in numbers or with survivability through round after round after round of general nuclear exchanges that could presumably go on for weeks or months, but rather [we] just focus on forces that are capable of deterring that attack in the first place," he said. "Now, that doesn't mean you have a very fragile deterrent. You still need a robust force that can absorb a first strike, rather than [one that must] launch on warning of an incoming missile."

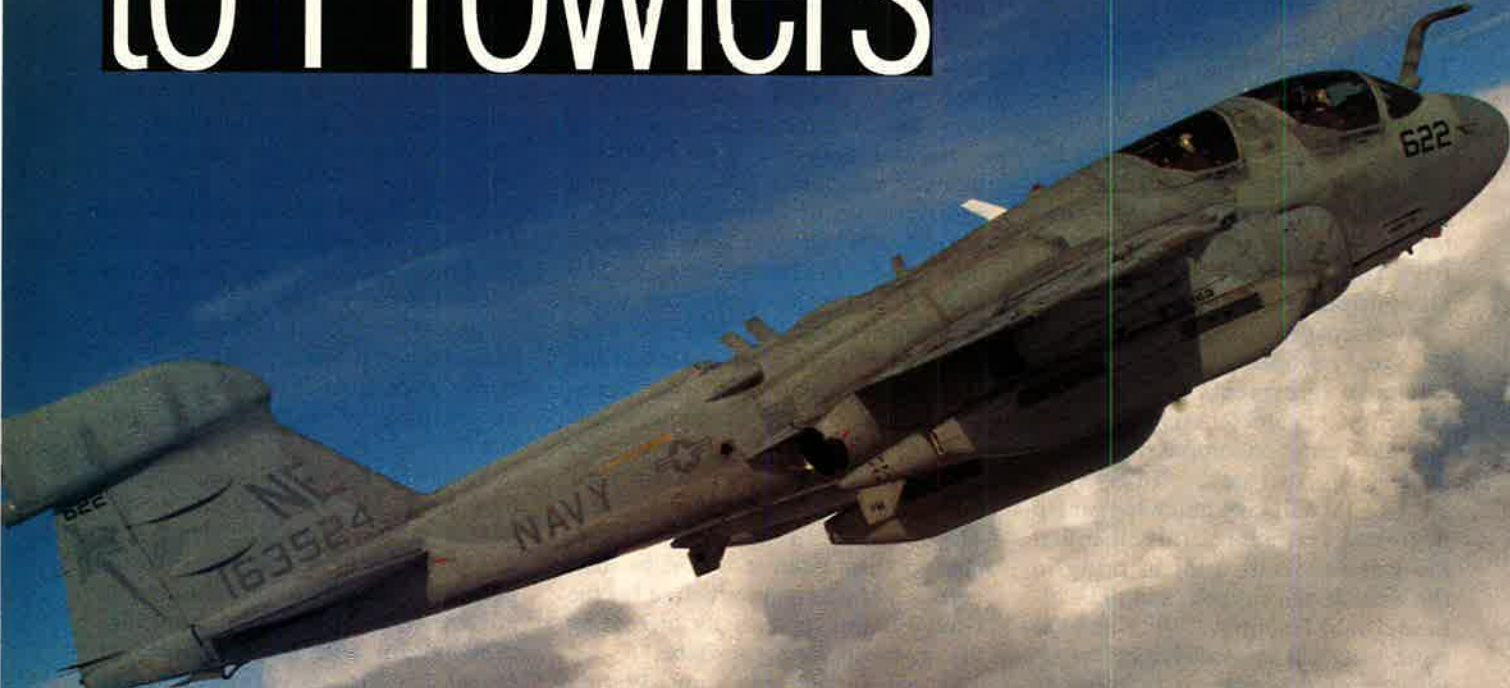
Sometime around 2010, the United States will have to address the apparent contradiction between a still dangerous world and an official policy which calls for elimination of nuclear weapons. Around that time, Washington will be compelled to invest sizeable amounts of money in modernizing nuclear delivery systems and stoking an increasingly cold nuclear weapons production complex, or the nuclear deterrent will begin to rapidly wither.

"We were one of the first nations, in 1968, to sign the Nuclear Non-Proliferation Treaty. [It] says that the ultimate goal of the treaty is the total elimination of nuclear weapons on planet Earth," said Habiger. "Then you have to read the fine print. [It] says, 'Given the proper preconditions.' That's the hang-up. ... I am not a zealot for having nuclear weapons onboard forever, [but] I think it's going to be difficult—if not impossible—to ever get that genie back into the bottle. We are on a stable, rational, verifiable glide path to get down to lower and lower nuclear weapon stockpiles. That is the right thing to do." ■

James Kitfield is the defense correspondent for National Journal in Washington. His most recent article for Air Force Magazine, "Sizing Up the Air Guard," appeared in the July 1998 issue.

In June the Air Force bid farewell to its last Raven and ushered in a new age of jointness.

From Ravens to Prowlers



Crewed by both Air Force and Navy aviators, the EA-6E Prowler is the dedicated joint-service tactical jammer. While not as fast or long-ranged as the supersonic-capable EF-111 Raven, the Prowler can land on aircraft carriers, and most of the type are relatively young. For those reasons, DoD officials chose to retain the EA-6B if there had to be only one tactical jammer between the services. Above, an EA-6B with a USAF crew flies a training sortie. At right, four EF-111s demonstrate the various angles of wing sweep for the Raven.





The last EF-111 Ravens left the Air Force in May, their departure having been twice postponed by regional commanders reluctant to give up their capability until the last possible moment. Budget cuts, and not obsolescence, forced the Ravens into retirement. Since the F-111 had already been phased out, the expense of the logistics tail for just 42 aircraft was deemed too great, but crises around the world gave the Raven a two-year stay of execution from the originally planned 1996 cutoff. The EF-111s at left returned home to the 429th Electronic Combat Squadron at Cannon AFB, N.M., for the last time in April. The 429th, which stood down June 19, had maintained continuous rotations in Southwest Asia since October 1993—more than 2,000 days.



In joint Prowler squadrons, with crew members wearing the same flight suits and patches, it's hard to tell who's Air Force and who's Navy until you can see the silver or gold of their wings, as evidenced by these two crewmen (at right) at NAS Whidbey Island, Wash. The Navy and Air Force began joint training there three years ago.



Photo by Erik Hildebrandt

Photo by Erik Hildebrandt



The Navy/Marines have 19 EA-6B squadrons. Five squadrons are tagged as expeditionary units that will remain ground-based but carrier-capable. USAF pilots converting to the EA-6B had to qualify for carriers, but the requirement has been dropped, and USAF pilots will go right to the expeditionary squadrons. The limited number of Prowlers available for flight training led to the shift, the Navy says.

The EA-6B is a four-man "office," with a pilot and three Electronic Warfare Officers. Air Force officers—some pilots and some EWOs—like Capt. Jeff Fischer, at left, will typically make up one-fourth of an expeditionary Prowler crew.



In the never-ending comparisons offered between their airplanes and those of the Navy, USAF crews point out that the EF-111 was not only much speedier than the EA-6B but also had much longer range and was automated enough to let a two-man crew do what requires four on the Prowler.

The EA-6B's speed, range, and loiter time are its major shortcomings, but a big factor in its choice as the new joint jammer was its recent avionics upgrade. (Funds for a similar upgrade for the Raven were channeled to the Prowler.) In addition, the Prowler can carry and shoot the HARM missile, giving it some lethal Suppression of Enemy Air Defenses capability. The other "ordnance" under its wings are generators to feed the voracious energy requirements of the jamming gear.



Pilot Maj. Pete Bussa (right) checks out a Raven before his next flight. Though officially dubbed Raven, the EF-111 was more affectionately known as "Spark Vark," a combination alluding to its electronic mission and its roots as the F-111 Aardvark.



Photo by Paul Kennedy

Staff photos by Guy Aceto



At left, A1C Samuel Johnson, checks the safety wires as he helps "button up" the electronics bay.

The EF-111 dates from 1973, when air combat in Vietnam and the Yom Kippur War showed that then-top line fighters like the F-4 Phantom needed escort jammers to help defeat increasingly lethal ground threats. The solution chosen to most quickly and inexpensively fill the void was to equip F-111As already in the force with jamming suites adapted from the Navy's Prowlers. Modifications started in 1979. Forty-two Aardvarks were converted into EF-111As, and the first operational unit stood up at Mountain Home AFB, Idaho, in November 1983.

Sporting a gray-blue camouflage and distinctive bulges on the tail and belly, the EF-111 has always been easy to distinguish from its bomb-dropping brethren. A veteran of real-world missions in Libya, Panama, Iraq, and Bosnia, the EF-111 racked up an impressive record of combat support. On Jan. 17, 1991, with an Iraqi Mirage F-1 on its tail, a Raven crew dropped low, employing chaff, flares, speed, and superb evasive maneuvers. In hot pursuit, the Iraqi pilot tried to close but flew into the ground.



Photo by Ted Carlson



The formal Raven good-bye was held in May at Cannon, with about 18 jets still on the ramp. With the inactivation of the 429th, the last of its Ravens, including the four-ship above, flew to the "boneyard" at Davis-Monthan AFB, Ariz. On June 29 the Air Force transferred control of Operating Location Alpha, the USAF element at the Whidbey Island EA-6B training facility, from Cannon to Mountain Home, the site of the first EF-111 electronic combat squadron and now home to USAF's Air Expeditionary Wing.

Air Force officials maintain that although USAF presence in Prowler squadrons may not be significant, their impact has been. Working more jointly than ever before, Prowler crews—the first combined squadron deployed to Japan in 1996—are showing that Air Force and Navy cultures and techniques can be harmonized to do the job.



Staff photo by Guy Aceto

Carefully managed, the Prowler force is expected to serve until 2005 or so; what happens then has not been decided. Leading replacement candidates are a variant of the F/A-18E/F and a version of the Joint Strike Fighter, neither of which would be ready in time. Industry offerings look promising, but the Navy has no money for such new development. USAF is not planning an EF-111 follow-on. ■



Photo by Erik Hildebrandt

**The North Vietnamese thought it was Dien Bien Phu
all over again. They thought wrong.**

*Keeping US forces alive during the
1968 Battle of Khe Sanh required
USAF airlifters to haul into the
combat base an average of 165 tons
of materiel daily.*

Airpower at Khe Sanh

By Walter J. Boyne

GEN. Vo Nguyen Giap and other North Vietnamese military leaders dreamed of doing to America at Khe Sanh what they had done years before to France at Dien Bien Phu. There, in 1954, Communist troops had cut off a sizeable French force, put it under siege, forced it to surrender, and shattered France's colonial

power. Hanoi hoped to do the same at Khe Sanh.

US leaders, particularly Gen. William C. Westmoreland, anticipated Giap's desire to re-enact his triumph and decided that any such attempt by the North Vietnamese could be turned into a massive US victory by the use of overwhelming airpower.

Westmoreland calculated that enemy forces attempting to overrun Khe Sanh could be trapped in a place where bombing would inflict huge numbers of military casualties yet harm a minimal number of civilians. The US military commander based his optimism in part on the successful defense of Con Thien in September 1967, when





On the first day of the Battle of Khe Sanh a direct hit on the main Marine ammunition dump destroyed 98 percent of available ammunition. C-130s and C-123s helped replenish artillery stocks.

US air and artillery support had driven off a large North Vietnamese attack on a Marine outpost.

Since 1962, Khe Sanh Combat Base had been an Army Special Forces site. Located in Quang Tri province in the northwest part of South Vietnam, Khe Sanh lay 10 miles from Laos and 15 miles from the line marking the demilitarized zone. A small village of the same name was located about two miles away. US Special Forces camp Lang Vei was five miles distant.

The combat base was located in the midst of four valley corridors and was surrounded by tall, forested hills, some rising as high as 4,000 feet. The base itself was on a flat plateau and was about a mile long and one-half mile wide. The laterite soil was good for digging trenches and bunkers. These would serve well as the North Vietnamese poured in an average 2,500 shells per week on the base.

Poor Foundation

Unfortunately, the soil was a poor foundation for the airstrip. The original 1,500-foot French runway had been extended to 3,900 feet and covered with aluminum mats. These rolled and pitched when rains soaked the ground—a frequent occurrence. They were displaced by the hard landings caused by the need to make high speed, high rate of descent approaches and were turned into tire-piercing angles when torn by shell fire.

The runway sat on an 800-foot rise, which made approaches from the east difficult because visual references were lacking. During the winter and early spring, visibility was usually less than three miles, with a ceiling of a thousand feet or less. As the day warmed, conditions would improve somewhat.

During late 1967 and early 1968, the US began to increase force levels at Khe Sanh, ostensibly to interrupt Communist troop movements but in fact to bait a trap. The base could accommodate only about 6,000 troops—initially, three battalions of the 26th Marine Regiment. These were later reinforced by a battalion from the 9th Marine Regiment and the South Vietnamese Army's 37th Ranger Battalion.

Unlike French forces at Dien Bien Phu, the Marines made sure they held the high ground and were supported by 16 of the Army's huge 175 mm cannons, all placed to deliver accurate fire on the Communist troops.

The North Vietnamese responded exactly as Westmoreland expected, ultimately bringing in two full regular divisions, the 304th and 325th, for a total of 23,000 troops. They were well-equipped with heavy guns, including the effective Soviet-made 130 and 152 mm guns and 122 mm rockets.

In effect, the enemy at Khe Sanh re-fought the battle of Dien Bien Phu with the same equipment and

tactics, seeking to tighten the noose around the base and then shelling it with artillery, rockets, and mortars. Unfortunately for them, the US was going to fight this battle with far more—and much more advanced—equipment than the French had possessed.

The Battle of Khe Sanh began Jan. 21, 1968, with inconclusive ground activity by US and North Vietnamese patrols. On the first day of battle, a big Communist rocket scored a direct hit on the main Marine ammunition dump, destroying 1,500 tons of high explosives, 98 percent of available ammunition.

It was a bad beginning to a long 77-day siege. As a result, the requirement for aerial resupply went to the top of the critical list for US military planners.

The US decided to permit the enemy to surround the Marine forces at Khe Sanh. US military authorities had prepared an air campaign, Operation Niagara, calling for the concentrated use of Air Force, Marine, and Navy airplanes to destroy the enemy. The plan had two phases: identifying targets before the battle and conducting a full-scale response by airpower and artillery once it started.

Tell It to the Marines

Westmoreland, as the commander of US Military Assistance Command, Vietnam, had emergency powers that would have permitted him to give total control over all aircraft in the operation to Air Force Gen. William W. "Spike" Momyer. Momyer was ideally positioned for the task, being Westmoreland's deputy commander for air and also commander of 7th Air Force.

It was not to be, however. Adm. U.S. Grant Sharp, commander in chief of US Pacific Command, acceded to the Marine Corps' traditional demand to have its own aircraft provide close air support for Marine ground troops. With that decision, Grant, in effect, refused to permit a unified command of US air operations. Momyer was given authority to direct and coordinate these operations, with the Marines supplying any excess assets for his use.

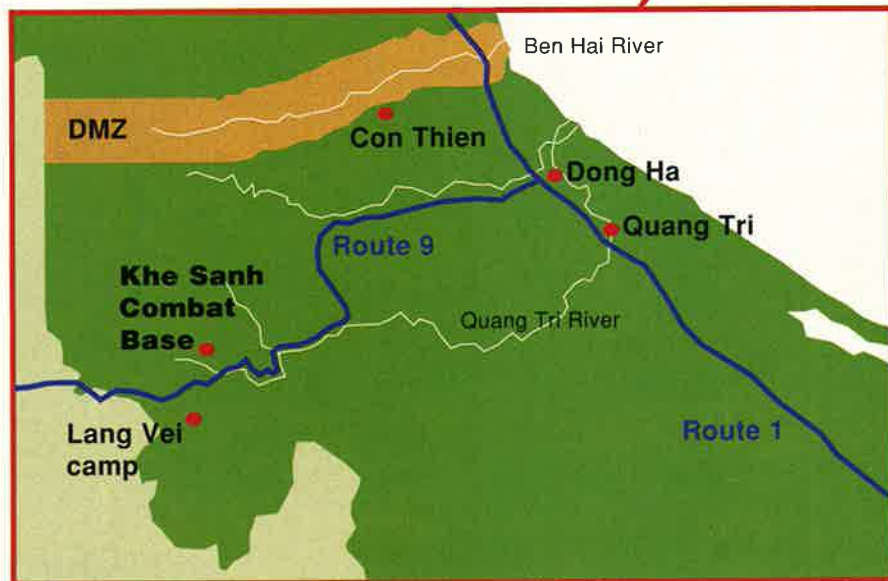
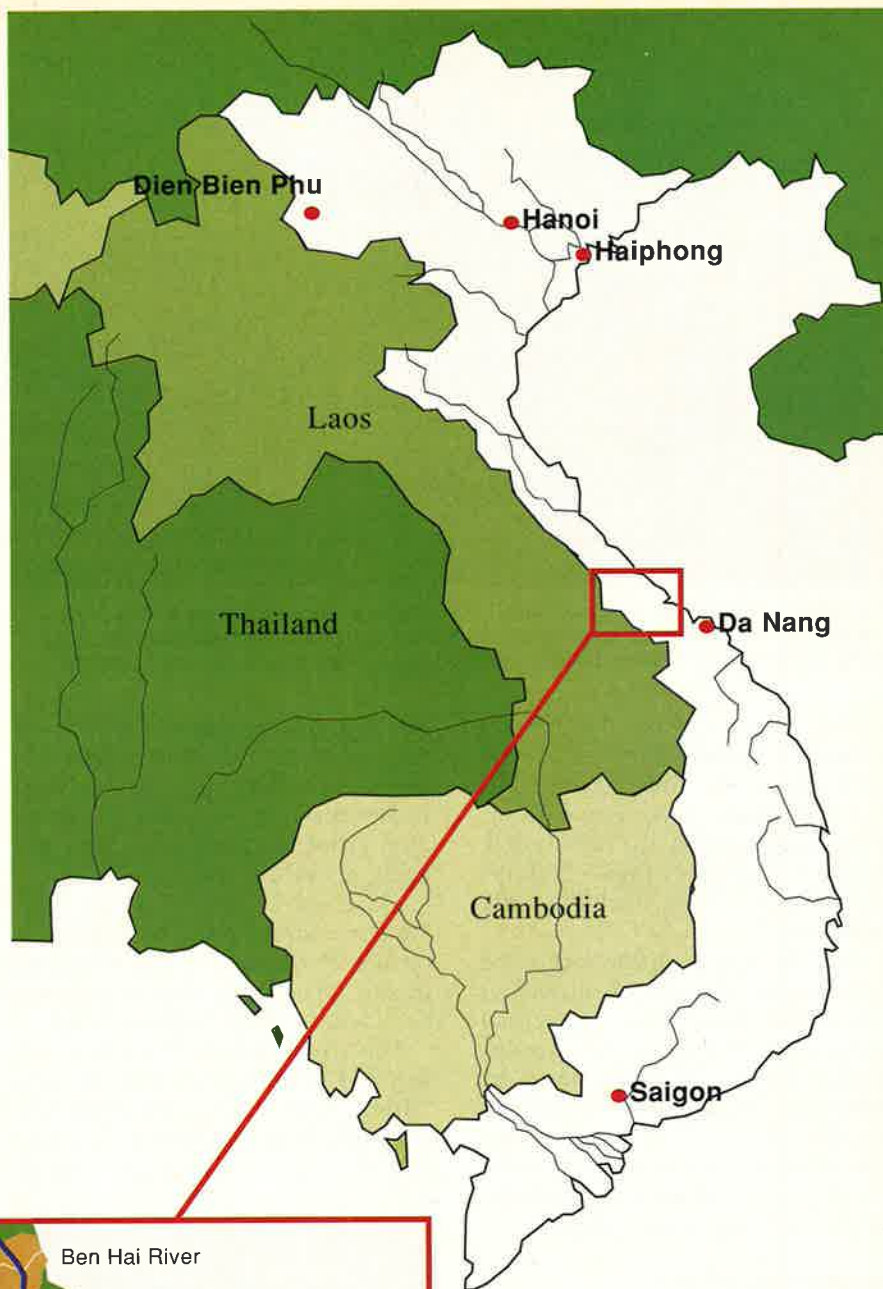
The net result was the creation of six zones around Khe Sanh. The Marines designated the four zones

closest to the base for their operations, while the two most distant zones were allotted to the Air Force.

Despite this rebuff, Momyer set about interdicting enemy supplies—in effect, besieging the besiegers—and bringing the maximum amount of firepower on the entrenched enemy. He used the full weight of Air Force capability, beginning with a centralized intelligence center at Tan Son Nhut. There, 200 people tracked the enemy to optimize both air and artillery attacks.

More than 250 ACOUSIDs (Acoustic/Seismic Intrusion Detectors) and ADSIDs (Air-Delivered Seismic Intrusion Detectors) sensors were emplaced around Khe Sanh to detect enemy movements. These sensors transmitted data to an orbiting Lockheed EC-121 aircraft, which relayed it to an American intelligence center at Nakhon Phanom in Thailand. These data were used for both air and artillery strikes.

Momyer also provided a C-130E Airborne Battlefield Command and Control Center aircraft to coordinate aerial attacks and artillery bombardment. It was incorporated into the Khe Sanh fire support coordination center. Working together, the ground and air centers were able to coordinate USAF, Navy, Marine, and even Army tactical air efforts with Arc Light B-52 operations and artillery fires.



Khe Sanh was an Army Special Forces site 10 miles from Laos and 15 miles from the DMZ. North Vietnam hoped to cut off US forces at Khe Sanh, put them under siege, and force a surrender, as had happened in 1954 at Dien Bien Phu.

(Air Force leaders felt that the command system failed to optimize the air situation for all of South Vietnam and continued to press for a centralized control. They finally achieved their objective March 21, 1968, when the battle was largely won and more than 87 percent of all sorties in the siege had already been made. It was, nonetheless, a step in the right direction.)

Westmoreland had counted on a “Niagara” of bombs falling upon the enemy, and his wishes were fulfilled. B-52s initiated the bombing campaign a week before the siege began, flying 94 sorties against 12 North Vietnamese targets. After the Com-



Khe Sanh was located on a plateau in the middle of four valley corridors, surrounded by high hills. Its runway sat on an 800-foot rise. This view shows the camp perimeter as well as craters around the aluminum mat-covered runway.

murist attack began, the US responded immediately on Jan. 22 with B-52 attacks on four targets. The next day, attacks by Air Force, Navy, and Marine tactical aircraft started. Within a week, more than 3,200 sorties had been flown, including 200 by B-52s.

Over the course of the siege, the B-52s would average 35 sorties per day. Air Force and Marine tactical aircraft would average 300 sorties per day. Two Combat Skyspot radar units were committed to the battle to fine-tune the B-52 drops. The first strikes were made at a distance the Marines considered comfortable; they would soon grow closer.

Uncovering a Trick

On Nov. 12, 1967, a group of nine B-52s mounted an attack against Con Thien. The operation revealed an enemy trick. The North Vietnamese, knowing that the B-52s required a three-kilometer-wide safety zone around friendly forces, began to move ammunition stores into the area near the American defensive perimeter. However, one of the Con Thien B-52s accidentally had dropped a bomb within the safety zone, and the blast had set off a series of secondary explosions. This gave American planners pause and caused them to rethink their tactics.

A series of tests using two Skyspot stations proved the B-52s could deliver their devastating bomb loads much closer to the defensive perim-

eter than had been thought. The first four raids at Khe Sanh resulted in many secondary explosions and fires in the area near the defensive perimeter, proof that the enemy was still using his safety zone tactics.

The close-in attacks became regular procedure for the bombers, the results of which led Westmoreland to say, "The thing that broke their back was ... the fire of the B-52s."

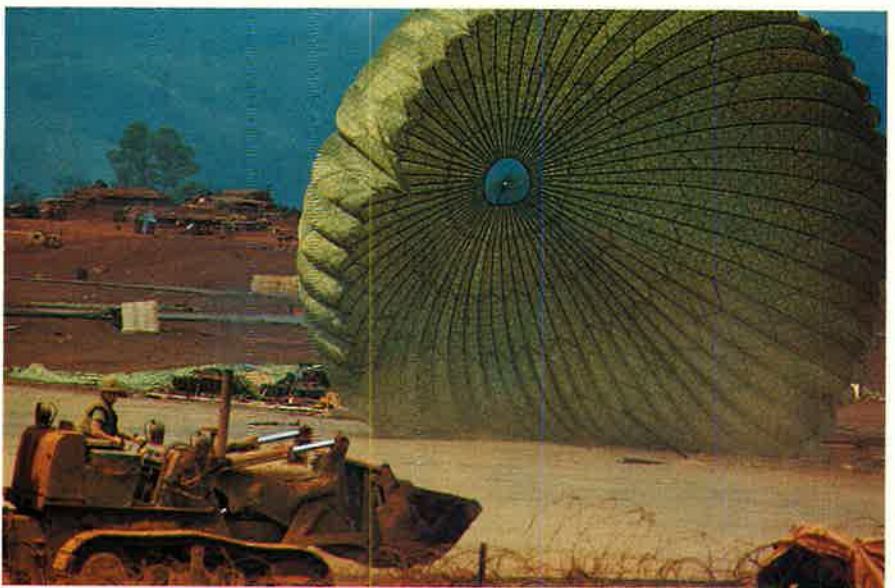
The effectiveness of the B-52 effort had been improved by the new "Bagle Note" tactics, adopted Feb. 15, 1968. With this procedure, a grid system of 1-by-2-kilometer blocks

was overlaid on a target area. The dimensions represented the amount of territory a drop from a single cell of three B-52s could saturate. When the procedure was carried out, six B-52s would arrive every three hours, to be directed to a particular block by the Combat Skyspot controllers. It had a devastating effect upon North Vietnamese troops, comparable to the shattering artillery barrages of World War I.

By the end of the siege, the B-52s had flown 2,548 combat sorties and dropped 59,542 tons of bombs on the North Vietnamese positions. The number of casualties inflicted on North Vietnamese forces was impossible to determine, but it was a significant proportion of their overall losses.

Despite headquarters disputes, tactical units of the Air Force, Marine Corps, and Navy worked in harmony at Khe Sanh. This was true despite the large number of aircraft employed (about 500), wide variety in types, and disparities in performance.

Controllers had to handle everything from Cessna O-1s to McDonnell F-4s, plus continuous streams of transport aircraft. Tactical aircraft from all services dropped about 40,000 tons of ordnance in fewer than 22,000 sorties. This effort was augmented by as many as 200,000 rounds from artillery pieces and mortars. Forward air controllers flew more than 1,000 sorties, and the US flew more than 1,400 reconnaissance missions.



C-130s later air-dropped supplies to Khe Sanh using the Low Altitude Parachute Extraction System and Ground Proximity Extraction System. The drop zone was a dangerous area, where ground crews worked under fire.

Slaughter From the Air

The coordinated attacks by B-52 heavy bombers, tactical aircraft, and artillery had slaughtered Communist troops in their bunkers and trenches, and these forces began withdrawing from the area in mid-March 1968. By April 8, the US Army's 1st Cavalry Division had linked up with Khe Sanh, which was soon being reached by road traffic.

Destroying the enemy had been only half the battle. The other half entailed keeping the US forces alive and able to keep fighting. To do that, USAF airlifters had to haul into Khe Sanh an average of 165 tons of materiel every day.

The loss of the Marine ammuni-



Photos by Robert Ellison / Black Star



Aircraft came under fire during approach and then became easy targets on the ground. At top a C-123 burns after being hit by North Vietnamese mortar fire. Above, a CH-46 transports wounded out of Khe Sanh. US fatalities totaled 500 by the battle's end.

tion dump on the battle's opening day created an immediate requirement to replenish lost ammunition. USAF's 834th Air Division rose to the task. Despite increasingly heavy anti-aircraft fire, Lockheed C-130 Hercules and Fairchild C-123 Providers landed at Khe Sanh, replenishing the artillery stocks and bringing out the wounded. During the first eight days, the airlifters brought in an average of 250 tons of cargo per day. The total was supplemented by Marine KC-130 deliveries and heavy use of the Boeing Vertol CH-46 Sea Knight helicopters.

The Communists continued to shell

the Khe Sanh airstrip, even as they built up their anti-aircraft strength. Transports were brought under fire during their approach to landing. Passive tactics using cloud cover and steep descents were adopted. As soon as an aircraft touched down it became a mortar magnet, a target for Communist fire. The C-123s were able to make the turnoff into the parking ramp, but the C-130s had to go to the end of the runway and then taxi back, sometimes being tracked by mortar shells all the way. Both air- and ground crews worked feverishly as unloading techniques were speeded up, with the airplanes liter-

ally taxiing out from under their palletized cargo.

The C-130s were tough, taking hits, getting repaired, taking more hits, and still managing to take off. On Feb. 5, a C-130E was blasted by machine-gun fire, which ignited the wooden ammunition boxes it was carrying. The aircraft commander, Lt. Col. Howard M. Dallman, coolly backed the airplane to the end of the runway, where it would do the least damage if it blew up, then set about putting out the fire. As the crew off-loaded the ammunition, the C-130 was struck again several times, with a tire being destroyed. After an improvised tire change, Dallman was taxiing out for takeoff when another mortar exploded, knocking out an engine. Undaunted, Dallman was preparing a three-engine takeoff from the 3,900-foot strip when the damaged engine was restarted. The airplane was hit by several more strikes, but Dallman managed to take off and get back to base. He was the first transport crewman to receive an Air Force Cross.

Many other 130s were damaged, sometimes while being repaired from previous mortar rounds. The only Hercules to be lost was a Marine KC-130 carrying fuel bladders, one of which burst into flames as the aircraft was on final approach. The airplane rolled down the runway, racked by explosions, and burned out, with a loss of six on board.

On Feb. 12, C-130 landings were suspended, with the smaller C-123s

Debacle at Dien Bien Phu

After World War II, France attempted to re-establish its colonial empire in what had been French Indochina until Imperial Japan conquered the area. France was snared in a losing struggle with the Viet Minh, the Communist forces. In 1953, the French attempted to cut enemy supply lines by occupying Dien Bien Phu, a mountainous outpost on Vietnam's border with Laos. The Viet Minh quickly cut off all road access, but, despite bitter dissension among their leaders, France was confident that it would use airlift to withstand the siege.

During the winter of 1953-54, North Vietnam's Gen. Vo Nguyen Giap showed a mastery of logistics by surrounding Dien Bien Phu with 49,000 combatants and more than 30,000 support troops. Armies of men and women toiled to bring in 250 pieces of artillery, which were placed on the high ground around the French forces. The artillery would prove to be decisive, for it destroyed the French airstrip early in the battle. Resupply efforts subsequently depended upon airdrops, which became less and less useful as Viet Minh anti-aircraft fire increased and the area held by the French was progressively reduced.

France was not challenged in the air, but their forces were inadequate to interdict the enemy or to supply their own troops. They had a theoretical maximum of 107 strike aircraft, all World War II vintage. Their transport force depended primarily on 100 C-47s and 20 C-119s. (The C-119 Boxcars were also used as bombers, dropping napalm.) In addition, support of the besieged forces was provided by a mixed bag of civilian aircraft that include Bristol Freighters, a 307B Stratoliner, C-46s, and DC-4s.

The Viet Minh launched a full scale attack on March 13, 1954. The French held out until May 7, when the last of Dien Bien Phu's fortified areas was overrun. The battle cost the French 2,200 killed and nearly 6,500 wounded. The Viet Minh had 8,000 killed and 15,000 wounded. It was a price they were willing to pay, for the victory spelled the end of the French resistance in Indochina.

and de Havilland C-7A Caribous being used instead. Three of the C-123s would be lost, one carrying 49 people. It was the single largest loss of life of the entire battle.

Alternative Means

Forbidden to land, the C-130s continued their support efforts by air-dropping containers into the camp, using Marine ground controlled approach equipment to signal when to drop. The method proved to be effective; only three out of 600 containers were lost. The Low Altitude Parachute Extraction System was used with some success, although the delivery method was at times hazardous both to air and ground personnel. In early March, tests were made with a Ground Proximity Extraction System in which the delivery aircraft fitted with a hook contacted a cable stretched near the ground. The hook engaged the cable, and the loads were pulled out of the aircraft. GPES proved to be well-suited to the Khe Sanh environment and was far less hazardous than LAPES.

The drop zone was the most dangerous area in Khe Sanh. Ground crews had to scramble in the open under fire to get the equipment out of the area, wrestling damaged pallets by hand when forklifts, so often in short supply, were unavailable.

For all the difficulties, the air supply of Khe Sanh was entirely suc-

cessful. At no time were the base's basic food, fuel, or ammunition stocks near depletion. By the end of the siege, the transports had completed 1,128 missions and delivered 12,430 tons of supplies. The supply effort had been made somewhat easier by an inexplicable factor: The Communists did not divert or poison the river from which the base drew its water. Had they done so, the tonnage requirements would have risen to carry out resupply of drinking water.

Even as the battle at Khe Sanh was building in intensity, the North Vietnamese on Jan. 30, 1968, launched the surprise Tet offensive throughout South Vietnam. More than 80,000 North Vietnamese Army and Viet Cong soldiers attacked South Vietnamese military positions, government buildings, and cultural centers. Despite the intense fighting throughout the length and breadth of Vietnam, the US support of the forces at Khe Sanh did not waver.

Some have advanced the argument that Giap never did intend to try to take Khe Sanh but instead used it merely as a diversion to distract US

forces from the buildup for the Tet offensive. He undoubtedly recognized the value of the siege as a diversion, but there is no question that Communist forces would have overrun Khe Sanh if they had possessed the capability to do so.

Giap's losses were severe, with some 15,000 killed, compared to 205 Marine deaths and 500 total US fatalities.

In the end, Westmoreland was correct: US airpower (which operated for part of the time under centralized USAF control) had turned the siege of Khe Sanh into a clear American victory. Giap had made two basic mistakes. First, he had underestimated the effectiveness of US airpower and determination of the American military to break the siege. Second, the forces he had allowed to be decimated around Khe Sanh could have been employed to far greater advantage in support of the Tet offensive, which proved to be an unmitigated military disaster for the Communists, who suffered an estimated 45,000 casualties.

Unfortunately for the United States, Khe Sanh and Tet inexplicably were perceived by press and the public to be defeats. For weeks, journalists and commentators had warned of the certainty that Khe Sanh would turn out to be another Dien Bien Phu-style defeat for a Western military force. When the victory was won, however, accounts of the battle faded out of the headlines and television reports. Tet was broadly construed by the media as an overwhelming defeat for US forces, ostensibly because it showed the potency of Communist forces even after four years of direct American military involvement in Vietnam.

Ironically, the North Vietnamese were well aware that they had been defeated and changed their tactics to adapt to the new reality. Despite the ambiguities of the time, one fact now stands out. The coordinated use of American airpower, augmented by new techniques and technologies, had decisively shattered the besieging enemy forces at Khe Sanh. ■

Walter J. Boyne, former director of the National Air and Space Museum in Washington, is a retired Air Force colonel and author. He has written more than 400 articles about aviation topics and 28 books, the most recent of which is Beyond the Wild Blue: A History of the United States Air Force, 1947-1997. His most recent article for Air Force Magazine, "The Young Tigers and Their Friends," appeared in the June 1998 issue.



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AFA Nominees for 1998-99

At a meeting May 23, 1998, in Colorado Springs, Colo., the Air Force Association Nominating Committee selected a slate of candidates for the four national officer positions and the six elective positions on the Board of Directors. This slate will be presented to the delegates at the National Convention in Washington, D.C., on Sept. 14.

The Nominating Committee consists of the five most recent past National Presidents (not serving as Chairman of the Board) and one representative from each of the 12 US regions.

Nominated for his first term as National President was **Thomas J. McKee** of Fairfax Station, Va. He currently serves as the Director of Customer Relations for Northrop Grumman. McKee is completing his second term as Chairman of the Board of the Aerospace Education Foundation and is a past President of the Foundation. He is a Charter Sustaining Life Member of AEF as well as a Life Member of AFA.

He has served as an Under-40 National Director, Chairman of both the Resolutions Committee and Industrial Associate Task Force, and

as a member of the Executive and Communications Committees. He has held various positions within the Iron Gate (N.Y.) Chapter, to include Chapter President, Vice President, and Chairman of the National Air Force Salute Foundation. He has received New York State AFA's Exceptional Service Citation and AFA's Exceptional Service Award and Presidential Citation.

He has twice been designated an AEF Doolittle Fellow in recognition of his seven years as Chairman of the National Air Force Salute Committee, coordinating the Iron Gate Ball that donated over \$2 million to Air Force-oriented charities. McKee has also served as AFA National Secretary and as a member of the AFA Board of Directors. In addition, he serves as a member of the following boards of trustees: Air Force Memorial Foundation in Arlington, Va.; Falcon Foundation at the US Air Force Academy in Colorado Springs; and the College of Aeronautics in New York City.

As an Air Force dependent, McKee traveled extensively and was later commissioned into the US Air Force through Officer Training School.

After earning his pilot wings at Reese AFB, Texas, he served as a T-38 instructor pilot and check pilot at Williams AFB, Ariz., and subsequently transferred to Tactical Air Command for which he flew the A-7D Corsair II while assigned to Myrtle Beach AFB, S.C. After seven years of service, he separated from the Air Force and began a career in the defense industry.

He joined Grumman Aerospace in Bethpage, N.Y., as a Customer Requirements Representative for Air Force programs. He later became the Director of Air Force Requirements and was subsequently transferred to Grumman's Washington Operations and elected a Corporate Vice President by the Board of Directors. When Grumman was acquired by Northrop in 1994, McKee assumed his current position with the new company, Northrop Grumman. McKee earned a bachelor's degree in political science from Southeast Missouri State University and completed the Emerging Executives Program at Pennsylvania State University.

McKee is married to the former Patricia Rizzuto from Midland Park, N.J., and they have two daughters,

Michelle and Catherine, and a son, Thomas Jr.

Doyle E. Larson of Burnsville, Minn., was nominated for his first term as Chairman of the Board. He retired from the Air Force in 1983 as a major general. In addition to his AFA work, he serves as a Trustee of Macalester College, St. Paul, Minn., and as a Visiting Lecturer at the National Security Agency.

Larson attended Madelia High

was awarded two Distinguished Service Medals, three Legion of Merit Medals, the Meritorious Service Medal, and four Air Medals. In 1982, he was inducted into the Order of the Sword by the noncommissioned officers of the Air Force.

He joined AFA in 1976. He has served on the Executive, Resolutions, Long-Range Planning, and Constitution Committees and as a National Director, National Vice President

ministration from the University of North Carolina. He completed his master's of business administration course work at Trinity University in San Antonio. Croom earned his pilot wings at Laughlin AFB, Texas, in 1964 and served as a T-37 instructor pilot at Moody AFB, Ga., until 1968. After upgrade training at Myrtle Beach AFB, S.C., Croom flew 218 combat sorties as an F-100 Super Sabre pilot while assigned to the



McKee



Larson



Croom



Church

School, Madelia, Minn., and Macalester College before the Korean War interrupted his studies. He enlisted in the Air Force in 1951 and served as a Russian linguist until entering flying training and receiving his wings and commission in 1953. He completed his bachelor's degree at Hardin-Simmons University in Texas, on Project Bootstrap, earned his master's degree at Auburn University in Alabama, and received an honorary doctorate from Pikeville College in Kentucky.

Early assignments included radar observer in F-94C Starfire and F-89D Scorpion aircraft, Chief of Language Training with USAF Security Service, and Commander of RC-121, RC-130, and RC-135 reconnaissance squadrons. He is credited with 71 combat-support missions in the Vietnam War. He served as the Director of Intelligence at US Pacific Command and Deputy Chief of Staff for Intelligence at Strategic Air Command. In 1979, he became the Commanding General of USAF Security Service, then the first Commander of Electronic Security Command and the first Director of the Joint Electronic Warfare Center. He

(North Central Region), Minnesota State President, and President of the Gen. E.W. Rawlings Chapter. He also serves as a Trustee of AEF. His national AFA awards include the Medal of Merit, an Exceptional Service Award, and a Presidential Citation. Larson is a Life Member of both AFA and AEF and served two terms as National President.

Nominated for his second term as National Secretary was **William D. Croom Jr.**, of Colorado Springs. Croom retired from the Air Force in 1984 as a lieutenant colonel. He is currently the Director of Military Affairs for the Colorado Springs Chamber of Commerce. Active in numerous civic and charitable organizations, he has served as a Board Member and as Treasurer of both the Pikes Peak USO and the Air Academy Federal Credit Union and as a member of the Chamber's Military Affairs Council. He is currently on the Board of Directors of the Pikes Peak Community College Foundation.

Croom was born in Raleigh, N.C. He graduated from Durham High School in Durham, N.C., and earned a bachelor's degree in business ad-

309th Tactical Fighter Squadron, 31st Tactical Fighter Wing, Tuy Hoa AB, South Vietnam, from July 1969 until June 1970.

Croom was shot down and rescued on a close air support mission near Tuy Hoa in May 1970. Following Vietnam, Croom served as a T-38 instructor pilot, personnel officer, technical training manager, executive officer at a major command, director of protocol at both Air Training Command and the US Air Force Academy, and squadron operations officer. He completed his service as the Assistant Director for Plans and Operations at USAFA. During his career, he earned three DFCs, 12 Air Medals, the Purple Heart, two MSMs, two Air Force Commendation Medals, and the Republic of Vietnam Gallantry Cross with Palm.

A Life Member, Croom joined AFA in 1964. He has served as National Vice President (Rocky Mountain Region), Colorado State President, and President and Vice President of the Colorado Springs/Lance Sijan Chapter. He has been a member of the Board of Directors, a member and Chairman of the Long-Range Planning and Resolutions Committees, and



Anderson



Cantu



McKinney



Politi



Seibel



Sleeman



Sparks

has served on the Finance and Executive Committees. He also serves as Chairman of the Colorado Constitution and Bylaws Committee and as a member of the Executive Council of his local chapter. Croom's national AFA awards include a Presidential Citation, Exceptional Service Award, and Medal of Merit, and he has been chosen Colorado AFAer of the Year.

Charles H. Church Jr., of Lenexa, Kan., was nominated for his fourth term as National Treasurer. Church was born in Kansas City, Mo., and he graduated from Southwest High School and from the University of Kansas with a bachelor's degree in political science. He has also completed several specialized courses sponsored by the American Institute of Banking.

A World War II Navy veteran, Church was in training to be an aerial gunner when the war ended. He went on to a successful career in banking and retired as Chairman of the United Missouri Bank of Hickman Mills. He still serves as an Advisory Director of the United Missouri Bank of Kansas City.

Church is past President of the Richards-Gebaur AFB (Mo.) Community Council and was President of the South Jackson County Kiwanis, South Kansas City Chamber of Commerce, and the Bankers Consumer Credit Association of Kansas City. He has been an American Cancer Society volunteer.

An AFA member for more than 30 years, Church has been a Life Member since 1983 and also is a Life

Member of AEF. He has held all chapter offices and currently serves on the Harry S. Truman Chapter's Executive Committee.

Nationally, he has been active for 19 years as a member of the Finance Committee. He was National Vice President (Midwest Region) for three years and has chaired AFA's Long-Range Planning Committee. He has received AFA's Medal of Merit, Exceptional Service Award, Presidential Citation, and Special Citation and has been designated an AEF Doolittle Fellow, in recognition of his superior service to both his region and national AFA.

The following individuals are permanent members of the AFA Board of Directors under the provisions of Article IX of AFA's National Constitution: John R. Alison, Joseph E. Assaf, Richard H. Becker, David L. Blankenship, John G. Brosky, Dan F. Callahan, Robert L. Carr, George H. Chabbott, O.R. Crawford, R.L. Devoucoux, Jon R. Donnelly, Russell E. Dougherty, George M. Douglas, Charles G. Durazo, Joseph R. Falcone, E.F. Faust, Joe Foss, John O. Gray, Jack B. Gross, Martin H. Harris, Gerald V. Hasler, Monroe W. Hatch Jr., H.B. Henderson, John P. Henebry, Robert S. Johnson, David C. Jones, Arthur F. Kelly, Victor R. Kregel, Jan M. Laitos, Frank M. Lugo, Nathan H. Mazer, William V. McBride, James M. McCoy, Edward J. Monaghan, J.B. Montgomery, Bryan L. Murphy Jr., J. Gilbert Nettleton Jr., Ellis T. Nottingham, Jack C. Price, William C. Rapp, Julian

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The seven people whose photographs appear here are nominees for the six elected Directorships for the coming year.

R. Donald Anderson, Virginia. Former National Director; Chapter Treasurer; Virginia State President. Currently National Vice President (Central East Region). Life Member of AFA and AEF.

Robert J. Cantu, Texas. Former National Director; National Vice President (Southwest Region); Long-Range Planning Committee; Executive Committee; Resolutions Committee; AEF Trustee; Chairman, AEF Membership Committee. Currently member of the AFA/AEF 2010 Committee. Life Member of AFA and AEF.

Ivan L. McKinney, Louisiana. Former State President and Chapter President; chapter Executive Council. Currently National Vice President (South Central Region) and member of the Finance Committee. Member of AFA and AEF.

John J. Politi, Missouri. Former State President; State Treasurer and member of the Membership Committee. Currently National Vice President (Midwest Region); Chairman of the AFA Audit Committee and member of AFA's Executive Committee. Life Member of AFA.

Mary Ann Seibel, Missouri. Former National Secretary; National Director; Under-40 Director; Chapter President; member of the Long-Range Planning Committee; Constitution Committee; Chairwoman, Resolutions Committee; Executive Committee. Currently member of AEF's Board of Trustees and Futures Committee. Life Member of AFA and AEF.

Dr. Phillip J. Sleeman, Connecticut. Former State and Chapter President; National Vice President (New England Region); member, AEF Board of Trustees. Currently AEF National Treasurer; AEF Executive Committee. Member AFA and AEF.

William L. Sparks, Florida. Former State and Chapter President. Currently AFA National Director and member, Audit Committee. Life Member of AFA. ■

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AFA / AEF National Report

By Frances McKenney, Assistant Managing Editor

AFA at Berlin Airlift Commemorations

Air Force Association National President Doyle E. Larson and Aerospace Education Foundation President Walter E. Scott traveled to Germany in May to participate in Berlin Airlift 50th anniversary activities that paid tribute to the men and women who kept the Western zones of Berlin supplied through a historic airlift of provisions between June 1948 and September 1949.

Scott arrived in Germany in early May and, with Frank M. Swords, AFA special assistant Europe, visited H.H. Arnold High School at Wiesbaden and attended the cadet corps' annual honors banquet held at the former Officers Club.

Scott and Swords delivered to retired Lt. Col. Mark Collins, the cadets' Aerospace Science Instructor, the new aviation curriculum called Take Off. Consisting of an eight-part video series, workbooks, and lesson plans, it is the European

counterpart to the *USA Today*-AEF Visions of Exploration educational program.

In late May Larson and Swords presented Gen. John P. Jumper, commander of US Air Forces in Europe, with a limited-edition print, "Staying Power—Berlin 1948-1949." The print depicts a scene from the Berlin Airlift.

The AFA and AEF leaders then attended the Berlin Airlift Anniversary Banquet, hosted by Jumper at Rhein-Main AB. The evening gala kicked off USAFE's year-long commemoration of the airlift.

One of the airlift's famous figures, Gail S. Halvorsen, now a retired colonel but a first lieutenant back when he earned the nickname the "Candy Bomber," also attended the festivities. He is a member of the **Salt Lake (Utah) Chapter**.

Touching Bases

Following the commemoration events, Larson visited AFA chapters in Europe.

At Spangdahlem AB, Germany, he met Brig. Gen. Victor E. Renuart Jr., commander of the 52d Fighter Wing

and an AFA member, and Capt. Larry J. Dannelley Jr., **Spangdahlem Chapter** president. Larson lunched with chapter members and conducted a workshop on how to build depth and stability into their chapter.

Next stop: Aviano AB, Italy.

On hand to greet Larson were AFA members Brig. Gen. Timothy A. Peppe, 31st Fighter Wing commander, and Col. Harry Davis and Capt. Eric J. Bjurstrom, the **Dolomiti Chapter's** president.

Larson conducted a workshop and attended several chapter functions during four days in Italy. He received mission briefings from, among others, chapter member Col. Steven J. Teske, 31st Fighter Wing vice commander.

Larson met with officials from AFA's Italian counterpart, *Associazione Arma Aeronautica*. Escorted by retired Gen. Riccardo Marchese, the local chapter's president, he traveled to Venice and spent the day with retired Gen. Vincenzo Manca, AAA president, and retired Gen. Catullo Nardi, AAA past president.

Stephen A. Michael, **United Kingdom Chapter** president, welcomed Larson at the AFA president's next stop, the UK.

He visited 3d Air Force headquarters and its commander, Maj. Gen. William S. Hinton Jr., a chapter member. He also went to several USAF units and received briefings from chapter members Lt. Col. Thomas J. Kopf and Capt. Lisa M. Breneman.

Larson conducted a workshop and attended the chapter's first-anniversary celebration at the Mildenhall Officers Club. Chartered May 1, 1997, the chapter began with 54 members and a year later has 171.

Swords said the outreach to European chapters gave Larson a chance to answer questions and provide ideas and guidance on, for example, how to involve corporate sponsors, spouses, and contractors in AFA.

Supporting a Larger Pay Increase

AFA issued a statement in early June, asking the Senate to support



Capping their participation in several Berlin Airlift 50th anniversary celebrations, AEF President Walter Scott (left) and AFA National President Doyle Larson (right) attended a memorial wreath-laying service at Berlin Airlift Memorial Park at Rhein-Main AB, Germany, in May. The memorial is a replica of the Luftbrücke monument in Berlin.



President Larson (left) was constantly on the go, conducting workshops for European chapters. At Aviano, he was accompanied by Capt. Eric Bjurstrom (center), chapter president, and Frank Swords, AFA special assistant Europe.

the Fiscal 1999 House Defense Authorization Act's additional .5 percent increase to the Administration's proposed 3.1 percent increase in military pay.

The Military Coalition—of which AFA is an affiliate—had put its five million-strong membership numbers behind the House bill.

Noting that the gap between military and civilian pay is now 14 percent, AFA National President Larson commented, "Our military people are serving this country every day across the globe. They are doing their part. It's time the Congress and the Administration did theirs."

Falcon to Schriever

Acting Air Force Secretary F. Whitten Peters, a host of USAF dignitaries past and present, AFA state and national officers, and the **Colorado Springs/Lance Sijan (Colo.) Chapter** helped retired Gen. and Mrs. Bernard A. Schriever celebrate the renaming of Falcon AFB, Colo., to Schriever AFB in June.

A black-tie dinner hosted by 50th Space Wing kicked off two days of events honoring the space pioneer. Gen. Howell M. Estes III, commander

of Air Force Space Command, was the guest speaker, and the Colorado Springs/Lance Sijan Chapter provided commemorative wine glasses for the several hundred guests.

Among the AFA officials who attended were George M. Douglas, national director emeritus; Howard R. Vasina, Colorado state president; Larry D. Fortner, state vice president (south), Joan Sell, state secretary; Charles P. Zimkas Jr., president of the Colorado Springs/Lance Sijan Chapter; and Deborah S. Canjar-White, chapter vice president.

William D. Croom Jr., AFA national secretary, commented that the evening was extraordinary. "We all discussed what a great concept it is to honor someone while they are living," he said.

The next day's official ceremony in the Joint National Test Facility included many VIPs such as Russell E. Dougherty, AFA national director emeritus; Donald H. Rumsfeld, former Secretary of Defense; John L. McLucas and Edward C. Aldridge Jr., both former Secretaries of the Air Force; and retired Gen. Thomas S. Moorman Jr., a former AFSPC commander.

Often called "the father of the US Air Force's space and missile program," Schriever's leadership of the Air Force Western Development Division from 1954 to 1959 enabled the US to deploy the first-generation ICBMs—Atlas and Titan.

At the renaming ceremony, he spoke about the history of the space and missile programs and related several anecdotes about his part in them. Now 87 years old, Schriever retired from USAF in 1966 and went on to hold many advisory roles for the government and private corporations. He is a member of the **Nation's Capital Chapter**. The **Gen. B.A. Schriever Los Angeles Chapter**, with more than 900 members, is named in his honor.

Space Day '98

AFA and AEF were among the more than 30 national organizations supporting Space Day '98 on May 21.

The second annual celebration of the achievements, opportunities, and benefits of space opened with ceremonies and exhibits outside the National Air and Space Museum in Washington. A tent on the Mall broadcasted Cyber Space Day, the first live interactive "webcast" devoted to space. It was hosted by journalists and allowed students around the world to ask questions of experts such as former US astronauts Buzz Aldrin and Wally Schirra.

To promote Space Day '98, AEF informed teachers about methods to introduce aerospace topics to their classroom. These teaching tools include a Cosmic EdVenture classroom kit and the Student Signatures in Space program. The latter project collects students' autographs in order to send them on the space shuttle with Glenn, when he returns to space later this year.

For the **Highpoint (N.J.) Chapter**, Space Day '98 meant welcoming Air Force Historian Richard P. Hallion to its chapter meeting at the Picatinny Arsenal (N.J.) Officers Club.

Hallion also visited Lounsberry-Hollow Middle School in Vernon, N.J. He spoke to 400 sixth-graders about the evolution of aerospace endeavors



AFA made the final payment in June on the mortgage on its Arlington, Va., headquarters building. National Treasurer Charles Church, President Doyle Larson, and Chairman of the Board Gene Smith (l-r) celebrated the occasion with a "mortgage burning" on the rooftop patio.



Lending a hand at the mortgage burning: National Directors Emeriti George Chabbott, Victor Kregel, John Brosky, and David Blankenship (l-r) had leading roles in securing a permanent AFA building. As national president 1979-81, Kregel championed approval of the idea. His successor, Brosky, made location and construction of a headquarters a primary focus of his term. Months of study by such leaders as Chabbott, then head of the Finance Committee, and Blankenship, chairing the Executive Committee, culminated in Board of Directors approval for the project in 1982. The building was completed in 1984.

and went to chapter member Susan L. Roche's sixth-grade classroom. Roche is the 1995 winner of the Christa McAuliffe Memorial Award. With fellow teacher and chapter member Amanda Z. Hofmann, the chapter's 1997 Teacher of the Year, Roche runs an educational program called "Go for Launch" in her classroom. By conducting a simulated mission in an 18-foot space shuttle mockup, their students sharpen their basic skills and learn team work, communication, and problem solving. An AEF

grant provided the seed money for this program.

According to Sandy L. Sardlin, chapter president, Hallion was "extremely impressed" by the Go for Launch program.

Hallion's day in New Jersey was funded with an AEF chapter matching grant and generated coverage by Air Force News Service, a local newspaper, and cable television.

Enola Gay Crew Honored
The General Doolittle Los Ange-

les Area (Calif.) Chapter co-hosted a dinner and tribute for retired Brig. Gen. Paul W. Tibbets Jr. and retired Col. Thomas Ferebee—*Enola Gay* pilot and bombardier—who dropped the atom bomb on Hiroshima in August 1945, hastening the end of World War II.

Along with Anthony I. Mazzolini and William E. Dietzel, officials of the Cleveland-based US Aviation Museum, Tibbets and Ferebee spoke briefly and showed a video interview about the *Enola Gay* mission and a video on the museum's efforts to rescue the B-29 *Returning to Glory* from the Navy's China Lake (Calif.) training facility.

Afterward, Paul A. Maye, California state president, moderated a question and answer session.

Louis J. Kridelbaugh, Doolittle Chapter president, said one guest, on signing up to attend the dinner, told him he wanted to be there to thank Tibbets for giving his father another 51 years of life. His father would have participated in an invasion of Japan, had that country not surrendered after atom bombs were dropped on Hiroshima and Nagasaki.

Also among the guests at the dinner was Robert A. "Bob" Hoover, the legendary test pilot.

Tibbets and Ferebee, both AFA members, were in California along with other *Enola Gay* crew members to participate in the US Aviation Museum's open house and ceremony for *Returning to Glory*, which it brought to Inyokern, Calif., for restoration.

The Doolittle Chapter's dinner took place at the Proud Bird restaurant, one of a chain of military aviation theme restaurants. Restaurant owner David Tallichat had invited Maye and Kridelbaugh to co-host the tribute to Tibbets and Ferebee.

Conventions: In the "Empire State"

Retired Gen. Michael J. Dugan, former USAF Chief of Staff and presently an AFA national director, headed the list of speakers during the 51st annual New York State Convention in Ronkonkoma, hosted by the tri-county downstate chapters—the **Nassau Mitchel Chapter, Francis S. Gabreski Chapter, and Queens Chapter.**

At the evening banquet, he gave a historical overview of the role of airpower. He also presented Jubilee of Liberty medals to 27 area veterans of the World War II Normandy invasion. The medal was commissioned in 1991 by the government of

Normandy, France, and the tricounty chapters have presented it to those who couldn't travel to France to receive them during 50th anniversary commemorations of the invasion.

Past presidents of New York state AFA were also honored at the convention. William Stroh and Joan R. Stroh of the **Chautauqua Chapter** did a roll call of 30 presidents, going back to 1947, based on research by Walter N. Zywan and Marylyn V. Zywan of the Nassau Mitchel Chapter.

Presidents at the gathering were Bonnie B. Callahan, current state president and an **L.D. Bell-Niagara Frontier Chapter** member; William G. Stratemeier Jr. of the Gabreski Chapter, who served from 1995-97; James E. Callahan from the L.D. Bell Chapter, 1994-95; Allen G. Harris from the **Gen. Daniel "Chappie" James Jr. Memorial Chapter**, 1993-94; Maxine Donnelly from the **Lloyd Schloen-Empire Chapter**, 1986-87; June Holland, for Robert Holland, who served from 1982-84; and David S. Levison of the Queens Chapter, 1953-55.

Thomas J. McKee, AEF board chairman, and James Callahan, national director, made presentations during the convention's business meeting at which 13 of New York's 15 chapters were represented. Elected as state officers during the meeting: Bonnie Callahan, president; Stratemeier, vice president downstate area; Edward J. Hayes Jr. of the **Albany-Hudson Valley Chapter**, vice president central area; Barry H. Griffith of the L.D. Bell-Niagara Frontier Chapter, vice president western area; Walter Zywan, treasurer; and Barbara C. Dunderdale of the Chautauqua Chapter, secretary.

At the awards luncheon, an Exemplary Service and Special Recognition award for 20 years of outstanding service went to Walter Zywan. The Nassau Mitchel Chapter received the Chapter of the Year award. James Callahan took home the Person of the Year award. Honored with unit awards were the 109th Airlift Wing (ANG) from Schenectady County Airport, N.Y., and the Air Force Research Laboratory's Information Directorate in Rome, N.Y.

Donnelly, Hayes, Stratemeier, Marylyn Zywan, Fred DiFabio and Irwin Hansen, both of the Nassau Mitchel Chapter, Barbara Dunderdale and John Dunderdale of the Chautauqua Chapter, Charles H. Jacob of the Lloyd Scholen Chapter, M.R. Kaletta of the L.D. Bell Chapter, and Charlene Nicholson from the **Iron Gate Chapter** all received Exceptional Service awards.

In the "Volunteer State"

The **Maj. Gen. Dan F. Callahan Chapter** hosted the Tennessee State Convention in Nashville in May, with Maj. Gen. Thomas H. Neary, director, nuclear and counterproliferation, Deputy Chief of Staff for Air and Space Operations, as guest speaker.

More than 60 guests attended the banquet, honoring several recruiters and cadets as well as George A. Vitzthum, of the **Gen. Bruce K. Holloway Chapter**, who received the AFA Tennessee Member of the Year award. Joseph E. Sutter, Holloway Chapter president, received an AFA Medal of Merit. In addition, Fred D. Womack of the Holloway Chapter was presented with an Exceptional Service Award. Charles H. Church Jr., AFA national treasurer, Ivan L. McKinney, national vice president (South Central Region), and Glenn Fuller, state president, presented the awards.

Elected for state offices were William E. Freeman Jr. from the **Everett R. Cook Chapter**, president; Nancy I. Blanchard of the **Chattanooga Chapter**, vice president; Vitzthum, secretary, and James C. Kasperbauer of the Cook Chapter, treasurer.

Thunderbirds Bring Them Out

The **Concho (Texas) Chapter** recorded its largest turnout for a chapter function when it hosted a reception for the US Air Force Air Demonstration Squadron—the Thunderbirds—and four Doolittle Raiders. The groups were in town for the precision flying team's performance at Goodfellow AFB.

Dr. Jackson Smith, chapter vice president for communications, wrote that more than 500 people attended the cookout, which also included the

Navy SEAL parachuting-underwater demolition team called the Leap Frogs.

Doolittle Raiders David M. Jones, pilot; Henry A. Potter, who was Jimmy Doolittle's navigator; Richard E. Cole, Doolittle's copilot; and Harry C. McCool, navigator for the No. 4 aircraft, had been invited to attend the Thunderbirds show because it included a reenactment of their April 1942 bombing of Tokyo. Under the leadership of then-Lt. Col. Jimmy Doolittle, the four had been among those taking off from USS *Hornet* in 16 B-25s for the first raid on the Japanese home islands. Their success was a tremendous morale boost for World War II America.

John M. Pecarina, chapter president, organized the cookout at Goodfellow Recreation Camp, with help from chief cook George L. Gosnell. Nancy M. Larson, Dennis L. Rasmussen, and Thomas P. Crowley headed the team turning out brisket for 500.

Big Bang

With help from the **C. Farinha Gold Rush Chapter**, JROTC cadets at McClatchey High School in Sacramento, Calif., were able to end their school year "with a bang," reported 1st Lt. Thomas Knowles, chapter vice president for communications.

John W. "Stan" Getz, who was interim chapter vice president for aerospace education earlier this year, had sent out packets of AEF information to seven JROTC Aerospace Science Instructors in the area, and McClatchey High's Aerospace Science Instructor, retired Lt. Col. Billy Lakes, was successful in



Honored for two decades of service as New York state's AFA treasurer, Walter Zywan (center) received congratulations from Thomas McKee (left), AEF Chairman of the Board, and Bonnie Callahan, state president, at an event-filled New York State Convention.

applying for a \$250 AEF Educators Grant.

"We started the year with outdated equipment and only a few rockets and engines," Matthew Ceccato, the cadet commander, told Knowles. "Thanks to the Air Force Association's support, we were able to purchase new equipment."

Educating Albuquerque

In April, the **Albuquerque (N.M.) Chapter** held its annual Education Luncheon at the Kirtland AFB Officers Club, with Brig. Gen. Ruben A. Cubero, dean of the faculty at the US Air Force Academy, as guest speaker.

Also in the spotlight at the luncheon were cadets from the University of New Mexico AFROTC Det. 510, at Albuquerque. Peter D. Robinson, state vice president, and Edward S. Tooley, chapter president, presented cadets Steven James and John Echols with \$500 scholarships funded by the chapter and state AFA organizations.

Earlier in the year, Joseph V. Traina, chapter vice president for aerospace education, visited a fifth-

grade classroom at Our Lady of the Annunciation School in Albuquerque that uses the *USA Today*-AEF Visions of Exploration program.

He spoke to the students about his background as an aeronautical engineer at a Grumman test laboratory and said the kids "fired questions" at him.

One youngster told Traina that he used to look only at the newspaper's sports section. Because of the Visions program, he said he now pays attention to the entire newspaper.

Inspired by this visit, Traina wrote to the chapter's Community Partners, seeking donations to sponsor the Visions program in more classrooms. He reports that several stepped forward, and the chapter will sponsor 11 classes in the coming school year.

More Chapter News

■ To help teachers plan educational activities for the upcoming school year, the **John W. DeMilly Jr. (Fla.) Chapter** sponsored a symposium on aerospace education programs and aviation resources available in the South Miami-Dade county areas. Held at Homestead ARB, the

half-day seminar brought together nearly two dozen leaders in education and aviation.

■ The **Del Rio (Texas) Chapter** presented its first two Phil Ricks Memorial Scholarships in May to Del Rio High School seniors Adriana Portillo and Jesus Pena. The scholarships are named for the late Phillip Ricks, an AAF veteran who was a founding member of the chapter in 1966. His son, Community Partner Lonnie Ricks, and grandson Ryan joined Patricia A. Watson, chapter president, and Edgar J. Thomas Jr., chapter vice president, in presenting the scholarships.

■ The Armed Forces Day open house at the 128th Air Refueling Wing (ANG), General Mitchell IAP/ARS, Wis., brought fund-raising and new membership opportunities for the **Billy Mitchell Chapter**. Chapter President Russ Klug said the group sold roasted corn on the cob, a long-standing Armed Forces Day tradition for the chapter, and ran two popcorn machines in the main hangar. From an AFA booth, they also sold lapel pins.

Earlier in the month, Charles W. Marotske Jr., state and chapter vice

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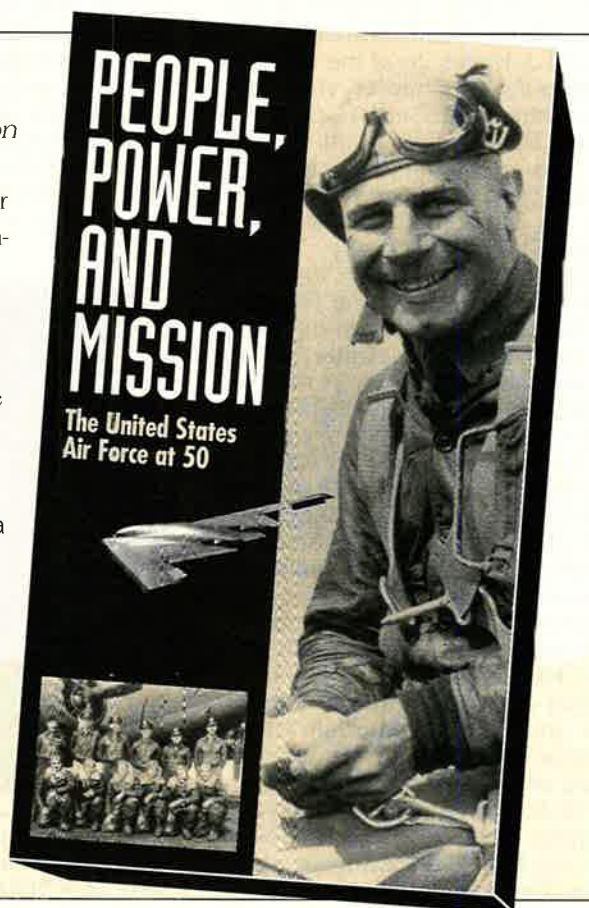
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president for government relations, attended the 440th Airlift Wing (AFRC) dedication of the Capt. Lance P. Sijan Memorial Plaza at the main gate of the General Mitchell IAP/ARS. Sijan, a native of Milwaukee, received the Medal of Honor posthumously for gallantry while a POW in North Vietnam.

■ It was a hit when first released in 1977, and "Star Wars" was a hit again when the **Thomas W. Anthony (Md.) Chapter** set up a cardboard figure of a character from the movie at the D.C. Air National Guard's Aviation Career Day in April. About 1,500 middle school and high school students saw the cutout at the annual event, held on the ramp of the 201st Airlift Squadron (ANG) at Andrews AFB, Md.

■ Chase Harvick, 11, received a \$450 scholarship from the **Altus (Okla.) Chapter** to attend an aerospace camp held at Oklahoma City University. Robert Ott, the chapter's education committee chairman, said that the scholarship is "highly prized."

■ In Enid, Okla., Oscar Curtis, **Enid Chapter** secretary and program chairman, attended the JROTC dining-out for the local school system. He presented Lisa Cornell with a savings

bond, recognizing her selection as Cadet of the Year.

■ With their AFA chapter banner in hand, **Mercer County (N.J.) Chapter** members Vincent Fairlie, Allen Hoffman, Charles Johnson, and Arthur R. Beach, chapter president, participated in an Armed Forces Day ceremony at Veterans Park in Hamilton Square, N.J. The chapter provided the funds for one of several flagpoles in a section of the park.

■ The **Richard I. Bong (Minn.) Chapter** honored AFROTC Det. 420 of the University of Minnesota, Duluth, at its quarterly meeting in May, presenting Michael L. Janssen with a Silver Medal Award as outstanding cadet. Guest speaker at the meet-

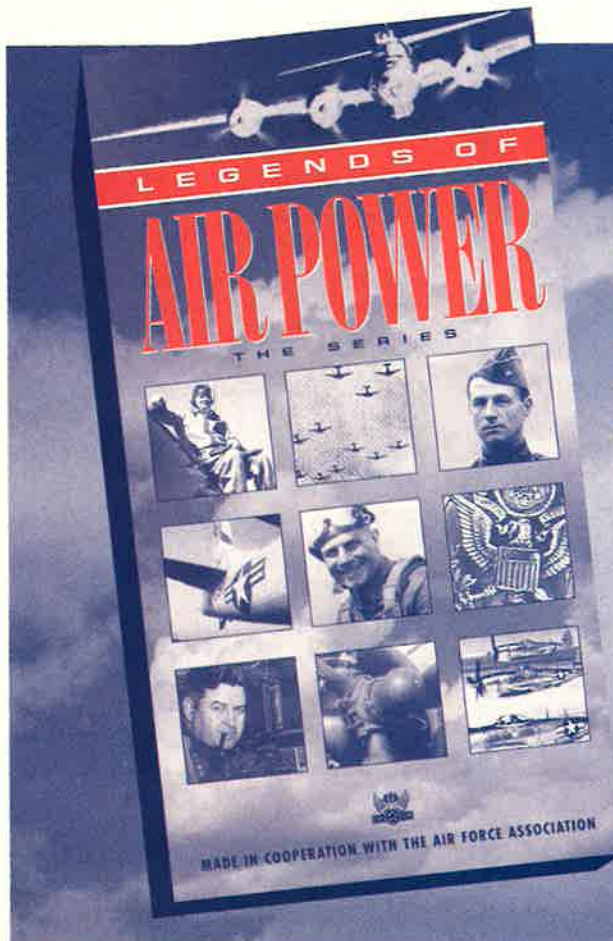
ing, held at the 148th Fighter Wing (ANG), Duluth IAP, Minn., was the state adjutant general, ANG Maj. Gen. Eugene R. Andreotti.

■ A group of 47 from the **Fort Wayne (Ind.) Chapter** took a bus trip to the US Air Force Museum at Wright-Patterson AFB, Ohio. Roger K. Myers, chapter secretary, arranged the trip.

■ National Director Emeritus John G. Brosky and Edmund and Edna Gagliardi from the **Eagle (Pa.) Chapter** presented a framed picture of an eagle to French Minister of State Jean-Pierre Masseret, who has responsibility for veterans issues for the Ministry of Defense, during a meeting in Washington. ■

AFA Conventions

Aug. 7-8, **Colorado State Convention**, Aurora, Colo.; Aug. 14-15, **Illinois State Convention**, Galesburg, Ill.; Aug. 15, **Georgia State Convention**, Savannah, Ga.; Aug. 15, **North Carolina State Convention**, Goldsboro, N.C.; Aug. 21-23, **California State Convention**, Vandenberg AFB, Calif.; Aug. 22, **Indiana State Convention**, Indianapolis; Aug. 22, **New Mexico State Convention**, Clovis, N.M.; Sept. 12, **Delaware State Convention**, Dover, Del.; Sept. 14-16, **AFA National Convention and Aerospace Technology Exposition**, Washington; Oct. 3, **Utah State Convention**, Ogden, Utah.



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Unit Reunions

15th Tactical Recon Sq Assn (WWII). Sept. 24-26, 1998, at the Hampton Inn Asheville Airport in Asheville, NC. **Contact:** Charles Livingston, 14 Clay St., Tiffin, OH 44883 (419-448-0888).

21st/6461st Troop Carrier Sq, "Kyushu Gypsies" (Korea). Oct. 15-17, 1998, at the Travel Lodge at Lake Buena Vista in Orlando, FL. **Contact:** Dana L. Mansur Jr., 8 Leffler Hill Rd., Flemington, NJ 08822 (908-782-1657) (Jbrands@eclipse.net).

44th BG (H), 44th ARS, 44th BW, and 44th Strategic Missile Wg. Oct. 25-29, 1998, at the Days Inn and Suites in Savannah, GA. **Contact:** Mike Yuspeh, 7214 Sardonyx St., New Orleans, LA 70124 (504-283-3424).

61st TCS (WWII) and 61st Airlift Sq (active). Dec. 3-5, 1998, in Little Rock, AR. **Contact:** Gordon Trendell, 3418 Dighton Rd., Bethlehem, PA 18017 (610-867-3610) (Gtrendell@aol.com).

64th TCG (WWII). November 1998 in San Antonio. **Contact:** Vern Montgomery, 6744 Carlsen Ave., Indianapolis, IN 46214 (317-241-5264).

79th TCS, 436th TCG. Sept. 24-26, 1998, in El Paso, TX. **Contact:** Sumner Youngblutt, 5232 Angelrock Loop, Roseville, CA 95747 (916-771-4903).

86th FIS and 79th FG (Youngstown MAP, 1955-60). Sept. 4-6, 1998, in Youngstown, OH. **Contact:** Bob Watson, Rt. #1, Box 277C, Warrenton, MO 63383 (314-456-3778) (rhwatson@mocyt.com), Dick Holland, 2561 Guntley Rd., Philo, CA 95466 (707-895-2136) (rsholland@pacific.net), or Bill

Mail unit reunion 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.

Willis, 206 Arch St., Clyde, OH 43410 (419-547-3487).

87th/512th FIS Assn and current or former squadron members. Nov. 5-8, 1998, at the Desert Hotel in Scottsdale, AZ. **Contact:** Gene Crooks, 33237 N. 68th Pl., Scottsdale, AZ 85262 (602-488-0388 or fax 602-488-5120) (Deserthotel@worldnet.att.net).

90th BS (LNI) (Korea). Nov. 5-8, 1998, in Galveston, TX. **Contact:** George Pittelkau, 5670 S.W. Fernbrook Way, Lake Oswego, OR 97035-7726 (503-639-5077).

97th BW. Sept. 24-27, 1998, at the Quality Inn and Suites in Bellevue, NE. **Contact:** Marty Colladay, 409 Dowding Ct., Bellevue, NE 68005 (402-291-7686).

330th BG (VH) Assn (North Field, Guam, 1945). Sept. 17-20, 1998, at the Wyndham Albuquerque Hotel at Intl. Sunport in Albuquerque, NM. **Contact:** Robert C. Flischel, 413 E. Center St., Germantown, OH 45327 (937-855-7946).

391st BG Assn, Ninth AF, B-26s and A-26s (WWII). Nov. 4-8, 1998, in St. Louis. **Contact:** B. Cox (818-781-3390).

394th BG and assigned units. Sept. 17-21, 1998, in San Diego. **Contact:** Harold Lundy, 1777 Leisure World, Mesa, AZ 85206 (602-985-5297) (haroldlun@aol.com).

441st TCG, all squadrons (WWII). Nov. 16-19, 1998, in Myrtle Beach, SC. **Contact:** David R. Bingham, 1686 Colonist Sq. S.W., Ocean Isle Beach, NC 28469-6506.

445th BS/323d BG (M) "Whitetail Marauders," Ninth AF (WWII). Oct. 28-Nov. 1, 1998, at the Holiday Inn Westport in St. Louis. **Contact:** Ollie Meyers, 3632 Rhode Island Ave. S., Saint Louis Park, MN 55426.

456th BG, Fifteenth AF (WWII, Italy). Aug. 19-23, 1998, at the Best Western Hanalei Hotel in San Diego. **Contact:** Ed Moore, 132 West 9th St., Box 507, Hays, KS 67601 (785-625-7515).

464th Wg (1954-74). April 21-24, 1999, at the Holiday Inn Bordeaux in Fayetteville, NC. **Contact:** Boyd L. McLean, 209 E. Robinson St., Gaffney, SC 29340.

1503d Supply Sq, Haneda, Japan (1946-56). Oct. 12-14, 1998, at the Westward Ho Hotel & Casino in Las Vegas. **Contact:** Rex G. Fisher, 233 Mountain View Ave., San Jose, CA 95127 (408-259-2657).

6147th Tactical Control Gp (Korea). Sept. 15-20, 1998, in Fairborn, OH. **Contact:** Jack Taylor, 6675 Tifton Green Trail, Centerville, OH 45459 (937-433-4580).

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C9 AFA Silk Tie. Embroidered AFA logo. Maroon with navy stripes or navy with maroon stripes. **\$23**

C10 AFA Necktie. Silk and polyester covered with full-color AFA logos. Dark blue only. **\$15**

6511th Test Gp (Parachute), Nov. 14, 1998, at El Centro, CA. **Contact:** Kenneth F. Cunningham (805-942-7712).

Air Commando Assn. Oct. 8-11, 1998, at the Howard Johnson Motor Lodge in Fort Walton Beach, FL. **Contact:** ACA, PO Box 7, Mary Esther, FL 32569 (850-581-0099) (aircomando@aol.com or aircommando1@earthlink.net).

Flying Training Class 55-E. Oct. 8-11, 1998, in San Antonio. **Contact:** Ernest N. Anthony, 102 DaGama, Universal City, TX 78148 (210-658-5176).

Pilot Training Class 53-C. May 27-29, 1999, on

the French Riviera. **Contact:** Class 53-C, 7741-A S. Curtice Dr., Littleton, CO 80120 (303-797-0420) (KCE7741@aol.com).

Raven FACs, Laos (O-1, U-17, T-28). Ground crews welcome. Oct. 15-18, 1998, in Universal City/Randolph AFB, TX. **Contact:** Ed Gunter, 132 Trelawney St., McQueeney, TX 78123 (830-560-2522) (edgunter@aol.com).

Suffolk County AFB, NY (52d FIG), all personnel. Oct. 8-11, 1998, at the Sheraton Hotel & Marina, New Bern, NC. **Contact:** Phil Geib, 837 Pelican Dr., New Bern, NC 28560 (919-633-4091) (pgg837beg@coastalnet.com).

Seeking **O-1 FACs** who participated in Operation Cricket at Nakhon Phanom, Thailand, in 1966 for a reunion in Fort Walton Beach, FL, Oct. 9-11. **Contact:** Rowdy Heartherton, 110 Rushton Ln., Tavernier, FL 33070 (305-852-6156).

Seeking **Pilot Training Class 56-N** members to plan a reunion. **Contact:** George Rabone, 36 Weatherly Dr., Salem, MA 01970 (george.rabone@ae.ge.com).

Seeking members of **Pilot Class 70-A** (Randolph AFB, TX) to plan a reunion in San Antonio in 1999. **Contact:** Fred May, 10218 Eagle Bluff, San Antonio, TX 78240-3558 (210-521-0589 or 210-493-8225) (fmay@txdirect.net).

Bulletin Board

For a book, seeking **war stories and memorabilia** from anyone who has been a **Lockheed C-141** crew member. **Contact:** Alec McGuyver, 8418 Delhi Rd., North Charleston, SC 29406 (amcguyver@juno.com).

Seeking contact with anyone involved in 1944-45 **nasopharyngeal radium treatments** at the Army hospital in Bari, Italy. **Contact:** E.S. Fraser Jr., 6 Garrison Ln., Madbury, NH 03820-9367 (603-742-1281).

Seeking a **USAF pilot**, guided by a US Army artillery unit, who dropped napalm during the April 1, 1970, battle at fire support base Illingsworth (XT 037 792) in Tay Ninh province, South Vietnam. **Contact:** Ralph H. Jones, 4388 Green Arbor Ln., Cincinnati, OH 45249.

Seeking information on the Aug. 15-17, 1969, **B-57 Canberra Fighter-Bombers** reunion at the Sands Hotel in Las Vegas, in which the 8th TBS and the 13th TBS were in attendance. **Contact:** William F. Ricketts Jr., 11650 E. Calle Aurora, Tucson, AZ 85748-8319 (bill-ricketts-jr@juno.com).

Seeking contact with **Lt. Col. James Kasler**, a repatriated Vietnam War POW. **Contact:** Ann Bartlett, 1041 Blue Water Dr., Canyon Lake, TX 78133.

For a book, seeking information on the 1942 crash of two planes shot down near **Koblentz, Germany**, whose crews were captured by civilians and a policeman in Bad Ems and possibly taken to Stalag Limburg. **Contact:** Wilfried Dieterichs, Heinrich Heine Weg 27, D 30880 Laatzen, Germany.

Seeking **Thomas Flemma**, who was the assistant air attaché in Buenos Aires, Argentina, 1984-89. **Contact:** Antonio Zelaya, Argentinean Embassy, SHIS QL 02 Conj. 01 Casa 19, Brasilia DF, Brazil, CEP 70442-900 (011-55-61-365-2594) or James Sconyers, Unit 3500 USDAO, APO AA 34030.

Seeking contact with members of the **21st SPS**, Elmendorf AFB, AK, 1980s. Also seeking anyone with 43d and 18th TFS **patches** and information on **F-4Es** at Elmendorf. **Contact:** Rick Ellington, 3 Castlegate Trailer Park, Townville, SC 29689.

Seeking information about **Capt. Mahlon Allison Smith II**, a 1949 West Point graduate, killed in an air accident at Ethan Allen AFB, VT, Nov. 11, 1954. **Contact:** Kitty Carson, 401 Springdale Dr., Union, SC 29379.

Seeking **SSgts. George J. Mahin**, of Elewell, MI, and **Sylvester W. Schrieber**, of River Rouge, MI, who were members of the 587th BS, 395th BG, and who were flying with the 584th BS when their plane crashed April 21, 1944, over Pas de Calais, France. **Contact:** Jim Pascoe, 6501 Milam Way,

North Highlands, CA 95660-4030 (baubo@calweb.com).

Seeking anyone interested in research information on **WWII Europe**, 1939-45. **Contact:** Arthur J. Pullin, 2806 Newnan Ridge Ct., Herndon, VA 20171-2110.

Seeking USAF servicemen who participated in the RCAF's **Pinetree Line**, early 1950s to late 1980s. **Contact:** Ren L'Ecuyer, PO Box 8389, Victoria, BC, V8W 3R9 Canada (250-381-6462) (www.islandnet.com/~rlecuyer/pinetree/homepage.html).

Seeking **WWII memorabilia** for display in Guam museum. **Contact:** Sen. Gordon Mailloux, c/o Marianas Military Museum, PO Box 793, Agaña, GU 96932.

Seeking **military aircrew insignias** from USAF and its components, all branches of military aviation, foreign air units, and military contractors. **Contact:** Joseph C. Caffarelli, 147 Park St., Montclair, NJ 07042-3901.

Seeking **slides or photos** of any service or contractor test, research, and support aircraft operated during 1950-75. **Contact:** T. Panopolis, 30 D'Auvergne Pl., Candiac, Quebec, Canada J5R 5R2 (514-444-1107) (terry.panopolis@eng.canadair.ca).

Seeking information on **US Air Forces Southern Command/Caribbean**, 1940-46, which began as Panama Canal Air Force and became Sixth AF. **Contact:** Joseph S. Dana, 721 83d Ave. N., #202, St. Petersburg, FL 33702.

Seeking the name and information on the colonel who founded the **Instrument Flying School** in Bryan, TX, during WWII. **Contact:** Robert D. Wilcox, 809 Hillaire Rd., Lancaster, PA 17601 (717-898-8617).

Seeking information and anecdotes about and aircrew and photos of the **SB-17G** and **SB-29** in the Air Rescue Service. **Contact:** Tim Hosek, 8012 Beckner Ct., Alexandria, VA 22309-1004 (703-780-9361).

Seeking information on **Trygue E. Johnson**, Army Air Corps, who lived in Addison, IL, and who knew Stella Hampton. **Contact:** Stella Hampton, 17 Oliver Leese Ct., One Oak Rise, Moss Pit, Stafford, Staffordshire ST17 9HW, UK.

Seeking **Lt. James O. Lykins** of Brownwood, TX, who flew in the Berlin Airlift, 1948-49, with the 53d TCS, 61st TCG, and received an award Sept. 13, 1948, from Gen. Lucius Clay. **Contact:** Gary W. Kirsten, 8005 E. Via de Viva, Scottsdale, AZ 85258-3008 (602-998-7050) (fax: 602-468-1710) (gkirsten@mica-az.com).

For a book, seeking veterans of **WWI through the Gulf War** to complete a questionnaire about war experiences. **Contact:** Phillip Arnot, PO Box 181, Lagunitas, CA 94938 or Robert Collin, 147 Temelec Cir., Sonoma, CA 95476.

Seeking photos of **SSgt. William J. Delehanty and 2d Lt. Donald D. Robins**, crew members of Colin P. Kelly Jr., shot down over the Philippines, Dec. 10, 1941. **Contact:** Gene Eisenberg, 3500 Mystic Pt. Dr., #PH-6, Aventura, FL 33180 (305-933-2603) (fax: 305-933-1041).

Seeking information on **Lt. Peter Maas**, pilot class 49-C, whose last known assignment was the 6th TCS, Tachikawa, Japan, 1949-50. **Contact:** Jim Rogers, 1520 Watson Blvd., Warner Robins, GA 31093 (912-923-3791 or 912-923-1564).

Seeking contact with **B-29 and B-50** personnel deployed to RAF bases during 1946-53. **Contact:** R.M. Robinson, 37 Home Farm Rd., Houghton, Huntingdon, Cambridgeshire, PE17 2BN, UK.

Seeking contact with or information on **Joseph Walters**, who was the rear gunner of a B-17 that crashed Aug. 17, 1943, in Belgium. It was piloted by Capt. Lorin Bisbrow and copilot Allen Chapin. **Contact:** Donald A. Hemphill, PO Box 663, Brookhaven, MS 39603-0663.

Seeking **patches** and pins of all kinds and eras particularly older inactive units. Especially interested in special operations: air commando, air resupply and command service, special air missions, air rescue, and Air Force crash boat units. **Contact:** Stephen M. Vinica, 1456D Chanute Pl., Bolling AFB, DC 20336-5217.

Seeking information on **2d Lt. W.R. Davis**, 510th FS, 405th FG, Ninth AF, who survived the crash of his P-47 on the Channel Islands, UK, during WWII. **Contact:** Maynard Y. Binge, 1535 Command Dr., Ste. A-122, Andrews AFB, MD 20762 (301-736-7563) (bingem@andrews.af.mil).

Seeking information, photos, and memorabilia on Ninth AF B-26 **Sky Queen**, of the 559th BS, 1943-45. **Contact:** David Weed, 856 Hazel Trail, Crownsville, MD 21032 (410-923-3468).

Seeking information on **John Rademacher**, who flew a P-38, and **Robert Bucholz**, who flew a P-51. **Contact:** Frank G. Mitola, 3005 Horse Shoe Ct., Orlando, FL 32822.

Seeking contact with **Sgt. Warren Dean Parman**, who served at COMIBERLANT in Lisbon, Portugal, Klamath Falls, OR, 1974-78, Vietnam, and Spain. **Contact:** John Salter, C/ Caminillo 14b, Torrox, 29770 Malaga, Spain (torroxman@oninet.es) (34-95-2539357).

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Air Force One backup. It left presidential service entirely in 1990 but still occasionally transported vice presidents and cabinet members. USAF retired 26000 in March. It now resides at the US Air Force Museum in Dayton, Ohio.

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<i>Total number of funds rated in the taxable bond funds category:</i>	1425	1425	873	336
USAA Growth & Income	★★★★	4★	4★	
USAA Income Stock	★★★★	4★	3★	4★
<i>Total number of funds rated in the domestic equity funds category:</i>	2495	2495	1430	705
USAA International	★★★★	4★	4★	
USAA World Growth	★★★★	4★	4★	
<i>Total number of funds rated in the international equity funds category:</i>	764	764	330	102

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