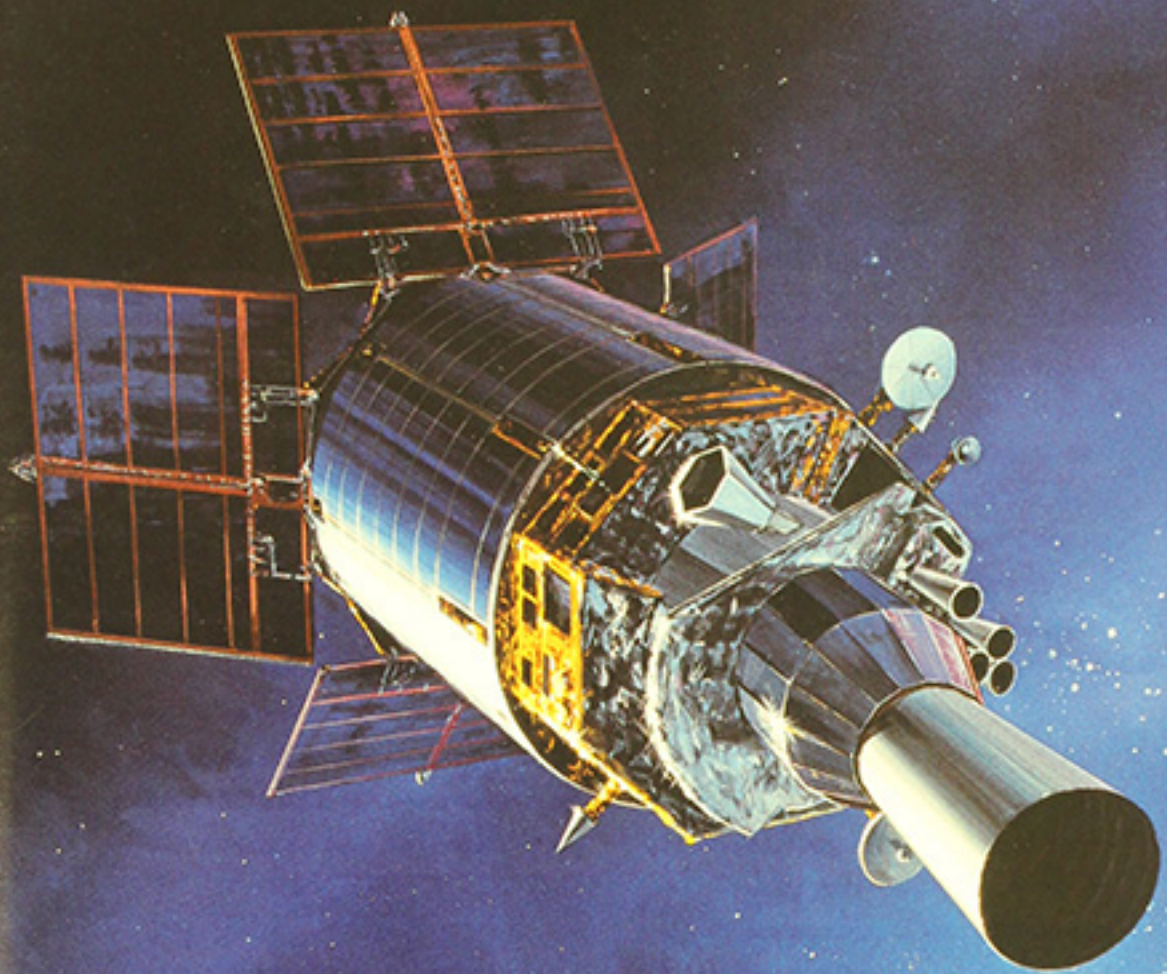
August 1999/$3

AIR FORCE MAGAZINE

PUBLISHED BY THE AIR FORCE ASSOCIATION



USAF Space Almanac

Honor Bound: The POW Story

Echoes From Allied Force

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August 1999, Vol. 82, No. 8

AIR FORCE MAGAZINE

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About the cover: Defense Support Program satellites have been part of North America's early warning system since the early 1970s. See: "Space Almanac," p. 26. Painting by Phil Weisgerber.

AIR FORCE Magazine (ISSN 0730-6784) August 1999 (Vol. 82, No. 8) is published monthly by the Air Force Association, 1501 Lee Highway, Arlington, VA 22209-1198. Phone (703) 247-5800. Second-class postage paid at Arlington, Va., and additional mailing offices. **Membership Rate:** $30 per year; $75 for three-year membership. **Life Membership (nonrefundable):** $450 single payment, $475 extended payments. **Subscription Rate:** $30 per year; $25 per year additional for postage to foreign addresses (except Canada and Mexico, which are $9 per year additional). Regular issues $3 each. Special issues (USAF Almanac issue and Anniversary issue) $5 each. **Change of address** requires four weeks' notice. Please include mailing label. **POSTMASTER:** Send changes of address to Air Force Association, 1501 Lee Highway, Arlington, VA 22209-1198. Publisher assumes no responsibility for unsolicited material.

Editorial

By John T. Correll, Editor in Chief

Visions and Countervisions in Space

A change to the Unified Command Plan will transfer the Computer Network Defense (CND) mission to US Space Command on Oct. 1. One year after that, Space Command will also pick up the Computer Network Attack (CNA) mission.

The implementing step is relatively small. The Joint Task Force for CND, created last December to coordinate the protection of the defense information infrastructure, will move from the Defense Information Systems Agency to Space Command.

No comparable organization exists for the highly classified Computer Network Attack mission. Even those with the appropriate clearances are uncertain of what CNA portends.

The significance of the changes may become clearer as a series of developments plays out over the next year, defining more precisely the military role in space and the relationship between space and Information Operations.

In May, the defense authorization bills from both the House and Senate Armed Services Committees asked for a fundamental review of how the Department of Defense is conducting the space mission.

Both raised questions about creating a new military service for space or appointing an assistant secretary of defense for space. The House bill called for a report by the Secretary of Defense. The Senate prescribed a study by an independent commission.

The Senate bill was critical of the Department of Defense for treating space operations as a subset of information superiority rather than "the strategic high ground from which to project power." It urged "the full range of power applications, from missile defense and space control to force application." Congress may be about to weigh in heavily on organizational and mission issues.

Meanwhile the Air Force, which supplies about 90 percent of the people, systems, and money for the military space program, is coming to grips with several issues of its own.

Its forthcoming white paper on aerospace integration is expected to emphasize that air and space are inextricably linked and complementary, not competitive. This will aggravate those who want space power to strike out on its own, separate from airpower.

The Air Force is also thinking about moving the Air Intelligence Agency—now a field unit of Headquarters USAF—to Air Force Space Command. This would put AIA's formidable capabilities for Information Operations into a major command and take advantage of the similarities between the space and intelligence missions.

Information is a weapon, and Space Command is a combat command.

The decision will depend on, among other things, where the joint service community decides to go with CND/CNA and with Information Operations. More about that may be revealed when the Office of the Secretary of Defense produces its strategic plan on Information Operations this fall.

It will be a while before we can see these developments in full context, but several conclusions are possible.

- The Congressional activity is well-meant but is not headed in a productive direction. The arguments about missile defense and force application from space are well-founded. However, they are matters of national policy, needing to be settled between the Administration and Congress rather than by organizational and management changes to the armed forces.

If emphasis on space is insufficient, that is a budgetary issue. The Air Force continues to provide most of the space support for all of the services without any compensating increase to its budget. Congress can and should help with this.

- This change to the Unified Command Plan solves a problem that popped up in Joint Exercise Eligible Receiver in 1997, an element of which was an attack on the defense computer network. In the simulation, the Joint Staff took charge by default—which it could not legally do in actual conflict—because such an attack was not covered by the missions of any of the unified combat commands, in which the nation's powers to fight are vested by law.
- The CND/CNA mission is in its infancy. There is no doubt about the seriousness of the problem. Defense officials say the military information networks are under constant assault. The emphasis so far has been on detection and warning of attack, firewalls, and various emergency response measures. Most of the work has concentrated on the force in home garrison. Protecting the networks of deployed forces is more difficult. Defense of the nation's non-military infrastructures is not an assigned mission and still lies far beyond the horizon.
- The assignment of the CND/CNA mission to Space Command confirms that information is a weapon and that Space Command is a combat command. That does not diminish or conflict with the responsibility to provide intelligence, surveillance, reconnaissance, and other support for the theater commands. In addition to its long-familiar role of enhancing force, Space Command may also apply force.

It will be some years yet before the capability is mature to employ directed laser energy from space, assuming that national policy permits it. At the same time, space will become increasingly important to the projection of power by the use of information, in support of conventional military operations as well as in the emerging domain of information warfare, in which information itself is a target and a weapon.

The Information Operations mission is moving inexorably toward space, and the linkage between space and information superiority is growing steadily closer. For the near-term future at least, the military space program will be defined, in one way or another, by information. ■


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Letters

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On Bombers

Your article, "The Bomber Roadmap" *[June, p. 30]*, was excellent and, given the stellar performance of the bomber fleet in the Balkans, timely.

Since I continue to get bombarded myself on the subject, I want to clarify your comment that I said we should invest about $100 million per year to continue to modernize each of the three bombers and add a budget line for "B-X" technologies.

What I thought I said was that we should invest about $1 billion annually to continue to improve the three existing bombers in the areas of survivability, lethality, and lower operating costs; about $100 million a year on B-X technologies; and start a new bomber sooner than the schedule in the roadmap.

The bombers' performance in the Balkans and their unique and ultra-efficient contribution to global power projection only serve to confirm and reinforce my views.

Gen. John Michael Loh,
USAF (Ret.)
Williamsburg, Va.

Aircraft Identification 101

[On] p. 42 [top photo]—I believe the caption on this picture to be in error. *[See "Airpower in Allied Force," June, p. 38.]* The receiver is a KC-10. Could it be that the tanker is a KC-135 and not the reverse as the caption states? Thanks for a great magazine with remarkably few errors.

Lt. Col. Owen S. Garner,
USAF (Ret.)
Southport, N.C.

■ *It clearly is, as you and several others have pointed out. The sad part is that we corrected it once, then changed it back, during the "quality control" cycle, to the incorrect identification to match the original photo caption provided by the Air Force.—THE EDITORS*

First Class

Excellent article. *[See "First Class," June, p. 56.]* I must take exception to the statement "their upperclassmen were stand-ins—USAF officers who had graduated from other academies." Those "stand-ins" were 65 lieutenants screened from 1,350 interviews throughout the Air Force. Each lieutenant had just graduated from flight school, was single (Jerry O'Malley was the lone exception), was highly motivated, and was called an Air Training Officer or ATO for short. Of the original 65 lieutenants, some 35 were from other service academies and the remainder were ROTC and aviation cadet graduates.

Col. Charles D. Taylor,
USAF (Ret.)
Former ATO, USAFA Class of 1957
Williamsburg, Va.

Everyone really enjoyed the article about the Air Force Academy's first graduating class. It was informative and interesting. The author wrote extensively about the USAFA honor code ("I will not lie, cheat, or steal, nor tolerate among us anyone who does.").

Anyone who actually believes that the graduating class of 1,000 cadets or so each year from the USAF Academy perfectly follows such an outdated code in word or deed is a fool. Not one class from the academy graduated "perfect angels." Let's do away with the idealistic code and thus end the systematic use of the USAFA honor code by the Academy commandant of cadets to eradicate and dismiss any and all undesirable cadets. That's actually what the code is used for anyway. Every graduate knows it. The honor code is merely a way to get rid of undesirable cadets—plain and simple! The "perfect honor code class" never existed in the past and won't exist in the future. Lying, cheating, stealing, and tolerating goes on at the USAFA every day of the year.

David Galvin
USAFA Class of 1974
Pittsford, N.Y.

I enjoyed reading your article about the Academy's first graduating class and their firsts. You said four had made four-star. I only know of three—[Hansford T.] Johnson, [Robert C.] Oaks, and [Michael P.C.] Carns. Who was the fourth?

You also mentioned some women from their first class (1980) [with female cadets]. I don't know how you decided which women to mention, but you left out many others that deserve mention, such as astronaut Lt. Col. Susan Helms.

Larry Chasteen
Richardson, Texas

■ *You are right. There were only the three you indicated. It was author choice on the list of notable females, but we should certainly have mentioned astronaut Helms. There are probably other accomplished graduates from the 1980 class, as well.—THE EDITORS*

Do you have a comment about a current article in the magazine? Write to "Letters," *Air Force* Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. (E-mail: letters@afa.org.) Letters should be concise and timely. We cannot acknowledge receipt of letters. We reserve the right to condense letters. Letters without name and city/base and state are not acceptable. Photographs cannot be used or returned.—THE EDITORS

Truly Lost

After reading in your June edition that "the government says the program is working," I know we are all truly lost. *[See "Tricare Goes Nationwide," p. 66.]* When I was commissioned back in 1966, I was assured of many things by my new Air Force employer, especially in the realm of health care after retirement. Since that distant day, broken contracts, false promises, misleading statements, and outright falsehoods have become the hallmark of a system which is corrupt with deceitful lies.

Maybe our various military associations should besiege Congress to place all federal government health programs under the same system we have and include the executive, legislative, and judicial branches, too. Call it NWAFTP: Now We All Feel The Pain!

The sad truth is that other branches

of our government have taken care of their own, while ours hasn't. Ask the President about his health care program in retirement. Or those in Congress. Even those in the State Department. I particularly pity our disabled veterans whose overall treatment has been pathetic—especially for a society in which one goes to jail for mistreating an animal. But you can ignore a veteran's suffering. Ask any of the 200,000 Gulf War veterans now about Gulf War Syndrome.

A surefire sign that Tricare is moribund is the active force's problems with it. Most regrettably now is that declining appropriations, because of the huge operational expenditures against Serbia, will soon shortchange DoD's human programs, as usual! With an exhausted force without munitions, spare parts, or funds, each of us must acknowledge that our animals and pets will get more humane treatment in the future than we will. Mine already does!

Col. Robert Miller,
USAF (Ret.)
Winter Springs, Fla.

I have found out that thousands and thousands of military retirees have federal employees health insurance. How did they get this wonderful benefit? They earned it the old-fashioned way. They worked for these benefits. When a person retires from the military, civil service gives them special consideration for jobs. They can work in the post office, in military positions, and in shipyards. There are plenty of jobs. All the retiree has to do is apply.

It only takes a few years to be vested in the civil service program. Plus you get your retired pay and civil service pay at the same time. What a good deal. Plus our military experience and work habits make civil service jobs easy. I am told that it is the retired officers who want these [health] benefits without earning them. If this is true, shame on the officers, because they get enough retirement pay to purchase benefits.

If it is becoming the thing to want something for nothing, then it won't be long until military retirees will want welfare and food stamps.

William H. Washburn
Ailverdale, Wash.

Before Tigers

As an admirer of Jimmy Doolittle I already knew that he was a skilled aerobatic pilot and could do just about anything else with an airplane, so I was delighted to read that he was also capable of acrobatics—and inside of a Curtiss Hawk, no less! *[See "Before the Flying Tigers," June, p. 72.]* [Check] p. 75 caption to picture of Doolittle.

George Fulford
Mill Valley, Calif.

■ *That's definitely a gotcha. And yet, maybe he was.—THE EDITORS*

I very much enjoyed Robert E. van Patten's story about the impact of [American aviators] on the very early history of aviation in China. I would like to add a name to that list of pioneers, my father, Floyd N. Shumaker. Dad resigned from the Air Corps in 1929 for a job with Aviation Corp. and went to China to explore the idea of starting an airline. Not long after our arrival, the stock market crash terminated that project and left dad unemployed. Those 20 "light–bombing–observation" airplanes (the first with radial engines) were not just ordered from Douglas, they were "sold" aggressively by dad, who guaranteed their performance.

At age 13, I watched after the first three arrived at Hunjao Aerodrome in crates, as dad assembled them with the help of two Chinese mechanics and saw each one take off as dad proved they could fly. Incidentally, Bob Short, who is mentioned as our first casualty, and dad became partners. They purchased a Fokker Tri-Motor in late 1931 with the intent of being first to fly the Pacific—there was a $25,000 prize at stake. The airplane was held up by the Japanese, so dad came home by boat and Bob Short went back to Shanghai.

Dad was on his way back to China in WWII as [Col. Harry H.] Halverson's intelligence officer, with the [Halverson Project] plan to bomb Tokyo at the start of the war. You may recall Halpro was held up in the Middle East and never got to China.

Lt. Col. Tom Shumaker,
USAFR (Ret.)
San Diego

Reflection of Sorry State

When I first read Lt. Col. Bill Goodwin's letter *["Timely Year Group," June, p. 12]*, my first reaction was to think the author was extremely self-centered. His complaint was having to retire as a major vs. retiring at his current grade because he was not going to have enough time in grade to retire at the higher rank. He blamed his situation on the delay of promotion boards in recent years.

As I said, my first reaction was to think Goodwin self-centered, but after some thought, I believe his arguments reflect the sorry state of the military these days. I can't criticize Goodwin

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PUBLISHED BY THE AIR FORCE ASSOCIATION

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for looking out for himself, since the military benefits have been eroding so dramatically. For the newer folks coming into the military, the retirement is approaching the measly level. The health care benefits promised to us in the past are evaporating faster than rubbing alcohol on a hot day. Combine this with the questionable worldwide deployments and you have very little reason for a young person to make a career of the military.

Goodwin's complaint, unfortunately, is ultimately a product of poor management at the national level. It's time to reverse this erosion of benefits if we ever expect to regain a dedicated, mission-oriented force.

Maj. Lawrence H. Smith, USAF (Ret.)
Vacaville, Calif.

Not Hot Air

By now, you have probably received a few letters about the caption error on p.65, June issue, "Flashback." That is not a hot air balloon; more likely [it is] a hydrogen filled balloon. There is no propane burner assembly visible, but the bottom of the bag is tied off.

Elias J. Vujovich
Southington, Ohio

■ *Only two spotted the goof. We'll correct our archive photo.—THE EDITORS*

Northrop on Symington

In the June issue, Col. [Charles] Stearns supposedly rebutted Richard D. Russell's letter regarding Stuart Symington's role in the destruction of the Northrop flying wings. *[See "Symington Letter Rebutted," p. 12.]* Stearns claims friendship with Jack Northrop and Symington. If that is so, he apparently was not in communication with Northrop, as Jack Northrop himself detailed the story of the destruction of the flying wings, the B-35 and B-49.

Symington summoned Northrop to Washington and told him to merge with Convair, which was owned by General Dynamics, which, in turn, was controlled by Floyd Odlum, [a] good friend of Symington. Northrop was accompanied by the chairman of Northrop, Richard W. Millar, and also at the meeting was Gen. Joseph T. McNarney, commander of Air Materiel Command. Northrop refused to give up his company and, as he had threatened to do, Symington ordered all the completed flying wings destroyed, refusing even to keep one for development purposes.

The flying wing had flown from California to Washington at an average speed of 519 mph, over twice the cruising speed of the first B-36s, and the [flying] wing had won a contest over the B-36. Northrop was awarded a contract for 35 bombers with [the] possibility of 200 to 300 more. At the time, Convair had no business and needed the B-36 contract to survive.

This entire sorry, sordid affair was detailed in a lengthy article in the *Los Angeles Times* on Dec. 8, 1980. It was also subject of an hour-long program on public TV station KCET, which was hosted by the eminent journalist Clete Roberts who had researched the matter.

Russell is correct. Symington's vicious act of vandalism did indeed set back development of the flying wing technology by 20 years or more.

Robert W. Fuehr
Alhambra, Calif.

Desert One—the Human Factor

After reading all the books and magazine articles and letters to the editor *["Desert One—More to Learn," June, p. 13; "Desert One," April, p. 9]* concerning Desert One/Operation Eagle Claw, what stands out in every effort by armchair generals is the fact

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that no one talks about the human factor side of the mission, that no matter how much they say the mission was a failure, in whatever terms, it was not.

Every member of the Air Force team was a handpicked volunteer. In a community that at that time was small enough for members to have known and worked with each other for over 20 years, the air commandos were the first consideration as fixed-wing assets. They were also the first to ask, at the very first mission planning assembly, where the rotorheads were. They expected their cohorts from Eglin AFB, Fla., air rescue to be in attendance, and when told it would be a multiservice operation not including [air rescue], they were amazed. All the same questions were asked: why not pararescue, why not Air Force helos, why not recall the old heads, etc.

Despite all the rhetoric, what remains most important to me is the general consensus by those who weren't there that this mission was a failure. Even in [Philip D.] Chinnery's fine history of the air commandos, *Any Time, Any Place,* he lists our operation under "failure." This mission was not a failure. The fact that the mission objective was not achieved doesn't mean it was not a success.

From the time the first phone call was made to begin a rescue operation to the actual return to Oman after the mission [was] canceled, security was maintained. New methods of secure communication, mission planning, weapons and tactics, intelligence gathering, and equipment were developed and obtained. Many firsts, some of which will never be revealed, were made by those Air Force volunteers. Those firsts are responsible for many victories and lives being saved in today's Air Force operations.

If the mission was a failure as some say, then how does one account for the fact that the Air Force assets were on the ground for so long that every USAF transport had time to land in-country? The rescue team prepped, planned, trained, executed, and recovered generally intact months after only one person had an idea that Americans could be rescued.

The only failure in my eyes today comes from those who refuse to provide proper recognition to those members who are fallen. Appropriate decorations were withheld from the fallen due to this being classified "noncombat."

What matters most is the fact that it was the people who did not fail. Those who participated, whether in-country or in whatever support phase, served with honor, pride, and humanity. That is what counts the most in determining if a mission was successful or a failure. They didn't go for glory or medals or recognition. They went because fellow Americans were in need. None of them came home with heads [hanging] in shame. They may have cried. They may have wondered. None was considered a failure.

TSgt. Jim McClain Jr.,
USAF (Ret.)
Loadmaster Republic O4
Desert One, Iran, April 24, 1980
Pensacola, Fla.

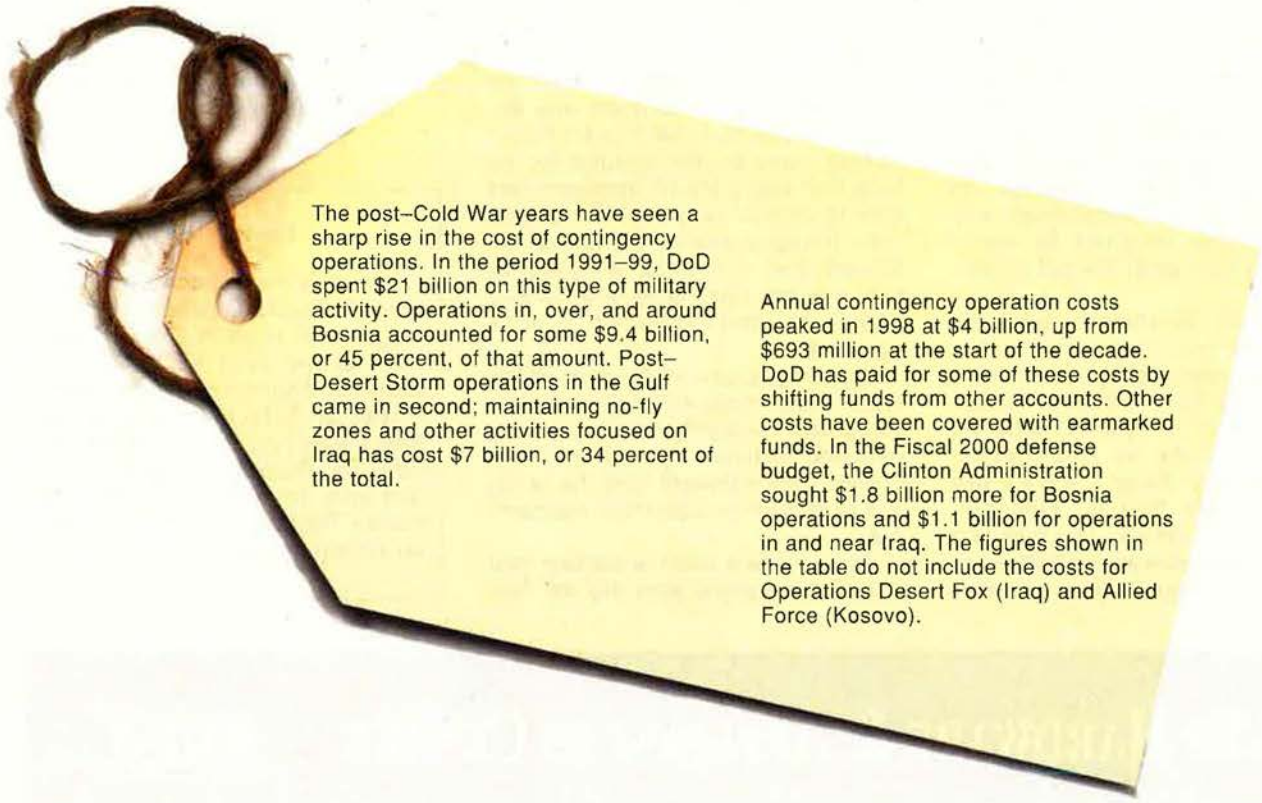
Correction

In June's "Aerospace World" column *["JASSM Crashes," p. 20],* the aircraft used in the first test flight of the Joint Air to Surface Standoff Missile was misidentified. It was an F-16 belonging to the 39th Flight Test Squadron at Eglin AFB, Fla. Thanks to Greg Ritz, F-16 Systems Integration, Lockheed Martin Tactical Aircraft Systems, for noting the mistake.

The Chart Page

By Tamar A. Mehuron, Associate Editor

The Price Tag for Contingency Operations



The post–Cold War years have seen a sharp rise in the cost of contingency operations. In the period 1991–99, DoD spent $21 billion on this type of military activity. Operations in, over, and around Bosnia accounted for some $9.4 billion, or 45 percent, of that amount. Post–Desert Storm operations in the Gulf came in second; maintaining no-fly zones and other activities focused on Iraq has cost $7 billion, or 34 percent of the total.

Annual contingency operation costs peaked in 1998 at $4 billion, up from $693 million at the start of the decade. DoD has paid for some of these costs by shifting funds from other accounts. Other costs have been covered with earmarked funds. In the Fiscal 2000 defense budget, the Clinton Administration sought $1.8 billion more for Bosnia operations and $1.1 billion for operations in and near Iraq. The figures shown in the table do not include the costs for Operations Desert Fox (Iraq) and Allied Force (Kosovo).

Running Tab, 1991–99 Contingency Costs

(In millions of current dollars)

Year	Bosnia*	Iraq	Haiti	Somalia	Other	Total
1991	$0	$346.5	$0	$0	$346.5	$693.0
1992	5.8	106.4	9.3	1.6	729.1	852.2
1993	138.8	838.5	2.8	943.1	241.8	2,165.0
1994	292.0	424.8	372.1	528.0	290.9	1,907.8
1995	347.4	864.3	569.0	49.4	392.9	2,223.0
1996	2,520.0	665.2	86.9	0	24.9	3,297.0
1997	2,282.5	793.1	0	0	0	3,075.6
1998	1,983.0	2,040.4	0	0	0	4,023.4
1999**	1,858.6	1,000.0	0	0	0	2,858.6
Total	**$9,428.1**	**$7,079.2**	**$1,040.1**	**$1,522.1**	**$2,026.1**	**$21,095.6**

*Also includes funding for operations in other parts of the former Yugoslavia.
**Does not include funding for Operation Desert Fox.
Note: Table does not include funding for Operation Allied Force (Kosovo).

Source: Center for Strategic and Budgetary Assessments, based on DoD and CRS data.

Aerospace World

By Peter Grier

F-22 Flight Test Avionics Delivered

The Air Force on June 4 announced that Boeing has delivered the first block of advanced flight test avionics for the F-22 to the airplane's primary contractor, Lockheed Martin.

The package, Block 1.1, represents 80 percent of the final flight test avionics hardware for the Raptor. It contains more than 900,000 lines of code—about half of all the software that will be delivered to the F-22 during engineering and manufacturing development.

Block 1.1 will support "power on" requirements for aircraft 4004, the fourth F-22 model off the assembly line. "Power on" means that the aircraft will be turned on with its integrated avionics and subsystems in place. A follow-on package, Block 1.2, will support 4004 taxi and first-flight testing.

"Delivery of Block 1.1 represents a critical step that demonstrates our ability to deliver the heart of the F-22's avionics on schedule and ahead of need dates," said Gerry Freisthler, deputy director of the F-22 program office. "Getting 4004 in the air will go a long way to proving system maturity."

Test Squadron Redesigns F-22 Launcher

The 412th Test Squadron, Edwards AFB, Calif., in concert with other members of the F-22 Combined Test Force, has completely redesigned the Raptor's weapons launchers. The new launchers are easier to service and will save the Air Force millions over the life of the program.

"The original launcher failed to meet the requested weight specifications and was not maintenance friendly," said Capt. Don Supon, of the F-22 CTF.

The launchers are located in the weapons bay beneath the F-22. The original model was a horizontal-type launcher that would swing down and then launch the missile. The new version is a vertical-type launcher, meaning missiles are pushed straight down out of the weapons bay.

The new launchers weigh 300 pounds less. "With the weight of the old launcher, it had to be installed using support equipment," said Supon. "The new launcher is light enough that two people can lift it while a third person installs the attaching bolts."

The improved equipment also provides for safer separation of missiles out of the main weapons bays.

Logistics testing of the type that led to this change will continue in the F-22 test program for the next three years.

"Without logistics testing, we would be fielding aircraft which might have simple-to-correct deficiencies," said MSgt. Richard Fournier, 412th Logistics Group test manager. "If you find deficiencies early, then you can fix them during testing and then incorporate the changes into the production model prior to going into full production."

USAF photo by MSgt. Raymond T. Conway

A combined crew of active and Reserve C-141 loadmasters from McChord AFB, Wash., drop vital medical supplies at the South Pole in mid-July to aid an American woman, working for the National Science Foundation research station there. The woman was diagnosed with cancer and cannot get out until the fall.

Boeing's JSF Coming Together

On June 13, Boeing announced that it had successfully attached the single-piece wing for the Joint Strike Fighter X-32 concept demonstrator to its fuselage. A small team of mechanics positioned and mated all the attach points between the wing and fuselage within six hours, company officials said.

"The X-32 is meeting its weight targets, meeting its schedule targets, and meeting its cost targets," said Frank Statkus, Boeing vice president and JSF general manager. "Overall fabrication and assembly costs, for example, remain at 30 to 40 percent below projections."

The wing is a single-piece, over-the-fuselage structure. It has one-piece upper and lower composite skins and reduces weight by eliminating heavy wing attachments at the sides of the fuselage. During assembly, laser tracker devices on the factory floor use 3-D design data to move parts into place for nearly tool-less work.

"Innovative techniques are helping Boeing reduce tooling costs by 60 to 70 percent over requirements for other developmental products we have built, such as the YF-22," said Tim Opitz, assembly team leader and program manufacturing manager.

Meanwhile, Boeing has expanded its JSF team, adding 25 subcontractors, including eight firms in Canada,

About the "Powell Doctrine" ...

Politicians, news analysts, and others have gone to some length in explaining what Operation Allied Force in the Balkans proved about the so-called "Powell Doctrine."

Rowan Scarborough of the *Washington Times* said, "The 'Powell Doctrine' became the Pentagon's biggest war casualty. Named after Gen. Colin Powell, the former Joint Chiefs Chairman, the 1980s rule said American troops would never again enter battle without decisive force and clear objectives. In other words, no more Vietnams."

Mortimer B. Zuckerman of *US News & World Report* wrote that Kosovo was a vindication of "the doctrine of limited power for limited ends. The Powell Doctrine ... was right in the Gulf [War] but wrong here: Incremental escalation of precision guided munitions worked when used long enough."

In fact, the Powell Doctrine was actually the Weinberger Doctrine, and the experience in Kosovo may not have done it as much damage as some of the recent interpretations suggest.

Secretary of Defense Caspar Weinberger made major headlines when he presented the concept in a speech at the National Press Club Nov. 28, 1984. The *Washington Post* dubbed it the Weinberger Doctrine. He spoke against the backdrop of not only Vietnam but also the deaths of 241 American servicemen, most of them Marines, killed when a truck bomb blew up their barracks in Beirut in 1983. The Marines, not configured or equipped for combat, were in Lebanon on a fuzzily defined peacekeeping mission as what the State Department called an "interpositional force."

Weinberger said that six tests should be met before US forces are committed to combat abroad. Is a vital US interest at stake? Will we commit sufficient resources to win? Are the objectives clearly defined? Will we sustain the commitment? Is there reasonable expectation that the public and Congress will support the operation? Have we exhausted our other options?

The Gulf War of 1991 met these criteria—in contrast to Vietnam, the Marine disaster in Lebanon, and the use of lethal military force in a series of loosely defined and tentatively prosecuted military actions to come during the Clinton Administration.

In 1984 Powell was Weinberger's military assistant. In his biography, *My American Journey* (Random House, 1995), Powell says he first saw the concept when Weinberger asked him to take a look at a draft document listing the six tests. "Weinberger had applied his formidable lawyerly intellect to an analysis of when and when not to commit United States military forces abroad," Powell said. Powell became further identified with the Weinberger Doctrine because he was Chairman of the Joint Chiefs of Staff during the Gulf War.

Its transformation into the Powell Doctrine, however, happened in the run-up to the 1996 Presidential election. Powell's right wing opponents, seeking to block his nomination as a Republican candidate, misconstrued the Weinberger Doctrine as a weakness and timidity, relabeled it, and then used it as an instrument in a "Stop Powell Movement."

Writing in the *New York Times* April 12, 1999, Weinberger said the Kosovo operation, then in its third week, met the guidelines of the doctrine "to some extent," in that "the principal feature of my thinking was that the United States should enter a conflict only if it was vital to our national interest. That is the case here. The Balkans have been at the heart of two world wars in this century, so stability of the region is important." He added that: "As a NATO member, the United States cannot ignore an assault in Europe against all our values by a thug who has directed brutal atrocities in Kosovo and Bosnia." However, he said, the objective in Kosovo had to be victory and that the United States and NATO had to be willing to apply sufficient force to win.

Operation Allied Force began in the classic mold of previous "Limited Force" actions of the 1990s. It opened in March with attacks on a handful of targets and obvious indecision about objectives. The incrementalism and gradualism of the operation were a throwback to the strategies of Vietnam.

"By the time of NATO's summit in Washington—almost a month into the air campaign—it became apparent to NATO that a constrained, phased approach was not effective," Gen. Michael E. Ryan, Air Force Chief of Staff, said in a newspaper column June 4. "At the insistence of US leaders, NATO widened the air campaign to produce the strategic effects in Serbia proper." The operation finally began moving with determination. The Serbian agreement to NATO's terms then followed in early June.

—John T. Correll

Denmark, Netherlands, and UK, to its original complement of six. Those added include Aerosystems of Yeovil, UK, which will provide logistics support; Fokker, of the Netherlands (airframe structural details and wire bundles); Hexcel, Kirkland, Wash. (composite raw materials); and Terma, Grenaa, Denmark (airframe structural parts).

ABL Laser Module Powers Up

On June 10, the Airborne Laser program's flight-weight laser module reached 107 percent of peak power in a test. The power level reached is 30 to 40 percent greater than that required to shoot down a missile target, officials said.

The test was held at TRW's San Juan Capistrano, Calif., facilities. TRW is developing the ABL's chemical oxygen–iodine laser and subsystems, while Lockheed Martin is developing the beam control system and Boeing is working on the battle management system and outfitting a 747 as an ABL platform.

"You never want to be overconfident, but we think the technology is proving itself," Maj. Gen. Bruce A. Carlson, Air Force director of operational requirements, said at a Washington breakfast June 11.

ABL is unlikely to run into the test problems that have plagued the Theater High Altitude Area Defense program, said Carlson. The program plans extensive mitigation tests before an actual flight test.

"We will have fired the laser at full power with full tracking system at least 34 times before we shoot down a [target]," said Carlson. He added that the ABL would boost the capability of other missile defense systems, including THAAD.

Defense Bills Advance

An amendment attached to the Senate defense appropriations bill for FY 2000 just before final floor action would force the Air Force to buy four new F-15E fighters at the expense of spare parts budgets and other O&M accounts.

The provision was sponsored by Missouri and Illinois lawmakers whose constituents would be affected by a shutdown of Boeing's St. Louis F-15 production line. It was inserted at the 11th hour during floor debate on the legislation June 8 and passed by voice vote.

About $70 million of the $220 million needed to purchase the aircraft would come from the Air Force's aircraft spares and repair parts budget, reducing this crucial area of funding by about 16 percent. Another $50 million would come from the Navy spares and repair budget.

Guard and Reserve spares and national missile defense budgets would yield the remainder of the funds.

Other amendments attached to the Senate appropriations measure include one that would fence off $63 million in Air Force research and development funds for C-5 modernization and another that would provide $4 million for supersonic aircraft noise mitigation R&D.

Senate floor action on the FY 2000 defense authorization bill also produced some last minute changes, though none had such profound funding implications as the appropriations changes.

One amendment calls for the Secretary of Defense to ensure that budget plans contain enough money for advanced Ballistic Missile Defense technology development, as well as major BMD acquisition programs. Another directs the Air Force to study its options for meeting mission requirements once its current inventory of Conventional Air Launched Cruise Missiles is exhausted.

The CALCM study, due Jan. 15, 2000, is supposed to weigh the virtues of restarting that CALCM production line, buying an all-new type of weapon, or using current munitions with upgrades.

Congress and Tricare

Tricare reform would get a boost under an amendment attached to the House Fiscal 2000 defense authorization act during final floor action June 10.

The plan—drafted by Rep. Mac Thornberry (R–Texas)—requires the Secretary of Defense to report on the best way to make sure Tricare benefits are portable from region to region. It would also permit third-party payers to reimburse military treatment facilities at Medicare rates or better for treatment provided to their clients.

The amendment also aims to cut red tape by allowing for electronic filing and by requiring that best business practices be implemented on awarded contracts.

Global Hawk Back in Skies

On June 3, Air Force officials announced that Global Hawk Unmanned Aerial Vehicle No. 1 resumed flight testing in mid-May, following reinstatement of its flight certification by a safety review board. The aircraft had been grounded since the March 29 crash of Global Hawk No. 2.

The Air Force investigation into the cause of the March crash is continuing.

"It's good to get back in the air again, after having not flown in a month and a half," said Lt. Col. Pat Bolibrzuch, Global Hawk program manager at Aeronautical Systems Center, Wright–Patterson AFB, Ohio. "This was a short sortie [7.8 hours] in which we wanted to check out the basic aircraft subsystems before the integration of synthetic aperture radar into the aircraft later this month."

The next year or so promises to be a busy one for the remaining UAV airframe. It is supposed to participate in 13 joint exercises through June of 2000 to assess its potential use for US military forces.

A developmental flight vehicle under the Advanced Concept Technology Demonstration Program, Global Hawk is intended to provide commanders high-altitude, long-endurance reconnaissance imagery in near real time.

USAF photo by SrA. Patty Zimmerman

The 820th RED HORSE Squadron, a construction and engineering unit from Nellis AFB, Nev., quickly creates a new taxiway at Rinas Airport in Tirana, Albania. Once a 15-flights-per-week facility, it now hosts 300 weekly to support the international humanitarian mission aiding ethnic–Albanian refugees from Yugoslavia.

THAAD Finally Hits Target

On June 10, the Theater High Altitude Area Defense missile did something it had never done before—it successfully intercepted a target missile.

This achievement came on the heels of six successive THAAD test failures. The last, in March, cost Lockheed Martin $15 million in penalty fees. The company was on notice to make two successful target intercepts by mid-July or face another $20 million in failure payments. Failure to make three successful hits by mid-October leads to additional penalties, for a total of up to $75 million by the end of 1999.

The successful test came at 5:19 a.m. over the central portion of White Sands Missile Range, N.M. The Hera target simulated an incoming Scud ballistic missile. It was destroyed on impact.

Proponents said the successful test demonstrated that the hit-to-kill concept underlying THAAD is the correct way to approach defense against ballistic missiles. But the system still has doubters within the Pentagon. Hans Mark, Defense Department director of defense research and engineering, recently sent new Ballistic Missile Defense Organization head Lt. Gen. Ronald T. Kadish a letter warning that THAAD may never work as well as its designers hope and that perhaps the requirements for the system should be eased.

Work Starts on Air Force Osprey

On June 7, an MV-22 Marine Corps Osprey arrived at Bell Helicopter Textron's Arlington, Texas, plant. When it leaves sometime next year it will be the first CV-22—the Air Force version of the new tilt-rotor craft.

"They're basically going to strip it down and rebuild it to the CV-22 specifications," said Maj. Scott LeMay, Aeronautical System Center's CV-22 deputy program manager. "It's going to have CV-22 production wiring and all CV-22 unique systems."

The Air Force plans to eventually buy 50 CV-22s to replace its fleet of MH-53J Pave Low helicopters. The aircraft's mission will be to deliver and retrieve special forces units from hostile areas.

The Air Force Osprey model will have integrated radio frequency countermeasures, including an active jammer. It will also have terrain following/terrain avoidance radar, an additional 900 gallons of fuel capacity, rope ladders, a survivor locator

system, and additional radios and upgraded computers.

The first CV-22 is currently scheduled to begin an initial operational test and evaluation at Kirtland AFB, N.M., in spring 2002.

"We'll put it through its paces by basically doing a mock deployment," said LeMay. "This is to make sure that it meets what's required in the operational requirements document and that it is operationally effective and suitable."

CV-22 procurement is scheduled to begin in 2001, with first deliveries in 2003.

Tinker B-2 Experts Keep Stealth in the Air

A major problem was threatening to damage the B-2's mission effectiveness during Operation Allied Force—until the System Engineering Branch of the B-2 System Program Management Division stepped in.

The glitch was the Actuator Remote Terminal, which works the various control surfaces on the airplane. Because of an airflow-cooling problem, the ART was a high-failure item on the bat-winged bomber.

The ART is so sensitive that it has to be set down on a solid granite surface for repairs, to ensure leveling.

Things reached a critical point when a shortage of ART supplies threatened to cause combat mission aborts. The Tinker AFB, Okla.–based System Engineering Branch stepped in and found that the vendor for the part had a limited capacity for repair.

"He was meeting a 23- to 24-day turnaround in some instances, but with the increased flying schedule, he was unable to surge his capacity to the point that he could take care of requirements," said Bob Cotton, avionics armament team lead for Oklahoma City B-2 System Program Office.

Cotton and others worked up repair procedures. A team of engineers traveled from Tinker to Whiteman AFB, Mo., to provide on-the-spot training. They worked a tight schedule around the B-2's continuing bombing mission to implement their solution.

Space Launch Chief Muses About Big Changes in Business

As yet investigators have found no common cause in the spate of recent launch vehicle accidents which have endangered US access to space. But the six launch failures may mean that the US needs to rethink its entire process for hurling payloads aloft, Air Force ICBM and Space Launch Division chief Col. James Puhek said June 9.

The legacy systems in use today—Atlas, Titan, and Delta rockets—all have their roots in 1960s technology, noted Puhek. Yet missions are different today, and program oversight is less, due to budget restrictions.

"Maybe we've gone a bit too far as a nation by treating space access as routine and fully operational with systems not designed to meet today's higher standards," said Puhek. "I don't know the answer, but we're finally looking at such possibilities now, as we should."

Three of the six launch failures were run by the government, and three by private industry. Initial indications were that each was the result of a different problem. A number of overlapping investigations are now probing US launch problems. The Air Force and NASA are both conducting separate reviews, which in turn will feed into a broad government-wide investigation ordered by President Clinton on May 19.

In addition, Boeing has assembled a group of experts to review its processes and procedures in the wake of failures of its Delta III and Inertial Upper Stage. Former Air Force Secretary Sheila E. Widnall will head the effort.

"Because the six incidents were so close in time, it has caused us to scope up and take a bigger look into the whole picture," Puhek said. "Lockheed Martin and Boeing have also started their own investigations, so you've got a lot of people working on the problem at the same time."

With some 25 launches scheduled for Fiscal 2000, answers need to be found quickly if changes are to be made to ensure US access to space.

NASA has already delayed three satellite launches, pending investigations into failures of Lockheed Martin's Centaur upper stage. Affected payloads are a Geostationary Operational Environmental Satellite (GOES-L), a Tracking and Data Relay Satellite (TDRS), and an Earth Observing System (EOS) Am-1.

Lockheed Martin C-130J Claims 50 World Records

On June 13, Lockheed Martin officials announced that a company flight crew piloting an unmodified C-130J Hercules transport had claimed 50 new world aeronautical records.

Four C-130J flights over two days broke 16 existing world marks and established standards in 34 other categories where no previous sanctioned attempts have been made, firm officials said.

"These records are simply a reflection of the capability of the C- 130J," said company pilot Arlen Rens.

Twenty-one of the records were set in the Class C-1.N, Turboprop category for speed over a 1,000- and 2,000-kilometer closed course and for altitude with payload. The airplane's 1,000 km speed of 396.17 mph, for instance, broke the previous mark—set by a Soviet crew flying an Antonov An-12 in 1991—by 8 percent.

The other 29 records were set in the short takeoff and landing, Class N, Turboprop category for similar speed and payload accomplishment, as well as time-to-climb achievement.

The aircraft reached 3,000 meters in 3 minutes, 49 seconds, while carrying a 10,000 kilogram payload, for instance.

"We didn't just set records for the sake of setting records," said Lyle Schaefer, who served as pilot in command for some of the flights. "We took a payload that represents a militarily usable cargo, flew a distance that is a realistic representation of a typical military mission, and we did it at high speed."

ACC Pursues Mustard Agent

Air Combat Command wants to find and clean up sites where chemical warfare materials may have been disposed on ACC facilities.

The search is focusing on chemical agent identification sets. These kits, which contain four-ounce vials of actual mustard agent, were used for training from the 1920s to the 1960s. Officials decided the search was necessary after some discarded sets were found during routine environmental cleanup at Ellsworth AFB, S.D., in August 1997.

The Army destroyed about 21,000 of the sets in the early 1980s, and Air Force officials believe most of the rest were used up during training. But the Ellsworth discovery alerted them to the fact that some may have been buried, which was an acceptable disposal method for many years.

"There isn't an immediate danger to the base or surrounding communities," said Norm Guenther, the ACC program manager. "The potential for a problem exists primarily during construction activities when digging is taking place."

The search effort, named the Chemical Agent Records Search Initiative, has already turned up records

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suggesting that the training kits were used at most ACC bases. But the records did not identify any specific disposal sites.

CARSI is now looking at more specific base and regional documents and conducting confidential interviews with current and former Air Force employees. Officials have completed and distributed a chemical warfare materiel handbook to make sure anyone who turns up the vials will know what to do.

"Part of this initiative is also to make sure our people know how to respond, should they encounter a problem unexpectedly," said Guenther.

Anyone with pertinent information should conduct chemical agent identification sets contractor Mitretek toll free at 1-877-237-8789 or send an e-mail to afsurvey@mitretek.org.

SA Area Gets More F-16 Pilot Training

The military-dependent San Antonio economy has been battered in recent years by base closures and the military drawdown. Now it is seeing a glimmer of good news, with the conversion of the Texas Air National Guard's 149th Fighter Wing from general-purpose unit to a flying training wing.

The change has created 80 full-time jobs within the unit for instructor pilots and support staff. It will also require construction of classroom buildings and the hiring of academic instructors.

Implemented in January, the mission switch is meant to train Air National Guard aviators in an effort to help ease the backlog of flight school students waiting to become full-fledged F-16 fighter pilots.

Attrition has been the main culprit creating the logjam, said wing commander Col. Robert J. Spermo. Airlines are taking some of Air Force's best pilots, notably instructor pilots. That leaves the service in the difficult position of trying to maintain its instructor force in the face of real-world deployments and a steady stream of student pilots waiting for flight training.

In Fiscal 1999, for instance, the National Guard requested 51 slots at the Air Force F-16 training school. It got only nine.

"That leaves 42 students coming out of pilot training and returning to their units without being able to perform the actual mission they signed up for," Spermo said.

Some unit pilots are not overjoyed about the change, which takes away their traditional warfighting role.

"Your average fighter pilot was really not that happy at first," said Maj. Jack Presley, operations officer for the wing's 182nd Fighter Squadron. "It's not that teaching is a bad duty assignment. It's just that the pilots are no longer frontline fighter pilots."

Others recognize that the change does have benefits.

"This will at least give us a chance to leave a mark," said Presley. "This can be very rewarding for all of us."

Allied Force Units Produce Big Numbers

On June 10, the 78th Expeditionary Fighter Squadron passed an amazing combat milestone—1,000 sorties in support of Operation Allied Force.

The unit reached that level only 53 days after the first "Bushmasters" sortie was launched in theater. When weather, higher headquarter's cancellations, and other scrubs are added into the picture, the 78th was prepared to launch 1,300 combat flights during the conflict.

"The folks out here [on the flight line]—my hat's off to them," said Lt. Col. Clyde Bellinger, the F-16CJ pilot who landed the historic flight. "They deserve this honor. I just happened to drive the bus, so to speak."

Maintainers generated an average 20 to 24 F-16CJ sorties every day.

"I think [when you look at] the big picture, it's a total team effort—all the technicians, weapons load crews, crew chiefs, and support staff have done a tremendous job," said Maj. James Ayers, squadron maintenance officer.

Meanwhile, the 92nd Air Expeditionary Wing can boast that its personnel had pumped more than 47 million gallons of fuel to support Allied combat sorties.

One airman in particular had been a workhorse, said Col. Vern M. "Rusty" Findley II, 92nd AEW commander. A1C Mike Rafa had single-handedly pumped more than 3.7 million gallons since Feb. 20.

"He's a hero with a capital 'H'," said Findley.

Stop-Loss Nears End

On June 22, Air Force officials announced the start of a phased termination of the Stop-Loss program. That means some 4,569 airmen in 85 career fields deemed critical to Operation Allied Force were able to resume planning for their post-service lives.

The announcement came two days after NATO Secretary General Javier Solana proclaimed that the Alliance's bombing campaign against Yugoslavia was officially over.

"With the end of hostilities, withdrawal of Yugoslav troops from Kosovo, and the redeployment of our forces home, it is appropriate to begin releasing our people from Stop-Loss," said Col. Lynn Pratt, chief of the Air Force's Military Personnel Policy Division.

The program did not end all at once, said Pratt. Both the Air Force and affected airmen needed some time and flexibility as they resumed peacetime operations.

Stop-Loss was over for affected personnel who were not deployed in the effort to halt ethnic cleansing in Kosovo, USAF officials said. For those who were deployed, Stop-Loss terminates when they return to their home station. Stop-Loss for Air Force reservists ended June 22.

The Air Force announced its decision to implement the program May 26. However, it was not to take effect until June 15, which turned out to be five days after NATO suspended its airstrikes.

For many it was not an absolute bar from leaving the service—the Air Force Personnel Center approved at least 129 waivers for lieutenant colonels and lower ranks, allowing them to retire or separate from active duty on their approved dates.

Air Force Units Wing Back From Europe

Air Force aircraft quickly flooded back to home bases in the weeks following the official end of Operation Allied Force, the NATO bombing campaign against Yugoslavia.

Secretary of Defense William S. Cohen authorized two increments of redeployment in late June. On June 21, 124 aircraft were released to return from bases in Europe to the continental United States. Among those affected were 12 F-117s, which flew from Spangdahlem AB, Germany, to Holloman AFB, N.M., and six B-1 bombers, which returned from RAF Fairford, UK, to Ellsworth AFB, S.D.

On June 25, Cohen allowed a further 221 aircraft to return to the US and 60 to return to European home bases. These included 24 F-16CJs which flew from Aviano AB, Italy, to Shaw AFB, S.C., and 18 F-15Cs, which moved from Cervia AB, Italy, to RAF Lakenheath, UK.

Meanwhile, President Clinton visited Whiteman AFB, Mo., to thank the crews of the 509th Bomb Wing for participating from the heartland of America in the conflict—something

no other unit has ever done. The 509th's B-2 Spirit bombers flew less than 1 percent of Operation Allied Force missions but dropped 11 percent of the bomb load.

"The pilots, the crews, ... and everyone who is part of the B-2 team stationed at Whiteman should take special pride in proving what a truly remarkable aircraft can do," said Clinton. "As far as we know, they still don't know you were there."

Allied Aircraft Continue to Pound Iraq

Iraq has kept firing at US and coalition aircraft that are enforcing no-fly zones over its territory—and the aircraft kept responding by pounding Iraqi military sites.

On June 24, for instance, Iraqi antiaircraft artillery fire targeted US and British aircraft patrolling over the south of the country. In response, coalition forces struck four military communications sites about 170 miles southeast of Baghdad near Ash Shatrah and a surface-to-air missile site in the vicinity of Kut Al Hayy, 100 miles southeast of Baghdad.

On June 21 and 22, aircraft patrolling both Iraq's northern and southern no-fly zones came under attack. Responding in self-defense, US Air Force fighters from Operation Northern Watch dropped precision guided munitions on a military command-and-control site southwest of Mosul. Navy aircraft patrolling the southern zone hit two surface-to-air missile sites near As Samawah.

The clashes represented something of a low-level, continuing conflict. Coalition and Iraqi forces have exchanged fire more than 190 times since the end of Operation Desert Fox in December.

Helo, Fighter Crashes Claim Lives

An MH-53J Pave Low helicopter from the 20th Special Operations Squadron, Hurlburt Field, Fla., crashed June 2 near Fayetteville, N.C., while on a routine training mission. One of the six crew members died the next day.

SSgt. Kurt Upton, of Niota, Ill., who was a gunner on the MH-53J and had served in the Air Force for seven years, died June 3 at the Ft. Bragg Medical Center in North Carolina from injuries he received during the crash. The other five were released from the hospital.

On July 1, a pilot with Air Force Reserve Command's 93rd Fighter Squadron, Homestead ARB, Fla., was killed when his F-16 crashed in a remote area near Avon Park Bombing Range in central Florida.

Maj. Samuel D'Angelo III, an American Airlines pilot and resident of Key Largo, Fla., was on a low-level training mission as part of a four-ship formation. The 19-year military veteran had recently returned from helping enforce the no-fly zone over northern Iraq.

Boards of officers are investigating each accident.

Y2K Problems? Call Air Force Fusion Center

The Air Force's Standard Systems Group is setting up a central help point for collection, consolidation, and reporting of the inevitable computer problems the service will encounter at the turn of the year 2000.

The help team will consist of a cross-functional group of SSG experts, bolstered by computer specialists from around the Air Force and a network of service help desks. The centralized Y2K Fusion Center is supposed to be up and running at Maxwell AFB, Ala., by Sept. 1.

The center will be equipped with a variety of specialized and secure—but unclassified—communications systems, including secret Internet protocol router networks and secure fax and video teleconference lines.

Personnel with potential Y2K problems should first go to the help desk

that normally supports their particular system, said Kenneth Heitkamp, SSG technical director. That desk will solve the problem, if it can, and report anomalies to the Fusion Center.

"No Department of Defense caller will be turned away," said Col. Robert Glitz, chief of SSG's Software Factory customer support division. "We have people working now with all other appropriate agencies so we'll know exactly who is responsible for what. So if a customer has a problem and doesn't know who the point of contact is, they can call the Fusion Center and get the name and number of the agency that can help."

Callers can reach the Fusion Center at DSN 596-5771; toll free 877-596-5771; or 334-416-5771.

Total Force Big at USTRANSCOM

The Total Force is a fact of life for everyone in the US military—but it is perhaps uniquely important to US Transportation Command and Air Mobility Command, according to TRANSCOM chief Gen. Charles T. "Tony" Robertson Jr.

"In every mode of transportation at least half of our capacity comes from our commercial partners [in the Civil Reserve Air Fleet]," Robertson said at a recent Air Force Association symposium in St. Louis.

On the military side, a majority of the command's airlift capability rests with the Guard and Reserve.

"Our dependence on the Total

Senators: Ground Forces Need More

The Senate Armed Services Committee at a June 8 hearing heard from Gen. Eric K. Shinseki of the Army and Lt. Gen. James L. Jones Jr. of the Marine Corps. The hearing's declared purpose was to confirm appointments of the two to serve as heads of their services. With the chairman, Sen. John W. Warner (R–Va.), in the lead, discussion veered to Kosovo and the relative importance of airpower and land power—in particular, the need to fund a bigger land force. Joining in were Sen. Joseph I. Lieberman (D–Conn.) and Sen. Pat Roberts (R–Kan.).

Here are some excerpts:

Warner: I'd like to have your views, and particularly whether or not, after you're in office for a period of time, that you would feel it would be necessary to petition the President and the Secretary of Defense to raise the overall force levels of your respective branches to meet what I perceive as an increasing worldwide threat to US forces and to those of our allies from an ever growing situation resulting from weapons of mass destruction and other threats, terrorism, and indeed the need—and it is essential—for the United States to participate in peacekeeping operations, ... which is really something that's somewhat new in the past decade for the armed forces of the United States. ...

Shinseki: The Army is structured, resourced, and equipped and trains with a focus on executing [a] two-Major-Theater-War scenario. We are currently capable of meeting that strategy requirement, but I would tell you that the Army's ability to handle that second MTW is one that would be done at high risk. ... In terms of force levels, ... end strength, I think that is a legitimate concern. The Army's in the midst right now of a top to bottom scrub, a total Army analysis process that is looking at just that very question. ... It would be a bit premature for me to tell you that raising the end strength right now is the right call, but I think it is a legitimate concern. ...

Warner: Do you think that at some point in time [it] is a valid requirement to go and look at the end strength in terms of possibly raising it?

Jones: I do, sir.

Warner: This has been a most unusual conflict. ... It has been basically an air-only campaign. ... Now your two services ... are both recognized for tremendous sacrifice of life and limb in previous conflicts. There could be a call for a shift to more emphasis, in terms of our resources, ... towards heavier and heavier [use of] air and less and less emphasis on the component which I believe remains essential and always will be—ground forces. ... We should prepare the public to recognize that this was an exceptional conflict, and it does not diminish the need for us to have a total force including significant ground forces. ... A short answer from both of you.

Shinseki: I think we need to keep perspective here on the reason why you have an Army, and that is to fight and win our nation's wars. And to the degree that we do that well, we do that with our cohorts in the Air Force, Navy, and Marine Corps. But resolution of conflict eventually goes to a land battle and I think keeping a trained and ready and strong Army is very much a part of that equation. ...

Jones: I totally agree with General Shinseki. The utility of ground forces is beyond question. ... It's the ultimate employment of our national will, but it's something that must be carefully considered. You have to have the capability and we should do everything to preserve it and enhance it.

Lieberman: [O]ne of the policy questions that people are going to be thinking about ... is whether, in fact, we can achieve objectives on the ground from the air. Now, I'm highly skeptical of that, but one of the advantages, one of the reasons we did it this way, and one of the advantages was that we had ... no casualties, no American casualties. And this was as a result of the enormous leveraging of technology. ...

Shinseki: Can you do it all from the air? I [take] great comfort in the quality of our Air Force, and I wouldn't have it any other way. ... I think Jim and I would both say ... I don't think we've ever been ... on a crowded battlefield. There has always been a requirement for a joint commitment to bringing decisive conclusion to any conflict I've seen or been a part of. And so, can we do it all from the air, I think, is a question that, I would say, no—not because I'm a ground guy but because I think we bring decisive closure to contests when we bring all of our capabilities to bear, and that's ground, air, and naval.

Jones: I would just only add that I think that it's not out of the realm of distinct possibility that the current state of negotiations has something to do with the fact that for weeks now there has been [talk of] possible ground operations. I think the presence of the Army brigade task force and its preparations have not been unnoticed on the Serbian forces. ... And also the presence of the US Army on the ground, the Apaches and the like, had a very strong effect. ... I think the observed naval demonstrations with the proximity of the Marine Expeditionary Unit off the coast of Greece obviously sends a message. I think the presence of the maritime prepositioned squadrons that are nearby also sends a message of intent. So, I believe that the ground forces did in fact have some contribution in bringing about the current state of negotiations. ...

Warner: I am certain that message got through to Milosevic, that the supreme allied commander of Europe ... was prepared to lead those forces and to put in place such other forces as he deemed necessary.

Roberts: The two leaders of the most powerful ground forces in the world are here at the same time to seek confirmation to lead their services into the 21st century. [It is] ironic in the sense that we are apparently are ending a conflict where the ground forces were only reluctantly considered, if they were seriously considered at all. And the United States and the NATO Alliance relied solely on airpower to seek a military solution to a problem. I sincerely hope that we as a nation have not learned the wrong lesson from this air campaign. ... I think there is always a vital role for the Marines and the Army.

Force ensures the taxpayer only pays for the additional capability when our nation needs it, during times of war or other major conflict," said the TRANSCOM commander in chief.

CRAF saved the US more than $3 billion during the Gulf War, for instance.

"During Desert Storm, we activated 117 aircraft from CRAF which flew 20 percent of the total strategic airlift missions," said Robertson. "The cost was $1.35 billion vs. maintaining a military fleet [at a cost of] $4 [billion] to $5 billion ... great bargain."

Peters Confident of Access to Space

During a late June visit to Schriever AFB, Colo., acting Secretary of the Air Force F. Whitten Peters said he is confident that there are no major problems with the hardware design of the nation's space launch vehicles, despite a recent string of expensive launch disasters.

Among other investigative efforts, an Air Force broad area review is now studying the failures to see if the service needs to change practice, procedures, or operations to ensure US military access to space.

"Right now, I don't see a systematic problem with our launch capability. Everything looks like separate and distinct problem[s]," Peters told Air Force Space Command's 11th Space Warning Squadron. "The real questions that seem to be coming up are: Have we lost an important experience base, and have we stopped doing some procedures that we once did that would protect us from this?"

There has been a brain drain on both the military and civil space industry, pointed out Peters. There have been retirements and consolidations in both sectors since the military drawdown began in the late 1980s.

"So at least one theory is that we've had a tremendous loss of corporate knowledge," he said. "If this assumption is true, then we need to go back and assess our processes and make sure we meet the standards."

The Air Force's move from direct oversight of quality to insight in the contractors' quality control practices has been a point of concern, Peters acknowleged.

"All insight does is put on the Air Force's shoulder the burden to look at the overall quality procedures, rather than do the quality tests ourselves," he said. "We look to make sure the basic safeguards are in place for the contractor. I still think that is the right way to go. However, the fundamental question is, do we have the right quality procedures today, given the work force today, to assure launch?"

The acting Air Force chief also talked about the need to upgrade the Air Force's two ranges. Both the Eastern Range at Patrick AFB, Fla., and the Western Range at Vandenberg AFB, Calif., are in need of major modernization.

"We have range modernization programs in place, but there's a historically very high risk that they will slip," said Peters, "not because the programs are at fault but because we keep taking the money for more high priority problems."

Rally '99 Tests Airlift Ops

Flames race across dry fields toward the isolated city. As they speed onward, an international airlift task force races against time, landing supplies and people needed to protect the outpost from the flames.

That was the scenario faced by aircrews that took part in Pacific Airlift Rally '99, held at Royal Australian Air Force Base, Darwin, Australia, on June 14 to 18.

The every-other-year rally was meant to test international airlift operations for humanitarian and disaster relief. This year's event included participants from Singapore, Indonesia, Malaysia, New Caledonia, Mongolia, Thailand,

Space

Electro-optical and radar payloads

Multi-spectral remote sensing

Communications payloads

Phased array antennas

Star trackers

Power systems

Satellite Control and Mission Management

Satellite control ground stations

Fixed and mobile receiver terminals

Imagery and multi-spectral processing

GPS receivers and navigation systems

Information Networks and Training Services

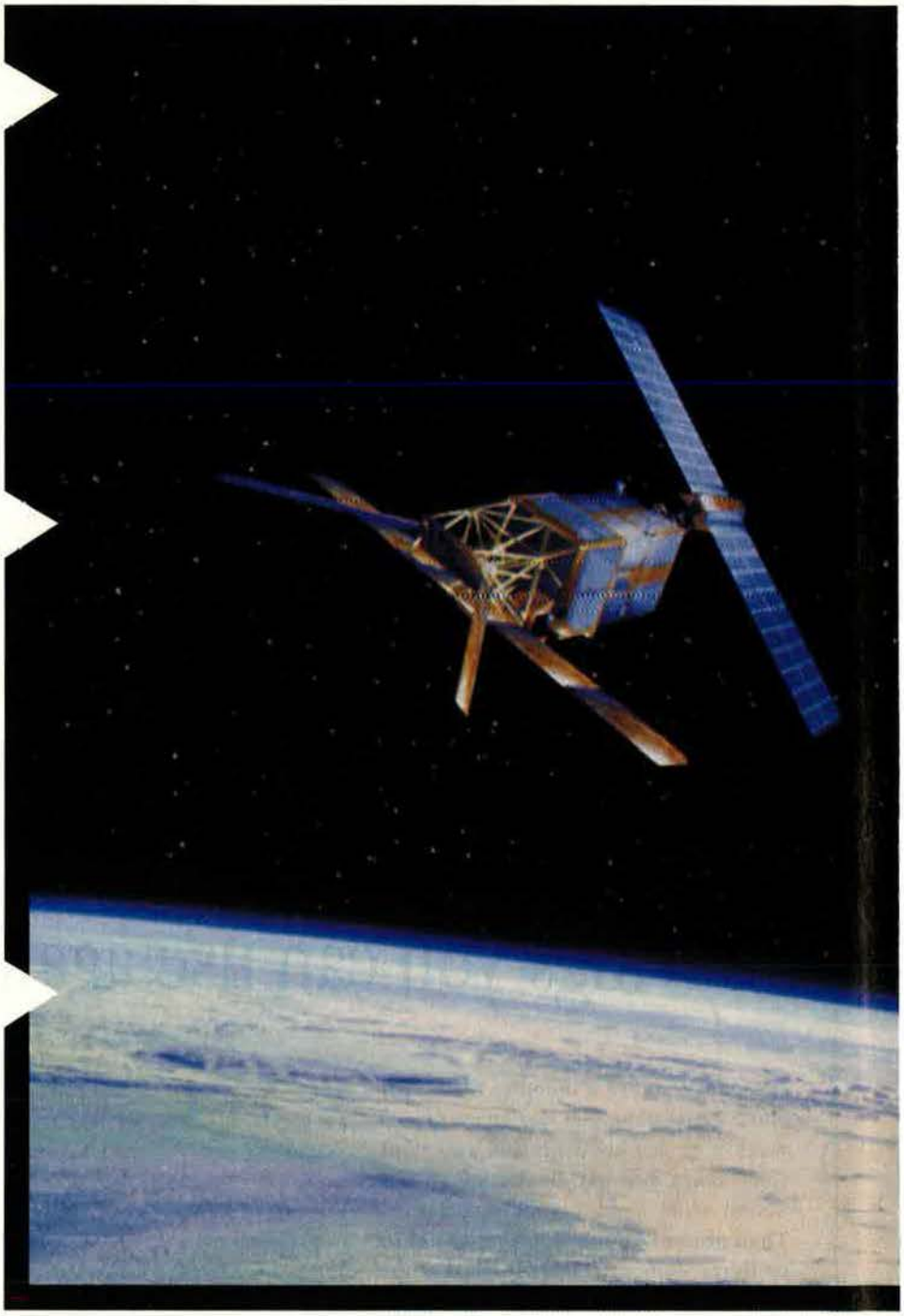
Network operations and archiving systems

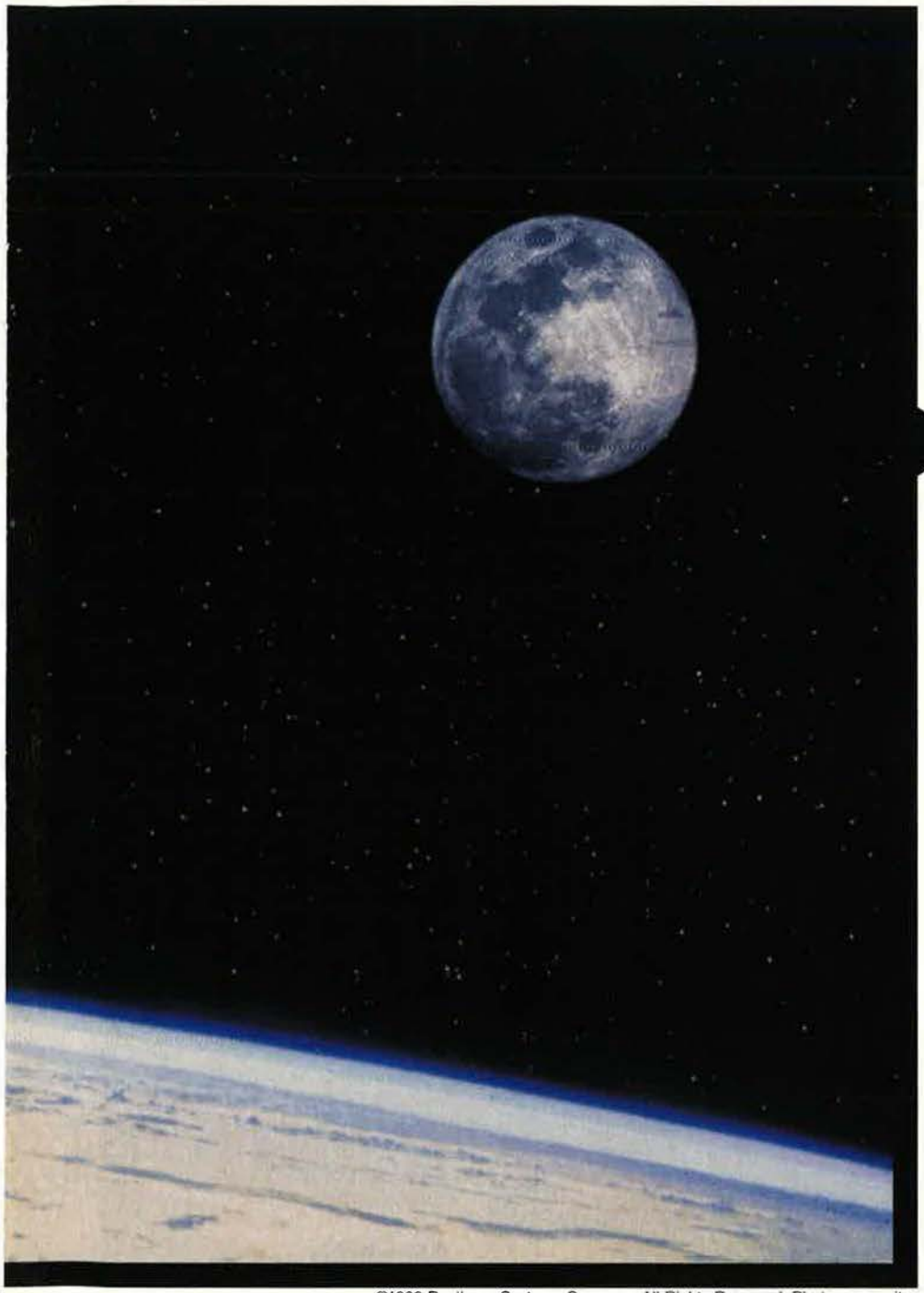
Geospatial information systems

Simulations and training for manned spaceflight

Launch range operations support

Satellite and missile tracking operations





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Papua New Guinea, Australia, and the US.

The US team included a C-130 from Yokota AB, Japan, and a C-130 from the Hawaii Air National Guard, Hickam AFB, Hawaii, along with their support personnel.

"The scenario revolved around a bush fire in the gulf country at Normanton in Queensland," said Tony Griffiths, operations officer for the New South Wales Rural Fire Service. "That's a relatively remote area with a small town with a small port nearby. It very quickly built into a situation where the local resources weren't capable of dealing with it."

Rally participants tried to commit about 30 additional fire tankers and 250 firefighters to control the fire in three or four days. Weather—at least in the scenario—got progressively worse.

"It was pretty interesting because we had to be able to interpret what the airlifters' requirements were, as in numbers of flights and what they could fit on particular aircraft with limitations due to weather," said Griffiths.

Participants split into two groups. One worked on turning around flights at two small airfields that could only accommodate one airplane at a time.

"It was challenging in that you got to work with multiple countries to see how they do things," said Capt. Andy McIntyre of the 36th Airlift Squadron. "Your basic airlift is the same, but some of the little nuances like crew duty day would come out and you had to work around that a little bit. You also had to work with the different airlift capabilities of the different platforms."

William R. Lawley Jr., Medal of Honor Recipient, Dies

Retired Air Force Col. William R. Lawley Jr., awarded the Medal of Honor for nursing a crippled B-17 back to base during World War II, died in Montgomery, Ala., on May 30. Cause of death was not reported.

Lawley, then a first lieutenant, was 24 years old on Feb. 20, 1944, the day his B-17 took part in a massive raid on German aircraft centers. With his bombs frustratingly stuck in the bay, Lawley was exiting his Leipzig target area when a 20 mm shell from an attacking German fighter blew away his windscreen, killing his copilot and sending the Flying Fortress earthward in a perilous dive.

Badly cut in the face and neck, Lawley regained control of the aircraft. Refusing to abandon badly wounded crew members, he set out on a flight from hell, extinguishing engine fires, dodging enemy aircraft, and at one point passing out from blood loss and exposure.

Five hours after being hit, with one engine still turning and another on fire, he crash-landed at a small fighter strip south of London. *[See "Valor," June, p. 37.]*

He received his Medal of Honor on Aug. 4, 1944. He remained on active duty until his retirement in 1972.

A second group worked on the logistics of what should and could go on each flight.

"The fact that we could only land one airplane at a time per airfield, on two different airfields, was just a logistical nightmare," said SSgt. Robert McLean, from Yokota's 374th Airlift Wing.

In addition to command post interaction, US crews got valuable experience flying on missions with foreign units.

JEFX '99 Starts in August

Despite the increased operations tempo caused by war in the Balkans, the two-week Joint Expeditionary Force Experiment '99 was scheduled to begin in August at locations nationwide.

The exercise aims to improve tactical or wing level command-and-control procedures using two Air Expeditionary Forces as the basis of the experiment. It entails joint and coalition force participation and integration of space capabilities into operations center activities.

"We've minimized the impact of real-world operations tempo, have kept the experiment on track, and the objectives and initiatives intact," said Col. Stephen Carr, vice commander of the Aerospace Command and Control Training and Innovation Group at Hurlburt Field, Fla. "From our perspective, we have a clear way ahead at this point for a successful experiment."

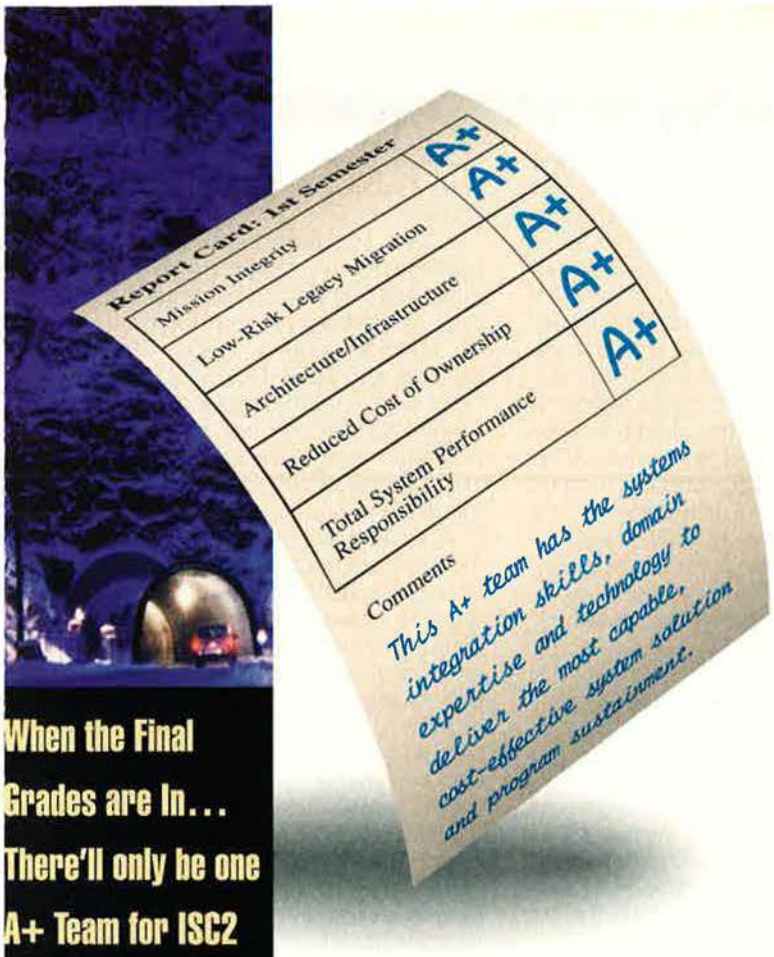
That does not mean that problems in Kosovo did not affect event planning. Changes had to be made to the experiment schedule because of competing demands on Air Force people and equipment. Communications equipment and manning were the biggest challenges.

"Our communications people had to go out and purchase additional communications equipment that was not available to us because of the [Kosovo] deployments," said Carr.

Planners had scheduled a fully manned aerospace operations center but could count on only a minimal number of operators for a systems and communications connectivity check called Spiral 3.

News Notes

■ Gen. Ralph E. Eberhart became the fourth commander of Air Combat Command June 11, succeeding Gen. Richard E. Hawley, who retired after 35 years of service. Eberhart, a 1968 graduate of the US Air Force Academy, came to ACC following his assignment at the Pentagon as vice chief of staff of the Air Force. He's a command pilot with more than 4,000 hours in fighter and trainer aircraft, including 300 combat missions as a



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forward air controller in Vietnam. As commander of ACC, Eberhart oversees 1,050 aircraft and approximately 103,400 active duty military and civilian people at 27 installations.

■ The Air Force's fifth E-8C Joint STARS aircraft has been refurbished and modified at Northrop Grumman's Lake Charles, La., facility 10 weeks ahead of plan. The aircraft will now have the Joint STARS system itself installed and tested at another company plant in Melbourne, Fla. The airplane should be delivered to the Air Force by the end of October.

■ An Air National Guard KC-135E that crashed Jan. 13 at Geilenkirchen NATO AB, Germany, pitched up to a near vertical attitude because the horizontal stabilizer trim was in a 7.5 nose-up condition. The aircraft then stalled, according to an accident report released June 4. The investigation was unable to determine how the stabilizer trim came to be in that condition. The crash killed the four Air National Guard crewmen. *[See "ANG Tanker Crashes in Germany," March, p. 13.]*

■ The cause of the crash of an F-16 near Kangnung AB, South Korea, last Aug. 24 was the failure of the No. 4 bearing in the engine, according to an accident report, released in June. The failure of an engine specialist to follow applicable technical orders following discovery of debris on the magnetic chip detector was a contributing factor, according to the accident investigation board president.

■ The first operational Marine helicopter unit assigned to Edwards AFB, Calif., is settling in. Marine Aircraft Group 46, Det. B, from MCAS El Toro, Calif., has been working to integrate its 21 helicopters and 400 people at Edwards. The unit's mission is to transport heavy equipment, weapons, and supplies.

■ Lt. Gen. Joseph E. Hurd, 7th Air Force commander, was recently recognized for his outstanding contributions to maintaining peace on the Korean peninsula. Hurd was awarded the 1998 Eugene M. Zuckert Management Award,which was awarded in a Washington, D.C., ceremony Aug. 4.

■ On June 15, two USAF F-15C/D aircraft from the 53rd Wing, Nellis AFB, Nev., crashed 60 miles east of the town of Tonopah while on a routine mission. Both pilots survived the incident.

■ Two Hurlburt Field, Fla., sergeants recently saved the Air Force hundreds of thousands of dollars when they retrieved a broken drill bit from an MH-53J engine. TSgt. Clayton Solberg and SSgt. Robert Sausman, 16th Component Repair Squadron propulsion branch, used ingenuity and a 24-inch-long wire to keep a T64-100 turboshaft power plant from having to be removed for costly repairs.

■ Six Air Force employees have won the Environmental Protection Agency Bronze Medal for significant contributions to streamlining environmental cleanup and closeout activities at federal facilities. The recipients are John Smith, Mario Ierardi, Shirley Curry, and Art Ditto, of the Air Force Base Conversion Agency, and Thomas McCall and Marilyn Null of the Office of the Deputy Assistant Secretary of the Air Force for Environment, Safety, and Occupational Health.

■ Operation Walking Shield is continuing to transfer excess Air Force housing units to American Indian reservations, giving low-income residents a chance to improve their lives. The program began in 1996 when Congress passed legislation allowing Grand Forks AFB, N.D., to convey 463 units to the Rosebud Sioux, Turtle Mountain Chippewa, and other nearby tribes. Transfer will be completed over the next two years. Malmstrom AFB, Mont., will transfer 29 units in 1999 to the Northern Cheyenne, Chippewa, Cree, and Gros Ventre tribes, among others.

■ On June 11, Air Force officials announced that shopping for military uniforms is now as easy as browsing the Internet. Catalogs from the Army and Air Force Exchange Service are now available on the World Wide Web at www.aafes.com.

■ AFRC C-130 units deploying for Coronet Oak duty will no longer be landing in Panama. Their new destination will be Luis Munoz Marin IAP, P.R., where the rotational mission was moved in May to comply with the terms of the Panama Canal Treaty of 1979.

■ On June 29, the Administration nominated Carol DiBattiste, a retired Air Force lawyer, to replace F. Whitten Peters as undersecretary of the Air Force. Peters has been nominated to become Secretary of the Air Force. DiBattiste enlisted in the service in 1971, was commissioned in 1976, and retired as a major in 1991. She is currently a deputy US attorney at the Department of Justice. ■

Senior Staff Changes

PROMOTIONS: To ANG **Major General:** Archie J. **Berberian II,** Verna D. **Fairchild,** Daniel J. **Gibson.** To ANG **Brigadier General:** George C. **Allen II,** Ronald J. **Bath,** Roger E. **Combs,** Michael A. **Cushman,** Thomas N. **Edmonds,** Jared P. **Kennish,** Paul S. **Kimmel,** Virgil W. **Lloyd,** Alexander T. **Mahon,** Marvin S. **Mayes,** David E. **McCutchin,** Calvin L. **Moreland,** Mark R. **Musick,** John D. **Rice,** Robert O **Seifert,** Lawrence A. **Sittig,** James M. **Skiff.** To AFRES **Major General:** John A. **Bradley,** Gerald P. **Fitzgerald,** Edward J. **Mechenbier,** Allan R. **Poulin,** Larry L. **Twitchell.** To AFRES **Brigadier General:** Ronald J. **Bath,** Thomas L. **Carter,** Richard C. **Collins,** John M. **Fabry,** Hugh H. **Forsythe,** Michael F. **Gjede,** Leon A. **Johnson,** Howard A. **McMahan,** Douglas S. **Metcalf,** Jose M. **Portela,** Peter K. **Sullivan,** David H. **Webb.**

CHANGES: Brig. Gen. (sel.) John D.W. **Corley,** from Cmdr., 355th Wg, ACC, Davis–Monthan AFB, Ariz., to Dir., Studies & Analyses, USAFE, Ramstein AB, Germany ... Brig. Gen. (sel.) Frank R. **Faykes,** from Comptroller, USAFE, Ramstein AB, Germany, to Dir., Budget Ops & Personnel, OSAF, Pentagon ... Brig. Gen. (sel.) John H. **Folkerts,** from Cmdr., 58th SOW, AETC, Kirtland AFB, N.M., to DASD, Policy & Missions, Spec. Ops./Low Intensity Conflict, Pentagon ... Brig. Gen. Edward L. **LaFountaine,** from Vice Cmdr., AFSOC, Hurlburt Field, Fla., to Dir., AEF Management Team, ACC, Langley AFB, Va. ... Maj. Gen. Everett G. **Odgers,** from Dir., Budget Ops. & Personnel, OSAF, Pentagon, to Dir., Financial Mgmt., AFMC, Wright–Patterson AFB, Ohio ... Brig. Gen. (sel.) Kevin J. **Sullivan,** from Prgm. Dir., Recon Mission Area Gp., ASC, AFMC, Wright–Patterson AFB, Ohio, to Vice Cmdr., Air Armament Center, Eglin AFB, Fla.

COMMAND CHIEF MASTER SERGEANT CHANGE: CMSgt. Kevin **Estrem,** to CCMS, ACC, Langley AFB, Va.

SENIOR EXECUTIVE SERVICE RETIREMENT: Helmut **Hellwig.**

SES CHANGES: Robert J. **Arnold,** to Technical Advisor, 46th Test Wg, Air Armament Center, Eglin AFB, Fla. ...William U. **Borger,** to Associate Dir., Air Platforms, AFRL, Air Vehicles Dir., Wright–Patterson AFB, Ohio ... Gerald B. **Kauvar,** to Principal Dep. Asst. Secy., Instl. & Environment, OSAF, Pentagon ... Hendrick W. **Ruck,** to Associate Dir., Investment Strategy, Plans, AFRL, Wright–Patterson AFB, Ohio ... Lyle H. **Schwartz,** to Dir., Aerospace & Materials Sciences, AFOSR, Arlington, Va. ... ■

Washington Watch

By John A. Tirpak, Senior Editor

Lessons Learned and Re-Learned

The USAF Chief of Staff reflects on what Operation Allied Force in the Balkans demonstrated and on what it reaffirmed.

Two months after the bombs stopped dropping in Yugoslavia, the Lessons Learned industry in Washington is cranked up and in full swing. The debate over the victory in Operation Allied Force—how big it was, what the decisive factors were, who gets the credit, and what could have been done better—will probably rage on for some time.

Indisputable are these facts: For the first time in history, the application of airpower alone forced the wholesale withdrawal of a military force from a disputed piece of real estate. The US Air Force was the chief engine of the campaign, carrying out more strike and support missions than any other service or any Allied partner. Precision guided weapons and stealth met or exceeded expectations. The 78-day operation was successfully conducted with the loss of only two Allied aircraft and no Allied combat casualties. A greater percentage of the active and reserve components of the Air Force was committed to the air campaign than was called on for either Vietnam or Desert Storm.

DoD's own lessons learned apparatus is already in place. The study will be headed by Deputy Defense Secretary John J. Hamre and Joint Chiefs of Staff Vice Chairman USAF Gen. Joseph W. Ralston. It is expected to take as much as a year to digest what happened and translate it into applicable policy, strategy, and budgetary action.

A Need for Speed

The Air Force has established its own team to feed the Pentagon study, but having borne the brunt of the air campaign, it must move much more quickly to size things up and take steps to posture itself for whatever comes next.

"We can't wait a year ... or two years" to learn the lessons of Operation Allied Force, USAF Chief of Staff Gen. Michael E. Ryan told *Air Force* Magazine in a late June interview. The force must "reconstitute and recover" from the action, which saw a substantial depletion of munitions stocks, loss of training time, sharply accelerated engine and airframe usage, deferral of depot maintenance, and a heavy toll on deployed personnel, Ryan said.

The Air Force will need time to "rest the force and recuperate it, and let people get ... their personal and professional lives back together," he added. Making quick use of the knowledge gained from the campaign will speed the process of regrouping, he said.

The air campaign demonstrated the indispensability, in any kind of military action, of controlling the air, Ryan pointed out. It was not a startling revelation, he added, and in the Balkans, the concept of air supremacy was not so much vindicated as reaffirmed.

"To do any kind of military operation, whether that's air or ground," he said, "[we] absolutely must have air superiority."

Against a well-equipped, well-trained air force and Integrated Air Defense System, "we essentially owned the air," he noted. Faced with the speed and precision of Allied attacks, the Serb integrated air defense network "went into a mode of trying to hide. ... We forced [it] to become essentially ineffective." Serb radar operators quickly figured out that attempting to guide weapons toward Allied airplanes meant they got "a missile followed by a bomb right down their throat."

Regardless of whether it was simply forced into hiding or destroyed, the Serb IADS went off the air, achieving the desired effect, Ryan explained. That effect was freedom for NATO airplanes to conduct 35,000 missions over Yugoslavia, suffering the loss of only two airplanes and no lives to enemy fire.

"We want every adversary to make the same decision these guys did," Ryan said. When given the choice of going against US–led airpower, they would say, in Ryan's words, "Oh, let's not."

The bottom line in Allied Force, Ryan said, was that "a very, very well-run air operation ... brought a cessation of hostilities and the withdrawal of the Serbian forces from Kosovo. "That fact," he added, "can't be rewritten, no matter how hard the pundits try to rewrite it."

The nation should be very proud of what was an "incredibly professional operation ... given all the political and military restrictions that were put on," Ryan declared. Those restrictions were hardly secret: The US wanted to strike more strategic targets right from the start, but NATO Allies insisted on a more gradual approach.

It Was Inevitable

In a June 4 op–ed column for the *Washington Post*, Ryan said, "The campaign did not begin the way that America normally would apply airpower—massively, striking at strategic centers of gravity that support Milosevic and his oppressive regime." A month into the campaign, he wrote, it became apparent that a constrained, phased approach was not effective. NATO broadened the air campaign to produce strategic effects. The result, Ryan said, summing up while the operation was still in the final stage, was that "Serbia's air force is essentially useless, and its air defenses are dangerous but ineffective. Military armament production is destroyed. Military supply areas are under siege. Oil refinement has ceased, and petroleum storage is systematically being destroyed. Electricity is sporadic, at best. Major transportation routes are cut.

"NATO aircraft are attacking with impunity throughout the country. With the continued buildup of our

aircraft and better weather, the attacks are intensifying and the effects are mounting.

"Cracks in the Yugoslav military and police forces are widening. Draftees are failing to report for duty. Unit desertions are on the rise."

The intensification of the air effort and the cumulative effects of previous strikes meant that it was "inevitable" that the Serb army would be destroyed, Ryan wrote.

"Airpower could not stop the door-to-door ... thuggery and ethnic cleansing that [were] going on, directly," Ryan told *Air Force* Magazine. "The only way you were going to be able to do that [was by] taking it to the heart of the matter—in this case, to Belgrade."

In a broader sense, Allied Force underlined that "in almost every situation, you'll have to have airpower involved, even if it's only for humanitarian reasons, in lifting forces in, and resupply. There are very few instances I can think of where airpower doesn't apply ... in some way."

Hand in hand with the military lesson learned is its hardware counterpart: The Air Force has to have the F-22.

"Sure, we did OK against some MiG-29s that came out," Ryan allowed, "but if you look at system vs. system, we need the next generation of air superiority to clean them out. We don't want any fair fights." The Serb air defense system may have been suppressed, but it had depth in surface-to-air missiles, antiaircraft artillery, and fighters and remained dangerous throughout the conflict, Ryan said.

"We can't say this was easy and therefore we don't need modernization," he noted. "This was not easy. This was hard. ... So we can't lose sight [of the fact that air superiority is] the enabler for everything else that we do."

When asked if the other services grasp the importance of the Air Force's role, Ryan said, "I think so." To do their operations, the other services need that cover which the USAF provides, he said.

The US has enjoyed control of the air in every armed conflict since Vietnam, and "we take it almost for granted, but we can't. We've got to keep working on it," he added.

At Lightning Speed

A second lesson of the conflict was the necessity to keep information flowing at lightning speed to everyone who needs it, Ryan said.

Command and control, as well as the intelligence, surveillance, and reconnaissance capabilities of the force, is "something we have to pay a lot of attention to," Ryan observed.

"Our ability to execute this program—this war—showed the leverage you have when you're able to ... move information around rapidly and make decisions" based on it.

The Link 16 data-sharing system, which essentially permits different aircraft, ships, or facilities to exchange information securely in real time, will be crucial in future operations, Ryan predicted. While the Air Force and Navy are "pretty well committed [to the system programmatically], we need to get on with the fielding of it," he added. The system will make possible to "within minutes, retarget, refocus, and command and control the force." While the airplane-to-airplane benefits of sharing tactical data are obvious, he said, the system will also feed and draw on the whole military network of sensors, permitting an even finer ability to manage the force "in an agile way."

The effectiveness of precision guided weapons was supremely evident in Yugoslavia, Ryan observed, and "day/night, all-weather precision" is the third-ranking area warranting close attention.

The joint direct attack munition—used only by the B-2 in all weather to attack the most highly defended targets in Belgrade—as well as the new joint standoff weapon and the venerable Conventional Air Launched Cruise Missile, all of which are satellite-guided, "did a fantastic job," he asserted.

The conflict showed "there's a place for mass, and there's a place for precision."

He noted, as an example, that precision guided bombs succeeded in boxing in aircraft on a runway. Then highly accurate bombers came and destroyed the airplanes and the rest of the runway with unguided bombs.

The Air Force must continue to work on the mix of precision guided munitions of various expense and dumb and cheap bombs that can still be accurately delivered by smart airplanes.

The service can't and shouldn't "rely ... on one class of munition or one class sensor or [in] one class of range. You have to have full-spectrum capability, depending on the situation that's presented to you," Ryan observed.

Another lesson re-learned was "what a wonderful, disciplined, trained, and committed force we have," Ryan said. "These people, whether ... on the ground or in the air, ... did an unbelievable job."

Once again, the Air Force was "in expeditionary mode," Ryan said, bedding down personnel and equipment "in lots of places we've never been before." Tent cities sprang up and operations commenced in numerous sites and, at some, were taken down just as quickly as the force packed up and went home.

"We do this expeditionary business pretty well. In fact ... very well," Ryan said. "In 38 hours, we're there and ready," which was "a tribute to these great people who respond to the call."

Now that the attack aspect of the operation is apparently over, the Expeditionary Aerospace Force concept will become "the blueprint" for USAF's recovery, Ryan said.

"What we're doing is recovering back to the AEF [Aerospace Expeditionary Force] schedule," Ryan explained. "It's our template for day-to-day operations around the world."

"Downtime Mode"

The AEF plan creates 10 force packages that will range from "on alert" for deployment to a contingency, all the way down to packages that have just returned from a contingency and are in downtime to recuperate, Ryan explained. In the case of Allied Force, units that went to the conflict earliest and worked hardest—flying the most missions without relief—will be first to go into the downtime mode. Units that were less heavily tasked will occupy a place somewhat higher in the rotation.

"We do this at a squadron level," and there are formulas that determine which units most urgently need rest and retraining, Ryan said.

Particularly hard hit by the war were people and systems in the "low-density, high-demand" mission areas: Joint STARS, AWACS, and U-2 reconnaissance and surveillance aircraft, special operations, and EA-6B electronic jamming units, he noted. In some cases, a system was so heavily tasked that all operational and all training assets were rushed into the fight, leaving a gap in training replacements at home.

A system exists for maintaining such mission areas at "sustainable"

levels of deployment "without driving the force into the ground," Ryan noted. In a Major Theater War, however, "all that goes out the window." Those gaps must now be filled, and substitute capabilities for such systems may have to be found.

"We'll work with the Joint Staff and others to see where we can plug holes or reduce the size of the mission we may have forward at the time," Ryan said. That may involve handing some missions off to other services that have approximate capabilities.

"We were the ones that surged," Ryan added, so the services that played lesser roles in the war should now fill in on the housekeeping missions.

Training will also get close attention in the recovery period, Ryan noted.

Training that was deferred for the air campaign "needs to be reinvigorated so that we are agile and flexible [and still able to] swing the force to a different kind of mission," he said. Tactics not practiced in Allied Force need refreshing in case they are called for in another theater.

"A Big Deal to Us"

The Air Force had "by percentage of force ... a greater proportion deployed during this period ... than we had deployed during Desert Storm or in Vietnam. So that's a big deal to us." However, "this is not the whole Air Force that we're drawing down. ... We still have a lot of capacity to cover the requirements that we have laid out there."

Ryan allowed that "we'll have to prioritize, some. And we'll have to have others cover [some] things. But we do that all the time, anyway. ... The Air Force will still be there in most areas. But we have to take the ... forces that were committed down awhile to reconstitute."

Had the AEF concept not already been well along in the works, with a goal of being set up by this October, "we wouldn't know what to recover to, quite honestly," Ryan noted.

The Air Force is "still calculating" what it will need in dollars in order to replace expended munitions, engines, and airplanes that were prematurely worn out, depleted spares kits, and other items. However, "we've gotten superb help out of the Administration and the Congress," Ryan noted, with a supplemental funding bill worth over $13 billion, of which USAF's share will be about $3.8 billion.

"We dropped a lot of munitions [and] ... flew a lot more ... time on the airframes than we expected to," Ryan pointed out. By this month, he expected to know "what it is we need to do right now [in terms of replacements] and what we can afford to push on the budget next year or the year after."

Senior USAF leaders said it will take six months to three years for the Air Force to fully recover from the Balkan War.

Units will be rested and back in the AEF rotation within about six months, while getting them full refresher training— "getting them back to the razor's edge of readiness," said one—and restoring the schedule of deferred exercises may take nearly a year. Buying replacement engines, missiles, bombs, and airplanes—even those already in the pipeline—will take up to three years simply because of the long lead time involved.

"CALCM is a good example," Ryan noted. "We started pushing back in December or January to start rebuilding [the CALCM stocks, even before Allied Force]," he said. "And the quickest we could get started was the November [1999] time frame ... with deliveries a year and a half after that."

Asked whether the Air Force had simply been stretched too thin by taking on a Major Theater War almost on its own, Ryan said it had not been.

"We found, in this case, we were OK for this size operation," he said. The Air Force did exercise Stop-Loss, an executive order which blocks people in key specialties from leaving the services until the cessation of hostilities—but Ryan reported he had very few complaints from those affected.

Disruption and Duty

"Most of them said, 'Yeah, it disrupted my life a little bit, but when there's a war going on, I know what my duty is,' " he related. The Air Force, he said, will do everything possible to help those affected by Stop-Loss to make a smooth transition to a postponed civilian life.

"We owe it to them," he said, "having changed their plans and altered their future."

The EAF structure requires about 2,300 to 2,400 more people to work properly without overtaxing some areas in the future, and Ryan is still not convinced the service has the right answer as to how many more are needed. Based on lessons learned from Allied Force, as much as an additional 2,500 may be required than previously thought.

"We've got a problem that's in the 5,000 [personnel] range," Ryan stated. While much of the problem will be attacked with outsourcing and privatizing, some re-engineering of the force may also be necessary, he allowed.

The operation also pointed up some deficiencies in the force.

"We don't have enough SEAD," Ryan said of Suppression of Enemy Air Defenses assets. USAF retired all its F-4G dedicated SEAD airplanes in Fiscal 1996, replacing some of the capability with the Block 50 F-16C with the HARM Targeting System, now known as the F-16CJ.

"We used almost every one of our Block 50 CJ capability by shipping [them to overseas bases], ... and we had to cease training in the States," Ryan reported. USAF had anticipated the shortfall and had already asked Congress to support purchase of 30 more F-16CJ airplanes in its last budget, but there were a number of such areas where there was inadequate depth in the force structure, he said.

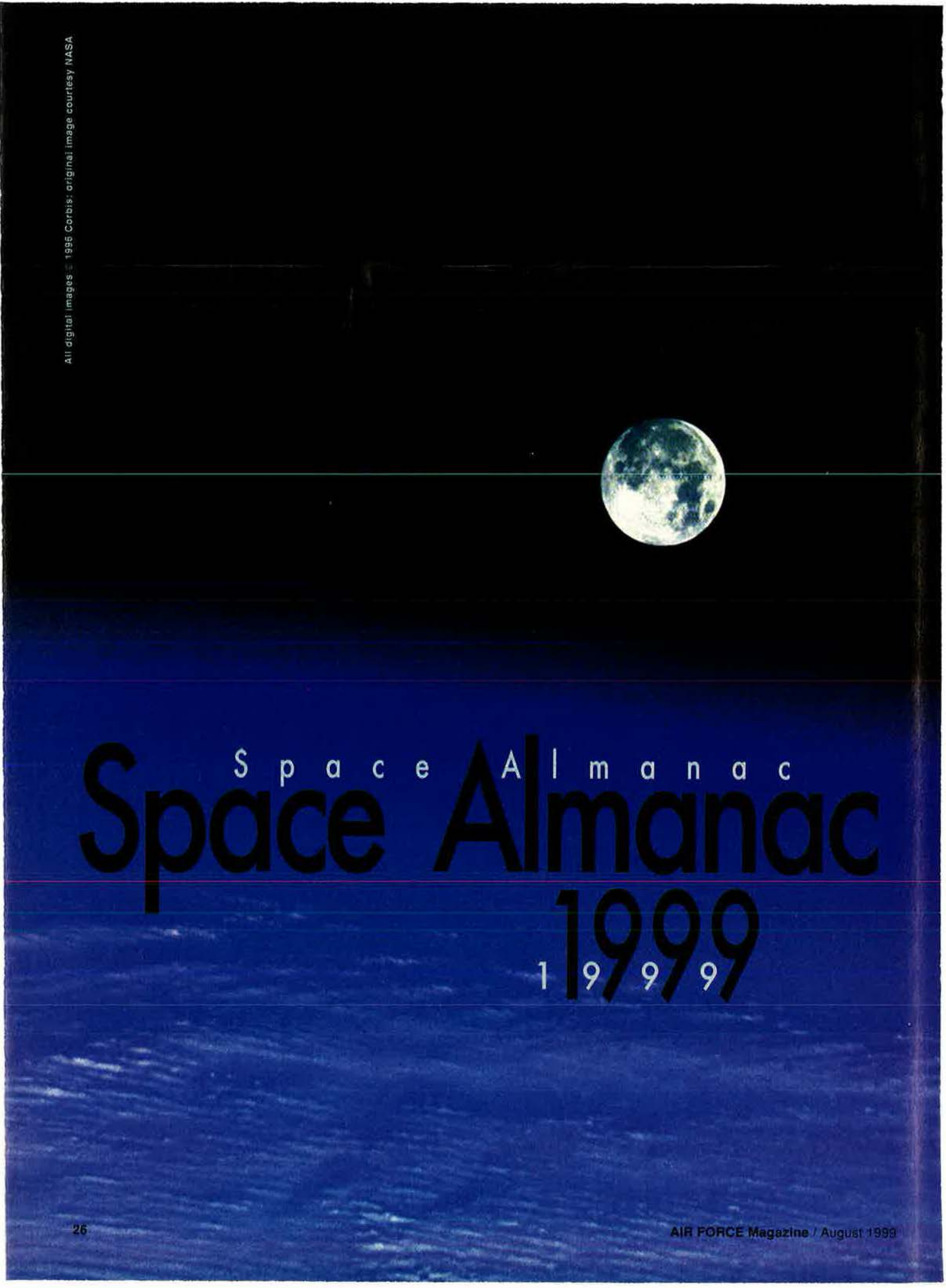
"You'll see us working that in budgets and [program objective memorandums] in the future," he added.

Moreover, Ryan believes the "whole area of electronic warfare" needs to be rethought for the Air Force. He has commissioned a RAND study to work with an in-house Air Force effort to come up with a new electronic warfare plan.

"It can't just be ... pumping electrons," Ryan said. "It has to be a balance between stealth, ... jamming, ... info warfare. They all play in this force protection business."

The formal lessons-learned process for the Air Force will not wait on a final-draft, comprehensive review, Ryan said. He'll settle for increments and the 80 percent solution because of the need to re-equip and restructure the Air Force on the fly. He has dispatched Brig. Gen. (sel.) John D.W. Corley to round up gun camera footage, eyewitness reports, battle damage assessments, and other kinds of data in Europe so that the raw information is not lost. Corley will report to Gen. John P. Jumper, commander of US Air Forces in Europe, "and Jumper to me," Ryan said.

First installments on the subjective lessons learned—like those Ryan mentioned—will form the outline of whatever restructuring needs to be done. Then, the data will undergo "a more objective look" and serve as "our impetus for change," Ryan added. ■



Space Almanac 1999

Earth

Compiled by Tamar A. Mehuron, Associate Editor

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 R.W. Sturdevant, Air Force Space Command 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.

.05g 60,000 miles

Geosynchronous Earth Orbit 22,300 miles

Hard vacuum 1,000 miles

Medium Earth Orbit begins 300 miles

.95g 100 miles

Low Earth Orbit begins 60 miles

Astronaut wings awarded 50 miles

Limit for ramjet engines 28 miles

Limit for turbojet engines 20 miles

Stratosphere begins 10 miles

Space facts from NASA public affairs.

Introduction

What's Here

As of May 99

Country/Organization	Satellites	Spacerobes	Debris	Total
USA	455	3,148	3,908
CIS (Russia/former USSR)	1	355	2,586	3,959
Iridium	0	0	86
Japan	4	51	120
Intl. Telecom Sat. Org.	0	0	56
France	0	16	46
Orbcomm	0	0	28
People's Republic of China	2	102	128
European Space Agency	2	216	242
Globalstar	0	0	20
India	0	5	24
United Kingdom	0	1	19
Canada	0	1	16
European Telecom Sat. Org.	0	0	15
Germany	0	1	18
Intl. Maritime	0	0	9
Italy	0	3	11
Brazil	0	0	8
Indonesia	0	0	8
Luxembourg	0	0	8
NATO	0	0	8
Sweden	0	0	8
Arab Sat. Comm. Org.	0	0	7
Australia	0	2	9
Argentina	0	0	6
Mexico	0	0	6
South Korea	0	0	5
Spain	0	0	5
Czech Republic	0	0	4
Thailand	0	0	4
Asia Sat. Corp.	0	0	3
France/Germany	0	0	3
Israel	0	0	3
Norway	0	0	3
Malaysia	0	0	2
Philippines	0	0	2
Turkey	0	0	2
Chile	0	0	1
Denmark	0	0	1
Egypt	0	0	1
Intl. Space Station	1	0	2
Portugal	0	0	1
Republic of China (Taiwan)	0	0	1
SEAL (SEAL Launch Demo)	0	1	2
STCT (Singapore/Taiwan)	0	1	2
South Africa	0	0	1
Total	489	6,134	8,821

In space, astronauts use a special windup shaver that contains a vacuum device to suck up cut whiskers, which could float about and possibly harm spacecraft equipment.

US astronaut Shannon Lucid who spent 188 days aboard the Soviet space station Mir, is the US spaceflight duration record holder and the world's female record holder.

US space shuttle cockpits are equipped with special "wicket tabs," devices that help astronauts feel and activate controls if their vision becomes temporarily blurred from acceleration or deceleration forces during launch or re-entry.

The Vehicle Assembly Building at the Kennedy Space Center, Fla., is one of the largest buildings in the world—525 feet tall, 716 feet long, and 518 feet wide, with nearly twice the cubic footage of the Pentagon.

Worldwide Launches by Site, 1957–98

Launch Site	Nation	Launches
Plesetsk	Russia	1,452
White Sands Missile Range, N.M.	US	1,112
Tyuratam/Baikonur	Kazakhstan	1,035
Vandenberg AFB, Calif.	US	538
Cape Canaveral AS, Fla.	US	540
Poker Flat Research Range, Alaska	US	274
JFK Space Center, Fla.	US	112
Kapustin Yar	Russia	83
Kourou	French Guiana	113
Tanegashima	Japan	30
Shuang Cheng-tzu/Jiuquan	China	23
Wallops Flight Facility, Va.	US	26
Uchinoura	Japan	23
Xichang	China	25
Indian Ocean Platform	Kenya	9
Sriharikota	India	8
Edwards AFB, Calif.	US	5
Hammaguir	Algeria	4
Taiyuan	China	8
Yavne	Israel	3
Woomera	Australia	2
Svobodny	Russia	2
Gando AFB, Canary Islands	Spain	1
Barents Sea	Russia	1
Total		**5,429**

Space on the Web

(Some of the space-related sites on the World Wide Web)

Defense	***Web address***
US Space Command	www.spacecom.af.mil/usspace
Air Force Space Command	www.spacecom.af.mil/hqafspc
21st Space Wing	www.spacecom.af.mil/21sw
30th Space Wing	www.vafb.af.mil
45th Space Wing	www.patb.af.mil
50th Space Wing	www.schriever.af.mil
Industry	
Boeing Space Systems	www.boeing.com/defense-space/space
Hughes Space & Communications	www.hughespace.com
Lockheed Martin Astronautics *(Click "Cosmic Classroom")*	www.ast.lmco.com
Orbital Sciences	www.orbital.com
Rotary Rocket	www.rotaryrocket.com
Space Systems Loral	www.ssloral.com
TRW	www.trw.com/seg/products.html
NASA	
Integrated Launch Manifest *(Launch forecast for shuttle and NASA payloads on ELVs)*	www-pao.ksc.nasa.gov/kscpao/schedule/mixfleet.htm
Jet Propulsion Laboratory Mission and Spacecraft Library	msl.jpl.nasa.gov/home
Mars Global Surveyor	mars.jpl.nasa.gov/mgs
NASA Human Space Flight	spaceflight.nasa.gov
Upcoming Space Shuttle Launches	www-pao.ksc.nasa.gov/kscpao/schedule/schedule.htm
Other	
European Space Agency	www.esa.int
Florida Today (current and planned space activity)	www.flatoday.com/space

Missile Badges

Missile Badge

onaut Pilot*

ssile Badge

Missile Operations Designator

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

The Year ie

July 4, 1998
M-5 rocket launches Pl be, renamed Nozomi (Hope Kagoshima Space Cen an only the third nation afr a to attempt interplanetar
July 21
Alan B. Shepard Jr., firt into space (May 5, 196 only 12 humans to walk on of leukemia at age 74.
Aug. 12
Titan IVA booster carry Reconnaissance Offic d breaks apart and explo seconds after launch, m six-month suspension and Titan II launches.
Aug. 26
Boeing Delta III booster AmSat Galaxy X commeica- tions satellite fails duringht.
Aug. 31
North Korea apparently t attempt to launch satelli myongsong-1, using muo Dong 1 rocket.
Oct. 3
Space Technology Expe(), first in series of low-cost demonstration satellites overhead intelligence an mission publicly descri ch, achieves orbit via Taurus m Vandenberg AFB, Calif.
Oct. 16
USAF announces its sel Lockheed Martin and Bo a new series of rockets—t Expendable Launch Veh ng the current Delta, Atlas, ets. Boeing is to conduct 19 l Lockheed Martin nine, use Canaveral AS, Fla., and The first launch is schedu.
Oct. 24
NASA's Deep Space 1 last 12 breakthrough technolo g advanced ion propulsion a navigation systems, en ro encounter with asteroid in
Oct. 29
Difficulties in assembling ve linear aerospike engine d ght of X-33 RLV prototype un r.
Oct. 29–Nov. 7
Shuttle *Discovery* returns t John Glenn to space 36 y e became first American to
Nov. 1
Motorola's Iridium—first L rbit (LEO) satellite communica m to use crosslinks—becom nal, thereby creating worldwid telephone network.
Nov. 5
Kodiak Launch Complex, e- brates its first mission whe Sciences launches USAF's Atmospheric Interceptor Te vehicle.
Nov. 16
Air Force space planners us- try to examine potential US a- lions of commercial space cial Space Opportunities Study d- uled for completion in Augu
Nov. 17–18
Leonid meteor storm, potentially largest in 32 years, leaves USAF satellites unharmed, but real-time data compiled during the storm may help prepare for the next Leonid meteor trail.
Nov. 20
Russian Proton rocket launches Zarya, first module of International Space Station (ISS).
Dec. 4–15
Shuttle *Endeavor* completes first ISS assembly mission, connecting Unity module to Zarya, and launches USAF research satellite MightySat I to evaluate composite materials, advanced solar cells, and other technologies.
Dec. 8
NASA selects Boeing for a four-year cooperative agreement to develop the first Future-X flight test bed, designed to be flown in both orbital and re-entry regimes. Boeing's proposal includes on-orbit maneuvering and other capabilities specifically sought for military space applications.
Dec. 11
Mars Climate Orbiter launch begins second installment of NASA program to explore Red Planet robotically.
Jan. 3, 1999
Mars Polar Lander, scheduled to fire two Deep Space 2 microprobes for subsurface exploration before itself setting down near Red Planet's southern polar cap, launches atop Delta II from Cape Canaveral.
Jan. 23
NASA's orbiting Compton Gamma Ray Observatory detects beginning of gamma ray burst and alerts astronomers, who capture first live images of this massive energy producing phenomenon.
Jan. 26
Athena 1 rocket launches Republic of China Satellite 1 (ROCSAT 1), Taiwan's first civil spacecraft, from Spaceport Florida Authority pad at Cape Canaveral.
Jan. 27
The Army announces its approval of Kwajalein Missile Range, Marshall Islands, in the Pacific for commercial space launches.
Feb. 4
After two unsuccessful attempts, Russian cosmonauts abandon plans to unfold 25 meter space mirror, Znamya 2.5, designed to reflect sunlight onto dark portions of Earth. Solar and Heliospheric Observatory (SOHO) spacecraft, which had been completely out of NASA engineers' control between June 24 and Sept. 16, 1998, solves longtime mystery and discovers source of high-speed solar wind.
Feb. 23
First Delta II launched from Vandenberg carries Advanced Research and Global Observation Satellite (ARGOS), first satellite controlled at Kirtland AFB, N.M., satellite control facility from launch to first contact, as well as first Danish and South African satellites—Orsted and SUNSAT, respectively.
March 1
NASA's Lewis Research Center is officially renamed John H. Glenn Research Center to honor Ohio's astronaut senator. Rotary Rocket Co. conducts rollout ceremony at Mojave, Calif., for initial prototype of Roton Atmospheric Test Vehicle (ATV), world's first privately financed, reusable, human-piloted spacecraft.
March 27
Inaugural mission of Sea Launch Co., a Boeing venture with Ukraine and Russia, uses Zenit-3SL booster, launched from Odyssey, a converted oil platform floating in Pacific Ocean 1,400 miles south of Hawaii, to send demonstration satellite into orbit.
April 9
Titan IVB/IUS launch vehicle sends 5,000-pound USAF Defense Support Program (DSP) satellite into improper, highly elliptical orbit.
April 15
NASA's Landsat 7 Earth imaging satellite successfully reaches orbit via Delta II launch from Vandenberg.
April 30
USAF mission to launch latest Milstar satellite fails when Titan IVB/Centaur launched from Cape Canaveral places satellite in improper orbit.
May 1
Curt Newport's remotely operated deep-sea rover locates and photographs astronaut Gus Grissom's Liberty Bell 7 capsule, which sank three miles beneath the surface of the Atlantic after splash-down July 21, 1961.
May 4
US space industry experiences fourth booster malfunction in less than a month when Delta III second-stage failure places Orion 3 communications satellite in wrong orbit.
May 18
Spaceport Systems International announces operating capability of its commercial Spaceport Launch Facility at Vandenberg. First satellite launch is set for fall 1999.
May 19
President Clinton orders DoD to investigate causes for costly string of six US launch vehicle failures in less than nine months and to take corrective actions.
May 22
First Titan IVB launched from Vandenberg carries NRO satellite into orbit, giving US space launch program a welcome shot in the arm after series of failures.
May 25
Hubble Space Telescope Key Project Team announces that, after eight years of precise measurement, it has determined universe's rate of expansion, which is essential to determining universe's age and size.
May 27
NASA releases first global, high resolution, 3 D view of Red Planet as generated by Mars Global Surveyor's Mars Orbiter Laser Altimeter.
June 24
NASA launches Far Ultraviolet Spectroscopic Explorer (FUSE) telescope to discover how primordial elements of universe were created during "Big Bang" and how the cosmos evolved.

Military & Civilian Space Budgets

US Space Funding, Current Dollars

(Millions, as of Sept. 30, 1998)

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	728	24,912
1998	12,321	12,359	768	25,448
Total	**$253,411**	**$267,352**	**$13,552**	**$534,315**

US Space Funding, Constant Dollars

(Millions, as of Sept. 30, 1998)

FY	NASA	DoD	Other	Total
1959	$1,266	$2,377	$165	$3,808
1960	2,198	2,669	205	5,072
1961	4,366	3,838	325	8,529
1962	8,350	6,032	929	15,311
1963	16,659	7,121	1,190	24,970
1964	22,777	7,261	981	31,019
1965	23,016	7,051	1,093	31,160
1966	22,315	7,441	956	30,712
1967	20,803	7,167	930	28,900
1968	18,498	8,026	740	27,263
1969	15,373	8,097	568	24,038
1970	13,665	6,464	443	20,572
1971	11,348	5,533	465	17,346
1972	10,688	4,897	338	15,923
1973	10,275	5,392	362	16,029
1974	8,779	5,620	369	14,768
1975	8,650	5,614	315	14,579
1976	10,807	6,489	379	17,675
1977	8,362	5,863	318	14,543
1978	8,448	6,385	366	15,199
1979	8,779	6,613	386	15,778
1980	9,416	7,742	469	17,626
1981	9,223	8,920	430	18,574
1982	9,298	11,234	523	21,054
1983	9,941	14,168	511	24,620
1984	10,298	15,309	589	26,195
1985	10,050	18,530	842	29,422
1986	10,052	19,818	664	30,533
1987	13,381	22,217	630	36,228
1988	11,033	23,439	977	35,449
1989	12,937	22,943	718	36,598
1990	14,088	19,197	629	33,914
1991	15,399	16,738	823	32,960
1992	14,938	17,002	870	32,810
1993	14,405	15,554	770	30,728
1994	14,020	14,175	647	28,841
1995	13,187	11,190	661	25,038
1996	12,960	11,872	773	25,605
1997	12,607	11,868	737	25,211
1998	12,321	12,359	768	25,449
Total	**$484,973**	**$420,223**	**$24,853**	**$930,049**

Figures may not sum due to rounding. 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 1998 figures are preliminary.

NASA Spending on Major Space Missions

FY 2000 Proposal, Current Dollars

Project Office	Millions
Human spaceflight	$5,468.9
Space science	2,196.6
Earth science	1,459.1
Aerospace technology	1,006.5
Mission communications services	406.3
Life and microgravity sciences	256.2
Safety and mission assurance	43.0
Total	**$10,836.6**

Maximum dynamic pressure, or max Q, is the point when dynamic pressures on the shuttle are greatest. It occurs about one minute after liftoff and at an altitude of 33,600 feet.

Ulf Merbold, a West German, was the first foreign citizen to fly in the shuttle. The launch occurred Nov. 28, 1983.

People & Organizations

Space Leaders

(As of July 1, 1999)

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, 1990–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–Aug. 14, 1998
Gen. Richard B. Myers	Aug. 14, 1998–

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–

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–

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
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–Aug. 14, 1998
Gen. Richard B. Myers	Aug. 14, 1998–

Air Force Space Command Headquarters, Peterson AFB, Colo.

(As of July 1, 1999)

Commander
Gen. Richard B. Myers

- **Space Warfare Center** • Schriever AFB, Colo.
  Commander **Brig. Gen. (sel.) Gary R. Dylewski**

- **14th Air Force** • Hq., Vandenberg AFB, Calif.
  Commander **Maj. Gen. Robert C. Hinson**
  - **21st Space Wing,** Peterson AFB, Colo.
  - **30th Space Wing,** Vandenberg AFB, Calif.
  - **45th Space Wing,** Patrick AFB, Fla.
  - **50th Space Wing,** Schriever AFB, Colo.

- **20th Air Force** • Hq., F.E. Warren AFB, Wyo.
  Commander **Maj. Gen. Thomas H. Neary**
  - **90th Space Wing,** F.E. Warren AFB, Wyo.
  - **91st Space Wing,** Minot AFB, N.D.
  - **341st Space Wing,** Malmstrom AFB, Mont.

Major Military Space Commands

	Personnel	Budget, FY2000	Activities
Unified Command			
US Space Command Peterson AFB, Colo.	851	$42.0 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.	33,669	$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 11,000 contractor personnel and operations and maintenance for seven bases and 50 worldwide sites.
Naval Space Command Dahlgren, Va.	526	$88.9 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.	606	$53.2 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.

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. Eugene L. Tattini**

- **Defense Meteorological Satellite SPO**[1]
- **Launch Programs SPO**
- **Advanced Systems SPO**
- **Satellite and Launch Control SPO**
- **Space & Missile Test & Evaluation Directorate, Kirtland AFB, N.M.**

USAF Program Executive Officer for Space
Brent R. Collins

- **MILSATCOM**[3]
- **Launch Systems**
- **Space Based Infrared System**[3]
- **Evolved Expendable Launch Vehicle**[3]
- **ICBM/National Missile Defense**
- **Navstar Global Positioning System JPO**[2]

USAF Mission Area Director for Space & Nuclear Deterrence
Brig. Gen. John L. Clay

[1]System Program Office [2]Joint Program Office [3]Program offices located at Los Angeles AFB, Calif.

National Imagery and Mapping Agency (NIMA)
Headquarters: Bethesda, Md.
Established: Oct. 1, 1996
Director: Army Lt. 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, for which assembly began 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.; Glenn 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	17,600
Contractors	166,000

National Oceanic and Atmospheric Administration (NOAA)
Headquarters: Washington, D.C.
Established: Oct. 3, 1970
Administrator and Undersecretary for Oceans and Atmosphere: 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	841
Other NOAA employees	12,267
Total	13,108

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 since it was formed in 1960 and officially recognized in 1961. 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, architectures, assessments, and acquisitions, 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 (38 percent), USAF (41 percent), Navy/Marines (5 percent), Army (1 percent), and DoD civilians (16 percent). Exact personnel numbers are classified.

National Security Agency (NSA)
Headquarters: Ft. Meade, Md.
Established: 1952
Director: USAF Lt. Gen. Michael V. Hayden

Mission, Purpose, Operations
Protect US communications and produce foreign intelligence information. Tasked with two primary missions: an information systems security mission and a foreign intelligence information mission. To accomplish these missions, the director's responsibilities include: prescribing security principles, doctrines, and procedures for the government; organizing, operating, and managing certain activities and facilities to produce foreign intelligence information; and conducting defensive information operations.

Structure
Established by a Presidential directive in 1952 as a separately organized 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 signals intelligence and communications security activities of the government. A 1984 Presidential directive charged the agency with an additional mission: computer security. An operations security training mission was added in 1988. 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.

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.

Proven Payloads

TRW's communications payloads exceeded customer expectations when we pioneered them four decades ago. They still do today. Our systems and components deliver reliable service to civil, military and commercial users around the globe.

Our payloads have grown from simple systems containing few parts and interfaces to complex multi-functional units that process data autonomously. TRW's advanced processing payloads and highly capable microelectronics have kept pace with ever expanding requirements, met demands for lower costs and performed with consistent reliability.

TRW: Communications you can count on

TRW

www.trw.com • ISO 9001 Registered

Space Operations

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–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. Sole site for test launches of USAF ICBM fleet. Furnishes facilities and essential services to more than 60 aerospace contractors on base. Base covers 98,400 acres. Originally Army's Camp Cooke, turned over to the Air Force January 1957. Renamed Vandenberg AFB Oct. 4, 1958.

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 Authority
Located 28.5° N, 80° W. State-operated commercial launch sites at Cape Canaveral AS. Launch Complexes 20 and 46 converted to handle small-to-medium-class commercial launch vehicles, boosting satellites into equatorial orbit. Lockheed Martin launched NASA's Lunar Prospector on Jan. 6, 1998, aboard their Athena II and ROCSAT-1 on Jan. 26, 1999, aboard their Athena I. LC 20 is designed for Quick Reaction Program activities and suborbital missions involving Litestar vehicles.

Spaceport Systems Intl. Commercial Spaceport
Located 34.33° N, 120.37° W. Designed to handle polar and near-polar LEO launches. Located adjacent to Vandenberg AFB, Calif. SSI, a limited partnership formed by ITT and California Commercial Spaceport, Inc., declared the facility fully operational in May 1999. Provides both payload processing and launch facilities. Launch complex is capable of handling a variety of small-to-medium launch vehicles, and the payload processing facility can handle small and heavy satellites. SSI has ongoing commercial, NASA, and Air Force contracts for both payload processing and launch.

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 November 1999. Upon completion, KLC will be the only non-federally run commercial launch range in the US. KLC will launch payloads up to 8,000 pounds into polar LEO, primarily communications, remote sensing, and scientific satellites. The KLC is designed for all indoor processing of the payload and launch vehicle.

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.

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
Operate ground-based systems and direct NOAA on the operations of space-based DMSP weather satellite systems to provide solar/geophysical support to the warfighter. Provide data on worldwide and local weather systems affecting combat operations.

Missile Defense
Employ space assets to support identification, acquisition, tracking, and destruction of ballistic and cruise missiles launched against forward deployed US forces, allied forces, or US territory.

Navigation
Operate GPS network. 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 capabilities, while denying their use to the enemy. This mission is assigned to

PACE in the Unified Command

satellite and booster preparation. Conduct launch
n activities. Operate Eastern
ern Ranges to support ballistic
eflight missions.

Early Warning
satellites to give national
arly warning of all possible
events, including launch of
lentify launch locations and
eas. Cue area and point
ystems.

Warning/Attack Assessment
e the NORAD mission calling for
sensors to detect and characattack on US or Canadian
US Space Command carries out
ctical warning in other theaters.

plication
e Command is identifying
future roles, missions, and
which, if authorized by civilian
p for development and deployld attack terrestrial and space
om space in support of national

Of 152 current NASA astronauts, 87 are in, or retired fro tary—37 Navy, 32 Air Force, nine Marine Corps, six Army, two Naval Reserve, Coast Guard.

Of the 293 current and former astronauts, 201 have taken part in a Scouting program, and 40 are Eagle Scouts.

Burning propellants from the shuttle ma engines reach a temperature of 6,000 d Fahrenheit, which is hotter than the boiling poin

In May 1962, NASA crews searched the ocean surface unsucc fully for three hours before finally finding Scott Carpenter bobb in his Aurora 7 capsule, which had landed 250 miles off target.

Non-recyclable waste on the International Space Station will be put on either a Russian return vehicle that will burn up on entering Earth's atmosphere or on a US shuttle which will bring it all the way back to Earth for disposal.

US Military vs. Civilian Launches

(As of Dec. 31, 1998)

Year	Military	Total
1957	0	0
1958	0	7
1959	6	11
1960	10	16
1961	19	29
1962	31	52
1963	26	38
1964	32	57
1965	28	63
1966	32	73
1967	24	58
1968	20	45
1969	16	40
1970	15	29
1971	10	32
1972	11	31
1973	8	23
1974	6	24
1975	7	28
1976	7	26
1977	9	24
1978	8	32
1979	4	16
1980	5	13
1981	5	18
1982	6	18
1983	7	22
1984	12	22
1985	6	17
1986	3	6
1987	6	8
1988	6	12
1989	13	18
1990	13	27
1991	9	18
1992	12	28
1993	13	23
1994	12	26
1995	9	27
1996	11	33
1997	9	37
1998	7	34
Total	**493**	**1,161**

US Satellites in Orbit and Deep Space

(As of Dec. 31, 1998)

Launch Year	Military	NASA & Civilian	Commercial	Total
1958	0	1	0	1
1959	0	4	0	4
1960	2	5	0	7
1961	5	3	0	8
1962	2	9	1	12
1963	8	9	1	18
1964	14	11	0	25
1965	17	18	0	35
1966	15	21	0	36
1967	27	16	0	43
1968	13	13	0	26
1969	15	12	0	27
1970	10	4	0	14
1971	12	3	0	15
1972	8	7	1	16
1973	8	5	0	13
1974	4	4	2	10
1975	5	6	2	13
1976	10	6	6	22
1977	11	4	0	15
1978	14	7	2	23
1979	8	1	2	11
1980	10	1	1	12
1981	5	3	3	11
1982	5	0	6	11
1983	14	4	4	22
1984	15	3	5	23
1985	9	1	4	14
1986	6	1	2	9
1987	10	1	0	11
1988	10	2	4	16
1989	14	3	0	17
1990	23	3	4	30
1991	10	5	2	17
1992	11	4	4	19
1993	13	5	3	21
1994	11	4	5	20
1995	10	5	10	25
1996	15	5	5	25
1997	9	5	66	80
1998	8	10	74	92
Total	**416**	**234**	**219**	**869**

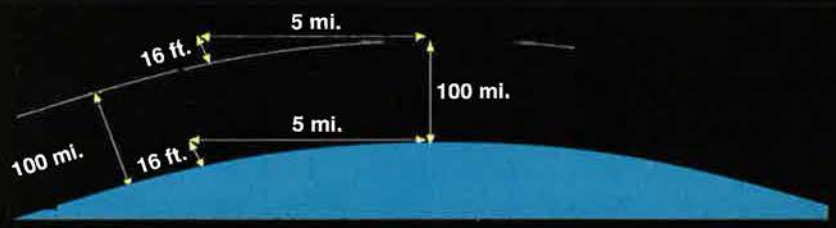
New York has produced 22 astronauts, most of any state. Next is California with 21, and Texas and Ohio, each with 19.

Upcoming Shuttle Flights

Month/Year	Mission	Name
7/1999	**STS-93**	*Columbia*
9/1999	**STS-99**	*Endeavour*
10/1999	**STS-103**	*Discovery*
12/1999	**STS-101**	*Atlantis*
2/2000	**STS-92**	*Discovery*
3/2000	**STS-97**	*Endeavour*
4/2000	**STS-98**	*Atlantis*
6/2000	**STS-102**	*Discovery*
7/2000	**STS-100**	*Endeavour*

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 1g. 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.

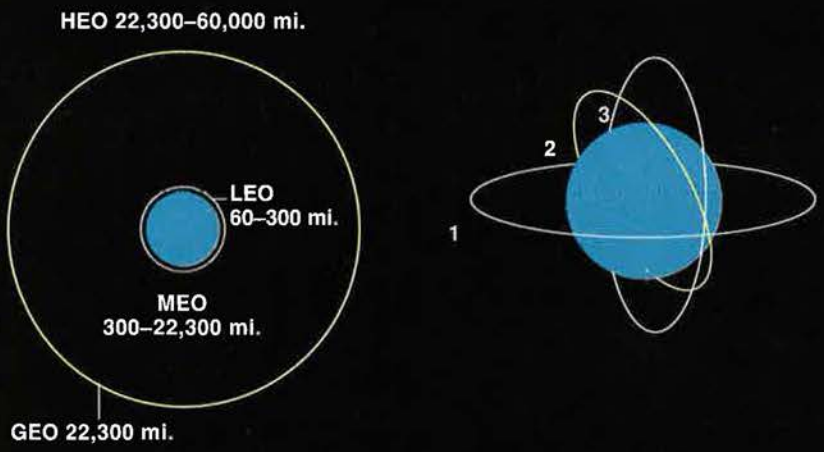


Orbital Altitude

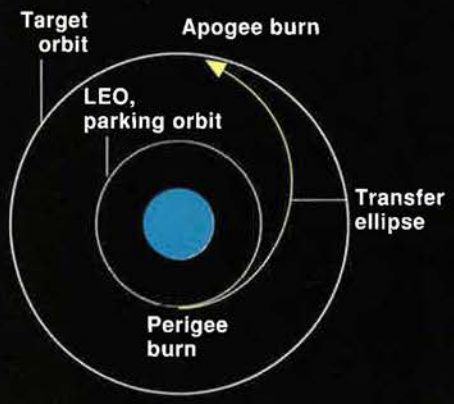
LEO Low Earth Orbit
MEO Medium Earth Orbit
GEO Geosynchronous Earth Orbit
HEO High Earth Orbit

Orbital Inclinations

1 Equatorial
2 Sun synchronous
3 Polar



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.

US Payloads by Mission, 1957–98

Category	Number
Platforms	0
Earth orbital science	230
Automated lunar, planetary	62
Moon	26
Mercury	1
Venus	8
Mars	12
Outer planets	5
Interplanetary space	10
Applications	569
Communications	432
Weather	103
Geodesy	20
Earth resources	12
Materials processing	2
Piloted activities	163
Earth orbital	112
Earth orbital (related)	14
Lunar	20
Lunar (related)	17
Launch vehicle tests	11
General engineering tests	61
Reconnaissance	431
Photographic	249
Electronic intelligence	95
Ocean electronic intelligence	39
Early warning	48
Minor military operations	44
Navigation	84
Theater communication	0
Weapons-related activities	2
Fractional orbital bombardment	0
Anti-satellite targets	2
Anti-satellite interceptors	0
Other military	18
Other civilian	4
Total	1,679

US Manned Spaceflights

Year	Flights	Persons
1961	2	2
1962	3	3
1963	1	1
1964	0	0
1965	5	10
1966	5	10
1967	0	0
1968	2	6
1969	4	12
1970	1	3
1971	2	6
1972	2	6
1973	3	9
1974	0	0
1975	1	3
1976	0	0
1977	0	0
1978	0	0
1979	0	0
1980	0	0
1981	2	4
1982	3	8
1983	4	20
1984	5	28
1985	9	58
1986	1	7
1987	0	0
1988	2	10
1989	5	25
1990	6	32
1991	6	35
1992	8	53
1993	7	42
1994	7	42
1995	7	42
1996	7	43
1997	8	53
1998	5	33
Total	123	606

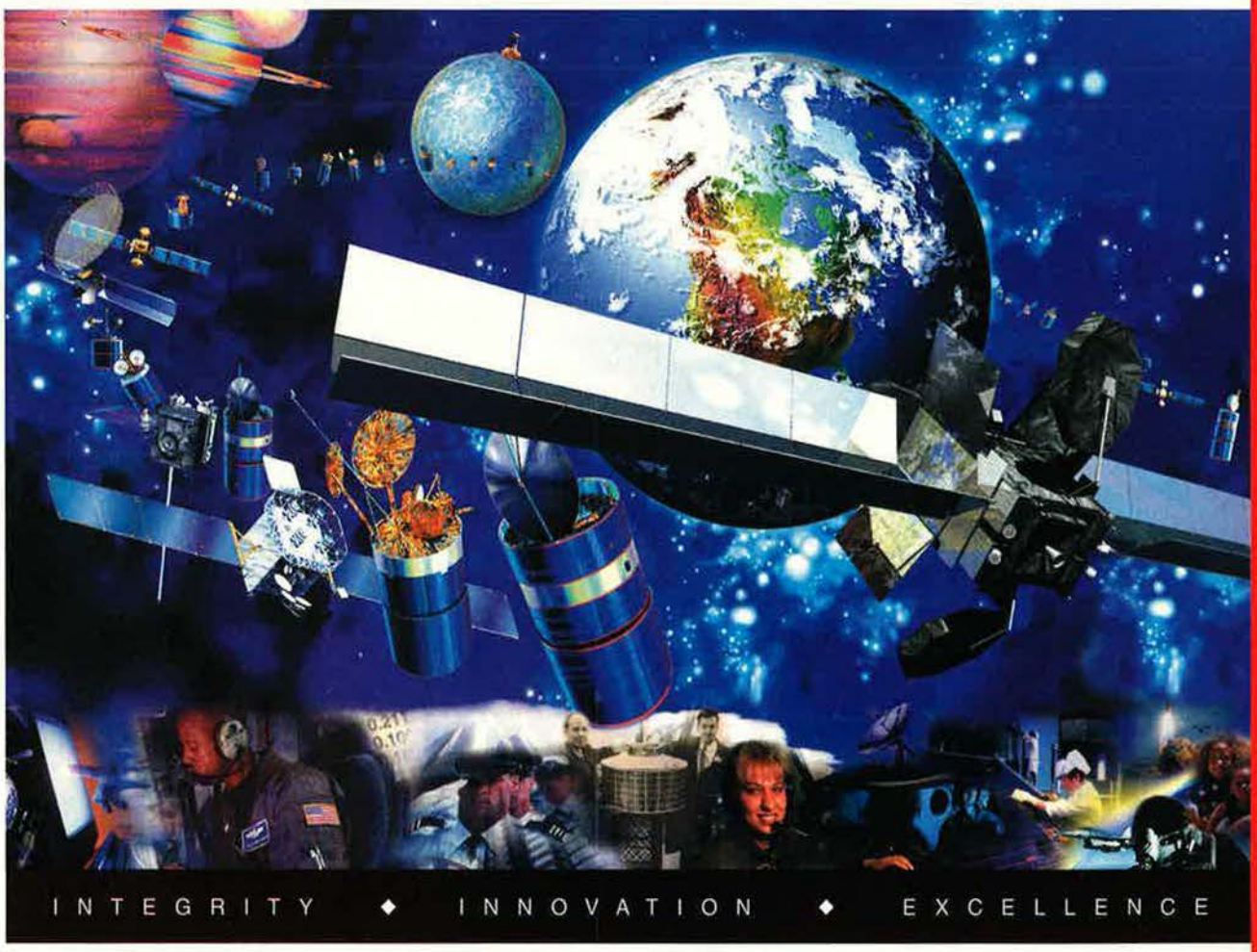
Space Shuttle Flights, 1981–99

(As of June 6, 1999)

Flight	Mission	Launch	Return
1	STS-1	4/12/81	4/14/81
2	STS-2	11/12/81	11/14/81
3	STS-3	3/22/82	3/30/82
4	STS-4	6/27/82	7/4/82
5	STS-5	11/11/82	11/16/82
6	STS-6	4/4/83	4/9/83
7	STS-7	6/18/83	6/24/83
8	STS-8	8/30/83	9/5/83
9	STS-9	11/28/83	12/8/83
10	STS-10	2/3/84	2/11/84
11	STS-11	4/6/84	4/13/84
12	STS-12	8/30/84	9/5/84
13	STS-13	10/5/84	10/13/84
14	STS-14	11/8/84	11/16/84
15	STS-15	1/24/85	1/27/85
16	STS-16	4/12/85	4/19/85
17	STS-17	4/29/85	5/6/85
18	STS-18	6/17/85	6/24/85
19	STS-19	7/29/85	8/6/85
20	STS-20	8/27/85	9/3/85
21	STS-21	10/3/85	10/7/85
22	STS-22	10/30/85	11/6/85
23	STS-23	11/26/85	12/3/85
24	STS-24	1/12/86	1/18/86
25	STS-25	1/28/86	No Landing
26	STS-26	9/29/88	10/3/88
27	STS-27	12/2/88	12/6/88
28	STS-29 (28)	3/13/89	3/18/89
29	STS-30 (29)	5/4/89	5/8/89
30	STS-28 (30)	8/8/89	8/13/89
31	STS-34 (31)	10/18/89	10/23/89
32	STS-33 (32)	11/22/89	11/27/89
33	STS-32 (33)	1/9/90	1/20/90
34	STS-36 (34)	2/28/90	3/4/90
35	STS-31 (35)	4/24/90	4/29/90
36	STS-41 (36)	10/6/90	10/10/90
37	STS-38 (37)	11/15/90	11/20/90
38	STS-35 (38)	12/2/90	12/10/90
39	STS-37 (39)	4/5/91	4/11/91
40	STS-40 (41)	6/5/91	6/14/91
41	STS-43 (42)	8/2/91	8/11/91
42	STS-48 (43)	9/12/91	9/18/91
43	STS-44 (44)	11/24/91	12/1/91
44	STS-39 (40)	4/28/91	5/6/91
45	STS-42 (45)	1/22/92	1/30/92
46	STS-45 (46)	3/24/92	4/2/92
47	STS-49 (47)	5/7/92	5/16/92
48	STS-50 (48)	6/25/92	7/9/92
49	STS-46 (49)	7/31/92	8/8/92
50	STS-47 (50)	9/12/92	9/20/92
51	STS-52 (51)	10/22/92	11/1/92
52	STS-53 (52)	12/2/92	12/9/92
53	STS-54 (53)	1/13/93	1/19/93
54	STS-56 (54)	4/8/93	4/17/93
55	STS-55 (55)	4/26/93	5/6/93
56	STS-57 (56)	6/21/93	7/1/93
57	STS-51 (57)	9/12/93	9/22/93
58	STS-58 (58)	10/18/93	11/1/93
59	STS-61 (59)	12/2/93	12/13/93
60	STS-60 (60)	2/3/94	2/11/94
61	STS-62 (61)	3/4/94	3/18/94
62	STS-59 (62)	4/9/94	4/20/94
63	STS-65 (63)	7/8/94	7/23/94
64	STS-64 (64)	9/9/94	9/20/94
65	STS-68 (65)	9/30/94	10/11/94
66	STS-66 (66)	11/3/94	11/14/94
67	STS-63 (67)	2/3/95	2/11/95
68	STS-67 (68)	3/2/95	3/18/95
69	STS-71 (69)	6/27/95	7/7/95
70	STS-70 (70)	7/13/95	7/22/95
71	STS-69 (71)	9/7/95	9/18/95
72	STS-73 (72)	10/20/95	11/5/95
73	STS-74 (73)	11/12/95	11/20/95
74	STS-72 (74)	1/11/96	1/20/96
75	STS-75 (75)	2/22/96	3/9/96
76	STS-76 (76)	3/22/96	3/31/96
77	STS-77 (77)	5/19/96	5/29/96
78	STS-78 (78)	6/20/96	7/7/96
79	STS-79 (79)	9/16/96	9/26/96
80	STS-80 (80)	11/19/96	12/7/96
81	STS-81 (81)	1/12/97	1/22/97
82	STS-82 (82)	2/11/97	2/21/97
83	STS-83 (83)	4/4/97	4/8/97
84	STS-84 (84)	5/15/97	5/24/97
85	STS-94 (85)	7/1/97	7/17/97
86	STS 85 (86)	8/7/97	8/19/97
87	STS-86 (87)	9/25/97	10/6/97
88	STS-87 (88)	11/19/97	12/5/97
89	STS-89 (89)	1/22/98	1/31/98
90	STS-90 (90)	4/17/98	5/3/98
91	STS-91 (91)	6/2/98	6/12/98
92	STS-95 (92)	10/29/98	11/7/98
93	STS-88 (93)	12/4/98	12/15/98
94	STS-96 (94)	5/27/99	6/6/99

LEGACY

More than **1,000** years on orbit



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Major Military Satellite Systems

Advanced Extremely High Frequency Satellite Communications System

Common name: AEHF
In brief: successor to Milstar, AEHF will provide assured strategic, worldwide C^2 communications with five times the capacity of Milstar II but in a smaller, cheaper package
Function: EHF communications
Operator: MILSATCOM JPO (acquisition); AFSPC
First launch: 2006, planned
Constellation: four
Orbit altitude: 22,300 miles
Contractors: Hughes Space and Communications and TRW for engineering model
Power plant: not available
Dimensions: not available
Weight: approx. 5,357 lb (on orbit)

Defense Meteorological Satellite Program

Common name: DMSP
In brief: spacecraft that provide information about cloud cover, atmospheric moisture, temperature, and other phenomena
Function: weather data collection
Operator: NOAA/AFSPC
First launch: circa 1960s
Constellation: two
Orbit altitude: 500 miles
Contractor: Lockheed Martin
Power plant: solar array, 1,000 watts
Dimensions: width 3 ft 11 in, length 20 ft 2 in (with array deployed)
Weight: 1,750 lb (on orbit)

Defense Satellite Communications System III

Common name: DSCS III
In brief: nuclear-hardened and jam-proof spacecraft used to transmit high-priority C^2 messages to battlefield commanders
Function: SHF communications
Operator: AFSPC
First launch: October 1982
Constellation: five
On orbit: 10
Orbit altitude: 22,300 miles
Contractor: Lockheed Martin
Power plant: solar array, avg. 1,269 watts (pre–System Life Enhancement Program); avg. 1,500 watts (SLEP; first SLEP satellite scheduled for launch in 1999)
Dimensions: rectangular body is 6x6x7 ft; 38-ft span (deployed)
Weight: 2,580 lb (pre–SLEP); 2,716 lb (SLEP)

Defense Support Program

Common name: DSP
In brief: early warning spacecraft whose infrared sensors detect heat generated by a missile or booster plume
Function: strategic and tactical missile launch detection
Operator: AFSPC
First launch: November 1970
Constellation: classified
On orbit: classified
Orbit altitude: 22,218 miles
Contractor: TRW
Power plant: solar array, 1,485 watts
Dimensions: width 22 ft (on orbit), length 32.8 ft (on orbit)
Weight: 5,250 lb

Global Broadcast System

Common Name: GBS
In brief: wideband communications program, initially using leased commercial satellites, then military systems, to provide digital multimedia data directly to theater warfighters
Function: high-bandwidth data imagery and video
Operator: AFSPC
First launch: March 1998 (Phase 2 payload)
Constellation: two
On orbit: two
Orbit altitude: 23,230 miles
Contractor: Raytheon (Phase 2)
Power plant: (interim host satellite: UHF Follow-On)
Dimensions: not available
Weight: 3,410 lb

Global Positioning System

Common name: GPS
In brief: constellation of 24 satellites used by military and civilians to determine a precise location anywhere on Earth
Function: worldwide navigation
Operator: AFSPC
First launch: February 1978
Constellation: 24
Orbit altitude: 12,636 miles (Block IIA); 12,532 miles (Block IIR)
Contractors: Boeing, Lockheed Martin, and Loral Fairchild Systems
Power plant: solar array, 700 watts (Block IIA); 1,136 watts (Block IIR)
Dimensions: width 5 ft, length 17.5 ft (deployed) (Block IIA); length 38 ft (deployed) (Block IIR)
Weight: 2,174 lb (Block IIA, on orbit); 2,370 lb (Block IIR, on orbit)

Milstar Satellite Communications System

Common name: Milstar
In brief: joint communications satellite that provides secure, jam-resistant communications for essential wartime needs
Function: EHF communications
Operator: AFSPC
First launch: Feb. 7, 1994
Constellation: four
On orbit: two
Orbit altitude: 22,300 miles
Contractor: Lockheed Martin
Power plant: solar array, almost 5,000 watts
Dimensions: rectangular body length 51 ft (116 ft deployed)
Weight: approx. 10,000 lb

Polar Military Satellite Communications

Common name: Polar MILSATCOM
In brief: USAF deployed a modified Navy EHF payload on a host polar-orbiting satellite to provide an interim solution for a cheaper alternative to Milstar to ensure warfighters have protected polar communications capability
Function: polar communications
Operator: AFSPC
First launch: late 1997
Constellation: three
On orbit: one
Orbit altitude: 25,300 miles (apogee)
Contractor: classified
Power plant: 410 watts consumed by payload (power from host solar array)
Dimensions: numerous items integrated throughout host
Weight: 470 lb (payload)

Space Based Infrared System

Common name: SBIRS
In brief: advanced surveillance system for missile warning, missile defense, battlespace characterization, and technical intelligence. System includes High (satellites in GEO and HEO) and Low (satellites in LEO) components
Function: infrared space surveillance
Operator: AFSPC
First launch: High planned, FY2002; Low, FY2006
Constellation: not available
On orbit: none
Orbit altitude: High at GEO & HEO; Low, LEO
Contractor: Lockheed Martin (High); Low not awarded
Power plant: not available
Dimensions: not available
Weight: not available

UHF Follow-On Satellite

Common name: UFO
In brief: new generation of satellites providing secure, anti-jam communications; replaced FLTSATCOM satellites
Function: UHF and EHF communications
Operator: Navy
First launch: March 25, 1993
Constellation: eight
On orbit: eight
Orbit altitude: 22,300 miles
Contractor: Hughes Space & Communications
Power plant: solar array, 2,500–3,800 watts
Dimensions: length 60 ft (F-2–F-7); 86 ft (F-8–F10) (deployed)
Weight: 2,600–3,400 lb

Wideband Gap-Filler System

Common name: WGS
In brief: high data rate satellite broadcast system meant to bridge the communications gap between current systems—DSCS and GBS—and an advanced wideband system, tentatively scheduled for launch in Fiscal 2008
Function: wideband communications and point-to-point service (Ka-band frequency)
Operator: AFSPC
First launch: FY2004, planned
Constellation: three
Orbit altitude: not available
Contractor: TBD
Power plant: TBD
Dimensions: TBD
Weight: TBD

Dark and Spooky

A number of intelligence satellites are operated by US 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 essentially open secrets but 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

Common name: ACTS
In brief: technology demonstration satellite for new types of Ka-band communications technologies
Function: communications
Operator: NASA
First launch: Sept. 12, 1993
Constellation: one
Orbit altitude: 22,300 miles
Contractor: Lockheed Martin
Power plant: solar array, 1,400 watts
Dimensions: width 29.9 ft, length 47.1 ft (deployed)
Weight: 3,250 lb

Geostationary Operational Environmental Satellite

Common name: GOES
In brief: hovers over the equator to collect weather data for short-term forecasting.
Function: storm monitoring and tracking, meteorological research
Operator: NOAA
First launch: Oct. 16, 1975 (GOES-1)
Constellation: two
Orbit altitude: 22,300 miles
Contractor: Space Systems/Loral
Power plant: solar array, 1,050 watts
Dimensions: 6.6-ft cube, length 88.6 ft (deployed)
Weight: 4,600 lb

Globalstar

Common name: Globalstar
In brief: mobile communications with provision for security controls
Function: communications
Operator: Globalstar L.P.
First launch: February 1998
Constellation: 48
Orbit altitude: 877 miles
Contractor: Space Systems/Loral
Power plant: solar array, 1,100 watts
Dimensions: width 4.9 ft, length 35.3 ft (deployed)
Weight: 990 lb

Inmarsat

Common name: Inmarsat
In brief: sometimes used for peacetime mobile communications services
Function: communications
Operator: International Maritime Satellite Organization
First launch: February 1982 (first lease), October 1990 (first launch)
Constellation: four
Orbit altitude: 22,300 miles
Contractor: Lockheed Martin (Inmarsat 3)
Power plant: solar array, 2,800 watts
Dimensions: width 6.9 ft, length 5.9 ft, 57.8 ft (deployed)
Weight: 4,545 lb (Inmarsat 3)

Intelsat

Common name: Intelsat
In brief: routine communications and distribution of Armed Forces Radio and TV Services network
Function: communications
Operator: International Telecommunications Satellite Organization
First launch: April 6, 1965 (Early Bird)
Constellation: 19
Orbit altitude: 22,300 miles
Contractor: Lockheed Martin (Intelsat 8)
Power plant: solar array, 4,800 watts
Dimensions: width 8.3 x 7.2 ft, length 11.3 ft, 35.4 ft (deployed) (Intelsat 8)
Weight: 7,480 lb (Intelsat 8)

Iridium

Common name: Iridium
In brief: voice, fax, data transmission
Function: mobile communications
Operator: Iridium LLC
First launch: May 5, 1997
Constellation: 66
Orbit altitude: 484 miles
Contractor: Motorola
Power plant: solar array, 590 watts
Dimensions: diameter 3.3 ft, length 13.5 ft
Weight: 1,516 lb

Landsat

Common name: Landsat
In brief: imagery use includes mapping and planning for tactical operations
Function: remote sensing
Operator: NASA/NOAA
First launch: July 23, 1972
Constellation: one
Orbit altitude: 437 miles (polar)
Contractor: Lockheed Martin
Power plant: solar array, 1,550 watts
Dimensions: diameter 9 ft, length 14 ft
Weight: 4,800 lb

Loral Orion

Common name: Orion
In brief: commercial satellite-based, rooftop-to-rooftop communications for US Army and other DoD agencies
Function: communications
Operator: Loral Orion
First launch: November 1994
Constellation: three
Orbit altitude: 22,300 miles
Contractor: Space Systems/Loral (Orion 2)
Power plant: solar array, 7,000 watts
Dimensions: width 5.6 ft, length 6.9 ft, 72.2 ft (deployed)
Weight: 8,360 lb (Orion 2)

NOAA-14 (NOAA-J) and NOAA-15 (NOAA-K)

Common name: NOAA (with number on orbit) (also known as Television Infrared Observation Satellite or TIROS)
In brief: weather updates for all areas of the world every six hours
Function: long-term weather forecasting
Operator: NOAA (on-orbit); NASA (launch)
First launch: October 1978 (TIROS-N)
Constellation: two
Orbit altitude: 530 miles
Contractor: Lockheed Martin
Power plant: solar array, 1,000+ watts
Dimensions: diameter 6.2 ft, length 13.8 ft (NOAA-15)
Weight: 3,245 lb (NOAA-15)

Orbcomm

Common name: Orbcomm
In brief: potential military use under study in Joint Interoperability Warfighter Program
Function: mobile communications
Operator: Orbcomm Global LP
First launch: April 1995
Constellation: 28
Orbit altitude: 500–1,200 miles
Contractor: Orbital Sciences
Power plant: solar array, 220 watts
Dimensions: width 7.3 ft, length 14.2 ft
Weight: 90 lb

Satellite Pour l'Observation de la Terre

Common name: SPOT
In brief: terrain images used for mission-planning systems, terrain analysis, and mapping
Function: remote sensing
Operator: SPOT Image S.A. (France)
First launch: Feb. 22, 1986
Constellation: three
Orbit altitude: 509 miles
Contractor: Matra Marconi Space France
Power plant: solar array, 2,100 watts (SPOT 4)
Dimensions: 6.6 x 6.6 x 18.4 ft (SPOT 4)
Weight: 5,940 lb (SPOT 4)

Tracking and Data Relay Satellite System

Common name: TDRS
In brief: global network that allows other spacecraft in LEO to communicate with a control center without an elaborate network of ground stations
Function: communications relay
Operator: NASA
First launch: April 1983
Constellation: three
Orbit altitude: 22,300 miles
Contractor: TRW
Power plant: solar array, 1,800 watts
Dimensions: width 45.9 ft, length 57.4 ft (deployed)
Weight: 5,000 lb

Major US Launchers in Military Use

Athena I

Function: low- to medium-weight spacelift
Operator: commercial (AFSPC oversight)
First launch: Aug. 22, 1997
Launch site: CCAS, VAFB
Contractor: Lockheed Martin
Stages: two
Propulsion: stage 1 (Thiokol Castor 120 Solid Rocket Motor), 435,000 lb thrust; stage 2 (Pratt & Whitney Orbus 21D SRM), 43,723 lb thrust
Dimensions: length 62 ft, max body diameter 7.75 ft
Weight: 146,264 lb
Payload max: 1,750 lb to LEO

Athena II

Function: low- to medium-weight spacelift
Operator: commercial (AFSPC oversight)
First launch: Jan. 6, 1998
Launch site: CCAS, VAFB
Contractor: Lockheed Martin
Stages: three
Propulsion: stages 1–2 (Castor 120 SRMs), 435,000 lb thrust; stage 3 (Orbus 21D SRM), 43,723 lb thrust
Dimensions: length 93 ft, max body diameter 7.75 ft
Weight: 266,000 lb
Payload max: 4,350 lb to LEO

Atlas II

Function: medium-weight spacelift
Variants: IIA and IIAS
Operator: commercial (AFSPC oversight)
First launch: Dec. 7, 1991; Feb. 10, 1992 (USAF)
Launch site: CCAS, VAFB
Contractor: Lockheed Martin
Stages: two
Propulsion: (IIA and IIAS) stages 1–2 (Boeing MA-5A), 490,000 lb thrust; (IIAS) four strap-on Castor IVA SRMs
Dimensions: length 82 ft, max body diameter 10 ft
Weight: with large payload fairing (IIA) 408,800 lb; (IIAS) 515,333 lb
Payload max: (IIA) 14,500 lb to LEO; (IIAS) 19,050 lb to LEO

Delta II

Function: medium-weight spacelift
Operator: commercial (AFSPC oversight)
First launch: Feb. 14, 1989
Launch site: CCAS, VAFB
Contractor: Boeing
Stages: up to three
Propulsion: stage 1 (Boeing RS-27A), 237,000 lb thrust; stage 2 (Aerojet AJ10-118K), 9,753 lb thrust; stage 3 (Thiokol STAR 48B SRM), 14,920 lb thrust; nine strap-on SRMs (Alliant Techsystems), 100,270 lb thrust
Dimensions: length 125.2 ft, diameter 8 ft
Weight: 511,190 lb
Payload max: 11,330 lb to LEO

Delta III

Function: medium-weight spacelift
Operator: commercial (AFSPC oversight)
First launch: Aug. 26, 1998
Launch site: CCAS
Contractor: Boeing
Stages: up to two
Propulsion: stage 1 (RS-27A), 237,000 lb thrust; stage 2 (Pratt & Whitney RL10B-2), 9,750 lb thrust; nine strap-on SRMs (Alliant Techsystems), 100,270 lb thrust
Dimensions: length 148 ft, diameter 13 ft
Weight: 663,200 lb
Payload max: 18,200 lb to LEO

Evolved Expendable Launch Vehicle

Function: medium/heavy spacelift
Variants: Delta IV Medium/Heavy; Atlas V Intermediate/Heavy
Operator: commercial (AFSPC oversight)
First launch: (Medium) planned first goverment, FY2002; (Heavy) planned first government, FY2003
Launch site: CCAS, VAFB
Contractors: Boeing (19 launches) and Lockheed Martin (nine launches)
Stages: Delta IV: two; Atlas V: two
Propulsion: Delta IV: Rocketdyne RS-68 (Heavy, two additional core engines), 650,000 lb thrust; stage 2 (Medium), P&W RL10B-2, 9,750 lb thrust. Atlas V: RD AMROSS LLC RD-180 (Heavy, two additional core engines), 860,200 lb thrust; stage 2 (both) Centaur, one or two P&W RL10A-4s, 44,600 lb thrust total
Dimensions: Delta IV: length 235 ft, diameter (Medium) 13 ft, (Heavy) 16.7 ft. Atlas V: length 89 ft, diameter 12.5 ft
Weight: Atlas V, 734,850 lb–1.2 million lb
Payload max: (medium) 2,500 lb to LEO; (heavy) 45,000 lb to LEO

Pegasus

Function: low-weight spacelift
Variants: Standard and XL
Operator: commercial (AFSPC oversight)
First launch: (Standard) April 5, 1990; (XL) June 27, 1994
Launch site: dropped from L-1011 aircraft
Contractor: Orbital Sciences
Stages: three
Propulsion: (XL) stage 1, 109,400 lb thrust; stage 2, 27,600 lb thrust; stage 3, 7,800 lb thrust (all Alliant Techsystems)
Dimensions: length 49 ft, wingspan 22 ft, diameter 4.17 ft
Weight: 42,000 lb
Payload max: (Standard) 850 lb to LEO; (XL) 1,050 lb to LEO

Space Shuttle

Function: heavy-weight manned spacelift
Operator: United Space Alliance (NASA contract)
First launch: April 12, 1981
Launch site: Kennedy Space Center, Fla.
Contractor: Boeing
Stages: delta-winged orbiter
Propulsion: three main engines, 394,000 lb thrust; two SRMs, 3.3 million lb thrust
Dimensions: system length 184.2 ft; span 76.6 ft
Weight: 4.5 million lb (gross)
Payload max: 55,000 lb to LEO

Taurus

Function: low-weight spacelift
Operator: commercial (AFSPC oversight)
First launch: March 13, 1994
Launch site: CCAS, VAFB, Wallops Is.
Contractor: Orbital Sciences
Stages: three
Propulsion: Castor 120 SRM, 495,400 lb thrust; stage 1, 109,140 lb thrust; stage 2, 26,900 lb thrust; stage 3, 7,200 lb thrust (stages 1–3, Alliant Techsystems)
Dimensions: length 89 ft, max body diameter 7.6 ft
Weight: 50,000 lb
Payload max: 3,000 lb to LEO

Titan II

Function: low- to medium-weight spacelift
Operator: commercial (AFSPC oversight)
First launch: April 8, 1964 (NASA); Sept. 5, 1988 (USAF)
Launch site: VAFB
Contractor: Lockheed Martin
Stages: two
Propulsion: stage 1, 430,000 lb thrust; stage 2, 100,000 lb thrust (both Aerojet)
Dimensions: length 94 ft, diameter 10 ft
Weight: 408,000 lb
Payload max: 4,200 lb to polar LEO

Titan IVB

Function: heavy-weight spacelift
Operator: commercial (AFSPC oversight)
First launch: (IVB) Feb. 23, 1997
Launch site: CCAS, VAFB
Contractor: Lockheed Martin
Stages: two; may add Centaur or Inertial Upper Stages
Propulsion: two SRM Upgrades (Alliant Techsystems), 1.7 million lb thrust each; stage 1 (LR87-AJ-11), 552,500 lb thrust; stage 2 (LR91-AJ-11), 105,000 lb thrust (stages 1–2, Aerojet); Centaur, 33,000 lb thrust; IUS (Boeing), 41,700 lb thrust
Dimensions: length (stage 1–2) 119.2 ft, diameter 10 ft
Weight: 1.9 million lb
Payload max: 47,800 lb to LEO

Selected NASA Projects Fiscal 2000 Proposal (Current Dollars)

■ **Cassini, no new FY2000 funding, activity ongoing.** 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.

■ **Chandra X-ray Observatory, $60.7 million.** Space science. The Advanced X-ray Astrophysics Facility (AXAF) spacecraft was renamed the Chandra X-ray Observatory in December 1998 after the late American Nobel Laureate Subrahmanyan Chandrasekhar, who made key contributions to the study of black holes and other phenomena. The observatory's mission is to study such interstellar phenomena, as well as the composition and nature of galaxies and stellar objects. Scheduled for launch aboard the space shuttle in July 1999.

■ **Discovery, $180.5 million.** Space science. Lunar Prospector launched in January 1998. In March 1998, its instruments detected significant amounts of water–ice in the shaded polar regions. The Stardust mission, launched 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, $663.2 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 1999.

■ **Explorer, $151.0 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 1998 to 2001.

■ **Galileo, no new FY2000 funding, activity ongoing.** Space science, planetary exploration. Funds to support operations of mission to explore Jupiter and its moons.

■ **Mars Surveyor, $250.7 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 launched December 1998, and the first lander launched January 1999.

■ **New Millennium Spacecraft, $16.1 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, launched in October 1998, tested several new technologies during its flight. Deep Space 2 spacecraft was launched in January 1999, attached to the Mars Polar Lander. DS 2 will develop and validate technologies and systems to deliver small packages to the surface and subsurface of Mars.

■ **Relativity (Gravity Probe B), $40.5 million.** Space science. Major test of Einstein's general theory of relativity. Development of a gravity probe. Launch is scheduled for October 2000.

■ **Space shuttle, $3.0 billion.** Spaceflight. Program emphasizes continuing improvement of safety margins, fulfillment of the flight manifest, reduction of costs, and launch of eight flights for Fiscal 2000 and nine in Fiscal 2001.

■ **International Space Station, $2.5 billion.** Spaceflight. International manned space facility. Ultimate capacity for seven persons. The first three inhabitants will arrive in early 2000, aboard a Soyuz rocket. ISS Commander Bill Shepherd will be the first US astronaut to live in the station, along with Russian cosmonauts Sergei Krikalev and Yuri Gidzenko. Station scientists will eventually be able to conduct experiments in six research facilities, including biotechnology and gravitational biology facilities.

■ **Russian Program Assurance, $200,000.** Spaceflight. Program provides for contract with Russian Space Agency for services and hardware and joint activities with Russia on the Mir and ISS. The ninth and final joint shuttle–Mir mission took place in June 1998.

■ **Other space operations, $375.1 million.** Space science. Operation of Hubble Space Telescope, the Chandra X-ray Observatory 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.

Foreign Space Acti

Russian Operational Spacecraft

(As of Dec. 31, 1998)

Mission	Type	Number
Communications	Kosmos (Strela-3)	15
	Gonets-D	6
	Raduga/Raduga-1	5
	Gorizont	10
	Molniya-1	4
	Molniya-3	4
	Kosmos (Geizer)	2
	Luch-1	1
	Ekran-M	1
	Ekspress	2
	Gals	2
Navigation	Kosmos GLONASS	20
	Kosmos (military)	6
	Kosmos (civil)	4
Meteorology	Meteor-3	1
Early warning	Kosmos (Oko)	6
	Kosmos (Prognoz)	2
Electronic intelligence	Kosmos (Tselina-2)	2
	Kosmos (FORSAT)	1
Photoreconnaissance	Yantar-1 KFT	1
	Kosmos (Yantar-4K class)	2
	Kosmos (Arkon-1)	1
Remote sensing	Okean-O	2
	Resurs-01	2
	Sich	1
Geodesy	Kosmos (Etalon)	2
	Kosmos (GEO-IK)	1
Space station activity	Mir	1
	Kvant-1	1
	Kvant-2	1
	Kristall	1
	Spektr	1
	Priroda	1
	Soyuz TM	1
	Progress M	1
	Zarya (ISS)	1

Russian Payloads by Mission, 1957–98

(As of Dec. 31, 1998)

Platforms	**498**
Earth orbital science	**211**
Automated lunar, planetary	**86**
Moon	34
Mercury	0
Venus	33
Mars	19
Outer planets	0
Interplanetary space	0
Applications	**520**
Communications	304
Weather	74
Geodesy	34
Earth resources	98
Materials processing	10
Piloted activities	**249**
Earth orbital	87
Earth orbital (related)	154
Lunar	0
Lunar (related)	8
Launch vehicle tests	**22**
General engineering tests	**4**
Reconnaissance	**1,094**
Photographic	801
Electronic intelligence	132
Ocean electronic intelligence	83
Early warning	78
Minor military operations	**161**
Navigation	**218**
Theater communication	**535**
Weapons-related activities	**56**
Fractional orbital bombardment	18
Anti-satellite targets	18
Anti-satellite interceptors	20
Other military	**1**
Other civilian	**2**
Total	**3,657**

A shuttle pilot does not deploy the orbiter's landing gear until the spacecraft reaches an altitude of only 250 feet above ground level and a speed of less than 345 mph.

i t i e s

Russian Military vs. Civilian Launches

(As of Dec. 31, 1998)

Year	Military	Civilian	Total
1957	0	2	2
1958	0	1	1
1959	0	3	3
1960	0	3	3
1961	0	6	6
1962	5	15	20
1963	7	10	17
1964	15	15	30
1965	25	23	48
1966	27	17	44
1967	46	20	66
1968	49	25	74
1969	51	19	70
1970	55	26	81
1971	60	23	83
1972	53	21	74
1973	58	28	86
1974	52	29	81
1975	60	29	89
1976	74	25	99
1977	69	29	98
1978	60	28	88
1979	60	27	87
1980	64	25	89
1981	59	39	98
1982	68	33	101
1983	58	40	98
1984	63	34	97
1985	64	34	98
1986	63	28	91
1987	62	33	95
1988	53	37	90
1989	42	32	74
1990	45	30	75
1991	30	29	59
1992	32	22	54
1993	26	21	47
1994	26	22	48
1995	15	17	32
1996	8	17	25
1997	10	18	28
1998	9	15	24
Total	**1,623**	**950**	**2,573**

Launches

1, 1998)

	Launches	Spacecraft
Communications	3	8
Photoreconnaissance	3	3
Unmanned space stat	3	3
Navigation	3	5
Manned flight	2	2
Commercial/Foreign	6	18
Remote sensing	1	1
Early warning	2	2
Space station module	1	1
Amateur radio	*	1
Total	**24**	**44**

*Launched on Progress-M 4 resupply mission.

Russian Site Activity

1, 1998)

Spacecraft	Number of launches
Baikonur Cosmodrom, Kazakhstan	
Proton-K	7
Soyuz-U	7
Zenit-2	2
Total	**16**
Plesetsk Cosmodrom, Russia	
Tsyklon-3	1
Kosmos-3M	2
Soyuz-U	1
Molniya-M	3
Total	**7**
Barents Sea (submarine)	
Shtil-1*	1
Total	**1**

*Launched from submerged Barents Sea, world's first satellite launch from a submarine.

Russian Manned Flights

Year	Flights*
1961	2
1962	2
1963	2
1964	3
1965	2
1966	0
1967	1
1968	1
1969	11
1970	2
1971	6
1972	0
1973	4
1974	6
1975	8
1976	6
1977	6
1978	10
1979	4
1980	13
1981	6
1982	8
1983	5
1984	9
1985	5
1986	2
1987	8
1988	9
1989	2
1990	7
1991	6
1992	6
1993	5
1994	8
1995	6
1996	5
1997	5
1998	6
Total	**197**

*Total number of persons in space in a given year. (Individuals may have multiple flights.)

Space

Nation	Persons	Nation	Persons
Afghanistan	1	Mongolia	1
Austria	1	Netherlands	1
Belgium	1	Poland	1
Bulgaria	2	Romania	1
Canada	7	Russia	89
Cuba	1	Saudi Arabia	1
Czechoslovakia	1	Slovakia	1
France	8	Switzerland	1
Germany	8	Syria	1
Hungary	1	Ukraine	1
India	1	United Kingdom	1
Italy	3	United States	243
Japan	5	Vietnam	1
Mexico	1		384

*Individuals who have flown in space

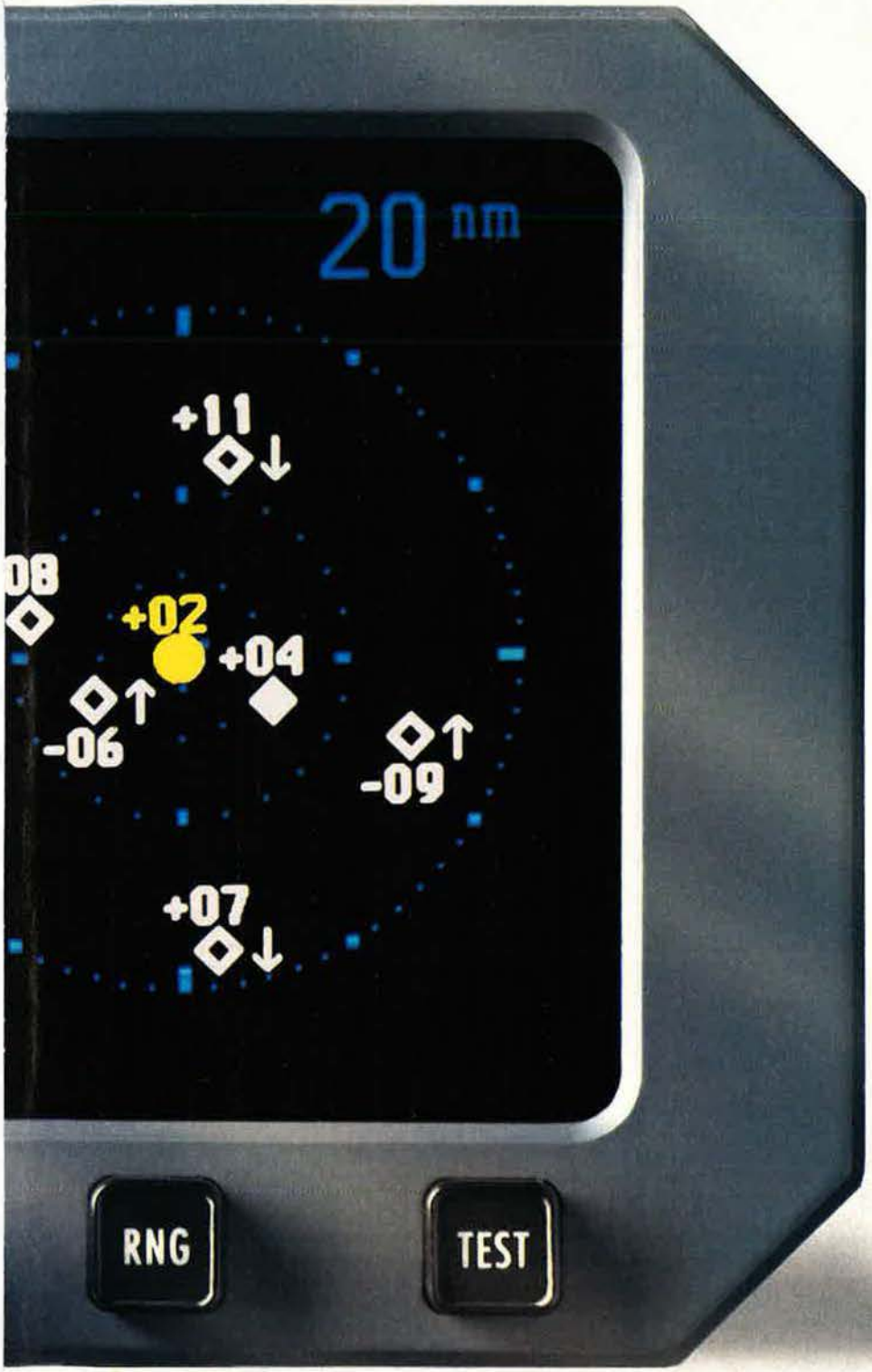
Payloads in Orbit

Launcher/operator	Objects	Launcher/operator	Objects
Argentina	6	Luxembourg	8
Australia	7	Malaysia	2
Brazil	8	Mexico	6
Canada	15	NATO	8
Chile	1	Norway	3
China	26	Philippines	2
Czechoslovakia	4	Portugal	1
Egypt	1	Russia	1,374
ESA	36	Saudi Arabia	6
France	34	Singapore	1
France/Germany	2	South Korea	4
Germany	18	Spain	5
India	17	Sweden	8
Indonesia	8	Thailand	4
Israel	3	Turkey	2
Italy	7	United Kingdom	26
ITSO*	56	United States	869
Japan	67	**Total**	**2,645**

*International Telecommunications Satellite Organization

Other Launches

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	
1998		6	2	11		
Total	**10**	**56**	**53**	**107**	**8**	**3**



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Space Lore

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/Agena 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/Agena 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. 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 Kosmos 139 anti-satellite 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 Kosmos 248 and Kosmos 249 spacecraft carry out first co-orbital anti-satellite 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 IIIC 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.
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 anti-satellite 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
Space shuttle *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 LEO.
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 Gaspra, 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.
July 5
One day after Mars Pathfinder lands on surface of Red Planet, Sojourner rover becomes first mobile, semiautonomous, robotic vehicle to traverse another planet's surface.
May 29, 1998
First transfer of operational military space system to civilian agency occurs when Air Force hands to NOAA control of DMSP spacecraft.
June 17
Hughes completes first commercial mission to moon, having used dual lunar flybys to maneuver errant HGS-1 satellite into usable, geosynchronous orbit.

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.

The first shuttle orbiter, the *Enterprise,* was supposed to be named *Constitution,* but fans of the popular TV program "Star Trek" mounted a successful write-in campaign convincing the White House to name the vehicle after the show's famous starship.

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The Golden Age of NASA

Name	**Project Mercury**
Duration	**Nov. 3, 1958–May 16, 1963**
Cost	$392.1 million (cost figures are in then-year dollars)
Distinction	First US manned spaceflight program
Highlight	Astronauts are launched into space and returned safely to Earth
Number of flights	Six
Key events	**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	**Project Gemini**
Duration	**Jan. 15, 1962–Nov. 15, 1966**
Cost	$1.3 billion
Distinction	First program to explore docking, long-duration flight, rendezvous, space walks, and guided re-entry
Highlight	Dockings and rendezvous techniques practiced in preparation for Project Apollo
Number of flights	10
Key events	**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 re-entry
Name	**Project Apollo**
Duration	**July 25, 1960–Dec. 19, 1972**
Cost	$24 billion
Distinction	Space program that put humans on the moon
Highlights	Neil Armstrong steps onto lunar surface. Twelve astronauts spend 160 hours on the moon
Number of flights	11
Key events	**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

Astronauts Mark E. Kelly and Scott J. Kelly, members of the 1996 group, are twins, the only siblings ever selected.

Anthony W. England, accepted for astronaut training in 1967 at age 25, is the youngest person ever accepted into the program. He flew only one mission, in 1985.

Patterns begin to emerge from the operational data.

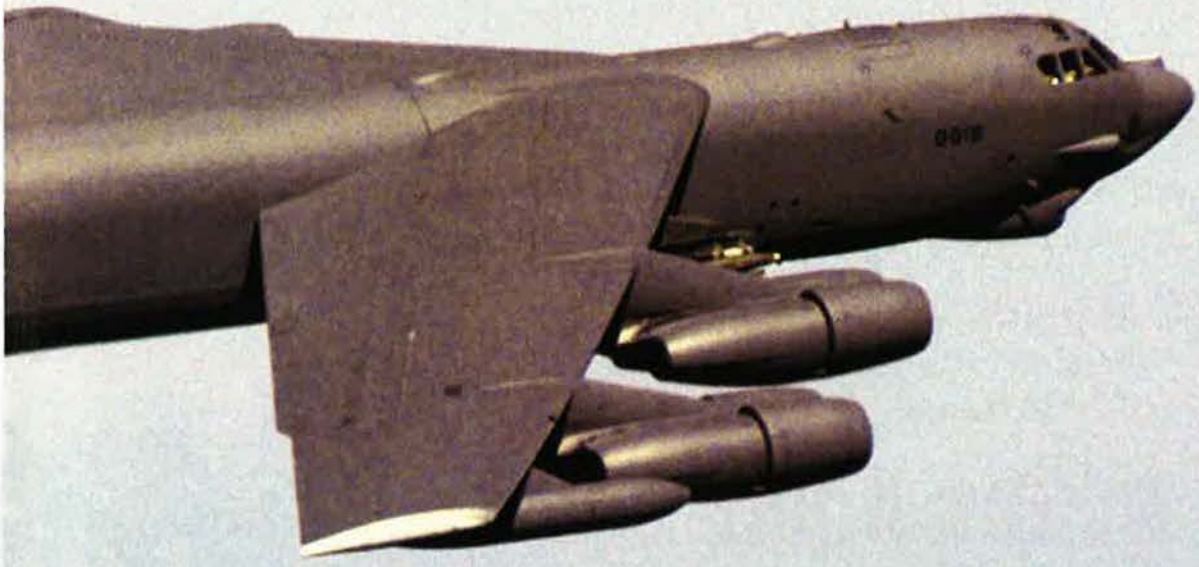
"The crews who flew the bombers, fighters, and support aircraft carried out the most precise air campaign in history." With those words, Defense Secretary William S. Cohen lauded the performance of US and Allied airpower in Operation Allied Force, NATO's 78-day attack on the

Echoes Fron

This 2nd Air Expeditionary Group B-52H heads toward Kosovo from RAF Fairford, UK, for a bombing run during Operation Allied Force. The 2nd AEG included crews and aircraft from Barksdale AFB, La., and Minot AFB, N.D.

Yugoslavian regime's brutal offensive in Kosovo. The United States—and especially USAF—dominated the campaign, a fact made inevitable by America's near-monopoly on precision weapons. The attacks forced Belgrade to capitulate on June 9.

n Allied Force



USAF photo by SrA. Greg Davis

KOSOVO

MILITARY DEPLOYMENT/HUMANITARIAN RELIEF

1,092 MISSIONS

98,280,000 LBS. OF CARGO

TANKS, TROOPS, & HELICOPTERS

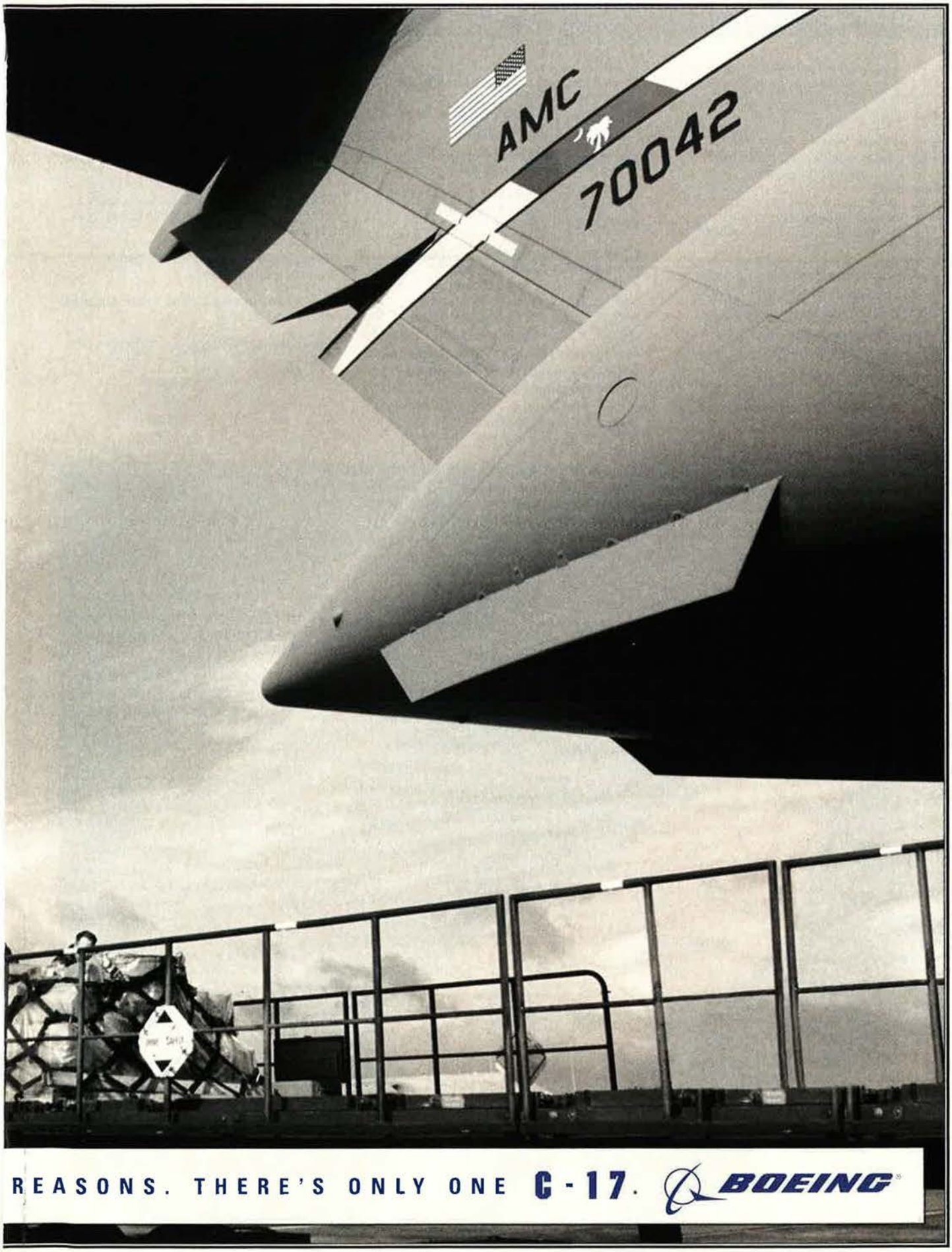
BLANKETS, FOOD & MEDICINE

ENGINE RUNNING ON-LOAD/OFF-LOAD

24 HOURS A DAY

From military deployment to humanitarian relief and anything in between, no other aircraft can deliver so much, so fast, and land virtually anywhere in the world.

THERE ARE A MILLION



Chronology of Key 1999 Events

Jan. 16. More than 40 ethnic Albanians executed by Serbs are found in village of Racak in Kosovo. Massacre draws international condemnation.

Jan. 19. Gen. Wesley Clark, NATO commander, states his forces are prepared for action in Kosovo, if necessary.

Feb. 6. Peace talks to halt ethnic violence in Kosovo open in Rambouillet, France.

March 15. Ethnic–Albanian delegation in Paris agrees to accept Rambouillet autonomy deal, but Serbs refuse.

March 19. Peace talks adjourn in failure, and Serbian forces mass in and around Kosovo.

March 22. Shelling edges toward Pristina as Serbs step up hostilities.

March 24. NATO begins airstrikes against Yugoslavian targets.

March 27. Serbs shoot down USAF F-117 fighter; pilot rescued.

April 1. Serbian forces capture three US soldiers near the Yugoslavian–Macedonian border.

April 24. The conflict in Kosovo dominates NATO's 50th anniversary summit, held in Washington.

May 2. Belgrade releases three US soldiers to Jesse Jackson.

May 5. Two US Army AH-64 Apache helicopter pilots die in crash during training in Albania.

May 7. NATO bombs hit the Chinese Embassy in Belgrade.

May 27. International Criminal Tribunal announces war crimes indictments against Milosevic and four other Serb officials.

June 3. Yugoslav officials accept NATO peace plan put forth by envoys from the European Union and Russia.

June 9. NATO and Yugoslavia sign accord outlining troop withdrawal from Kosovo.

June 10. Serb withdrawals begin, bombing suspended.

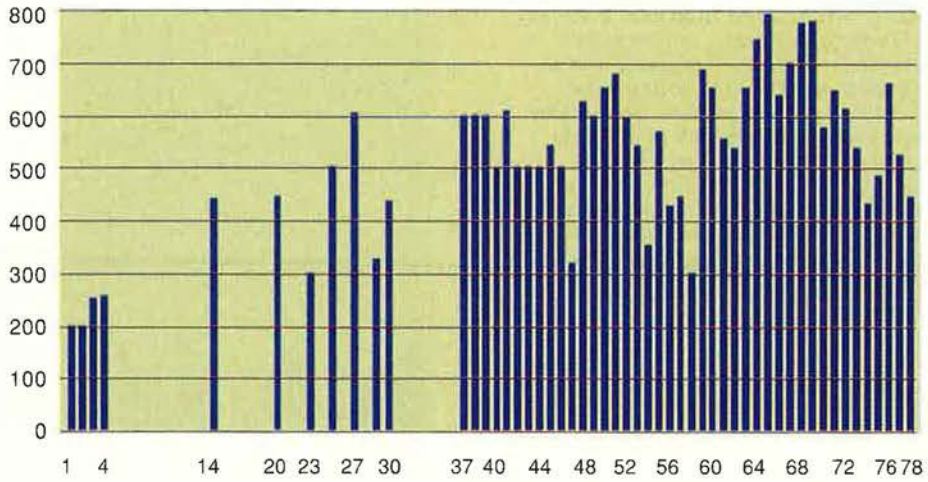
June 11. Russian troops make surprise move into Kosovo.

June 20. NATO declares formal end to war.

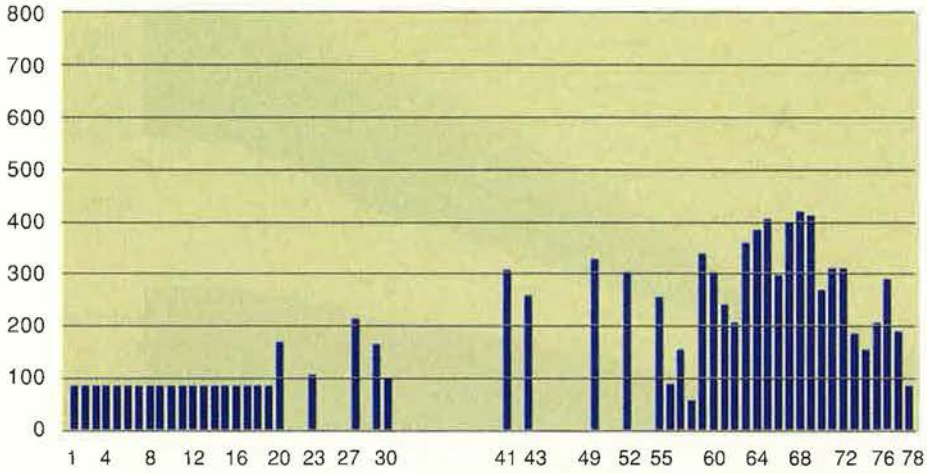
Sorties

In a bit more than 11 weeks, NATO forces flew about 35,000 sorties, of which about 10,000 were attack sorties. The first phase of the air war was tentative, featuring limited attacks and vague objectives. In time, NATO shifted gears and stepped up the daily number of sorties. By the end of the war, NATO strike aircraft were flying nearly 400 missions on some days. Information on sorties remains incomplete. Poor weather caused aborts of many missions on some days.

Total Sorties, March 24–June 9, By Day

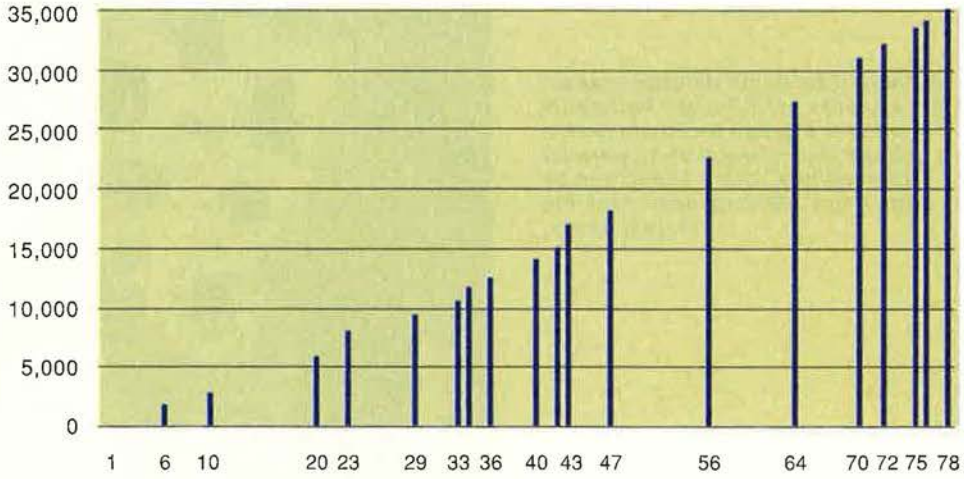


Strike and SEAD Sorties, By Day



The information on these pages is preliminary and drawn from several official sources, primarily NATO and Defense Department briefings presented almost daily during the war. Several different US and Alliance entities are conducting reviews, with sometimes significant variations in data.

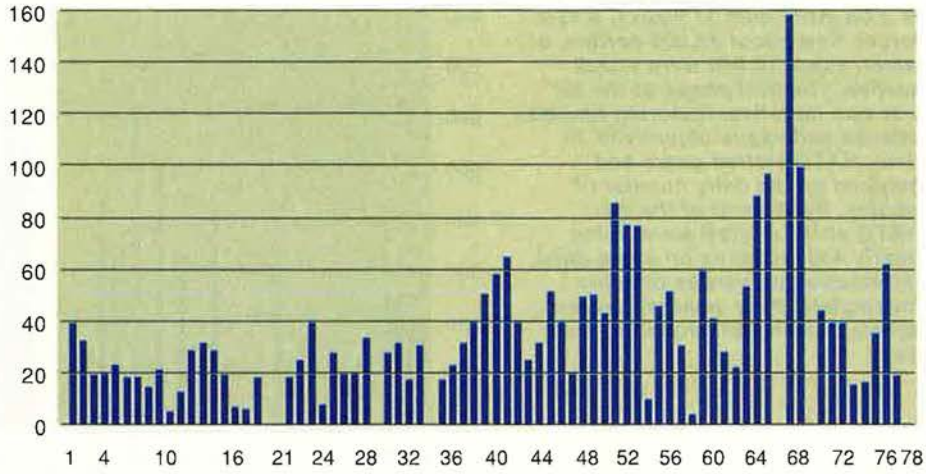
Total Sorties, Cumulative



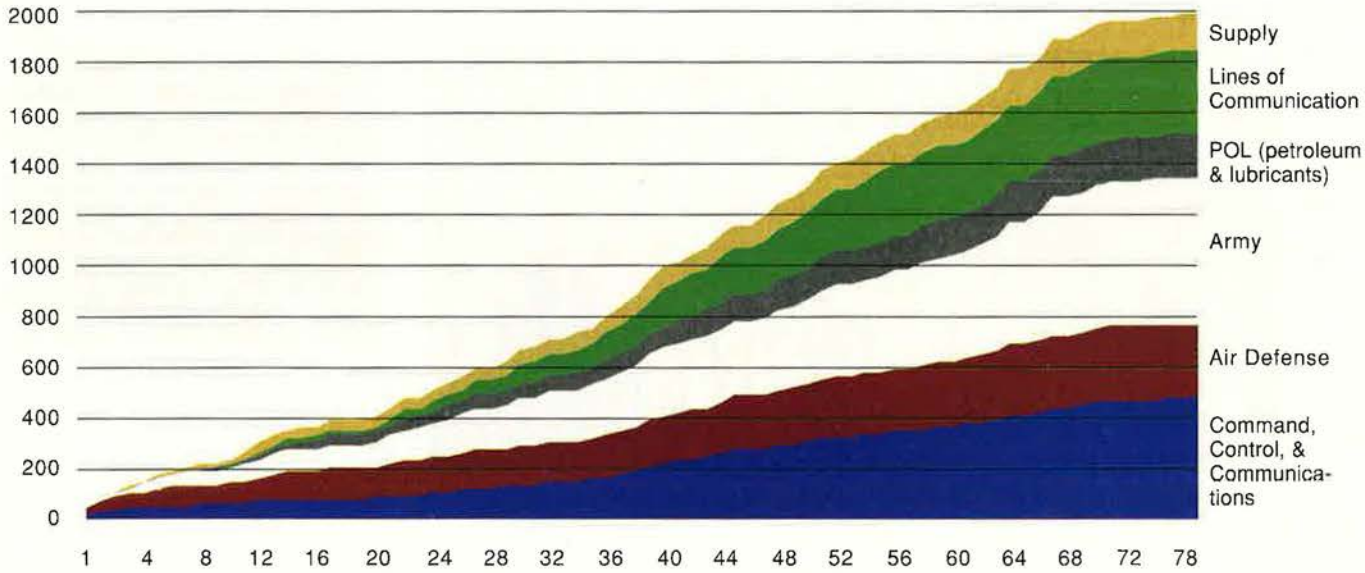
Targets Struck

Total Targets Struck and Restruck, By Day

NATO struck (and restruck) a variety of targets in Serbia, which were deemed "strategic" targets, and in Kosovo, which were considered "tactical." Some targets were hit by many different aircraft in a single raid. At first, NATO confined its attacks to a limited number of target groups. Day by day, the Alliance broadened the scope of its campaign. Strategic targets fell into six categories, as shown below.



Strategic Targets Struck and Restruck, Cumulative



A post-strike bomb damage assessment photo of the Pozega Petroleum Products Storage facility in Serbia shows that storage units were hit individually. There appears to be little, if any, damage apart from the storage tanks.

Mobile Military Targets

NATO encountered difficulty locating and destroying mobile systems. By the time the Allies suspended bombing operations, officials thought they had destroyed considerable amounts of artillery and armored vehicles and were starting to consistently hit Serbian tanks. Definitive numbers weren't yet determined. Numbers at right were provided by DoD on June 10 and subsequently confirmed by Army Gen. Wesley K. Clark, Supreme Allied Commander Europe.

Mobile Serbian Military Weapons

System	Number Destroyed	Percent of Total
Tanks	122	41%
Armored Personnel Carriers	222	33%
Artillery & mortars	454	50%

Air Defense System

NATO fairly quickly achieved air superiority, neutralizing the fighter and missile elements of Yugoslavia's integrated air defense system. Most of the time, the Serbs declined to turn on their tracking radars for fear of drawing an attack. Many systems remained in operation, however, and NATO remained wary until the end of the conflict. DoD said NATO pilots observed nearly 700 firings of SAMs, some of which could not be identified by type.

Air Defense Fighters

Component	Number Destroyed	Percent of Total
MiG-29 fighter	14	85%
MiG-21 fighter	24	35%

Surface-to-Air Missile Systems

Component	Number Destroyed	Percent of Total
SA-2 battalion	2	67%
SA-3 battalion	10	70%
SA-6 battery	3	10%

Yugoslav Air Defense Missile Attacks

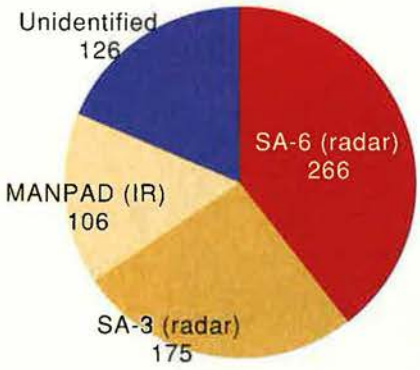


Photo by Gert Kromhout

Suppression of Enemy Air Defenses was the primary responsibility of F-16s like this one, armed with the HARM targeting system and AGM-88 missiles. This fighter shows a yellow star under its canopy—evidence of a MiG kill.

Defense Industry, Infrastructure

Defense Industry and Infrastructure

Attacks from the air took a heavy toll on military-related industry and lines of communications. Yugoslavia's refining industry virtually ceased to exist. The 3rd Army in Kosovo, responsible for the bulk of the atrocities, suffered the loss of 60 percent of its barracks, headquarters, storage sites, and other facilities. Power was turned off in as much as 80 percent of Serbia at a time.

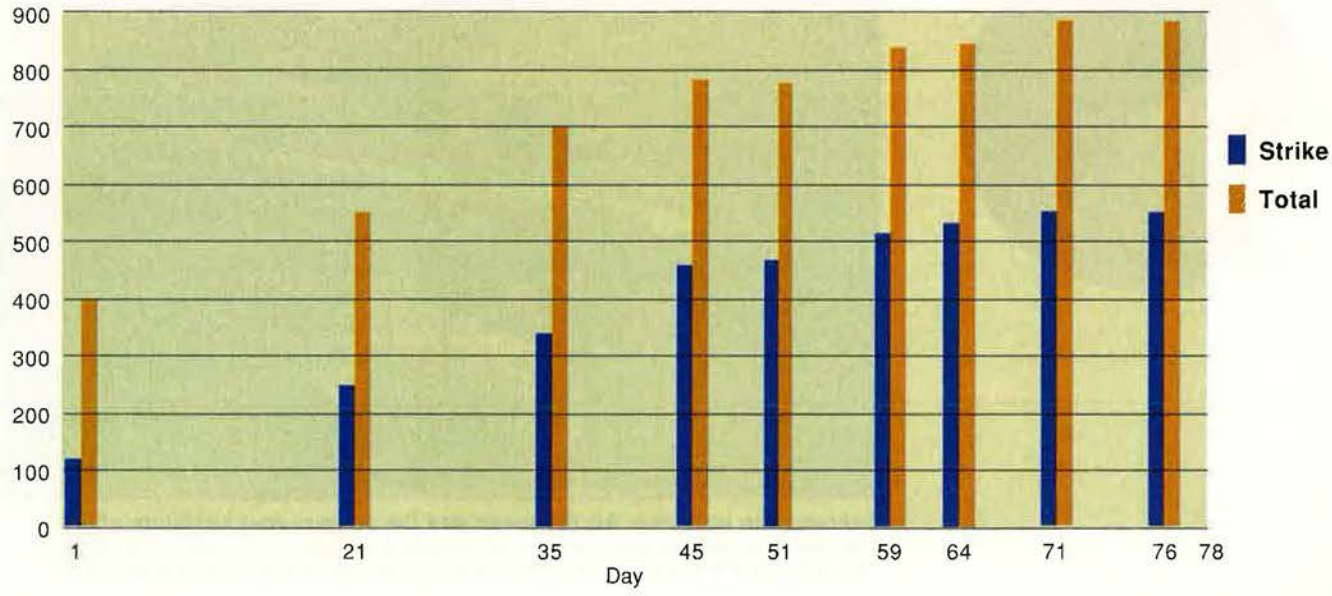
Component	Percent of Capacity Destroyed
Explosives production	50%
Ammunition production	65%
Aviation equipment assembly & repair	70%
Armored vehicle production & repair	40%
Petroleum refining	100%
1st Army facilities	35%
2nd Army facilities	20%
3rd Army facilities (Kosovo)	60%
Electric power	35%
Serbia–Kosovo road corridors	50%
Serbia–Kosovo rail corridors	100%

Aircraft Deployed

NATO Aircraft by Source

On March 24, the number of NATO aircraft committed to the air campaign numbered 400, of which 120 were strike aircraft. By the end of the war, the numbers were 883 and 550, respectively. US forces provided 581, or about 66 percent of the total. With the larger fleet, NATO commanders began to hit Serb assets with strikes from multiple directions and around the clock.

NATO Aircraft, Total and Strike



Aircraft Types Contributed

Country	Aircraft
US (Air Force)	A-10, AC-130, B-1B, B-2, B-52H, C-5, C-17, C-130, C-135, C-141, E-3B/C, E-8C, EC-130, F-15, F-15E, F-16, F-117, KC-10, KC-135, MC-130, MH-53J, MH-60G, Predator UAV, RC-135, U-2S
US (Other)	EA-6B (Navy), F-14 (Navy), F/A-18 (Navy and USMC), KC-130 (USMC), P-3C (Navy), Hunter UAV
Belgium	F-16
Britain	E-3D, GR-7, GR1, L-1011K, Tristar, VC-10, aircraft on HMS *Invincible*
Canada	CF-18
Denmark	F-16A
France	C-135F, C-160, E-3F, F1, Jaguar, Jag-A, Mirage 2000C/D, MIR-IVP, Puma SA-330, Horizon, UAV CL-289, UAV CR, aircraft on FS *Foch*
Germany	Tornado PA-200H/E, UAV CL289
Italy	AMX, Boeing 707T, F-104, PA2001, Tornado ADV, aircraft on ITS *Garibaldi*
Netherlands	F-16A, F-16AM, KDC-10
NATO Common	E-3A
Norway	F-16A
Portugal	F-16A
Spain	CASA, EF-18, KC-130,
Turkey	F-16, KC-135, TF-16C

USAF photo by TSgt. Brad Fallin

Thirteen NATO nations supplied aircraft for Operation Allied Force. One F-16 from the Netherlands, such as the one above, defeated a MiG in air combat. By the end of the operation, there were 550 strike aircraft out of some 883 participating.

USAF photo by SrA. Jeffrey Allen

A USAF KC-135 refuels an F-16 during Allied Force. Active, Air National Guard, and Air Force Reserve Command crews were kept busy refueling NATO aircraft throughout the operation.

Verbatim Special: The Balkan War

For a fuller version see www.afa.org/magazine

"It was less than three weeks ago that the realization first dawned on me: Airpower might actually be winning the Balkan War. I turned the thought round for a while and looked at it from several directions, rather as a Creationist Christian might have done on being shown his first dinosaur bone. I didn't want to change my beliefs, but there was too much evidence accumulating to stick to the article of faith. That article of faith, held by all military analysts outside a few beleaguered departments of airpower studies in the service academies, was that air forces could not, alone, win wars. ... It now does look as if airpower has prevailed in the Balkans and that the time to redefine how victory in war may be won has come. ... After this war, ... there will be no grounds for debate or dispute. Aircraft and pilotless weapons have been the only weapons employed. The outcome is therefore a victory for airpower and airpower alone."***—Military historian and commentator John Keegan,*** **London Daily Telegraph (LDT),** ***June 4.***

"What did the trick was the accuracy of the precision weapons, the avoidance of losses, and the increasing destruction of the Serb forces."***—Army Gen. Wesley Clark, Supreme Allied Commander Europe,*** **New York Times (NYT),** ***June 5.***

"It's a strange situation. Just because it comes out reasonably well, at least in the eye of the Administration, doesn't mean it was conducted properly. The application of airpower was flawed."***—Retired Gen. Ronald Fogleman, former USAF Chief of Staff,*** **NYT,** ***June 5.***

"What you've got is a mess. We may have gotten Milosevic to cry uncle, but it was the absolute worst way to fight a war."***—Retired Adm. Leighton Smith, former commander of NATO's southern region and the Balkans, Associated Press, June 5.***

"There are certain dates in the history of warfare that mark real turning points. Nov. 20, 1917, is one, when at Cambrai the tank showed that the traditional dominance of infantry, cavalry, and artillery on the battlefield had been overthrown. Nov. 11, 1940, is another, when the sinking of the Italian fleet at Taranto demonstrated that the aircraft carrier and its aircraft had abolished the age-old supremacy of the battleship. Now there is a new turning point to fix on the calendar: June 3, 1999, when the capitulation of President Milosevic proved that a war can be won by airpower alone."***—Keegan,*** **LDT,** ***June 6.***

"Already some of the critics of the war are indulging in ungracious revisionism, suggesting that we have not witnessed a strategic revolution and that Milosevic was humbled by the threat to deploy ground troops or by the processes of traditional diplomacy, in this case exercised—we should be grateful for their skills—by the Russians and the Finns. All to be said to that is that diplomacy had not worked before March 24, when the bombing started, while the deployment of a large ground force, though clearly a growing threat, would still have taken weeks to accomplish at the moment Milosevic caved in. The revisionists are wrong. This was a victory through airpower."***—Keegan,*** **LDT,** ***June 6.***

"Not only were we fighting Hitler; we were fighting fascism. Not only were we fighting Stalin; we were fighting communism; Now, we're not only fighting Milosevic, but we're fighting genocide and ethnic cleansing and crimes against humanity."***—Secretary of State Madeleine Albright,*** **Washington Post (WP),** ***June 6.***

"There can be circumstances short of an existential threat to the United States where the use of force is appropriate."***—White House National Security Advisor Sandy Berger,*** **WP,** ***June 6.***

"The lesson for NATO should be: If you're serious about applying power, don't screw around. Get at it. Turn out the lights, take the phone system down—not this incremental 'maybe we'll hit it, maybe we won't.' That's no way to fight a war."***—A "high-ranking military officer,"*** **WP,** ***June 6.***

"I don't think anyone should walk out of this thinking we ought to only have airpower."***—Gen. Henry Shelton, Chairman of the JCS,*** **WP,** ***June 6.***

"The lesson for the Army is, it's not going to be in the game unless it develops some sort of medium-weight force that it can deploy rapidly."***—Retired US Army officer John Hillen, defense analyst with the Council on Foreign Relations,*** **WP,** ***June 6.***

"We own the Balkans. NATO is now in the position of a real estate investor who keeps buying properties where the taxes exceed the rent."***—Michael Mandelbaum, professor at Johns Hopkins University,*** **WP,** ***June 6.***

"I can't give you a timetable [for the NATO occupation of Kosovo], and I'm not going to say, 'Is it six months? Is it a year? How long is it going to take?' We will do our best to facilitate the transformation of Kosovo into a self-governing province under the aegis of NATO and the UN."***—Defense Secretary William Cohen,*** **NYT,** ***June 6.***

"This war was worth fighting."***—Sen. John McCain, Presidential aspirant,*** **Los Angeles Times (LAT),** ***June 6.***

"We just overwhelmed them with destruction. It was technically excellent but strategically bankrupt."***—Retired Air Force Maj. Earl H. "Butch" Tilford Jr., former editor of*** **Air University Review,** ***now director of research at the US Army War College's Strategic Studies Institute,*** **NYT,** ***June 6.***

"We never said that we're going to disarm the KLA. [The term "demilitarization" means] no longer having organized units, getting rid of the uniforms, the heavy weapons, things of

this type. To our knowledge today, they [the KLA] still intend to comply with that."—***Shelton,* NYT, *June 7.***

"This war didn't do anything to vindicate airpower. It didn't stop the ethnic cleansing, and it didn't remove Milosevic."—***Retired Army Lt. Gen. William Odom, former director of the National Security Agency,* Time *magazine, released June 7.***

"Once you get the air defenses suppressed, you can just fly over and puke out JDAMs."—***Retired Gen. Merrill McPeak, a former USAF Chief of Staff,* Time, *released June 7.***

"We achieved our goals with the most precise application of airpower in history. ... Of more than 23,000 bombs and missiles used, we have confirmed just 20 incidents of weapons going astray from their targets to cause collateral damage."—***Cohen, DoD news conference, June 10.***

"We will continue to use ground forces wherever they are required in the best possible military campaign that can be devised under the most optimum of circumstances. We are not afraid to use ... a ground component to a military campaign."—***Cohen, DoD news conference, June 10.***

"In Kosovo, NATO's American–led bombers, some originating their missions from inside the US, destroyed discrete targets measurable by addresses on a doorway."—**Wall Street Journal (WSJ)** ***editorial, June 11.***

"Airpower, in this particular case, has been effective and has been successful. It should not be seen as the only course of military combat in the future."—***Cohen,* WP, *June 11.***

"Proponents of airpower will also see this as a victory. Ever since the early days of military aircraft, 'victory through airpower' has been the Air Force's goal in war. It failed in World War II, Korea, Vietnam, and Desert Storm, and critics predicted it would fail in the Balkans. It didn't. Two factors led to success. Precision guided bombs performed as advertised, despite periodic but embarrassing and costly exceptions, such as mistakenly bombing civilians. And high-tech weaponry permitted pilots to fly high out of harm's way while visiting destruction below. An estimated 5,000 to 10,000 Serbs were killed in the bombing at no cost to the airmen. This has troubling moral and political implications. Despite the accuracy of the air attacks, too many civilians were killed while Allied combatants avoided risk. This turns a principle of a just war on its head—specifically, the obligation to protect the innocent at the expense of the warrior. Another troubling and similar aspect of the so-called 'immaculate' air campaign is the ability to drive an enemy to his knees without shedding a drop of the bomber's blood. Normally, the litmus test of going to war was the willingness to suffer casualties in pursuit of its objective."—***Retired Marine Lt. Gen. Bernard Trainor,* Boston Globe, *June 11.***

"Beyond the shadow of a doubt, the B-2 is every bit the technological marvel it was meant to be."—***President Clinton, remarks June 11 at Whiteman AFB, Mo.***

"This really wasn't a war. It was diplomacy backed by force."—***Clark,* NYT, *June 12.***

"The final standard is: Did it work? Did it provide crucial leverage to diplomacy? I think yes, it did."—***Clark,* NYT, *June 12.***

"I don't use the word 'victory.' I very carefully say they have advanced substantially the five goals of NATO that we have steadfastly adhered to. Any assessment of who won and who lost should await the ground campaign and how well we survive the risks and the return to their homes of the refugees. Then is the time to make that assessment."—***Sen. John Warner, chairman of the Senate Armed Services Committee,* Washington Times (WT), *June 13.***

"As long as Russia possesses nuclear warheads, it is allowed to pretend it is a superpower. Russia's tough and uncompromising stance on the Kosovo conflict is nothing but a face-saving measure designed to help Russia avoid complete humiliation."—***Gennady Oreshkin, retired colonel of the Russian Interior Ministry,* LAT, *June 15.***

"Certainly airpower played a very pivotal role, as it has in so many times since the invention of the airplane. ... A lot of defense pundits have egg on their face[s] at this point, and they will find reasons for explaining away this decisive use of airpower. But there's no doubt that, if facts have any power to convince, this was a victory for airpower."—***McPeak, PBS "Newshour," June 16.***

"We've got to think about what transpired during the time that we started on the 24th of March until we closed this down last week. There's a lot of ethnic cleansing that took place. The results are coming in daily, and it doesn't look very good or very pretty. We've created a refugee population of a million-plus people, and we've destroyed all of the infrastructure out there in the province. So we [won] sort of a Pyhrric victory in some sense. We destroyed Kosovo in order to win it."—***Retired Marine Corps Gen. Richard Neal, former assistant commandant (1996–98), PBS "Newshour," June 16.***

"So many people have predicted that airpower would be ineffective if it's used alone that, now, they have to describe what's happened in this case as some sort of a defeat. Now, victory comes in many flavors, and this one will obviously not be to the taste of everyone, but the fact of the matter is, airpower carried the day here."—***McPeak, PBS "Newshour," June 16.***

"It's sad, actually. The Army's got the best strategy of all the services for avoiding casualties, and that is the Army avoids combat. It can't get there. It's too heavy. It's obese."—***Retired Army Lt. Col. Ralph Peters, PBS "Newshour," June 16.***

"There is very little stomach for young infantrymen and other soldiers coming home in body bags, and it's very difficult to fight any sort of ground conflict without having casualties. There are some people who will continue to believe that airstrikes are surgical, that casualties do not occur, and that you can bring down an enemy without inflicting civilian casualties or suffering losses yourself. We all know that not to be correct, but some people will draw the wrong lessons."—***Lt. Gen. Michael Short, head of NATO air operations in Kosovo,* NYT, *June 18.***

"I hope those [NATO] nations that could not participate in the way they would have liked will take the necessary action and make the necessary investments to catch up. Otherwise, we run the risk of creating second or third teams within the Alliance."—***Short,* WP, *June 20.***

"I thought that there was maybe a 50 percent chance it [the war] would be over in a week. I knew if he [Milosevic] decided to take the punishment of the air campaign, it could go a long, quite a long, time."—***Clinton, interview on CNN's Late Edition,* NYT, *June 21.***

"The whole policy of gradual escalation is back. Something very different happened in this war, and to simply pass it off as being an aberration is dangerous. I think we need to think through it."***—USAF Col. Philip Meilinger, US Naval War College professor,* WP, *June 22.***

"As a result of Kosovo, I'd expect there'd be more careful scrutiny of some heavy systems that hardly ever seem to be taken to war these days and hopefully a little more respect and appreciation for those Air Force capabilities that get there quickly, are easily integrated in coalition operations, and provide only fleeting or invisible targets for enemy guns."***—Retired USAF Maj. Gen. Charles Link,* WP, *June 22.***

"The war in Kosovo wasn't really the work of one man. Saying that Serbia needs to unseat Mr. Milosevic is shorthand for saying that Serbs need at least to begin to come to terms with the terrible things their armed forces and their paramilitaries have done in this decade, to the approval or silence of most of them."**—WP *editorial, June 22.***

"The B-2 really did the job. One thing the Air Force and all of us will want to be reviewing is the bomber force and whether we ought to be investing more in it."***—Sen. Joseph Lieberman, Senate Armed Services Committee, remarks to Defense Writers Group, June 23.***

"At this point in our march through history, our heavy forces are too heavy and our light forces lack staying power."***—Gen. Eric Shinseki, Army chief of staff,* WP, *June 24.***

"With the seeming victory of airpower in Kosovo, we are again in danger of thinking there is some easy way to win wars."***—Retired Army Col. Harry Summers Jr., military commentator, WT op-ed, June 24.***

"Albanians and Serbs will not be able to live together in peace in Kosovo until they've had a period of time with international security forces to keep them from tearing each other to pieces."***—Richard Holbrooke, former Balkan negotiator,* NYT, *June 25.***

"I was surprised about some of the things. ... I was surprised, on the one hand, that we lost no pilots. I was surprised by that. I was surprised that we'd lost only two planes and no pilots. I know that from your point of view, there were a lot of civilian casualties, but that's because you got to cover them, as opposed to covering the civilian casualties of the Gulf War. If you talked to any military person that was involved in both conflicts, they will tell you that there were far, far more civilian casualties in Iraq. I mean, many more. ... Several times as many. I was a little surprised that we had no more problems than we did in maintaining our allied unity, given the enormous pressures that were on some of our Allies. And I think that gives you some indication about the depth of conviction people had that this was right. I was surprised and heartbroken that the Chinese Embassy was hit because of the mapping accidents. That did surprise me. I had no earthly idea that our system would permit that kind of mistake. That was the biggest surprise of all."***—Clinton, White House press conference, June 25.***

"We have not put a price on Mr. Milosevic's head for someone to kill him. ... We don't try to do that to heads of state."***—Clinton, White House press conference, June 25.***

"What the Serbian people decide to do, of course, is their own affair. But they're going to have to come to grips with what Mr. Milosevic ordered in Kosovo. ... And then they're going to have to decide whether they support his leadership or not; whether they think it's OK that all those tens of thousands of people were killed, and all those hundreds of thousands of people were run out of their homes, and all those little girls were raped, and all those little boys were murdered. They're going to have to decide if they think that is OK. And if they think it's OK, they can make that decision. But I wouldn't give them one red cent for reconstruction if they think it's OK, because I don't think it's OK. ... I do not believe we should give them any money for reconstruction if they believe that is the person who should lead them into the new century. I do not, and I will not support it."***—Clinton, White House press conference, June 25.***

"Everyone agrees on the lessons to be learned from the Kosovo experience, but few people here [NATO headquarters] are confident that we will apply them. It would take the Europeans two decades to catch up with the Americans [in military power], even if they had the money and the will to spend it."***—A "senior NATO intelligence official,"* WP, *June 28.***

"In the end, Short and Clark say, it was NATO's ability to hit 'strategic, fixed targets'—causing an estimated $30 billion damage and widespread hardship among civilians—that ultimately compelled Milosevic to accept the Alliance's demands."***—Correspondent William Drozdiak,* WP, *June 28.***

"The Russians have expressed concern that they will be used as target practice by the Kosovo Liberation Army. The Russians want protection. They are edgy."***—A "senior officer attached to the North Atlantic Treaty Organization's KFOR peacekeeping force,"* WSJ, *June 28.***

"JDAM was the hero of this war, and the B-2 was the hero of the early days of Kosovo."***—Maj. Gen. Dennis Haines, ACC director of combat weapon systems,* Defense Week, *June 28.***

"We are both aware, as God knows, how much evil has been done [in Kosovo] in the course of the last year and especially in the last three months. The great part of the guilt lies with Milosevic."***—Bishop Artemije, senior representative of Serbian Orthodox Church, speaking for himself and Patriarch Pavle, head of the church,* NYT, *June 29.***

"The apology phase is long since over. That [delivery of a US apology to China for the bombing of its embassy] was done immediately. I think it was done genuinely. It was done personally. It was done repeatedly, both publicly and privately, and I don't think there's any more, really, that could be said on this score. It was a tragic accident, and we have, you know, expressed our regrets as personally as we could. ... You know, China really must recognize that this is the only explanation that it's going to get."***—Stanley Roth, assistant secretary of state for Asian Pacific affairs,* WT, *June 30.***

"The bottom line is that there is no way to protect them [the Serbs in Kosovo], and we will indeed have a new refugee exodus, which is very sad when what we wanted is a multi-ethnic society. A lot of them would like to stay, but they are dead scared."***—Soren Jessen-Petersen, assistant UN high commissioner for refugees, remarks at a UN news conference, July 1.*** ■

Valor

By John L. Frisbee, Contributing Editor

Miracle at U Tapao

Logic said no one could be alive in the B-52, but something drew Capt. Brent Diefenbach to the blazing bomber.

LINEBACKER II, the 11-day bombing campaign of December 1972 that persuaded North Vietnam to sign a cease-fire, had been halted on Christmas Day. Now it was the night of Dec. 26 and the operation was on again. The B-52 with Lt. Robert Hymel as copilot was assigned a target near Hanoi.

Everyone knew the North Vietnamese had used the bombing break to restock and repair their Surface-to-Air missile sites. It was going to be a rough night.

As Hymel's B-52 dropped its bombs and turned off target, the rear gunner called two SAMs coming up. Despite evasive action by the B-52, the missiles exploded just to the right of the bomber, wounding the gunner, knocking out two engines, and causing major fuel leaks and other undetermined damage. The aircraft commander headed for an emergency landing at Da Nang, then decided that, with several refuelings, they could make it back to their base at U Tapao, in Thailand. The wounded gunner would have better medical treatment there.

Shortly after midnight, the BUFF started a straight-in approach to the Thai base. Capt. Brent Diefenbach, a B-52 aircraft commander who had just returned from a mission in the North, sat in a crew bus, waiting to cross the end of the runway as Hymel's battle-damaged bomber neared the runway lights. The approach didn't look or sound right. Suddenly, the aircraft veered to the left and the engines roared as power was added for a go-around. Diefenbach watched, horrified, as the big bomber pitched up, plunged to earth about a mile beyond the runway, and exploded in a ball of fire.

Diefenbach later remembered the compulsive thought that he had to get to the crash site. "It appeared obvious to me that no one was alive, but something kept drawing me to go." He knew he had to get there fast. Jumping off the bus, he went out an entrance gate and climbed aboard a Thai bus that was headed in the direction of the crash. When the driver refused to go farther, Diefenbach ran down the road toward the burning B-52 until he spotted a path in the tall grass that seemed to lead to the aircraft.

"For a second," Diefenbach recalled, "I thought, 'Why go on? No one is alive in that inferno.'" But again he felt impelled, almost against his will. He approached the wreckage, shouting to see if anyone was alive. To his surprise, he heard a voice inside the bomber calling for help. Rolling down the sleeves of his flight suit for protection against the heat, he entered the burning plane amidst a fusillade of exploding ammunition and pressure lines. There was no way of knowing if bombs were still aboard.

Diefenbach followed the cries—the only sign of life—through a pall of smoke to find copilot Hymel, badly injured, crumpled in a position that prevented him from unbuckling his seat harness and with one fractured leg trapped in the wreckage. Diefenbach remembers accusing Hymel of not helping and of falling asleep—"anything to keep him conscious." In desperation, Hymel told his rescuer to cut off the leg if he had to. Finally, working together for what seemed an eternity, they were able to free the injured man. "By that time, the explosions [and] the heat were nearer than I care to think about."

Diefenbach dragged Hymel out of the fuselage and carried him away from the blazing wreck just as a helicopter and fire trucks arrived. The rescue crew was unable to approach the B-52, now engulfed in flames.

Hymel was air evacuated to Clark AB in the Philippines, then to a hospital in the States where he eventually recovered from multiple fractures and lacerations.

After Diefenbach had reported details of the rescue to the wing commander and his staff, he was taken to the base hospital "for some minor repairs and bandages." Some time later, he discovered there were "a lot of thank you's in order for the Chief Pilot in the Sky." He had extricated the copilot from an armed ejection seat. That it had not fired in the struggle to free Hymel was a miracle within a miraculous and heroic rescue, for which the commander in chief of Strategic Air Command, Gen. John C. Meyer, presented Diefenbach the Airman's Medal. ■

First appeared in August 1983 issue.

Dell product family shot. Pictured systems do not match configurations shown.[1]

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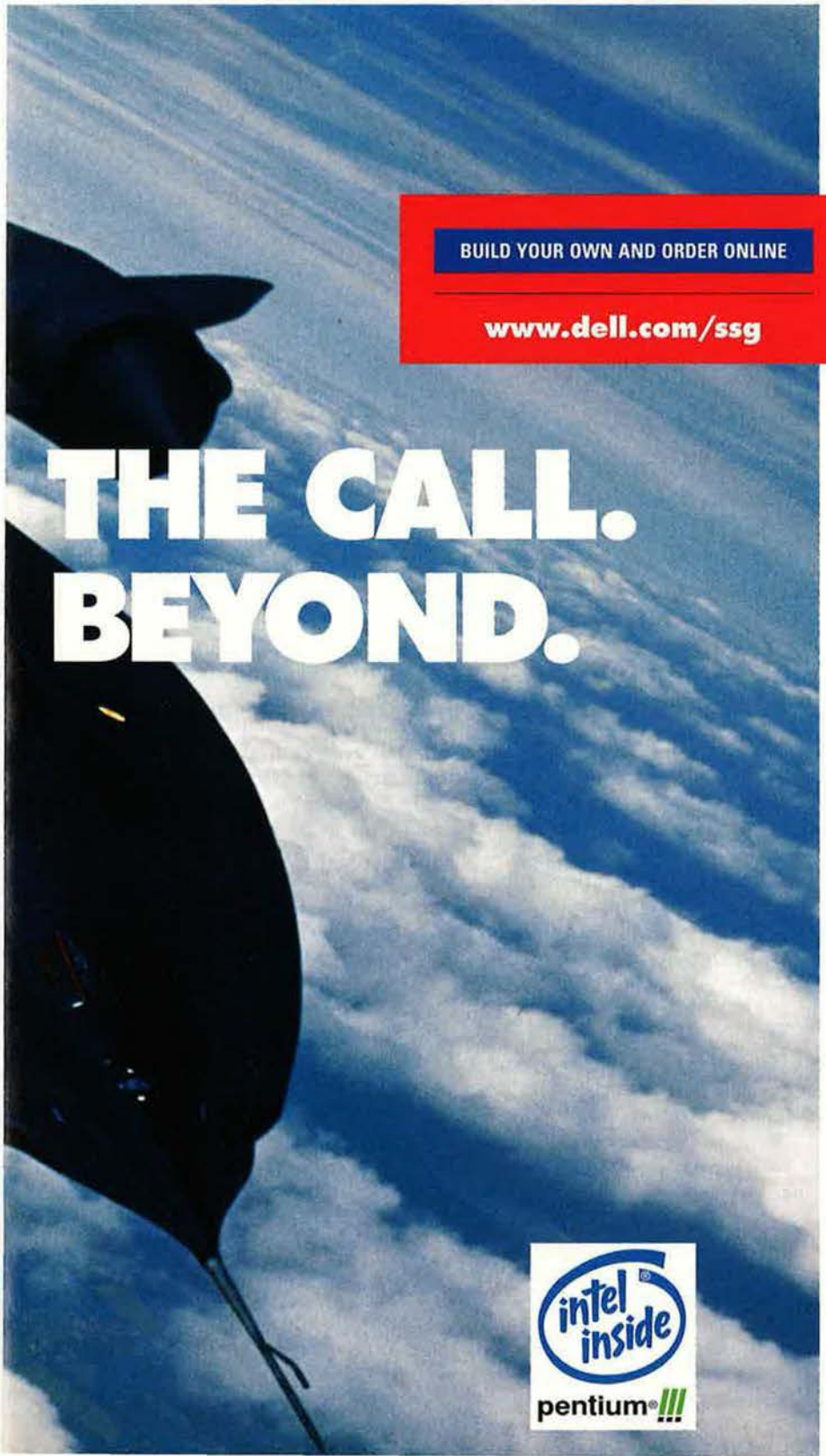

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Congressional investigations document China's massive acquisition of US technology.

The China Problem

By Peter Grier

In 1992, US intelligence agencies started to become concerned about China's designs for its next-generation nuclear weapons. A series of explosions monitored by the West suggested that the People's Republic of China was working on smaller, lighter thermonuclear warheads, with an increased yield-to-weight ratio. US officials did not think Chinese science was advanced enough to produce such sophisticated weapons on its own. They suspected something else—that the PRC had stolen US nuclear secrets.

Three years later the US received apparent confirmation of such thefts from the Chinese themselves. An unsolicited Chinese individual—a "walk-in," in the argot of espionage—turned a pile of PRC documents over to the CIA. Among them was a paper stamped "secret" which contained design information on perhaps the most advanced warhead in the US arsenal, the Trident II's W88.

Since then, the CIA has come to believe that the walk-in was a plant, someone who in fact worked for PRC intelligence. The US conclusion is that China, for some reason known only to its own top officials, had decided to flash a glimpse of its stolen knowledge in front of US eyes. If that is the case, it could turn out to have been a colossal misjudgment. The recent report of a special House panel, chaired by Rep. Christopher Cox (R–Calif.), on Chinese espionage has detailed years of systematic PRC spying, outraging many members of Congress. It might well have an impact on the relationship between Washington and Beijing for years to come.

That US companies, through their own laxity or greed, may have speeded the loss of secrets is faint comfort to Washington. China has obtained everything from US nuclear data to crucial help in missile upgrades and US computers and machine tools far more powerful than domestic Chinese models.

Many of the details alluded to in the House report remain classified and beyond public view. In general, however, purloined US technology and data could allow the Chinese to produce state-of-the-art nuclear weapons, upgrade their combat aircraft and submarines, conduct more extensive and effective anti-submarine warfare, equalize battlefields via information warfare, and improve their command-and-control capabilities, according to the Congressional study.

"The PRC seeks foreign military technology as part of its efforts to place the PRC at the forefront of nations," concludes the House Select Committee on US National Security and Military/Commercial Concerns with the People's Republic of China report—more simply called the Cox report. "The PRC's long-run geopolitical goals include incorporating Taiwan into the PRC and becoming the primary power in Asia."

Use of Western military technology obtained under questionable circumstances is not new for China, of course. Its current arsenal of CSS-4 nuclear-tipped ICBMs traces its design lineage to the US Titan ICBMs of the 1950s, thanks to CSS-4 lead designer Qian Xuesen, who worked on the Titan program.

A Chinese citizen educated in the US during the Japanese occupation of China, Qian became one of the world's top experts on jet propulsion during World War II. After earning a PhD at the California Institute of Technology and then working with a Cal Tech rocket research group, he was recruited to join the US military's long-range missile programs. He received a direct commission to colonel in the US Army Air Forces and began work on what became the Titan. However, spy allegations dogged Qian, and eventually he lost his security clearances. Negotiations between the US and the PRC resulted in his return to China in 1955. After serving as chief project manager in all PRC ballistic missile programs, he became head of the government arm responsible for all aeronautics and missile development research.

Theft and Diversion

Today, China uses what US intelligence calls a "mosaic" approach to the collection of technical data, which takes small bits of information collected by many individuals, then pieces them together in the PRC.

Classic spying remains a major part of this approach. Witness the case of Peter Lee, a Taiwanese–born, naturalized US citizen who worked at US national laboratories until evidence of espionage surfaced. In 1997, Lee passed China classified US developmental research on very sensitive detection techniques that could be used to threaten previously invulnerable US nuclear subs, alleges the Cox report. In 1985, Lee passed to China data about the use of lasers to create nuclear explosions on a miniature scale.

Mosaic intelligence also takes advantage of the relative openness of US society. PRC nationals attend US universities, host foreign scientific delegations, and pump visiting scientists for information that is on the edge of classified. The PRC also gets valuable bits from open forums such as arms exhibits and computer shows.

The report alleges that, at one recent international arms exhibit, PRC nationals were seen videotaping every static display and collecting all possible brochures. When a contractor left his booth unattended, Chinese spies stole a display videocassette that had been playing continual information on the US Theater High Altitude Area Defense system, a theater missile defense program.

"Converting the stolen cassette to a frame-by-frame sequence could yield valuable intelligence information to the PRC," says the select committee report.

Simple purchase of equipment plays a part in PRC intelligence gathering. Chinese front companies take advantage of US military downsizing to buy surplus high-tech US military goods, including some that are proscribed from export to all but close allies.

Two years ago, the US Customs Service seized more than $36 million in excess military property being shipped overseas illegally. Among the goods bound for the PRC and Hong Kong were 37 inertial navigation units for F-117 and FB-111 aircraft, Patriot missile parts, 500 electron tubes used in the F-14 fighter, and 26,000 encryption devices.

Military goods that find their way to the PRC can be reverse-engineered, or copied, for indigenous models. Thus the PRC's C-801 anti-ship cruise missile is thought to be a copy of the French Exocet anti-ship cruise missile. The Chinese Z-11 helicopter is a reverse-engineered French Aerospatiale AS-350 Ecureuil, according to the Cox report.

Because of the decentralized nature of the Chinese collection effort, Washington finds it very difficult to track, according to the report. It adds that, because of the FBI's historic focus on the Soviet Union during the decades of the Cold War, the US has never made monitoring the PRC's acquisition activities a priority.

"There is little or no coordination within the US government of counterintelligence that is conducted against the PRC–directed efforts to acquire sensitive US technology," concludes the Cox report.

Nuclear Weapons

It is in the area of nuclear weaponry that this lack of spy defenses may have hurt the US the most.

China has focused espionage activities on the relatively open environment of the US national labs for decades, according to the report of the select panel. The penetration "almost certainly continues today," claims the study.

Impetus for the PRC effort came following the end of the domestic chaos of the Cultural Revolution in 1976, when military planners sat back and assessed the state of their atomic weapons. PRC warheads of the late 1970s were large, multimegaton devices comparable to US technology of the 1950s. Officials may have decided that it was time to move to more advanced warheads and a new generation of ballistic missiles.

Over the years, the Chinese made major moves on American national laboratories located at Los Alamos and Sandia, N.M., Livermore, Calif., and Oak Ridge, Tenn. The effort evidently yielded the PRC a trove of stolen secrets. The Cox report says the Chinese obtained classified information on every currently deployed US Intercontinental Ballistic Missile and Submarine-Launched Ballistic Missile. Details remain classified, but the study says the warheads on which the PRC obtained information include the W56 warhead for the Minuteman II; the W62 for the Minuteman III; the W76 Trident C-4 SLBM, the W78 Minuteman III Mark 12A ICBM; the W87 Peacekeeper ICBM; the W88 Trident D-5 SLBM; and the W70 Lance short-range ballistic missile.

In 1996, US intelligence reported that China had stolen technology for the neutron bomb, which is intended to maximize radiation damage while reducing heat and blast. Such a weapon would be a useful tool if its possessor wished to wipe out human defenders but occupy the battlefield following conflict and avoid inflicting destruction on the area.

The PRC has also stolen data on weapons design concepts, on weaponization features, and on re-entry vehicles—the hardened shells which protect warheads during their plunge back into the atmosphere.

It may have obtained classified nuclear weapons computer codes. Theft of the so-called legacy computer codes, such as those used in development of the W88 Trident warhead, would fill in gaps in Chinese knowledge about how advanced

thermonuclear devices perform when exploded. To successfully produce a W88–like weapon, the PRC may need dynamic, three-dimensional data on warhead packaging, primary and secondary coupling, and the chemical interactions of materials inside the warhead over time, according to the Cox report.

Specifics on the leaked codes remain largely classified. However, the House report confirms China acquired the MCNPT code, which is useful in determining a system's ability to survive electronic penetration; the DOT3.5 code, which performs similar calculations in a different manner; and the NJOYC code, which acts as a translator between the two other codes.

In the mid-1990s, US intelligence officials learned that China had acquired US technical information about insensitive high explosives. Conventional explosives are the first step in the chain reaction which leads to an atomic blast; insensitive high explosives are safer for use on mobile missiles. Such material can be dropped, struck, or even shot with a bullet but still not detonate.

The House Select Committee believes that the PRC theft of US secrets indicates that China will soon follow the US lead and move toward a nuclear force that is heavily reliant on lightweight, mobile, innovative nuclear weapons.

China is already known to be developing several new solid-propellant mobile ICBMs. The road-mobile DF-31, for instance, is likely to undergo first flight tests in 1999 and may be deployed as early as 2002, according to House data. The warhead for this smaller weapon would likely use elements of the US W70 or W88.

Chinese engineers may not be able to precisely match the sophistication of US warheads, but the difficulties they face in bending the US information to their own use are surmountable, according to the Cox report.

"Work-arounds exist, using processes similar to those developed or available in a modern aerospace or precision guided munitions industry," says the House study. "The PRC possesses these capabilities already."

The deployment of a new generation of thermonuclear warheads by China could prove strategically troublesome for the US.

For one thing, smaller, more efficient designs could allow the PRC to deploy missiles tipped with Multiple Independently Targetable Re-entry Vehicle warheads. The Chinese have frequently expressed opposition to US deployment of ballistic missile defenses, and MIRVs might allow the Chinese to put heavy stress on, or possibly break through, such a shield.

In addition, smaller, lighter warheads might allow China to extend the range of their SLBMs, enabling them to strike the US from distant Pacific waters.

Finally, China might not be the only nation that gets to take a peek at the secret US data. "The PRC is one of the world's leading proliferators of weapons technologies," says the Cox study. "Concerns about the impact of the PRC's thefts of US thermonuclear warhead design information, therefore, include the possible proliferation of the world's most sophisticated nuclear weapons technology to nations hostile to the United States."

High Performance Computers

US nuclear secrets are of little use to Chinese scientists unless they have access to modern computers. And the House Select Committee judges that High Performance Computer equipment recently acquired from the US represents a major leap forward in China's computing power.

In recent years, US export controls on HPCs have steadily relaxed. As a result, China now has more than 600 US–origin HPCs, estimates the Cox report. Three years ago, they had none.

Furthermore, "the Select Committee judges that the PRC has been using High Performance Computers for nuclear weapons applications," says the report.

High Performance Computers—defined as systems able to perform 1,500 to 40,000 MTOPS (Millions of Theoretical Operations Per Second)—have a wide array of legitimate civilian applications. They are useful in everything from financial market transactions and credit analysis to weather prediction and petrochemical research.

They are also essential building blocks of modern weapon design. Everything from nuclear weapons to anti-submarine warfare systems and command-and-control installations benefit from HPC power.

To keep HPCs from being used for military purposes, the Commerce Department controls their export. In general, the sale of HPCs with a performance level of greater than 2,000 MTOPS to nations other than reliable US allies requires some degree of Commerce scrutiny and/or licensing.

Under a law passed by Congress in the Fiscal 1998 defense authorization bill, Commerce is supposed to perform post-shipment verifications on all exports of HPCs with greater than 2,000 MTOPS to so-called Tier 3 nations, including China, Vietnam, and nations of the former Soviet Union.

China has long resisted any such inspections of purchased US technology, however. A June 1998 US–PRC agreement on end-use checks holds that China will consider requests for such inspections to be nonbinding. If inspections are carried out, they will be conducted by one of the PRC's own ministries.

"The Select Committee has reviewed the terms of the US–PRC agreement and found them wholly inadequate," says the Cox report.

At the time the House report was written, only one post-shipment verification had actually taken place. Yet Commerce and Defense Department data indicate that US HPCs have been obtained by Chinese organizations involved in the research and development of missiles, submarines, aircraft, communications, and microwave and laser sensors.

US companies have at times abetted such technology diversion. Compaq Computer paid a $55,000 civil penalty in 1997 to settle alleged charges that it had shipped equipment to the PRC without obtaining the proper export licenses. Digital Creations Corp. of New Jersey pleaded guilty to criminal charges that it had shipped a computer to China without the required license and was sentenced in 1997 to pay a criminal fine of $800,000.

The Select Committee believes that China is particularly interested in acquiring the kind of computer power needed for the simulation of nuclear blasts. As a signer of the Comprehensive Test Ban Treaty, the PRC can no longer legally conduct actual

tests to judge the performance of weapons. Yet HPC performance in the millions of MTOPS is needed for adequate computer modeling of aging nukes.

"For this reason, the Select Committee judges that the PRC is almost certain to use US HPCs to perform nuclear weapons applications," says the report.

Satellite Launches

Today's global market in space launch services is brutally competitive. China serves the same position in this market as it does for many consumer goods: It is the low-cost option. Its bids sometimes come in at half the price of Western launch firms, but it is not the high-quality option. PRC boosters have been known to veer off course and slam into nearby mountainsides, with disastrous results.

In general, the Cox report casts doubt on the wisdom of allowing US firms to put their satellites on Chinese rockets. The reason is that the boosters used are closely related to the PRC's military ballistic missiles. Launches financed by US firms and foreign agencies inevitably have given China the opportunity to refine booster reliability. In addition, US satellites are poorly guarded once they arrive in the PRC and present a tempting espionage target.

To bolster its point that the Chinese military benefits from civilian launches, the Cox report examines two cases in which US contractors may have skirted export restrictions to improve PRC boosters.

These companies—Hughes and Loral—were worried about the fate of their own satellites. Hughes Space and Communications, for instance, attempted in 1992 and 1995 to launch communications satellites on Chinese Long March rockets. Both satellites were lost when their launch vehicles exploded.

An internal Hughes investigation located the problem as being the Long March's hammerhead fairing—a sheath that protects the satellite as the rocket roars into orbit and then splits away as the payload is pushed into space. US engineers believed that the rivets that held the fairing together were not strong enough. They also thought the shape was slightly off and was vulnerable to strong winds during ascent.

The Chinese did not want to hear these points, at least not at first. They were very reluctant to admit fault in their boosters. However, commercial insurers were reluctant to back more Hughes launches in China unless changes were made. So Hughes conveyed their findings to the Chinese in a formal manner, and eventually the Long March 2E fairing was improved through such measures as an increase in the nose cap attachment screws.

Fairings are not necessary with single-warhead ICBMs. But multiple-warhead missiles use them to

Inhofe Pierces Administration "Smoke Screen"

Ever since the Chinese espionage scandal erupted, harsh criticism has been falling on the Clinton Administration's team of national security advisors—and the President personally. Their foes in Congress and the media accuse them of incompetence, inattention, poor judgment, and playing low politics with the nation's defenses.

Few if any critics have been as fierce or well-informed as Sen. James Inhofe (R–Okla.), member of the Senate Armed Services Committee. Inhofe's view: "This President and this Administration are singularly culpable for orchestrating a politically inspired cover-up [of Chinese spying] in order to advance policies they knew were causing harm to US national security."

Inhofe dismisses as a "smoke screen" the White House's suggestions that most of the cases occurred long ago and that all recent Presidents are equally culpable.

"Sixteen of the 17 most significant major technology breaches ... were discovered after 1994," charged Inhofe, citing data uncovered by a Congressional panel led by Rep. Christopher Cox (R–Calif.). "The notion that Presidents Carter, Reagan, and Bush knew the extent to which China's efforts to steal US nuclear and military technology were successful is fantasy."

In a recent statement posted on his Senate Internet site, Inhofe went on to say, "At least eight (and maybe more) of these breaches actually occurred after 1994. ... Among these breaches—occurring on the Clinton watch—are many of those that go the farthest in advancing China's potential as a direct nuclear threat to the United States."

According to Inhofe, the eight breaches are:

- Transfer of so-called legacy codes containing data on 50 years of US nuclear weapons development, entailing more than 1,000 nuclear tests.
- Sale and diversion to military use of some 600 High Performance Computers, enabling China to enhance its development of nuclear weapons, missiles, and advanced aviation equipment.
- Compromise of nuclear warhead simulation technology, thus enhancing China's ability to perfect miniature nuclear warheads without actual testing.
- Compromise of advanced electromagnetic weapons technology useful in the development of anti-satellite and anti-missile systems.
- Transfer of missile nosecone technology that enables China to substantially improve reliability of its ICBMs.
- Transfer of missile guidance technology enabling China to substantially improve the accuracy of its ballistic missiles.
- Compromise of supersecret space-based radar technology, which would give China the ability to detect our previously undetectable submerged submarines.
- Compromise of some other "classified thermonuclear weapons information" which "the Clinton Administration ... has determined ... cannot be made public."

Inhofe is especially incensed at the way that President Clinton's national security advisor, Sandy Berger, has cast his role in the infamous W88 nuclear warhead case. China's theft of the design of the W88 miniaturized warhead happened in the 1980s and was discovered in 1995. It was an "enormously significant" event, said Inhofe. However, Berger claims he didn't tell the President about the theft until perhaps as late as early 1998.

"The idea that Sandy Berger, ... who was fully briefed about the W88 technology breach in April 1996, did not immediately communicate this information to the President is preposterous," said Inhofe.

Inhofe went on, "The President had to have known about the W88 breach no later than April 1996, well before the 1996 election. The President deliberately withheld this vital national security information from key members of Congress for obvious political reasons. He withheld it for almost three years—a cover-up that is nothing less than a scandal of gigantic proportions."

Inhofe charges that the underlying source of Administration action was the desire to maintain close relations—especially trade relations—with China.

"Notra Trulock, the Energy Department's former director of intelligence who had first briefed Berger in April 1996, testified [that] he was prepared to brief members of the House and Senate Intelligence Committees as late as July 1998 but was denied permission to do so by acting Energy Secretary Elizabeth Moler, a political appointee. Moler reportedly ordered Trulock not to conduct the briefing because she said the information would be used to hurt Clinton's China policy."

shroud re-entry vehicles, and the knowledge Hughes conveyed to China could help speed their development of MIRVs, believes the House Select Committee.

There is evidence that US government officials improperly approved at least some of the fairing discussions between the US firm and the PRC. Committee members allege, however, that Hughes knew that transferring the knowledge in question required additional review by the State Department.

"Hughes deliberately acted without the required State Department license," says the Cox report.

Loral was similarly worried about the reliability of the Long March rocket. On Feb. 15, 1996, a Loral Space Systems Intelsat 708 satellite was destroyed when a PRC booster tipped over even before it cleared the launch tower. The rocket crashed into a nearby hillside after 22 seconds of flight, devastating a village and killing upwards of 100 people, by some estimates.

A Chinese probe concluded that the spectacular accident was caused by a broken wire within the inner frame of the guidance system's Inertial Measurement Unit. Loral engineers thought that explanation did not come close to explaining the rocket's wild behavior. A Loral review pointed to two other possible causes: the IMU's follow-up frame or an open loop in the feedback path of the guidance system.

Loral faxed the report to the PRC in May 1996 without prior review by any US government authority, charges the Cox committee. China eventually concluded that Loral was right, and that the IMU follow-up frame had failed.

Improvements in the reliability of the Long March guidance system hurts US security because it is one of the candidates for use in the PRC's next-generation DF-31 ICBM, says the House Select Committee. Though not accurate enough to allow more than targeting of cities, the system is lightweight and compact.

One major danger in these technology transfers is simply that China has learned much about Western diagnostic processes, according to the Cox study.

"This exposure could improve the PRC's pre- and postflight failure analysis for their ballistic missile programs," says an interagency review team formed to answer questions about the Long March. "This, in turn, could increase the PRC's future ballistic missile reliability."

It is also possible that China has gleaned valuable technical information from the mere presence of US–built civilian satellites at Chinese launch sites. US firms are responsible for launch site security in the PRC, but buildings in which the satellites are prepared have numerous security weak points, from underground steam pipe tunnels to large unlocked window areas and paper door seals which can be peeled off, undetected, when cold.

Private US guards aren't exactly the epitome of professionalism, either. They routinely arrive for work drunk and then go to sleep, charges the Cox report. Trips to town to meet prostitutes are common.

The hunt for hookers became so intense at one point that a Defense Department monitor was approached by a PRC official who told him that one of the guards had been soliciting prostitutes in front of the local police department.

In another incident, a guard pulled a table out of line of sight of a video surveillance camera, to use it as a bed. Since the table blocked the room's door, the Defense Department monitor called the room to have it moved back. The guard reportedly responded that he was "not in the furniture moving business."

One guard even reported for work carrying a sleeping bag, charges the Cox study.

Technology Transfer

Espionage is not the only way the PRC obtains technological secrets. It also buys them, by relentlessly scouring the West for civilian items that may have military uses.

US law theoretically blocks sale of dual-use technology. However, determining what can and cannot be sold to the PRC is a difficult process, made harder by the PRC use of numerous front companies and long-term investments in Western firms.

Some efforts are rebuffed. In 1990, the PRC tried to advance its cruise missile program by buying the Williams FJ44 civil jet engine. This compact turbofan was derived from the power plant for the US Tomahawk, so the purchase was denied.

Others succeed. In 1993, a PRC company joint venturing with McDonnell Douglas to produce civilian airliners was allowed to buy 19 advanced US machine tools for its manufacturing plant. There were warning signs—the number of airliners to be built in China was cut by 50 percent, for example—but McDonnell Douglas insisted the tools were necessary for the PRC plant, so the Commerce Department approved the deal.

Two years later, McDonnell Douglas reported that six of the tools had been diverted to a factory that made military aircraft and cruise missiles, as well as commercial products.

Some attempted PRC purchases resulted in changes in US policy. In 1991, the Commerce Department decided to decontrol a popular series of civilian jet engines manufactured by AlliedSignal's Garrett Engine Division, the Garrett TFE-731. That meant that the engines could be exported without a license or US government review. The PRC quickly began negotiating with AlliedSignal over terms of a coproduction deal. Reportedly, the Chinese motivation was the need for a reliable engine for its developmental K-8 multirole military aircraft.

In July 1992, the Department of Defense learned of the negotiations. The reaction of military officials to the news sparked an interagency review of the decontrol decision. The co-production deal died after the review concluded that transfer of such jet engine production capabilities could threaten US national security.

"The PRC has mounted a widespread effort to obtain US military technologies by any means—legal or illegal," concludes the Cox report. "These pervasive efforts pose a particularly significant threat to US export control and counterintelligence efforts." ■

Peter Grier, the Washington bureau chief of the Christian Science Monitor, *is a longtime defense correspondent and regular contributor to* Air Force Magazine. *His most recent article, "Roadman on Tricare," appeared in the July 1999 issue.*

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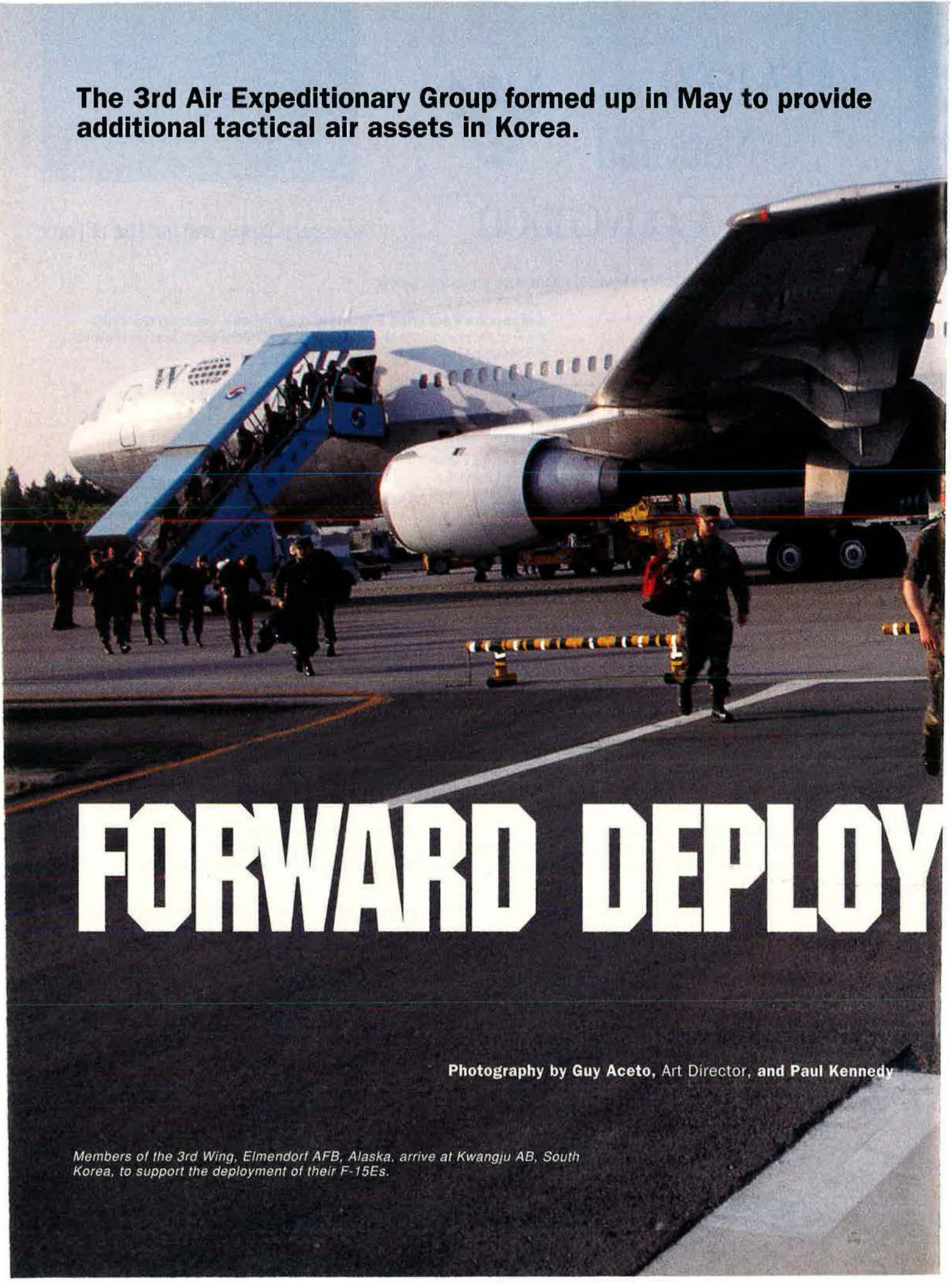
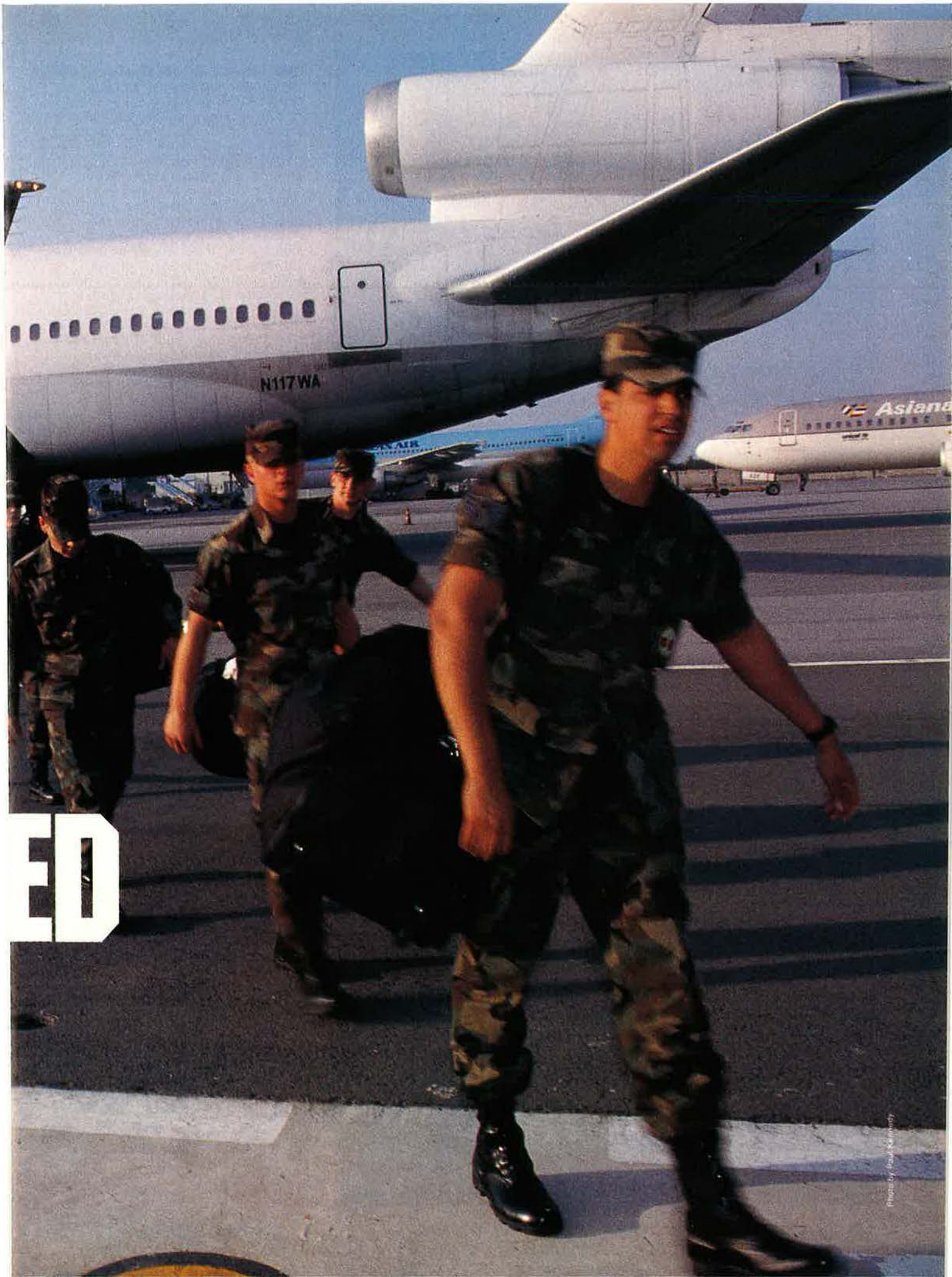
The 3rd Air Expeditionary Group formed up in May to provide additional tactical air assets in Korea.



FORWARD DEPLOY

Photography by Guy Aceto, Art Director, **and Paul Kennedy**

Members of the 3rd Wing, Elmendorf AFB, Alaska, arrive at Kwangju AB, South Korea, to support the deployment of their F-15Es.



ED

Photo by Paul Kennedy

Photos by Paul Kennedy

The Balkan War affected forces well outside that immediate theater. The Air Force quickly deployed Pacific Air Forces units and individual troops to form the 3rd Air Expeditionary Group. The purpose was to fill a gap in Korea created by temporary removal of a carrier battle group from the Pacific region. USS Kitty Hawk *went to bolster US forces in Southwest Asia when USS* Theodore Roosevelt *moved to the Mediterranean to support Operation Allied Force. At left, personnel from the 3rd Wing, Elmendorf AFB, Alaska, arrive at Kwangju AB in South Korea via a commercial contract aircraft. In all, some 640 personnel from eight different bases came to Kwangju, which is about 160 miles south of Seoul and serves as a military facility and civil airport. A small detachment of PACAF forces maintains nearly 250 acres of the base year-round.*

Recent confrontations between North and South Korea underscore the constant tensions in the area. At the United Nations security area at Panmunjom on the border between the two rival nations, a South Korean soldier (right) helps maintain the watch that has continued since the Korean War ended in 1953.

Photo by Guy Aceto

At Osan AB, South Korea, 38 miles south of Seoul—South Korea's capital—and 50 miles from the border, USAF security forces (left, foreground) use M-113 armored personnel carriers in addition to standard security vehicles to patrol the base. In the background, a Patriot missile battery continuously points north.

Photo by Paul Kennedy

About 110 miles south of Seoul is Kunsan AB, South Korea, home to PACAF's 8th Fighter Wing. The "Wolf Pack," which came to Kunsan in 1974, has two F-16 squadrons, the 35th FS and 80th FS. The wing's heritage dates to World War II, but it was Col. Robin Olds, the unit commander during the Vietnam War, who provided the wing's nickname.

Photos by Guy Aceto

F-16s at Kunsan and Osan, joined the 90th and other US forces in the Cope Jade exercise. The F-16 airmen showed their versatility as they took on roles as both aggressors and allies. One of the chief benefits of the exercise, according to Col. James E. Reed, 3rd AEG commander, was the opportunity to experience and refine the command, control, and communications process for a diverse group of forces.

The 8th FW personnel, unlike their 3rd AEG counterparts, are in South Korea for a one-year tour. Kunsan has all the usual Stateside amenities, from a fitness center to a base exchange food court, with pizza, burger, and ice cream vendors just like home—but on a smaller scale.

Photos by Guy Aceto

Airlifters played a key role in the deployment. Establishing the 3rd AEG at Kwangju required movement of nearly one million pounds by nine C-5s, two C-130s, and a commercial contract aircraft.

Above, a C-130 flight crew from Elmendorf's 517th Airlift Squadron hangs loose on the way from Kunsan back to Yokota AB, Japan. The 517th routinely flies some of the resupply missions between Japan and units in South Korea to supplement the C-130s of the 374th Airlift Wing at Yokota. At right, navigator Capt. Rob Wanner checks the position of an Elmendorf C-130 on one of its supply runs.

Photo by Paul Kenredy

The Air Force ensures that troops can take a break from the mission. Basketball is a typical pastime at most American facilities. However, even Kwangju offered more—the 3rd AEG Services Squadron set up a base theater, a recreation center complete with video games, Ping-Pong, and darts, and arranged overnight weekend tours to Osan, a much larger facility and close to Seoul.

Photo by Guy Aceto

Kwangju has only a few permanent aircraft shelters available. Above, protective steel revetments not only provide some protection for the 90th's F-15Es but also create a more secure environment for maintenance crews as they work on the aircraft.

Photos by Paul Kennedy

Photo by Guy Aceto

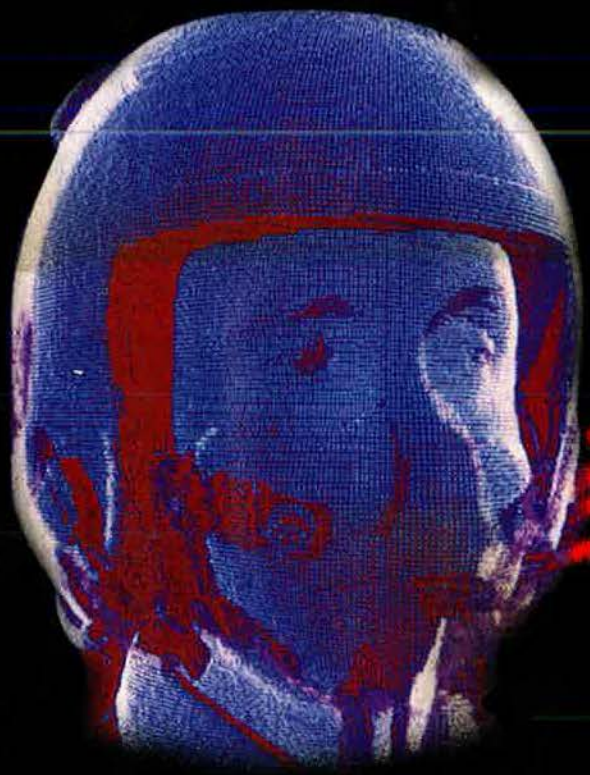
The F-15Es from the Pair o' Dice at Elmendorf could make plans to return to their home base with the end of the Balkan War. However, for one of PACAF's most in-demand units, the next deployment is probably not far off.

Along with the Dicemen from Elmendorf, the 3rd AEG team included forces from Andersen AFB, Guam, Eielson AFB, Alaska, Hickam AFB, Hawaii, Kadena and Yokota ABs, Japan, and Kunsan and Osan.

Forces in South Korea are daily "at the tip of the spear," to quote the Kunsan AB welcome brochure. At left and above, security forces specialists at Kwangju perform flight line security. The potential for hostilities is still high, and USAF forces are at the edge. ■

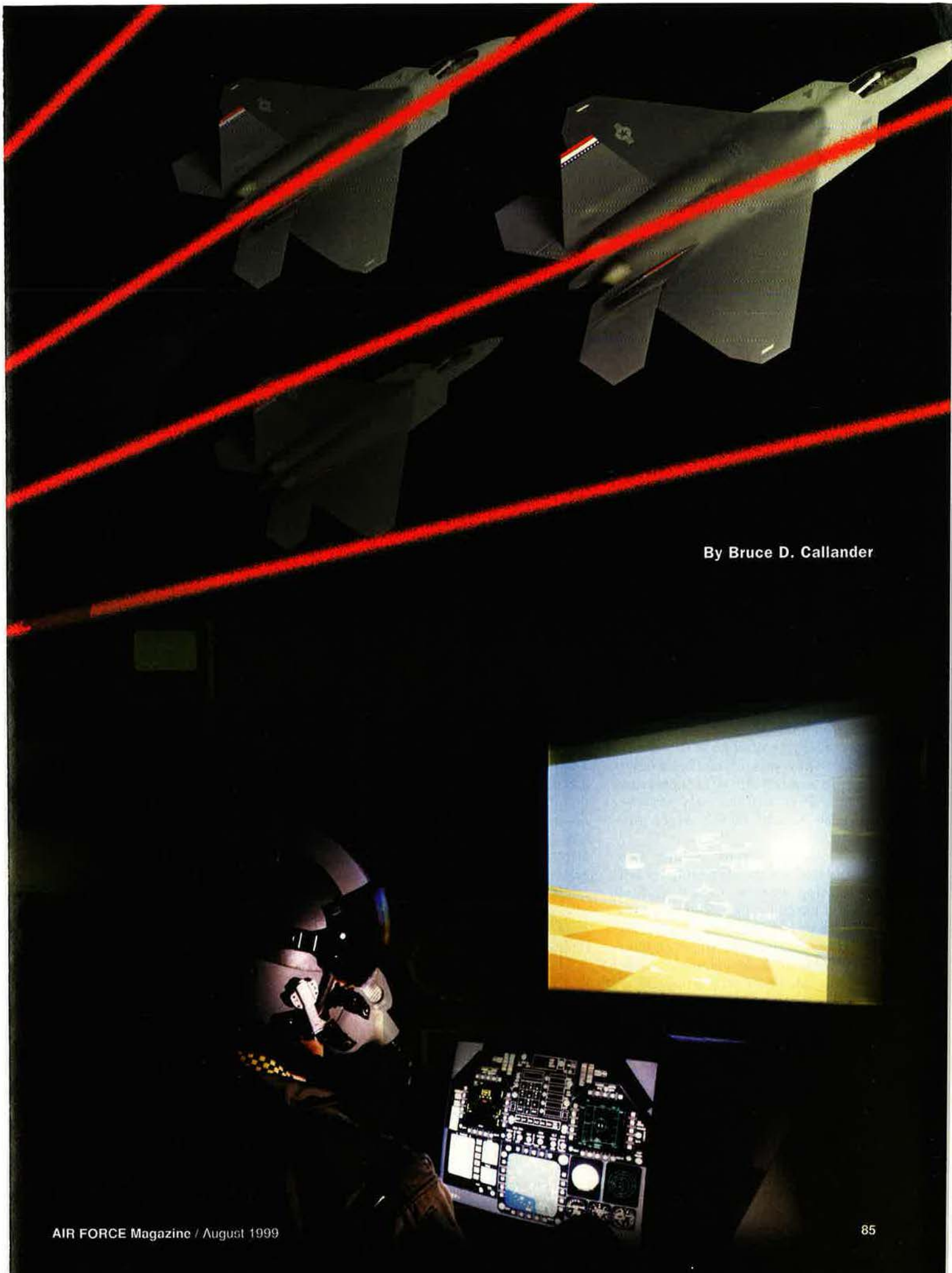
Photo illustration by Cathy Cavanaugh

"Distributed training" technology allows pilots in one area to interact with those in other areas as if they were in the same airspace.



TRAINING IN NETWORKS

By Bruce D. Callander



Not long ago, Gen. Richard E. Hawley declared to a public gathering, "I am perhaps the Air Force's most outspoken proponent [of] Distributed Mission Training." Hawley, the commander of Air Combat Command at the time, then went further, saying that the concept had "a tremendous future" in the combat forces.

What exactly is it?

In a typical distributed training episode, a flight of four F-15C fighters from Eglin AFB, Fla., would join a flight of F-16s from Shaw AFB, S.C. At the same time, controllers aboard an E-3 AWACS from Tinker AFB, Okla., would choreograph an attack against an enemy target while an adversary force from Nellis AFB, Nev., would be hostile fighters. As they near the objective, Air Force pilots would see not only their wingmen but also the land battle, enemy interceptors, and bursts of anti-aircraft fire.

Here's the news: None of the participants in these exercises would ever leave their home stations.

Thanks to a new generation of telecommunications and aircraft simulators with computer-generated visual effects, Air Force operators of the future are going to be able to experience virtually all conditions of combat at more or less the same time, despite being separated by hundreds or thousands of miles. They won't face just a computer-simulated threat. They will interact with other friendly aircraft and with enemy airplanes. They will not only observe but also be part of the larger air–ground battle.

The Air Force took a major step toward this advanced training format this spring when it opened its first ground-based F-15C Mission Training Center at Eglin. Plans called for the start of training in July at another F-15C MTC, this one at Langley AFB, Va. The Air Force will follow up in 2001 with the AWACS center at Tinker and an F-16C site at Shaw. The adversary force at Nellis will come after those, as will a number of additional centers at other sites.

Distributed Mission Training, known as DMT, is being developed in a number of forms throughout the Air Force. In Air Combat Command, the focus is on aircrew training, or DMT-A. Another program, DMT-C2, will train operators of AWACS. The Air Force later will add bombers and other weapon systems.

When the whole program is up and running, the full array of battle elements will be linked in what officials term a "system of systems." The result is what you might get if you crossed a video game, a wide movie screen, and theme-park adventure ride.

What it Does

Maj. Edward Maxwell, chief of ACC's Distributed Mission Training Team, said the Air Force has moved beyond the basic procedural task trainers and has begun to use simulation to train pilots in advanced combat tactics and concepts.

"While we used to focus on predominantly task-oriented use of simulators, we are now focusing on training team and interteam skills," said Maxwell. "Obviously, to do this you need a much more advanced simulator. We require high-fidelity systems with full-field-of-view visual systems to produce an accurate representation of what you would expect to encounter in actual flying and in combat."

It's not just that the new equipment will provide more realism than conventional simulators. DMT will also allow pilots in one location to interact with those in other, geographically separated locations as though they were in the same airspace.

The Eglin F-15C MTC, for example, will have four high-fidelity advanced simulators. Pilots can use them individually as they have used older simulators, but the four also will be linked together so that four pilots can "fly" in formation and practice unit combat tactics. And, as other training centers come on line, pilots at any center will be able to train with a variety of widely scattered units.

The potential of DMT is particularly appealing to the Air Force as it develops its new Air Expeditionary Forces, formed of scattered units and tailored to meet specific contingencies.

Physically assembling this variety of units for training on a regular basis would be prohibitively expensive and logistically challenging. Environmental concerns, safety factors, civilian competition for the airspace, and the problems caused by high optempo add to the problem.

"Think about the AEF," said Hawley, who retired July 1. "This is a collection of units from across the Air Force that is a virtual organization made up of perhaps eight or 10 different squadrons. It's made up of earmarked ground [forward air control] people, combat communications, and RED HORSE and Prime BEEF [construction and engineering teams], which are all the elements that it takes to deliver combat power to the [theater commander in chief].

"What's better to prepare them for their task in the theater than to train together in a distributed crew training environment, without having to incur the further optempo of deploying someplace in order to work together?"

The possibility of linking these geographically separated units electronically and exposing them to realistic, albeit artificial, combat environments has thus spurred the Air Force's interest in taking simulation to new levels.

Making it Feel Real

From the earliest days of flight, simulation has remained a game of make-believe. In theory, the closer the trainer can approximate the conditions of actual flight, the better pilots will be able to handle the real thing.

The new generation of simulators carries that philosophy a step further. An individual trainer can include mechanisms to shake the pilot's seat and flight controls, imitating turbulence. The visual system can be jittered to give the illusion that the ship has been hit by a flak burst or missile. And, wraparound, computer-generated presentations can give the pilot the sense of flying through a real sky and over real terrain.

The technology for creating these make-believe environments has exploded in recent years, driven in no small degree by Hollywood's special effects departments. Theater seats jolt moviegoers as they watch an earthquake, and stereophonic sound puts them in the midst of battles. Wide Imax screens give roller coasters a stomach-turning realism.

From Disney World to Caesar's Palace, "rides" that are no more than visual effects send patrons on harrowing adventures. For those who can't make it to a theme park, computer software brings into the home

computer anything from a World War I dogfight to a stealth fighter mission.

The services have drawn on the advances of both the aviation and entertainment industries to add reality to their simulators. The question, at times, has been which technology to exploit.

The Army, for example, has been exploring the virtual reality approach, which uses helmet-mounted visuals and strap-on sensors to give the wearer the illusion of being in the action. The Air Force has not ruled out that technology as a future possibility, but, at the moment, it is concentrating on using actual cockpit hardware and creating a virtual world around it with artificial, full-field-of-vision presentations.

Either way, the object is the same—to immerse the pilot in his environment so that he comes out, as Hawley said, "smiling and sweating."

It seems to be working. The Air Force Research Lab's Warfighter Training Research Division at Mesa, Ariz., has a four-ship high-field-of-view F-16 simulator; USAF has been running some testing and training programs using actual aircrews. "Recently," said Maxwell, "they had a pilot in there who was actually performing a g-straining maneuver, tightening the muscles that he would need during advanced combat maneuvering. Yet he was sitting in 1g, so the realism is there, and we have to assure it will be there to create a high-threat, high-immersive environment."

That environment is likely to become even more convincing in the future. In current simulators, most of what the pilot sees is computer-generated, but the Air Force is exploring possibilities of adding photo-realistic imagery to it. This means overlaying even more convincing images on the artificial landscape to provide the randomness and subtle color variations that computer generation lacks.

Beyond that, there are still more imaginative possibilities. One, still little more than a concept, is laser-generated targeting. At least in theory, it could paint objects onto the imagery so realistically that the pilot would not just see a representation of his wingman's airplane or of an oncoming enemy but have the sense that they actually were there.

One of the aims of the DMT approach is to take advantage of such improvements as they come along. "In the simulation world," said Maxwell, "there is something called open architecture. We are trying to structure the development of these systems on that principle, which will allow much easier integration of other systems and other capabilities as they occur."

Combat in a Hangar

If the only object were to give Air Force pilots a more realistic feel of flying, however, there would be no need for the Distributed Mission Training effort. Improved individual simulators would be enough.

The real object of DMT is to help train aircrews not only to fly but to fight—alone, in groups, and with the full array of supporting elements and opposing forces. This means expanding the one-pilot cockpit environment into something close to a real-time aerial view of a war and then making the pilot an interactive part of it.

In effect, a Mission Training Center can stage such an air or air–ground battle with all the elements, from friendly forces to enemy aircraft to ground units, both ours and theirs. More important, the pilot in one simulator can react to the actions of all these elements and, in turn, have impact on them by his own actions.

In short, DMT is designed to make the participants not just observers of some high-cost video game but active players.

ACC has used much the same approach for years in its Red Flag exercises at Nellis, where pilots train with other Air Force units and a va-

Distributed Contracting

The Distributed Mission Training concept meshes well with current Air Force efforts to speed modernization of the forces but hold down costs. Under conventional acquisition practices, it would take decades for the Air Force to develop such an extensive system, but the new program includes a contracting system as innovative as the hardware itself. The Air Force will not buy simulators but instead contract for simulator services.

So far, USAF has awarded contracts to Boeing for F-15C simulation services at Eglin AFB, Fla., and Plexsys Interface Products for the AWACS center at Tinker AFB, Okla. Other contracts are being negotiated. Under them, the Air Force will rent the services and not own the hardware. The contractors will set up, operate, and train the trainers, with the Air Force paying hourly rates for using them.

The arrangement not only spares the service the large up-front expense of buying simulators, but it also speeds the process of starting up. Under traditional acquisition practices, it would take up to six years to develop, purchase, and install a new simulation system. The contract-services approach reduces the time to as little as 18 months. Moreover, in negotiating the service contracts, the Air Force can require that the systems be updated periodically as new technology becomes available.

Officials say this helps solve one of the long-standing problems with service-owned simulators—ensuring that they are compatible with the latest models of the aircraft on the ramp. Now, with concurrency priced into the contract, it is up to industry to comply.

The transition to DMT may not be a complete break with conventional simulation. ACC has decided that contractor-supplied services is the best approach for the F-15C and the F-16, but it is considering other weapon systems on a case-by-case basis.

It is looking at the simulators for the F-15E, for example, to see if it is possible to convert them to the DMT environment. It will take a similar look at trainers for the A-10, B-1, B-52, and the rest of the inventory. Even if it is possible to modify some of them to be compatible with DMT, however, it may prove more cost-effective to contract for services on new ones than to update the old ones.

riety of other combat elements. In fact, USAF is drawing heavily on the Red Flag experience in designing its DMT approach. Like Red Flag, for example, DMT will incorporate stand-ins for the opposition forces. Instead of flying aircraft disguised as the potential enemy, however, the "bad guys" will operate threat consoles linked to the simulators. In effect, they will fly against the trainees, both attacking and reacting to being attacked.

Only the opening scenarios of such battles will be scripted, officials say. Once the forces begin to interact, no training session will develop like any other.

"We can have them flying against real people, not just computers," said Hawley. "I think that's a very important part of the synthetic training environment—you've got to be able to fly against more than a computer-generated threat."

Nor do all of the site's simulators need to be occupied to stage a war. A DMT can as easily take a single pilot through a combat mission with just as much realism. In this case, console operators populate both sides of the fight, some flying the friendly aircraft and some the opposition.

In addition, the computer can generate anything from a civilian aircraft that must be avoided to an unknown that must be identified to a hostile that must be destroyed. It also can fill the ground environment with opposing forces, from tanks to individual troops to heavy artillery. Theoretically, it could recreate much of Operation Desert Storm in a training hangar.

The object is not to refight past air wars but to incorporate lessons from them. This also follows the tradition of Red Flag, which has drawn on the experience of Desert Storm and doubtless will do likewise with Operation Allied Force.

With the Air National Guard and Air Force Reserve handling more and more of the total mission load, DMT plans also call for drawing Guard and Reserve personnel into the new environment. In fact, some individual reservists already have flown the new simulators.

For some reserve members, this could pose a problem. Most work short training schedules and have only limited time to meet their flight training requirements. Squeezing in the additional simulator time could be difficult. There may be a temptation to use the DMT time to substitute for actual flying hours, but USAF officials say many reservists already are close to the minimum number of sorties they need to stay proficient.

Limitations

That could be a problem in the active force as well. But, while they are enthusiastic about DMT, officials are quick to say that they do not want simulation to become an excuse for further reducing the service's number of flying hours.

"One thing that we have to make very clear," said Maxwell, "is that simulators are just that. They are ground-based. When you crawl into one, you know you are going to walk away from that flight. The DMT-A effort is not a replacement for flying training. It is an enhancement to our flying training. It is a way to capture those types of events that we cannot capture or cannot completely train due to current constraints to training."

Impressive as they are, simulators cannot duplicate all the sensations of flight. Officials concede, for example, they never are likely to reproduce the kinds of g-forces generated by high-performance aircraft. The Air Force produces g's in centrifuges, but the prospect of wedding a centrifuge with a massive simulator is not now in the cards. Even if it is theoretically possible, doing it probably would be prohibitively expensive.

With any advance in simulation, the Air Force usually has had to fight off attempts to cut back on actual flying hours. The DMT project may have a similar result, but USAF officials hope to ward off that threat. They say they will make the case that, even though simulators may help pilots spend their flying hours more productively, there still is no substitute for air time. ■

The Long Winding Path of Simulation

As early as 1910, the Wright brothers were putting their beginning students into a ground-bound flying machine rigged to tilt unless they worked the controls properly.

World War I trainees were subjected to similar devices, some of them suspended from trees, overhead gantries, and even captive balloons. One early trainer put the pilot in a barrel that rolled from side to side in response to his movement of the controls.

By the 1920s, Edwin A. Link had developed a motorized trainer that incorporated not only responsive controls but flight and navigation instruments. Thus was born the Link Trainer known to thousands of World War II pilots.

After the war, improved technology led to more realistic trainers which could simulate many sensations and experiences of flying. Still, until recently, the focus has been on individual pilot training in a single aircraft.

By the early 1990s, however, the Air Force Research Laboratory's Warfighter Training Research Division at Mesa, Ariz., was working with advanced, multi-airplane simulation techniques for use in testing programs.

Gen. Richard E. Hawley, while commander of Air Combat Command, heard of the program and asked why the testing program trainers couldn't be used for operational training as well. The early focus was on the F-15, but it has widened to include a whole array of other aircraft.

Bruce D. Callander, a regular contributor to Air Force *Magazine, served tours of active duty during World War II and the Korean War. In 1952, he joined* Air Force Times, *serving as editor from 1972 to 1986. His most recent story for* Air Force *Magazine, "To Fix Air Force Housing," appeared in the July 1999 issue.*

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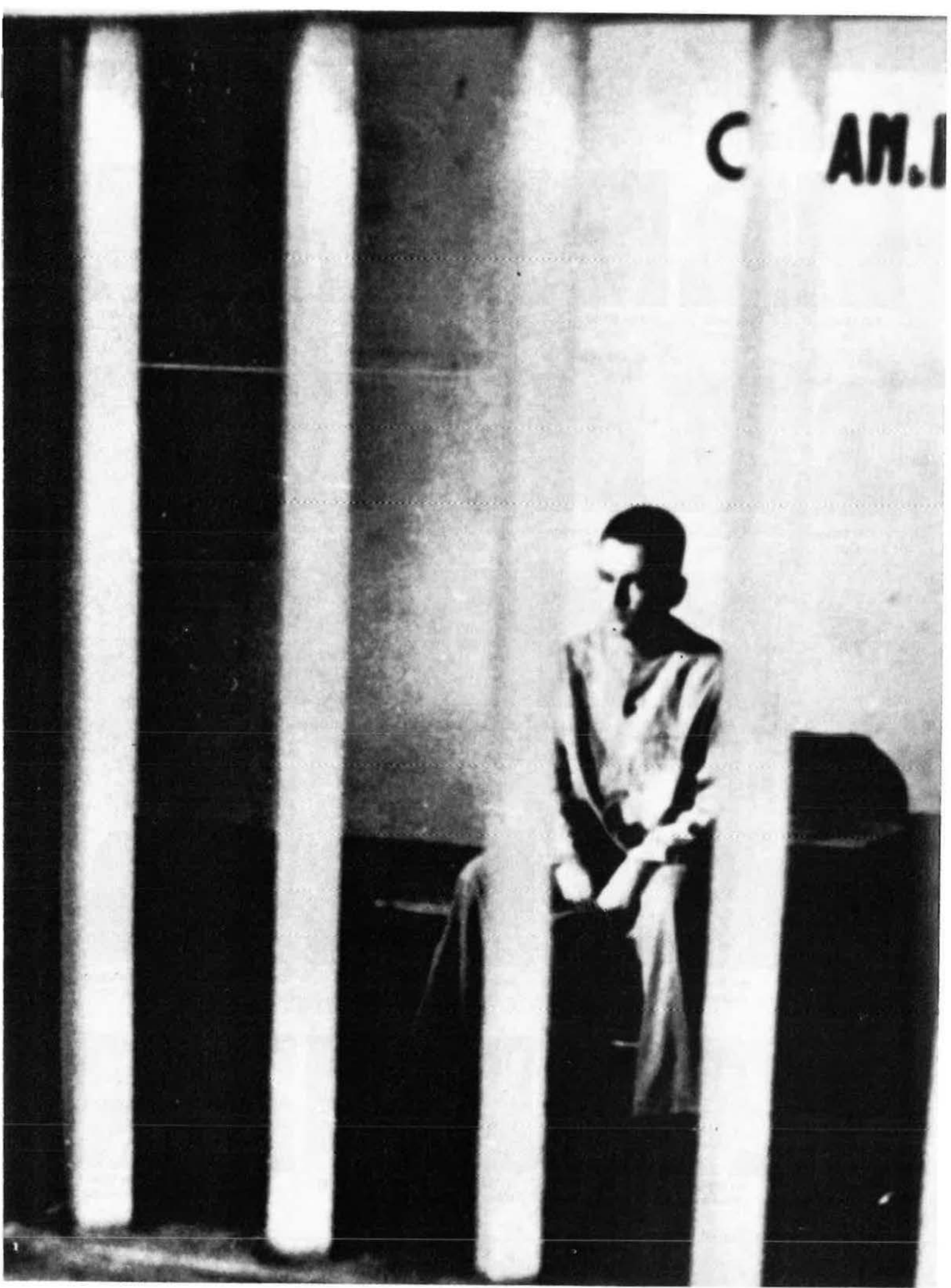
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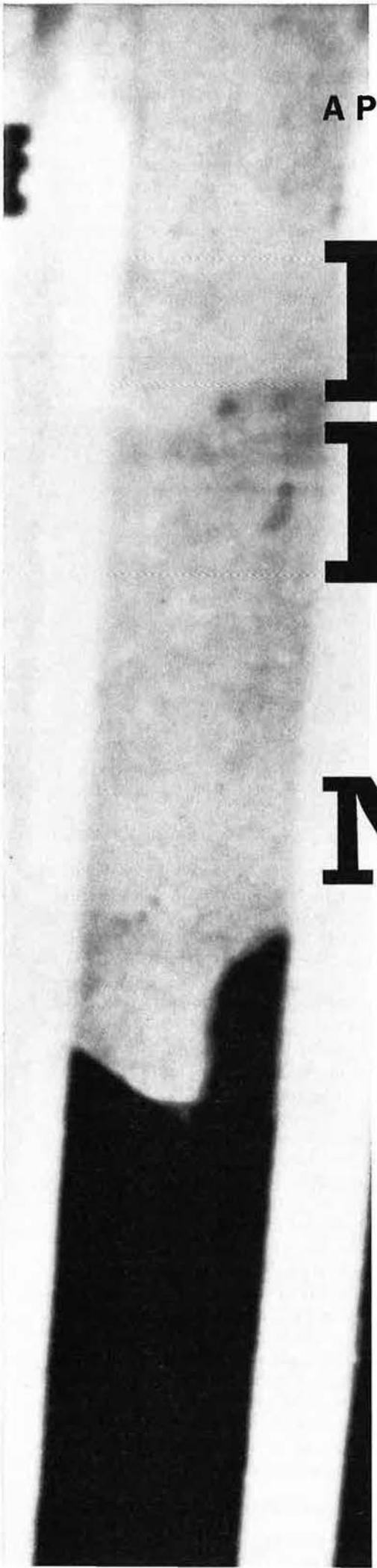

A Pentagon study provides new details—about bravery, torture, and endurance—on the experience of American POWs in Vietnam.

Honor Bound

By Stewart M. Powell

NAVY Capt. Jeremiah A. Denton was the senior officer of the 40 Prisoners of War who left Hanoi on Feb. 12, 1973, aboard the first Air Force C-141 out of North Vietnam. Once airborne, Denton calmly asked a flight attendant for a piece of paper. He thought for a moment and then scribbled the memorable words that he would utter in a short time as he and his comrades stepped off the airplane into the arms of freedom at Clark AB in the Philippines.

"We are honored to have had the opportunity to serve our country under difficult circumstances," Denton declared. "We are profoundly grateful to our Commander in Chief and to our nation for this day. God bless America."

With that, the Navy pilot who went down in an A-6 carrier attack aircraft during a bombing run over North Vietnam's Thanh Hoa bridge complex on July 19, 1965, marked the end of the longest wartime captivity of any group of US prisoners in history.

It was a triumph for Denton, who had alerted the world to the communists' torture of prisoners in May 1966. Dragged before propaganda cameras after 72 hours of nonstop indoctrination, the sleep-deprived pilot had numbly blinked his eyelids to relay the message "t-o-r-t-u-r-e" in Morse code as a Japanese television news crew filmed the interview.

A total of 771 Americans were captured and interned during the Vietnam War. Of those, 113 died in captivity and 658, or 85 percent, were returned to US authorities during or at the end of a grueling conflict that claimed the lives of more than 58,000 American troops in Southeast Asia.

The number of prisoners taken during the Vietnam War was relatively small. Of the 142,255 Americans captured and interned during major wars in

American POWs in the Vietnam War endured the longest captivity of any group of US wartime prisoners. One of them was Navy Lt. Paul Galanti, shown here in an East German propaganda film, sitting under a sign that reads "Clean. Neat."

the 20th century, a total of 17,033 died in captivity. The Korean War had the highest casualty rate among US prisoners—with 38 percent of the 7,140 prisoners perishing.

For Americans searching for meaning in a controversial conflict and yearning for heroes, the POWs became a touchstone for the traditional values of loyalty and inspiration often overlooked during the conflict itself.

The First POW

The first American taken prisoner by the Viet Cong was Army Spec. 4 George F. Fryett, seized Dec. 26, 1961, while riding a bicycle on the way to a swimming pool on the outskirts of Saigon. He was freed in June 1962: His captors simply came out of the jungle at a main road and put him on a bus back to Saigon.

The last POW was seized Jan. 27, 1973—the day the cease-fire was signed in Paris. Navy Lt. Cmdr. Phillip A. Kientzler, shot down near the Demilitarized Zone, was held for two months in North Vietnam under perhaps the most benign conditions of the war, with captives and captors awaiting prisoner releases. Kientzler was freed March 27, 1973, with the last wave of captives to go home.

Between these two bookends, the story of American POWs unfolded. Their triumphs and tragedies are vividly recaptured in *Honor Bound: The History of American Prisoners of War in Southeast Asia, 1961–1973*. The immensely detailed 592-page study was prepared by Stuart I. Rochester, deputy historian of the Office of the Secretary of Defense, and Frederick Kiley, a former Air Force Academy professor and noted POW historian. Drawing from memoirs, interviews, classified documents, and other sources, the historians provide the most sweeping view of American POWs since the return of the prisoners in 1973.

"We were convinced in the end that, on the whole, the PWs [the acronym commonly used by the military services] of the Vietnam War were indeed an extraordinary company of men who endured an extraordinary captivity," the historians wrote. "Both suffering and valor, tragedy and triumph, occurred on a large scale."

Prisoners captured and held in South Vietnam had a far different experience than the aviator officers shot down and held in the North. During the early years, one out of three Americans taken prisoner was expected to die in captivity—a toll reduced to one out of five by war's end. In the North, only one in 20 captives died in prison.

The longest held POW was captured in the South and spent much of his imprisonment there. Army Ranger Capt. Floyd J. "Jim" Thompson, commander of a Special Forces detachment in Quang Tri Province, was captured March 26, 1964, following the shootdown near the DMZ of his low-flying reconnaissance aircraft. He was held at a dozen jungle sites during the nearly nine years before his release on March 16, 1973. Thompson's captivity made him the longest held Prisoner of War in American history.

In the North, Navy Lt. j.g. Everett Alvarez Jr. became the first American pilot shot down. His carrier-based

Encouraged by the anti-war movement in the US, Hanoi went to great lengths to present its case through a persistent propaganda campaign aimed at its own people and the world, in this example staging the capture of a downed "pilot." In propaganda films made about the time of the Hanoi March, USAF F-105 pilot Capt. Murphy Jones was paraded first bandaged and dirty, clad in underwear, then (at top) aboard a truck, wearing his flight suit. Both films were part of the North Vietnamese effort to establish American pilots as "criminal aggressors" and "air pirates."

A-4 Skyhawk was hit during retaliatory airstrikes on Vietnamese patrol boats and oil storage facilities Aug. 5, 1964, not long after the Gulf of Tonkin incident in which Navy destroyers *Maddox* and *C. Turner Joy* reported coming under North Vietnamese attack.

Alvarez, who ejected not far from shore, was captured by armed Vietnamese in a fishing vessel. By Aug. 11, he had been taken to Hanoi's notorious Hoa Lo Prison, a turn-of-the-century French–built facility with thick two-story concrete walls known in Vietnamese as the "fiery furnace." Rats infested his cell. Food, consisting of animal hooves, chicken heads, rotten fish, and meat covered with hair, was sickening.

North and South

Prisoners in the North suffered far more extensive and systematic torture than comrades held captive in the South. "With the expanding American war effort, prison authorities were under increasing pressure to obtain information and statements that could be used for propaganda purposes," the historians said. "To produce these they had to break down the PWs' resistance."

The Air Force lost its first pilot in early 1965. Air Force Lt. Hayden J. Lockhart, flying an F-100, was seized by the communist forces March 2, 1965, after evading capture for a week. He was locked in the dreaded central prison in Hanoi soon thereafter.

The complex, ringed with guard towers, soon became known as the "Hanoi Hilton," with sections known as "Heartbreak Hotel," "New Guy Village," "Little Vegas," and "Camp Unity." The complex was so formidable that not a single US serviceman managed to make an escape during the entire war.

The most systematic torture of American POWs during the conflict began in fall 1965 and didn't end until fall 1969, when the Nixon Administration finally went public with evidence of the mistreatment. An estimated 95 percent of the prisoners in the North experienced some form of torture.

Navy Lt. j.g. Rodney A. Knutson, a radar intercept officer captured with pilot Lt. j.g. Ralph E. Gaither when their F-4 was shot down on Oct. 17, 1965, got an early taste of what lay ahead. His captors bound his arms so tightly that they lost circulation. He was denied food and water. He was beaten. When he still refused to cooperate, his torturers moved on to a new, more sinister method—the "rope torture." Knutson was subjected to this technique on Oct. 25, 1965. The prisoner was forced face down onto a bunk with his ankles in stocks and a rope tied at his elbows, with the rope then pulled up to run through a hook in the ceiling. The guard hoisted the prisoner off the bunk so he could not ease any of his weight—producing extreme pain and constricting breathing.

USAF Capt. Konrad W. Trautman suffered the rope torture on a dozen occasions. "The pain is literally beyond description," said Trautman, who was shot down and captured Oct. 5, 1967. "After about 10 or 15 minutes in this position, tied up so tightly, your nerves in your arms are pinched off, and then your whole upper torso becomes numb. It's a relief. You feel no more pain. ... However when they release the ropes, the procedure works completely in reverse. It's almost like double jeopardy—you go through the same pain coming out of the ropes as you did going in."

Hanoi March

On July 6, 1966, 52 prisoners were assembled, blindfolded, handcuffed in pairs, and taken by truck to downtown Hanoi. The plan was to parade the Americans in public view and then use them as props in a war crimes show-trial to take place at a nearby stadium. This event came to be known as the "Hanoi March" and is viewed as a watershed in the propaganda war. "Oh boy, I love a parade," quipped USAF Capt. Robert B. Purcell, captive since July 27, 1965, when his F-105 went down 30 miles west of Hanoi.

The prisoners were prodded through the streets at the point of bayonets, past the Soviet and Chinese Embassies and through threatening crowds standing 10 deep. One prisoner estimated the crowd as high as 100,000. Guards incited the angry mob with loudspeakers. Over a two-mile route, the POWs were punched and pummeled by flying bricks and bottles. The march highlighted the lengths to which Hanoi would go to score propaganda points against the US.

Air Force Capt. Earl G. Cobeil, captured on Nov. 5, 1967, feigned mental illness, as did some other POWs, to protect himself from the experimental brainwashing carried out by a dreaded Cuban interrogator. The Cuban, known among POWs as "Fidel," convinced that Cobeil was faking, mercilessly beat him day after day. One day, Cobeil refused to bow. For the offense, Cobeil on May 21, 1968, was trussed in ropes overnight and mauled for 24 hours straight. Fidel, enraged, emerged from one torture session to shout to prisoners within earshot: "We've got

In 1967, the propaganda war continued as USAF Lt. Col. James Hughes was paraded through Hanoi visibly injured the day after his capture. Such scenes backfired, resulting in international revulsion at the prisoners' mistreatment.

Navy Lt. Cmdr. Hugh Stafford broke his arm, collarbone, and ribs when his A-4 was downed by a SAM over Haiphong in August 1967. After three days without water, he was then subjected to the rope torture. Despite his injuries (damage to his left arm is evident in this photo), he became what the study's authors call "a spark plug in the resistance."

[a POW] that's faking. Nobody's gonna fake and get away with it. ... I'm gonna teach you all a lesson. ... I'm gonna break this guy in a million pieces." Cobeil was last seen in the fall of 1970 and did not return with the other POWs in 1973. The Vietnamese later reported Cobeil had died in November 1970; his remains were returned March 6, 1974.

The prisoners believed that, when captured, "their mission had changed, from one of active fighting to one of resistance and survival," the Pentagon historians said. "They still had a soldierly function to perform—to disrupt, to stymie, to exhaust the enemy, finally to defeat him, in this case on the battlefield of propaganda and psychological warfare."

One prisoner estimated that communist torturers exacted statements of some sort from 80 percent of the POWs. As soon as they recovered from the physical trauma, the prisoners faced the torment of having collaborated and, theoretically, having violated the Code of Conduct. However, the Code, updated after the Korean War and reviewed after the USS *Pueblo* incident off Korea in 1968, assumed that captors would observe the minimum provisions of the Geneva Convention governing POWs. Under relentless torture, "the Code increasingly seemed to be a noble, but meaningless, abstraction that paled into irrelevance before the harrowing reality of the ropes and stocks," the historians found.

Cherry's Ordeal

Vietnamese communists played the race card. Air Force Maj. Fred V. Cherry, the highest ranking black POW in the North, recalled his captors trying to exploit him by treating him differently. The Vietnamese housed Cherry with Navy Lt. Porter A. Halyburton in apparent hopes of sowing dissension between a black aviator and a white Southerner. The tactic backfired. Cherry later credited Halyburton with saving his life, when his injuries from being shot down became so infected that he had to be fed by hand and assisted with his bodily needs.

Cherry's resistance won him some of the war's most severe exactions—including one 93-day stretch of unbroken torture and 53 straight weeks of solitary confinement.

Prisoners fashioned elaborate means of reaching out to comrades. Navy Lt. Cmdr. Robert H. Shumaker spied a fellow prisoner in March 1965 and surreptitiously left a note in the latrine that was never found. Guards found a second note, and Shumaker was threatened with punishment. His persistence paid off in the summer of 1965 when he left another note in the latrine that was read by Air Force Capt. Ronald E. Storz, downed while flying a small observation airplane near the DMZ. Storz scratched his name in reply on a piece of toilet paper with the burnt end of a match.

"Thus was accomplished the first exchange of messages among American PWs in North Vietnam," the historians said.

The names of captured pilots soon appeared on the undersides of plates and the handles of food pails as makeshift communications began. By the summer of 1965, Air Force Capt. Carlyle S. Harris perfected and spread a tap code that became the gold standard for communication throughout the prisoner population. Harris recalled the code from survival training at Stead AFB, Nev., where an instructor had shown him the code during a coffee break.

The prisoners used a five-by-five grid for the letters of the alphabet, with two numbers assigned to each letter. They dropped the "K." Prisoners quickly reverted to short cuts—so that "God bless you" became GBU—the universal sign-off.

By the summer of 1966, Navy Cmdr. James B. Stockdale, the senior officer and the POW leader, had become so proficient that he carried on a virtual conversation with Air Force Maj. Samuel R. Johnson, a prisoner in an adjoining cell.

In his memoir, Stockdale recounted, "Our tapping ceased to be just an exchange of letters and words; it became conversation. Elation, sadness, humor, sarcasm, excitement, depression—all came through. ... I laughed to think what our friends back home would think of us two old fighter pilots standing at a wall, checking for shadows under the door, pecking out a final message for the day with our fingernails—'Don't let the bedbugs bite' [DLTBBB]."

The grueling, day-to-day stresses took a toll. A generational split developed between prisoners captured between 1965 and the bombing suspension of November 1968 and the younger generation of pilots shot down after resumption of bombing

in December 1971. Newly seized prisoners tended to be more cynical about the war, the Pentagon historians found. They also operated under a more flexible interpretation of the Code of Conduct.

"Peace Committee"

Dissension remained an undercurrent.

"In truth, over the years, there would be breakdowns of authority, lapses in the chain of command, intramural squabbling, even instances of resentment and outright disobedience of the leadership," the historians found. For example, by the fall of 1971, a group of at least eight enlisted prisoners became known as the "Peace Committee," its members receptive to the communists' propaganda. "Whether they were turncoats who willfully disobeyed orders, ratted on comrades, and bartered anti-war messages for special privileges, or were simply confused youngsters who sincerely opposed the war and saw no downside to expressing their feelings, depends on the perspective of participants," the historians said.

In January 1973, after the signing of the Paris peace accords, freedom drew near. Resentful American prisoners weighed the idea of executing members of the Peace Committee. USAF Lt. Col. Theodore W. Guy, the senior officer in charge at the POW camp called "Plantation," spent two weeks persuading the angry conspirators to drop that plan. He also talked them out of a subsequent plan to shave the Peace Committee members' heads. He planned to file court-martial charges after their release.

The most prominent turncoat of the war was Marine Pfc. Robert R. Garwood, 19, a motor pool driver who disappeared on Sept. 28, 1965, near Da Nang, South Vietnam. He cooperated with the enemy and remained in Vietnam long after the other Americans had been repatriated. Garwood himself voluntarily returned to the US on March 22, 1979, and was immediately taken into custody. The historians found that Garwood "did cross over [to collaboration with the communists] but that his 'defection' stemmed more from opportunism than any genuine political or ideological conversion."

Throughout the war, barriers to escape were indeed formidable, so much so that not a single GI made it to freedom from North Vietnam, according to the historians. While the Code of Conduct called for prisoners to "make every effort to escape," senior commanders realized that escape attempts triggered such Draconian retaliation that attempts could jeopardize the lives of other prisoners.

Air Force Capt. John A. Dramesi, who was captured April 2, 1967, was determined to escape despite the odds. The pugnacious former star high school wrestler and son of a boxer had already tried to escape en route to Hanoi. For months, he and fellow conspirators squirreled away string, wire, and bamboo that could be used for tools or weapons. Donated scraps of food were hidden in a cache. They gathered straw, thread, and cloth to weave civilian attire. Conical peasant hats were fabricated from rice straw taken from sleeping mats. Dramesi acquired brown iodine pills for water purification and to help darken the skin color of those attempting to escape. On May 10, 1969, Dramesi and Air Force Capt. Edwin L. Atterberry advised the leadership, "We're going tonight."

Horror Chamber

They did. Dramesi calculated that, by dawn, they had traveled four or five miles from the compound. But that was it. A North Vietnamese patrol found the pair hiding in a bramble thicket near an abandoned churchyard. The two were captured, blindfolded and handcuffed, and returned to prison. Dramesi was tortured for 38 days, flogged with a fan belt, punched, strapped into excruciating positions by ropes, and kept awake. He was strung in the ropes 15 times. Eventually he broke.

In a horror chamber close to Dramesi, the communists tortured Atterberry so gruesomely that his shrieks of pain could be heard two blocks away. Atterberry died on May 18, 1969, just eight days after the breakout.

The communists didn't stop with punishing Dramesi and Atterberry. They tortured other prisoners—some for weeks—who had not participated in the escape attempt and even extended the torture to other prisons.

"So traumatic had been the overall experience that even when escape became a more feasible option late in the captivity, the prisoners were still haunted by the catastrophic consequences of the Dramesi–Atterberry attempt," the historians wrote.

To the South, the historians found that about two dozen Americans—about 10 percent—managed to escape from their captors and make it to freedom.

Perhaps the most stunning getaway was the one that was staged by Army Lt. James N. Rowe, a Special Forces advisor seized Oct. 29, 1963, in the Mekong Delta, along with Army Capt. Humbert R. Versace and Army Sgt. Daniel L. Pitzer. Versace later

Navy Lt. Cmdr. John McCain (now a US senator) suffered severe injuries in 1967 from bailing out of his A-4 over Hanoi and being beaten by a mob. A prize hostage because of his prominent father, he rejected offers of quick repatriation.

was executed by his captors. Pitzer was released in 1967.

On Dec. 31, 1968, after more than five years of jungle captivity, forced marches, starvation, and disease, Rowe and his Viet Cong guards cowered in the underbrush to elude US gunships and advancing South Vietnamese troops seeking battle. Suddenly, Rowe found himself alone with a single guard. He clubbed the man unconscious, rushed to a clearing, and waved frantically toward a descending US helicopter gunship.

Luckily, the commander of the air cavalry group, Army Maj. David Thompson, spied what he thought was a Viet Cong guerrilla vulnerable to capture and, rather than opening fire, swooped in to pick him up. "Only when the command ship swept in and lifted the black-clad figure out of the jungle amid a hail of fire from VC in the woods did the helicopter crew realize that it had bagged an American," the historians wrote.

Rowe left the Army in 1974, returned to duty in 1980, and died in April 1989, victim of an ambush by left-wing Marxist terrorists in the Philippines.

Dreams of escape similarly inspired two GIs who received the Medal of Honor posthumously for valor during captivity. Marine Capt. Donald G. Cook remained endlessly defiant after being captured east of Saigon in late December 1964, when Viet Cong overran the South Vietnamese force he was advising. Cook nursed civilian Douglas Ramsey, a US foreign service officer captured in January 1966, back from a sinking malaria-induced coma and saved his life, despite the ravages of his own illnesses. On Dec. 8, 1967, as the POWs were moved to another camp, Cook died on a jungle trail, probably from a malaria seizure, stated the historians. Ramsey's account of Cook's heroism, provided upon his release in 1973, led the US on May 16, 1980, to bestow on Cook the nation's highest decoration for valor.

Tale of Lance Sijan

Air Force 1st Lt. Lance P. Sijan also received the Medal of Honor. The backseater on a disabled F-4 that crashed in Laos on Nov. 9, 1967, Sijan bailed out at low altitude and evaded capture for 46 days, despite a compound leg fracture, mangled hand, and head concussion. North Vietnamese soldiers found him by the side of the road on Christmas morning 1967. He was taken in early 1968 to North Vietnam, where he was held with Air Force Lt. Col. Robert R. Craner and Capt. Guy D. Gruters. His Air Force Academy buddy Gruters did not recognize him. The strapping 220-pound former football player had lost a great amount of weight. His leg was badly infected, yet he asked his comrades to help him exercise so he could escape. Sijan died of pneumonia on Jan. 22, 1968. In March 1976, Sijan was awarded the Medal of Honor—the first graduate of the Air Force Academy to receive the award.

As a 19-year-old Air Force Academy cadet, Lance Sijan learned survival skills that he later used to elude the North Vietnamese for 46 days. He received a Medal of Honor posthumously for his heroic fight for freedom and determined resistance.

Some prisoners were lucky enough to win early release. Prisoner leaders, including Navy Lt. Cmdr. Richard A. Stratton and Navy Lt. Cmdr. John S. McCain III (now a US senator and Presidential candidate) rejected Vietnamese offers of immediate repatriation, fearing that such a release would yield a propaganda bonanza for Hanoi and have a disastrous impact on POW morale and cohesion. They also thought that such an act would run contrary to their duty to stay with their men until all were safe.

On Feb. 16, 1968, in the midst of the Tet Offensive, North Vietnam released three prisoners from Plantation, turning them over to peace activists Daniel Berrigan, a Jesuit priest, and Howard Zinn, a professor of history and government at Boston University. Navy Ensign David P. Matheny, a 24-year-old pilot, Air Force Maj. Norris M. Overly, and Air Force Capt. Jon D. Black were turned over. The freed officers became known at Plantation as the "MOB," an acronym for their last names. The stay-behinds debated whether the freed prisoners had broken faith. Many saw the value in having Matheny carry out the memorized names of at least 70 POWs, helping the Pentagon update the list of captured pilots.

Senior officers became deeply concerned over the possibility that early release offers could decimate unity. USAF Lt. Col. Hervey S. Stockman, senior officer at Plantation, was fearful that his men now knew that Hanoi's "promises of amnesty were not completely empty." He quickly issued orders that future releases under the early release program would be accepted "only in order of shootdown with sick and wounded first."

Additional releases followed. Navy Seaman Douglas B. Hegdahl, freed by North Vietnam in 1969, came out with the first word actually confirming that American servicemen had been captured by the communists in Laos and were being held prisoner. Hegdahl, 19, the youngest POW seized in the North, had been serving as an ammunition handler aboard the guided-missile cruiser USS *Canberra* in the Gulf of Tonkin. During a night bombardment, he went topside where he was knocked overboard by

the concussion of the ship's guns. He was picked up by North Vietnamese fishermen and turned over to the militia.

Turning Point

The release of Hegdahl and two others on Aug. 4, 1969, marked a turning point in the Nixon Administration's public relations policy, with an end to the low-key approach to allegations of mistreatment and torture. The plight of American prisoners was brought to the attention of the world, and, about that same time, a new regime took over in North Vietnam upon the death of Ho Chi Minh. Conditions began to improve in the prisons of North Vietnam.

By the time of the peace accords, a total of 113 American POWs had died in captivity. Operation Homecoming saw the return of 600 prisoners—591 Americans and nine foreign nationals. The Americans included:

- USAF, 325
- Navy, 138
- Army, 77
- Marines, 26
- Civilians, 25

Air Force Lt. Col. Robinson Risner, a Korean War ace and test pilot, scored a symbolic victory for the prisoners at Unity who had just been notified of their impending release. Risner had been held captive since Sept. 16, 1965. He had commanded the Hanoi Hilton as the senior officer in charge since Sept. 20, 1965. An interpreter for the presiding North Vietnamese officer known as Dog read from a prepared text, telling the prisoners that they would be released 120 at a time in two week increments. Dog demanded that the prisoners "show good attitudes" until release. He then dismissed the prisoners.

For all of Dog's officiousness, it was not until Risner did a smart about-face, looked at his men, and issued the order that the prisoners moved. Risner called the men to attention. Some 400 men snapped to attention, and, as one POW remembered it, "the thud of 800 rubber tire sandals coming together smartly was awesome." Squadron commanders returned Risner's salute and dismissed their squadrons in unison.

Some prisoners ran into each others arms, hugged, and whooped with joy. Others felt the weight of their suffering drain from their bodies, what Navy Lt. Cmdr. Hugh A. "Al" Stafford called a "profound, bottomless fatigue."

"What the hell had I done the last seven [years]," wondered Navy Lt. Gerald L. Coffee, downed while on a photoreconnaissance mission near Vinh on Feb. 3, 1966. "During the prime years of my life, I'd sat on my ass in some medieval dungeons, broken my teeth, screwed up my arm, contracted worms and God knows what else, and had gotten old."

The vanguard of the prisoners arrived at Clark on Feb. 12, 1973. It was there that many of the ex-prisoners finally relinquished the self-control that had enabled them to survive.

One of the Best

Ernest C. Brace, a pilot for a private airline flying supply missions in Laos and Thailand under contract to the US Agency for International Development, had been held since May 21, 1965, the day his small airplane was ambushed on a runway in Laos.

He "survived barbarous mistreat-

USAF Maj. Roger Ingvalson, an F-105 pilot captured in May 1968, reads what was called Christmas mail in a propaganda photo, at top. Navy officers (l–r) Lt. j.g. David Everett, Lt. Carroll Beeler, and Lt. Cmdr. Theodore Triebel and USAF Maj. James Padgett were among the POWs brought forward to meet an American who traveled to North Vietnam in fall 1972.

ment and decimating illness over an eight-year period ... to become one of the most seasoned and respected PWs among all the Americans captured in Southeast Asia," the historians wrote.

But upon hearing that his wife had left him, Brace broke down and cried at the processing center in an emotional outpouring that he could not remember yielding to through all the years of beatings and persecution.

Over three to five days, prisoners called families, went through debriefings and medical evaluations, and, in general, decompressed before the trip home.

Air Force Maj. George E. "Bud" Day, captured Aug. 26, 1967, after being shot down near the DMZ and later awarded the Medal of Honor for heroism, learned that some family members had died during his captivity. Day had managed to escape his initial capture and evade the enemy for two weeks and was within two miles of a US Marine outpost when he was shot and recaptured. His legendary resistance to communist torturers won him the everlasting respect of his colleagues.

Day recalled feeling "as if I might melt into the phone" as he spoke to his wife for the first time in more than five years. "She came through strong and clear. She was well. The children were well. They were as anxious to see me as I was to see them. All of the important things in my existence were in order."

Lt. John H. Nasmyth, taken captive Sept. 4, 1966, recalled locating a bathtub in a staff room, locking the door, and "wallowing" in the hot water until it spilled over the tub. His first bath lasted an hour—the first of half a dozen he took the first night of freedom.

As they prepared to fly home, some ex-prisoners found it hard to leave fellow POWs who had shared the same horrific experiences.

"Of course, getting out was what we had all anticipated and dreamed of," recalled Craner, captured Dec. 20, 1967. "But I and everyone did establish friendships and very intimate personal relationships up there, which I don't believe any other set of circumstances would have allowed. And it was with just a little bit of melancholia that I finally said goodbye."

Operation Homecoming brought back 600 POWs, including then Maj. R.E. "Gene" Smith, who was among the jubilant group repatriated in March 1973 and who went on to become an AFA president and board chairman. He had been a POW since 1967.

At Travis AFB, Calif., Air Force Capt. Peter P. Camerota got a quick lesson that little had changed. A crew member on a B-52 that had been shot down in the December 1972 raids, he had eluded capture for 10 days by hiding in a cave. He knew he was home when he went through processing and he was told that he would be paid $5 for each of his 88 days in captivity. But, Camerota explained, he had been in North Vietnamese territory for 98 days, including the 10 days of evasion.

The official explained that the money was expressly for "substandard quarters and subsistence" and that during his 10 days evading capture he had no quarters and subsistence and therefore did not have substandard quarters and subsistence.

Coming face to face with that bureaucratic explanation, said Camerota, "I knew I was home."

Coming Home

The historians found that some prisoners made the transition to life back home more easily than others.

"Some picked up their lives as normally as if they had merely served overseas for the better part of a decade, and some never recovered from dissolved marriages, missed career opportunities, or the awful memories," the study found.

Two returned POWs committed suicide soon after release. One, Marine Sgt. Abel L. Kavanaugh, was a young man captured on April 24, 1968, after being inadvertently left behind by Marine helicopters lifting his unit back to base camp. Kavanaugh had been a member of the so-called Peace Committee. He killed himself June 27, 1973.

Ex-prisoners ran for public office, including four elected to Congress—Denton, McCain, Johnson, and Douglas B. "Pete" Peterson. Peterson, an Air Force captain who later represented a Florida Congressional district, became the first postwar US ambassador to Vietnam, taking up his post on May 9, 1997.

"Those who made it back gave their countrymen an occasion to celebrate patriotism and heroism unencumbered by the vexing moral and political issues that beclouded so much of the war effort," the Pentagon historians concluded. "The PWs, even when they were no longer incarcerated, continued to wield a symbolic power out of proportion to their small numbers. Their proud return to a grateful nation remains one of the few truly shining moments of that troubled era." ■

Stewart M. Powell, White House correspondent for Hearst Newspapers, has covered national and international affairs since 1970 while based in the United States and Britain. His last article for Air Force *Magazine was "A Half Century of NATO," which appeared in the April 1999 issue.*

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Compiled by Chanel Sartor, Editorial Associate

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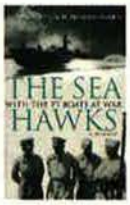

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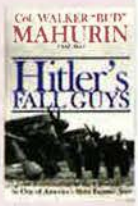

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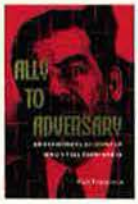

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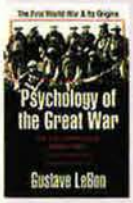

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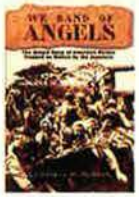

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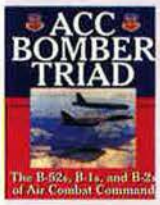

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AFA Nominees for 1999–2000

At a meeting May 29, 1999, 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. 13.

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 second term as National President was **Thomas J. McKee** of Fairfax Station, Va. He currently serves as an aerospace industry executive for Northrop Grumman. McKee is past Chairman of the Board and past President of the Aerospace Education 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 Special Recognition Award 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, Colo.; 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 Northrop acquired Grumman in 1994, McKee assumed responsibilities for Customer Relations 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 second 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.

McKee | Larson | Croom | Church

Larson attended Madelia High 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 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.

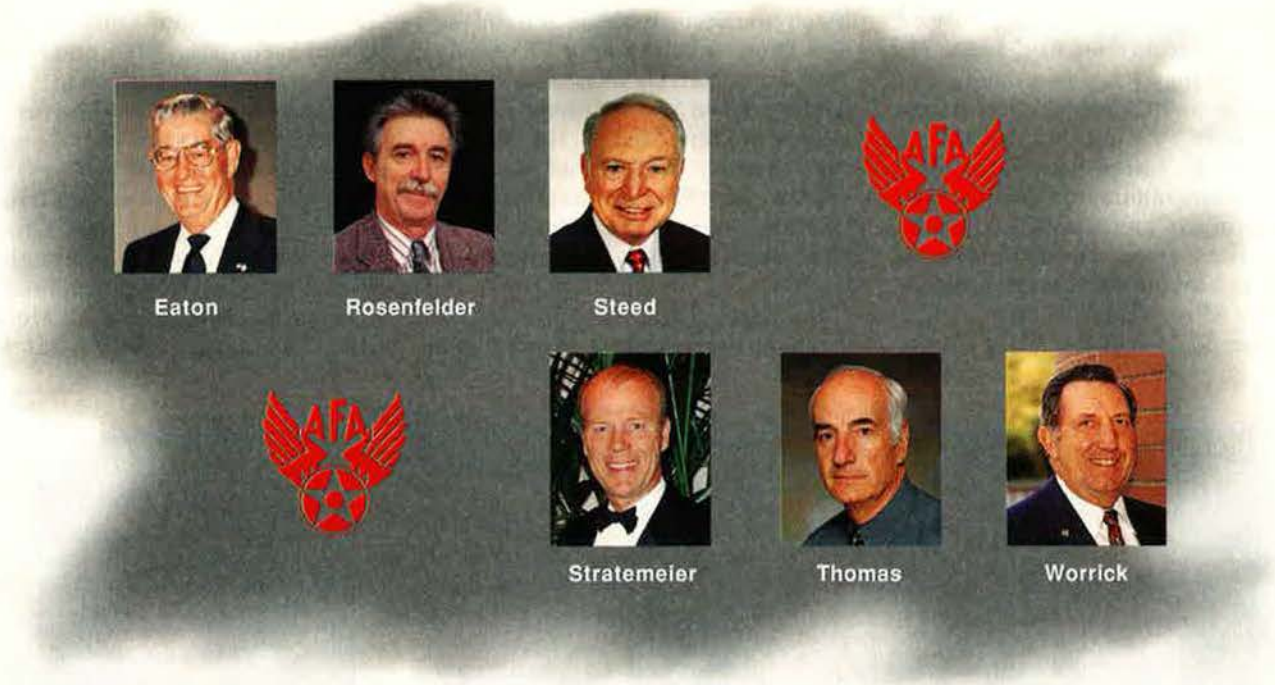
He joined AFA in 1976. He has served on the Executive, Resolutions, Long-Range Planning, and Constitution Committees and as a National Director, National Vice President (North Central Region), Minnesota State President, and President of the Gen. E.W. Rawlings Chapter. He also serves as a Trustee of AEF. 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 third 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 administration from the University of North Carolina in 1963. 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 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 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 fifth 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 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 six people whose photographs appear on this page are nominees for the six elected Directorships for the coming year. Five are nominees from their respective regions and are to be ratified by the delegates to the convention.

Ted Eaton, Indiana (Great Lakes Region). Former Vice President of Communications and Treasurer for the Great Lakes Region; Indiana State President; Chapter Secretary. Currently Secretary of the Great Lakes Region. Life Member of AFA.

I. Fred Rosenfelder, Washington (Northwest Region). Former Region Vice President (Northwest Region); Washington State President and Secretary; Chapter President and Vice President. Currently Washington State President and Communications Director of the Greater Seattle Chapter.

Jack H. Steed, Georgia (Southeast Region). Former Georgia State President; Chapter President, Vice President, and Treasurer. Currently Region Vice President (Southeast Region). Life Member of AFA.

William G. Stratemeier Jr., New York (Northeast Region). Former New York State President, Vice President, and Communications Director; Chapter President. Currently New York State Vice President. Life Member of AFA.

Charles G. Thomas, New Mexico (Southwest Region). Former Region Vice President (Southwest Region); State President and Vice President; Chapter President and Vice President. Currently New Mexico State President. Life Member of AFA.

The sixth person is the nominee to be elected at large.

Mark J. Worrick, Colorado (Rocky Mountain Region). Former State President and Vice President; Chapter President. Currently Region Vice President (Rocky Mountain Region). Life Member of AFA. ■

AFA State Contacts

Following each state name are the names of the communities in which AFA chapters are located. Information regarding these chapters or any of AFA's activities within the state may be obtained from the appropriate contact.

ALABAMA (Birmingham, Huntsville, Mobile, Montgomery): **Roy A. Boudreaux,** P.O. Box 1190, Montgomery, AL 36101-1190 (phone 334-241-2739).

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ARIZONA (Green Valley, Phoenix, Prescott, Sedona, Sierra Vista, Sun City, Tucson): **Angelo Di Giovanni,** 973 Vuelta Del Yaba, Green Valley, AZ 85614 (phone 520-648-2921).

ARKANSAS (Fayetteville, Hot Springs, Little Rock): **John L. Burrow,** 352 Rollston Ave. #1, Fayetteville, AR 72701-4178 (phone 501-751-0251).

CALIFORNIA (Apple Valley, Bakersfield, Edwards AFB, Fairfield, Fresno, Los Angeles, Merced, Monterey, Orange County, Palm Springs, Pasadena, Riverside, Sacramento, San Diego, San Francisco, Sunnyvale, Vandenberg AFB, Yuba City): **Paul A. Maye,** 1225 Craig Dr., Lompoc, CA 93436 (phone 805-733-5102).

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CONNECTICUT (Brookfield, East Hartford, Middletown, Storrs, Stratford, Torrington, Waterbury, Westport, Windsor Locks): **Joseph R. Falcone,** 14 High Ridge Rd., Ellington, CT 06029 (phone 860-875-1068).

DELAWARE (Dover, New Castle County, Rehoboth Beach): **Stephanie M. Wright,** 5 Essex Dr., Bear, DE 19701-1602 (phone 302-834-1369).

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FLORIDA (Avon Park, Broward County, Daytona Beach, Fort Walton Beach, Gainesville, Homestead, Hurlburt Field, Jacksonville, Leesburg, Miami, New Port Richey, Orlando, Palm Harbor, Panama City, Patrick AFB, Spring Hill, Tallahassee, Tampa, Vero Beach, West Palm Beach): **David R. Cummock,** 2890 Borman Ct., Daytona Beach, FL 32124 (phone 904-760-7142).

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AFA / AEF National Report

By Frances McKenney, Assistant Managing Editor

AFA Looks at Quality of Life in the Pacific

On invitation from Gen. Patrick K. Gamble, Pacific Air Forces commander, Air Force Association National President Thomas J. McKee spent two weeks in May at several PACAF bases. He met with AFA chapters and listened to USAF service members and their families explain how quality-of-life and other issues affect them in Hawaii, Japan, and South Korea.

The operations tempo, McKee said later, was the biggest issue at every stop. Other topics that Air Force personnel discussed with him included weapon systems and hardware, pay and compensation, housing, Tricare, child care, and employment for spouses.

McKee took every opportunity to promote AFA—in one instance addressing an audience from the back of a trailer.

Media interviews along the way resulted in significant coverage for AFA, including a front page article in the May 19 *Pacific Stars and Stripes*, where McKee stated AFA's position on the high optempo, aging equipment, health care, Redux, military pay, and other quality-of-life concerns.

USAF photo by TSgt. Lance Cheung

Air Force Association President Thomas McKee (center) got hands-on experience with USAF hardware—even operating an explosives disposal robot—during stops in Hawaii, Japan, and Korea. Here, pilot Capt. Don Grantham, 36th Fighter Squadron, Osan AB, South Korea, prepares him for an F-16 orientation flight. They were part of a four-ship formation that departed from Suwon and flew as far north as Hwach'on, South Korea.

First Stop: Hawaii

On the first stop of this trip, McKee received a warm aloha from the 50th State's AFA members. They included Gamble, Lt. Gen. Charles R. Heflebower, PACAF vice commander, and Maj. Gen. Steven R. Polk, then PACAF director of air and space operations.

Personnel at Hickam AFB, Hawaii, told McKee about concerns such as the quality of public education—a topic that also arose at USAF bases in Asia, where home schooling is becoming more common.

At the 154th Wing (ANG), Guardsmen were worried about the lack of employer support, particularly because of the Balkan War call-up. McKee told them that AFA strongly supports tax credits as an incentive for employers who employ reservists.

After mission briefings on Hickam's 15th Air Base Wing the next day, McKee toured squadrons and facilities.

The lead story in the base newspaper promoted the Hawaii State Convention, held that afternoon at the Officers' Club. A panel discussion featured Cheryl L. Waller, region vice president (Far West Region); Norman R. Baker, state president; Col. Michael Solomon, **Hawaii Chapter** president; and John Wilt, **Maui (Hawaii) Chapter** president.

In addition to delivering the convention's keynote address, McKee presented a Teacher of the Year award to Jennifer Watkins, a fifth-grade teacher at Nanakuli Elementary School in Nanakuli, Hawaii. Watkins uses aerospace-oriented projects and the Visions of Exploration program in her classroom with such success that her students' parents, aunts, and uncles have joined the class for activities. She is also the AFA Regional Teacher of the Year.

Crossing the Dateline

At Kadena AB, Japan, two days later, McKee met members of the **Keystone Chapter.** Impressed by their all-ranks slate of leaders—MSgt. Michael E. Schorn, president; SMSgt. Robert W. Knight, vice president; Lt. Deborah Haussler, secretary; and civilian Karin L. Fones, treasurer—he called this a "Total Force chapter."

He noted that the chapter is boosting membership by subsidizing the membership fee for newcomers, paying $10 of the cost. It's an important break in an area where the high cost of living is a major issue.

McKee had breakfast with Kadena's enlisted leadership and called on Brig. Gen. James B. Smith, 18th Wing commander, before heading off for a facilities tour.

At a chapter luncheon, he presented the Teacher of the Year award to Susan Ward, an eighth-grade math teacher at Lester Middle School, Camp Lester, Okinawa. Andy Smith of Kubasaki High School received $500 as winner of the chapter's aerospace essay contest. Kadena High School AFJROTC cadets Michelle Abruzzo and Billy Cole were presented with $350 scholarships.

Also In Japan

AFA's special assistant Pacific, Gary L. McClain, and the **Tokyo Chapter** president, Maj. Stephen D. Clutter, greeted McKee on his arrival in Tokyo. Following morning briefings and a visit with Lt. Gen. John B. Hall Jr., commander, US Forces Japan, and 5th Air Force commander at Yokota AB, Japan, the AFA president met chapter members at a luncheon. That afternoon, he flew by helicopter to the Air Staff Office in downtown Tokyo to meet Gen. Yuji Hiraoka, chief of staff of the Japan Air Self-Defense Force.

Hiraoka joined McKee that evening for dinner with the Japanese–American Air Forces Goodwill Association. The group is made up of current and former members of the JASDF and the Japanese aerospace industry.

The **Miss Veedol (Japan) Chapter** (formerly the Misawa Chapter) welcomed McKee with a luncheon for which everyone from the chapter's then president, Col. Wyatt "Chris" Cook, to its community relations person, Sgt. Jo Ann Bramletter, signed up.

Following briefings on quality-of-life issues and Japanese Facilities Improvement Projects, McKee toured 35th Fighter Wing facilities.

Misawa's senior leaders turned out for a dinner that evening with McKee. Guests included US Air Force and Navy officers who all serve alongside the JASDF at Misawa.

Forgotten Warriors

The US must remain engaged in the western Pacific, McKee concluded after visiting South Korea. "We are the one country that they [Asian nations] turn to to work issues," he said. Yet, with attention focused in the Balkans, those stationed in Korea seemed to be the "forgotten warriors," he added.

In addition to an AFA luncheon at Osan AB, McKee received briefings on 7th Air Force and the 51st Fighter Wing, whose commander is Brig. Gen. Robert R. Dierker. Also on the agenda was a tour of the Hardened Theater Air Control Center and numerous wing facilities.

At Kunsan AB, South Korea, an equally comprehensive look at 8th Fighter Wing operations included visiting a 1+1 dormitory, driving a humvee, and firing an M-60 machine gun.

Photo courtesy Air Staff Office

Japan Air Self-Defense Force Chief of Staff Gen. Yuji Hiraoka met with AFA President McKee at an Air Staff Office reception room. L–r are Col. Tadashi Hayasaka, chief, foreign liaison section; Maj. Gen. Osamu Ninomiya, administration director; Lt. Gen. Yasuo Okoshi, vice chief of staff; and Hiraoka, all from the JASDF; Maggie Surls (center), special assistant to the US Forces Japan commander; McKee; and USAF Lt. Gen. John Hall Jr., commander, USFJ and 5th Air Force.

The highlight of one morning was a visit to the demilitarized zone in the border town of Panmunjom, where the North Koreans carefully observed McKee, trying to determine his identity because he was escorted by an Air Force officer.

"It was sobering," McKee said of his five days in South Korea. "There are bunkers everywhere; there are armed guards everywhere." The constant state of readiness is stressful, he noted.

From Hawaii to South Korea, McKee found USAF personnel paying for equipment out of their own pockets, carrying out self-help projects, and, at one hospital in Korea, making stretchers out of chain-link fencing because funds are so scarce.

"We in the Air Force Association are trying to work with members of Congress, their staffs, and the American public to inform them of the needs of our men and women who are serving," McKee said in a PACAF News Service interview. "You can't keep asking the Total Force to keep going everywhere and to do everything unless you give them the resources to do it."

Changes for Visions

The Aerospace Education Foundation's three-year agreement with *USA Today* expired in May, leading to changes in its joint program, Visions of Exploration.

The program encourages students to study math and science by providing a class with 30 copies of *USA Today* and a teacher's lesson plan for an 18-week period.

The newspaper had proposed increasing the price of the program and the number of newspapers per classroom. AEF convinced *USA Today* to limit the increase to 1.9 cents per newspaper, instead of increasing the number of newspapers, which would have significantly raised the price for the program.

The chapter's share will be $94. This is $5 more than the amount chapters paid from 1996 to 1999. AEF's

At Misawa, 1st Lt. Herb Keyser briefed Thomas McKee (left) and Patricia McKee on quality-of-life initiatives. On fact-finding tours of schools, medical facilities, housing areas, and family support and community centers in Hawaii and Asia, Patricia McKee had a significant role in gathering information on the challenges faced by USAF families overseas.

share of the cost per classroom will be $189.

Other changes:

- The Visions of Exploration curriculum has been expanded to reach a wider range of upper elementary and middle school students.
- AFA chapters can now register for the program online at www.aef.org/visions.html.
- Teachers will be able to download the teacher's and student's guides from the Internet, through a password-protected area at www.education.usatoday.com.
- The newspaper is also providing a new teacher's packet of lesson guides, based on science and technology articles that appeared over the past year in its Tuesday editions.
- AEF is establishing Visions Teacher of the Year awards to send four teachers to a Space Camp teacher training program.

Visions of Exploration started in 1991 with 30 classrooms. In the 1998–99 academic year, 1,288 classrooms participated in the program.

Convention: Ohio

The **Greater Cincinnati Chapter** took home the 1999 Chapter of the Year award from the Ohio State Convention at Wright–Patterson AFB, Ohio, in June.

During the convention, hosted by the **Wright Memorial Chapter,** Patricia M. Ventling of the **Steel Valley Chapter** was named the state's Person of the Year. The award recognized her work on Visions of Exploration programs in Youngstown, Ohio, schools.

Parker E. Reed, president of the **Cleveland Chapter;** Daniel E. Kelleher, president of the Wright Memorial Chapter; Ron Thompson also from Wright Memorial; and Fred Kubli Jr., Steel Valley Chapter president, received state-level awards for meritorious service.

The convention delegates re-elected Joseph R. "Ray" Lesniok Jr. of the Cleveland Chapter, state president; Kenneth B. Wheeler and Charles B. Spencer, both from the Wright Memorial Chapter, vice president and treasurer, respectively; and Sharon M. Johnson, Steel Valley Chapter, secretary.

A convention highlight was a visit to the Dayton–Wright Brothers Airport in Miamisburg, Ohio, where a replica of the Wright B flyer—the first production airplane—is housed.

Earlier in the year, the Wright Memorial Chapter raised $15,000 through its Wright Brothers Heritage Benefit and Anniversary Ball. During a luncheon meeting at Wright–Patterson AFB, the chapter formally presented these funds to representatives of four organizations.

Receiving the donations were Charles D. Metcalf, director of the US Air Force Museum at Wright–Patterson; John Warlick, the Wright B Flyer's chief pilot; and Matt Hickey of the Miami Valley Culture Works, a group that supports the arts in the Dayton area. The chapter's scholarship fund received the fourth donation.

AFA Executive Director John A. Shaud; Lt. Gen. Stewart E. Cranston, vice commander of Air Force Materiel Command and chairman of the benefit's advisory group; Kelleher, benefit chairman; and Dennis Kelly, chapter secretary, were on hand for the presentations.

Convention: South Carolina

The South Carolina State Convention, hosted by the **Columbia Chapter,** took place at Ft. Jackson in May.

State, regional, and national AFA updates were followed the next day by Air Force briefings by Col. Daniel J. Darnell, 20th Fighter Wing commander from Shaw AFB, S.C.; Lt. Col. Bill Erikson, now commander of the 15th Airlift Squadron at Charleston AFB; and Col. George B. Patrick, then commander of the 169th Fighter Wing (ANG), McEntire ANGB, S.C.

The convention honored the Columbia Chapter's Stanley D. Hood with an Exceptional Service award and MSgt. Tillman Meetz Jr., chapter vice president, as Air National Guard Recruiter of the Year.

Re-elected as state officers were Guy R. Everson of the **Strom Thurmond Chapter,** president, Roger Rucker, vice president, and Sam Finkley, secretary-treasurer. The latter two are from the Columbia Chapter.

Convention: Iowa

The **Richard D. Kisling Chapter** hosted the 1999 Iowa State Convention in Sioux City, Iowa, in June, holding the business meeting at the Mid America Air Museum.

After lunch at the museum, delegates toured the 185th Fighter Wing (ANG), an F-16 unit at Sioux Gateway Airport. The evening banquet, downtown at the Sioux City Convention Center, featured Reserve Brig. Gen. William E. Albertson, mobilization assistant to the director of intelligence, US Strategic Command, Offutt AFB, Neb. According to AFA Iowa State President Donald E. Persinger, Albertson spoke to the attendees about SAC and the post–Cold War situation, particularly the dangers of smaller nuclear-armed countries.

The state's AFA officers were re-elected: Persinger, president; Robert D. Persinger, treasurer; and Deborah Carson, secretary. They are all from the Kisling Chapter. Norman J. Beu from the **Northeast Iowa Chapter** will again be vice president.

Aerospace Day in Lincoln

The **Lincoln (Neb.) Chapter** cosponsored Aerospace Day '99 at the

155th Air Refueling Wing (ANG), Lincoln MAP, in May.

Over a two-day period, nearly 1,000 elementary school students visited the ANG facility to learn about the Air Force, astronomy, aviation, space, and careers in these fields. They toured two KC-135Rs on display and met former astronaut Kenneth D. Cockrell, a veteran of three shuttle flights (in 1993, 1995, and 1996) and former chief of the Astronaut Office Operations Development Branch.

An Aerospace Day co-sponsor, the Experimental Aircraft Association, gave rides on Beechcraft and Piper aircraft to more than 40 kids. Another sponsor, the University of Nebraska at Lincoln, had its astronomy club set up telescopes at the 155th.

Allan Muller, who is a Northrop Grumman B-2 engineer, and Pam Christol, a NASA aerospace education specialist, held workshops for students and teachers who participate in the Visions of Exploration program. Muller and Cockrell also went to the university to speak to students there.

Chapter President Mark Musick said, "Hopefully, the events surrounding the two days created enough interest in aviation and space that one of these children will become a future astronaut."

Teeing Off

They could have stayed at home in front of the television and watched golf's legendary players compete in the Masters. But **Falcon (Fla.) Chapter** President Homer H. Humphries Jr. was proud to say that his chapter members, local businessmen, and even a Navy rear admiral instead turned out for an AFA golf competition held at the same time as the more famous tournament to the north. As a result, the Falcon Chapter's first annual AFJROTC Scholarship Golf Tournament, held in April in Jacksonville, Fla., raised enough for four $750 scholarships, with money left over to start next year's tournament.

Humphries said about six chapter members and several nonmembers stepped forward and rounded up 60 players, sponsors for each hole, negotiated with the country club for a lower rate on the golf fees and luncheon, and collected prizes—enough for nearly every participant.

At high school ceremonies later on, Annalisa Cachin of Nathan B. Forrest Senior High School received a scholarship presented by chapter member Gordon H. Fair. Theodore J. Stumm represented the chapter in a scholarship presentation to Christina Barnes of Sandalwood Senior High. At Andrew Jackson Senior High School, Ernest L. Webster awarded Candida Colon the third scholarship.

Lake to Lake

The US Coast Guard Air Station at Cherry Capitol Airport, east of Traverse City, Mich., was the site of the **PE–TO–SE–GA (Mich.) Chapter's** May meeting.

Coast Guard Cmdr. Barry A. Harner welcomed Chapter President Jon Dayton and the guests, who included Civil Air Patrol cadets from Alpena, Mich., participating at the invitation of William L. Stone, president of the **Huron (Mich.) Chapter.**

Harner explained that with five HH-65A Dolphins as their primary equipment, the air station covers the area from northern Lake Superior to Lake Michigan, south to Chicago, west to Wisconsin, and east to Lake Huron. Their basic missions are winter and spring ice patrols, search and rescue, aids to navigation, and marine environmental response.

Following dinner at the air station, the guests toured the facilities.

Salute to ACC

The **Langley (Va.) Chapter's** three-day annual "Salute to Air Combat Command" got under way with a reception at Langley AFB's Officers' Open Mess on May 13. More than 200 aerospace industry representatives and AFA members attended the next day's briefings and panel discussions around the theme of "Moving the Combat Air Forces into the 21st Century." These all-day information sessions involved senior staff from ACC, Air Force Space Command, and the Aerospace Command and Control Intelligence, Surveillance, and Reconnaissance Center at Langley.

ACC's then-commander, Gen. Richard E. Hawley, delivered the keynote speech at the gala banquet for nearly 500 guests, held that evening at the Virginia Air and Space Center in Hampton, Va.

AFA's Chairman of the Board Doyle E. Larson presented Hawley with an AFA award, recognizing his 35 years of Air Force service. Larson also presented Donald Anderson, former region vice president (Central East Region), Dick Phillips, Robert M. "Rocky" Kuhns, and Donald A. Elliott with fellowships representing $1,000 donations from the chapter, in their names, to the Aerospace Education Foundation.

Rep. Herbert Bateman (R–Va.), a member of the House Armed Services Committee, and his wife, Laura, joined nearly 200 players for a Saturday golf tournament that closed out this year's Salute to ACC.

More Chapter News

■ The Illinois Aviation Hall of Fame selected AFA Illinois and its six chapters for the 1999 Spirit of Flight Award. The chapters received the recognition for establishing *USA Today*–AEF Visions of Exploration programs in the state; sponsoring a state Teacher of the Year award; supporting the state's Civil Air Patrol cadet camp; and helping Young Astronaut chapters in several schools. AFA's Illinois chapters are **Chicagoland–O'Hare, Greater Rockford, Land of Lincoln, Richard W. Asbury, and Scott Memorial.**

Casting Your Vote

Through Contact Congress, a new section of AFA's web page, association members can "cast a vote," monitor the voting record of their representatives, e-mail their representatives, and research legislation.

"Voting" through Contact Congress generates an e-mail, for or against a bill, sent directly to an AFA member's senators or representative. AFA members can also send personal messages via e-mail links at this site to their representatives and can set up preferences for the type of bills they want to track.

Contact Congress was created through a partnership with USADemocracy as a way to give AFA members instant access to Congress. Regular communication from AFA members helps the association maintain its effectiveness on Capitol Hill.

AFA Conventions

Aug. 6–7	**Michigan State Convention,** Mount Pleasant, Mich.
Aug. 7–8	**Missouri State Convention,** Branson, Mo.
Aug. 14	**Georgia State Convention,** Warner Robins, Ga.
Aug. 20–21	**Colorado State Convention,** Colorado Springs, Colo.
Aug. 21	**Illinois State Convention,** Galesburg, Ill.
Aug. 21	**Indiana State Convention,** Indianapolis, Ind.
Aug. 27–28	**Arkansas State Convention,** Fayetteville, Ark.
Sept. 11	**Delaware State Convention,** Dover AFB, Del.
Sept. 13–15	**AFA National Convention,** Washington, D.C.

■ Lt. Col. Clyde D. Moore II, F-22 combined test force director and commander of the 411th Flight Test Squadron at Edwards AFB, Calif., was guest speaker for the **Bakersfield (Calif.) Chapter's** quarterly meeting in May. He had just that morning been on an F-22 flight test—something that especially thrilled the audience. Moore is a member of the **Antelope Valley (Calif.) Chapter.**

■ Several AFA state officers attended Indiana University's AFROTC Spring Dining-out and Awards Ceremony in April in Bloomington. James E. Fultz, Indiana state president, presented an AFA Award to cadet Kyle Bate. **Southern Indiana Chapter** President Gordon Reuter presented cadet Laura Beeson with the John R. Cummings Warrior Spirit Award, named for a chapter charter member.

■ The **Fort Wayne (Ind.) Chapter** hosted the AFA Great Lakes Region meeting in May and combined the event with an Armed Forces Day banquet. MSgt. Brian A. Grear, TSgt. Eric T. Lehman, and Sgt. Anthony G. Vining were honored at this dinner as outstanding enlisted members of the 122nd Fighter Wing (ANG), Fort Wayne IAP, Ind.

■ Correction: "An Evening in Fort Worth" in the June 1999 "AFA/AEF National Report," p. 89, mistakenly reported that Texas Gov. George Bush attended the event. He did not.

Patricia C. Brownelle (1947–1999)

It is with great sadness that the AFA headquarters staff notes the passing of Patricia C. Brownelle, a member of the support staff since 1985. She began at AFA in the Membership Operations Department, where she was instrumental in starting the AFA Visa credit card program. She was later promoted to manager of policy administration, managing insurance policies sold to members and insurance financial reports. In 1989, she became AFA's purchasing agent and also carried out a wide range of duties, including working at Air Force 50 and, more recently, planning the renovation of AFA's headquarters building. Brownelle was twice chosen as staff member of the quarter in recognition of her outstanding, enduring achievements at AFA. ■

Unit Reunions

reunions@afa.org

3rd ERS. Sept. 16–19, 1999, in Springfield, OH. **Contact:** Joseph A. Horvath, 515 Paine Ave., Toledo, OH 43605 (419-693-6422).

4th Emergency Rescue Sq Assn, southwest Pacific (WWII). Oct. 13–17, 1999, in Louisville, KY. **Contact:** Chet Gunn, 237 Franklin St., Reading, MA 01867-1030 (781-944-6616).

22nd BW. Oct. 5–8, 1999, at the Ramada Mountainview Inn in Albuquerque, NM. **Contact:** Doris F. Hager, 7406 Hobble Dr., San Antonio, TX 78227-2767 (210-673-3754).

30th Communications. Oct. 6–9, 1999, in San Antonio. **Contact:** John La Hiff, 3304 Covered Wagon Ct., Sacramento, CA 95827-3215 (phone: 916-366-7451 or fax: 916-366-0682).

39th FS, including members of the 40th and 41st FS of the 35th FG, Fifth AF. Oct. 20–24, 1999, at the Clarion Hotel and Conference Center in Oklahoma City. **Contact:** Dick Clothier, 1825 Callender Hill Rd., Mansfield, TX 76063-6091 (817-473-2310) (rich1152@aol.com).

60th TCG (WWII). Oct. 20–23, 1999, in Birmingham, AL. **Contact:** John Diamantakos, 3525 Lynngate Cir., Birmingham, AL 35216-5239 (205-823-4747).

63rd Military Airlift Wg (MAC). Oct. 8–10, 1999, at the American Legion Post 421 in Highland, CA. **Contact:** Marty Martinez, 27212 Baseline St., Highland, CA 92346-3114 (909-864-6169) (lifter05@aol.com).

66th Air Police Sq, Laon AB, France. Oct. 26–30, 1999, at the Red Roof Inn in San Antonio. **Contact:** Reunion, 942 NE 5th Ave. Dr., Hillsboro, OR 97124 (shookbob@aol.com or mcpoes @aol.com).

74th TCS (WWII), including squadrons of the 434th TCG. Oct. 6–10, 1999, in St. Charles, MO. **Contact:** P. Lindloff, 74th TCSA, PO Box 9147, Waco, TX 76714 (254-776-9637) (vfgn82a @prodigy.com).

91st SRW, including 91st BG (WWII), Recon Gp/Wg (KB-29, KC-97, RB-45, and RB-47 aircraft). April 13–16, 2000, at the Holiday Inn Bossier City in Bossier City, LA. **Contacts:** Art I. Schocken, 210 Carol St., Waskom, TX 75692 (903-687-3139) or John P. Noonan, Rt. 1, Box 192B, Linden, TX 75563-9738 (903 835 1014).

115th Observation Sq. Nov. 13, 1999, at the Airtel Plaza Hotel in Van Nuys, CA. **Contact:** William Glenn or Mary Helwig, 146th Airlift Wing, 106 S. Mulcahey Dr., Bldg. 106, Port Hueneme, CA 93041 (805-986-7563) (wglenn@cantd.ang. af.mil).

303rd BW (SAC), B-47s, Davis–Monthan AFB, AZ (1953–64). Nov. 4–7, 1999, at the Viscount Suite Hotel in Tucson, AZ. **Contact:** D.H. Bott, 1996 Sunderland Dr., Bethlehem, PA 18015-5144 (610-868-5503) (dhbott@juno.com).

315th BW (VH) Assn, Northwest Field, Guam. Oct. 27–30, 1999, in Tucson, AZ. **Contact:** Beverly Green (217-893-3197).

366th FG, 366th AE Wg, FBW, TFW, and support units. Oct. 21–24, 1999, in Fort Walton Beach,

Unit Reunions

FL. **Contact:** J.F. Peterson, PO Box 392, Harrodsburg, KY 40330 (phone or fax: 606-734-7912).

422nd Night FS, Ninth AF (WWII). Oct. 13–17, 1999, at the Ramada Inn on the Beach in Virginia Beach, VA. **Contact:** Alfred F. Dorner, PO Box 770383, Ocala, FL 34477-0383 (352-237-3614).

454th BG, Italy (WWII). Oct. 5–10, 1999, in Louisville, KY. **Contact:** Ralph Branstetter, PO Box 678, Wheat Ridge, CO 80034-0678 (303-422-6740).

461st BW (4128th Strategic Wg), SAC B-52/KC-135. Oct. 14–17, 1999, at the Clarion Hotel and Conference Center in Abilene, TX. **Contact:** James Browall, 41 Rue Maison St., Abilene, TX 79605-4710 (915-793-2995) (jimr461@juno. com).

493rd BG, Eighth AF (WWII). Oct. 26–31, 1999, at the Marriott Riverfront in Savannah, GA. **Contact:** Jack Rude, 2609 S. Bowie St., Amarillo, TX 79109-2109 (806-353-2486).

555th FS ("Triple Nickel"). Sept. 23–26, 1999, at the Wyndham Westshore in Tampa, FL. **Contact:** Goldie Goldfein (phone: 702-233-8765 or fax: 702-243-5635) (rube@juno.com) (www.lvcm.com/555fs/reunion.htm).

6147th TCG, Fifth AF, Korea. Sept. 7–12, 1999, at the Sheraton Shreveport Hotel in Shreveport, LA. **Contact:** Bud Noles, 304 Ellerbe Ridge Dr., Shreveport, LA 71106 (318-797-6526) (http://members.aol.com/mosquitowm/index.htm).

AFROTC Det. 720, Penn State alumni. Nov. 4–6, 1999, in State College, PA. **Contact:** Capt. Randy Lugent, 109 Wagner Building, University Park, PA 16802 (814-865-5453) (rzl2@psu.edu) (www.psu.edu/dept/acad_afrotc/).

Air Commando Assn. Oct. 7–10, 1999, in Fort Walton Beach, FL. **Contact:** ACA, PO Box 7, Mary Esther, FL 32569 (phone: 850-581-0099 or fax: 850-581-8988) (aircomando@aol.com or aircommando1@earthlink.net) (home.earthlink.net/~aircommando1).

Airlift/Tanker Assn. Nov. 4–7, 1999, at the Adam's Mark Hotel Dallas in Dallas. **Contact:** T.P. Williams, 4404 Dawson Ave., N. Little Rock, AR 72116-7037 (501-758-6885) (alfttnkr@aol.com).

B-52 Assn. Oct. 7–10, 1999, at the US Air Force Museum in Dayton, OH. **Contact:** Wayne Pittman, 498 Carthage Dr., Beavercreek, OH 45434-5865 (fax: 937-426-1289).

F-16 Viper Pilots Assn. Oct. 7–10, 1999, at Andrews AFB, MD. **Contact:** www.f16viper.org.

OCS Class 60-B. June 15–17, 2000, in San Antonio. **Contact:** Don Wilkinson, 122 Fox Glove Ln., Universal City, TX 78148 (210-658-1707) (laverl@gateway.net).

Pilot Class 49-A, Barksdale AFB, LA; Enid AFB, OK; Goodfellow and Randolph AFBs, TX; and Williams AFB, AZ, cadets and student officers. Oct. 22–25, 1999, in St. Joseph, MO. **Contact:** Earl Steeb, HC#33, Bates Creek Rte., Casper, WY 82604 (307-473-2012). After Sept. 30 (816-364-0840).

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.

Pilot Training Class 59-A. Oct. 13–16, 1999, in San Antonio. **Contacts:** Dick Gibbons, 3434 Hunters Stand St., San Antonio, TX 78230 (210-492-4655) (rgibbons@express-news.net) or Dick Klekotka, 1450 W. Chester Pike, Apt. 512, West Chester, PA 19382 (610-692-4527).

RCAF 426th Sq, including 4 (T) OTU. Aug. 3–6, 2000, in Ottawa. **Contact:** A.J. Timmins (613-521-9459) (dc251@ncf.ca).

Scouting Force Assn, scouts of Eighth AF, including aircrew, ground personnel, and historians. Oct. 28–31, 1999, at the Sheraton-Grand Hotel in Irving, TX. **Contact:** Dick Atkins, 1304 Cochise Dr., Arlington, TX 76012 (817-261-3007) (dick8af@flash.net).

TAC Tankers Assn Ltd. April 6–8, 2000, at the Holiday Inn Palo Verde in Tucson, AZ. **Contacts:** Nate Hill, 231 King St., Lancaster, OH 43130-3158 (740-653-3835) (nhill@greenapple.com) or Dan Weber (drweber@pacbell.net) (www.greenapple.com/~nhill).

WWII Glider Pilots Assn. Oct. 7–10, 1999, at the Henry VIII Hotel in St. Louis. **Contact:** David Truman, 336 Longview Blvd., Kirkwood, MO 63122 (314-965-2529). ■

Bulletin Board

bulletin@afa.org

Seeking contact with former members and surviving family members of the **4th Mobile Com. Gp/Combat Com. Gp** for 4th MOB "Roadrunners" Assn database. **Contacts:** Ed Swanson, 310 S. 73rd Ave., Pensacola, FL 32506 (850-456-4621) (wolverinefan@worldnet.att.net) or Bill Rainville, 1714 Whitehaven, San Antonio, TX 78232 (210-496-3231) (rainvilleb@stic.net).

For museum exhibit, seeking contact with members of **Eighth AF** who departed the US from Dow Field, Presque Isle AAF, or Houlton AAF, ME, during WWII. Also seeking **active duty and Guard** personnel who were or are stationed in Maine. **Contact:** Maine Air Museum, c/o Rob Rohr, 84 Union St., Apt. #5, Brunswick, ME 04011-2431.

Seeking desktop **models** of aircraft and missiles. **Contact:** Bob Kasprzak, 4213 Pleasanton Rd., Englewood, OH 45322-2657 (937-836-1609) (tokasprzak@aol.com).

Seeking information on **Lt. Walter Brunn,** B-24 pilot, 579th BS, 392nd BG, who completed his tour of duty in summer 1944 and transferred to 14th Wg Hq. He may have trained in B-17s before he was killed in an airplane crash. **Contact:** James H. Hair, 715 Pineview Dr., Thomson, GA 30824-2361 (706-595-4773).

To share experiences, seeking contact with **WWII aviation cadet wives** who accompanied their husbands during flight training. **Contact:** Margaret Ridler, 1839 Tumbleweed Ct., Wesley Chapel, FL 33543 (813-973-0192) (mcr1839@aol.com).

Seeking information on or contact with the crew of **B-17 #297385** that crashed in Ley, France, in summer 1944. They were captured by German soldiers and taken to a village until they were transported to another location. **Contact:** Roger Lefevre, 42 rue pasteur Musculus, Dieuze, France 57260.

Seeking contact with B-26 gunner **Ralph T. Danielson** and navigator **Harold N. Davis,** who were awarded the DFC for their March 22, 1951, mission. Also seeking the awards and decorations officer of the 8th BS at Iwakuni, Japan. **Contact:** David B. Van Pelt, 1155 Kimberly Dr., Yuba City, CA 95993 (530-673-5458).

For a dissertation on the role of the fighter pilot in combat, seeking contact with active duty and retired **F-15, F-86, F-100, F-101, F-104,** and other fighter aircraft pilots. **Contact:** Francis G. Neubeck (850-265-9025).

Seeking contact with anyone who knew **1st Lt. Newman Van Tassell,** B-17 pilot, WWII, 509th BS, 351st BG, in the UK. He retired as a colonel and died in 1955. **Contact:** George W. Hicks, 23033 Westchester Blvd., F-316, Port Charlotte, FL 33980-8467 (migehss@sunline.net).

For Prairie Aviation Museum documentary, seeking contact with pilots, especially **WWII pilots,** in central Illinois. **Contact:** Pat Jones, 2140 Quiet Lake Pl., Martinez, CA 94553 (925-602-1949).

Seeking contact with **Clifford Leroy Christensen,** who may have been a flight sergeant with Eighth AF at Bovington AB, UK, 1942–45, and a school teacher as a civilian. **Contact:** Sue van Diemen, PO Box 144, Uraidla, South Australia, Australia 5142 (fax: 61-8 8379-6244).

Seeking contact with members of the **21st TCS "Kyushu Gypsies"** for commemorative pamphlet on combat cargo in the Korean War. **Contact:** W.M. Leary, Dept. of History, University of Georgia, Athens, GA 30602 (wleary@arches.uga.edu).

For a booklet on the library's history, seeking contact with anyone who served in the **Portadown, Ireland,** area during WWII and used the local library. **Contact:** Aideen D'Arcy, Portadown Branch Library, 25 Edward St., Portadown, County Armagh, N. Ireland BT62 1LX.

For a history, seeking contact with and information on anyone who **crashed or bailed out** in the Austrian and northern Italian Alps during WWII. Also seeking contact with American **POWs** who were in the Luftwaffen Lazarette at Oberfehring. **Contact:** Keith M. Bullock, 6491 Mils Bei Imst, Unterdorf, Tirol, Austria 18 (01143-5418-5306) (Keith.Bullock@oberland.or.at). ■

If you need information on an individual, unit, or aircraft, or want to collect, donate, or trade USAF–related items, write to "Bulletin Board," *Air Force* Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Items submitted by AFA members have first priority; others will run on a space-available basis. If an item has not run within six months, the sender should resubmit an updated version. Letters must be signed. Items or services for sale, or otherwise intended to bring in money, and photographs will not be used or returned.

Pieces of History

Photography by Paul Kennedy

Flying Tigers

Memorabilia courtesy 23rd Fighter Wing, Pope AFB, N.C.

Recruited by Claire Lee Chennault just before World War II to provide air defense in China and Burma, the American Volunteer Group helped the nationalist Chinese government by fighting the Japanese with such ferocity that they earned the nickname "Flying Tigers." The AVG was disbanded and the 23rd Fighter Group on July 4, 1942, took over the Flying Tigers' mission.

The 23rd consisted of three fighter squadrons—the 74th, 75th, and 76th—and was a component of the China Air Task Force (later Fourteenth Air Force), headed by Chennault, by then a brigadier general. Today, the 23rd Fighter Group is headquartered at Pope AFB, N.C. Its A-10s sport distinctive and historic nose art: the Flying Tigers shark teeth.

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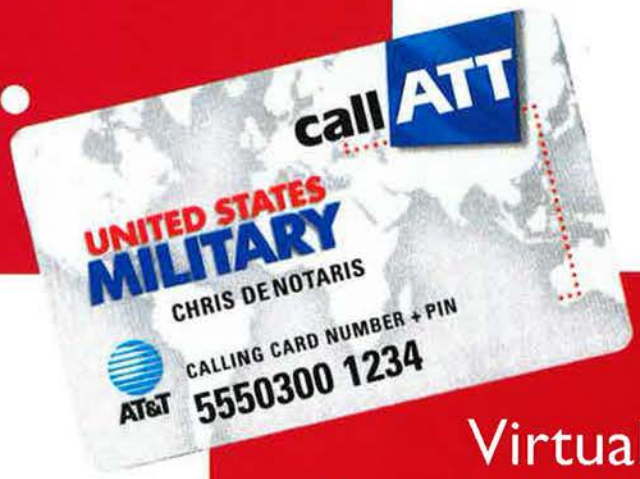

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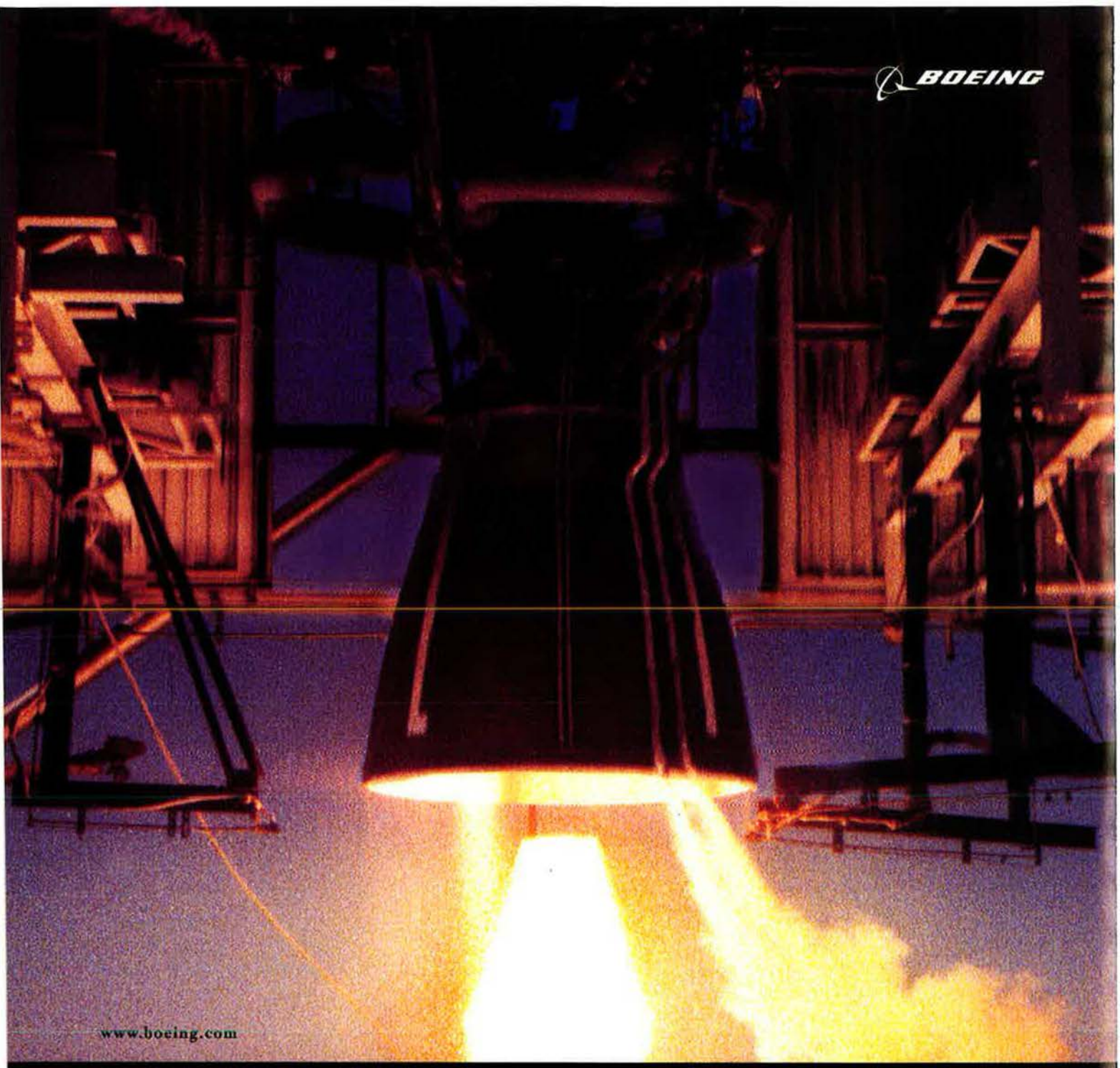

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