

JUNE 1968 / \$1.25

Ninth Annual
Missile and Space Almanac
PLUS
Special Reports on AFA's
22d Annual National Convention

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and SPACE DIGEST



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Vandenberg AFB, Calif.

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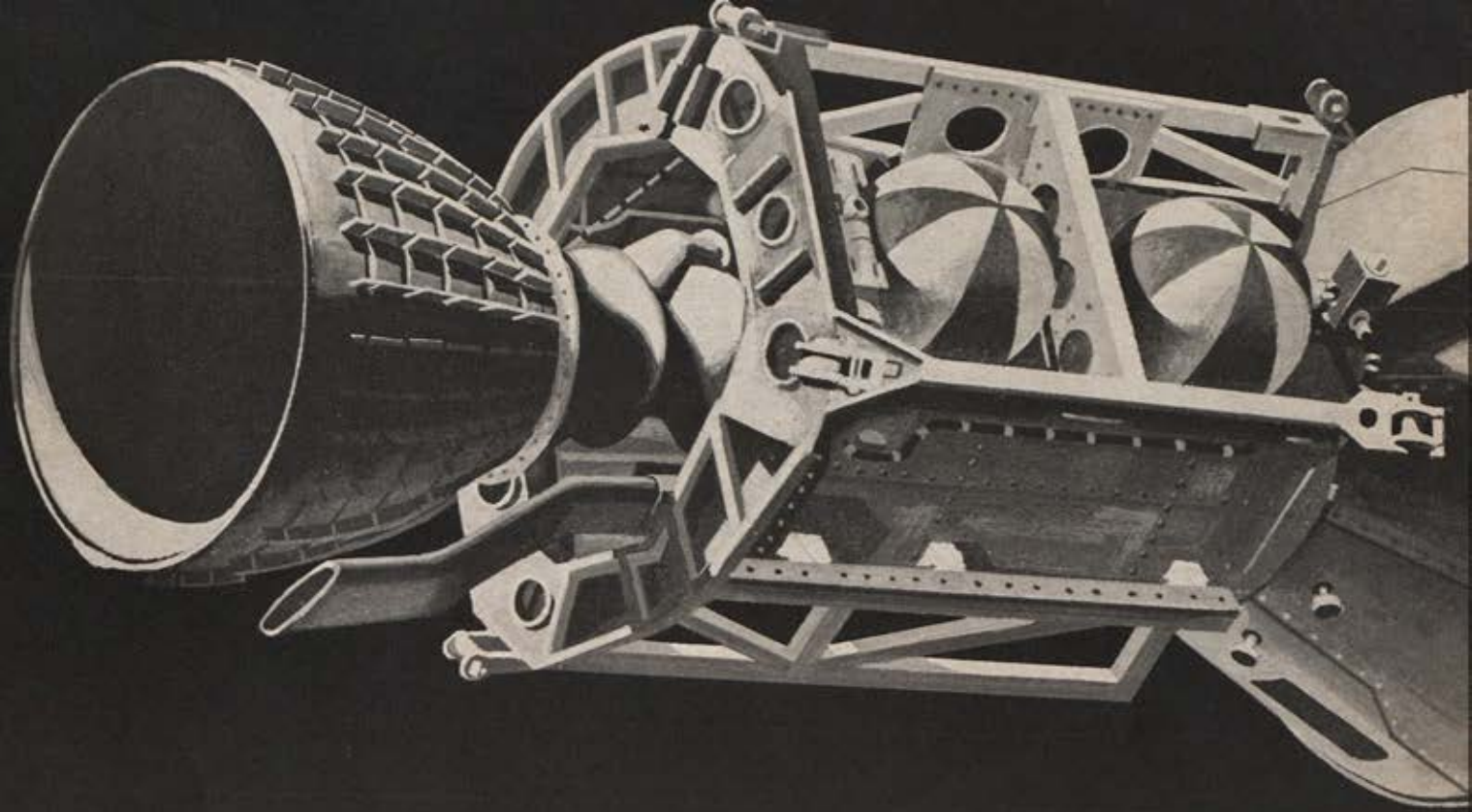
Twin turbine Boeing helicopters, built by Vertol Division, are deployed to Vietnam. They serve with U.S. Army, Navy, Marine Corps.

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upper stages. It's applicable to almost all USAF launch vehicles, also scientific experiments, weather, navigation or communications satellites.

NASA's Apollo/Saturn V moon rocket, largest, most powerful in world, will launch first Americans to moon. Boeing builds first stage booster, integrates Saturn V with Apollo command, service and lunar modules, and performs systems engineering, launch and integration support for NASA on entire Saturn V system.

BOEING



America's

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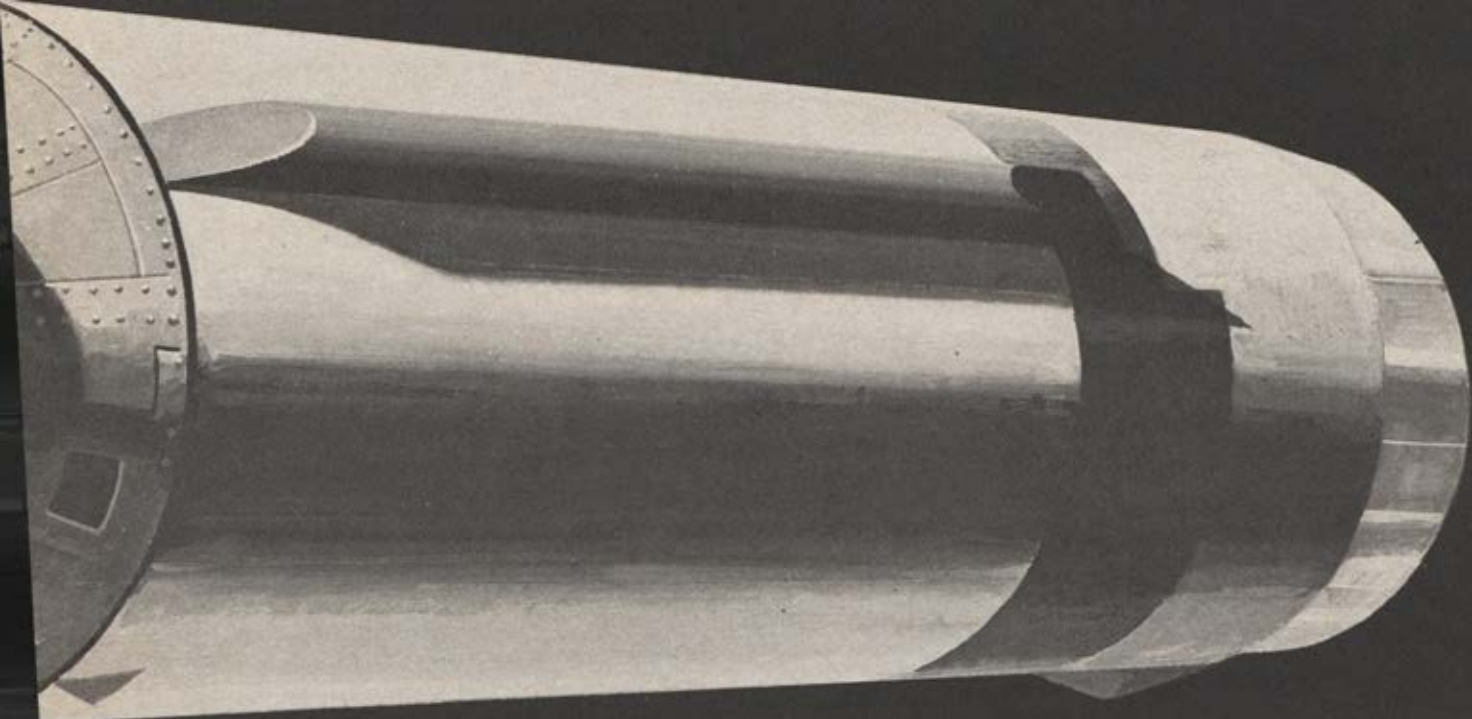
Lockheed also designed Agena to be an orbiting satellite—a job

it has performed on some 200 missions. And getting there is often only half the run for Agena. Meeting another need, it can be restarted in space to alter orbit altitude or inclination. As many as nine restarts per Agena have been achieved so far.

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T. L. Norton,
Vice President,
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AIR FORCE

and SPACE DIGEST

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VOLUME 51, NUMBER 6

JUNE 1968

Ninth Annual Missile and Space Almanac

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Now that the space program has produced measurable payoffs and promises more, it should not be allowed to go down the drain in a flood of indiscriminate criticism.

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With much of its attention and effort devoted to the war in Vietnam, the Strategic Air Command increasingly depends on Minuteman to bolster its fundamental responsibility in America's security setup.

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The Secretary of the Air Force describes how our capabilities in aerial resupply have increased in giant steps.

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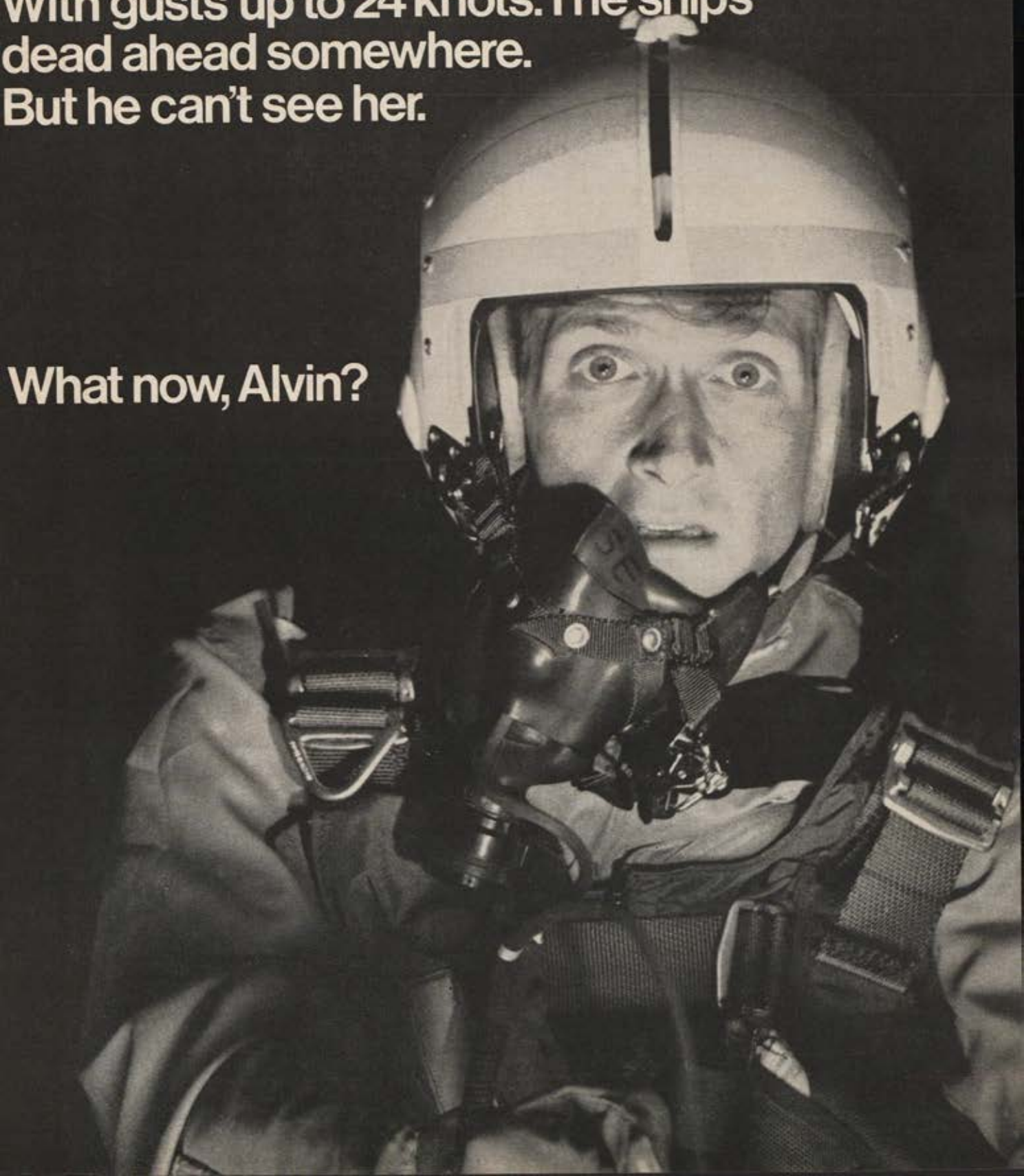
BY GEN. JOHN P. MCCONNELL
The USAF Chief of Staff's major policy statement from the AFA Convention in Atlanta.

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Meet Ensign Alvin Parser. One month out on his first carrier tour of duty. Right now he's in an A-7 barely twenty seconds away from a landing. In a hammering squall. With gusts up to 24 knots. The ship's dead ahead somewhere. But he can't see her.

What now, Alvin?



You're allowed a sweaty flight suit on an approach like that, even with a LSi Astronics automatic flight control system. A man's always a little nervous in marginal landing conditions and if he can't see the carrier, he's bound to be even more tight. But our AFCS does take the worries out of many a flight situation.

Of course it's one thing to know the theory of 60 pounds of electronics bringing you to a hands-off touchdown on the button, but another thing to experience it.

The AFCS system has two modes. A hairy flight uses both of them. The first mode controls the plane's handling. Keeps it the same under all conditions. Makes sure it won't mush out on you. Assures a response as snappy in a high cross wind landing as hauling at Mach 0.9. Aloft it holds attitude and altitude within an eyelash so a pilot can pay more attention to his radar, nav and ECM systems

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Control augmentation is achieved by a force sensor in the stick. There's a complete dual system of transducers, accel-

ometers, rate gyros and dual servos that provides a closed-loop command to rudder, ailerons and horizontal stabilizers.

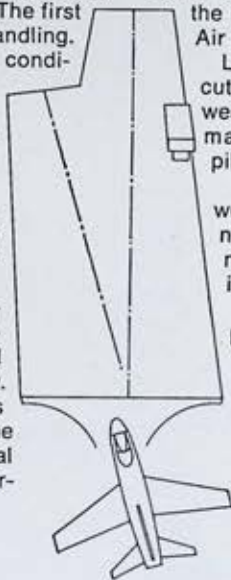
The second mode of our AFCS is for automatic carrier landing. Shipboard radar tracks the incoming plane within a foot. The system compensates for the roll and pitch of the deck, the wind conditions, and takes the plane through the slight flare out and drops it home safe.

This isn't slide rule theory or part of an "interesting test series." AFCS is operational on the LTV Aerospace Corp. A-7's; the Navy A, B and E models and the Air Force D.

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We've prepared a little pamphlet on this system called "Questions and Answers About Automatic Flight Control Systems for the Military." It's written in plain English and is available by writing:



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Priorities and Payoffs

BY WILLIAM LEAVITT

SENIOR EDITOR/SCIENCE AND EDUCATION

THERE is little question that, in the large, the US space program has been a major casualty of the Vietnam War. But one must also point out that its wounds have been serious rather than mortal. Important programs, particularly planetary probes and follow-ons to the Apollo moon-landing effort, have been sharply cut back. But there is still plenty going on in space.

The Apollo moon-landing program itself is proceeding toward its climax. A sizable array of unmanned utility satellites, ranging from strategic reconnaissance and military communications to weather patrol and commercial communications devices, clicks away in the void. And the Air Force's Manned Orbiting Laboratory (MOL) is quietly moving along, albeit at a slower pace than originally expected, toward its mission of examining manned military operations in space during the early 1970s.

For US military and civilian space planners, conscious of the continuing Soviet interest in using space for military and propaganda advantage, the Vietnam-induced US space slowdown is a continuing frustration. Such proto-weapon systems as the Russian Fractional Orbit Bombardment System (FOBS) cannot be dismissed lightly, nor is it pleasant to contemplate the national uproar that would take place if, after all we've spent, the Soviets were to make it to the moon before us.

Against such a bleak backdrop, it obviously is hard to project pictures of happier tomorrows for space technology. The kind of impetus space technology had only a few years ago has simply faded away. And once the original thrust of an effort has been spent, it is exceedingly hard to revive, at least in its original form and intensity.

But it is not so much the relative slowdown in today's effort that should cause concern but rather the probability that after the pressures of Vietnam are off, today's nay-sayers will continue their campaign to portray the space program in all its aspects as a profligate outpouring of money, talent, and time that somehow ought to be diverted to other enterprises.

This is the real problem. It is a problem not only for the planners and builders of the space program but also a challenge for the politicians and the electorate in this highly political year. For the gut question

is: Shall the enormous investment already made in space technology go down the drain now that it has paid off in terms of sharp improvements of hitherto earth-bound endeavors ranging from reconnaissance to weather prediction—a payoff that could increase enormously in the years ahead?

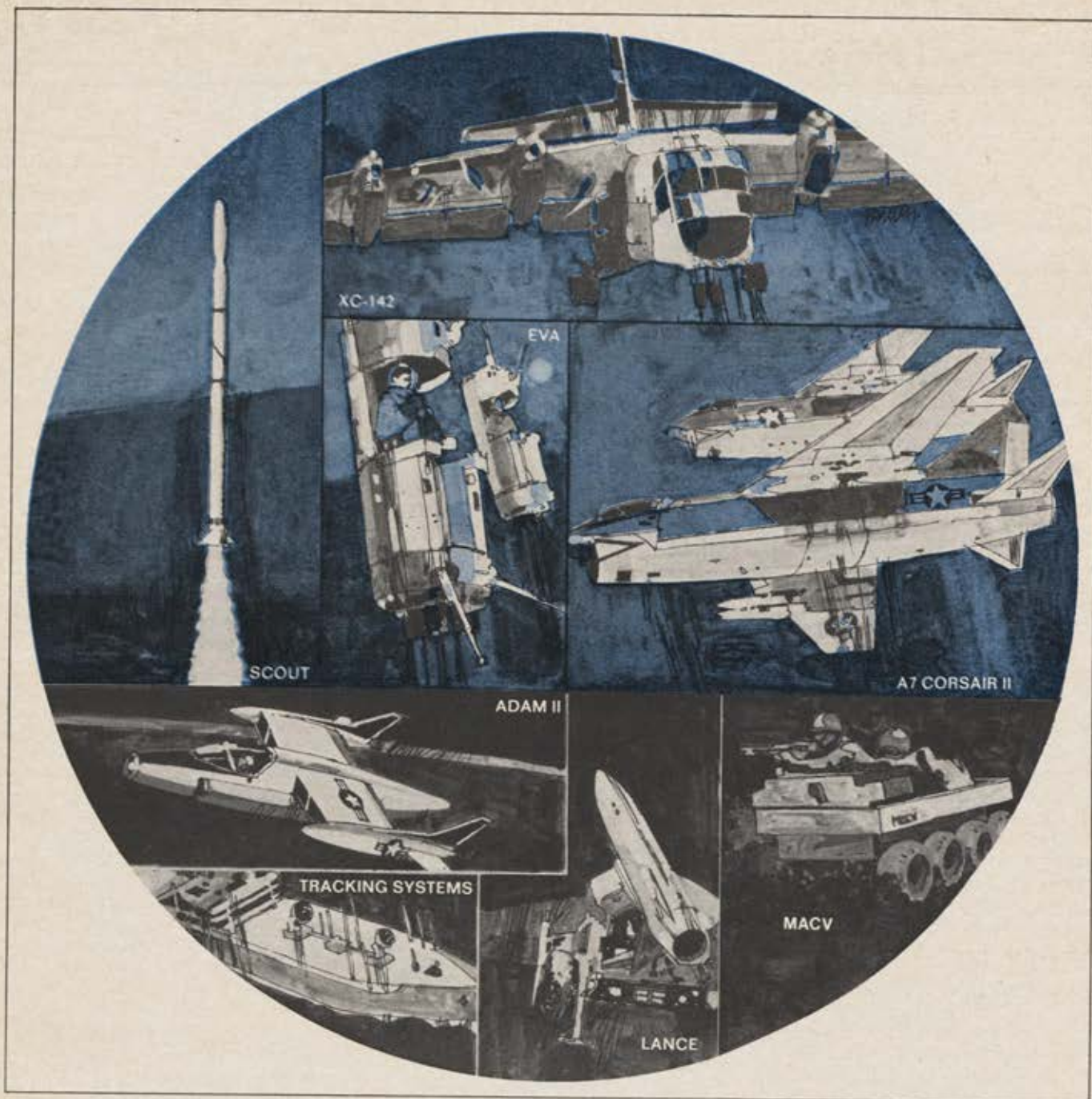
The logical answer is no. But cool logic, experience shows, does not by itself rule decision-making in our intricately political and often emotional society. This fact requires all of those who believe in the future potential of space technology as a tool for the improvement of man's lot on this planet and, equally important, as a necessary enlargement of US military strength in a world still threatened by aggression to devise the kind of vigorous and well-documented sales program for future investments in space technology that will again elicit public acceptance and backing.

Such a task is far from easy. Manned spaceflight, which once held the nation and the world enthralled, no longer thrills. Even the moon landing, when it occurs, will be sensational, but only for a time. In an age of riots, assassinations, protests, financial crises, and seemingly endless war abroad, the public inevitably reaches a saturation point.

Yet it is a sales campaign, vulgar as that term may sound, that is sorely needed and that must be mounted.

Somehow the space program, as we suggested last September, must be brought down to earth. The space program must be correctly identified in the public mind with the idea of the intelligent and beneficial application of technology for the public good, which is, after all, its best justification in terms of public support. If space technology can, as it is already doing, help maintain our security, as well as improve the understanding of our environment, then it deserves public support.

All this is not to denigrate in any way the scientific yield of the space program. It is only to suggest that satisfying the curiosity of a scientist about, say, the composition of the atmosphere of Jupiter may not, in this time of ferment, be of great import to taxpayers. If people are demanding new priorities for the whole range of national enterprises, they are certainly entitled to a reordering of priorities within the space program itself. The top priority in space is a demonstrable return on investment.—END



This is LTV Aerospace

LTV Aerospace Corporation traces its aeronautics history back to 1917, when its first aircraft was produced—a marvel of wood, wire and canvas with an “unbelievable” top speed of 116 miles an hour.

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Most Important Element

Gentlemen: Congratulations to Claude Witze for a splendidly compiled presentation of "Declining Defense Profits—Government Economy, or a National Security Risk?" appearing in your April issue.

It is regrettable that no mention was made of the most important factor in a production and cost analysis of war materiel: the human element.

Perhaps it was considered too obvious to mention. But it is the human element which causes a person or a government agency to succeed or fail. Technical knowledge alone, acquired at perfunctory seminars, etc., will not cause an inexperienced government employee to deal reasonably and successfully with tycoons, whose earnings are ten to fifty times the salaries paid to said government personnel. The mere knowledge of such an imbalance places the contractor on a pedestal of importance and the government employee, military or civilian, in a position of great disadvantage.

It has been mentioned before that during a war crisis, when training periods are out of the question, contracting officers and cost analysts should be men of great experience, preferably retired businessmen who are thoroughly familiar with the pitfalls of mass production and accounting.

The wisdom of such a procedure was proved by World War II. The results were highly profitable and satisfactory to all persons concerned.

ALBERT JASON
Oakland, Calif.

Reverse Geography

Gentlemen: It's a little late to be worrying about our future, I think. "Debauch Road" [William R. Kintner, April '68] pretty well lays it on the line. But haven't we had the same problem since WW II?

As an AAF dogface, I was taught daily that we were fighting Hitler because of Haushofer's and MacKinder's theories of "Geopolitik." Four years after that war ended we gaily waved good-bye to one-fourth of the world's people, situated on the same landmass that Hitler wanted to conquer. We killed fifty million people to prevent him from conquering the

world via the [European] "Heartland."

I remember looking at a globe sometime after December 7, 1941, and wondering how anybody could have the colossal arrogance to take on practically all the world's people and resources. It looked like only a matter of time; and it was, with "Geopolitik" going for us.

Look at the same globe today. It's doubtful if the US has ever been so isolated. We have rapidly moved to the place where we can't possibly, because of "Geopolitik" alone, do the job that we and the world seem to expect.

In lieu of friendly geography and a bottomless pit of money and resources, the only power we still have left is nuclear. Have the peacemongers finally driven us to the peace they feared most—using nuclear weapons to even survive?

There have been some of us who resisted these moves all the way, and do you know what we're known as? Yeah. Extremists.

L. S. ABBOTT
Wichita, Kan.

Ill Winds

Gentlemen: In the interesting article by Maj. Robert Mikesch, "The World's First Intercontinental Missiles" (April), I have noticed one error worth correcting.

The author writes that "the Japanese undertook history's first balloon-bomb campaign" (p. 158). Actually, during the Italian War of Independence, 1848-49, the Austrians augmented (though how successfully I do not know) their bombardment of Venice by employing bomb-carrying balloons (presumably unmanned) over the city. The technique was developed by a Lieutenant Uchatius.

DR. R. H. STACY
Syracuse University
Syracuse, N. Y.

• *They weren't too successful. Small bomb-laden balloons were set loose on the city of Venice. The bombs were fitted with fuzes timed to explode them over the city. However, winds blew most of the balloons away from the target, and some even drifted back to explode among the Austrian forces.*—THE EDITORS

Airborne Mountain

Gentlemen: I thoroughly enjoyed reading your coverage of the C-5's rollout, April '68 issue. Truly a magnificent bird.

Your articles on the various characteristics of the C-5 I found to be very interesting and informative. Just looking at the size of the entire plane on the inside of the foldout cover is impressive, to say the least.

Since several Air Force planes are eventually given nicknames such as "Puff, the Magic Dragon," "Herkie," or "Flying Banana," it would seem quite appropriate to dub this C-5 Galaxy the "Flying Mountain."

1ST LT. ROBERT E. DANT
Tempe, Ariz.

Reply in Kind

Gentlemen: With the *Pueblo* incident, it has become increasingly clear that our government is almost totally unprepared to meet the various twists and turns of the cold war. Because we are unprepared, we continually sell out to our adversary with condescension and concession, and by our weakness actually maximize the strength required of us to meet the situation, as well as the potential danger. Incidents such as these, if allowed to go by the boards without morally equivalent response by our side, can piecemeal reduce us to be the eventual pawns of communism and contribute to the downfall of the free world without the necessity of a cataclysmic showdown.

It is time that we fully understand that the enemy is international communism. The enemy is not North Korea, or Red China, or Russia, or North Vietnam, etc. We can no more continue to treat these areas as independent entities than we can treat an arm or a leg for malaria. The whole body must be treated, and so, too, with communism.

We must fully understand that we are in a deadly power struggle with our opponent, in the same manner that he believes he is in a deadly power struggle with us, and that "peace" is really an equilibrium condition in that struggle. As in any struggle between two opponents, and there are really only two, neither side should be foolish enough to content
(Continued on page 13)

SCIENCE/SCOPE

The BADGE air defense system which will safeguard Japan against aerial attack was completed on schedule. Its network of sites extends from the northern tip of Hokkaido to the southern end of Kyushu. System was accepted in Tokyo recently by the Self Defense Agency of Japan.

Nerve center of BADGE is its high-speed Hughes computers. In seconds they will enable the system to detect, pinpoint, and identify a potential airborne threat... tell pilots and missilemen its altitude, speed, and direction... and automatically select the best defensive weapon to counteract it.

A new underground air defense center completed recently in Belgium is the first operational link in the \$300-million NADGE system that will provide 10 NATO nations with an integrated early-warning and weapons-control system extending from Norway to Turkey. It will be used in conjunction with command centers Hughes will build in Belgium, The Netherlands, and West Germany. Hughes is providing data processing computers and programming for the entire NADGE system.

Three promising uses for lasers developed by Hughes include: 1) A laser trimmer for the manufacture of precision hybrid microcircuits. Trimmer uses a gas argon laser, is ideal where a probe-type tool is undesirable. 2) The first tank fire-control system that integrates a laser rangefinder with a high-speed analog computer. It is now being tested on the Belgian army's Mark 47 tank. 3) Color TV transmission by laser beam. New system has been demonstrated on an 18-mile link over land and water, and shows a remarkable ability to penetrate smog and haze.

The Collier Trophy for significant achievement in aeronautics and astronautics in 1967 has been awarded to Lawrence A. Hyland, representing the Surveyor program team at Hughes, Jet Propulsion Laboratory, and associated organizations. Hyland is vice president/general manager of Hughes.

The Surveyor program for which Hyland received the award set the amazing record of five successes out of seven launchings -- including three soft landings on the moon in 1967.

A new mass sensor demonstrated recently by Hughes research scientists is the first instrument that is sensitive enough to measure extremely small gravitational forces -- yet can be made rugged enough to fly on an aircraft or spacecraft.

Potential uses for the sensor would be aboard an airplane, to make a fast, gravitational-field survey of the earth to detect oil or mineral deposits; aboard an orbiting satellite, to map the mountains, valleys, and craters of the moon.

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HUGHES

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TECHNICAL MOMENTUM

**Operational testing:
the indispensable link between
missile system R&D and combat
readiness.**

"You can't build an effective missile capability with theories alone. Between completion of R&D and use in combat, there's a vital step: operational testing. The challenge is to strike the essential balance between realistic operational conditions and those necessary to acquire meaningful data. It takes a real team effort between the user and his supporting organizations."

P. W. Constance, Director, Test and Evaluation



At last count, we'd taken part in over 250 flight tests. Apart from the specifics each has taught us, these tests have collectively helped to give us a unique quality we call Technical Momentum.

Technical Momentum? That's the dynamic combination of management, experience, and skilled people that adds up to unusual expertise across the broad spectrum of aerospace technology. With special emphasis on re-entry vehicle systems.

In fact, we've designed, developed and tested virtually every R/V now in America's ICBM arsenal. The backlog of advanced, technical skill gained through this experience has suited us well to the role of supporting SAC, SAMSO, SAAMA, and others responsible for evaluating the operational performance of our missiles.

No one knows the performance requirements of the weapon systems better than this USAF/Industry team; no one is in a better position than the Avco scientists and engineers who designed these systems to help the Air Force plan for the testing. And determine which measurements can be made without distorting combat configuration and performance. And analyze the test measurements in order to generate valid conclusions about these systems' reliability, accuracy, penetrability and credibility.

We've done precisely this in the past; we're doing it presently.

We have exactly the right kind of momentum to do critical work like this.

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itself with punching on the adversary's arm while the other is trying to shove a knife in his opponent's stomach, that is, if he can get away with it. The gist of the game is to utilize our power to our advantage, not to our opponent's. Let us not delude ourselves into thinking that the dupes of communism would fail to destroy us completely if they ever got the edge on us in any way.

To maintain our honor and dignity in the world, we must meet these incidents with like coin, thereby preserving the balance of power and preventing the danger of a nuclear holocaust, and we must consider all Communist nations as our adversary. We must realize that given the present-day conditions of power, we must trade an eye for an eye and a tooth for a tooth on a relative power scale, not man for man by any means, so that a succession of little incidents doesn't add up to a great advantage for the other side—psychologically, militarily, economically, politically, or territorially. . . .

R. C. GLICKSBERG
Santa Monica, Calif.

History of the 332d

Gentlemen: I am engaged in conducting research on the 332d Fighter Group, and Lt. Gen. Benjamin O. Davis, Jr., Commander, Thirteenth Air Force, PACAF, Clark AFB, Philippines. This is an approved project of the Department of Defense and the Air Force Museum.

Data is urgently needed, either of a graphic nature such as photos or drawings, or written documents which relate to any of the following units during World War II: the 99th Fighter Sqdn. (Twelfth AF, later Fifteenth AF), 100th Fighter Sqdn., 301st Fighter Sqdn., 302d Fighter Sqdn., and 332d Fighter Control Sqdn., all of which were at one time or another attached to the 332d Fighter Group.

I am particularly anxious to contact any former members of any of these units and would appreciate information as to the whereabouts of any of these men. The ultimate goal of all this research will be, hopefully, an approved unit history.

DONALD W. THORPE
22301 Paraguay Dr.
Saugus, Calif. 91350

Propaganda Leaflets

Gentlemen: I am in the process of writing a book on the use of aerial propaganda leaflets during WW II.

I would be interested in hearing from any readers who have taken part in the dropping of these leaflets over
(Continued on following page)

Problem:

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The CALC system has proved to be a highly versatile management tool which provides a wide variety of cost information. Total project costs can be isolated for each component or total configuration, and are allocated to the sponsoring agency or program. It rapidly determines feasibility and cost impact of alternative options. CALC has been in constant use for managing the APOLLO program and for investigating various post-APOLLO projects.

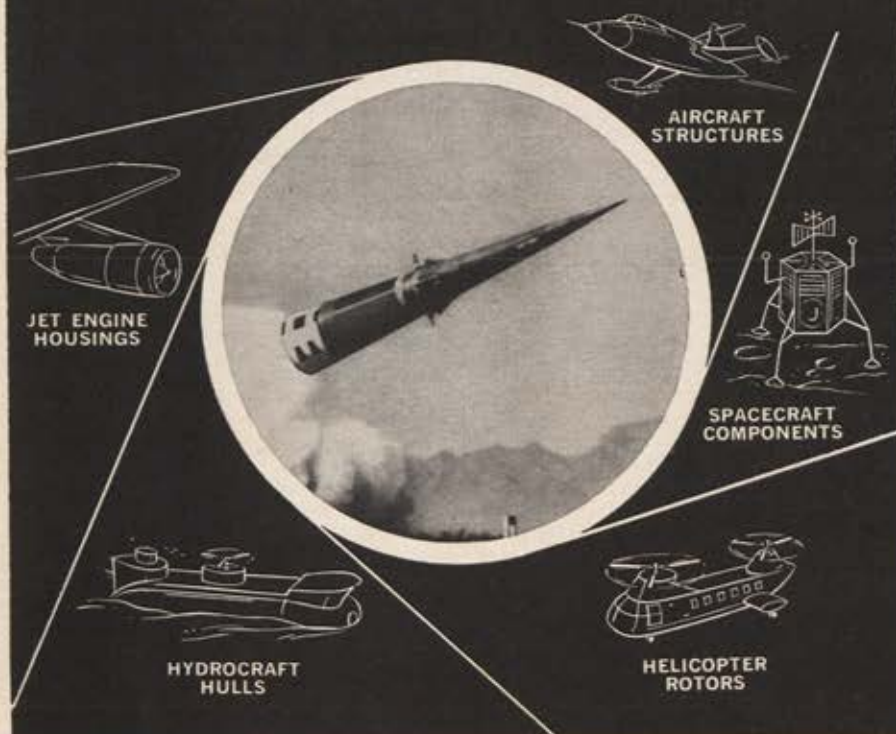
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enemy territory. I would also like to hear from any members who have been on the receiving end of an Axis leaflet drop.

If you had any propaganda experiences of this type, please send me a short note telling of the approximate time and place of the drop, the type of leaflets, etc. Any amusing or personal anecdotes will also be of great help. In fact, any information on any aspect of this field will be highly appreciated.

HERBERT A. FRIEDMAN
30-75 47th St.
Long Island City, N. Y. 11103

Recon History

Gentlemen: I am writing a book about the history of aerial reconnaissance under contract to a major publishing house. I would appreciate hearing from any persons who have interesting narratives about aerial reconnaissance, photographs they would be willing to have included in the book, or any relative material. I am very interested in obtaining personal narratives from pilots who flew reconnaissance during WW I, WW II, or Korea.

GLENN INFELD
3507 Fourth Ave.
Beaver Falls, Pa. 15010

UNIT REUNIONS

4th Air Rescue, Flight "C"

A reunion of the members and families of the 4th Air Rescue, Flight "C," stationed at McChord AFB, Wash., from 1947 to 1951 will be held at the home of MSgt. Frank M. Dowdy, 760A Sabre, Paine AFB, Everett, Wash., on Saturday, August 17, 1968. For further information contact

Harvey R. Amundsen
11803 Pawnee Dr., S.W.
Tacoma, Wash. 98499
or
Joseph D. Coyle
P.O. Box 18
Buckley, Wash. 98321

11th Bombardment Group (H) Assn.

The 8th Annual National Reunion of the 11th Bombardment Group (H) Association, Inc., will be held in Boston, Mass., August 1-4, 1968. For further information, contact Robert E. May, Secy-Treas. 11th Bomb Group (H) Assoc., Inc. P.O. Box 11 Perrysburg, Ohio 43551

19th Bombardment Association

Albuquerque, N. M., will be the scene of the annual reunion of the 19th Bombardment Association on August 10 and 11, 1968. Contact

Dean H. Anholt
3441 Pinehurst Circle
Springfield, Mo. 65804

CBI Hump Pilots Association

The twenty-third annual reunion of the China-Burma-India Hump Pilots Association will be

AIR FORCE/SPACE DIGEST • June 1968

held at Kings Inn, Crockett, Tex., August 23-25, 1968. Contact

Herb Fisher
Aviation Department
Port of New York Authority
111 Eighth Ave.
New York, N. Y. 10011
Phone (212) 620-8396

49th Fighter Group

The reunion of the 49th Fighter Group, World War II, will be held July 19-20, 1968, at Poplar, Wis. Contact

Ralph H. Wandrey, Chairman
23 S. York
Mason City, Iowa 50401

362d Fighter Group

The Silver Anniversary reunion of the 362d Fighter Group will be held August 21-24, 1968, in Nashville, Tenn. Please contact one of the following Squadron Chairmen for additional information:

The 377th Fighter Sqdn:

Charles Mann
4626 Craigmont Dr.
Memphis, Tenn. 38128

The 378th Fighter Sqdn:

Richard Law
12 Bradbury
Littleton, Colo. 80120

The 379th Fighter Sqdn:

William K. Marles
2838 Blue Brick Dr.
Nashville, Tenn. 37214

397th Medium Bomb Group

The first reunion of the famous "Bridge Buster" outfit, the 397th Medium Bomb Group, WW II, will be held on July 20, at the Moose Home, located on Rte. 36, 6 miles east of Petersburg, Va. For further information contact

Ray Daniels
426 Grove Ave.
Petersburg, Va. 23803

414th Bomb Sqdn., 97th Bomb Group

The biannual reunion of the 414th Bomb Squadron, 97th Bomb Group, will be held August 16, 17, and 18, at the Sheraton Motor Inn, Memphis, Tenn. All members of other squadrons of the 97th are welcome. Contact

M. D. Jones
15 S. Barksdale St.
Memphis, Tenn. 38104

464th Bomb Group, 15th Air Force

The reunion of the 464th Bomb Group, 15th Air Force, will be held in Erie, Pa., on August 9, 10, and 11. For additional details contact

Henry Robert Anderson
4321 Miller Ave.
Erie, Pa. 16509

485th Bombardment Group

The fourth reunion of the 485th Bomb Group will be held August 17 and 18 in Dearborn, Mich. For further information about the reunion and future reunions, contact

Carl P. Gigowski
344 Eola St., S.E.
Grand Rapids, Mich. 49507

487th Bomb Group Association

The reunion of the 487th Bomb Group Association will be held in Omaha, Neb., August 1-4, 1968. Members of the Association and all former members of the 487th who have not been in touch should contact

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1002 N. Rosiland Dr.
Santa Maria, Calif. 93454

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By Claude Witze

SENIOR EDITOR, AIR FORCE/SPACE DIGEST

The Scales Have Not Yet Settled

WASHINGTON, D. C., MAY 14

The peace talks in Paris are barely under way. It is too early to hazard a comment, but we have seen the President speaking in a relaxed mood at a dinner of the White House Correspondents Association, and it is evident he is optimistic. His withdrawal from the presidential race in his television appearance of March 31 had been anticipated by only a few observers, and even they are surprised at the resulting increase in Mr. Johnson's prestige and influence.

In addition to this year's unusual election campaign, there are a number of other matters that make this the strangest spring in the memory of Washington natives. Both the Daughters of the American Revolution and the American Society of Newspaper Editors have held their annual conclaves, which usually mark the arrival of balmy weather. This year they had almost no impact on the front pages.

Naturally, the major center of attention at this moment is the Poor People's Campaign, brought to town almost before the smoke cleared from last month's outbreak of violence. In fact, the outbreak is not over because there still are small bands of young hoodlums setting a few fires every night and harassing selected local merchants. There are a few citizens, including this one, who have seen it all before in the Germany that was Hitler's. The

same types with the same kind of prejudices and goals, conducting themselves in the same way. Apologists have, in both cases, attributed what has happened—circa 1934 and circa 1968—to grievances. The martyred Dr. Martin Luther King was opposed to violence, and our arsonists were not among his followers. But it remains legitimate, we believe, to wonder why Dr. King chose to organize a march on Washington to influence Congress. He could have been elected to Congress this very year, and by mid-January the House of Representatives would have no choice but to listen to his speeches.

It is a cinch that this has not escaped attention in the White House. President Johnson told us last Saturday that "looking about him, at his nation and his world," the Chief Executive "could see the making of catastrophe all around him. He could see the raw elements of hatred and prejudice, of division and demagoguery, and disorder all over the place . . . but a President could also look about him and find promise that would balance the peril . . . men trying to pull together the strands of decency and common sense, compassion, and moderation."

Mr. Johnson concluded:

"I did what I did on March 31 to put the full weight of the presidency and of the President on the hopeful side of that balance. Now, six weeks later, the scales have not yet settled."

If there is any place the scales are settling it is in Con-
(Continued on page 21)

We're not suggesting that this is how it really looks. . . . Yes, it is the Pentagon, home of the Defense Department, across the Potomac River from Washington, sometimes called the Concrete Cobweb. This unusual picture was taken with a "fisheye" lens by Chief Photographer's Mate Richard R. Stover, from an altitude of 500 feet, out of a US Army H-21 helicopter. The cloverleaf highways that surround the building show clearly, with the marina in the foreground. Sprawling parking lots suggest size of traffic jam twice a day.



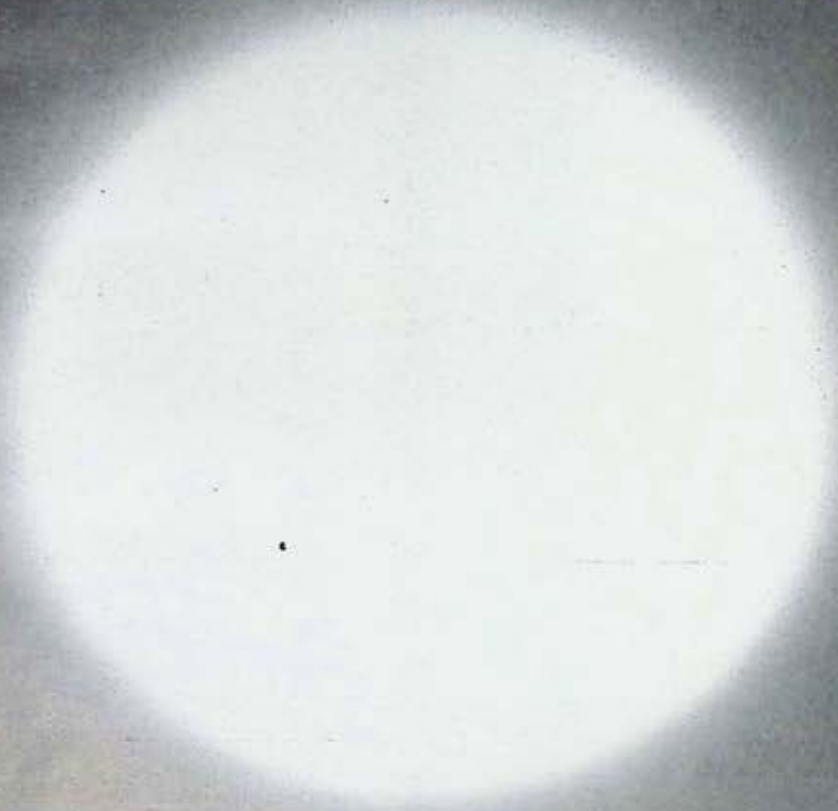
As fantastic as it might seem, it can be done. Electro-Optical Systems, a Xerox company, is the world's leading supplier of high radiance illumination systems to the military. And for good reasons. Its long experience in optics, reflectors, advanced light sources, lasers, plasma arc technology and precision manufacturing has resulted in a wide line of searchlights... airborne, combat vehicle-mounted and hand-held. *The Minilight...*

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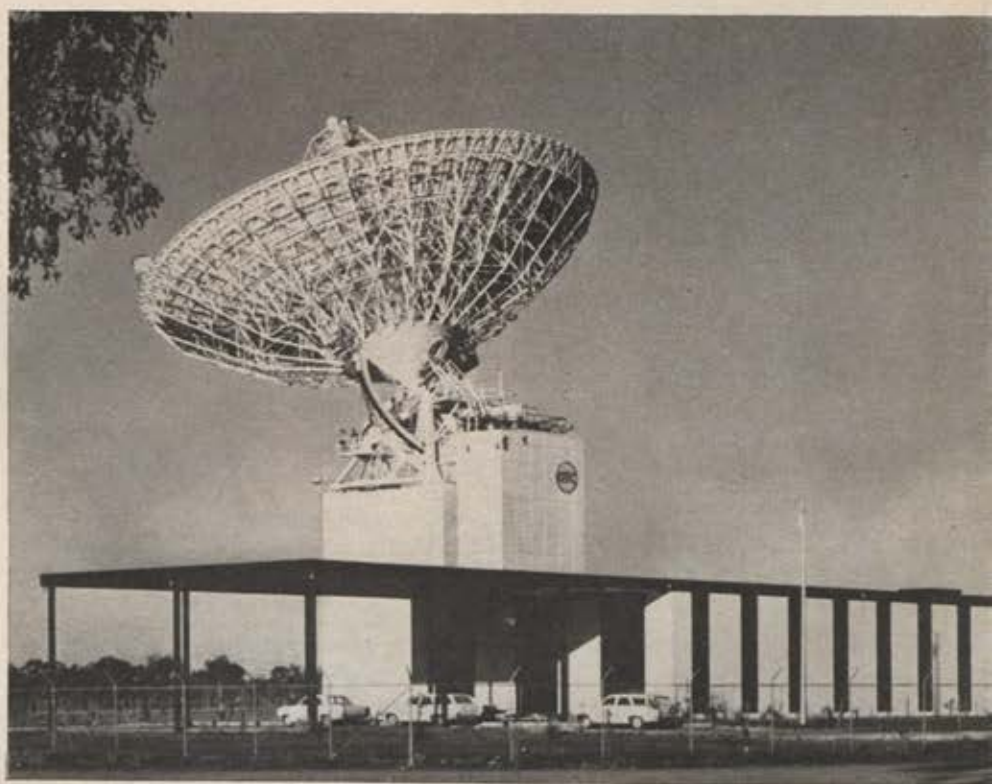
also the leader in light amplification devices.) EOS manages the darkness.

Guerrilla warfare and insurgency have so changed military tactics that EOS is offering a free copy of the complete book, *Mao-Tse-tung on Guerrilla Warfare*, to members of the U.S. Armed Forces and allied industries. Write on your letterhead to Pasadena, California 91107. **Electro-Optical Systems, Inc.**
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Australian earth station serves vast area



Australia's new computer-controlled earth station near Moree permits satellite communication with any country from the U. S. to Thailand — or from Alaska to New Zealand.

Procured by the Australian Overseas Telecommunications Commission, the earth station can accommodate 600 telephone calls and one television channel simultaneously, with a capacity for later expansion. The facility employs a 90-foot-diameter antenna with shaped reflector. Design of the pedestal permits pointing of the antenna at satellites in approximately equatorial orbits.

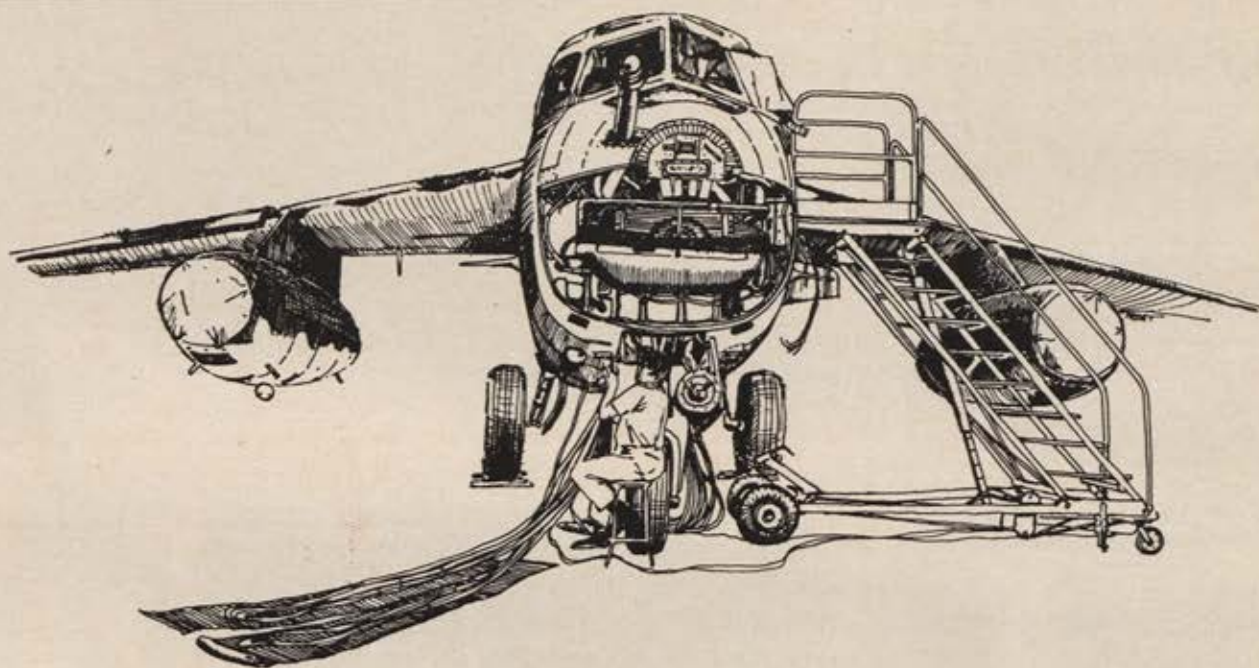
Collins provided transmitting and receiving equipment, the antenna, the building, all associated control and monitoring systems, installation, and testing. The facility is the first fixed ground station designed and built by one manufacturer for satellite communications.

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gress, and even that progress is hard to discern. And it does not come without a generous portion of gall. The President, it now appears, will get the tax increase he so long has endorsed, and from legislators he was able to scold openly and heatedly after March 31.

It was on May 3 that he said, "The time has come for all the members of Congress to be responsible and, even in an election year, to bite the bullet and stand up and do what ought to be done for their country."

It is not necessary to review all of his exhortation, but he expressed deep skepticism that Congress will see the way clear to cut expenditures by more than \$1.5 or \$2 billion. He said his \$186 billion budget is a lean one and probably should be increased, both for the war on poverty and for the military. There, "we have additional needs from our men in uniform, additional equipment in the form of helicopters, armaments, ammunition, and things that we couldn't foresee..."

Well, the defense budget now is before the Senate and there is some effort under way, most notably from the office of Senator J. W. Fulbright, the Arkansas dove, to cut it back. Having challenged Mr. Fulbright to put his opinions to such a test, in these pages only two months ago, there will be no criticism here for his straightforward reply. He is joined, incidentally, by such Senate stalwarts as Mike Mansfield of Montana, the majority leader, John Sherman Cooper of Kentucky, Stuart Symington of Missouri, and Philip A. Hart of Michigan.

This year's authorization bill was passed on April 19 by a vote of fifty-four to three. The negative votes were cast by Ernest Gruening of Alaska, Gaylord Nelson of Wisconsin, and Mr. Mansfield. The authorization bill for military procurement and research and development called for \$1,043,314,000 less than the Administration request of \$22,385,052,000. It was reduced \$383,263,000 in committee and another \$660,051,000 on the Senate floor.

During the floor debate, which lasted three days, the Senate rejected amendments that would block work on the Sentinel antiballistic missile system and procurement of fast deployment logistic ships. The criticism at that time was against the projects themselves, not their cost. Indications are the opponents now will seek the same end by arguing that the ABM and the FDL programs should go as an economy measure. Likewise, questions are being raised about the requirement to keep six Army divisions in Western Europe. Each of these items has a bearing on more than the budget alone; they can be dropped only with the realization that the action has an impact on our nation's entire strategic philosophy. It is significant that the men leading the fight are, for the most part, the same ones who have been most critical of defense policies.

The largest specific cutback imposed by the Armed Services Committee, before the authorization bill went to the floor, was the \$460 million item for continuing work on the Navy's F-111B. It also included a three percent across-the-board reduction in research and development requests and elimination of an Air Force proposal—at \$28 million—for redesign of the F-106 interceptor into an improved version called the F-106X. The committee discounted the danger of a bomber attack on the United States and said the main threat is from missiles.

Once on the floor, the authorization bill took another across-the-board three percent cut. That came with passage of an amendment by Senator John J. Williams of Delaware that did not specify where the cuts were to be made.

Now it is evident that foes of the military budget, long articulate but shy when it came to being counted in a



USAF Maj. Ronald W. Terry, director of evaluation team for Gunship I and Gunship II—the side-firing C-47s known in Vietnam as "Spooky"—wins Harvey C. Knowles Award from the American Ordnance Association. Check is being offered by Lt. Gen. Levin H. Campbell, director of AOA. In background is John R. Alison, AOA vice president.

vote, are hoping to profit from the President's challenge to bite a bullet.

With all our continuing concern about weapon systems and the constant pressure of competition from Soviet military technology, it is evident that the one issue most likely to face heated debate is the suggested withdrawal from Europe.

There are a good many people, President Johnson and Dean Rusk included, who feel that these soldiers are a necessary part of our pledge to the NATO powers. Senator Henry M. Jackson's subcommittee on national security and international operations has recorded volumes of testimony vouching for the essentiality of showing our flag in Europe over US Army encampments.

Now, there appears a genuine danger that, with the focus on the talks in Paris that seek an end to the war in Vietnam, and with the Poor People snapping at congressional heels in Washington, decision-making will get more difficult instead of easier. No wonder it is hard to get men to run for President.

Let's Stick to the Facts

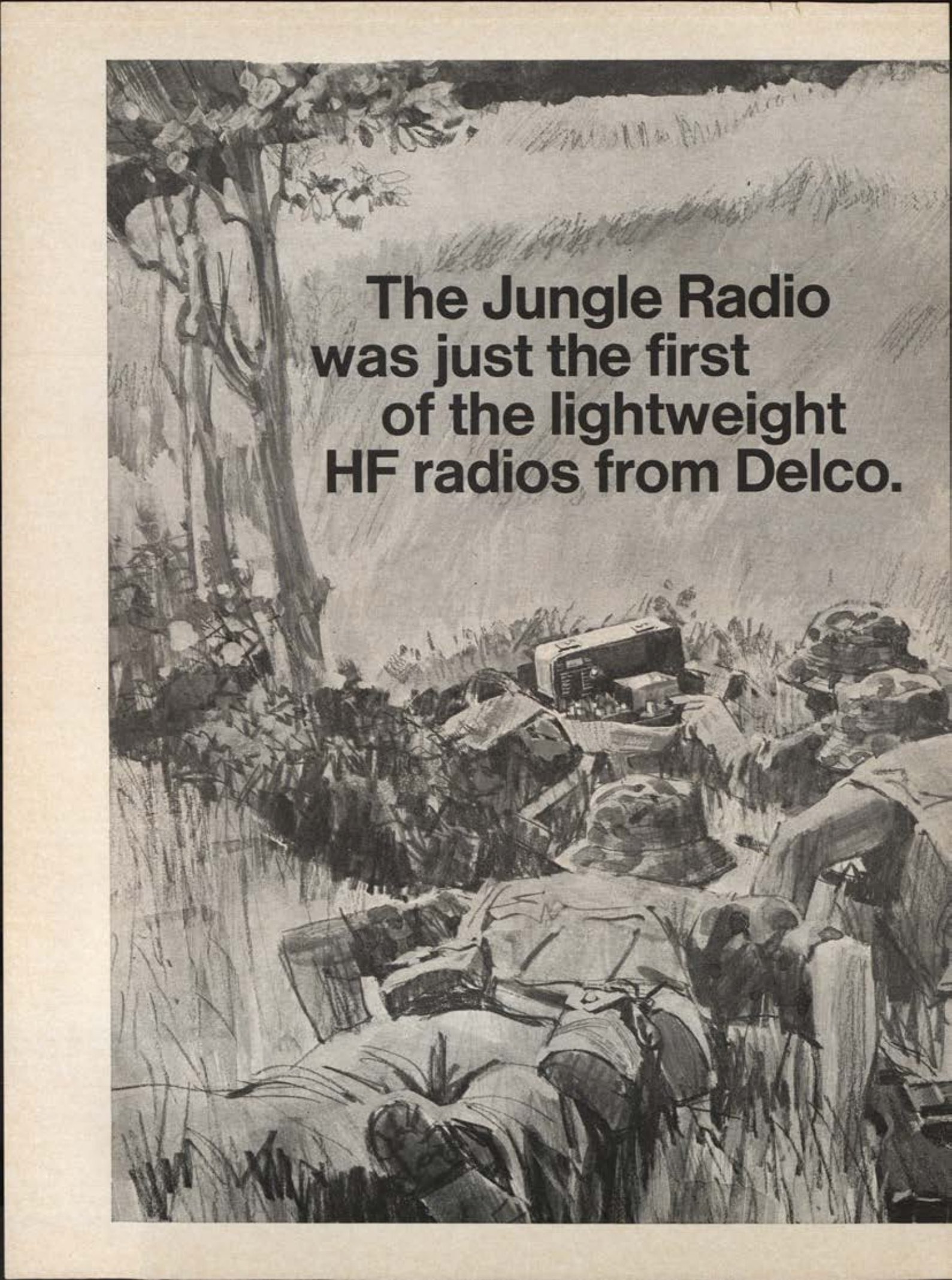
Yesterday, in Omaha, Neb., Senator Robert F. Kennedy, a candidate for the Democratic presidential nomination, told students at Creighton University:

"The fact is, if you look at any regiment or division of paratroopers in Vietnam, forty-five percent of them are black."

According to the US Army, which should know, this is not a fact. The facts are:

- 11.1 percent of Army personnel in Vietnam are Negro.
- 16.8 percent of the 101st Airborne Division are Negro.
- 17 percent of the 173d Airborne Brigade are Negro.
- 11.2 percent of the 1st Air Cavalry Division are Negro.

Incidentally, paratroopers volunteer for that kind of activity; they are not assigned.—END



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And that's one of our biggest accomplishments. **NORTHROP**



AEROSPACE WORLD

By Allan R. Scholin

ASSOCIATE EDITOR, AIR FORCE/SPACE DIGEST

WASHINGTON, D. C., MAY 17

Despite difficulties that marred the second unmanned test of the Apollo Saturn V in April, NASA has decided to proceed with the first manned test of the Apollo spacecraft in an earth orbital mission late this summer.

The three-man crew is headed by Navy Capt. Walter Schirra, one of two of the original seven US Mercury astronauts still active as a spaceflight crew member, who will be accompanied by Walter Cunningham, a civilian, and USAF Maj. Donn Eisele, on their first space mission.

Problems with the April test centered in the second stage when two of its five Rocketdyne J-2 engines shut down prematurely. One engine failed when a fuel line broke; an onboard computer, noting the failure, triggered an order to cut off fuel to the engine, but an incorrectly wired circuit sent the order instead to another engine, shutting it down, too. As an indirect result of these malfunctions, the single J-2 engine in the third stage failed to reignite after placing the spacecraft in a parking orbit, and several test objectives were not met. But reentry telemetry, and inspection of the capsule after its recovery in the Pacific near Hawaii, proved that the crew would not have been endangered by

the mishaps, and after a detailed review, NASA decided to move on to the manned test.

A third unmanned test would have cost another \$280 million and delayed the manned lunar-landing schedule. But NASA Administrator James Webb emphasized that neither NASA's money problems nor the moon race influenced his decision to go ahead. "My instructions from President Kennedy and President Johnson," he said, "have always been, and remain, to go when we were ready and not to go until we were ready."



Bunker Hill AFB, Ind., was renamed Grissom AFB on May 12, honoring Lt. Col. Virgil I. Grissom, the Air Force astronaut who died with Lt. Col. Edward H. White, II, and Navy Lt. Cmdr. Roger B. Chaffee when fire consumed the Apollo spacecraft they were testing atop a Saturn booster at Cape Kennedy, Fla., in January 1967. Grissom was a native of Mitchell, Ind.



Talks which may some day lead to a settlement of the Vietnam War are going on in Paris at this writing, but the war continues as hot as ever in Southeast Asia.

Recoiling from its defeat at Khe Sanh and a US and South Vietnamese reconnaissance in force at A Shau, which destroyed tons of cached supplies and ammunition, the North Vietnamese Army swung south to threaten Da Nang and forced a withdrawal from the Special Forces camp at Kham Duc, thirty miles southwest of Da Nang and thirteen miles from the Cambodian border. The US plan was to evacuate friendly personnel from the camp, then pound the enemy with B-52s and fighters.

Carrying out the evacuation, however, proved costly. One C-130, taking off with about 150 Vietnamese soldiers and dependents and a six-man USAF crew, was disabled by enemy fire and crashed into a mountainside. The death toll of 156 was the highest of any air crash in aviation history. A second C-130, hit by enemy fire on landing, was destroyed but its crew escaped. Several Marine helicopters



Next Apollo Saturn V, to be launched in August or September, will carry this three-man crew in earth orbital test. From left, NASA's Walter Cunningham, USAF Maj. Donn Eisele, and Navy Capt. Walter Schirra, spacecraft commander.

and at least two more fixed-wing aircraft were also shot down in the fray.

Secretary of the Air Force Harold Brown toured Southeast Asia late in April. Arriving at Tan Son Nhut on April 17, he met with Gen. William C. Westmoreland, MACV Commander, and his air deputy, Gen. W. W. Momyer, and then proceeded to Cam Ranh Bay, Da Nang, Hué, and Tuy Hoa in Vietnam. From there he went on to Thailand, stopping at Ubon, Korat, Takhli, and Udorn before returning to the US.

During his tour he presented the Air Force Cross to Capt. John B. McTasney, an HH-3E Jolly Green Giant rescue pilot, and Silver Stars to Capt. Jerry D. Clearman and Sgt. Alvin A. Malone, Jolly Green crewmen, at Da Nang; Maj. Alan R. Iverson, an F-105 pilot, and 1st Lt. James E. Thompson, EB-66 electronics warfare officer, at Korat; and Col. George R. Hammond, Director of Operations, 432d Tac Reconnaissance Wing, at Udorn.



New, or relatively new, aircraft for several countries are in the news these days.

The US Air Force's A-7D Corsair II made its first flight at the Dallas, Tex., plant of its builder, Ling-Temco-Vought. In order to begin evaluation of the avionics suit developed for the



On visit to Southeast Asia, Air Force Secretary Harold Brown talks with Maj. H. L. Uken, left, and Lt. Col. Steve Neiley, Jr., of 432d Tac Recon Wing, Udorn RTAFB, Thailand, just back from North Vietnam mission.

Swedish government has boosted its order for these SAAB 37 Viggens to 175, totaling more than \$450 million. Three versions are on contract—attack, reconnaissance, and trainer—destined for service in early 1970s.



Air Force plane, it was powered by a Navy Pratt & Whitney TF30-6 engine instead of the Allison TF41 that will equip the USAF model. The first TF-41 engines, adapted from the British Rolls-Royce Spey, are scheduled for completion in June.

Included in the A-7D's avionics system are a terrain-avoidance radar and a Head-Up Display (HUD) which gives the pilot a visual presentation at eye level of everything he needs to know to carry out day or night attack, radar bombing, or all-weather navigation and landing.

In other developments, Denmark has ordered twenty-three 35X *Draken* fighters from SAAB in Sweden, including three trainers, to replace a squadron of F-100Ds, with an option for twenty-three more. Deliveries will begin in 1970. Unit cost of the supersonic double-delta fighter, if the option is exercised, will be about \$1.35 million. The 35X is similar to the Swedish Air Force's J.35F, but with increased range and attack capability. Underwing pylons will accommodate up to nine 1,000-pound bombs, with a gross takeoff weight of 35,270 pounds.

Sweden, meanwhile, has boosted its order for the SAAB 37 *Viggen* to a total of 175 planes. The contract price of about \$450 million is the largest ever awarded to a Swedish industry. Three versions are included—the AJ-37 attack, S.37 reconnaissance, and

Sk.37 two-place trainer. Purchase of a fourth model, the JA.37 all-weather interceptor, was deferred to 1969.

Royal Australian Air Force pilots are training in the General Dynamics F-111C at Nellis AFB, Nev., and Mather AFB, Calif., preparing to fly the first six RAAF versions to Australia in September, after post-acceptance flight checks at McClellan AFB, Calif. Other crews will follow each month until all twenty-four are delivered by December.

The Northrop CF-5 for the Canadian Armed Forces made its first flight on May 3 at Edwards AFB, Calif. Built by Canadair, Ltd., of Montreal, it was shipped to Edwards for its flight-test program. A total of 115 CF-5s are on order for what used to be known as the RCAF. Since the armed forces merger, the RCAF has been redesignated the Air Environment of the Canadian Armed Forces.

First test flights of the Anglo-French Jaguar trainer/strike fighter are scheduled for this summer at Istres, France. The first prototype was rolled out in mid-April, with the first British model due next year. Powered by two Rolls-Royce Turbomeca jets, each producing 6,945 pounds of thrust with afterburner, the Jaguar's top speed ranges from a low-level Mach 1.1 to 1.7 at altitude. Maximum takeoff weight is 29,765 pounds with a 10,000-pound external military payload. Five versions have been programmed so far—

single-seat tactical planes and two-seat trainers for each country and a single-place carrier-based model for the French Navy.

Britain introduced the McDonnell Douglas F-4K into the Royal Navy on April 30, with ceremonies marking arrival of the first three Phantoms from St. Louis. The F-4K is similar to the US Navy's F-4J, though Rolls-Royce Spey engines have replaced the General Electric J79-10s and other modifications have been made to adapt it to British carrier operation. The Royal Navy won't get to fly its Phantoms for long, however. They're destined for transfer to the RAF in 1970-71 when Britain retires its carriers.



The first Air Guard F-100 squadron, of eight called to active duty in January, is flying combat missions from Phan Rang Air Base in Vietnam. It's the 140th of Denver, Colo., commanded by Lt. Col. Bob Cherry. The squadron was greeted on its arrival by Gen. William W. Momyer, Seventh AF Commander.

Several other ANG F-100 squadrons are expected to reach Vietnam in coming weeks. Two recalled squadrons, the 121st of the District of Columbia ANG, and the 119th, Atlantic City, N. J., have been assigned, along with DC ANG's 113th Wing headquarters, to Myrtle Beach AFB, S. C., to comprise a TAC replacement training wing. (See "Demolition of a Good Unit," page 134.) All indications are, though, that their pilots will also be assigned to Vietnam tours, either as individuals or through rotation of complete squadrons.



Gen. Carl Spaatz, World War II Air Force combat leader and first USAF Chief of Staff, received the US Air Force Academy's Thomas D. White Award for 1968 "for his outstanding contributions to the national defense (Continued on following page)"



First prototype of the Anglo-French Jaguar twin-engine trainer/strike fighter was rolled out in mid-April and will begin trial flights at Istres, France, this summer. With maximum gross weight of 29,765 pounds, Jaguar can carry up to 10,000 pounds of external stores. Top speed at altitude is Mach 1.7.

—Wide World Photos

Gen. Carl Spaatz, USAF's first Chief of Staff, honored for contributions to military aviation spanning years from earliest days to present, receives USAFA's Thomas D. White Award for 1968 from Lt. Gen. Thomas S. Moorman, Academy Superintendent.



and security of the United States in war and peace." The award, named for the late Gen. Thomas D. White, Chief of Staff from 1961 to 1965, was presented by Lt. Gen. Thomas S. Moorman, Academy Superintendent, during a formal review of the Cadet Wing.

"The service career of General Spaatz, followed by his active participation in Air Force and civic activities, spans the years from the early days of military aviation to the present," the citation read.

General Spaatz commanded US Strategic Air Forces in Europe in World War II until Germany surrendered, then led final strategic operations

against Japan. He was appointed Commanding General of the Army Air Forces in February 1947, succeeding Gen. H. H. Arnold, and when the Air Force became a separate service in September 1947 he was named its first Chief of Staff. Among his activities after retiring from active duty in June 1948, he has been Chairman of the USAF Academy site selection board and the Civil Air Patrol, and President of the Air Force Historical Foundation.

Meanwhile, the 1967 Collier Trophy for "significant achievement in aeronautics" was awarded to Lawrence A. Hyland, vice president and general manager of Hughes Aircraft Co., for

his leadership in NASA's unmanned Surveyor program, which in seven attempts made five successful soft landings on the moon. Hyland, in accepting the trophy from Vice President Hubert H. Humphrey in Washington on May 7, said he did so on behalf of the "tens of thousands" who participated in the project from NASA, Cal Tech's Jet Propulsion Laboratory, and Hughes Aircraft, which developed and built the Surveyor vehicle.



Three aircraft firms have been awarded a three-month extension of design contracts for a short takeoff and landing light intratheater transport (LIT). They are Boeing's Vertol Division, Vought Aeronautics Division of LTV, and McDonnell Douglas Corp. The contracts total \$158,500.

The new studies, according to the AFSC's Aeronautical Systems Division, Wright-Patterson AFB, Ohio, "will seek designs for STOL versions to evaluate and compare with the basic V/STOL designs obtained from the original studies."

In a speech before the AFA Convention in Atlanta, Ga., in April, Air Force Secretary Brown (see page 114) reported that funds are provided in the FY 1969 budget for LIT contract definition.

He explained that the LIT is intended to receive cargo from the Lock-

NEW BOOKS IN BRIEF

Air Transportation 1975 and Beyond: A Systems Approach, ed. by Bernard A. Schriever and William W. Seifert. These summarized results of a recent transportation workshop provide a complete review of present and projected problems of air transportation, and the measures necessary to cope with them. A variety of statistics, charts, and related technical information makes this a valuable guide for the air transport industry. The M.I.T. Press, Cambridge, Mass. 516 pages. \$20.

Can We Win in Vietnam? by Frank Armbruster, Raymond Castil, Herman Kahn, William Pfaff, and Edmund Stillman. Five politico-military analysts debate the possibility of victory—a term they take pains to qualify—in the Vietnamese War. Their scenarios cover a wide range of alternatives between defeat and success to illustrate the courses the war may yet develop. Praeger, N. Y. 427 pages. \$7.95.

Guerillas: A History and Analysis, by Arthur Campbell. A British Army officer's history of guerrilla warfare from the early nineteenth century to the present. More space is devoted to descriptions of physical hardships, often told as personal narrative, than to more detached philosophical analysis. John Day Co., N. Y. 344 pages. \$6.95.

Helicopters and VTOL Aircraft, by John W. R. Taylor. A compact, comprehensive book with photos and descriptions of all vertically operating aircraft, American and

foreign. From midget autogiros to military fighters, the coverage is thorough. A good reference work. Doubleday, N. Y. 93 pages. \$3.95.

The Luftwaffe War Diaries, by Cajus Bekker, translated and edited by Frank Ziegler. A detailed account of the Luftwaffe's war history, gleaned from documents largely inaccessible outside Germany, and from veterans' personal accounts. With appendices and photographs. Doubleday, N. Y. 399 pages. \$7.95.

The New American Commonwealth, by Louis Heren. A noted British newsman undertakes to update the classic outline of America's governmental structure written by Lord Bryce, a nineteenth-century British politician. His chief emphasis is on how presidential powers have expanded as a result of technological and social revolution. A competent and optimistic analysis. Harper & Row, N. Y. 367 pages. \$7.95.

The Ordnance Department: On Beachhead and Battlefront, by Lida Mayo. Publication of this book completes the three volumes covering the Ordnance Department in the continuing and valuable series on the US Army in World War II. Emphasis is on unit organizations and supply problems, from London in 1941 to Okinawa in 1945. Office of the Chief of Military History, US Army, Washington, D. C. 20315. 523 pages. \$5.50.

—MARIA T. ESTEVEZ



For leadership in building Surveyor moon-landing spacecraft, Lawrence A. Hyland, vice president and general manager of Hughes Aircraft, receives 1967 Collier Trophy, presented by Vice President Hubert H. Humphrey.

heed C-5A or C-141A for delivery direct to battlefield units.

"This aircraft, to be available in the 1970s," he said, "will be able to make short takeoffs and landings, and may be capable of vertical takeoffs. We are considering a speed of 350 to 400 knots, and over a 500-nautical-mile range. . . . Its payload may be as much as twenty tons."



The free world's largest experimental communications satellite, designed to provide tactical communications among military units in the field, ships at sea, and aircraft, is being built for AFSC's Space and Missile Systems Organization by Hughes Aircraft Co. in Culver City, Calif.

Scheduled for delivery late this year, the satellite, tall as a two-story house and with a capacity comparable to 10,000 telephone channels, will be the largest and most powerful ever developed, according to Col. Walter W. Sanders, director of SAMSO's Communications Satellite Systems Program Office.

A cluster of antennas will radiate signals capable of being picked up by all types of terminals, including antennas as small as one foot in diameter. This will enable even small Army units in the field to maintain constant communications with their headquarters.

The 1,600-pound satellite will be launched from Cape Kennedy, Fla., by a Titan IIIC space booster and placed in a synchronous orbit 22,300 miles above the equator.

A few such satellites, said Colonel Sanders, placed in orbit above the
(Continued on following page)

BURBANK IS ALIVE AND LIVING IN SOUTHERN CALIFORNIA

There have been some sneery rumors going about that bouncy little old Burbank, Cal., is out of it. Lost.

No way, fellows. She's very much alive. And still pretty glamorous.

You should have been around her the big day last March 29 when news of the biggest commercial aircraft contract yet was announced. It was a champagne day for the lady and a happy, look-forward day.

But also a day for reminiscences.

So Burbank recalled other great days. That time, thirty-four years earlier, when she was younger and a little trimmer, when Lockheed commandeered the "Town Pump" for a beer bash to celebrate the successful flight of the first Electra. And early August, 1945, when she toasted aviation's largest block of commercial orders for one company; 103 Constellations for \$75.5 million.

Yes, Burbank can tell you the whole story, but you ought to read it in detail for yourself, sometime. Two brothers, Allen and Malcolm Loughead (pronounced Lock-head) had some radically designed, fearsome fast plywood airplanes.

When Burbank and Lockheed met, they struck it off right away. There were a couple of tense moments after a harrowing merger and a depression bankruptcy when she almost lost a friend. But Burbank rooted. New people came in and scrapped guttily through all sorts of economic troughs, reaching higher every year. Burbank can spin stories about some of the greats associated with the Lockheed winged star: Northrop, Stearman, Vultee, Varney, Roscoe Turner, Wiley Post, Amelia Earhart, Lindbergh. And the planes: Vega, Sirius, Orion, Electra, Lightning, Shooting Star, Connie.

And, if the occasion is right, she'll reach all the way back to recount, in detail, the uncanny guidance of Robert Gross and the unflagging belief of her friends—Courtland Gross, Cyril Chappallet, Carl Squier, Hall Hibbard, Clarence "Kelly" Johnson—who sweated and nurtured the company from a red brick ranch house to today's two hundred fifty plus passenger L1011 sky lounges.

That great track record gave a place for a lot of other companies to grow. We're one of them. And we'd like to say, congratulations.

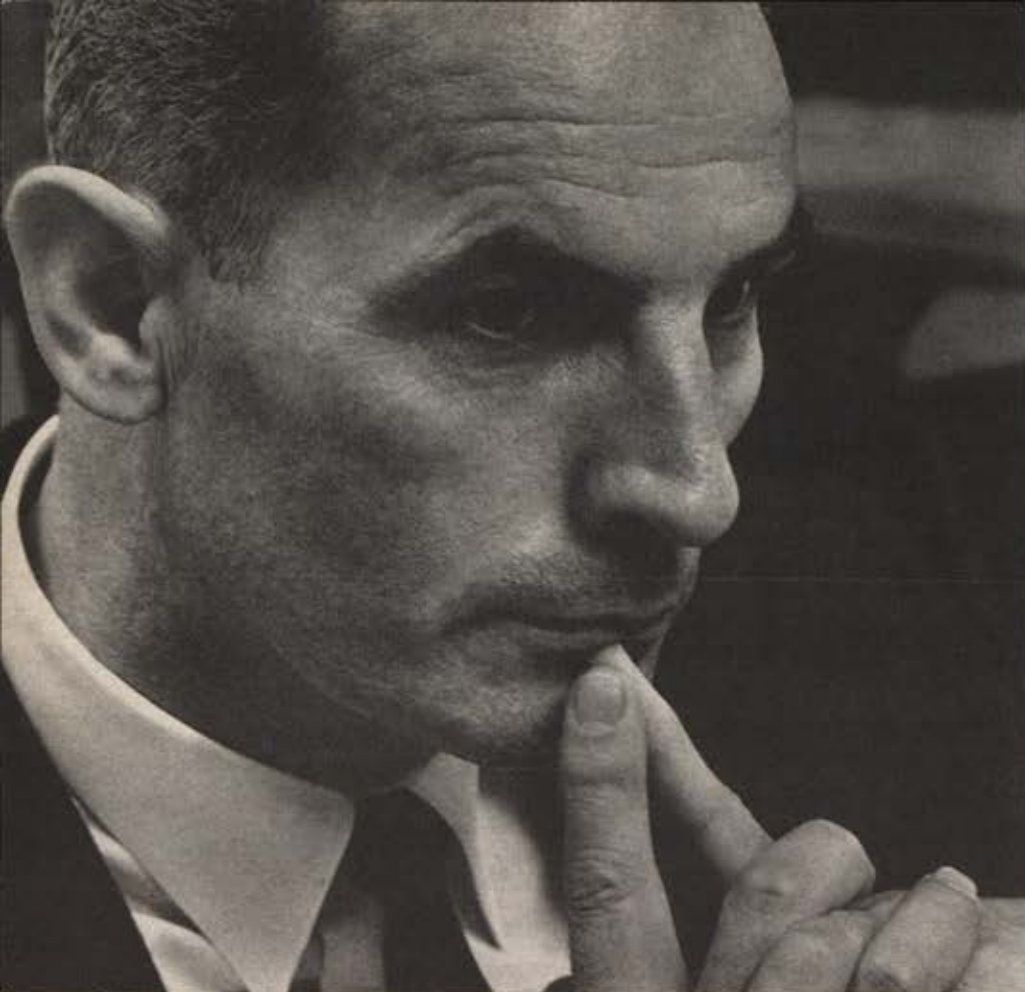
From your neighbors down the street.



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What do you do when your customer tells you: "Give us a low-cost propulsion system that can be throttled in flight"?

You come up with a hybrid propulsion system: the first of its kind designed for operational use. □ The parameters for such a system are complex and challenging: in-flight throttle from 50 to 500 lb thrust; operation in air-launch environment involving ignition at 50,000 feet or higher; ambient temperatures from -65° to $+165^{\circ}$ F; high vibration levels; burn-time of at least 5 minutes; and safe handling in the field. □ Solution? A hybrid rocket propulsion system using a common plastic as the solid fuel, a combination of nitric oxides as the liquid oxidizers, and a simple numerical dial for programming boost and sustain thrusts. □ The proof was the successful series of flight tests under the direction of the Air Force at Eglin AFB. The tests used a modified Beech Aircraft target missile as a test bed. Work is now proceeding at UTC to establish this propulsion system as on-the-shelf hardware for use by the armed forces.

In addition to its leadership in hybrid rockets, UTC has proven capabilities covering the entire spectrum of rocket propulsion technology. This includes such reliable products as Stage Zero for the Titan III-C, and the FW-4 upper-stage solid rocket for the Scout, Thor, and Delta space-launch vehicles.



United Technology Center

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DIVISION OF UNITED AIRCRAFT CORPORATION

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AEROSPACE WORLD

equator, could provide enough channels to link military commands throughout the world.



A major gap in Air Force tactical reconnaissance capability is being filled by a device called TAPIT—tactical photograph image transmission—developed by the Air Force Avionics Laboratory.

TAPIT, contained in a pod mounted under the wing, takes panoramic pictures from low altitudes, develops the film in seven seconds, electronically scans the pictures, and transmits the resulting signals to a ground station. There the signals are recorded on film, producing a copy within another seven seconds.

The US Army's OV-1 Mohawk has for some time been able to transmit pictures electronically to field commanders, but Air Force reconnaissance aircraft have had to land to remove film for processing and printing before its photos could be evaluated, often resulting in a delay of several hours in attacking discovered targets.

The TAPIT design may be similar to that carried in Ranger and Surveyor spacecraft, which transmitted highly detailed pictures of the lunar surface back to earth. The TAPIT instrument pod contains a 35-mm pano-



USAF's 10,000-channel experimental tactical communications satellite in rear dwarfs its predecessors. From front are Syncom, world's first synchronous communications satellite, Early Bird, Intelsat II, and ATS-1.

When Ed Mack Miller interviewed Snoopy, noted WW I aviator, for this magazine's April issue, he said he took on the job not for money, but for Peanuts. Here Snoopy drops in to make sure that AF/SD's payment to Mr. Miller, at right, is in the bag.

—Photo by Pat Coffey



1945, has been elevated to a newly created position as Chairman of the Board and Chief Executive Officer. His successor as president is T. A. Wilson, a former Minuteman program manager and executive vice president since October 1966.

A "Hall of Heroes," inscribed with the names of some 3,300 recipients of the Medal of Honor since the nation's highest decoration was established in 1863, has been dedicated in the Pentagon. The display includes large reproductions of each service's Medal.

The first auction sale of vintage aircraft was to be conducted by New York's Parke Bernet Galleries at Orange County Airport, Santa Ana, Calif., on May 29. The aircraft, once part of a collection formed by Frank Tallman and the late Paul Mantz, mainly for motion pictures, includes a Sopwith Camel, Spad 7, Nieuport 28, and Pfalz D-XIII of World War I, along with replicas of the *Spirit of St. Louis*, a Flying Tiger P-40, and a Grumman F4F Wildcat.—END

ramic camera, a film processor, equipment to convert the film image into electronic signals, and an FM transmitter. Since FM operates on line-of-sight, the system is limited by the altitude of the aircraft, height of re-

ceiving antenna, and intervening obstructions.



NEWS NOTES—William M. Allen, president of Boeing since September

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Western Union uses more computers for communications than anybody.

We first got involved in computers when the government assigned us an impossible job.

To design an information/communications network that would simplify things for the Department of Defense.

Once we'd done that, everything else was easy.

Today, Western Union maintains computers in 22 separate centers across the country and around the world.

Our computers are programmed almost entirely for message switching.

Which means not only do they accept and route messages, but they store messages for receiving stations that are busy, then forward them on.

Many of them also handle code conversion: translating punch cards in New York, for instance, into mag tape, punch tape, or hard copy in Los Angeles.

And if an error has occurred in transmission, the computer will automatically check with the sender to correct it.

Our computers are so good they even make studies and analyses of how well they're doing their job.

If they discover that the flow of messages is greater than they can comfortably handle,

or are not being handled in the most efficient way, they let us know.

And our programmers make the necessary adjustments.

Besides the system we set up for the Department of Defense, there's the private network we designed, built, and maintain for GSA—which serves more than 35 Federal civil agencies.

Plus Classified Projects (which we'd love to talk about, if only they weren't classified).

The computers in all these systems must not only handle all the functions we've described above, but must also be able to switch messages on a priority basis.

And, more importantly, many of them are specially coded to maintain the highest security regulations.

The computers know, automatically, which stations receive which kinds of information. And which don't.

The greatest advantage of Western Union's computers and computerized systems, is that they make impossible communications jobs so possible.

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SPACE

DIGEST

VOLUME 11, NUMBER 6

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JUNE 1968

Ninth Annual Missile and Space Almanac

AIR FORCE/SPACE DIGEST, continuing a tradition now nearly a decade old, proudly presents its Ninth Annual Missile and Space Almanac. We are confident that the information contained in this year's edition will be of lasting use to all our readers.

When the Space Age opened in 1957, there was no way of predicting that not many years later our country would be facing severe tests in a jungle war thousands of miles from home in which foot-slogging infantry would be supported by airpower and seapower used with all the ingenuity and flexibility American planners can muster. Nor could it have been foreseen then that space technology, in such forms as communications satellites and weather-watchers, would be the vital tools they have proved to be in this difficult conflict. Nor could it have been predicted then that now we would be charting third and fourth generations of the strategic missiles that have come to form such a major portion of our shield against general war.

Thousands of Americans, in and out of uniform, have contributed to the aerospace and defense technology that has kept us the strongest power in the world, and the main defender of freedom on our planet. To all of them, this Ninth Annual Missile and Space Almanac is respectfully dedicated.

—THE EDITORS

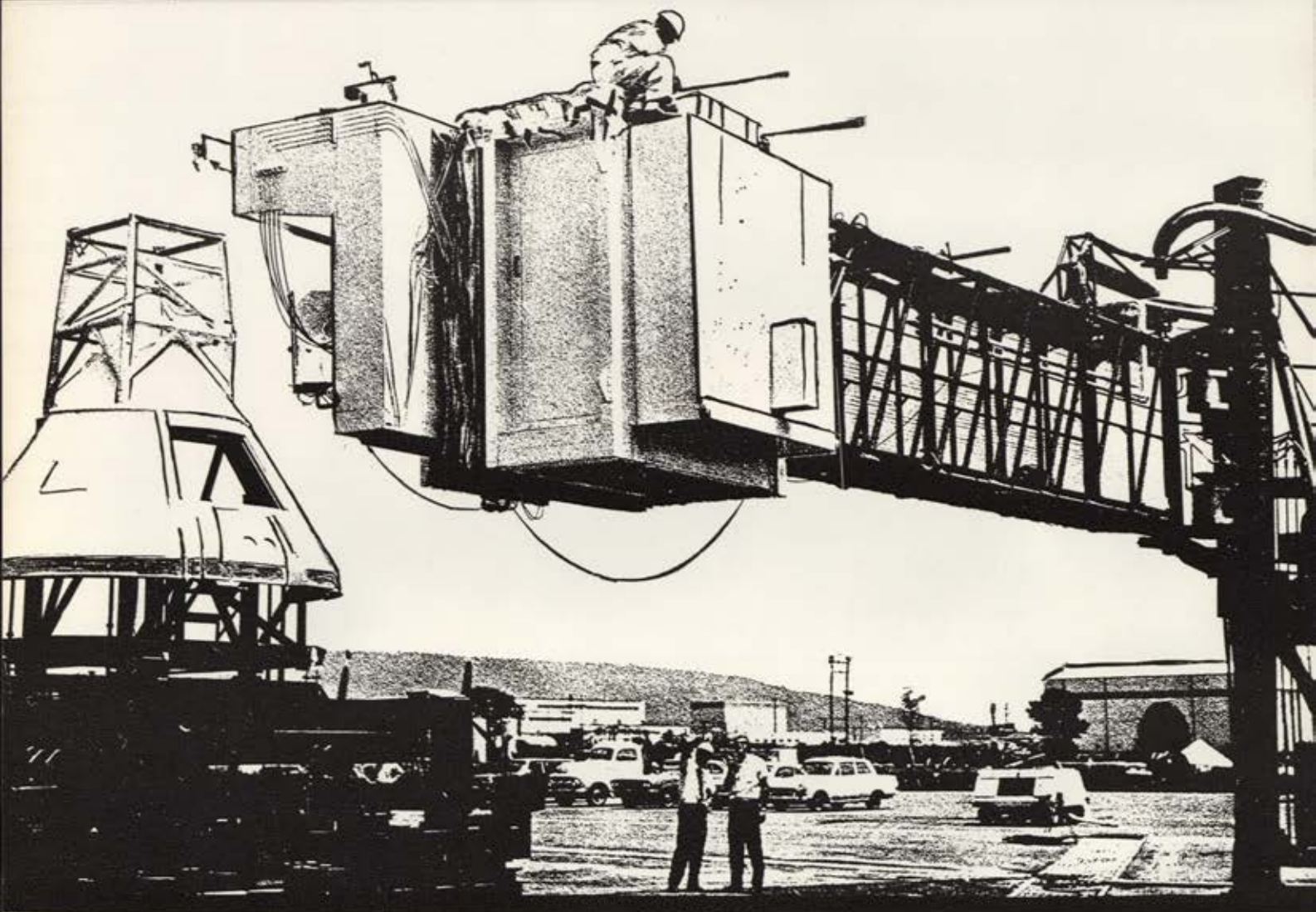
Arms for Apollo

Astronauts will use this access arm to reach their Apollo spacecraft 320 feet up atop the Saturn V rocket. Here it is being tested at NASA-Marshall Space Flight Center at Huntsville, Alabama, with instrumentation and data acquisition systems engineering and maintenance being done by Vitro Services. Nine such arms, or umbilicals, are connected to the Apollo/Saturn V to provide power and communications during the long countdown. They are undergoing extensive testing here before shipment to the NASA-Kennedy Space Center.

Here at Huntsville, and at Eglin, Goddard, White Sands, and Guantanamo, Vitro engineers and technicians provide objective test support. Their responsibilities range from the acquisition of test data on aerospace and military systems to the management, operations and maintenance of facilities and instrumentation. And, because Vitro will not furnish production hardware on projects where we have support responsibilities, we can provide these services with arm's length objectivity. Vitro Services, Industrial Park, Fort Walton Beach, Florida 32548.

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**TEST
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Attacks on the basic assumptions of national defense—a progressive military and continued technological development—are becoming almost hysterical. Charges of lack of integrity in the “industrial/military” complex have already taken their toll, silencing “Young Turks” who may have new ideas, and encouraging the rigid status quo. To renew public faith, an outside group of prestigious advisers is needed to review US military/technical policy. The military might be well advised to put out a sign reading . . .

AIR FORCE

JUNE, 1968

HELP WANTED:

Young Turks and Elder Statesmen

BY J. S. BUTZ, JR.

TECHNICAL EDITOR, AIR FORCE/SPACE DIGEST

IT IS time to consider the need for a new von Neumann Committee, a prestigious board of visitors to look over US military/technical policy.

Over-all, the need for outside review is as urgent as it was in 1953 when the von Neumann group, then known as the “Teapot Committee,” was called in to examine US ballistic missile policy.

Today’s technical questions are not as clear cut and specific as in 1953. There is no revolutionary new weapon close at hand, such as the ICBM, which could tip the balance of power. But the potential for technological change, and a shifting of the balance, remains just as real as it was fifteen years ago.

The new problem is the bitter fact that the very purpose of national defense is being attacked. Not questioned, attacked.

No longer is the maintenance of progressive, forward-looking US armed forces widely regarded as a necessity for the future, as a means of preserving peace while the world works toward a better life through negotiation and economic expansion. Constructive criticism has gone out the window. The emphasis has shifted to almost hysterical warnings that our greatest danger lies in the “industrial/military complex” with its “plots” and its endless “pressures” for more and bigger weapons.

A basic part of this new climate is the theory which holds that man has created the ultimate weapon, *i.e.*, the current versions of the ICBM, which no nation will ever be able to counter. By this reasoning any suggestion of further armaments is specious and self-serving. The idea has become so popular that the men and organizations involved in national defense now

are facing one of the vaguest, and consequently the most insidious, scare campaigns ever directed against any element of our society.

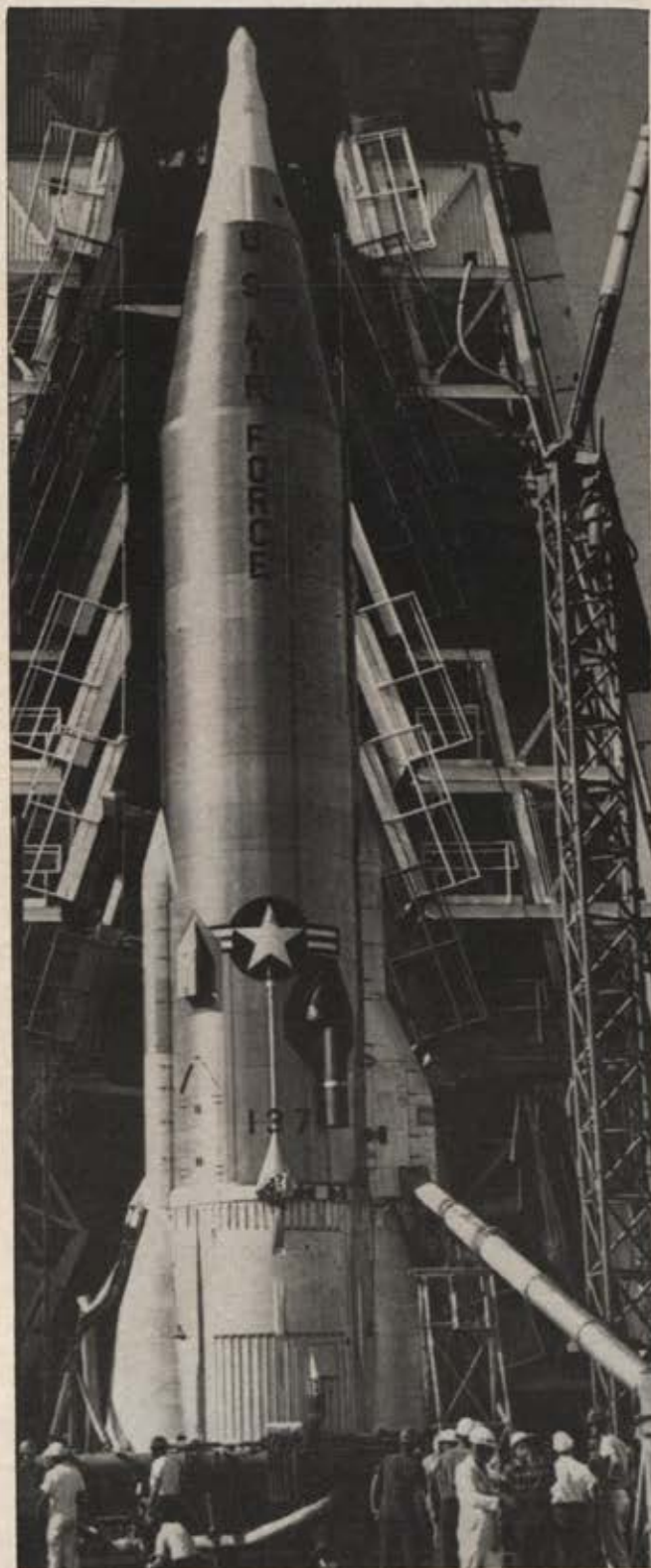
Ironically, the argument that the military establishment does not have the integrity to put the national interest first comes from inside, as well as outside, the Pentagon. Robert S. McNamara, the recently resigned Secretary of Defense, disassociated himself from most of his colleagues last fall when he announced the “thin” missile defense. He left the strongest impression that the US was precipitating an arms race in deploying this weapon, that he had been pushed into okaying it, and that he was unalterably opposed to a stronger system.

Dr. Jerome B. Wiesner, now Provost of the Massachusetts Institute of Technology, a long-time adviser to the White House and DoD, and a member of the original von Neumann Committee, wrote in *Look* that “a real defense against the nuclear-armed missile is a mirage.” He also claimed, “The word in Washington is that President Johnson was forced to bend under the pressure of the military, congressional, and industrial sponsors of the antiballistic missile system,” whereas Presidents Eisenhower and Kennedy had resisted them.

Taking another tack, Vice Adm. Hyman G. Rickover, father of the nuclear submarine, recently warned Congress about what he called the “fourth branch of government,” a partnership between Washington bureaucrats and giant corporations which exerts “power without political responsibility.” He claims that contracting procedures are so lax that real profits from doing defense business are at least twice those stated

(Continued on following page)

by DoD, and that the government consequently is subsidizing the civilian business of defense contractors. Admiral Rickover also consistently reports that DoD is too easy in the technical standards it imposes on industry, and that industry in many cases is not doing its job as specified.



Ballistic missiles have the most rapid obsolescence rate of any major weapon in history. First-generation Atlas (above) entered service about ten years ago, has now been retired. We are already working on third-generation missiles.

The Captive Government?

Dr. Ralph Lapp, in his new book *The Weapons Culture*, claims that the federal government is the captive of the aerospace industry. He suggests that the Cuban missile crisis was a natural outcome of the arms race, and that President Kennedy managed its timing to influence the 1962 congressional elections. Dr. Lapp also alleges the F-111 contract was let as a political payoff for campaign contributions, and that the defense budget has become the nation's biggest "pork barrel" and source of patronage.

Richard J. Barnet of the Institute for Policy Studies, Washington, D. C., reviewing *The Weapons Culture for Science*, contends that Dr. Lapp did not go far enough. He says that "military power is less and less relevant to the real threats to national security in a world undergoing political revolution. . . . The plain truth is that after spending \$1,300 billion since 1945 on national defense, the Pentagon cannot prevent the nuclear annihilation of the United States." Mr. Barnet holds that the electorate must reject "the very assumptions of the arms race" and must recognize the "great bureaucracies that feed on the defense budget . . . for what they are: a threat to the national security."

Obviously the forces at work inside the technical revolution have become as divisive as those of the social revolution now shaking the United States. The defense establishment and its purposes have never been under more serious fire. Disenchantment inside the establishment has become rampant during the 1960s.

The degree to which US military efficacy has been eroded is open to question, but one point is incontestable. The electorate and the military establishment are not prepared for a period of great innovation. If the technical revolution continues unabated for the next twenty years, many new weapon systems must be acquired in the 1970s and 1980s. So many, in fact, that the 1950s and 1960s will be remembered as a period of relative stability.

Unless there is a shift away from the present *status quo* climate inside the defense establishment, there is great doubt that the United States can remain a first-class power. It is inconceivable that US technology of the late 1960s can be a match for Soviet technology of the 1980s. The establishment must be prepared for change; it must encourage innovation.

Change also demands a healthy support from the

John von Neumann (right) headed the "Teapot Committee" in 1953, which played a vital role in President Eisenhower's decision to launch the US into a crash development program for intercontinental missiles.



electorate. If each new weapon is represented as part of a vast military/industrial plot, the whole system will come crashing down sooner or later. No power structure can withstand an endless attack on its integrity.

A new von Neumann Committee appears to be the only feasible mechanism for rebuilding public faith in the defense establishment and for laying a proper foundation for the 1970s and 1980s. The character of this new review board would have to be closely allied to that of the group that Professor John von Neumann of the Institute for Advanced Studies was selected to head in 1953 for a review of the US effort on ICBM development.

The original von Neumann Committee was composed of men of such stature in science and industry that their collective opinion could not be discounted in any circle. They were: Professor Clark B. Millikan; Professor Charles C. Lauritsen; Professor Jerome B. Wiesner; Dr. Louis G. Dunn; Dr. Hendrik W. Bode; Allen E. Puckett; Dr. George B. Kistiakowsky; Dr. Simon Ramo; Dr. Dean E. Wooldridge; and Lawrence A. Hyland.

Most important, perhaps, is to find another leader with the qualities of Dr. von Neumann, who died in 1957. He was twice blessed, with intellectual brilliance and with a personality that could bring harmony to a group of men holding the most diverse views, a talent which is as rare in science as in politics. John von Neumann was a towering figure in every respect.

In any event, the members of a new policy review committee must bring to the job the finest technical credentials and the highest reputations for objectivity.

Hopefully, the conclusions of the new committee would carry the weight of the original von Neumann group, for no other group has gotten the attention of government quite so effectively. Essentially, they told the Eisenhower Administration that its program for ballistic missile development was too haphazard, too slow, and too small. They said the basic ICBM technology was at hand in Russia as well as the United States, and judged that this nation would be in mortal danger if we didn't put the technology to use. President Eisenhower accepted their judgment and completely reversed his Administration's earlier policy.

Two Questions for 1968

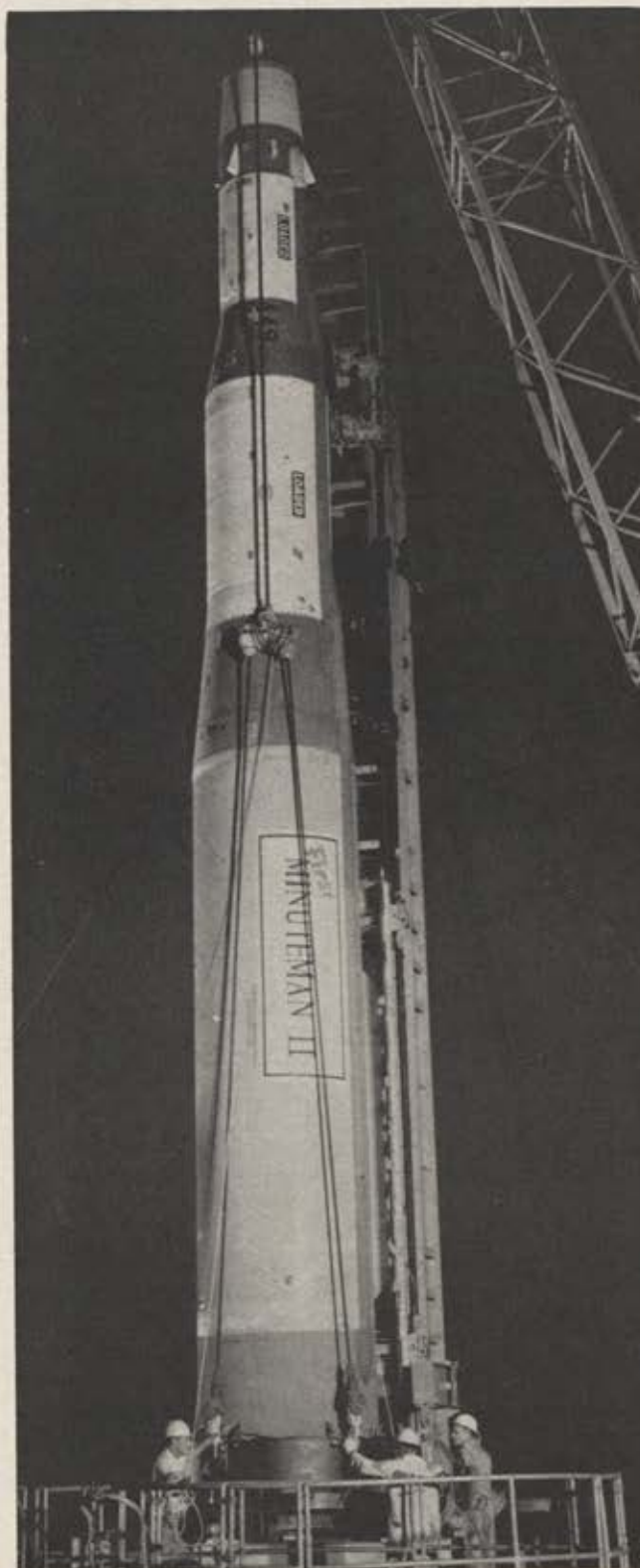
Two questions would confront the new policy review committee. The first concerns a general estimate of the technical revolution, its pace and scope. "Does the United States have any choice in building new strategic weapon systems in the 1970s and 1980s?" Or, "Is it possible safely to slow down technical development and rely ever more heavily on the ICBMs now in hand?"

The second question concerns the antiballistic missile (ABM) and largely centers on the advice of many of the most vocal senior scientists, among them Drs. Wiesner and Herbert York (former Director of Defense Research and Engineering). They contend it is the wildest folly even to think of a viable missile defense.

Still, there is enough pressure from the opposite side to call for a close review. The question must be asked, "Is the technology in hand, or in sight, to construct a

missile defense which could stop a very high percentage of warheads in a sophisticated barrage-type ICBM attack?"

The most compelling reason for posing such a question to such a committee is that Dr. John S. Foster, *(Continued on following page)*



Minuteman II (above) is third-generation ICBM, now entering service. Minuteman III is in development. Technology is moving so rapidly that silo-based missiles will have to be replaced in 10 to 20 years, probably by a mobile system.

John Foster, top DoD scientist, says the \$500 million or so spent annually on antimissile research is moving the technology ahead rapidly. He would "welcome" a "von Neumann-type" group to review this complex technology.



present Director of Defense Research and Engineering, thinks it would be a good idea. In a recent discussion with the writer he said, "When the US pours half a billion dollars a year into research on a given subject, something is bound to happen." He added that the money is not being wasted and that ABM technology is moving at a fast pace. According to Dr. Foster, anyone who is not familiar with the new information generated in the past six months is far out of touch with the program. "I would welcome a von Neumann-type review of the program," he said. It is pertinent to note that Dr. Foster believes the remainder of the defense technology program is on solid ground, and he doesn't think a committee is needed to look over his shoulder on any other major question.

Does the US Have a Choice?

Several purposes would be served if an independent answer were available to the question, "Does the United States have any choice about building new strategic weapon systems in the 1970s and 1980s?" The answer would not please everyone. No single committee could achieve this regardless of its credentials. But if one may be allowed a guess, it is probable that the committee would come up with a pretty sound, balanced position.

A balanced report could not ignore the fact that most men of science and industry understand fully that we are caught up in a technical revolution of immense proportions. The flood of new technology cannot be stopped. This is one of the central facts of our time.

In the military sense, then, a nation has two options. One, it can work hard to stay on the crest of this technical flood and maintain modern armaments. Two, it can work with other major powers for agreements to refrain from using advanced technology militarily, and for eventual disarmament. The United States has the resources and the inclination to follow both courses. Although it might be argued that the nation has put more energy into the first course, the US record on arms control and disarmament attempts is excellent.

A balanced report would have to illuminate the fact that a nation commits itself to unilateral disarmament

if it does not modernize its weapons while other powers are doing so. History reveals this truth, in that it is obvious that an air force of 1945 would have been hopelessly outclassed by one of 1955. The mismatch, without doubt, would have been sufficient to attract an aggressor nation. Similarly, a jet-powered air force of 1955 would have been helpless against aircraft/missile forces that existed in 1965.

Fortunately, no US administration to date has failed to be impressed by this situation. Certainly, Mr. McNamara during his record tour in the Pentagon stressed his intention to keep US forces in first-class technical shape. Even though many observers believe he did not do enough, technical change came more rapidly in the McNamara era than in any other.

A good example is ballistic missiles, which appear to have the shortest useful life of any major weapon system in history. The ICBM has been operational for about ten years, yet the first generation has been retired, the second generation is being replaced by the third, and the fourth is well along in its development and will be in service soon. Most of this change was directed by Mr. McNamara because he felt that technical advances left him no alternative.

Now a crucial point has been reached in military thinking, because the policy of staying abreast of technology is under attack. Ironically, Mr. McNamara is contributing to the attack.

Is Nuclear Superiority Possible?

The idea causing trouble is that it is impossible to achieve nuclear superiority. Some scientists inside and outside the defense establishment have stressed this idea for several years. They contend that the US and the USSR could obliterate each other in any nuclear war and that no amount of effort in developing new offensive or defensive systems could change this fact. According to this idea, no conceivable technical development could change the stalemate.

Mr. McNamara made his support of this concept clear during his last years as Defense Secretary. Now, as one of the first projects following his departure from the Pentagon, he is planning to write a book on the impossibility of achieving nuclear superiority and the absolute necessity for achieving nuclear disarmament.

Early reports on this book indicate that it will not clear up two popular misconceptions that have fallen out of this idea of the impossibility of nuclear superiority.

The first misconception is that nuclear parity has become a fact and will remain a fact, and that a nation will not have to expend substantial resources to stay abreast of strategic technology in the future. Somehow many people have come to believe that today's weapons will be adequate for the foreseeable future.

But this would be true only if the Soviets and all other nations stuck with their present weapons. Our 1970-model fourth-generation weapons could not, by any stretch of the imagination, be a match for the nth generation of Russian weapons in 1985 or so. Future administrations would no more accept that situation than Mr. McNamara would have called a halt to ICBM development in 1961, leaving the US with the first-generation Atlas above ground, while the Soviets had



—Wide World Photos

Gen. B. A. Schriever (above, talking to congressional leaders) was a "Young Turk" of the early 1950s who helped move USAF into ballistic missile development. He believes present DoD leaders err in not encouraging similar groups.

the option of going to Minuteman-type weapons in silos. No one knows exactly how strategic missiles will change, or what technology will bring, but few would want to wait for the Soviets to show us. (See particularly General McConnell's comments in the article beginning on page 121.)

The second misconception is that all are villains who propose pushing ahead with technology to attempt nuclear superiority and guarantee nuclear parity. In the popular caricature, men of this persuasion have become the archetypes of the military/industrial complex who would perpetuate the arms race and risk nuclear holocaust, all for some self-serving purpose.

A balanced report should relieve national confusion about strategic planning choices. At the very least, it should make it clear that nuclear parity will not be a fact unless Soviet Russia and all other nations join the US in renouncing the use of advanced technology.

The report undoubtedly would go back over the basics of maintaining nuclear parity. It cannot be an on/off effort. It is a long-term affair requiring highly educated, highly motivated men in science, industry, and the military. Over the years the quality of these groups is not going to hold up unless they receive substantial public support. They cannot bear full blame for all the surprises of the technical revolution, or the continuation of the arms race, or the failure of disarmament.

Perhaps the committee will even be able to report that, over-all, the military/industrial complex actually has a good record in the responsible use of its power and in subordinating its own interests to the national interest.

In any event the committee would have much ground to cover if the public's education on the technical revolution problems of the next decades is to be complete. Lead times of six to ten years must be discussed. A clarification must be given of the three necessary steps in technical developments of all types, *i.e.*, basic research, exploratory development or operation of prototype hardware, and development of complete systems.

The clarification undoubtedly would involve a discussion similar to Dr. Foster's congressional testimony this year in which he said the US exploratory develop-

ment program had been effectively cut in half during the mid-1960s while the Soviets had enlarged their program. He emphasized that the US program must be put back in balance, because the orderly development of new weapon systems could not be accomplished without continuous basic research and prototype programs to build a strong foundation of engineering data.

Whatever administration takes over the federal government in 1969 could reap big benefits from an independent balanced report. Hopefully, this report could add to public understanding of the problems ahead in the technical revolution in the way that the Kerner Report illuminated the social revolution. Neglect of either of these phenomena certainly could bring the nation to disaster in the decades ahead.

No 'Young Turks'

If the report could bring an expressed commitment to necessary military change from the new administration, it undoubtedly would bring a new spirit to the Pentagon. The current atmosphere, according to most military men, is hard for the *status quo*. Present conditions were reflected in the response of Gen. Bernard A. Schriever, recently retired Chief of the AF Systems Command, to this writer's question, "Why doesn't the military have any 'Young Turks' anymore, similar to the group you were in during the early 1950s?"

"First of all," General Schriever answered, "I believe every organization needs Young Turks, young men with new ideas, who question the existing system and are trying to bring constructive change. The point is that no organization, especially a military organization, has Young Turks unless the leaders want them. It is too easy to squelch the junior men.

"In the late 1940s and early 1950s, the leaders of the Air Force considered Young Turks to be necessary. We had plenty of opportunity to present our ideas. Sometimes it took years to sell them, and sometimes they never sold, but we were at least listened to.

"You ask where are the Young Turks today? Well, I believe there are some, but they just don't have the opportunity to speak that they did ten or fifteen years ago. The whole system has become too centralized, and a young officer is much more concerned today about speaking out."

As the new administration creates its climate for the 1970s it probably should take note of the current French view as reflected in a statement by Gen. Pierre Gallois, a prominent defense adviser to President Charles de Gaulle. General Gallois said, "A technological war involving the advanced industrial states has replaced the cold war. . . . In this new confrontation the most effective scientific and technological efforts are the surest guarantors of independent existence. It is not only imperative that the American people place this task in the front range of their pre-occupations, but they must concede that other states, beginning with their friends, may do so as well."

The starting point in creating the necessary national policy is to understand that there is one sure way for one nation to achieve nuclear superiority. That is for the other nations to opt out and neglect their technology for a decade or so.—END

The "instant missile" that is Minuteman has in a decade changed the face of deterrence. But what now seems so simple a weapon system was not always so. Minuteman's story is a chronicle of a brilliant concept that had to be fought for and a saga, too, of daring management . . .

MINUTEMAN

An Idea Whose Time Came—In Time

BY WILLIAM LEAVITT

SENIOR EDITOR/SCIENCE AND EDUCATION

TEN years ago, on February 27, 1958, to be exact, the Department of Defense gave its approval to Air Force development of the world's first solid-fueled intercontinental ballistic missile, the silo-sheathed three-stage space bullet called Minuteman.

It was a momentous decision that changed the face of deterrence. It made possible the mass production and deployment in record time of a new species of weapon system that has since grown to an array of 1,000 "instant ICBMs" standing guard against potential aggressors. It marked the opening of a decade that has seen Air Force development of not only first and second generations of the Minuteman—350 Minuteman IIs are already on station—but also current work on a third generation of Minuteman as well as assessment of a possible *fourth* generation tailored for the strategic needs of the 1970s and perhaps beyond (see "What's Ahead for US Deterrent Forces," page 52).

Thus what started out as a revolutionary development in missilery—the taming of volatile and hard-to-handle solid fuels to power in a controlled and reliable manner a fleet of thermonuclear missiles—has evolved into the preferred strategic weapon system of the 1960s, the 1970s, and perhaps even the 1980s.

Minuteman as a weapon system is an eloquent example of the execution of an idea whose time had come. But what looks so simple now did not always seem so. In the early 1950s, after the establishment of then-Brig. Gen. Bernard A. Schriever's Western Development Division of the old Air Research and Development Command and the commitment to an Air Force crash program to develop the liquid-fueled Atlas and Titan ICBMs, the idea of using solid fuels to power ICBMs seemed far in the future—for a host of technical reasons ranging from insufficient thrust to great difficulty in controlling the burning rate of the self-igniting chemical cakes. Not that liquid fuels were by any means ideal—they required plumber's nightmares of piping, large crews, and the kind of tender care

more appropriate to laboratory equipment than to operational weapon systems. It was rather a question of choosing between the lesser of two technical evils in that Neanderthal period of missile development.

This is not to say that there were not, even then, strong proponents of well-funded research and development programs to overcome the problems associated with solid fuels.

The solid-fuel advocates of the period, those who wanted to make a strong effort to develop solid-fuel technology to a level of reliability that would allow its use in long-range missiles, had to press their cause in much the same way that others earlier had had to fight for the liquid-fueled rocket. They were calling for more attention to the potential of solids at a time when the crash program to develop the liquid-fueled Atlases, Thors, and Titans were themselves young and newly blessed with hard-earned top priorities. To campaign for an even newer, and in the view of many experts a chancier, approach, was a very sporty course. But the course was run and the final outcome was success. Although there is here and there in the missile community some latter-day sense of recrimination over who advocated or opposed what and when, the ending was a happy one in that Minuteman arrived on the operational scene in time to succeed its liquid-fueled predecessors.

A large cadre of industrial and military planners combined their talents to get Minuteman going once the Defense Department bought the idea of an Air Force solid-fueled ICBM system. But if there is a conceptual father of Minuteman, in the sense that, long before the program drew its first developmental breath, he was in the forefront of the campaign for solids, he is Edward N. Hall. Hall not only advocated solid research but also, when the time was ripe, contributed heavily to the original design concept for Minuteman.

In the early 1950s, Hall was a lieutenant colonel and top propulsion specialist on General Schriever's WDD staff at Inglewood, Calif. Ed Hall was and is an



Minuteman shows its stuff in a salvo launch from Vandenberg AFB, Calif. One of the major advances associated with the Minuteman program was the ability to fire such salvos from a single control center, enhancing retaliatory power.

outspoken and persistent advocate of technical causes in which he believes. Today he holds a major technology post with United Aircraft at Hartford, Conn. In the WDD days, he spent a good deal of time, with the backing of a few other technologists in the youthful missile-development business, pushing for the investment of time, money, and talent in solid-fuel research programs. He wanted industrial participation so that test-beds could be set up for a vigorous attack on the instability and other problems that then plagued solids. Although he and those who agreed with him were able to spark some small and low-priority industrial experimental efforts, which were monitored out of Wright-Patterson AFB, Ohio, it was really not until 1957—the year of Sputnik—that the campaign for solids really began to pay off.

By then, events all along the weapon-development front were beginning to converge, making the time ripe for the birth of Minuteman. By then Atlas and Titan and Thor liquid-fueled missiles, although still plagued by problems, were on the road to development, and the Air Force was able to draw its breath long enough to start thinking about a "second-generation ICBM."

At the same time, the Navy, in its search for a viable strategic-missile role, was talking about the possibility of mounting a seaborne version of the Army's Jupiter liquid-fueled IRBM on submarines. The idea was impractical, really a kind of holding action until the Navy could think of something better. Something better was, of course, the solid-fueled Polaris. The Navy, in the

process of developing the Polaris, was able to use a good deal of the solid-fuel data that the Air Force had developed in the small research programs Ed Hall and his allies—including Adolph Thiel and Barnett Adelman of the Ramo-Wooldridge organization then serving WDD—had been able to get going earlier.

In any case, 1957 was the crucial year in the prehistory of the Minuteman. With Atlas and Titan and Thor under way, the second-generation missile requirement loomed larger in the Air Force. Ed Hall, who even during a tour as Thor IRBM program chief, when he was busy shuttling back and forth from England in preparation for deployment of the Thors to the United Kingdom, had continued his interest in solids. He completed his Thor tour in 1957 and was back at Inglewood with an assignment from General Schriever to look at the second-generation problem. The Minuteman concept developed out of the studies by Hall and the group that eventually gathered around him. The study was called Project Q. But so far as Hall was concerned it was no study but a real-life design of a weapon system per se. Ideas piled up: the concept of missiles standing unattended for long periods; small crews; putting missiles in protected holes out of which they would be fired directly; automatic checkout of missile conditions with "black boxes" of transducers in a manner modeled on techniques used in the semi-automated oil refinery business; launching several missiles under the control of a single command center. The ideas were, for their time, truly revolutionary.

As the Project Q ideas ripened, so did the Air Force missilemen's enthusiasm for a second-generation missile program and the commitment of funds to finance it. The campaign within the Pentagon for approval of a new program proceeded through the maze of briefings that usually attend such efforts. At about the same time, there were in the Pentagon hopper some suggestions that the Air Force use a land-based version of the Polaris that the Navy was by then developing. Project Q had evolved into a set of concepts for three missile systems: an ICBM called Sentinel, an intermediate-range ballistic missile that would be called Minuteman, and a tactical short-range missile named Scout. The surviving idea was the solid-fueled ICBM, and the surviving name, which struck General Schriever's fancy as ideal for a continental-based US instant weapon system, was Minuteman.

General Schriever, his deputy, then-Col. Charles
(Continued on following page)



Edward N. Hall, propulsion expert on General Schriever's staff in the 1950s and now with United Aircraft, is credited as "Father of the Minuteman." He fought for solid-fuel research and developed original conceptual design for what became the Minuteman.

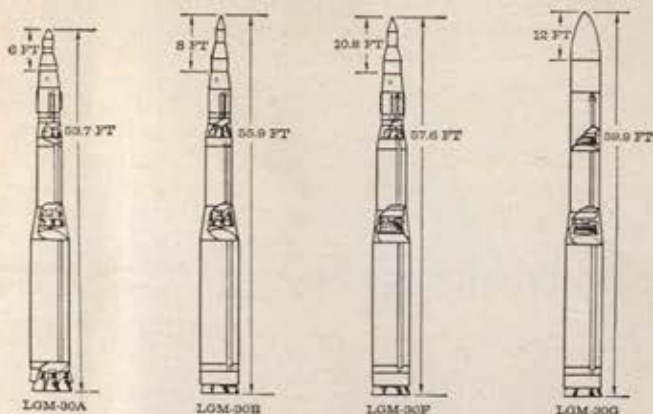
First director of the Minuteman program and major contributor to both the sales campaign for the system in the Pentagon and the plan for R&D was now-Maj. Gen. Otto Glasser, in the 1950s a top assistant to General Schriever.



Terhune (now Lieutenant General Terhune and Vice Commander of the Air Force Systems Command), Hall, and others worked their way through the Pentagon in advocacy of the Minuteman concept. They got the support of Air Force leadership, including strong acceptance from USAF's Vice Chief of Staff, Gen. Curtis LeMay, the Air Force civilian secretariat, and finally, the Defense Secretary, Neil McElroy.

By early 1958, the Defense Department was willing to invest \$50 million in Fiscal Year 1959 for Minuteman research and development. This was scarcely as much as General Schriever had asked for to prove the Minuteman case. But it was an important commitment. There was still a campaign ahead for more money and top priority. It took time to convince skeptics in the labyrinth of committees that examined the Minuteman concept. That struggle took until September 1959. By then, Otto Glasser, at that time a colonel on Schriever's Inglewood staff, had been named first director of the Minuteman program. Today he is a major general and Assistant DCS/Research and Development, Hq. USAF. Ed Hall meanwhile had been assigned to a missile-development post with NATO. He was able to leave for Europe with the knowledge that what had grown out of Project Q would see the light of day.

By then, too, Boeing, which had done an enormous amount of homework for its bid to work on Minuteman, had been approved as assembly and test contractor for the new system—a role that grew by 1960 to designation as integrating contractor for installation and checkout of Minuteman at operational facilities.



Minuteman family portrait—from left, Minuteman I, the original system; Modified Minuteman I, the "B" model, with improved performance; Minuteman II, with new second-stage engine, improved guidance; developing III.

MINUTEMAN AT A GLANCE

Mission: Strategic intercontinental ballistic missile.

Using Command: Strategic Air Command (SAC).

Development Command: Air Force Systems Command (AFSC), Space and Missile Systems Organization (SAMSO).

Principal Contractors: (see also "Missile and Space Gallery," page 75):

Boeing (systems integration, installation, checkout);
TRW Systems (systems engineering and technical direction);
Thiokol, Aerojet-General, Hercules (propulsion);
Autonetics Div., North American Rockwell (guidance);
Avco, General Electric (reentry vehicle).

Performance: (see complete listing for Minuteman, page 75).

As the Minuteman program was laid down, other contractors were chosen (see "Minuteman at a Glance" box). Boeing's Minuteman boss was T. A. Wilson, who was recently named president of the company. Not long ago he looked back on the Boeing Minuteman role, which has now extended to a decade, remarking that "contrary to some of the popular conceptions [top management] . . . had to work on a surprisingly low level of detail.

"We managed by exception," he said, "[and] we look back with intense pride at our part in fielding the Minuteman system. If you look at it from the standpoint of cost-effectiveness, it's a matter of dollars invested to maintain the peace." An interesting historical aside: During the Air Force's Minuteman Pentagon sales campaign, the phrase "cost-effectiveness" was heavily, and justifiably, used, long before the days of Mr. McNamara's whiz-kids.

Once Minuteman was approved, the pressure was on at General Schriever's missile shop in California. Schedules called for test flights by late 1960 and an operational weapon system in 1963. Such requirements were a good deal to ask for. But by 1959, even more was asked for: an acceleration of the program so that some operational Minutemen could be on station a year earlier, in 1962. Glasser, as interim project head, had devised a plan that stressed heavy use of the Air Force concurrency concept as well as the willingness



Maj. Gen. Samuel C. Phillips, who, as a colonel, managed the Minuteman program through development to operational status, overcame staggering problems and made the accelerated deadline. Today he is running the Apollo moon-landing program.

to accept some design/performance compromises for the earliest batch of missiles. Having fulfilled his interim task, he was succeeded as Minuteman chief by a young Air Force research and development colonel named Samuel C. Phillips. Phillips was destined to direct, not too many years later, the NASA Apollo moon-landing program. He is today an Air Force major general and at one time was the youngest general officer in the Air Force. He earned his first star during his Minuteman stint.

There was a fantastic array of management and tech-

nical problems facing Colonel Phillips as he took over the Minuteman job. They ranged from the need to maintain continued support of the program in Washington (those were the prejet days of the overnight "red-eye" piston-plane shuttles to Washington, D. C., from California) to working out the designs for the sites. They included negotiations with the Atomic Energy Commission for handling and provision of the nuclear warheads, and arranging the all-important structure of the industrial team that would be building

(Continued on following page)

MINUTEMAN MILESTONES

1955		December 11	Malmstrom AFB, Mont., becomes the first Minuteman operational base with the turnover to SAC of the first two flights.
December	Western Development Division, ARDC, starts solid-propellant research program.	1963	
1957		February 28	First operational Minuteman I squadron is transferred to SAC (Malmstrom).
April 1	ARDC assigns to WDD responsibility for planning and eventual management of a solid-propellant ICBM program.	December 31	By this date, 350 Minuteman launchers are available to SAC (first two Minuteman I wings and five flights of the third wing).
1958		1964	
February 10	OSD approves Minuteman as "second-generation" ICBM.	February 24	First "ripple" launch (two Minuteman Is) from Vandenberg.
February 27	Air Force is authorized to proceed with Minuteman development.	September 24	First launch of prototype Minuteman II.
October 9	Boeing Airplane Co. is approved as assembly and test contractor for Minuteman.	December 31	By this date, 700 Minuteman missiles and silos have been turned over to SAC.
1959		1965	
September 4	Highest national priority is assigned to Minuteman.	August 18	Successful first launch of operationally configured Minuteman II (LGM-30F) from Vandenberg AFB.
September 15	Minuteman is fired in tethered test from underground silo at Edwards AFB, Calif.	August 24	Launch of Minuteman I from Vandenberg AFB in conjunction with Gemini-5—first missile firing observed by US astronauts.
1960		June 15	Turnover of last Minuteman I flight to SAC, completing Minuteman I site activation program. By this date, 800 Minuteman I missiles have been turned over to SAC, all flights transferred on or ahead of schedule.
June 20	Start of actual test program of rail-mobile Minuteman.	December 14	Minuteman I is launched from Vandenberg AFB in conjunction with Gemini-7—first ICBM reentry vehicle observed in flight by US astronauts.
July	Boeing is selected and awarded contract as integrating contractor for installation and checkout of Minuteman operational facilities.	1966	
1961		February 24	First US salvo launch of ICBMs (Minuteman Is) from Vandenberg AFB.
February 1	Successful first firing from surface pad (Cape Canaveral, Fla.) of first complete, full-range Minuteman.	March 8	Minuteman I becomes the 500th major ballistic and space launch from Vandenberg AFB.
March 30	Mobile Minuteman force is deferred, and three fixed-base squadrons are added to program.	1967	
November 17	First fully successful launch and flight of Minuteman I from underground silo (Cape Canaveral).	March 3	AFSC announces current Air Force design engineering study on conversion of Minuteman I ICBMs to space-launch vehicles.
1962		December	200th Minuteman I is launched at Vandenberg AFB.
April 10	Start of Minuteman I production program with assembly and checkout of first production missile (formal rollout: April 12, 1962).	1968	
June 29	First Minuteman I is launched from Cape Canaveral by Air Force "blue-suit" crew; this is the eleventh successful shot in thirteen firings from silos.	January 5	By this date, 1,000 operational Minuteman missiles are under SAC control, including 350 Minuteman IIs.
July	Start of Minuteman II development.		
September 28	First Minuteman I launch from Vandenberg AFB, Calif.		



A major achievement of the original Minuteman program was development of the rail-carried mobile Minuteman system. This was what the Minuteman train looked like as it made a test run out of Hill AFB, Utah. But DoD dropped the program. The idea of mobility is being examined anew.

all the major components and subcomponents of the system. Beyond those chores, Phillips had to build into the program a research and development effort for a mobile system—the memorable rail-mounted Minuteman project. The idea of mobility, which in 1968 is coming to the fore again, was strongly desired by the Strategic Air Command. Other mobility systems had been considered, including truck operations, and even barges at sea, but the railroad idea won out. As matters turned out, the rail-carried Minuteman, after being developed to operational feasibility, was discarded by DoD in favor of greater hardening of static Minuteman sites.

Phillips struggled as Minuteman boss with costs and schedules, with design freezes and the problems of frequently having to take technical gambles before all the technical evidence was in. Major techniques were proved out, such as the "take-apart" concept, by which reentry vehicles could be delivered for installation in the field. Guidance had to be removable in the field, and the all-important hardened and secure launch control system had to be developed. But the milestones began to pile up.

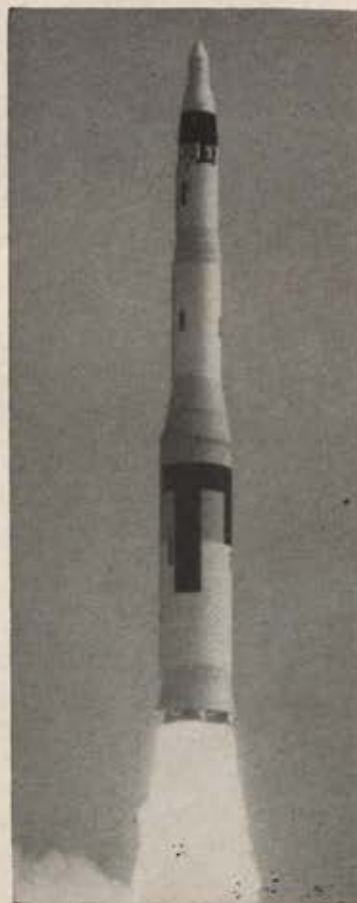
By February 1961 there was a successful first firing from a surface pad at Cape Canaveral. November 18 that same year saw the first fully successful launch and flight of a Minuteman I from an underground silo at the Cape. In April 1962, Minuteman I production started. Only two months later, the first "blue-suit" Minuteman I launch took place at the Cape. And by then there could be considerable confidence in the developing system. For the "blue-suit" launch was the *eleventh* successful launch from a silo out of thirteen attempts—an excellent batting average in anybody's scorebook. That kind of early-in-the-game testing success was in contrast to the much more discouraging opening of the liquid-rocket test era earlier. Much had been learned.

The following month saw the start of Minuteman II development, in July 1962. In September 1962, the first Minuteman I launch took place at Vandenberg AFB, Calif. And on December 11, 1962—about as on sched-

ule as you can get in the missile business, especially when you've advanced your target dates by a year, Malmstrom AFB, Mont., became the first operational Minuteman base, with the turnover of the first two flights to SAC. Actually by October 1962 the weapon system was considered virtually operational.

Just as there were hosts of technical, political, and management problems associated with the program from the start, there were also numerous heroes in the Minuteman story, too many to credit in this telescoped account. There were the crusaders and conceptualizers like Ed Hall, the people in high places in the Pentagon who were willing to take the risks involved in fielding such an effort, the R&D managers like General Schriever and Colonels Glasser and Phillips, and the industry people who made up the team that made the system work and put it together. Then, as now, there were the nay-sayers and the questioners and the quibblers, the people who said you could never fire an ICBM directly out of a hole in the ground, run the system with minimum crews, or trust solid fuels to behave properly, or procure the real estate to site the system the way you wanted to, or deliver the fully assembled missile by road, rail, or air to its base. They proved to be wrong. The Minuteman stands as evidence.

Thinking back on the Minuteman program not long ago, General Phillips paid tribute to the excellence of the conceptualization by those who originally put the bird on the drawing boards. "Minuteman was perhaps unique," he said, "in that by the time it became operational as a flyable bird it looked almost exactly like its original system design."—END



If a thermonuclear missile can be called beautiful, Minuteman, shown here in a telephoto shot as it rises skyward, is so describable. The clean lines of the bird are dramatically visible as it begins its flight. The nation got its first look at Minuteman in 1960 when it was unveiled at that year's Air Force Association Convention, in San Francisco.

The Silo-Sitters of SAC

USAF's Strategic Air Command, much of its attention and effort diverted by the war in Southeast Asia, depends on the ten-year-old Minuteman system to hold its real place in America's security setup. While Washington and the Pentagon keep up the running examination of our weaponry and the vehicles, SAC's combat crews in the air and deep underground are not allowed to forget that . . .

Deterrence Is Still the Prime Mission

BY CLAUDE WITZE

SENIOR EDITOR, AIR FORCE/SPACE DIGEST

NOW THAT Minuteman is ten years old, and has moved through the cycle from concept to operational readiness, it clearly has become the backbone of deterrent power in the arsenal of USAF's Strategic Air Command.

It was during those past ten years that SAC headquarters, here at Offutt, listened incredulously to predictions that the Air Force was not going to fly anymore. And that the "silent silo-sitters," deep underground in their concrete vaults, would slowly go mad from the strain of their responsibility, if not from claustrophobia.

Actually, of course, the impact of Minuteman on SAC is not a thing that can be measured by the kind of yardsticks being applied a decade ago by military strategists and glib commentators. The SAC of today was not in any of the forecasts. Yet, in hindsight, the SAC we have today was inevitable.

Robert S. McNamara, the Russians, the technologists, and Hanoi have all contributed to molding the face of today's SAC.

The increased reliance on missilery for deterrent power is evident in the arithmetic. Projected forces include 1,000 Minutemen, 496 Poseidon and 160 Polaris submarine-launched missiles, and fifty-four Titan IIs programmed for Fiscal 1969 to 1973.

As for manned bombers in the same period, the B-52Cs through -Fs and the B-58s will be phased out, leaving an authorized active inventory of 281 B-52Gs and -Hs, plus 253 FB-111s.

Decision Under Scrutiny

The determination to use this type of mix was not made by SAC or Congress. It was made by Mr. McNamara, and the decision is under close scrutiny today by his successor, Clark Clifford, by the Air Force itself, and by the Senate Preparedness Investigating Subcommittee, which is headed by Senator John Stennis.

Mr. Stennis has hearings under way at this moment, behind tightly closed doors. No report is expected until after the November elections, but the chairman has said, "The adequacy of our strategic weapons in both numbers and capabilities and our ability to retaliate effectively after an initial Soviet nuclear attack are basic to our very survival.

"The rapidly growing strategic nuclear forces of the Soviet Union pose a most dangerous threat to our national security," Mr. Stennis added. "We must examine this threat in some detail since it requires primary consideration in developing our force goals, national policy, and military strategy."

In these hearings, Senator Stennis went on, "it is imperative that we take a good hard look at the policy which controls our development and procurement of strategic weapons and how such policy is determined. Among the questions which arise is whether we are planning and building for assured superiority over the collective capabilities of our potential enemies or are willing to settle for something less, such as parity."

The obvious target here is the McNamara philosophy on deterrent power and the application of his systems analysis approach to weaponry in the years between 1961 and early 1968.

The War in Vietnam

Here at headquarters of SAC it is impossible to escape the feeling that there is a camel in the tent. The camel is the war in Vietnam.

One of Mr. McNamara's first steps, when he took control of the Pentagon, was to realign the Defense budget. This is when he stopped the fiscal breakdown by branches of the armed forces—Army, Navy, Air Force—and turned to the breakdown by mission—Strategic Forces, General Purposes Forces, and Airlift and Sealift Forces.

What has happened, of course, is that SAC has
(Continued on following page)



There are 1,000 Minuteman silos like this, many in midst of roaming cattle. Grass is eliminated as a fire hazard.



Minuteman transporter-erector is a monster truck that is capable of raising the missile and lowering it into silo.

jumped the fence. The manned bombers have become a critical ingredient of the General Purpose Forces, a fact that Mr. McNamara did not acknowledge, even in his most recent posture statement to Congress last January.

There is ample arithmetic to support this conclusion. Since 1965 well over 5,000 SAC personnel have seen duty in Southeast Asia. Of all rated personnel—including boom operators and gunners—nearly thirty-six percent have experience in the theater. Out of 140,614 airmen assigned to SAC, 55,000 have been to Southeast Asia. Since August of 1964, when the Gulf of Tonkin incident brought the first major escalation of the US effort, SAC has transferred 52,966 airmen out of the command in support of the war.

The missions flown out of Guam and bases in Thailand and Okinawa have become routine, and the enemy has been shaken by unprecedented bombings. The combined sortie rate for B-52 bombers and KC-135 tankers is more than 3,000 a month. Bombs dropped are estimated at more than 21,000 tons a month.

In Washington, it has been disclosed that USAF plans to reduce its total personnel in Fiscal 1969 by about 16,500. Testimony on Capitol Hill indicates there

will be a cut of almost 17,000 spaces in SAC. USAF's General Purpose Forces, on the other hand, will be increased by about 9,500 spaces.

While this is going on, it is clear that continued use of manned strategic systems for tactical missions in Southeast Asia cannot help but further stretch SAC's resources, both in men and machines. The recent events at Khe Sanh—where a besieged garrison credits its rescue to the B-52 operation—and the unaltered demand for tankers to refuel fighters and fighter-bombers indicate there is little outlook for relief.

But SAC, as Senator Stennis persists in remembering, cannot lose sight of the Soviet Union and its ambition to achieve strategic superiority, and the continuing requirement for a deterrent. SAC has it from the boss:

"The principal military threat to US national security," says Gen. J. P. McConnell, USAF Chief of Staff, "is posed by the large and rapidly improving offensive and defensive capabilities of the Soviet Union. . . . Soviet defense policy is clearly aimed at attempting to improve the strategic position of the Soviet relative to the United States."

The Prime Mission

In the SAC Command Post, deep beneath the headquarters building at Offutt, it is hard to realize that so much of the effort is being expended on a conventional and grubby war in Southeast Asia. The Command Post may be the one place in SAC where the focus remains on the prime mission.

This is where the battle staff congregates. The essential data on weather, on force movements, and on the readiness of the missiles and aircraft is stored in computers. The Strategic Air Command Communications System (SACCS) can spew forth this information in printed form or project it on screens in seven colors.

From here the aircraft and missiles would be ordered out, by direction of the President, in time of war. At all times, there is another command post in the air—the "Looking Glass"—and there are alternate posts on the ground at some other SAC bases.

"Looking Glass" is a Boeing EC-135C carrying some of the most elaborate communications and computing equipment ever lifted off the runway. The control



SAC airborne command post is called "Looking Glass." One of these planes has been airborne at all times since 1961.



C-133 is used to haul Minuteman on long trips. Sixty-foot-long missile wears protective covering on journey.



Skilled technicians are required to ready Minuteman for its vigil in silo. Installation of warhead is last step.

team on board is headed by a general officer with a staff of experts from operations, intelligence, materiel, and communications. They fly a random pattern not far from Offutt. The normal mission is eight hours, and the aircraft must remain on station until a replacement plane has arrived and established its communications. This schedule has been maintained since February of 1961.

Increasingly, the weapon controlled from this post, underground or aloft, is the Minuteman. Yet, SAC still adheres to the mixed-force concept and has a stated requirement for manned systems. What SAC has proved in Southeast Asia is that the manned system—the B-52 in this case—designed for one mission, has innate flexibility. Budgeted as a Strategic System, given pylons and a big belly, it has been modified into a General Purpose System.

SAC has no illusions that a new bomber—the Advanced Manned Strategic Aircraft—will be studied with any emphasis on its possible use for anything except the prime SAC mission. The FB-111, viewed by USAF as only an interim bomber, is scheduled to be in the inventory if SAC is to continue in its role of supporting ground forces in battle.

Warm Welcome for Minuteman

It is interesting and significant that Minuteman, like Polaris and Titan, was inherited by the McNamara administration when it took office in 1961. Minuteman was the youngest of the systems, and it is about the only one warmly embraced by the Secretary.

The 1,000 Minutemen now in inventory are located at six bases: Malmstrom AFB, Mont.; Ellsworth AFB, S. D.; Minot AFB, N. D.; Whiteman AFB, Mo.; Warren AFB, Wyo.; and Grand Forks AFB, N. D.

A portion of the Minuteman I force now is being replaced by Minuteman II. This is a shift that will continue while Minuteman III continues under development. Eventually, Minuteman III will move in and replace Minuteman I wherever possible.

Air Force Chief of Staff McConnell described the modernization to the Senate Armed Services Committee:

"The program will include improvements in the

launch control centers and launch facilities to ensure their compatibility with Minuteman II and III.

"Eventually, all Minuteman I missiles will have been replaced while maintaining the current force level. Thereafter, the Minuteman III will continue coming into the force at a reduced rate to replace the Minuteman II missiles which are allocated to the operational test program."

Minuteman III will include an improved third-stage motor, control system, and payload capability. It will be able to use the Multiple Independent Reentry Vehicles (MIRV) in its warhead, as well as penetration aids.

Also under development is an improved silo that will be compatible with both the Minuteman III and an Advanced ICBM, if one is deployed eventually.

A New Kind of Life

To the people in SAC, the advent of Minuteman and its climb to preeminence in the inventory has resulted in a new kind of life on duty, with no letup in the discipline and the requirement for perfection.

(Continued on following page)



Minuteman missile combat crew is responsible for keeping ten silos under surveillance from underground quarters.



Missile procedures trainer is used to keep combat crew in practice at 351st Strategic Missile Wing, Whiteman AFB, Mo. Here two new men learn about procedures from instructors, in white. Standards set by SAC for missile crews hit same high level traditionally imposed for crews of bombers.

The Launch Control Officer (LCO) may find it hard to understand why he was not replaced by a computer before he ever got the job. The answer, of course, is that a man and not a machine has got to be in charge.

When the LCO sits at his console he has no straightforward view of the outside world. A submariner has at least a periscope, and a B-52 pilot can, in good weather, see the horizon or the ice caps far below. But the LCO is blind to all except the blinking lights before him and deaf to everything but alarms and messages that come out of a telephone.

He has no information that comes out of his own experience; only what he is told by signal or message. Even the message can be written out and handed to him by the machine. There is no intellectual payoff; the world of the LCO is vicarious.

The problems native to this situation have been recognized from the start by both SAC and the Boeing Co. The Minuteman Education Program, discussed on page 49, is one ingenious effort to overcome these handicaps, but not all LCOs are taking master's degrees.

At the outset, rated officers were reluctant to volunteer for duty in the missile units. Nonpilots were more eager and predominated in the first crews trained and sent out to put in underground duty. Later, the rated officers who did draw LCO assignments arrived to find their nonflying colleagues had become senior officers in this subterranean military world. But it is still the practice to select nonrated men whenever possible.

Foolproof Procedures

There are redundant and foolproof procedures, of course, to prevent any unauthorized firing. In the combat capsule there are two consoles, about fifteen feet apart, at which the crew members sit on duty. The colored lights tell the status of each of ten missiles in the flight. Trouble is spotted and identified automatically.

The check is continuous; the computer is queried when a malfunction shows up and the computer tells, in printed form, what the malfunction is.

Actual firing of a missile must be preceded by direct orders from SAC and the USAF command, who relay it from the White House. The coded directions on how to carry out the order are locked in a safe; each crew member has his own lock. In the safe are the two keys that will make firing possible, and the locks they fit are in the consoles fifteen feet apart. They must be

turned simultaneously, which makes it impossible for one man to turn both.

Further, one crew of two men cannot do it by themselves. Another crew in another capsule, but in the same squadron, must go through the same procedure. Thus, it takes four men, cooperating, to fire a missile.

Suppose one man, a sick LCO, did not cooperate? With that team aborted, the move can be shifted to another squadron.

Each year, 600 new LCOs are trained for Minuteman. There are nearly 1,500 of them now among the six Minuteman bases. SAC says their performance must meet the same high standards that have always distinguished SAC aircrews. In the future, SAC will need more of them, and they will be even more important.

Meanwhile, SAC will continue to fly, while the silositters take care of the prime mission.—END



Three-stage solid-fueled Minuteman is ready for instant launch by SAC combat missile crew. The typical smoke ring that marks every Minuteman firing appears at the top of this photo taken of evaluation test at Vandenberg AFB, Calif.

The only place in the military services where a young officer can get an MS along with his ER is on a Minuteman combat crew. Under the Minuteman Education Program, now conducted at six USAF bases, master's degrees in Business Administration and Industrial Management can be earned from accredited universities. As a result, graduates move on to important management jobs in SAC and in other commands . . .

How USAF Brings the Campus to the Silo

BY CLAUDE WITZE

SENIOR EDITOR, AIR FORCE/SPACE DIGEST

H. G. WELLS, the historian and sociologist, once wrote that human history is becoming "more and more a race between education and catastrophe."

If Mr. Wells could visit any of the Strategic Air Command's six Minuteman wings, including the 351st here in central Missouri, he would find some of USAF's finest young officers working hard to affect the results of that race.

Peace is their profession, as it is in all of SAC, and

they are the key operators of the nation's most potent deterrent. At the same time, many combat crew members are working for graduate degrees in Business Administration from the University of Missouri.

It is all part of the Minuteman Education Program, started in 1963, chiefly at the instigation of Gen. Thomas Power, SAC Commander in the early days of the Minuteman effort. General Power, aware that combat crews in underground silos would miss the more inspiring satisfactions realized by combat crews in airplane cockpits, hit on the education program as an incentive device. When the program was initiated at the end of 1961, it was not approved as an Air Force requirement; it was an incentive program, designed to make silo service more attractive to the kind of mature and resourceful young officers whom SAC needed in these posts.

Over-all supervision of the Minuteman Education Program is under the Air Force Institute of Technology (AFIT) with headquarters at Wright-Patterson AFB, Ohio. In the first effort, started in January of 1963 at Malmstrom AFB in Montana, AFIT itself set up the course of instruction, leading to a degree of Master of Science in Aerospace Engineering.

While AFIT continues to control the program, and has a supervising officer at each Minuteman base, the actual teaching now is contracted out to universities. The initial emphasis on engineering has given way to courses that concentrate on management skills.

Here are the essential facts on the six Minuteman wings and their education programs:

- Malmstrom AFB, Mont. Seventy-four men have
- (Continued on following page)*



Mrs. Murine Abney is the librarian in charge of the AFIT collection of 1,900 books on Business Administration here at Whiteman AFB. She is helping Capt. John J. Williams, a missile combat crew commander who seeks master's degree.



Dr. Robert Lynn (standing) is resident director for the University of Missouri AFIT program at Whiteman AFB. Here he chats with students who soon will go on alert duty in a Minuteman launch control capsule a few miles away.

so far taken the engineering degree from AFIT. Another 113 now are enrolled, with the University of Montana offering a master's degree in Business Administration.

- **Ellsworth AFB, S. D.** South Dakota State University offers a master's degree in Economics with a minor in Aerospace Management. One hundred and two men have graduated, and more than another 100 are enrolled.

- **Minot AFB, N. D.** Master of Science in Industrial Management/Industrial Administration given by the University of North Dakota. The school has 120 graduates, and nearly 100 students now enrolled.

- **Whiteman AFB, Mo.** Here the classes lead to a master's degree in Business Administration. Graduates total 114, and there are more than fifty now enrolled. The course is conducted by the University of Missouri.

- **Warren AFB, Wyo.** The contractor is the University of Wyoming, which offers a master's degree in management. The university already is holding undergraduate courses in engineering, with 130 students, but this will be discontinued.

- **Grand Forks AFB, N. D.** Like the courses at Minot, these are given by the University of North Dakota and lead to a master's degree in Industrial Management/Industrial Administration. There are 146 enrollees.

The degrees, in all cases, are granted by the university. And the classes, although conducted on the Air Force base, are identical to the ones given on campus in each case. In fact, both students and instructors say they believe the USAF curriculum, conducted in an atmosphere that necessarily feels the impact of some military discipline, is more valuable and intense for being off the usual college campus.

Of course, not all combat crew members take advantage of the schooling. Here at Whiteman, one of the prize-winning Minuteman wings has an authorized strength of ninety crews, or 270 officers for this duty. In late April, the base had sixty-six of these crews prepared for duty, and the number will grow until the 351st Wing reaches authorized strength in September of this year. Of the 198 men now serving in the silos—

they monitor a total of 150 missiles—only fifty-two are in the AFIT program. Another seventy-eight on the base have applied for admission. A number of other men are attending night college classes at nearby schools, where other subjects are offered.

When the Minuteman program started, the first crew members were rated officers—pilots and navigators out of the SAC personnel. The changeover is well under way, and substantial numbers of the present crews, captains and majors, are nonrated officers not long out of Officer Candidate School or ROTC.

All of them, once assigned to the project, have spent a month at Chanute AFB, Ill., for formal missile launch officer training under the Air Training Command. From there, they went to Vandenberg AFB in California for about six weeks of operational readiness training. Back at Whiteman, the preparation for the basic job was finished off, and the combat crew member ready for his responsibility in less than six months.

Once in operation, the combat crew officer works on a four-day cycle. For capsule duty, he must allocate about thirty-six hours, twenty-four of which are actually spent at the silo. He reports first here at headquarters, is briefed on the current situation, and goes by ground vehicle to his assigned launch control facility.

The 351st has dispersed sites scattered over 16,000 square miles of west central Missouri. There are fourteen launch control sites and 150 missile silos, split up among three squadrons. Each squadron—the 508th, 509th, and 510th Strategic Missile Squadrons—has five flights of ten missiles under its control.

Some of the launch control centers are as much as 130 miles from Whiteman headquarters, and it requires a two- or three-hour auto trip, over state and county highways, to reach them. This accounts for the fact that, although a combat crew normally spends twenty-four hours on a duty tour, it takes a day and a half to go through the routine, back to the debriefing held at the conclusion.

Following a half a day of rest, men in the educational program have one day of AFIT classes. These are held on base. At Whiteman, a building formerly housing B-47 alert crews, complete with circular fast-

Minuteman Education Program

Students in the Minuteman Education Program must volunteer for the service. To be eligible, a man must be a career officer, not above the rank of major, and the holder of a B.S. degree. Any personnel officer can provide additional information and an evaluation can be requested by writing directly to:

Admissions Division
Air Force Institute of Technology
Wright-Patterson AFB, Ohio 45433

This request should be accompanied by two copies of each college transcript and a true copy of USAF Form 11.

Another source of additional information on request:

Minuteman Information Center
Hq. SAC (DPSE)
Offutt AFB, Neb. 68113
Attn: Mr. Paul E. Huff, Administrator



Informal discussion among Minuteman II combat crewmen who are enrolled in education program is supervised by Dr. Donald Rogoff. Dr. Rogoff is an Associate Professor of Business Administration, the University of Missouri.

exit ramps, has been adapted for the AFIT purpose. It is complete with classrooms, seminar rooms, faculty offices, studies, snack bar, and a library. Outside, the ramps and runways that once were crowded with bombers and tankers stand empty except for the auto parking area.

After a day of classes, the combat crew member is scheduled for a full day off. Almost as frequently, this time is taken up by some required refresher training course or proficiency tests, required by SAC to keep crews alert and up to the standard long set by its airplane crews.

Every fifth day the cycle starts again. The crews now average seven or eight "capsule tours" each month. There are four terms in an AFIT college year, and the student is given one of them as a vacation from his educational part of the routine. Most men complete the requirements for the graduate degree in three years and three months of their four-year tour of duty with the 351st. In this time, they can pile up credit for from fifty-six to sixty-two semester hours.

The Minuteman Education Program, it must be reiterated, was designed as an incentive effort. It is too early to evaluate results, but there are already signs of the impact on both USAF and the young officers enrolled in the courses.

Men who have been through the experience talk freely and enthusiastically about what they have done. They find their capsule tours not entirely unlike the B-52 missions carried out by their flying brothers. There are the same hours of boredom, broken by moments of terror, when the lights blink on the Minuteman control panel, alarms ring, and the computer spews forth its mechanized report that tells what an automatic troubleshooter has discovered about malfunctions.

"Keep the bird in the green" is the requirement, but that leaves plenty of time for grinding away at the books and preparing for class. Red lights can interrupt the study from time to time, but they don't interfere with the scholastic records being set at the 351st.

One officer pointed out that this is the only place in the military service "where a guy can get a master's degree and an effectiveness rating at the same time."

Another, clearly a man with a houseful of children

at home, says he is thankful for the quiet hours in the capsule, where he can study without what he considers far more rugged distractions.

At the outset, one of the things on the mind of General Power was the concern over long hours of duty, far below the ground, in an isolated and eerie atmosphere. The men deny that claustrophobia or any of its related anxieties are a factor.

One captain says the only time he felt "closed in" at his duty post was the freak occasion when the monster door got stuck and he had to send for a maintenance crew to open it from the outside. The same man says he has much greater misgivings about riding in a subway, a transportation system he considers New York City's most unattractive feature.

Of each twenty-four hours spent at the duty station, eight are set aside for sleep—two of the three-man crew always are monitoring the control system—and the lounge and sleeping quarters above the capsule are comfortable for a break from the job.

So far as USAF is concerned, SAC already is providing a small reservoir of new talent in management and administration. SAC cannot keep all the new graduates, nor was it intended that they should.

A few men are reassigned after their four-year hitch with Minuteman to other parts of SAC. More are expected to end up in the Systems Command, the Logistics Command, the Training Command, or elsewhere that the requirement exists. A few, carefully selected with an eye to their future USAF careers, are sent off to serve a tour in defense industry plants, from which they can return even more valuable to the complex contracting and procurement setup as it exists today.

Probably most important for the future of USAF and SAC is the fact that the education program can add new luster to an Air Force career. Without it, a young officer assigned to this duty could get the impression that he is serving a mere lame duck term in his four years as a Minuteman combat crew member.

It is hard to see his job as one of the lower rungs on a ladder to success in the military service, but this now is possible. USAF's rare effort to combine graduate studies with a critical job could easily help determine the outcome of that race between education and catastrophe.—END



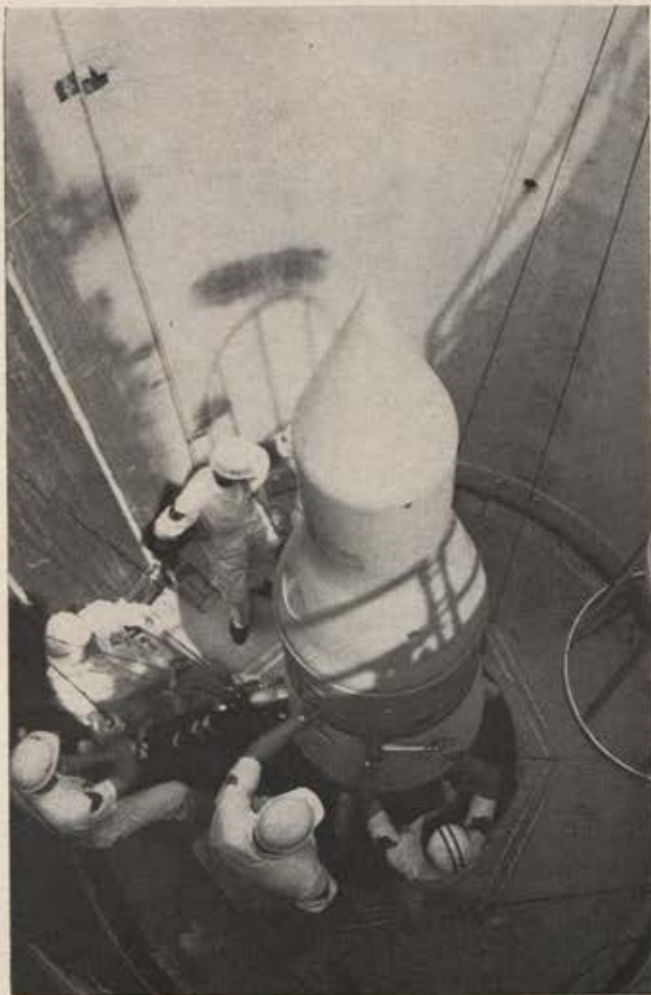
Class in Business Administration, conducted at Whiteman AFB by Dr. Norman D. French, is small, providing plenty of individual attention for Minuteman combat crewmen. Students and professors see advantages over campus work.

The US is looking at a whole range of possibilities in formulating plans to maintain and improve as necessary the deterrent ICBM missile force. The Minuteman III is being built, and plans are already developing for Minuteman IV. Receiving very careful attention is the superhard silo to ensure survivability in the face of increasingly more accurate Soviet missiles. But many other possibilities, from mobile missiles to underwater sites, are being considered in planning . . .

What's Ahead for US Deterrent Forces

BY IRVING STONE

WEST COAST EDITOR, AIR FORCE/SPACE DIGEST



An Air Force crew installs the reentry vehicle atop Minuteman II in its silo to ready missile for operational status.

ADVANCE planning for the deterrent ICBM force over the next ten to fifteen years covers a broad spectrum with many shades of emphasis. Development of superhard silos, analysis of land- and sea-based weapon systems, payload hardening, weights, delivery accuracies, and reentry modes for warheads and penetration aids—all have been examined thoroughly.

Immediate emphasis focuses on the superhard, or very-hard-rock, missile silo, because it promises to evolve as the most critical element in the ability of the ICBM force to survive and be able to retaliate. As a "dual capability" launch pad, this superhard silo would accommodate any completely new ICBM likely to be developed, and would also house the Minuteman III, now approaching its initial 1970-71 deployment in silos built for Minuteman I. The superhard silo also would be adaptable for any downstream evolutions of Minuteman, such as Minuteman IV, or V, if these should be introduced.

Behind the immediate emphasis on the superhard silo for the Air Force, a Navy evaluation of new submarine-basing possibilities for ballistic missiles, and Air Force analyses for future ICBM system requirements, lies the Defense Department's policy of extending its assured destruction capability as a hedge against a possible Soviet dual achievement—a substantial hard-target kill capability in the form of a large number of highly accurate "small" ICBMs or large ICBMs carrying highly accurate multiple independent reentry vehicles (MIRV), coupled with an extensive and effective antiballistic missile (ABM) defensive system.

The superhard silos, housing Minuteman III or new ICBMs, would be designed to take an initial Soviet strike, with enough of the silo-based missiles surviving

to penetrate a hostile ABM defense force, together with submarine-based and bomber-carried weapons.

The key to the new silo development is its "super-hardness." Today, neither the Soviets nor the United States possesses the ICBM guidance accuracy to "take out" one silo with one reentry vehicle. This would demand a zero circular error probability (CEP), and no silo could survive this bull's-eye accuracy. So, while current Minuteman silos can cope with current Soviet ICBM accuracy, the new silos would have to be designed to withstand the expected attainable CEP—substantially less than one-half nautical mile. This level of hardness might require the ability to withstand overpressures of between 3,000 to 5,000 pounds per square inch, probably ten to fifteen times that of present Minuteman silos.

Lead time for initial study, construction, and installation and checkout of the new silo may take three to five years, depending on the initial pace of the program. This means the new silo would not be available for two to three years after Minuteman III is fielded. Because the new silo effort will involve new techniques and evaluation, it's likely that only full-scale prototypes—perhaps six—may be covered by the initial program funding. Eventually, however, a large number would be required and construction would be conducted simultaneously to provide a wing of 150 missiles.

Judging by the current emphasis on the program, a contract-definition phase of six months' duration for the prototype silos may be kicked off this fall under the sponsorship of USAF's Space and Missile Systems Organization's (SAMSO) Minuteman Systems Project Office, Norton AFB, San Bernardino, Calif.

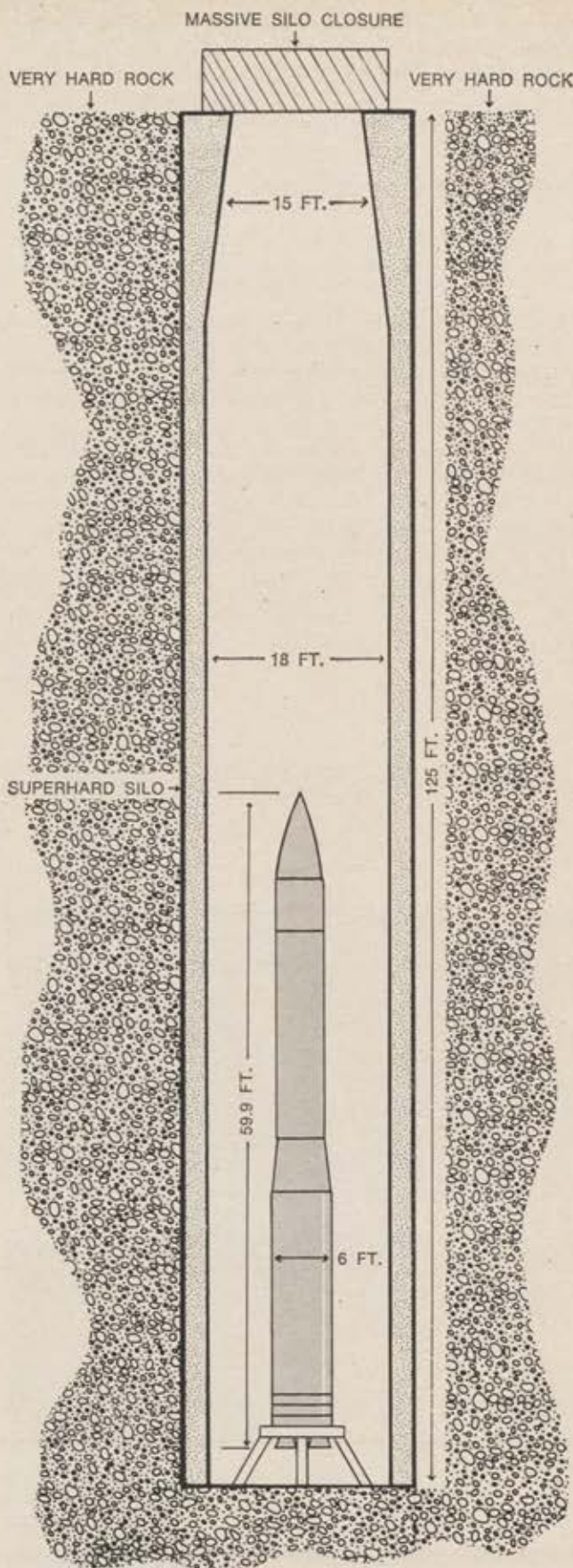
Hard-Rock Siting

The superhard silos would have to be located in a hard-rock area, indicating that the new silos would be sited away from many of the current Minuteman complexes. However, chances are that locations will be as close as possible to current Minuteman sites to minimize maintenance and support.

Deployment of the silo in very hard rock undoubtedly will permit lighter silo-wall construction, because the combination of rock and wall will resist blast overpressure. A silo emplaced in a soil environment would require much heavier construction for comparable resistance to blast.

The superhard silo will be much larger than a current Minuteman hole. It probably will be at least 125 feet deep. Diameter will be about eighteen feet, large enough to accommodate a 156-inch-diameter (thirteen-foot) missile, while still allowing thirty inches of "rattle" space (a function of blast overpressure) between missile and silo walls. This doesn't mean that a 156-inch-diameter solid-propellant missile is the logical selection for a completely new weapon system, but enough test-firing experience has been generated with this size rocket motor for it to serve as a logical guide for speculation.

Today's Minuteman silo is only slightly deeper than the fifty-nine-foot ten-inch length of Minuteman III, (Continued on following page)



In this artist's conception of the proposed superhard silo, the greater size, depth, and protection for the missile can be seen. Located in very hard rock, the silo will be hardened to 3,000 to 5,000 psi to resist hits by ICBMs with CEP accuracy of less than one-half nautical mile. Larger size would accommodate Minuteman III, as shown, and also be able to take new, much larger ICBM, if developed.

and its diameter is about twelve feet against the six-foot two-inch diameter of the missile. The superhard silo probably will be necked-in toward the top to provide an exit area not more than about fifteen feet in diameter. This would allow a smaller silo closure deck, giving greater resistance to overpressure and a considerable saving in weight against a full eighteen-foot opening, since the mass of the closure deck increases exponentially with increase in span.

The closure, massive as it is likely to be, will be the key element for quick retaliation. Following a near-impact of an enemy ICBM, debris (rock and other clutter) likely would be strewn over the closure. The simplest operational scheme would be to combine the opening and debris-clearing functions in one or a series of motions before full opening.

The critical function of the silo closure, its actuating and locking system, will require extensive operational testing, probably to be conducted with full-scale models. Test conditions would simulate various probable after-blast conditions so that the closure operation could be realistically appraised.

Dynamic Testing

Dynamic testing may involve a complete silo with simulated nuclear environment to determine how well the structure will resist ground and atmospheric shocks. Nuclear resistance tests, under current conditions, would have to be conducted in an underground environment and are likely to involve critical components of a Minuteman III missile.



This artist's conception of the USAF Minuteman III, newest version of the solid-fuel ICBM, illustrates bullet-shaped shroud which covers new reentry system. Larger third-stage engine increases the missile's flexibility and payload.

The superhard silo, plus a wide variety of other schemes for basing missiles—fixed on land, mobile on land, new submarine systems—were analyzed for the Defense Department by the STRAT-X Committee, comprised of representatives of industry, the military, the RAND Corporation, and the Institute for Defense Analyses. STRAT-X considered the threats to be expected within given time spans, systems proposed to meet the threats, and evaluation of the threats and the systems. Apparently, from the STRAT-X effort stemmed the decision to proceed with the very hard launch facility for Minuteman III and its follow-ons, as well as a program to analyze feasible new submarine-based systems, which the Navy is performing. This means that a good part of the follow-on military effort will be concerned with tasks more or less independent of the design of the missiles themselves.

Nevertheless, the decision to build the very hard launch facility will have a pronounced effect on the Air Force's missile planning effort. It will continue to examine, in relation to the superhard silo, possibilities for new-generation systems in terms of size, range, accuracy, and other factors.

Another effort to define a specific missile configuration might stem from studies performed under cognizance of the Minuteman Systems Project Office. These studies would be concerned with configurations feasible as follow-ons to Minuteman III as a hedge against building a completely new large ICBM, with its high attendant cost and six to seven years of lead time.

Minuteman IV

Thus, Minuteman IV might evolve with some or none of the propulsion components of Minuteman III. One possible configuration might include a first-stage with a diameter of eighty-five to ninety inches (compared to seventy-four inches for Minuteman III), plus the second and third stages of Minuteman III. Another configuration might include the eighty-five- to ninety-inch first stage topped by the seventy-two-inch-diameter first and second stages of the Navy's Poseidon missile. A logical progression from these configurations to Minuteman V might involve using three of the eighty-five- to ninety-inch stages, for still more thrust.

Or a completely new three-stage ICBM might have to be designed from scratch to meet the foreseeable threat in the 1970s. It would be sized somewhere between 120 inches and 156 inches in diameter. This could accommodate a "throw weight" well in excess of 5,000 pounds—expected to be adequate for foreseeable requirements. "Throw weight" would be a payload consisting of a powered "bus" carrying a load of individual reentry vehicles. The bus is an accepted operational concept and will be carried on Minuteman III to accommodate the multiple independent reentry vehicles (MIRV).

Operationally, the bus would separate from the top stage of the ICBM booster after burnout and relatively early in the trajectory. As the bus continues along the flight path, it uses thrust from an integral power source to change speed and attitude to provide a different trajectory for each reentry vehicle it dispenses. Thus, each reentry vehicle is targeted, by the



At left is a mockup of the Boeing-built Minuteman III, which is scheduled for deployment in present Minuteman I silos in 1970 and 1971. Behind the missile mockup is its mobile transporter and erector system. Although they will initially be deployed in the presently operational silos, it is probable that the missiles will later be moved to new superhard silos now under development.

bus guidance and control system, for a selected impact point. Penetration aids (decoys) are also dispensed by the bus along the flight path.

Obviously, the more reentry vehicles and decoys carried, the greater are the opportunities for penetrating the defensive antiballistic missile system. But more vehicles mean more weight. Hardening of the payload would introduce still more weight.

Another refinement is the probability of providing built-in maneuverability for each reentry vehicle in addition to that of the bus. This again means more weight.

Each of these approaches could go beyond the Minuteman III throw-weight limit, and may justify development of a larger, more powerful ICBM. However, the decision to use more and/or more-sophisticated reentry vehicles in the bus, which in turn would affect booster capability, ultimately would be decided by the interaction of the US offense with the Soviet defense.

Antennas for a superhard silo and its associated command and control system will pose a problem, because no transmitting or receiving units hardened to the extent required have yet been used. Deeply buried, trenched dipoles may be considered if cost-effectiveness and reliability justify their use instead of hardened land lines.

Self-Ejection Concept

An important consideration with respect to silo deployment of future solid-propellant ICBMs is whether they should be "hot launched" in the conventional blast-out manner or "self-ejected" by utilizing a special end-grain in the propellant to provide controlled, progressively increasing acceleration during liftout with full missile thrust delayed until the missile is fifty to seventy-five feet above the silo.

The self-eject controlled liftout aims to eliminate hazards associated with high gas pressure, heat, and noise levels encountered in conventional hot launches, which might damage the missile structure or its precision equipment.

While the projected eighteen-foot-diameter superhard silo would seem large enough to minimize these effects, the silo's fifteen-foot-diameter neck might counteract this by introducing a choking effect. Also, since only prototype superhard silos are programmed to be

constructed initially, it's possible that the operational version of the superhard silo may be smaller than eighteen feet in diameter.

SAMSO has been supporting an analytical and experimental investigation of the self-eject concept for more than two years. Scale-model ejection was successfully demonstrated by Lockheed Propulsion Co. at Edwards AFB, Calif., in October 1966. And even though SAMSO recently has had to cut back by about two-thirds the initial funding of about \$700,000 each for Aerojet-General, Lockheed Propulsion Co., and Thiokol Chemical Co. to conduct analyses and field tests of self-eject, it intends to continue to consider the advantages of self-eject for future ICBM application. The efforts of the three contractors will end this month without having conducted field tests for three different propulsion schemes for silo liftout.

Proponents of self-eject contend that the technique's prime advantage lies in reducing the hardening cost for the silo, simply by permitting a reduction in silo diameter. It's claimed that expense of hardening a silo increases, roughly, as the cube of the hole diameter. Comparing an eighteen-foot silo with one thirteen and a half feet in diameter, this could mean an increased cost of about 240 percent to harden the larger size silo to 3,000 to 5,000 psi.

In addition, proponents say that using self-eject will save ten percent in the weight of the booster's first stage by reducing propellant web thickness, because of the higher velocity achievable. When you blast out with a hot launch from a large-diameter silo, an initial velocity of 2 Gs may be attained. Length of time to clear the silo will be about one and one-half seconds longer, from ignition, compared with the self-eject launch. During this time more than 15 Gs can be generated, depending on the strength of the missile inter-stage structure, the limiting structural constraint.

Thus, in the hot launch the exhaust gases at low velocity spill around the sides of the missile and up the silo walls. In contrast, during self-eject the gases are "sealed" in the silo because the latter is almost the same diameter as the missile. The gases then provide a lifting force under the missile across its entire cross-sectional area.

Self-eject proponents declare that theoretically it's feasible to deploy a thirteen-foot missile in a thirteen-and-one-half-foot-diameter silo. They contend no space

(Continued on following page)

is needed for maintenance—which can be done at ground level, with the missile brought to the surface by compressed air at twenty-five to thirty-five pounds per square inch.

Mobile Minuteman?

Air Force planners haven't written off the mobile ICBM concept, even though the STRAT-X Committee has said that hardened land-based systems and submarine systems appear to provide the best options. If for no other reason, Air Force planners are interested in land-based mobile systems just to analyze how a potential enemy would operate them.

Road-basing definitely appears to be a more attractive operational concept than rail-basing. Apparently, the Soviets have the same philosophy.

Any future road-mobile system would include a capability for desert mobility. To accommodate an ICBM a road-mobile carrier would have to be a tremendous vehicle. The van probably would be 125 feet long, thirty feet wide, and thirty feet high, to house the missile and associated erecting and checkout equipment. Tires might be ten to fifteen feet in diameter coupled with a five-foot tread for ample footprint. The truck would require a battery of high-horsepower diesel engines. Operation might be limited to specially constructed roads or specifically adaptable terrain.

Colossal as the task of designing and operating such a missile-carrier may be, its deployment probably would be no more difficult or complicated than a new, sophisticated, fixed land-based installation.

Hardening a mobile system could offer substantial problems but, to complement the survivability inherent in the vehicle's mobility, various hardened interim basing schemes could be used. These basing schemes could include:

- An above-surface hardened "garage" to which the mobile vehicle could return after roving around the countryside.
- A below-surface hardened garage.
- A tunnel leading into a mountainside.
- A circuitous tunnel, many miles in length, in the base of a mountain, from which the mobile system need not emerge, launching its missile through one of a number of vertical shafts.

Underwater Basing

Supported by STRAT-X Committee interest and Defense Department funding, the Navy is reviewing and analyzing possibilities for next-generation underwater basing of ballistic missiles. In this approach, as in the case of land-based mobile vehicles, mobility could be translated into survivability by the simple expedient of being able to hide. But underwater basing need not necessarily involve mobility. In the past, both the Navy and the Air Force, with industry assistance, have studied basing missiles in underwater environments, including fixed, cocooned emplacements in lakes and coastal areas. Carrying large missiles on the sides of relatively simple undersea carriers also was envisioned, with the missile released to right itself for pop-up and firing.

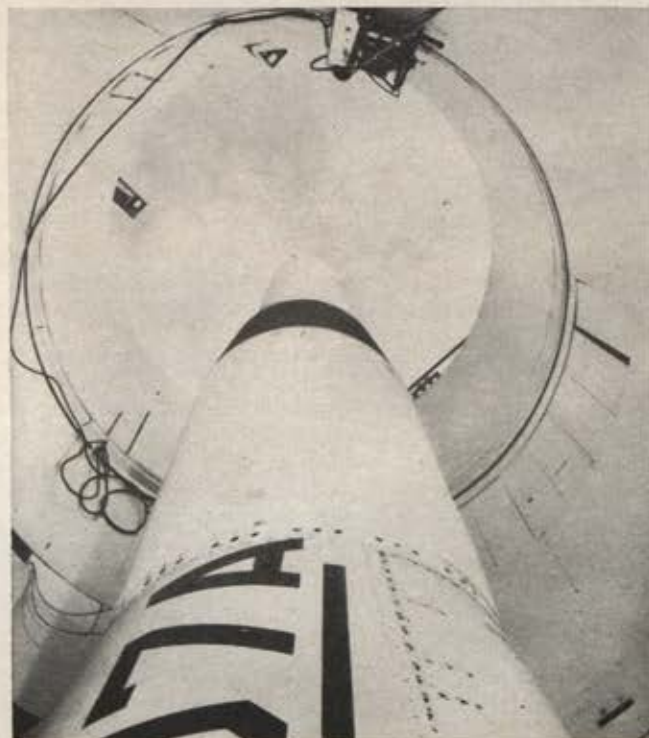
The large number of submarines which carry Poseidon and Polaris missiles would be an effective deterrent and retaliatory force. To justify a replacement for, or complement to, this strategic force would demand a major improvement. Indications, therefore, are that a new underwater basing scheme would involve a different and less expensive approach than the conventional nuclear submarine/missile combination.

The probability of development of a US counterpart to the Soviet's fractional orbit bombardment system (FOBS) appears very dim, although various countermeasures are being considered.

The prime concern is how FOBS could downgrade the US retaliatory capability. FOBS is not yet considered a threat to the Minuteman ICBM force, but conceivably it could be with future refinement. However, it could be a threat to airborne retaliation in that FOBS launched in numbers conceivably could destroy Strategic Air Command bomber bases.

Early warning therefore becomes critical. It would involve radars for scanning 360 degrees—to monitor FOBS approaches from both the south and the north to make it feasible for Sentinel ABMs to intercept. If the suspected Soviet vehicle were to approach the US from the south, probability is that it would be a FOBS. If launched to come across the US from the north, it might be any type of space vehicle, introducing the difficult problem of discrimination and attack.

Development of space-based weapons, such as FOBS, and space-based defensive measures against such weapons, is still in the earliest stages, compared with land- and sea-based ballistic weapons. Development approaches US planners are likely to underscore in this regime will be those that offer the most promising alternatives to known or expected Soviet space-based threats.—END



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MOTOROLA

Government Electronics Division / Instrumentation Products Office

Although the US space effort on all fronts has suffered fiscal setbacks as a result of the high cost of the Vietnam War, there is still plenty going on in the void. The Apollo moon-landing program continues toward its climax, the Air Force MOL proceeds, albeit at a slower pace than originally expected, and a host of useful working satellites is clicking away in the firmament . . .

Highlights of the US Space Program: 1968

Following are principal current US space programs as of present writing. Programs now completed, such as Surveyor and Lunar Orbiter, which were listed last year, are deleted, as are recently canceled or postponed projected efforts such as Voyager, NASA's earlier planned 1973 Mars-probe effort, now superseded by the newly proposed Titan-Mars-1973 mission.

—THE EDITORS

NASA Programs

Manned Spaceflight

Apollo: Mission—manned lunar landing before the end of the decade; **prime contractor**—North American Rockwell; **launch vehicle**—Saturn V; **major subcomponent**—Lunar Excursion Module (LEM) in which 2 astronauts will descend from "mother ship" to lunar surface; **prime LEM contractor**—Grumman.

Apollo Applications: Mission—projected series of manned and unmanned earth-orbital, lunar-orbital, and lunar-surface survey and scientific flights, using modified Apollo crew modules and Saturn V booster components; first step would be month-long manned earth-orbital mission with crew occupying emptied-out S-IVB stage of

Saturn booster as so-called Orbital Workshop; **prime contractor**—unannounced; Martin Marietta has been designated as experiments integrator, McDonnell Douglas as modifier of S-IVB stage and airlock contractor.

Lifting Bodies

HL-10: Mission—manned maneuverable reentry flight research program, using 3-finned lifting-body shape developed at NASA Langley Research Center, carried to high altitude by modified B-52; has had 2 flights, is being modified; **prime contractor**—Northrop.

M-2: Mission—manned maneuverable reentry flight research program, using lifting-body craft, carried to high altitude by modified B-52; 14 successful flights, but craft crash has made future of program indeterminate at this time; **prime contractor**—Northrop. HL-10, M-2, and X-24A programs (see below) are all parts of over-all NASA and Air Force lifting-body flight-research effort.

Planetary Probes

Mariner-Mars-1969: Mission—planned 1969 flyby of planet Mars of 2 Mariner-type spacecraft; **prime contractor**—Jet Propulsion Laboratory, California Institute of Technology; **launch vehicle**—Atlas-Centaur.

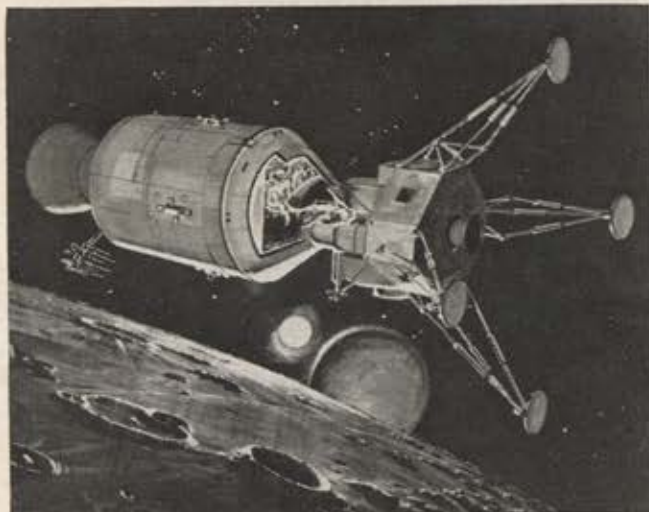
Mariner-Mars-1971: Mission—proposed 1971 orbiting of 2 Mariner-type spacecraft around Mars; **launch vehicle**—Atlas-Centaur.

Titan-Mars-1973: Mission—proposed 1973 orbiting of 2 Mariner-type spacecraft around Mars, with plan to rough-land 2 probes on planetary surface; **launch vehicle**—Titan III.

Applications Satellites

Applications Technology Satellite (ATS): Mission—to advance space communications, gravity-gradient stabilization, meteorological, and other aspects of space technology; 2 successful missions to date, 2 more in present series scheduled, also later launches of advanced models; **prime contractor**—Hughes; **launch vehicles**—Atlas-Agena for early models, Atlas-Centaur for later ones.

Geodetic Explorers (GEOS): Mission—to obtain better understanding of earth's shape, gravitational field, other geodetic data; 2 types: PAGEOS inflatable sphere for geometric optical measurements with 5-year life, launched successfully in 1966; and GEOS, gravity-gradient-stabi-



Artist's view of crew entering Apollo LEM. NASA is said to be planning circumlunar flight before actual landing.

lized spacecraft with solar and magnetic attitude controls, launched successfully in 1965; **prime contractor** for GEOS—Applied Physics Laboratory, Johns Hopkins University; **prime contractor** for PAGEOS—Schjeldahl; **launch vehicle** for GEOS—Thrust-Augmented-Delta; **launch vehicle** for PAGEOS—Thrust-Augmented-Delta.

Nimbus: Mission—to obtain earth-weather data from polar orbits, using advanced TV camera and automatic picture transmission systems, with cameras constantly earth-oriented; 2 successful missions to date; additional launches of advanced models planned; **prime contractor**—NASA Goddard Space Flight Center; **launch vehicle**—Thrust-Augmented-Thor.

Television Infrared Observation (TIROS): Mission—continued launchings by NASA of near-polar-orbit weather satellites which become part of US Commerce Department Environmental Science Services Administration (ESSA) operational weather-watch system called Tiros. Operational System (TOS), which serves receiving stations around the world; 10 successful missions to date; advanced model "M" now in development; **prime contractor**—Radio Corporation of America; **launch vehicle**—Thrust-Augmented-Delta.

Scientific Satellites and Orbiting Observatories

Air Density Explorer (AD): Mission—upper atmospheric studies in polar areas; 2 successful missions to date; **prime contractor**—NASA Goddard Space Flight Center; **launch vehicle**—Scout.

Biosatellite: Mission—long-duration studies of space-environmental effects on subjects ranging from low-order cellular organisms to primates; 1 successful mission to date; additional launches planned; **prime contractor**—General Electric; **launch vehicle**—Thrust-Augmented-Delta.

Energetic Particles Experiments (S-3): Mission—experiment packages placed aboard various spacecraft to study energetic particles and fields in circular orbits; 3 successful missions to date; **prime contractor**—NASA Goddard Space Flight Center; **launch vehicle**—Thor-Delta.

Interplanetary Monitoring Platform (IMP): Mission—analysis of energetic particles and fields in elliptical orbits; 6 successful missions to date; additional launches planned; **prime contractor**—NASA Goddard Space Flight Center; **launch vehicle**—Thrust-Augmented-Delta.

Delayed into the 1970s but still very much in business is the Air Force's MOL, which will test man's military utility in orbit.

McDonnell Douglas is principal contractor, with GE integrating the experiments.



Martin Marietta-built X-24A lifting body craft is important element of USAF and NASA lifting-body research effort.

Orbiting Astronomical Observatory (OAO): Mission—to orbit an astronomical telescope; first mission in 1966 failed after battery failure; 3 more scheduled; **prime contractor**—Grumman; **launch vehicle**—Atlas-Agena, Atlas-Centaur.

Orbiting Geophysical Observatory (OGO): Mission—investigation of space phenomena including solar influences on near-earth environment and magnetosphere, in polar and eccentric orbits; 5 missions to date, with varying degrees of success; 2 more scheduled; **prime contractor**—TRW Systems; **launch vehicle**—Atlas-Agena, Thrust-Augmented-Thor.

Orbiting Solar Observatory (OSO): Mission—analysis of solar emissions; 4 successful missions to date; 3 more scheduled; **prime contractor**—Ball Brothers; **launch vehicle**—Thor-Delta.

Owl: Mission—to study effects of Van Allen radiation belts on aurora; none launched to date; **prime contractor**—Rice University; **launch vehicle**—Scout.

Radio Astronomy Explorer (RAE): Mission—to analyze radio emissions from celestial sources; launches to start in 1968; **prime contractor**—NASA Goddard Space Flight Center; **launch vehicle**—Thrust-Augmented-Delta.

Military Programs

Manned Spaceflight

Manned Orbiting Laboratory (MOL): Mission—Air Force program to orbit for month-long periods in canister-shaped lab military crews in so-called "shirtsleeve" environment (crews will be able to doff spacesuits during mission), to determine military utility of man in space; first manned missions expected in early 1970s; **prime contractor**—McDonnell Douglas; **launch vehicle**—Titan IIIM.

Lifting Bodies

X-24A: Mission—Air Force manned maneuverable re-entry research and development program, using lifting-body vehicle to be launched from very high altitude from modified B-52; glide flight scheduled for summer 1968; **prime contractor**—Martin Marietta.

Applications Satellites

Aerospace Research Support Program (ARSP): Mission—broad-based Air Force orbital research effort, directed by Air Force Office of Aerospace Research, including OV-1, OV-2, OV-3, OV-4, OV-5 (OV stands for Orbital Vehicle)

(Continued on following page)

series of spacecraft, and various contractors; OV-3 portion now completed; **prime contractor**—OV-1: General Dynamics/Convair; OV-2: Northrop; OV-3: Space-General; OV-4: Raytheon; OV-5: TRW Systems; **launch vehicles**—Titan III, Scout, Atlas.

Discoverer: Mission—Air Force orbital military-space-system testing program; **prime contractor**—Lockheed; **launch vehicle**—Thor-Agena and Atlas-Agena.

Environmental Research Satellites: Mission—Air Force scientific-research satellite program to obtain diverse space data; **prime contractor**—TRW Systems; **launch vehicle**—Atlas, Titan IIIC.

ICBM Alarm (formerly MIDAS) (Program 461): Mission—Air Force classified developmental program for spaceborne detection of ICBM launches.

Initial Defense Communications Satellite Program (IDCSP): Mission—Defense Department-directed global near-synchronous equatorial active-repeater military satellite network; 3 successful multisatellite launchings to date; all services active in program; **prime contractor**—Philco-Ford; **launch vehicle**—Titan IIIC.

Integrated Satellite System: Mission—Air Force developmental program for advanced early-warning satellite system that would eventually have multiple capabilities, including ICBM-launch detection, nuclear-detonation detection, and damage assessment; **launch vehicle**—Titan IIIC.

Lincoln Experimental Satellite (LES): Mission—Air Force space-component testing program, orbiting various military communications-satellite devices; **prime contractor**—Lincoln Laboratory, Massachusetts Institute of Technology; **launch vehicle**—Titan IIIA and IIIC.

Navy Navigation Satellite (NAVSAT) (formerly TRANSIT): Mission—operational nuclear-powered spaceborne gravity-gradient-stabilized navigational satellite system used to aid fleet operations; **prime contractor**—Applied



Helping guide the movements of Polaris submarines is the Navy's NAVSAT. Its capabilities have been offered to commercial sea traffic.

Physics Laboratory, Johns Hopkins University; **launch vehicle**—Thor-Ablestar.

Nuclear Detection Satellite (formerly VELA): Mission—Defense Department operational satellite system designed to detect violations of nuclear test-ban treaty; 4 pairs of satellites in far-ranging orbits; another pair to be orbited during 1968; **prime contractor**—TRW Systems; **launch vehicles**—Atlas-Agena, Titan IIIC.

Program 720-A (formerly SAMOS): Mission—Air Force classified operational strategic reconnaissance system in polar orbit, with continuing development of improved and more versatile techniques and components.

Space Experiments Support Program: Mission—Department of Defense-sponsored program, managed by Air Force Systems Command Space and Missile Systems Organization (SAMSO) to fly government-sponsored developmental-engineering experiments as multiple primary payloads or as subsatellites on space-available basis aboard boosters; projects include SECOR geodetic satellite and Aurora-1 satellite, designed to measure electrical phenomena associated with aurora borealis; **prime contractor for SECOR**—Cubic Corp.; **prime contractor for Aurora**—Rice University; **launch vehicle**—Thor-Burner II.

Surveillance Calibration (SURCAL): Mission—Navy satellite program to check on calibration of ground-based space-surveillance systems; **prime contractor**—Naval Research Laboratory; **launch vehicle**—Thor-Ablestar.

SYNCOM: Mission—synchronous military communications-satellite system, originally launched by NASA, now used by Defense Department; **prime contractor**—Hughes; **launch vehicle**—Thor-Delta.

Tactical Communications Satellite: Mission—triservice program to develop satellite system to handle tactical military communications; **prime contractor**—Hughes.

Communications Satellite Corporation (COMSAT) Programs

Communications Satellites

Intelsat-1 (Early Bird): Mission—experimental, also operational, first synchronous over-the-Atlantic communications satellite, launched in 1965 and still transmitting between Europe and US; **prime contractor**—Hughes; **launch vehicle**—Thrust-Augmented-Delta.

Intelsat-2-F-3 (Canary Bird): Mission—improved over-the-Atlantic synchronous communications satellite, follow-on to Intelsat-1; launched in 1967; **prime contractor**—Hughes; **launch vehicle**—Thrust-Augmented-Delta.

Intelsat-2-F-4 (Lani Bird) (Pacific-2): Mission—synchronous over-the-Pacific satellite, launched in 1967; **prime contractor**—Hughes; **launch vehicle**—Thrust-Augmented-Delta.

Intelsat-3 (Global Communications Satellite System): Mission—COMSAT developmental program for worldwide synchronous communications satellite network with capacity for 1,200 2-way voice circuits; hoped-for late 1968 launching; **prime contractor**—TRW Systems; **launch vehicle**—Long-Tank-Thor.

—WILLIAM LEAVITT



Patrolling the void are pairs of satellites that look like this—the Nuclear Detection spacecraft built by TRW Systems. Their job is to watch for violations in space of the nuclear test-ban treaty.

Hughes is developing for the military the world's largest experimental communications satellite, TacComSat, for military tactical communications. Two stories high, its size is illustrated by this photo in which earlier, Syncom-size satellite is placed in front of TacComSat mockup. TacComSat would serve all military services.



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In the nine years since the first airdrop and glide of the rocket-powered X-15 aircraft, volumes of valuable data have been added to the files of both spacecraft and aircraft designers. Amid the fanfare of the US space program, the X-15, with comparatively little publicity, has broken record after record, providing a means for extensive research on man and machines in space, as well as contributing to the design of many new aircraft in the inventory or under development today. With the program reaching the end of its road, here is a report on . . .

The Quiet Records of the X-15

BY IRVING STONE

WEST COAST EDITOR, AIR FORCE/SPACE DIGEST

LOS ANGELES, MAY 1
THERE'S a strong probability that the famed rocket-powered X-15 aircraft will be retired from its research role at the end of this year. The activity of this remarkable vehicle now stretches more than nine years from its first airdrop and glide, and more than twelve years since the contracts for the X-15 airframe and engine were awarded. To date the program encompasses 194 flights, in which aircraft performance frontiers have been pushed to the space-equivalent altitude of 354,000 feet (approximately sixty-seven miles) and a speed of Mach 6.73 (about 4,534 miles per hour), coupled with safe landings after very severe entry profiles.

This is an impressive research attainment for a manned aircraft. In the nine-plus years of X-15 flights, there have been only three instances of severe structural damage (repaired), and only one of the three aircraft in the program was lost—an extraordinary record for a hazardous supersonic flight regime.

An estimated \$300 million has been spent on the program—for design, development, construction, and operation of three X-15 aircraft, together with associated support and some facility charges. By today's, or even earlier, cost standards this is a bargain. Other programs have cost a good deal more without contributing anything comparable to advancing the state of the art or underscoring man-machine integration as has the X-15.

Combination Aircraft-Spacecraft

X-15 research has been an extensive and detailed aerodynamically oriented investigation conducted with a combination aircraft-spacecraft. It has spanned a critical spectrum of hypersonic flight in atmospheric and nonaerodynamic regimes. In these unfamiliar operational areas for manned aircraft, it has provided valuable data and established firm guidance for future development and test programs.

The aircraft's entry regimes have been of much shorter duration than the orbital entry, but have presented more severe control problems, considering the rapid buildup in dynamic pressure and acceleration. The heating regime for the X-15 has involved structural demands never required previously in research aircraft. Spacecraft, by comparison, have used heat shields and a less critical (more shallow) entry trajectory, which has not imposed the combined severe aerodynamic and heating loads experienced by the X-15.

The X-15 program—a joint effort mainly involving the Air Force and the National Aeronautics and Space Administration, with some participation by the Navy—emphasizes the close degree of teamwork between Air Force and NASA.

The bulk of the financial support, mainly for contractor costs, has come from USAF, which also has participated with planning, engineering, and aeromedical cooperation and support, mainly through Air Force Systems Command's Aeronautical Systems Division (X-15 Systems Project Office), Wright-Patterson AFB, Ohio, and Air Force Flight Test Center, Edwards AFB, Calif. NASA, through its Flight Research Center at Edwards, has been responsible for day-to-day technical management of the program and has contributed substantial financial support in the form of personnel salaries and facilities.

From the beginning, the program has been guided by joint groups established with Air Force, NASA, and Navy personnel. The last formal meeting of a joint coordinating group was in October 1966. It established priorities that are still being followed. Subcommittees examined the program in detail and submitted recommendations.

Building on X-15 Experience

Using the operational record of the X-15 as a base, NASA now is contemplating directing its efforts to-

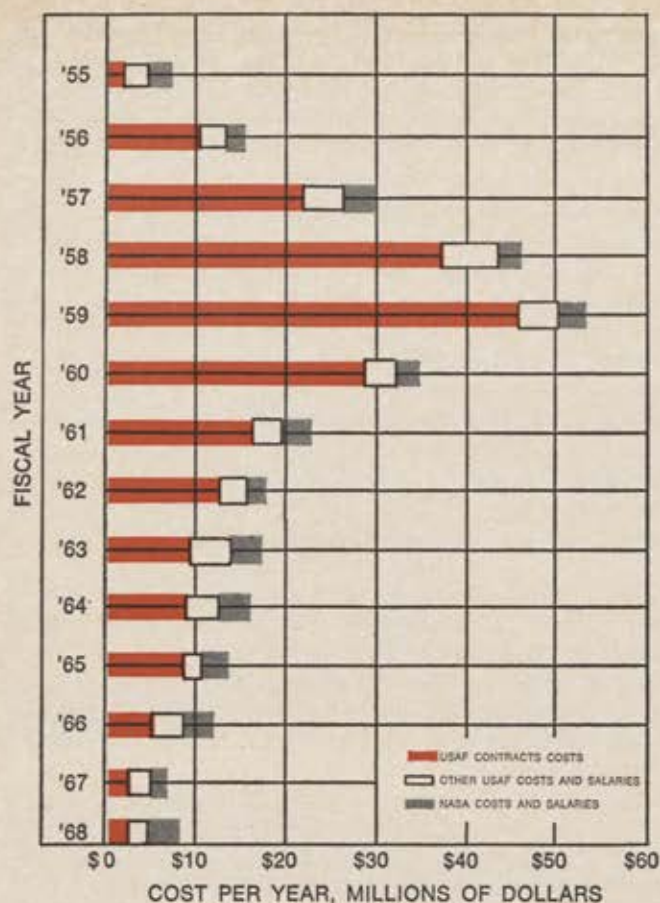


Chart shows costs of the X-15 program by fiscal years. Costs do not include use of nonreimbursable government facilities, such as wind tunnels and the B-52s used as launch ships, or military salaries of Air Force personnel.

ward a more advanced vehicle capable of the next quantum jump in hypersonics—from the achieved Mach 6.73 to a Mach 10 to 12 capability. This is envisioned as an entirely new program involving a new aircraft configuration, new engine, structure, and materials, as well as advanced manufacturing technology. This new development might cost \$500 million to \$1 billion—and this estimate could turn out to be conservative. Are we ready to design a new research aircraft having a Mach 10 to 12 capability? The consensus is that we are not. But the time is right to start focusing on the requirements for such a vehicle so that it can be ready, perhaps, in eight to ten years.

An air-breathing engine would seem preferable to a rocket powerplant. It would provide greater duration at a given hypersonic speed within a sensible atmosphere, plus saving considerable weight because no oxidizer would have to be carried in the aircraft. Garrett Corporation's AiResearch Division is now developing a ramjet engine under contract for NASA. The engine is not projected to propel the X-15, but would be carried aloft for evaluation in the X-15 environment in the Mach 5 to 6 regime. These ramjet tests would indicate the feasibility of Mach 10 to 12 flight with a more advanced ramjet. If the X-15 program is curtailed, the engine would be tested only in a ground facility.

The X-15 has greatly advanced the understanding of manned flight in the region of hypersonic aerodynamics, heating, stability and control, and bioastro-

nautics. It has underscored the value of the pilot in a near-space environment and has indicated its utility for contributions to manned space programs. Through operational use of simplified techniques, the X-15 program has emphasized reliability and its offshoot—safety.

Lessons for Space Operations

For future operations in space, the X-15 has strikingly demonstrated the technology of lifting entry—a technique destined to play a critical role in controlled return to earth. The X-15 is more like a lifting body than an aircraft during its hypersonic glide phase, which follows the staging, boost, and exoatmospheric ballistic phases. There is a direct relationship between X-15 experience and what might be expected in the advanced technology development for lifting flight vehicles such as the lifting body and recoverable, manned, first-stage boosters.

Operational data from X-15 operations in near space in the ballistic regime and in reentry management and terminal area guidance control are applicable to lifting-body problems. The staging and boost area experience of the X-15 and, to some extent, the energy management and terminal control, are more applicable to the manned, recoverable booster problem.

While conditions for staging of the recoverable booster are not the same as those for the X-15, the staging functions are similar. For example, the booster might stage at 70,000 to 100,000 feet altitude, whereas the X-15 stages at 45,000 feet (dropped from the B-52 mother ship). Pilot control of the boost appeared to be the only way to conduct this phase with the X-15, and its successful achievement tends to support the ability of a pilot to control a space booster. And whether it would be a first- or second-stage booster or

(Continued on following page)

MAIN X-15 CONTRACTOR PARTICIPATION

Primes:

Airframe: North American Aviation Inc.'s (now North American Rockwell Corp.) Los Angeles Division

Powerplant: Thiokol Chemical Corp.'s Reaction Motor Division

Subcontractors:

Auxiliary Power Units: General Electric Co.

Ballistic Control System: Bell Aerosystems Co. of Bell Aerospace Corp.

Adaptive Control System: Honeywell Inc.

Cooling and Pressurization: Garrett Corp.'s AiResearch Division

*Inertial Guidance: Sperry Rand's Sperry Gyroscope Division

Ball Nose: Northrop Corp.'s Nortronics Division

Pressure Suit: David C. Clark Co.

*Originally in all three aircraft. Subsequently No. 1 and No. 3 aircraft received Honeywell inertial guidance system, and the Sperry system in No. 2 aircraft was modified by NASA.



One finding of X-15 program was that pilots experienced excessive heart rates just before launch from the B-52, indicating tense anticipation rather than physical stress. Above, one of the early airdrops from B-52 mother ship.

an orbital-injection stage shouldn't make any difference, because the acceleration levels of the X-15 during the boost and guidance tasks are the same as those required for a manned boost vehicle, whether a first or second stage.

It's likely, too, that X-15 experience in the boost area played a controlling part of the decision of the NASA Manned Space Group that man should fly and control the Apollo program's lunar ascent vehicle. With a pilot, the margins for successful completion in face of malfunction and anomalies are much greater.

X-15 Contributions in Near Space

In the ballistic region, in near-space flight, the contributions of the X-15 in judging man's ability to use jet reaction for control are now history, but they served as the pathfinder for the Mercury, Gemini, and Apollo spacecraft, which have used X-15 experience in the design of control systems and for providing manual backup. This appears to have been a very wise decision, because the success of several of the spacecraft missions depended on the use of manual control, following malfunction of the automatic system. It's likely that other future manned spacecraft will rely on X-15-developed reaction-control technology.

Lifting entry involves a pullout and a glide, in contrast to ballistic entry, which is simply a deceleration along the original flight path. The X-15 manned entry experience (control capability, management of deceleration energy, and human tolerance to entry environment) appears applicable to all lifting entry vehicles. But, on a comparative basis, the X-15 entry is more severe than orbital entry and probably would be nearly equivalent to a boost-abort entry. Most critical task of the entry phase would be to establish and maintain the required entry attitude. This technique was unknown before the information was generated by X-15 experience. By the same token, the task would be no less critical for any follow-on entry vehicle but no more demanding than that encountered with the X-15. The follow-on entry vehicles could include a boost vehicle's manned, recoverable second stage or a space ferry. Both of these are envisioned for future development but are still in the conceptual stage, with no approved mission for either.

An entry vehicle would have an initial speed of 24,000 feet per second, or greater, and decelerate while gliding down to a speed of 6,000 feet per second. From this point on, the remainder of the entry glide can be simulated with the X-15 down through landing. During this terminal maneuvering phase, X-15 experience has demonstrated that the pilot, with assist from the ground, can maneuver to a desired landing site and touch down on the runway, without power.

The footprint size of the X-15 also simulates that which would exist for the entry vehicle. The X-15 has demonstrated the ability to cope with the demands of energy management and approach maneuvering in approximately 180 flights, and in ninety percent of the occasions has landed within 1,000 feet of the planned touchdown point.

Manned Research Lifting Bodies

The reason why NASA decided to establish the design of its first manned research lifting bodies—the Northrop M-2 and HL-10—as rocket-powered air-launched vehicles was the direct result of the operational procedures demonstrated successfully with the X-15. The Air Force's Martin X-24 manned research vehicle also drew on X-15 experience.

With the M-2 lifting body, the X-15 approach pattern already has been simulated (unpowered fifth flight of the M-2, piloted by NASA's Milton O. Thompson). This simulation consisted of a circling approach to a landing at a planned location on the runway. This full circle pattern has not yet been demonstrated with the HL-10 lifting body. Thus far, there have been seventeen glide flights with the M-2 and four glide flights with the HL-10.

The aim of the M-2 and HL-10 programs is to demonstrate the same terminal energy management beginning at about Mach 2, and the subsequent low lift-to-drag ratio approach, as with the X-15. For powered flight with these vehicles, the air launch from the B-52 will be at 45,000 feet and Mach number of about 0.7, when the rocket engines will be ignited, followed by accelerating climb to 80,000 feet and Mach 2 speed (burnout). From this point down to landing the energy management curve of an entry mission vehicle will be simulated.

Another significant contribution of the X-15 program has been its valuable assistance in establishing the validity of existing ground facility measurements (wind tunnels, laboratories, and other simulation facilities) and analytical procedures for predicting the behavior of vehicles in aerodynamic regimes extending to hypersonic speeds.

It also has revealed, in the hypersonic flight environment, phenomena which could not be predicted within the capability of existing ground facilities, indicating the need for continued advanced research aircraft of which the X-15 has been a pioneer.

Thus, X-15 flights have revealed that aerodynamic heating predictions for hypersonic speed have over-predicted the heat transfer rate by approximately thirty to forty percent.

Also, some local heating effects could not be predicted and caused such damage as buckling and cracking. Buckling was experienced on side panels, on



Pioneer X-15 pilots, from left, NASA's Joe Walker, AF's Bob White, NAA's Scott Crossfield.



McKay



Rushworth



Thompson



Engle

the skin behind the heat shield leading edge, and on the retainer for the canopy glass, causing the windscreen to crack. Initial indications were that the glass wouldn't be subjected to more than 750 degrees Fahrenheit, but subsequent investigations indicated that the glass would attain the same temperatures to which the adjacent Inconel X structure was heated, introducing a condition which could have been catastrophic in flight. The windscreen design and shape of the retainer frame were changed to minimize hot spots and the chance of cracking. This heating problem, though confined to a local area, underscored the difficulty associated with predicting thermal stresses for such a condition. In some instances X-15 program managers have been using predictions corrected by flight-determined empirical factors to anticipate the heating effects during X-15 flights.

Hypersonic Flight

Conditions of hypersonic flight, particularly relating to the skin temperature level, had been completely investigated in previous studies of the heat transfer from a turbulent boundary layer. Early X-15 flights revealed that the turbulent boundary-layer heat-transfer coefficient was lower than those predicted by methods current at that time (prior to 1961). As a result, the methods, which previously had been developed from wind-tunnel data, were revised. Tunnel experimenters thus reevaluated the effects of skin temperature and defined trends toward lower heat transfer rates, which had been demonstrated during X-15 flights.

The X-15 program also has established that experimental skin friction is lower than predicted for hypersonic speeds. With increases in speed, skin friction becomes an increasing part of over-all drag. X-15 experience has indicated that over-all drag at hypersonic speed may be less than previously predicted.

The skin-friction coefficient findings plus the heat-transfer flight results point out the necessity, for prediction purposes, to simulate as nearly as possible the vehicle boundary-layer conditions in ground facilities in testing models. This can't always be done; hence new facilities and revision in prediction procedures

may be required, relying more on the empirical factors determined in the X-15 program.

The same uncertainties in the areas of heat transfer (as well as other aerodynamic and system areas) would apply to any vehicle designed for the next quantum jump to Mach 10 or 12, as they applied to
(Continued on following page)

PILOT PARTICIPATION

Pilots, in the order of their participation in the X-15 program, their affiliations during the program, and total flights for each, are shown below:

Pilot	Number of Flights
*A. Scott Crossfield, North American Aviation, Inc. (now North American Rockwell Corp.)	14
**Joseph A. Walker, NASA	25
Col. Robert M. White, USAF	16
John B. McKay, NASA	29
Lt. Col. Robert A. Rushworth, USAF	34
Capt. Forrest S. Petersen, USN	5
Neil A. Armstrong, NASA	7
Milton O. Thompson, NASA	14
Maj. Joe H. Engle, USAF	16
Maj. William J. Knight, USAF	14
William H. Dana, NASA	13
**Maj. Michael J. Adams, USAF	7
	194

On the three aircraft, up to and including 194 flights, there has been a total of 105,191 seconds of combined powered and free flight. Powered flight time alone was 21,255 seconds. Total time above Mach 6 was about 76 seconds.

*Now Eastern Airlines' Division Vice President for Flight Research and Development.
**Deceased.

the X-15 in raising the speed barrier from Mach 3 (X-2 research aircraft) to the peak speed of Mach 6.73.

Thermal Expansion

Effects of thermal expansion on the functioning of systems has indicated some critical areas. For example, both the nose gear and the main gear (skids) of the X-15 have been inadvertently deployed in flight due to thermal expansion. In the nose gear, the latch was unlocked by heat effects as surely as if the pilot had pulled the release handle. With the main gear in the stowed position, the strut bowed under the influence of thermal gradients, overloading the uplock hook, causing it to fail and release the gear. Redesign solved both problems.

Each of these gear deployments occurred at about Mach 4 speed, obviously well above the intended operational envelope for the gear system. Either incident could have resulted in a crash landing if the gear had not "miraculously" held together.

In other cases, the low temperature at altitude, plus the influence of cryogenics in areas affected by liquid oxygen (minus 300 degrees Fahrenheit), have caused problems. These difficulties generally have had to be solved by use of insulation or electrical heaters. In effect, it has been a matter of providing an environment suitable for the device, where the initial design of the equipment cannot incorporate the protection.

Effects of local heating also focused attention on the need for design study of small, but potentially critical, structural areas. The slot in the Inconel X leading edge of the wing induced a turbulent flow, which caused a local hotspot around and behind the slot, in turn causing the Inconel X skin to buckle. Applying cover plates to the slot was a relatively simple correction, but the problem showed that small discontinuities can produce severe local heating as a structural hazard. In another case, inadequate provision was made for expansion of the side fairings attached to the cold structure of the internal propellant tanks. Local buckling resulted, causing an increased



Front view of X-15 with auxiliary propellant tanks, which are jettisoned during flight and recovered by parachute housed in tank forward section. Ball nose of aircraft is attitude sensor. Note elliptical windscreens on cockpit.

heating rate and providing a focal point for potential structural damage. Solution was to provide simple expansion slots.

Use of Ablative Coating

An ablative coating—as may apply to future entry vehicles—was applied to the No. 2 aircraft to protect skin and substructure from heat effects for flights above the Mach 6 design speed, for a capability between Mach 7 and 8. The ablative coating burned off the lower ventral during a recent flight of the aircraft, holes were burned in the Inconel X skin, and some of the substructure also was burned. This incident was caused by flow off the underslung mockup of a ramjet engine carried during flight to a top speed of Mach 6.73. Temperatures encountered were well above 2,000 degrees Fahrenheit.

Anticipating the need for more advanced, lightweight, high-temperature structures technology for future application, Lockheed California Company has been working under a NASA contract to develop an X-15 outer wing panel with a span of about four feet, which would serve as a structural techniques and materials test-piece for hypersonic flight. Aim was to see if the outer wing panel would behave in a flight environment of perhaps Mach 7 as predicted by the structural design. This structure was programmed to be substituted for an equivalent right wing portion on the X-15 No. 2 aircraft, but probably won't be ready for installation for two years. Object is to determine correlation, using the same structure, between flight data and ground facilities comprising a heated wind-tunnel and high-temperature loads calibration facility. Because of the time gap, the structure isn't likely to be tested in flight on the X-15.

Emphasis also has been focused on the need to test systems in their entirety rather than individual components. This applies to both mechanical and electrical

(Continued on page 71)



—Wide World Photos

Maj. William J. Knight is helped from X-15 after record flight to 4,534 mph (Mach 6.73), October 3, 1967, at Edwards AFB, Calif. White coating on X-15 is ablative material to protect the aircraft to temperatures of 1,500° F.

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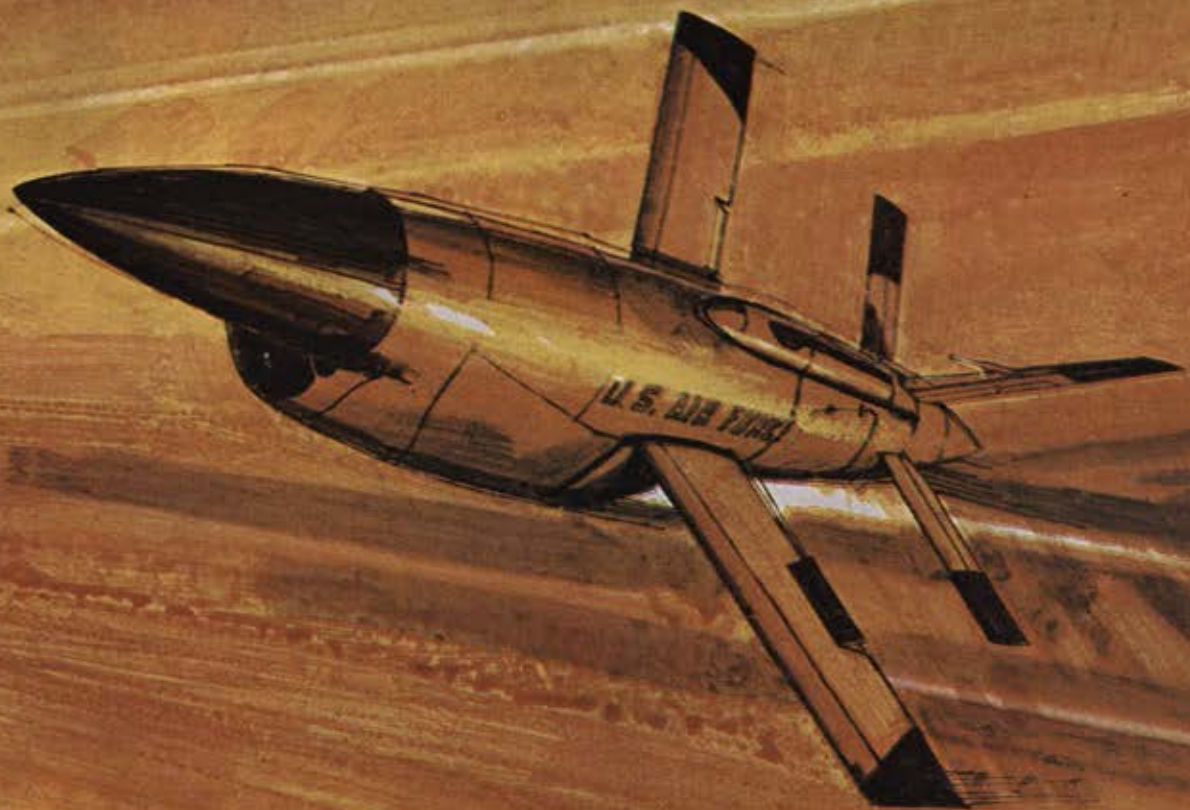
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In record time, Boeing tripled the Chinook's ton-mile productivity.

Boeing's first Chinook, the CH-47A, which met all performance guarantees and was named the Army's standard medium transport helicopter, had a maximum payload of 13,800 pounds, with a speed of 107 mph.

In June, 1966, Boeing was awarded the contract for two new Chinook models—the CH-47B and C.

In May, 1967, Boeing delivered the first B models. They could lift 19,300 pounds and fly 172 mph.

In March, 1968, Boeing started delivery of the C models. These will lift 23,100 pounds and fly 183 mph.

In less than two years, Boeing's Vertol Division made the Chinook lift 69% more, go 72% faster and 72% farther, achieving a tripling of ton-mile productivity.

BOEING HELICOPTERS

installations. For example, high-altitude corona effects have been underscored by X-15 experience. Arcing has caused malfunctions in other systems not related to the system which experienced the corona. An example is the digital computer, which is particularly affected by electrical disturbances, causing the computer to malfunction and, in turn, affecting the navigation displays and creating a critical situation.

Effects of Altitude

Effects of altitude have been encountered in other instances. In some of the early flights, several auxiliary power unit gearbox failures resulted from the lubricating oil foaming at high altitude, causing insufficient cooling and lack of lubrication of the pinion gear. The simple expedient of pressurizing the gearbox prevented the oil foaming. These failures were random in nature but could have occurred simultaneously on each of the two (redundant) APU systems. This situation would have deprived the aircraft of hydraulic power, with resultant loss of control.

New capability in high-speed stability and control has been demonstrated with the X-15. The No. 1 and No. 2 aircraft are fitted with conventional control systems having irreversible, hydraulically operated surface controls with three-axis damping augmentation. For flights in thin air outside the appreciable atmosphere, the X-15 uses a ballistic control installation—the first such system. Eight hydrogen peroxide rockets (thrusters) in the nose of the aircraft control pitch and yaw. Two other rockets are located on each wing for roll control. This first application of reaction jets involves use of a separate controller by the pilot.

The No. 3 aircraft (lost in November 1967, as a result of a system malfunction leading to an uncontrollable maneuver which exceeded the X-15's structural limits) utilized the Honeywell adaptive control system developed under Air Force contract. The concept had been tested on the F-101 during the development phase, but use of the system in the X-15 was the first application in a high-performance aircraft with a very large operational range of speed and dynamic pressure. The system is designed to adapt its control functions to the local operating environment—to move its own system gains to provide optimum control. In the No. 3 aircraft the aerodynamic controls and the reaction (ballistic) controls were blended.

Faith in this advanced control system and its reliability permitted the No. 3 aircraft to go to a higher altitude—peak of 354,200 feet—than ever achieved with the No. 1 or No. 2 aircraft. The system performed according to requirements and provided adequate control for entry from peak altitude. This probably was the most critical regime for testing the system. Program managers claim an X-15 aircraft would not have been programmed to this altitude with conventional controls.

Use of the X-15 as a proving vehicle for the system has been summed up by program personnel as follows: "An adaptive control system that has been successfully demonstrated in the X-15 is worth about ten proposed new adaptive concepts that have not been exposed to the idiosyncracies of control system hardware."

X-15 CRASH INVESTIGATION

In all the 194 flights of the X-15, despite the fact that the aircraft was operating in an environment about which little is known, there has been only one fatal crash. It occurred on November 15, 1967.

Congressional testimony, recently released, disclosed that the rocket-powered aircraft broke up in flight after hitting the earth's atmosphere sideways at 4,000 miles an hour.

In his testimony, NASA Chief James C. Webb speculated that the pilot, Maj. Michael J. Adams, may have reentered the atmosphere in the wrong attitude from fifty miles high because he misread the instruments.

"He slid into the atmosphere sideways," said Mr. Webb. "This aircraft comes in at a terrific speed and the effect is just like a spacecraft hitting the air."

Because the adaptive control system was designed to provide control over a large dynamic pressure range, this undoubtedly contributed to its selection for the F-111, which has a design capability for high speed at low altitude.

Physiological Measurements

Physiological measurements in the X-15's severe operational environment have been generated for a keener understanding of the pilot's adaption to hypersonic and space flight. Prior to the X-15 program, physiological measurements were relatively meager. One of the important X-15 findings was that excessive heart rates—averaging 145 to 160 beats per minute and, in some cases, as high as 185 per minute—mostly occurred before launch of the vehicle from the B-52, indicating tense anticipation rather than direct physical stress.

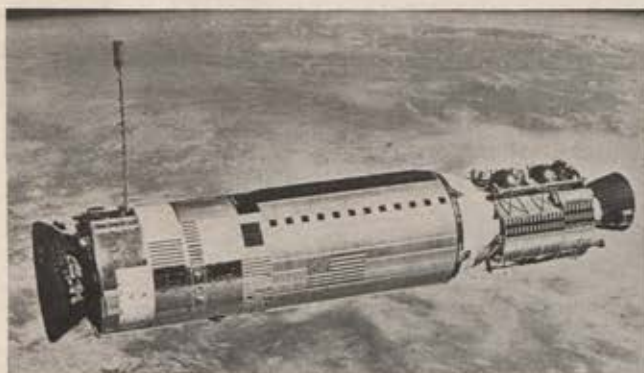
The aeromedical work, in which the Air Force Aeronautical Systems Division's Aeromedical Laboratory, the Flight Test Center's Bioastronautics Branch, and the School of Aviation Medicine participated, also resulted in development of instrumentation techniques for integration with pressure suits.

Pressure suit technology developed for the X-15 has been adapted for USAF's Air Defense Command fighter squadrons and for space programs.

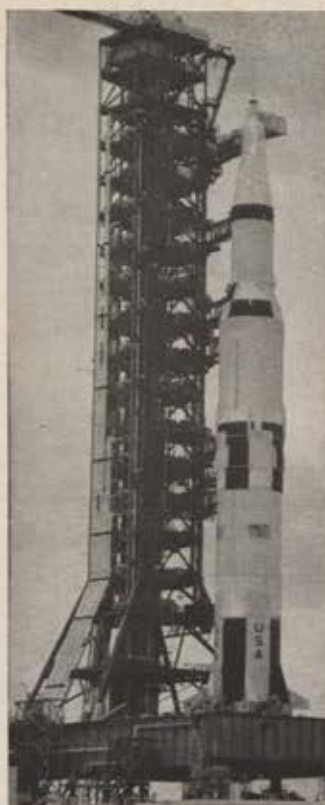
A workhorse test-bed role for the X-15 encompasses approximately forty wide-ranging experiments contributing valuable data, each associated with high-speed, high-altitude, or high-heat flights. These involve such investigations as optical degradation, high-temperature window analysis, heat transfer at zero-G, infrared scanning and background measurements, zero-G expulsion, and simultaneous photographic horizon scanner.

Many of the experiments have been completed. Others are in flight status, or in design or fabrication phases. The experiments are being conducted for Air Force and NASA, or by NASA for other organizations.—END

The Boosters



Agena (photographed from Gemini)



Apollo-Saturn V



Uprated Saturn with proposed boosters

Saturn

Booster for US heavy spacecraft, including manned Apollo moon-landing program; 2 versions of Saturn are being built—Uprated Saturn I (formerly Saturn IB), 2-stage booster capable of putting 20 tons in earth orbit; and Saturn V, 3-stage vehicle capable of placing more than 140 tons in earth orbit or sending 49 tons to the moon; original Saturn I program completed; **prime contractor**—NASA's Marshall Space Flight Center, systems engineering, assembly, and guidance; **length** (without spacecraft)—Uprated Saturn I, 142 ft.; Saturn V, 281 ft.; **diameter**—Saturn I, 21.7 ft.; Saturn V, 33 ft.; **launch weight**—Saturn I, 1,006,000 lb.; Saturn V, more than 6 million pounds; **thrust**—Uprated Saturn I: first stage (S-IB), 8 H-1 engines, 200,000 lb. thrust each, totaling 1.6 million pounds; second stage (S-IVB), 1 J-2 engine, 200,000 lb. thrust; Saturn V: first stage (S-IC), 5 F-1 engines, each 1,500,000 lb. thrust; second stage (S-II), 5 J-2 engines, each 200,000 lb. thrust; third stage (S-IVB), 1 J-2 engine; **guidance**—inertial; **status**—first manned flight of Saturn V with Apollo spacecraft is scheduled for August or September, after 2 flight tests of unmanned Saturn V system in November 1967 and April 1968. Though April test was not entirely successful, NASA concluded flaws would not have endangered astronaut crew members; manned flight this year keeps Apollo project on schedule for lunar landing by 1970; Uprated Saturn I with strap-on auxiliary rockets proposed for post-Apollo applications; **other contractors**—S-IB stage, Chrysler Corp.; S-IVB, McDonnell Douglas, Marshall Space Flight Center; S-IC, Boeing; S-II, Space and Information Systems Div., North American Rockwell; propulsion, H-1, F-1, J-2, Rocketdyne Div., North American Rockwell; control computer, Electronic Communications, Inc.; ST-124 inertial platform, Bendix Corp.; launch vehicle digital computer and data adapter, IBM Federal Systems Div.

Titan II

(See entry under USAF missiles.)

Titan III

Standardized space launch system for variety of manned and unmanned booster missions, including USAF's Manned Orbiting Laboratory. Among principal configurations are Titan III Common Core Vehicle, an outgrowth of Titan II with Transtage,

an upper stage; Titan IIIC, common core plus 2 5-segmented strap-on motors of more than a million pounds thrust; manned Titan IIIM, with 7 segments in each strap-on motor, which will be used to launch MOL; Titan IIIB, employing first 2 stages of common core and Agena upper stage; Titan IIID, outgrowth of Titan IIIB, and consisting of first 2 stages of common core, with 2 solid-rocket motors like those on Titan IIIC; employs integrate-transfer-launch (ITL) complex, permitting booster to be completed, assembled, and checked out in assembly area, then moved intact to simplified launch pad, reducing time on pad and number of pads required; **system integrator and airframe**—Martin Marietta; technical assistance, Aerospace Corp.; **length**—core, 124 ft.; IIIC, 127 ft.; IIIM, with MOL, 145 ft.; **diameter**—core, 10 ft.; IIIC, 30 ft.; **launch weight**—core, 345,000 lb.; IIIC, 700 tons; IIIM, 850 tons; **thrust**—core, 430,000 lb.; IIIC, 2,870,000 lb.; IIIM, 3,300,000 lb.; **guidance**—all-inertial; **status**—core vehicle made first flight in September 1964, IIIC in June 1965; being used to launch Initial Defense Communications Satellites, VELA, tactical communications satellites, and multiple engineering payloads; **other contractors**—propulsion, Titan III core, Aerojet-General; strap-on booster segments, United Technology Center; guidance, AC Electronics Div., GMC.

Atlas

Developed for USAF by Convair Division of General Dynamics, Atlas boosters have been used for more than 350 DoD and NASA missions, alone or in combination with Agena or Centaur upper stages; man-rated Atlas was booster for US manned Mercury flights. Currently, 2 new versions of Atlas—the SLV-3A, for use with Agena, and SLV-3C, for use with Centaur—are in production. Both are uprated versions of first standard Atlas space-launch vehicle, SLV-3. SLV-3A is 117 inches longer than earlier SLV-3, increasing usable propellants by 48,000 lb. SLV-3C is 51 inches longer and carries an additional 21,000 lb. of usable propellants. SLV-3A first mission was successful launch of NASA Orbiting Geophysical Observatory early in 1968. SLV-3C successfully launched final 3 missions in Project Surveyor. Missions ahead for SLV-3C include launching Orbiting Astronomical Observatories, an Applications Technology Satellite, and 2 Mariner-Mars flybys in 1969. **Prime contractor**—Convair Div., General Dynamics; **length**—



Titan IIIC



Atlas-Agena



Thrust-Augmented-Thor



Scout



Atlas-Centaur

SLV-3A, 89 ft.; SLV-3C, 83 ft.; diameter—10 ft.; launch weight—SLV-3A, 311,000 lb.; SLV-3C, 284,000 lb.; guidance—radio command; other contractors—propulsion, Rocketdyne Div., North American Rockwell; guidance, General Electric.

Thor

Space booster in combination with various upper-stage vehicles, as Thor-Able, Thor-Delta, Thor-Agena D, and Thor-Burner II; currently employed primarily in Thrust-Augmented-Thor (TAT) and Long-Tank-Thor configurations; TAT is equipped with 3 solid-propellant strap-on motors with 55,000 lb. thrust each, increasing total first-stage thrust to 330,000 lb.; Long-Tank-Thor combines all TAT features with new propellant tankage, providing substantial increase in payload capacity; higher-thrust strap-ons (to 70,000 lb. thrust each) under development; Air Force also procures Thors for NASA for use as first stage of Delta and Thrust-Augmented-Delta (TAD) boosters; prime contractor—McDonnell Douglas; length—76 ft. to 90 ft.; diameter—8 ft.; launch weight—120,000 lb. or more; thrust—basic Thor, 160,000 lb.; TAT, 330,000 lb.; Long-Tank-Thor, 357,000 lb.; payload—800 lb. for Thor-Delta to 2,600 lb. for Long-Tank-Thor in earth orbit; 250 lb. or more to escape velocity; has launched scores of unmanned space vehicles, including Discoverer and classified military satellites, Telstar, Syncom, Transit, Tiros, and Nimbus; other contractors—propulsion, Rocketdyne Div., North American Rockwell (basic Thor), Thiokol (strap-on motors); guidance, Bell Telephone Labs, Honeywell.

NASA/DoD Scout

Four-stage, solid-propellant launch vehicle used by NASA, agencies of the Department of Defense, and a number of foreign nations for orbital, high-altitude probe, and high-speed reentry space projects. Recent solid-motor improvements, including fourth-stage motor by United Technology Center and second-stage motor by Thiokol, have upgraded performance considerably; it can place 320-pound payload in nominal 300-nautical-mile orbit; prime contractor and systems manager—Missiles and Space Division, LTV Aerospace Corp.; length—72 ft.; diameter—3 ft. 4 in.; weight—40,000 lb.; thrust—first stage, Algol IIB, 105,000 lb.; second, Castor II, 60,000 lb.; third, Antares II, 22,000 lb.; fourth, FW-4S, 6,000 lb.; all solid propellant; alternate stages may be substituted; guidance—inertial; status—operational with NASA and DoD; payload—has launched dozens of unmanned spacecraft, including Explorers and classified military satellites, space probes, and reentry ve-

hicles; other contractors—propulsion, Aerojet-General, Thiokol, Allegany Ballistic Laboratory, Hercules, United Technology Center; guidance, Honeywell.

Agena D

Upper-stage booster and spacecraft used in combination with Atlas and Thor; served as rendezvous vehicle in Gemini program; Atlas-Agena combination has launched numerous space vehicles, including Ranger, Samos, OGO, Mariner, Lunar Orbiter, and VELA. Thor-Agena provided boost for Echo, Nimbus, Discoverer, and others; employs restartable liquid-fueled engine with 16,000 lb. thrust; AFSC issued contract in 1967 for Agena E to accommodate heavier satellite payloads; program involves modifying engine to operate on storable propellant, developing secondary propulsion module operating off main tanks, and increasing over-all thrust; prime contractor—Lockheed Missiles & Space Co.; other contractors—propulsion, Bell Aerosystems; guidance, Honeywell.

Burner II

Upper-stage booster, adaptable to any standard USAF launch vehicle, bridging payload gap between Scout booster and more expensive Agena and Ablestar upper stages; may become fourth stage of Minuteman I when that former ICBM enters on new career as spacecraft booster; prime contractor—Boeing Co.; status—operational since March 1967; other contractors—propulsion, Thiokol; guidance, Honeywell; gas reaction control, Walter Kidde; nose shroud, Goodyear.

Centaur

Two-stage booster with Atlas Standard Launch Vehicle-3C first stage, Centaur second stage, latter powered by 2 Pratt & Whitney RL-10 liquid-oxygen/liquid-hydrogen engines capable of being stopped and restarted in space; NASA's prime vehicle launching Surveyor spacecraft to soft landings on moon; Centaur combinations with Titan II, III, and Saturn under study; prime contractor—Convair Div. of General Dynamics; length—30 ft.; diameter—10 ft.; launch weight—322,000 lb.; thrust—Atlas first stage, 395,000 lb.; Centaur second stage, 30,000 lb.; payload 11,800 lb. into earth orbit; 2,900 lb. on lunar trajectory; 2,100 lb. to Venus and Mars; guidance—inertial; status—operational; launched Surveyor series for unmanned moon probes; selected to launch Application Technology Satellites, Orbiting Astronomical Observatories, and Mariner spacecraft and Mars flyby in 1969; other contractors—RL-10 engines, Pratt & Whitney; guidance, Honeywell.

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Mace B



Minuteman



Bomarc B



Titan II

CGM-13B Mace

Type—tactical, air-breathing, surface-to-surface missile launched from fixed, hardened sites; **prime contractor**—Martin Marietta; **speed**—600 mph plus; **range**—1,200 mi.; **length**—44 ft.; **diameter**—4.5 ft.; **span**—22 ft. 9 in.; **launch weight**—18,000 lb.; **power system**—J33 turbojet with 5,200 lb. thrust, plus rocket booster of 100,000 lb. thrust for zero launch; **guidance**—inertial; **warhead**—conventional or nuclear; **status**—1 Mace B squadron remaining in Germany is being phased out in favor of Army's Pershing missile; remaining Mace Bs deployed in Okinawa are tentatively scheduled to remain through 1972; **other contractors**—engine, Allison; booster, Thiokol; guidance system, AC Electronics Div., GMC, General Mills.

LGM-25C, Titan II

Type—2-stage, liquid-propellant ICBM; man-rated Titan II was launch vehicle for NASA-DoD Gemini program and serves as core for Titan III (see "The Boosters," page 72); employs storable propellants and is silo-launched in less than a minute; has thrust, range, and payload greater than any other US ICBM; **prime contractor**—Martin Marietta; **speed**—over 15,000 mph; **range**—over 9,000 mi.; **length**—103 ft.; **diameter**—10 ft.; **launch weight**—330,000 lb.; **power system**—first-stage thrust, 430,000 lb.; second stage, 100,000 lb.; **guidance**—all-inertial; **warhead**—nuclear; **status**—pairs of Titan II squadrons, 9 missiles per squadron, are based at McConnell AFB, Kan.; Davis-Monthan AFB, Ariz.; and Little Rock AFB, Ark.; 54-missile force to be retained through FY 1973; procurement ended, but production capability is on standby basis; **other contractors**—technical direction, TRW Systems, Inc.; propulsion system, Aerojet-General; guidance, AC Electronics Div., GMC; reentry vehicle, General Electric.

LGM-30A, B, F, G Minuteman

Type—solid-propellant ICBM; principal US deterrent missile weapon; program includes 6 Minuteman wings with total of 1,000 missiles; LGM-30As being replaced by -30Fs; studies now in progress to develop engineering and support requirements to convert replaced Minuteman Is into spacecraft boosters; because initial deployment of LGM-30G, Minuteman III, has slipped, phasedown of Minuteman I will be slowed to compensate for slippage. Advances of strategic significance are being made to give it "very good chance" of penetrating an ABM defense system; **systems integration contractor**—Boeing Co.; **speed**—over 15,000 mph; **range**—6,300 mi. in LGM-30B to 8,000 mi. or more in LGM-30F, G; **length**—30B, 56 ft.; -30F, 57 ft. 6 in.; **diameter**—6 ft. 2 in.; **launch weight**—70,000 lb.; **power system**—3-stage solid-propellant rockets; first stage, 170,000 lb. thrust; second stage, 65,000 lb. (A & B models); third stage, 35,000 lb. (A & B models); **guidance**—all inertial; **warhead**—nuclear;

status—Wing I, Malmstrom AFB, Mont., has 50 -30Fs, and 150 -30As being replaced by -30Fs; Wings II, III at Ellsworth AFB, S. D., and Minot AFB, N. D., have 150 -30Bs each; Wings IV, VI, Whiteman AFB, Mo., and Grand Forks, N. D., have 150 -30Fs each; Wing V, Warren AFB, Wyo., has 200 -30Bs; as more -30Fs and -30Gs become available they will replace -30As and Bs; -30Gs are to be equipped with improved third stage which will further increase payload; **other contractors**—systems engineering and technical direction, TRW Systems, Inc.; propulsion, first stage, all models, Thiokol; second stage, all models, Aerojet-General; third stage, -30B, F, Hercules; -30G, Aerojet-General; guidance, Autonetics Div., North American Rockwell; reentry vehicle, Avco, General Electric; post-boost control system for reentry vehicle, Bell Aerosystems; F-model ground electronics system, Sylvania.

Advanced ICBM

Following completion of a comprehensive study of new strategic ballistic missile systems last summer, Department of Defense has requested \$56 million in FY 1969 budget for advanced ICBM technology.

CIM-10B Bomarc B

Type—surface-to-air, winged area-defense missile; **prime contractor**—Boeing Co.; **cruise speed**—2,000 mph; **range**—440 mi.; **ceiling**—100,000 ft.; **length**—45 ft.; **diameter**—35 in.; **span**—18 ft. 2 in.; **launch weight**—16,000 lb.; **power system**—solid-propellant booster, 50,000 lb. thrust; 2 ramjet cruise engines, 16,000 lb. thrust; **guidance**—homing radar; **warhead**—nuclear; **status**—operational, with total of 188 missiles at 6 US sites (Duluth, Minn.; Kincheloe AFB, Mich.; Langley AFB, Va.; McGuire AFB, N. J.; Niagara Falls Municipal AP, N. Y.; and Otis AFB, Mass.) and 2 RCAF sites; production completed; **other contractors**—booster, Thiokol; ramjet engines, Marquardt; guidance, General Precision, Westinghouse, IBM; fuze, Bendix; erector-launcher, FMC Corp.

AIR-2A Genie

Type—air-to-air rocket; **prime contractor**—McDonnell Douglas Corp.; **speed**—Mach 3; **range**—6 mi.; **length**—9 ft. 7 in.; **diameter**—17 in.; **span**—2 ft.; **launch weight**—800 lb.; **power system**—solid-propellant rocket, 36,000 lb. thrust; **guidance**—none; **warhead**—nuclear; **status**—operational on F-89J, F-101B, and F-106; may be employed on F-4C; **other contractor**—propulsion, Aerojet-General.

AIM-4A through G; AIM-26A, B; AIM-47A Falcon

Type—air-to-air guided missile, of which 9 configurations are in use, production, or development; AIM-4Bs all converted
(Continued on following page)



Genie



Hound Dog



Hornet



Quail



SRAM



Falcons

to -4Ds; AIM-47A designated as primary weapon for F-12A or projected F-111 interceptors; launched from aircraft at 70,000 to 80,000 feet, it can strike targets from ground to about 95,000 feet at range of 100 miles or more; **prime contractor**—Hughes Aircraft Co.; **speed**—-47A, Mach 6; AIM-4F, G, Mach 3; others, Mach 2; **range**—4F, G, 7 mi.; others, 5 mi.; **length**—-47A, 12.5 ft.; -4F, 7 ft. 2 in.; -4G, 6 ft. 9 in.; -26A, 7 ft.; others 6 ft. 6 in.; **diameter**—-47A, 13 in.; -26A, 11 in.; others, 6.5 in.; **launch weight**—47A, 800 lb.; -26A, 203 lb.; others from 120 to 150 lb.; **power system**—4F, G, 2-stage solid-propellant; others, single-stage solid; **guidance**—4C, D, G, infrared homing; others, semiactive radar homing; **warhead**—-26A, -47A, nuclear; others, conventional; **status**—all but AIM-47A operational; -4C and -26B being produced for Swedish AF by SAAB; carried on F-89J, F-101, F-102, F-106, F-4C; -4D guidance system being modified to make possible tighter turns for "dog-fighting" Falcon; **other contractors**—propulsion, -47A, Lockheed; all others, Thiokol; engine casings, Norris Thermador; fuze and arming, General Sintering, Philco; guidance—Hughes.

AIM-7D Sparrow III

Type—air-to-air missile; *see entry under Navy.*

AIM-9B, E Sidewinder

Type—air-to-air missile; *see entry under Navy.*

AGM-12B, D Bullpup

Type—air-to-surface missile; *see entry under Navy.*

ADM-20C Quail

Type—air-launched, air-breathing missile, simulating B-52 in flight; **prime contractor**—McDonnell Douglas Corp.; **speed**—comparable to B-52 bomber, high subsonic; **range**—250 mi.; **length**—12 ft. 10 in.; **diameter**—2 ft. 6 in.; **span**—5 ft. 4 in.; **launch weight**—1,200 lb.; **power system**—J85 turbojet engine with 2,450 lb. thrust; **guidance**—gyro autopilot; **warhead**—none; carries ECM to confuse enemy radar; **status**—operational; each B-52 bomber can carry several Quail missiles; advanced version with longer range in development; **other contractors**—powerplant, General Electric; guidance, McDonnell Douglas; countermeasures gear, TRW Systems, Inc.; aircraft modification, Boeing.

AGM-28B Hound Dog

Type—air-to-surface, air-breathing SAC standoff missile; **prime contractor**—North American Rockwell; **speed**—Mach 2 plus; **range**—700 mi.; **ceiling**—above 50,000 ft.; **length**—42 ft. 6 in.; **diameter**—28 in.; **span**—12 ft.; **launch weight**—9,600 lb.; **power system**—J52-P-3 turbojet, 7,500 lb. thrust; **guidance**—inertial; **warhead**—nuclear; **status**—operational; will continue at least until 1970; in 1971, with phaseout of B-52C to F, Hound Dog force will be phased down accordingly; new termi-

nal-guidance terrain-following navigation system being added to improve reliability; **other contractors**—propulsion, Pratt & Whitney; guidance, Autonetics Div., North American Rockwell; astrotracker, Kollsman Instrument.

AGM-45A Shrike

Type—air-to-surface missile; *see entry under Navy.*

AGM-62A Walleye

Type—air-to-surface missile; *see entry under Navy.*

ZAGM-64A Hornet

Type—air-to-ground TV-guided missile; **prime contractor**—Columbus Div., North American Rockwell; **guidance**—monitoring cockpit display relayed from missile's seeker head, pilot locates target and locks missile on it; **warhead**—conventional; **status**—description classified.

AGM-65A Maverick

Tactical air-to-ground powered missile, TV-guided; Hughes and North American participating in contract definition; initiation of engineering development expected soon; conventional warhead; intended for A-7D, F-4D, F-111A.

AGM-69A SRAM

Type—short-range, supersonic, air-to-ground standoff attack missile with nuclear capability; Boeing was selected to design and develop SRAM on October 31, 1966; **status**—DoD contract totals \$143.5 million; Air Force has firm option with Boeing to be exercised within 2 years from contract award, for an initial production quantity of SRAM missiles for \$93.5 million; designed to be carried by AMSA and FB-111, adaptable for use on G and H models of B-52; Boeing is responsible for total SRAM system performance, including mating system to carrier aircraft; test program in progress at Holloman AFB, N. M., to run into 1969; **other contractors**—propulsion, Lockheed; guidance, General Precision; B-52 inertial measurement unit, Litton; FB-111 and B-52 computers, Autonetics Div., North American Rockwell; B-52 radiating site target acquisition system, Sylvania Electronics; missile safe-arm fuze, Unidynamics Phoenix.

AGM-76A

Air-to-surface antiradiation missile under development by Hughes; employs Lockheed XSR13-LP-1 rocket motor.

XAGM-79A, 80A

These are experimental approaches toward improving Bullpup air-ground missile effectiveness, being conducted for USAF by Martin Marietta and Chrysler, respectively. Objective is to modify existing Bullpup inventory by incorporating "launch-and-leave" capability. Martin Marietta's is reportedly an optical system, while Chrysler's is inertial.



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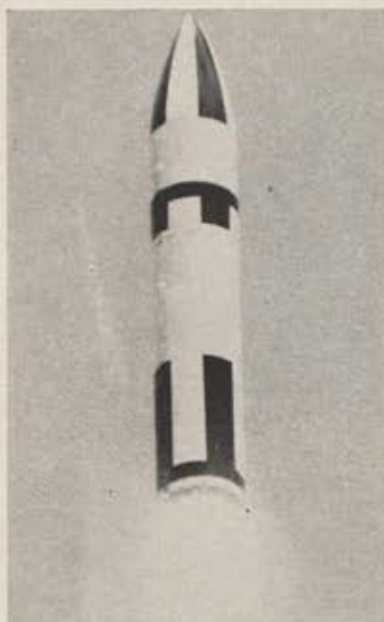


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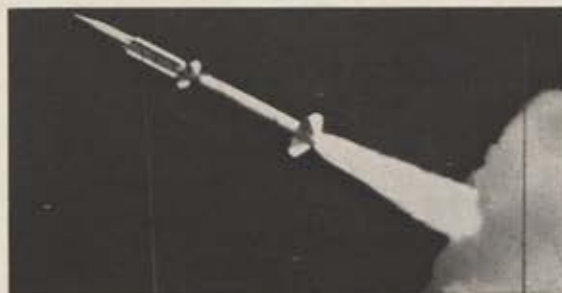
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United States Navy



Polaris A-3



Terrier



Talos



Poseidon



Tartar

UGM-27B, C Polaris

Type—underwater- or surface-to-surface fleet ballistic missile (FBM); deployed on submarines of US Navy; UGM-27C programmed for British Navy; **prime contractor**—Lockheed Aircraft Corp.; **speed**—hypersonic (to Mach 10); **range**—-27B, 1,725 mi.; -27C, 2,880 mi.; **length**—31 ft.; **diameter**—4 ft. 6 in.; **launch weight**—-27B, 30,000 lb.; -27C, 35,000 lb.; **power system**—2-stage solid-propellant rocket; **guidance**—inertial; **warhead**—thermonuclear; **status**—41 Polaris subs with total of 656 missiles operational; 5 subs formerly equipped with -27B and 5 with -27A being converted to -27C; **other contractors**—powerplant, Aerojet-General, first stage; Hercules Powder, second stage; guidance and fire control, General Electric, Honeywell, Hughes, Raytheon; reentry vehicle, Lockheed; launch equipment, Westinghouse; ignition programming, Systron-Donner; systems engineering coordination, Vitro Labs; sub inertial navigation, Autonetics Div., North American Rockwell; about 20,000 contractors in all.

UGM-73A Poseidon

Type—underwater- or surface-to-surface missile, follow-on to Polaris with twice the accuracy and payload of Polaris C; larger payload will permit Poseidon to carry more and larger penetration aids; **prime contractor**—Lockheed Aircraft Corp.; **speed and range**—comparable to Polaris -27C; **length**—34 ft.; **diameter**—6 ft.; **launch weight**—60,000 lb.; **status**—6 Polaris subs will be retrofitted with Poseidon in FY 1969; total of 31 will be retrofitted during regular overhaul cycle; **other contractors**—propulsion, Hercules/Thiokol, first stage; Hercules, second stage; fire control, General Electric; guidance, Raytheon, MIT, General Electric; launch system, Westinghouse; navigation, Sperry Gyro.

RIM-2E Terrier

Type—surface-to-air guided missile for fleet air defense; **prime contractor**—General Dynamics/Pomona; **speed**—Mach 2.5; **range**—beyond 12 mi.; **ceiling**—50,000 ft.; **length**—27 ft., including 12-ft. booster stage; **diameter**—13 in.; **span**—20 in.; **launch weight**—3,000 lb.; **power system**—2-stage solid-propel-

lant; **guidance**—radar beam rider and homer; **warhead**—conventional; **status**—operational; to be replaced by RIM-67A extended-range Standard missile; **other contractors**—systems engineering, Vitro Labs; propulsion, Hercules, Atlantic Research, Allegany Ballistic Lab; guidance, General Dynamics/Pomona, Applied Physics Labs.

RIM-8G Talos

Type—shipboard surface-to-air and surface-to-surface guided missile; capable of much greater range and altitude than present versions of Terrier and Tartar; **prime contractor**—Missile Systems Div., Bendix Corp.; **speed**—over Mach 2.5; **range**—over 65 mi.; **ceiling**—100,000 ft.; **length**—31 ft. 3 in., including 10-ft. booster; **diameter**—2 ft. 6 in.; **span**—9 ft. 6 in.; **launch weight**—7,000 lb., including booster; **power system**—solid-propellant booster to cruise speed, cruises on ramjet engine with 9,000 lb. thrust; **guidance**—beam riding with semiactive homing radar; **warhead**—nuclear or conventional; **status**—operational; RCM-8H surface-to-surface version in development; **other contractors**—airframe, Chambers Aircraft Div. of Altamil Corp.; booster, Naval Ordnance Station, Indian Head, Md.; powerplant, Bendix ramjet; launch gear, General Electric, Northern Ordnance Div. of FMC; guidance, Sperry, Bendix; systems engineering, Vitro Labs.

MIM-23A Hawk

(See entry under Army.)

RIM-24B Tartar

Type—surface-to-air guided missile for fleet air defense; Tartar is approximately same size and has same range and speed capability as Terrier, but requires no separate booster stage and is effective at low as well as high altitudes; **prime contractor**—General Dynamics/Pomona; **speed**—Mach 2.5; **range**—beyond 12 mi.; **ceiling**—50,000 ft.; **length**—15 ft.; **diameter**—13.4 in.; **launch weight**—1,500 lb.; **power system**—1 dual-thrust solid-propellant rocket which lowers thrust for sustained flight after short high-acceleration boost to cruise

(Continued on following page)

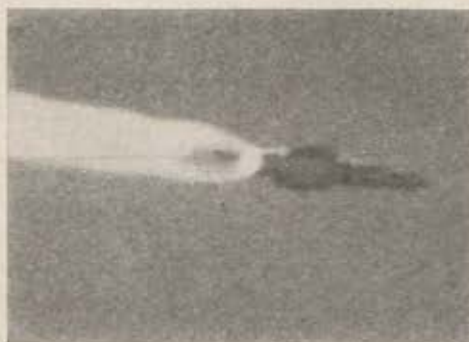
Sparrow III



Phoenix



Sidewinder



Bullpup

speed; guidance—homing; warhead—conventional; status—operational; to be replaced by RIM-66A medium-range Standard missile; other contractors—systems engineering, Vitro Labs; powerplant, Aerojet-General; guidance, Raytheon; fuze, Sperry Farragut, Philco.

RIM-66A, -67A Standard Missile

Type—surface-to-air guided missile, now in production to replace Tartar and Terrier, offering improved reliability, faster reaction time, improved high-altitude and multiple-target capabilities, easier maintenance; will use presently installed control and launching systems with minor modifications; **prime contractor**—General Dynamics/Pomona; **status**—2 versions are being produced—RIM-66A, medium (12 mi.) range, employs dual-thrust rocket motor similar to that currently used by Tartar; RIM-67A, extended-range (35 mi.) version, replacing Terrier, uses 2 individual solid-propellant rockets, booster for initial flight and sustainer for remainder of flight; both employ same high-explosive warhead used in Tartar/Terrier; see also Standard ARM, AGM-78A; other contractors—see Terrier, Tartar entries.

BPDSMS Sea Sparrow

Type—basic point defense surface-to-air missile system for use on amphibious assault ships and destroyers operating independently near hostile land areas; employs modified Sparrow III (see below) installed on existing gun-mount foundations, with greater range and faster reaction time than current systems; being developed under direction of Navy's Ship Missile Systems Engineering Station, Puget Sound, Wash.; advanced PDSMS program, incorporating modified Sparrow III, being designed to meet more sophisticated aircraft or missile threats of late 1970s; development closely coordinated with Army's Advanced Forward Area Air Defense System (AFAADS) program to maximize common use of technology and components.

ASMS

Type—automated integrated air defense system being developed as possible replacement for 3-T (Terrier, Tartar, Talos) systems; because it makes use of some Army SAM-D components (see Army entry), its development lags up to a year behind SAM-D; contract definition phase pending.

AIM-7E Sparrow III

Type—air-to-air guided missile, providing 360-degree attack capability; **prime contractor**—Raytheon Co.; **speed**—Mach 3; **range**—8 mi.; **effective ceiling**—well above 50,000 ft.; **length**—12 ft.; **diameter**—8 in.; **span**—3 ft. 3 in.; **launch weight**—450 lb.; **power system**—solid-propellant rocket; **guidance**—

semiautonomous radar; **warhead**—conventional; **status**—operational; procurement continuing; employed on F-4s in Marine Corps and USAF as well as in Navy; will be used on British F-4K and M and Italian F-104S; advanced Sparrow (AIM-7F) in development for close-in combat, AIM-7G for F-111A; other contractors—propulsion, Rocketdyne Div., North American Rockwell, Aerojet-General, Hercules; guidance, Raytheon.

AIM-9B, C, D, E Sidewinder

Type—air-to-air guided missile; -9C, D are improved versions of -9A, B; -9E, employed by USAF, is similar to -9B but capable of wider angle of attack; **prime contractor**—-9B, Philco, General Electric; -9C, Motorola; -9D, E, Philco, Raytheon; **technical direction**—Naval Ordnance Test Station; **speed**—-9B, Mach 2.5; C, D, Mach 2.5 plus; **range**—B, 2 mi.; C, D, 8 mi.; range increases with altitude; **length**—9 ft.; **diameter**—5 in.; **span**—about 2 ft.; **launch weight**—B, E, 160 lb.; C, D, 185 lb.; **power system**—solid-propellant rocket; **guidance**—B, D, E, infrared homing; C, semiautonomous radar; **warhead**—10 lb. high explosive; **status**—operational; large-scale production for Navy and USAF is continuing; -9B produced in Europe for NATO allies under license; surface-to-air version, Chaparral, being produced for US Army; other contractors—propulsion, B, E, Naval Ordnance Station; C, D, Rocketdyne Div., North American Rockwell; guidance, Philco, Raytheon, General Electric, Motorola; warhead, ACF Industries; motor parts, Norris Thermador; fuze, Eastman Kodak, Honeywell, Baldwin Piano.

AIM-54A Phoenix

Type—long-range air-to-air missile; originally part of fire-control system developed for Navy's F-111B; now that production of F-111B has been deferred, if not canceled, Phoenix is contemplated for use aboard projected Navy VFX-1; Phoenix is designed for fleet air defense as well as air superiority role; **prime contractor**—Hughes Aircraft Co.; **range**—greater than that of any operational air-to-air guided weapon; **length**—13 ft.; **diameter**—15 in.; **launch weight**—1,000 lb.; **power system**—single-stage solid-propellant rocket; **guidance**—radar-homing; **status**—is being flight-tested aboard Navy F-111B in carrier trials; other contractors—propulsion, Rocketdyne Div., North American Rockwell; guidance, Hughes.

AGM-12B, C, D, E Bullpup

Type—air-to-surface guided missile; **prime contractors**—AGM-12B, C, Maxson Co.; -12D, E, Orlando Div., Martin Marietta Corp.; **speed**—B, 1,200 mph; C, D, 1,400 mph; **range**—B, over 2 mi.; C, D, over 3 mi.; **length**—B, 10 ft. 6 in.; C, 13 ft. 7 in.; **diameter**—1 ft.; **launch weight**—B, 571 lb.; C,

(Continued on page 83)



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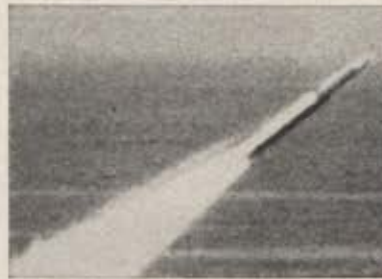
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SUBROC



ASROC

1,785 lb.; **power system**—storable, liquid-propellant rocket; **guidance**—command (radio signals from launch plane); plane must continue to sight on target to guide missile to impact; improved guidance system which will enable pilot to "launch and leave" being developed for USAF by Martin Marietta and Chrysler, designated XAGM-79A and -80A, respectively; **warhead**—B, C, conventional; D, nuclear or conventional; **status**—operational on aircraft of Navy, Marine Corps, USAF; very effective against hardened targets, though pilot is vulnerable to ground fire as he must fly along missile's path to guide it onto target; -12E is high-fragmentation airburst version; AGM-12B being produced in Europe for NATO air arms; **other contractors**—powerplant, Thiokol; AGM-12B, C initially produced by Orlando Div., Martin Marietta.

AGM-45A Shrike

Type—air-to-surface antiradiation missile designed to home on electromagnetic signals from enemy radar installations; **systems manager**—Naval Ordnance Test Station; Texas Instruments is prime contractor for guidance-and-control system; **range**—10 mi.; **length**—10 ft.; **diameter**—8 in.; **launch weight**—390 lbs.; **power system**—solid-propellant (Rocketdyne); **guidance**—electromagnetic; **warhead**—high-explosive; **status**—operational on Navy and Air Force planes attacking targets in North Vietnam; guidance mechanism can be thrown off if ground transmitter shuts off or operates intermittently; improvements devised to broaden memory span, widen frequency sweep.

AGM-53A Condor

Type—air-to-surface standoff missile allowing tactical aircraft to hit targets from beyond range of AA weapons; **prime contractor**—Columbus Div., North American Rockwell; **technical direction**—Naval Ordnance Test Station; **range**—50 mi.; **warhead**—conventional; **status**—in engineering development; intended for A-6A and A-7B, E; **other contractors**—propulsion, Rocketdyne Div., North American Rockwell; guidance, Hughes.

AGM-62A Walleye

Type—air-to-surface, television-guided weapon with movable fins; **prime contractor**—Orlando Div., Martin Marietta Corp.; **technical direction**—Naval Ordnance Test Station; **range**—6 mi.; **length**—11 ft. 4 in.; **diameter**—16 in.; **launch weight**—1,100 lb.; **power system**—none (gravity glide bomb); **guidance**—after pilot visually acquires target, he locks TV guidance system on target, releases weapon, and takes whatever evasive action is necessary. Weapon guides itself to target without further signals or commands from pilot or aircraft; **warhead**—high explosive; **status**—operational in Navy and Air Force; **other contractors**—vidicon tube, RCA; ram air turbine, Hamilton-

Standard Div., United Aircraft; servo controls, Weston Hydraulics Ltd., Borg-Warner Corp.; gyros, R. C. Allen Business Machine Co., Courter Products Div., Memcor, Inc., National Waterlift; castings, ALCOA, Skagit, and Willard Bronze; guidance lens and window, Argus, Bell & Howell; inner shell assembly, Intercontinental Manufacturing Co.; gyro motors, signal generators, American Electronics, Inc.

AGM-78A Standard ARM

Type—air-to-surface antiradiation missile, to augment and replace AGM-45A Shrike; **prime contractor**—General Dynamics/Pomona; **length**—14 ft.; **diameter**—12 in.; **launch weight**—1,300 lb.; **power system**—solid-propellant rocket; **guidance**—radar-homing; **status**—operational aboard Navy and USAF aircraft in Southeast Asia; **other contractors**—propulsion, Aerojet-General; guidance, Texas Instruments.

RUR-5A ASROC

Type—antisubmarine ballistic rocket; **prime contractor**—Honeywell; **range**—8 mi.; **length**—15 ft.; **diameter**—1 ft.; **launch weight**—1,000 lb.; **power system**—solid-propellant, 11,000 lb. thrust; **guidance**—none; **warhead**—Mark 44 or Mark 46 torpedoes or nuclear depth charge; **status**—operational; Navy is equipping nearly all destroyers with ASROC for anti-submarine warfare role; modified ASROC has been developed to be launched from Terrier launchers, giving firing crews weapons to combat either subs or aircraft interchangeably; development study under way for extended-range ASROC; **other contractors**—sonar, Sangamo Electric, General Electric, Sperry; computer, Librascope; propulsion, Naval Ordnance Station; torpedo, General Electric, Honeywell; launcher, Uni-dynamics.

UUM-44A SUBROC

Type—long-range, underwater-to-underwater, solid-propellant rocket, armed with nuclear warhead, fired from standard submarine torpedo tube; leaves water in flight; reenters water to seek enemy submarine; **prime contractor**—Goodyear Aerospace Corp.; **range**—25-30 mi.; **length**—21 ft.; **diameter**—21 in.; **launch weight**—4,000 lb.; **power system**—single-stage, solid-propellant; **guidance**—inertial; **warhead**—nuclear; **status**—operational on nuclear attack subs; **other contractors**—propulsion, Thiokol; guidance, Goodyear; inertial reference system, General Precision; fire control, Librascope.

ZRGM-59A Taurus

Type—surface-to-surface missile for amphibious assault forces; tests in progress to determine feasibility of adapting Army Lance missile to seaborne role.

(Continued on following page)

United States Army



Shillelagh



SS-10



Entac



Pershing



Sergeant



Lance

MGM-21A (SS-10)

Type—wire-guided antitank missile, NORD designation SS-10; prime contractor—Nord Aviation (France); speed—180 mph; range—1,600 yd.; length—45 in.; diameter—6 in.; launch weight—33 lb.; power system—solid-propellant; guidance—wire-guided; warhead—conventional; status—operational with US, French, and NATO units.

MGM-29A Sergeant

Type—medium-range, surface-to-surface, single-stage ballistic missile; prime contractor—Univac Div., Sperry Rand; speed—2,500 mph; range—30-85 mi.; length—34 ft. 6 in.; diameter—31 in.; launch weight—10,000 lb.; power system—high-energy, solid-propellant rocket, 45,000 lb. thrust; guidance—inertial, range control provided by drag-brakes upon entry into slipstream; warhead—nuclear or conventional; status—operational, deployed with US troops overseas and West German Army; other contractors—powerplant, Thiokol; guidance, Sperry; erector/launcher, Ling-Temco-Vought; gyroscopes, Honeywell; trailers, Fruehauf.

MGM-31A Pershing

Type—2-stage, surface-to-surface, selective-range ballistic missile; prime contractor—Orlando Div., Martin Marietta Corp.; speed—more than 3,000 mph; range—460 mi.; length—35 ft.; diameter—3 ft. 4 in.; launch weight—10,000 lb.; power system—2-stage solid-propellant rocket; guidance—inertial; warhead—nuclear; status—operational in US and West German armies; capabilities of Pershing battalions have been increased, particularly so that those stationed in Europe can take over quick reaction alert (QRA) mission now performed by tactical aircraft; transported by Army's M656 5-ton wheeled vehicles; it can also be carried in C-130 or airlifted by helicopter; other contractors—propulsion, Thiokol; guidance, Bendix-Eclipse Pioneer; warhead, fuzing, and arming, Ford Instrument, Sperry

Farragut; transporter-erector, FMC, Universal Match Co.; communications, Collins Radio Co.

MGM-32A Entac

Type—wire-guided antitank missile; prime contractor—Nord Aviation (France); speed—190 mph; range—2,200 yd.; length—32½ in.; diameter—5½ in.; launch weight—27 lb.; power system—solid-propellant rocket; guidance—wire-guided; warhead—high-explosive shaped charge; status—operational in US, Belgium, Canada, France; will be replaced by TOW.

MGM-51A Shillelagh

Type—surface-to-surface lightweight antiarmor guided missile for close-in troop support; armament system includes guided missile and conventional ammo, both fired from same 152-mm combination gun/launcher; main armament of General Sheridan lightweight, air-transportable armored reconnaissance vehicle; also employed on M60 A1E1, Army's workhorse medium tank, and will arm US/FRG Main Battle Tank; prime contractor—Aeronutronic Div., Philco-Ford Corp.; range—10 mi.; length—45 in.; diameter—6 in.; launch weight—40 lb.; guidance—command, plus infrared heat-seeking; warhead—conventional or nuclear; status—in production, but difficulties with Shillelagh missile/gun system have slowed production schedule of Sheridan and M60 tank; Shillelagh will not be retrofitted to existing M60s; other contractors—powerplant, Picatinny Arsenal, Amoco Chemicals; guidance, Aeronutronic; second production source, Orlando Div., Martin Marietta Corp.

MGM-52A Lance

Type—surface-to-surface, battlefield guided missile for division support; employs Automet guidance concept developed by Army Missile Command; prime contractor—Missiles and Space Div.-Michigan LTV Aerospace Corp.; range—30 mi.; length—20 ft.; diameter—22 in.; launch weight—3,200 lb.; power sys-

(Continued on page 87)

There are only a few hundred people in this country working on gravity gradient stabilization. They're assaulting basic principles, analysis, hardware and total system requirements. But seldom all four.

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TOW



SS-11



Honest John



Nike-Hercules

tem—prepackaged storable-liquid propellants; guidance—inertial; warhead—nuclear or conventional; status—entire Lance program being reoriented to extended-range version with improved engine, increasing maximum range to 60 mi. with nuclear warhead; propulsion problems, however, have delayed production; Honest John battalions will be retained until problems are overcome; Navy considering adaptation for Landing Force Support Weapon (LFSW); other contractors—propulsion, Rocketdyne Div., North American Rockwell; launcher, Hawker Siddeley; transport/loader, FMC, Ordnance Div.; gyro, American Bosch Arma; guidance and control, Systron-Donner.

BGM-71A TOW

Type—heavy antitank assault weapon for infantry use against armor or hard targets; TOW stands for tube-launched, optically tracked, wire-guided; may be fired from ground or from helicopters; in latter role will replace Nord AGM-22B (see below); prime contractor—Hughes Aircraft Co.; systems manager—Army Missile Command; range—2,200 yd.; launch weight—200 lb., including tripod, missile, tracking unit; power system—2 separate solid-propellant motors, 1 to eject from launch tube, other to power it to target; guidance—wire-guided, linked electronically to telescope sight; stabilized sight in helicopter permits gunner to track target while pilot takes evasive action; warhead—conventional; status—production difficulties have delayed procurement to FY 1969; intended to replace Entac and AGM-22B; other contractor—powerplant, Hercules.

XFGM-77A Dragon

Type—medium antitank assault weapon system, shoulder-fired; light enough to be carried by one soldier; prime contractor—McDonnell Douglas; range—1,500 yd.; launch weight—28 lb.; power system—recoilless solid-propellant; several pairs of small rocket motors are mounted in rows around missile body; guidance—automatically guided to target by infrared sighting device linked with missile by wire; status—in production engineering; formerly called MAW.

MGR-1B Honest John

Type—surface-to-surface unguided tactical rocket; systems manager—McDonnell Douglas; speed—about 1,200 mph; range—20 mi.; length—25 ft.; diameter—30 in.; launch weight—4,500 lb.; power system—single-stage solid-propellant rocket; guidance—preaimed, spin-stabilized; status—operational in US Army and Marine Corps, deployed in Europe and Japan and supplied to NATO forces; to be replaced by extended-range Lance; other contractors—frame, McDonnell Douglas, American Machine & Foundry; motor parts and pedestal, Emerson Electric; powerplant and spin rockets, Hercules.

AGM-22B (SS-11)

Type—wire-guided antitank missile, Nord designation SS-11; prime contractor—Nord Aviation (France); speed—425 mph; range—3,500 yd.; length—46 in.; diameter—6 in.; launch weight—63 lb.; power system—solid-propellant; guidance—wire-guided; warhead—conventional; status—operational; used primarily from helicopters; UH-1B carries 6 missiles.

MIM-14B Nike-Hercules

Type—surface-to-air guided missile; prime contractor—Western Electric Co.; speed—2,500 mph; range—86 mi.; ceiling—above 150,000 ft.; length—41 ft. with booster; diameter—31½ in.; launch weight—10,000 lb.; power system—solid-propellant sustainer and booster; guidance—command; warhead—nuclear or conventional; status—operational since 1958; widely deployed in continental US and Hawaii; new development program initiated this year to ensure that the system will operate effectively in the 1970s, as hedge against slippage in development of SAM-D; other contractors—airframe, McDonnell Douglas; powerplant, Thiokol; JATOs, Hercules; warhead, Aerojet-General, Iowa Ordnance Plant, Silas Mason; guidance, Western Electric; acquisition radar, General Electric; ground-support equipment, Pacific General Construction.

MIM-23A Hawk

Type—surface-to-air missile for use against targets from tree-top height to 50,000 ft.; prime contractor—Raytheon Co.; speed—supersonic; range—20 mi.; length—16 ft. 9 in.; diameter—14 in.; launch weight—1,350 lb.; power system—solid-propellant dual-stage booster; guidance—semiactive radar homing; warhead—conventional; status—operational in Army and Marine Corps; deployed in Vietnam, Europe, Okinawa, and Panama; being procured by Israel, Japan, Saudi Arabia, Sweden; propulsion improvements being made to decrease reaction time, speed up target-handling capability, improve reliability, using polyurethane propellants; antitactical missile version under development; other contractors—frame, Northrop; propulsion, Aerojet-General; guidance, Raytheon; launcher/carrier, FMC; radar components, Bendix, Goodyear.

FIM-43B Redeye

Type—surface-to-air, shoulder-fired heat-seeking guided missile for use against low-flying aircraft; prime contractor—General Dynamics/Pomona; speed—1,500 mph or more; length—48 in.; diameter—3 in.; launch weight—28 lb.; power system—dual-stage, solid-propellant booster; guidance—infrared homing; warhead—high-explosive; status—in production for

(Continued on following page)

Hawk



Redeye



Army and Marines; procurement continuing; improved version, XFIM-43C, in development; USAF testing air-to-air capability, particularly for close-in combat; **other contractors**—propulsion, Atlantic Research; launch tubes, Koppers-Lamtex; guidance, General Dynamics/Pomona.

Nike X

Type—advanced concept of antimissile defense; primary components are those for Sentinel system (*see below*)—Spartan and Sprint missiles—plus multifunction array radar (MAR), and TAC MAR, scaled-down MAR for smaller, less sophisticated attack, as well as PAR and MSR radars in Sentinel system. Nike X system would position far more Spartan and Sprint missiles to defend populated areas as well as missile sites and other military points. In posture statement of February 1968, former Defense Secretary McNamara told Congress: "... Deployment of the Nike X system for defense of our cities against a Soviet attack would, under present circumstances, be a futile waste of our resources." However, elements of Nike X system, including Spartan long-range missile and Sprint local-defense missile, plus PAR and MSR radar, being developed for simpli-

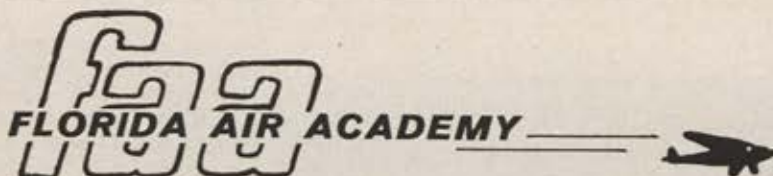
fied Sentinel system, whose components are described below.

Sentinel

Type—simplified antiballistic missile system oriented toward Red Chinese ICBM capability; employs elements of projected Nike X system; consists of long-range perimeter acquisition radar (PAR), missile site radar (MSR), Spartan and Sprint missiles, and data-processing system; **prime contractor**—Western Electric Co.; system design, development, Bell Telephone Labs.

Spartan—3-stage missile, developed by McDonnell Douglas as outgrowth of former Nike-Zeus, and equipped with advanced warhead, able to intercept objects at ranges of several hundred miles and at exoatmospheric altitudes; it also forms part of defense against the fractional orbit bombardment system (FOBS).

Sprint—local defense missile, developed by Martin Marietta, designed to attack incoming warheads after atmosphere has helped to separate out accompanying decoys, chaff, etc. Capable of climbing thousands of feet in few seconds to make intercepts between 5,000 and 100,000 ft. at ranges of 15-25 miles. Employs "pop-up" launch technique in which missile is ejected



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Chaparral



Sprint



from tube by gas pressure and ignites in flight; status—FY 1969 budget includes \$1,232 million to continue high-priority development—\$651 million for deployment of Sentinel, \$313 million for its development; \$165 million for ABM advanced development (Nike X); and \$103 million for related ARPA project DEFENDER; tests of Sentinel system, including Spartan and Sprint missiles, scheduled at Kwajalein Island early in 1969.

MIM-72A Chaparral

Type—surface-to-air gun-missile system for defense of forward area forces against low-altitude air attack; incorporates Vulcan 20-mm gun and Army modification of Navy AIM-9C Sidewinder missile operating together; **system contractor**—Aeronutronic Div., Philco-Ford Corp.; **status**—3 types of gun/Chaparral battalions are being formed: fully self-propelled battalions for armored and mechanized divisions, modified self-propelled version for infantry divisions, all-towed version for airmobile and airborne divisions; Army may field some gun batteries before Chaparral is ready, since gun is formidable air defense weapon alone; **other contractors**—missile, Naval Ord-

nance Test Station; Vulcan gun, General Electric.

AFAADS

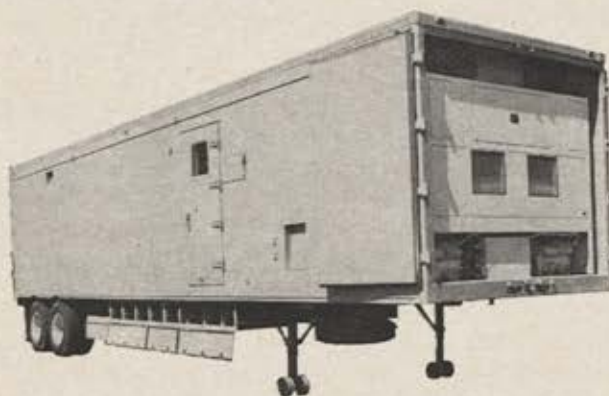
Type—advanced forward area air defense system, in early stage as replacement for Chaparral/gun system; will share components with Navy's point-defense surface-to-air missile system (PDSMS).

SAM-D

Type—advanced surface-to-air missile system, designed to provide all-weather defense against medium- and high-altitude aircraft threat both to Army in field and continental US; should also provide some defense capability against very-low-altitude aircraft and tactical ballistic missiles; closely related to Navy's Advanced Surface-to-Air Missile System (ASMS), with fully coordinated development of subsystems and components; **status**—contract definition completed, system now in development; employs only one type of radar, rotatable in any direction of attack, and improved missile guidance system; being studied as replacement for Hercules and Hawk.

—ALLAN R. SCHOLIN

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MOBILE TEST UNIT: Electronics equipment for making dynamic tests on the structures of National Aeronautics & Space Administration Saturn space vehicle is housed in this trailer built for Brown Engineering, a Teledyne Company, Huntsville, Ala. The fully air conditioned van was designed to meet special shock, vibration and structural requirements and contains RFI shielding.

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Khe Sanh—Beginning of the End

North Vietnamese General Vo Nguyen Giap was confident that the tactics he employed at Dien Bien Phu fourteen years ago would work again at Khe Sanh. A victory there, he thought, might bring on a US withdrawal from Vietnam. But nothing in his experience had prepared him for the awesome airpower with which the US systematically destroyed his troops, weaponry, and reinforcements. US airpower converted his dream of victory to a nightmare defeat that helped bring Hanoi to the conference table in Paris . . .

An Airpower Lesson for Giap

BY ALLAN R. SCHOLIN

ASSOCIATE EDITOR, AIR FORCE/SPACE DIGEST

AIRPOWER broke the siege of Khe Sanh. Thanks to airpower, the climactic ground battle never came off.

As the western anchor of South Vietnam's northern defense alignment, Khe Sanh is essential to the security of South Vietnamese and US forces along the Demilitarized Zone (DMZ). It sits astride the major enemy infiltration route into Quang Tri province, South Vietnam's northernmost province.

When Vo Nguyen Giap, the North Vietnamese general who engineered the French defeat at Dien Bien Phu, decided to attack Khe Sanh he may have felt the US was playing into his hands by committing itself to defend the site. Khe Sanh is ringed with mountains where Giap could dig in his heavy artillery as he had at Dien Bien Phu. When the US Joint Chiefs of Staff solemnly declared to President Johnson that Khe Sanh would be held, Giap knew that by taking it he might seriously undermine the already precarious level of US support for Administration policies in Vietnam. If he could, by taking Khe Sanh, precipitate a US pullout, he would clear the way for a swift Communist takeover of South Vietnam.

But as Giap proceeded to follow much the same battle plan he had used at Dien Bien Phu in 1954—massing guns and troops to steadily tighten the noose around the Marine base, cut it off from outside support, and pound the garrison into submission—he found the US introducing a new factor that had not been available in any significant degree to the French in 1954. That factor was airpower, which the US unleashed in an ever-increasing flood of bombs, rockets,

napalm, and strafing. Giap poured in more supplies; airpower systematically wiped them out. He funneled more and more troops down the Ho Chi Minh trail, only to see them die by the hundreds in fearful air bombardments.

"Khe Sanh, when the archives are finally studied and the history is finally written, probably will be the first major ground action won entirely or almost entirely by airpower," a senior Army general on the Joint Chiefs of Staff told a group of editors in Washington recently. "There never has been anything like it in the history of warfare. . . ."

In his enthusiasm, the general may have overlooked two other notable examples. A quarter-century ago, the Italian-held island of Pantelleria in the Mediterranean between Tunisia and Sicily surrendered to Allied forces after being attacked by aircraft, the first territory in World War II to be taken by airpower alone. And in 1945, worn out by devastating B-29 fire-bomb raids on Tokyo and aghast at the power of atomic weapons which leveled major sections of Hiroshima and Nagasaki, Japan sued for peace before a single US soldier set foot on its homeland.

It Differs Only in Degree

Khe Sanh may have been the first major battle won by airpower in which US and enemy troops were in direct confrontation. Considering the stakes on both sides—the general suggested that it might well represent the "high-water mark" in North Vietnam's military campaign in the South—Khe Sanh is an im-



Because Air Force and Marine transports were the target of small arms and mortar fire whenever they landed at Khe Sanh, techniques were introduced to cut ground time to a minimum. Some cargo was dropped by parachute, other shipments were delivered, as shown here, by a low-altitude extraction system. As the plane flies at minimum altitude over the airstrip, the crew releases a parachute that drags the cargo out the rear ramp.

portant victory. But it differs only in degree from countless other engagements in Vietnam in which airpower drove a wedge between the opposing forces and punished the enemy until he withdrew.

In late January, Giap was estimated to have 20,000 men in a five-square-mile area around Khe Sanh. It included the 320th, 325C, and elements of the 304th North Vietnamese divisions, totaling six infantry regiments, an artillery regiment, and an anti-aircraft unit with 37-mm radar-guided guns, the first in South Vietnam. The Khe Sanh garrison, on the other hand, was made up of a reinforced US Marine regiment, a South Vietnamese ranger battalion, and one Marine company each on hills 881 and 861 adjoining Khe Sanh—a total of about 6,000 men.

The ground operation at Khe Sanh was code-named Operation Scotland, while the air support was called Operation Niagara. Both, unlike most code names, were descriptive; the ground phase was most frugal in preserving manpower, while from the air a torrent of ordnance and firepower inundated the enemy.

Between January 21 and April 8, US airpower hit the North Vietnamese around Khe Sanh with more than 100,000 tons of bombs and 700,000 rounds of aerial-cannon and machine-gun fire. B-52s operating from Guam and U Tapao in Thailand pulverized enemy-occupied territory in 2,500 sorties, leveling jungles and rendering the hillsides barren. USAF tactical fighters flew 9,700 sorties; Marine air added 7,000, and naval aviation another 5,000.

Until the middle of March, when the monsoon season was drawing to an end, Khe Sanh was blanketed in rain and low-hanging clouds most of the time. B-52s normally bomb by their own airborne radar, but in the Khe Sanh area they loosed their tonnage closer to US positions than ever before. This was made possible by Skyspot, a technique in which ground controllers track the aircraft and tell them when to release their bombs. It is a modification of the SAC radar bomb scoring system used in training, which predicts where bombs will impact when the bombardier in the aircraft signals "bombs away."

Skyspot was also employed with fighter aircraft when ceilings were too low to enable pilots to bomb visually.

US Marines and South Vietnamese rangers defending Khe Sanh took frequent artillery and mortar barrages—as many as 1,300 incoming rounds in a single day—but the volume and accuracy of enemy fire was far below that delivered on the North Vietnamese by US airpower. One indicator: The Marines, in February and March, lost ninety-three dead on the ground at Khe Sanh. General Westmoreland put enemy losses at 15,000.

Jungle Becomes a Desert

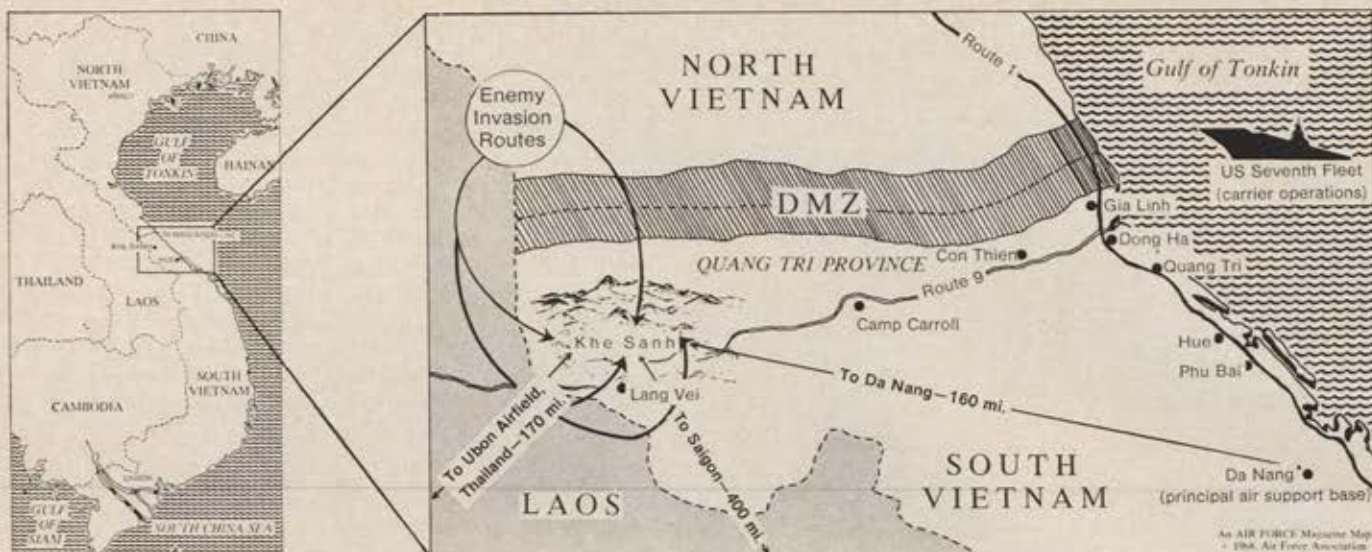
Here is an eyewitness report of the changes wrought in the Khe Sanh countryside by the enormous and incessant air attacks. It comes from the Vice Commander of an F-100 wing in Vietnam, in a personal letter to the Editor of *AIR FORCE/SPACE DIGEST*.

"The tonnage of ordnance that has been placed in a five-mile circle around that area is unbelievable,"

(Continued on following page)



New techniques improved accuracy of airdrops to keep supplies from falling into enemy hands even in bad weather.



Situated in northwestern corner of South Vietnam, Khe Sanh straddles main enemy invasion route into Quang Tri province. Airpower based in South Vietnam, Thailand, and on carriers prevented enemy from mounting attack to overrun base.

he wrote. "I was up there on a mission four days ago. I hadn't seen Khe Sanh for about four weeks. The last time I saw it, it looked like the rest of Vietnam, mountainous and heavily jungled with very little visibility beneath the jungle canopy except for the cleared areas that were obviously friendly positions. This time—what a change! The jungle has literally been turned into a desert. There is hardly a tree standing. In fact, there is barely a whole tree on the ground. It is just a landscape of splinters and bomb craters."

When the North Vietnamese pulled out from Khe Sanh it was more a rout than a withdrawal. In past NVA retreats, they left literally nothing behind, not even their dead. But when the Marines and the Army's 1st Cav Division swept the surrounding area after the enemy withdrawal from Khe Sanh, they found not only more than 1,200 enemy dead, but caches totaling 200,000 rounds of small-arms ammunition, 5,000 rounds of mortar shells, another 5,000 hand grenades, and some 600 Soviet-built rockets.

Resupply by Air

While air attacks prevented the enemy from launching his offensive, US airlift was keeping the Khe Sanh defenders supplied with food and ammo.

"General Momyer wanted us to maintain a twenty-day level of supplies at Khe Sanh, so they wouldn't run low even if we hit a long stretch of bad weather when we couldn't get in," one Air Force officer explained. "We never let it get below that level."

A variation of Skyspot was used by the cargo planes in airdropping supplies. In addition to the standard ground-controlled approach system, which guided planes over the runway, the Marines laid reflective strips which showed up on the aircraft radar indicating boundaries for a safe drop. This technique enabled cargo planes to maintain circular error averages as low as thirty yards in supply drops.

In all, USAF and Marine tactical transports flew more than a thousand sorties into and over Khe Sanh,

delivering 12,500 tons of food, supplies, and munitions. In one day, twenty-three C-130 and C-123 transports airdropped 250 tons and fourteen C-130s airdropped another 209 tons. The daily average was more than 150 tons. If ground resupply had been possible during the siege, it would have taken sixty 2½-ton trucks per day to do that job. Airlift did it all.

Throughout the siege, more than 3,300 passengers were flown in or out. Men whose year's tour was up departed as replacements arrived, and others took their normal turn on R&R.

Transports Were 'Mortar Magnets'

Cargo planes were prime targets for North Vietnamese gunners. "The Marines were mighty glad to get the cargo we delivered," one C-130 pilot told me at Cam Ranh Bay. "But they knew that we also attracted enemy rocket or mortar fire. One night we landed, slid our cargo onto the ramp as we taxied past, continued out to the runway, and took off, without seeing a soul."

Many planes were damaged by small-arms or mortar fire. One C-130 crew had a particularly harrowing experience. They arrived as the runway was being shelled and while a Marine patrol was engaged in a fire fight just outside the perimeter. The Hercules, bringing in a load of ammunition, took a hit in the fuselage, setting fire to one cargo pallet. The navigator and loadmaster manned fire extinguishers as the pilot, copilot, and engineer landed the plane. As soon as they taxied off the runway, the copilot and flight engineer joined in pushing cargo pallets out to keep the fire from spreading. On the taxi strip, one tire was flattened by an enemy bullet, halting the plane.

Now exposed to enemy guns, the pilot and copilot succeeded in putting out the fire in the cargo pallet, while other crewmen rounded up a jack to replace the flat tire. During this time the plane was hit repeatedly by small-arms fire, but somehow the crew escaped injury. With the tire replaced, they scrambled back into the plane and hurriedly took off.

Clear weather was the exception during lengthy siege, but through good weather and bad, US transports maintained a twenty-day level of supplies for Khe Sanh defenders. Planes delivered a daily average of 150 tons of food and ammunition, and handled more than 3,300 passengers. Props continued turning while cargo was unloaded, to keep ground time to minimum. Hole in aluminum matting in foreground was caused by an enemy mortar.



By mid-February, North Vietnamese guns were making it too hot for cargo planes to land during the day, so most deliveries were made by parachute or low-altitude extraction. But some delicate cargo, such as medical supplies and shell fuzes, still had to be landed.

More than a dozen transports were destroyed on the ground at Khe Sanh, but it is as much a tribute to the skill of airlift crews as to the haphazard aim of North Vietnamese gunners that only two were lost from hits sustained in the landing pattern. One of those, however, represented the greatest single loss of the entire siege. A C-123 carrying forty-four Marine replacements and a five-man crew was shot down when it had to make a go-around because another aircraft was on the runway. All of its occupants were killed. The other transport downed was a C-130 whose crew succeeded in landing the disabled plane and got out safely before it burned up.

Gradually, the two elements of airpower—bombing and resupply—turned the tide. Week after week, Giap saw his fresh resources of troops and supplies being ground down under US airpower, while the

Khe Sanh garrison remained dug in and alert. By early March, Generals Westmoreland and Momyer were privately expressing the view to newsmen in Saigon that Giap might not risk an attack. When his expected target date—March 12, the anniversary of the fall of Dien Bien Phu—passed with his forces still too ineffective to take the initiative, and the gradually improving weather conditions exposed them to even greater punishment from the air, Giap began his withdrawal, pulling back his 320th Division into North Vietnam.

Hanoi Seeks Propaganda from Defeat

On March 31, when President Johnson announced a pause in bombing above the 20th parallel, Hanoi seized the opportunity to cover Giap's defeat by declaring it was "lifting" the siege of Khe Sanh as a reciprocal gesture of good faith.

"I do not interpret it as a deescalation on their part," Defense Secretary Clark Clifford told Congress on April 11. "The President's speech was the evening of
(Continued on following page)



USAF medical technicians move a wounded Marine from the aid station to a waiting C-130 to be airlifted to a military hospital at Da Nang. US casualties at Khe Sanh were relatively light, with fewer than 100 Marines killed on the ground, despite enemy shelling that reached a high of 1,300 rounds in one day. General Westmoreland estimated the enemy lost 15,000 to round-the-clock attacks by US bombers and fighter planes.

March 31. The major withdrawal from the Khe Sanh area by the enemy started on March 12. So for a period of over two weeks before he made his speech, they were in the process of withdrawing.

"I believe we have sufficient information now to indicate to us that the reason they were withdrawing was because they were in the process of being destroyed. . . . We got a number of prisoner statements that indicate that the area around Khe Sanh from the enemy standpoint was becoming increasingly untenable, that the casualties they were taking were prohibitive, and they had no alternative but to withdraw."

A Montagnard refugee reported that 20,000 enemy troops launched the Khe Sanh battle, but that half the original force, and many replacements, had been killed by air attacks, mainly from B-52s.

Prisoners said that three-fourths of an entire regiment was lost in one B-52 raid, and many North Vietnamese were evacuated with severe concussion injuries. "Our troops are hungry," they declared. "The daily ration is down to six grams of rice and salt."

They said they had been told they were going south to liberate the South Vietnamese from the "American aggressors." Instead they found they were fighting the South Vietnamese as well.

They reported that morale was low, and many wanted to give up but didn't know how. They were afraid of being shot by their own people as well as by

the allies. Forty men in one company had deserted, they stated, and a cadre sent to North Vietnam for replacements had failed to return. The prisoners admitted they were "happy and relieved" to be captured, and they gave information freely.

US intelligence figured Khe Sanh was to be the second part of a one-two punch, the first being the Tet offensive against major cities late in January. The two successive blows, had they been successful, might well have toppled the South Vietnamese government and prompted a swift reexamination of the US position in Southeast Asia.

As the JCS Army general told US editors: "He sent down just about everybody he could get his hands on, and he sent all the weapons and the ammunition, and he issued the necessary orders to attack. They attacked, and they simply didn't succeed. . . .

"I don't think he has an unlimited option or an unlimited, inexhaustible reservoir, so I think he came down and made the college try, and that's been made. It didn't defeat the Vietnamese army. It certainly didn't defeat ours, and it certainly didn't overthrow the government. . . . I think the abortive attempt at Khe Sanh might well represent the high-water mark on the military side, from his standpoint."

Airpower—one element which Giap obviously underestimated—had won the battle for Khe Sanh.—END



Three members of an Air Force C-123 crew of the 311th Commando Squadron, Phan Rang Air Base, watch as the cargo they have just kicked out of their twin-engine transport floats down to the Khe Sanh garrison. For the last six weeks of the siege, four-engine C-130s seldom landed at Khe Sanh, but C-123s often braved enemy mortars and small-arms fire to land with medical supplies and ammo fuzes that could not be airdropped.

A Hercules transport demonstrates another technique of precision supply delivery, called the Ground Proximity Extraction System. When the pilot brings the plane in low over the airstrip in a modified touch-and-go, the loadmaster releases a hook attached to the cargo pallets. The hook snags a cable stretched across the runway and, as the cargo slides out, the pilot applies power and climbs swiftly away.



An Aerospace
Capabilities
Report on
Beech Aircraft
Corporation



The Beechcraft U-8F



The Beechcraft NU-8F

BEECH MILITARY AIRCRAFT

...a story of growth

The Beech family of Utility and Indirect Support Aircraft was developed to meet the Department of Defense policy requirements for commonality in procurement. These aircraft are true tri-service vehicles with versatility and growth potential to meet the varied requirements of the individual services.

Beech has built more aircraft in this size class than any other manufacturer in the world. Its production facilities, along with a continuing research and development program for improvements, keep Beech Aircraft Corporation in its position of leadership.

The Beechcraft U-21A





This Beechcraft NU-8F Indirect Support Transport has served the U. S. Army since 1964. Its 2,000 pounds cargo capacity in a total interior volume of 423 cubic feet is quickly converted from cargo carrier to medical evacuation transport...to troop transport...to administrative carrier. The Beechcraft NU-8F meets higher-than-normal standards for strength, versatility and performance. Evolved from the Beechcraft U-8F which has established an exceptional 8-year service record, the NU-8F is powered by two Pratt & Whitney PT6A-6 turboprop engines rated at 550 shaft horsepower each. Cruise range is 1280 nm at a cruise speed of over 200 knots.



This Beechcraft King Air, designated VC-6A, is a member of MATS' Special Air Missions (SAM) fleet. It is, in essence, a pressurized NU-8F. After its first year of service experience the VC-6A received a ready rating of 95%, and had a record of 100% mission completion. Over 300 King Airs have been delivered to owners throughout the free world since it was certified in 1964. The King Air is powered by two Pratt & Whitney PT6A-20 turboprop engines. Full pressurization, plus turboprop-quiet sound level, combine with the best utilization features of the other members of the U-8 family.

Beech Military Aircraft keep pace with joint service requirements

Low direct operating cost is the key to the Beechcraft twin turboprop's economic advantage. Low-cost fuel, very low oil consumption and low maintenance costs account for considerable savings.

High ready rate has become commonplace, proved by succeeding generations of Beech Military Aircraft—in the Department of Defense inventory since 1953. Non-military versions of these Beechcrafts—the Queen Air and King Air—have been chosen by several state governments, foreign governments, United States government agencies, airlines and hundreds of companies to fulfill business, commercial and administrative assignments.

A single pilot can fly these Beechcrafts efficiently, yet each has ample room for a crew of two on the separate flight deck. Transition of piston engine pilots to the turboprop Beechcraft is easy.

Another time-and-money saving benefit of these Beech Utility and Indirect Support aircraft is "parts and service commonality". Beech's world-wide service organization maintains parts supplies for any Beechcraft, and is staffed by men especially trained for Beechcraft service. Logistic requirements are reduced.

A continuous research and development program has enabled Beech to pioneer many advancements and new performance capabilities for single and twin-engine aircraft. The King Air C is an example of the growth capability engineered into all Beechcrafts.



Short, rough field operation is a special capability of the Beech family of Indirect Support and Utility aircraft. The Beechcraft U-21A, shown in action here, adds an extra element of speed and mobility to troop deployment.



Big, roomy interiors are extremely flexible for adaptation to a wide variety of missions. In a minimum time this high-density staff transport can be transformed into a high-density troop transport...to aerial ambulance service...to high priority cargo carrier.



All-weather operation with full instrumentation is available on all Beech military aircraft. Engine and surface de-icing systems are standard. This is a U-21A panel.



This is the versatile Beechcraft 99, now in production as a part of the Beech planned program of product growth. Powered by two Pratt & Whitney PT6A—20 reverse flow, free turbine engines, it will carry pilot and 16 passengers in comfort—will cruise over 200 knots. The spacious interior is readily adaptable in the field for high-density seating, cargo, air ambulance, or executive transport use. Off-the-shelf availability combines with big payload and turboprop economy for modest original investment, excellent utility and low operating cost. The Beechcraft 99 has built-in growth potential to match tri-service Utility, Indirect Support and Air Attache requirements of the future.



Proved and in production, the Beechcraft U-21A series aircraft rolls steadily off the production line for on-time, "off-the-shelf" delivery. The army has ordered 129 of these turboprop utility aircraft that will carry six staff members or ten combat-ready troops. In addition, it has exceptional adaptability to meet cargo and medical evacuation duties.

The Beechcraft T-42A
won a 2-year Army
evaluation...then
joined the famed
T-34 Mentor
in winning friends

The Beechcraft T-42A has already established an enviable record at Ft. Rucker. Its fast take-off, climb-out and speed to the training area have increased its value as a trainer.



The Army knew what it was getting when the first T-42A (above) was delivered to Ft. Rucker in 1965. It had already been flown for two years of competitive evaluation—and won. So the 90% ready rate obtained from the 63 T-42A twin-engine instrument and transition trainers now in service surprised no one. It is an off-the-shelf item at Beech, where its non-military counterpart, the B55 Baron, is a solid favorite with the business flying community.

Many veteran pilots of the U.S. Navy and the U.S. Air Force, received primary training in the Beechcraft Mentor (left). Its durability, dependability and safety records mark it as one of the world's most outstanding trainers.

Eleven other nations have joined the

U.S. Military in recognizing the exceptional performance of this Beechcraft. Pilots of the following countries receive their primary training in the T-34:

Argentina	El Salvador	Spain
Canada	Japan	Venezuela
Chile	Turkey	Philippines
Colombia	Mexico	Portugal

**Beech has a 27-year record
of service to the Military**

As a dependable, on-time supplier of aircraft and related products, missile target systems, prime contractor and sub-contractor, R & D and testing programs, Beech Aircraft Corporation has served the military, NASA and other aerospace associated agencies and companies for over a quarter of a century.



U. S. Army Air Corps UC-43



U. S. Navy SNB-5



U. S. Air Force AT-11



Beechcraft XA-38



U. S. Air Force C-45

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For full information about how you may take advantage of Beech's experience in systems management and proven capabilities in designing, developing, manufacturing and testing of components for aviation and aerospace projects, write, wire or phone Contract Administration, or Aerospace Marketing, Beech Aircraft Corporation, Wichita, Kansas 67201, U.S.A.

Diverse aerospace topics, ranging from the man in the cockpit over Vietnam to the C-5 as a missile launcher and what the chic modern WAF wears for close-order drill, were highlighted at the Air Force Association's twenty-second National Convention in Atlanta, Ga. Convening at a time of national crisis and change, the Convention addressed itself to the burning issues that divide the country at home and recast national policy concerning the war in Southeast Asia. Thus, AFA once more underscored its deep and constructive involvement in the nation's political mainstream with its . . .

Historic Aerospace Event

BY EDGAR E. ULSAMER

ASSOCIATE EDITOR, AIR FORCE/SPACE DIGEST

THE 1968 National Convention of the Air Force Association in Atlanta, Ga., April 2-5, convened amidst historic events which reshaped national policy in Southeast Asia and convulsed the nation in civil disorders.

The response of AFA to the two pivotal occurrences of that historic week—President Johnson's announcement of a partial bombing pause in North Vietnam

and the wave of disorderly reaction to the slaying of Dr. Martin Luther King, Jr.—was rapid and of national impact.

An emotional high point was comments by Col. Daniel "Chappie" James, Jr., veteran Negro combat commander and fighter pilot. His message on racial harmony in the United States Air Force, which sets an example for the nation, echoed through the country. Nationwide radio and television coverage of Colonel James's words acted as a damper to racial violence. The fervor, patriotic dedication, and eloquence of Colonel James, who spoke first during the Convention's Air War Symposium and later at the Secretary of the Air Force Luncheon, where Colonel James was awarded AFA's Citation of Honor, prompted AFA
(Continued on following page)



Veteran commander of Vietnam combat, Col. Daniel James, speaking here during Secretary of the Air Force Luncheon, was accorded nationwide news coverage for his hard-hitting comments on racial strife gripping the nation's cities.



Head table luminaries Congressman L. Mendel Rivers, Chairman of House Armed Services Committee, and the USAF Chief of Staff, Gen. J. P. McConnell, listen attentively to policy speech by Secretary of the Air Force Harold Brown.

Board Chairman Jess Larson to say: "I only wish all of America could have heard you, Chappie."

The Negro combat officer said: "I am a citizen of the United States, and I am no second-class citizen either, and no man here is unless he thinks like one and reasons like one and performs like one. This is my country, and I believe in her, and I believe in her flag, and I'll defend her, and I will fight for her, and I'll serve her, and I'll contribute to her welfare whenever and however I can. If she has any ills I'll stand by her until, [in] God's given time, through her wisdom and consideration for the welfare of the entire nation, she will put them to rights."

Terming unity the most important weapon at the disposal of American democracy, he urged: "Stop finding so many ways to hate each other because of race, creed, religion, political party, section of the block, social strata, or what have you. Stop using personal grievances as an excuse to break the laws of the land. I will not join with any lawless mob at any time, no matter what the provocation, in a disregard for law and order. A thief is a thief—I don't care what he gives as his reason or provocation for stealing. A mob is a mob, no matter what the provocation, and these things get maximum publicity on the other side and somehow smother the good things that are being done by others."

Following his acceptance of AFA's Citation of Honor for inspirational leadership in combat as well as community relations, Colonel James renewed his plea for national unity and racial harmony.

The Air Force Association's 1968 Statement of Policy, meanwhile, set forth AFA's clear stipulations concerning the bombing pause, coupled to specific recommendations for follow-on action. The Air Force Association thereby became one of the first national organizations to formulate and recommend detailed and pertinent contingency plans regarding national policy in Southeast Asia keyed to the Administration's redoubled quest for a negotiated peace in Vietnam. (See "We Must Stay . . . We Must Prevail," pp. 8-9, May '68 AF/SD.)

Key event of the 1968 Convention, in terms of setting, clearly was the special luncheon honoring the Chief of Staff of the United States Air Force, held in the Lockheed-Georgia Company's huge C-5 Flight Test Center. The giant new aircraft, towering behind the speaker's table, furnished a dramatic backdrop for a pace-setting policy speech by Gen. J. P. McConnell and a special AFA awards program. Chairman of the Board Jess Larson acted as Master of Ceremonies and read special greetings to the Convention by Vice President Hubert H. Humphrey. (See box for Mr. Humphrey's greetings and page 121 for General McConnell's speech.)

General McConnell called for "new orders of military capability across the entire spectrum of national defense" of a magnitude comparable to the quantum jump in airlift capability represented by the C-5. Prefacing his remarks with the comment that "AFA Conventions offer the opportunity to engage in open discussions of important aerospace issues and problems which call for broad public understanding and support," General McConnell enumerated pressing re-



Gen. Gabriel P. Disosway, outgoing Commander of the Tactical Air Command, is shown accepting AFA's Citation of Honor for "Distinguished Leadership," presented by AFA's Board Chairman Jess Larson during "Chief's Luncheon."



Gigantic C-5 Galaxy served as dramatic backdrop of the Chief of Staff Luncheon held at the Lockheed-Georgia Company's new Flight Test Center. More than 1,500 heard General McConnell's policy speech on future USAF needs.



THE VICE PRESIDENT
WASHINGTON
April 4, 1968

Dear Bob:

As the membership, nation-wide, of the Air Force Association gathers for its 22nd national convention, I am delighted to send my warm greetings and best wishes for a most successful meeting.

May I commend each of you for your personal commitment through membership and participation in many significant programs of the Air Force Association to the high purpose of national defense and aerospace power. The Air Force Association has steadfastly pursued these worthy goals throughout its history. I know our dedicated airmen who are even now defending our national objectives at stations all around our globe will appreciate your continued support. These are truly trying times, but with dedication equal to our military men, we will prevail.

Sincerely,

Hubert H. Humphrey
Hubert H. Humphrey

Mr. Robert Smart
President, Air Force Association
22nd National Convention
Regency Hotel
Atlanta, Georgia

quirements for future weapons technology. Of these, he said, none is more urgent than to maintain a margin of nuclear superiority in the face of "the still growing nuclear strength of the Soviets and the nuclear potential of such aggressive nations as Communist China."

He contrasted improvements in ballistic missiles, such as multiple independent reentry vehicles, with "no such progress in our aging and shrinking force of nuclear bombers" and added, "I believe very strongly that there will be continuing and urgent need for a proper mix of manned and unmanned strategic weapon systems."

Turning to the equally crucial area of missile defense, General McConnell stated a twofold technological challenge inherent in the current situation where "there is little we can do to keep the bulk of an aggressor's missiles from impacting on our soil": Development of a system which would destroy hostile missiles as soon as possible after launch and before their warheads are separated from the boosters; and, representing an ever greater technological challenge, "to find some means other than antimissiles for defense against ballistic missiles."

He rated as a "promising approach" to missile defense the concept of using an airborne platform, such as the C-5 Galaxy, as a mobile missile defense system which could operate worldwide and would carry a dozen or more antimissile missiles. In the category of advanced antiballistic missile defense, General McConnell listed the idea of an "electronic fence which might use an advanced form of laser or similar beam to destroy" any penetrating object.

To demonstrate the need for keeping up our technological guard General McConnell cited the consequences of one hypothetical breakthrough: The possibility of the Soviets developing radar-absorbing paint which could "give them a new order of military capability which would be so far-reaching as to render

most of our present detection, tracking, and interception systems useless."

He termed it "vital" to the nation's security that "we be the first to conceive and discover those fundamental principles that will lead to operational breakthroughs and new orders of military capability."

General McConnell ended on a note that has been struck over and over by AFA in this magazine, in policy statements, and in speeches: The teamwork of
(Continued on following page)



AFA's 1968 David C. Schilling Trophy for Flight was presented by Board Chairman Jess Larson to Col. Robin Olds, Commandant of Cadets, US Air Force Academy, formerly Commander of famed 8th Tac Fighter Wing in Thailand.

Central theme of 1968 National Convention was the revolution in USAF airlift capability resulting from 360-ton C-5. Special seminar, moderated by Lockheed-Georgia Co. President T. R. May, at podium, featured ten individual briefings by AFSC, AFLC, and MAC, as well as by Lockheed and other industry experts.





Long-term airlift needs were the subject of Secretary Brown's address at the luncheon in his honor. Emcee Jess Larson, Gen. J. P. McConnell, Dr. Brown, Lt. Gen. T. R. Milton, and Col. Daniel James are shown at reception.

science, industry, and the military must "forge the superior weapons of tomorrow that will discourage aggression at all levels and thus bring us closer to our ultimate goal of secure peace for all peoples of the free world."

Among the seven AFA awards presented at the USAF Chief of Staff Luncheon (see next page) by Chairman of the Board Jess Larson was the David C. Schilling Trophy to Col. Robin Olds, former Commander of the 8th Tactical Fighter Wing in Thailand, now Commandant of Cadets, US Air Force Academy, and nominated for his brigadier's star.

In accepting the high award Colonel Olds, who is also the air ace of the Southeast Asian war with four

C-5 Briefers at the AFA Convention

Lloyd Balsam
C-5 Program Director,
Nortronics Div., Northrop Corp.

Donald C. Berkey
General Manager, TF39 Program
General Electric Co.

Col. Orion P. D. Canant, USAF
Director of Current Operations,
Military Airlift Command

Lt. Col. George Grubic, USAF
C-5 Systems Program Office Team,
Air Force Logistics Command

J. B. Hippler, Program Manager,
C-5 Command & Control Systems,
Lockheed-Georgia Co.

Soren C. Ibsen
Radar Systems Marketing Manager,
Norden Div., United Aircraft Corp.

R. B. Ormsby
Chief Advanced Design Engineer,
Lockheed-Georgia Co.

William J. Pattison
Vice President-Sales,
Garrett Corp.

H. Lee Poore
Vice President,
Lockheed-Georgia Co.

Brig. Gen. Guy Townsend, USAF
Dir., C-5 Systems Program Office,
Aeronautical Systems Div., AFSC



AFA's 1968 Theodore von Kármán Trophy for Science and Engineering was awarded to Col. Alterio Gallerani of Aerospace Audio Visual Service, Orlando Air Force Base, Fla., during luncheon in honor of Air Force Secretary.

THE WHITE HOUSE
WASHINGTON

April 3, 1968

Dear Bob:

In these troubled times when American courage and determination are challenged on so many fronts, my special greetings go out to the Air Force Association as you meet in Atlanta.

Your membership has been unshaken in its unwavering devotion to the cause of national security in a world beset by tyranny and aggression. It has marshaled public understanding of the value of air power in the deterrence and containment of international lawlessness.

Today in Southeast Asia, American air power is a principal weapon against aggression. Our brave airmen daily risk their lives in combat. But air power is more than a weapon. American airmen also fight the "other war" in Vietnam. They serve as a people-to-people force to bring food, medicine, and other vital supplies to citizens all across South Vietnam.

The Air Force Association has keenly understood the indispensability of air power as a source of national strength. For this -- and for your inspiring service to the public trust -- a grateful nation salutes you, and your President wishes you well.

Sincerely,

Mr. Robert W. Smart
President, Air Force Association
1750 Pennsylvania Avenue, NW,
Washington, D. C. 20006



AFA's Board Chairman Jess Larson presented special AFA Citation to SSgt. Larry E. Mills of the USAF Security Service, San Antonio, Tex., named the USAF Outstanding Recruit and Distinguished Young Airman of the Year.

MIGs to his credit, explained that he did so as the representative of all American fighting men in Southeast Asia.

He added: "I accept particularly on behalf of the aircrews—men of the Air Force, Navy, and Marines—who have carried out missions in the North—men from Udorn, Korat, Takhli, Nakorn Phanom, Ubon—men from the carriers in the Gulf of Tonkin, men from Da Nang and Hue—all of them—who daily fly into the face of the most sophisticated, concentrated, deadly defenses that have ever opposed airpower."

And he explained that he accepted the trophy "in the name of my friends who are missing or who are known to have made the ultimate sacrifice.

"Let their devotion to God and country serve as an everlasting reminder to each of us of our obligation for personal dedication to the principles of freedom and to our country that stands today, proudly, as the first-line defender of that freedom."

The audience of more than 1,500 responded with a prolonged, standing ovation.

Prior to the luncheon, more than a thousand people participated in a briefing on the technology, impact, and potential of the C-5, moderated by Lockheed-Georgia Company President T. R. May. (See box.) The text of the briefings was published in the April issue of AIR FORCE/SPACE DIGEST.

(Continued on following page)

AWARDS AT THE 1968 AIR FORCE ASSOCIATION NATIONAL CONVENTION

AIRPOWER AWARDS

H. H. Arnold Trophy—To Gen. William W. Momyer, Commander, Seventh Air Force, PACAF, named "Aerospace Man of the Year" for outstanding contributions to the Air Force and the nation in pursuing the air war in Southeast Asia.

David C. Schilling Trophy—To Col. Robin Olds, Commandant of Cadets, US Air Force Academy, Colo., for outstanding contributions to the Air Force and to the nation in the field of flight.

Theodore von Kármán Trophy—To Col. Alterio Gallerani, Aerospace Audio Visual Service, Orlando AFB, Fla., for outstanding contributions to the Air Force and the nation in the field of engineering while serving in Southeast Asia.

Gill Robb Wilson Trophy—To Mr. Robert F. Engel, Chief, Motion Picture Services, 1352d Photographic Group, Lookout Mountain AFS, Calif., for outstanding contributions to the Air Force and the nation as producer and director of the film, "There Is a Way."

AFA President's Trophy—To the Chapters of the Utah State Organization, named "AFA Unit of the Year."

AFA President's Trophy—To Sam E. Keith, Jr., Fort Worth, Tex., named "AFA Man of the Year."

AIR FORCE ASSOCIATION CITATIONS OF HONOR

Lester J. Charnock, Aeronautical Systems Division, Wright-Patterson AFB, Ohio, named outstanding "AF Civilian Employee of the Year."

Gen. Gabriel P. Disosway, Commander, Tactical Air Command, Langley AFB, Va., for distinguished leadership during a challenging period in the history of tactical airpower while serving as Commander, Tactical Air Command, USAF.

48th Aerospace Rescue and Recovery Squadron, Eglin AFB, Fla., for planning and operation of the first nonstop crossing of the Atlantic Ocean by helicopter, June 1, 1967.

Sgt. Russell M. Hunt, 636th Combat Support Group, Clark AFB, Philippine Islands, for repeated acts of extraordinary heroism as a helicopter crewman in the rescue of allied forces on March 31, 1967, near Dak To, in the Republic of Vietnam.

Col. Daniel James, Jr., Vice Commander, 33d Tactical Fighter Wing, Eglin AFB, Fla., for inspirational leadership in combat during three armed conflicts and in furtherance of public understanding of the USAF mission.

Ralph D. Marker, Air Force Academy, named outstanding "AF Civilian Employee of the Year."

Lt. Col. James H. McInerney, Jr., Operations Officer, Operations Plans, DCS/Operations, Hq. PACAF, for distinguished combat leadership in pioneering new tactics for the air war in Southeast Asia.

Dermot M. O'Neill, Tactical Warfare Center, Eglin AFB, Fla., named outstanding "AF Civilian Employee of the Year."

Senator Richard B. Russell for distinguished leadership in support of national security while serving with great distinction as Chairman of the Committee on Armed Services, United States Senate.

Capt. Robert G. St. Clair, Office, Director of Supply and Services, Hq. Eighth Air Force, SAC, Westover AFB, Mass., for outstanding support of the war effort in Southeast Asia while serving as Base Equipment Officer, 388th Tactical Fighter Wing.

SPECIAL AWARD

The Royal Air Force for its fiftieth anniversary as a separate and coequal military service, paying special tribute to the gallant men and women of the RAF, whose skill and bravery have contributed beyond measure to the security of free men and their institutions.

SPECIAL CITATIONS

SSgt. Larry E. Mills, Hq. USAF Security Service, San Antonio, Tex., named "Distinguished Young Airman of the Year as USAF Outstanding Reenlistee."

SMSgt. Stanley W. Edwards, Hq. Squadron, 306th Combat Support Group, McCoy AFB, Fla., named "USAF Personnel Manager of the Year."

AIR NATIONAL GUARD UNIT TROPHY

141st Fighter Group (AD), Spokane, Wash., named "Outstanding Air National Guard Unit of the Year."

AIR RESERVE UNIT TROPHY

349th Military Airlift Wing, Hamilton AFB, Calif., named "Outstanding Air Force Reserve Unit of the Year."

PRESIDENT'S TROPHY FOR THE AIR FORCE RESERVE

Flight Crew, 305th Aerospace Rescue and Recovery Squadron, Selfridge AFB, Mich., named "Outstanding Air Reserve Flight Crew of the Year."

CITATIONS

Col. Charles F. Bock, Executive Secretary, Air Reserve Forces Policy Committee, Washington, D. C., for outstanding service to Air Reserve Forces programs.

Lt. Col. Stephen Harrison, Industrial College of the Armed Forces, Washington, D. C., for appearances before local, state, and regional AFA units.

Maj. Hugo Marek, Hq. Tactical Air Command, Langley AFB, Va., for appearances before local, state, and regional AFA units.

Brig. Gen. Joe F. Meis, USAF (Ret.), for outstanding service to Air Reserve Forces programs.

Lt. Col. David L. Stiles, Office of Information, Department of the Air Force, Washington, D. C., for services as USAF Assistant Project Officer and USAF Project Officer for many AFA national events.

Lt. Col. James Wall, Air University Briefing Team, Maxwell AFB, Ala., for appearances before local, state, and regional AFA units.

The C-5 was also featured prominently in the address by Air Force Secretary Harold Brown at a luncheon in his honor on the final day of the annual meeting. In his discussion of the revolution in airlift Secretary Brown sketched the dramatic advance in strategic mobility effected by the C-5. He described the planned interface between the C-5 and new light intratheater transports with either STOL or V/STOL capability. With an envisioned cruise speed of 350 to 400 knots and a range of more than 500 nautical miles, Secretary Brown said, the LIT, which is funded for contract definition in the FY 1969 budget, may accom-



AFA's highest award, the 1968 H. H. Arnold Trophy honoring the "Aerospace Man of the Year," was awarded to Gen. William W. Momyer, Deputy Commander for Air Operations in Vietnam and Commander of Seventh AF.



Maj. Gen. William C. Garland was principal speaker of the Convention's Opening Ceremony and called for home-front support of US fighting men in Vietnam. He commended AFA for "outstanding" support of US aerospace mission.

modate payloads of up to twenty tons. This system, he explained, will enable airlift to bring personnel and cargo as close to the battle lines as possible and to carry on resupply by air.

The over-all benefits of this improved airlift capability of the next decade centering on the C-5, Secretary Brown said, "will permit us to use our military power more effectively and at less cost. It provides us the choice of a smaller presence in peacetime, reduces adverse balance of payments, and allows a central reserve of military forces to guard against any one of several contingencies." (See page 114 for text of Secretary Brown's speech.)

Chairman of the Board Jess Larson served as toastmaster and read a letter of greetings to the Convention from President Johnson. (See box, page 102.)

Highlight of the special AFA awards program featured at the Secretary's luncheon was the presentation of AFA's highest award, the H. H. Arnold Trophy honoring the "Aerospace Man of the Year," to the Deputy Commander for Air Operations, United States Military Assistance Command in Vietnam, and Commander of the Seventh Air Force, Gen. William W. Momyer. In making the presentation AFA Chairman of the Board Jess Larson explained that General Momyer, in the words of Chief of Staff General McConnell, "is the greatest tactical air technician and knows more about the operations of tactical warfare than anyone else the Air Force has ever produced."

Highlight of the Opening Ceremony of the 1968 Convention was an address by the Air Force's Director of Information, Maj. Gen. William C. Garland, who urged that "when a half million of our countrymen are putting their lives on the line for us [in Southeast Asia] the least they can expect is the hundred percent backing and support of the home front." In this mission as well as in the task of explaining the role of aerospace power, the help and support provided the Air Force by AFA "is outstanding."

"We rely heavily on your state and local organizations to provide a link to the community leaders, the
(Continued on page 107)



One of the Convention's gala events was festive dinner in honor of twenty-two Outstanding Airmen of the United States Air Force who were awarded special AFA plaques. Col. Daniel James is shown here with some of the airmen.

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Convention finale, Air Force Reunion Reception and Dinner Dance, was occasion of first public showing of just-approved new WAF uniforms. Attractive WAFs showed stylish new uniforms intermingled with what the service used to wear.

businessmen, the local officials, and to the general public. Your projects and programs contribute greatly and provide a real communications channel to influential opinion-makers in all walks of life," General Garland said.

He cited individually, for the "outstanding events which they produced," the Wright Memorial Chapter of Dayton, Ohio; the El Paso Chapter; the Fresno and Santa Monica Chapters; the Tucson Chapter; and the Chapters in Georgia.

He also singled out for individual mention the Utah State Organization, the Alamo Chapter of San Antonio, the Ak-Sar-Ben Chapter of Omaha, and the Iron Gate Squadron of New York City. As for AFA's national leadership, General Garland said, "They represent you well, showing a motivation and dedication . . . that I find unequalled."

The following morning, at the Convention's Business Session, Atlanta Mayor Ivan Allen welcomed AFA to his city. In his warm and witty speech he stressed the importance the city of Atlanta attached to having AFA meet in its confines.

The Air Reserve Forces Seminar convened later in the afternoon. Reports on these two events as well as the Air War Symposium of Friday appear on pages 110, 128, and 138 of this issue.

One of the gala events of the 1968 Convention was the dinner honoring the twenty-two Outstanding Airmen of the United States Air Force. X-15 pilot USAF Maj. Pete Knight was toastmaster. The twenty-two

Outstanding Airmen were presented special AFA plaques in recognition of their achievements. Air Force Vice Chief of Staff Gen. Bruce K. Holloway and AFA President Robert W. Smart spoke during the program.

The twenty-two Outstanding Airmen were: CMSgt. THOMAS W. ANTHONY, Air National Guard; MSGT. JOHN G. DALTON, Office of Aerospace Research; MSGT. LUTHER M. DAVID, Jr., United States Air Force Security Service; MSGT. ERNEST FLORES, United States Air Forces Southern Command; MSGT. DANIEL A. GOSS, Air Force Reserve; SGT. DUANE D. HACKNEY, Military Airlift Command; MSGT. HORST K. H. HEUGLE, Air Training Command; TSgt. LARRY G. HODSON, Air Defense Command; CMSgt. ALVIN J. JOHNSON, Air Force Systems Command; MSGT. JOHN A. KEARNEY, Jr., Strategic Air Command; SMSgt. JAMES W. KEMP, Air Force Accounting and Finance Center; SMSgt. RENE C. LEBLANC, Air Force Logistics Command; SMSgt. JESUS MORADO, Air University; CMSgt. RALPH C. MORGAN, Tactical Air Command; MSGT. RALPH L. PARRISH, United States Air Forces in Europe; MSGT. PATRICK L. RABUN, Alaskan Air Command; SMSgt. JOHN P. SCHUMANN, Air Force Systems Command; SMSgt. BRYAN D. STEWART, Headquarters Command; MSGT. WILLIAM A. STOKES, United States Air Force Academy; TSgt. DONALD D. THOMAS, Continental Air Command; TSgt. WILLIAM H. YOUNG, Aeronautical Chart and Information Center; TSgt. ALFRED ZARB, Pacific Air Forces.

The Convention's finale was the Air Force Reunion Reception and Air Force Reunion Dinner Dance on Friday evening, which featured the first public showing of the new WAF uniforms. Themed to the coming twentieth anniversary of the WAF, the special fashion show climaxed in the presentation of a surprise birthday cake to Col. Jeanne M. Holm, WAF Director. Following the presentation of Air Force Medal of Honor winners, the Airmen of Note, directed by Chief Warrant Officer Bob Bunton, provided dance music.

Some 1,700 AFA members as well as governmental, military, and industrial aerospace leaders attended the twenty-second National Convention of the Air Force Association.—END



Surprise birthday cake, in honor of coming twentieth anniversary of WAF, was presented during Air Force Reunion Dinner Dance program to WAF Director, Col. Jeanne Holm, who is shown here working hard to blow out twenty candles.

Continued support of the war effort in Vietnam; a call for advanced aircraft for strategic, interception, intratheater transportation, air superiority, and close air support purposes; reaffirmation of the need for research and development; protection for fighters on the ground; more general officers; nonnuclear munitions research; and an expanded program of finding nonmilitary uses for airpower make up the list of . . .

AFA's 1968-1969 Policy Resolutions

NO. 1, CONTINUING RESOLUTIONS

WHEREAS, a number of Resolutions adopted at preceding Conventions are still valid and remain in force;

NOW, THEREFORE, BE IT RESOLVED that they receive the full support of the Air Force Association. These are:

US War Effort in Vietnam.

Advanced Manned Strategic Aircraft.

Improved Manned Interceptor.

Advanced Technology.

(Following is the action clause, or clauses, for each of the Resolutions from previous years, as renewed by this Resolution.)

US War Effort in Vietnam

NOW, THEREFORE, BE IT RESOLVED that the Air Force Association, in Convention assembled, pledge to the President of the United States its continued vigorous support in the fulfillment of our nation's responsibility to achieve a just and honorable peace in Southeast Asia. (Policy Resolution No. 1, 1967)

Advanced Manned Strategic Aircraft

NOW, THEREFORE, BE IT RESOLVED that the Air Force Association urge the President and the Secretary of Defense to expedite action and authorize contract definition of an advanced manned strategic aircraft so as to ensure the continued strategic military superiority of the United States. (Policy Resolution No. 2, 1967)

Improved Manned Interceptor

NOW, THEREFORE, BE IT RESOLVED that the Air Force Association urge the Administration, and specifically the Secretary of Defense, to procure and deploy aircraft to ensure an adequate defense of our nation in future years against the threat to our security which will be posed by advanced air-to-surface missiles and supersonic bombers. (Policy Resolution No. 3, 1967)

Advanced Technology

NOW, THEREFORE, BE IT RESOLVED by the Air Force Association that the Congress, the Administration, and the Department of Defense take every step required to ensure:

First, that the national research and development program is sufficiently broad to furnish the technology needed to deter future conflicts from the lowest to the highest ends of escalation, including space, and

Second, that this program is sufficiently deep to minimize the possibility of technological surprise in any critical scientific discipline by an enemy who stands committed to

exploit science and technology for the enslavement of the free world. (Policy Resolution No. 2, 1966)

NO. 2, ADVANCED FIGHTER AIRCRAFT

WHEREAS, events in the past year in Southeast Asia and the Middle East have confirmed that superiority in the air is essential to winning on the ground; and

WHEREAS, the Soviet Union has already displayed several new fighter aircraft estimated to have maximum speeds of about 2,000 mph; and

WHEREAS, we are currently relying on an aircraft to win and maintain air superiority which is tailored to interdiction and close support roles; and

WHEREAS, Air Force officials have proposed the development of an advanced tactical fighter, the FX, for the air superiority role; and

WHEREAS, studies show that an outstanding tactical fighter aircraft can be developed by exploiting improvements which have been made in the technologies of wing design, engines, and avionics, and that such an aircraft would be a superior air-to-air combat aircraft;

NOW, THEREFORE, BE IT RESOLVED that the Air Force Association urge Congress and the Secretary of Defense to support the development of an advanced tactical fighter aircraft as expeditiously as our technologies can provide, with the goal of having such an aircraft operational in the Air Force inventory early in the 1970s.

NO. 3, LIGHT INTRATHEATER TRANSPORT AIRCRAFT

WHEREAS, the intratheater airlift force is being depleted through attrition in Southeast Asia; and

WHEREAS, airlift units of the Air National Guard and AF Reserve are being converted to other missions; and

WHEREAS, it is becoming increasingly urgent that we develop an airlift aircraft to augment or replace our current force of intratheater airlift aircraft; and

WHEREAS, a replacement aircraft should be designed to provide an improved payload capability with a reduced requirement for prepared and improved runways, permitting direct logistic support to Army combat units down to and including squad level;

NOW, THEREFORE, BE IT RESOLVED that the Air Force Association urge the Secretary of Defense and the Secretary of the Air Force to support the development and procurement of a light transport aircraft which will provide the flexibility required to support many different kinds of military tasks at all levels of conflict and in varied climate and terrain conditions.

NO. 4, CLOSE AIR SUPPORT AIRCRAFT

WHEREAS, the experience of our ground forces in South Vietnam has emphasized the importance of reliable, timely, accurate close air support; and

WHEREAS, the tide of battle has often been turned in the favor of our forces through the effectiveness of the close air support provided by our pilots and our aircraft; and

WHEREAS, the action taken by the Army to streamline units for greater mobility presents a much greater requirement for the accurate air delivery of munitions; and

WHEREAS, a specialized close air support aircraft having as design objectives survivability in a hostile ground environment, speed, loiter time, and STOL characteristics can be developed effectively from off-the-shelf items;

NOW, THEREFORE, BE IT RESOLVED that the Air Force Association urge the Congress and the Secretary of Defense to support the expeditious development of a modern, low-cost aircraft designed primarily for the close air support role as a replacement for the airplanes currently being employed in Southeast Asia for this function.

NO. 5, THEATER AIR BASE VULNERABILITY

WHEREAS, our forces and bases along the periphery of Communist states could be subjected to surprise attacks; and

WHEREAS, the Air Force has for the past several years sought Congressional authority and funds to initiate a construction program (TAB VEE) at certain overseas installations to provide adequate protection for our military aircraft based there; and

WHEREAS, authority and funding thus far has permitted only limited runway improvement and on-base dispersal; and

WHEREAS, the most important requirement is for protective shelters for the aircraft themselves;

NOW, THEREFORE, BE IT RESOLVED that the Air Force Association support the Department of the Air Force in its efforts to obtain Congressional approval for an increased level of funding for TAB VEE military construction to expand the program to reduce overseas air base vulnerability.

NO. 6, MANNED ORBITING LABORATORY

WHEREAS, recent disclosures concerning Soviet space efforts, including the development of the Fractional Orbit Bombardment System, emphasize the need for the United States to pursue its space research efforts as a matter of national emergency; and

WHEREAS, the coming year is expected to be one of peak activity in the MOL program, including test firings of the Titan III booster, fabrication of hardware, and installation of ground equipment in the launch complex; and

WHEREAS, the Department of the Air Force has requested \$600 million in Fiscal Year 1969 for the MOL project;

NOW, THEREFORE, BE IT RESOLVED that the Air Force Association urge the Congress to continue its support of the Manned Orbiting Laboratory program as a matter of urgent concern to our national security interests.

NO. 7, GENERAL OFFICER REQUIREMENT

WHEREAS, the Air Force has been unable for several years to meet the increasing requirements for general officers; and

WHEREAS, general officer authorizations for the Air Force are prescribed in the Officer Grade Limitation Act of 1954 (10 U.S.C. 8202); and

WHEREAS, under this statute general officer authorizations are based upon total active-duty officer strength, which experience has demonstrated is an inadequate criterion for measuring general officer requirements; and

WHEREAS, the Air Force problem of meeting general officer requirements has been further aggravated in recent

years by action of the Senate Armed Services Committee in 1955 in establishing an administrative limit for the number of general officers who may serve on active duty, which limitation is below the number which would be authorized by the applicable statute; and

WHEREAS, detailed studies of this problem have clearly established that the Air Force has valid requirements for a number of general officers substantially in excess both of the number authorized by the Senate Armed Services Committee and of the number which would be authorized by the statute if that were controlling; and

WHEREAS, the increase in requirements has resulted from many factors including the variety of threats which our armed forces must be prepared to meet, the need for more capable armed forces, the necessity for responsible control of worldwide joint forces, the need for intensified resource management to ensure that maximum results are obtained for monies expended in the Defense budget, the increase in research and technological developments bearing upon National Defense, and the obligations of the United States in the preservation of world peace; and

WHEREAS, the most recent comprehensive study of general officer requirements has only recently been completed by the Office of the Secretary of Defense and it has clearly established a shortage of authorized general officer spaces within the AF of more than eighty-five positions; and

WHEREAS, the Secretary of Defense has prepared legislation which, if enacted, would provide relief for this critical problem;

NOW, THEREFORE, BE IT RESOLVED that the Air Force Association urge the Secretary of Defense to submit the aforementioned proposal to the Congress as part of the Department of Defense legislative program as expeditiously as possible; and

BE IT FURTHER RESOLVED that the Air Force Association urge the Congress to take favorable action upon this legislation as soon as possible after submission.

NO. 8, NONNUCLEAR MUNITIONS RESEARCH

WHEREAS, so-called "Wars of Liberation" will pose a threat to the security of the United States for the foreseeable future; and

WHEREAS, the preponderance of strike munitions being used by US aircraft in Southeast Asia in 1967 employ substantially the same technology as those used during World War II and the Korean conflict; and

WHEREAS, the technological capabilities to significantly increase both the delivery accuracy and the terminal effectiveness of nonnuclear air-to-ground munitions are within the grasp of the research and development community;

NOW, THEREFORE, BE IT RESOLVED that the Air Force Association support an expanded and continuing program of basic and applied research into the fields of nonnuclear munitions for delivery against ground targets by aerial vehicles.

NO. 9, NONMILITARY USES OF AIRPOWER

WHEREAS, opportunities to exert the potential constructive influences of the USAF as well as its destructive capabilities are becoming more and more available in Southeast Asia; and

WHEREAS, the challenges of improving the combat effectiveness of aerial operations in Southeast Asia have heretofore overshadowed the needs for noncombat uses of airpower as a civic action tool;

NOW, THEREFORE, BE IT RESOLVED that the Air Force Association support an expanded and continuing program of research and development into the use of aerial vehicles in civic actions, psychological operations, pacification campaigns, economic development, and other sociopolitical endeavors.

The 1968 AFA Air War Symposium was a highlight of the Twenty-second National Convention in Atlanta, Ga. It presented a factual report on what airpower has accomplished in Southeast Asia in the past year by the men who have conducted the war and participated in the attacks. All the panelists reaffirmed, from personal experience and analysis, that this was . . .

The Year Airpower Was Tested and Paid Off

THE 1968 Air Force Association Air War Symposium, a top feature of the Atlanta Convention, was a factual report on USAF's performance in Vietnam and concentrated for the most part on what has been accomplished in the Southeast Asia war theater in the past year.

It was a year in which airpower was put to the test and paid off. The report stood in sharp contrast to the 1967 Air War Symposium, held in San Francisco, where the emphasis was on the handicaps. In Atlanta, there was almost no mention of restraints imposed on airpower by the policy-makers, of the difficulty faced in winning approval for new targets, and the curbs on decisions made in the cockpit.

Probably the only issue carried over from last year's session is the continued sanctuary provided for the North Vietnamese port of Haiphong.

Maj. Gen. George B. Simler, Director of Operations at USAF headquarters and former Director of Operations for the Seventh Air Force in Saigon, was on the platform in both 1967 and 1968. He still reports that at least seventy-five percent of North Vietnamese imports flow through Haiphong and that the imports of petroleum, oil, and lubricants (POL) have increased forty-four percent from 1965 through 1967.

Unable to bomb the port itself, USAF and Navy airpower has destroyed about 48 million gallons of the POL storage capacity in North Vietnam since June 1966. The enemy still has a dispersed storage capacity for 25 million gallons, while the requirement has steadily increased. The burden has grown as electric power sources were destroyed and replaced by diesel-driven generators, and there has been increased use of trucks for ground transport. On top of this, North Vietnam has increased use of the MIG fighter in the air defense system, and aircraft are hungry consumers of POL.

General Simler said that USAF provided more than 94,000 close-support sorties in 1967. The Army's in-

creasing reliance on airpower last year is indicated by the fact that the corresponding figure for 1966 was about 70,000 sorties.

"As in any war, the name of the game is to kill more of them than they do of you," General Simler said. "The combined firepower of the ground and air forces is doing just that. It is estimated that close air support is provided for ninety-five percent of operations of battalion size or larger; however, these statistics do not tell the whole story. If you consider all the attack sorties flown in South Vietnam, including B-52s, only a small percent can be quantified in relation to enemy killed in action."

The General also noted that the North Vietnamese and Viet Cong find they cannot afford to mass without suffering a high casualty rate from American airpower. This results in more small unit engagements and fewer that involve battalion-size units. This year's Tet offensive was one exception. Khe Sanh was another.

In 1967, General Simler said, USAF flew 216,000 out of a total of 329,000 attack sorties. This does not include missions for reconnaissance, refueling, and rescue. And there is tactical airlift. In South Vietnam, there is an airlift sortie every eighty-two seconds. One of the most dramatic examples of their effectiveness, of course, was at Khe Sanh.

For a report on the B-52 operations, which until recently have been entirely in South Vietnam, the symposium heard a report from Maj. Gen. Alvan C. Gillem, II, Deputy Chief of Staff for Operations at the Strategic Air Command. The SAC missions are called Arc Light and Young Tiger. The first is the iron bomb activity by B-52s, and the latter is the C-135 refueling effort over much of Southeast Asia.

General Gillem used slides to show how the B-52 has been modified to boost its carrying capacity from twenty-seven armed bombs to 108, a fourfold increase. External racks and changes in the bomb bay—to the "big-belly configuration"—made this possible.

The bombs—primarily 500- and 750-pound weapons



Maj. Gen. Alvan C. Gillem, II, left, Deputy Chief of Staff for Operations, SAC, reported on B-52 operations over Vietnam at the Symposium, while Maj. Gen. George B. Simler, Director of Operations, Hq. USAF, discussed the tactical side.

—are used to deny the enemy his sanctuary, to support our ground forces, and for interdiction. The story of Khe Sanh (*see page 90 of this issue*) offers a history-making example of the effectiveness of airpower in support of a ground operation.

As illustrated at Khe Sanh, General Gillem said, "We can put the bombs down on the target, rain or shine, night or day. Further, we can do it from altitudes which can make it very difficult to tell from the ground that we are in the vicinity. Frequently, the first warning the enemy has is when the bombs start falling. . . ."

Customarily, the B-52s use radar to find the target, but the heavy jungle in Vietnam sometimes makes this difficult. Here, SAC uses a ground-directed bombing system called Combat Sky Spot. It is similar to the common Ground Controlled Approach (GCA) used on airport approaches, and was described by the General as "one of the greatest innovations of the war."

On flights from Andersen AFB, the SAC base on Guam, the mission takes eleven or twelve hours for a round trip of 5,200 miles. In three years of operations, the average time on target vs. the scheduled time has been forty-five seconds, an achievement that speaks well for SAC's navigators, many of them fresh out of flying school.

The refueling operation—Young Tiger—has been under way since the first USAF fighters started operating over North Vietnam.

"The presence of these tankers is essential to any worthwhile effort by the fighters," General Gillem said. "As a result of this support, this is the first conflict where fighter aircraft have enjoyed a sphere of influence which is limited primarily by crew endurance and ordnance available, rather than by fuel tank capacity. . . ."

"It's a very popular line of work with our tanker crews. They take tremendous satisfaction in the support they are able to give, and they no sooner get home than they are volunteering to go back. Their enthusiasm is at least matched by that of the fighter

pilots. It's impossible, almost, for a tanker pilot to pay for his own drink at the bar at Ubon or Udorn or Takhli."

General Gillem said there is no record of a tanker ever having missed a scheduled refueling. There have been aborted flights, but a standby tanker always is ready to go.

The war over Vietnam is giving SAC crews unprecedented exercise in the cockpit. In peacetime, with heavy alert commitments to the prime SAC mission, a B-52 crew flies about thirty hours a month and a tanker crew about twenty.

A six-month tour in Vietnam will force a B-52 crew to fly about 600 hours. The figure is about 500 hours for the tankers. General Gillem added:

"A few years ago, a pilot coming out of flying school and assigned to a B-52 unit was hard pressed
(Continued on following page)



Mr. John R. Blandford, chief counsel of the House Armed Services Committee, was question-and-answer moderator.



Three pilots, just returned from the theater, told their experiences. From left, they are Lt. Col. Stephen E. Harrison, air liaison officer with Army; Maj. Hugo E. Marek, F-105 pilot; Col. Daniel "Chappie" James, Jr., wing vice commander.

to reach 1,000 flying hours in less than four to five years. Today, he will hit that in a year or two. Furthermore, it is tough flying in the sense that every takeoff is a heavy takeoff. Most of the missions include heavyweight refueling and . . . a heavy dose of overwater navigation. Moreover, he said, "The ECM operator is finding himself exposed to signals that a trainer can't always provide."

The tankers, it was pointed out, have set an exceptional safety record. There has been one accident in more than 60,000 sorties.

Further facts were brought out in a question-and-answer period moderated by John R. Blandford, chief counsel of the House Armed Services Committee. The chairman of the committee, Congressman L. Mendel Rivers, was seated in the front row of the audience and himself contributed to the exchange.

The subject of the port of Haiphong was brought up again by a questioner. Would a blockade stop the flow of seventy-five percent of North Vietnam's POL supplies? General Simler replied:

"Eliminating the capability . . . of Haiphong is from a military standpoint still a necessity. If you are able to do that and force [the enemy] to use multiple handling points, he will become a lot more vulnerable."

Another listener asked about the practicability of using the huge new C-5A "to make retail deliveries right up to the battle line" and to such places as Khe Sanh. Gen. Howell Estes, Commander of the Military Airlift Command, was in the audience and responded to a request for an answer by Mr. Blandford. General Estes said:

"I don't think there has been anything as controversial within the Air Force as this question as to what the C-5A is going to do in the forward area."

" . . . We have attempted to develop an aircraft in the C-5A that has the capability . . . to deploy troops, and their heavy equipment . . . as far forward as the tactical situation demands."

"We are not saying that the C-5A is going to displace tactical airlift as a follow-on to the C-130. There are going to be at least ninety percent of the situations in which supplies must be delivered forward from rear base areas and that certainly is the job of the tactical airlifter, not the C-5A."

"On the other hand, if the situation demands direct delivery from the United States . . . to the brigade area, we have the capability in the C-5A to do that."

. . . The question of the vulnerability of the C-5A, as compared to other aircraft, is one that must be decided by the commander involved at the time."

General Simler was asked why North Vietnamese SAM sites are not bombed while under construction and before they are a menace to USAF and Navy planes. The answer was that it does little good to bomb an empty site, before it is equipped with missiles, radar, and enemy personnel.

In a similar vein, he was asked what is being done to improve flak suppression. His reply:

"One of the greatest contributions is ECM. . . . The best way to control antiaircraft fire is to jam [the enemy's] fire control radars. . . . The same thing applies to the SAM missiles. . . . When he falls back on optics, the speed and maneuverability of the aircraft give him a very difficult problem, except when he goes to barrage fire in the lower altitudes. . . . We have weapons in development, some of them guided, which will enhance the capability to suppress flak."

Three veteran pilots, recently returned from the theater, were given an opportunity to tell about their personal experiences in Vietnam and define the meaning of the war as they saw it.

The speakers were:

- Lt. Col. Stephen E. Harrison, who was an air liaison officer with the 1st Infantry Division and now is assigned to the Industrial College of the Armed Forces.

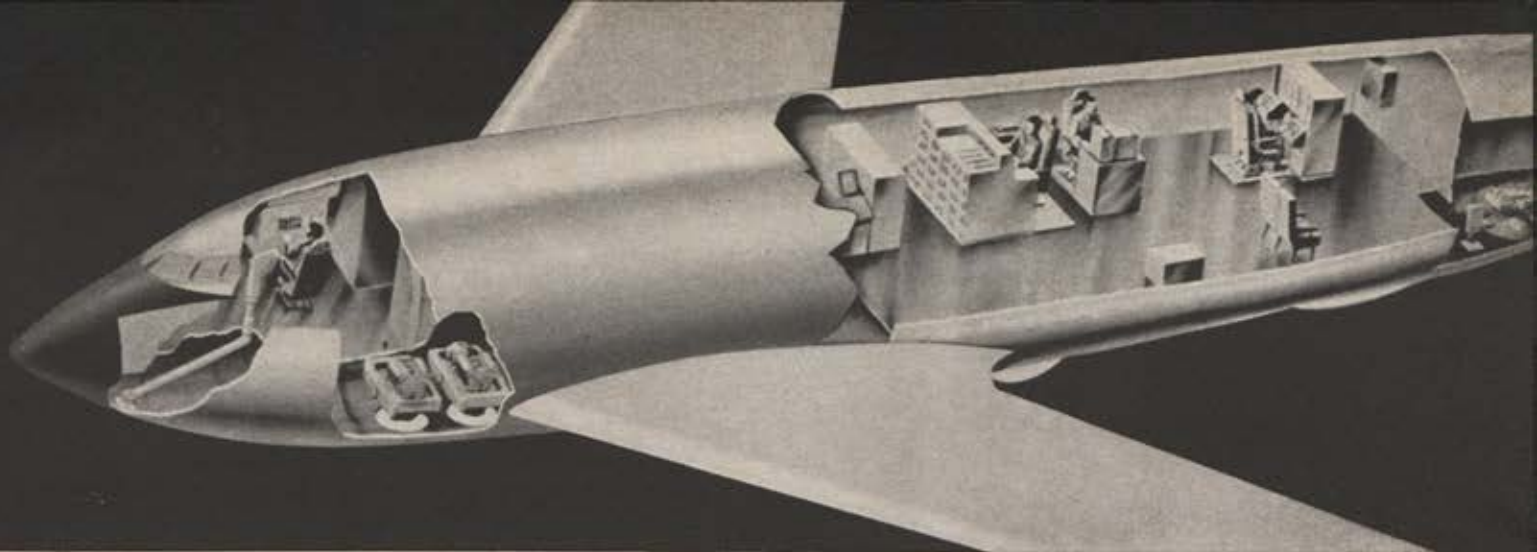
- Maj. Hugo E. Marek, former flight commander of an F-105 squadron operating out of Thailand. He flew 101 combat missions over North Vietnam and now is on the staff of the Tactical Air Command at Langley AFB.

- Col. Daniel "Chappie" James, Jr., who spent 1967 as vice commander of a tactical fighter wing in Thailand, and is now vice commander of the 33d Tactical Fighter Wing, Eglin AFB, Fla.

Their presentations, highly personal, contained rare bits of humor, patriotism, pathos, and pride. Common to all three were the tributes they paid to their USAF and Army companions in arms. Also, the clear understanding they voiced about their mission in Vietnam, betrayed no gap in credibility or the basic essentiality of what they were doing in the cockpit.

If the three veterans were querulous about anything, it was the reports they heard from home that raised doubts about the support they enjoyed from their fellow Americans.

—CLAUDE WITZE



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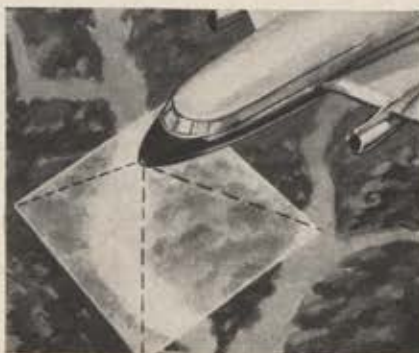
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"We have moved from token resupply by air to extensive resupply, to deployment of troops, to deployment of troops with much of their equipment. We will soon be able to deploy entire major units with all of the equipment needed for combat" . . .

The Revolution in Airlift

BY DR. HAROLD BROWN

SECRETARY OF THE AIR FORCE

LIKE most revolutions, the one that has taken place in military airlift had evolutionary roots. The first flight in a powered aircraft took place less than sixty-five years ago. At the start of the First World War, military planners considered the airplane a toy. The term airpower did not exist, and the potential of the aircraft as a logistics tool, a transporter of persons and cargo, was considered—but not very seriously.

In the Second World War, airpower became a meaningful term, related primarily to the destructive power of airborne weapons. But airlift, in that war, and even in the Korean conflict, involved the delivery of relatively small, high-priority items in support of forces whose mobility was supplied predominantly by surface transport.

Revolution in Long-Range Airlift

It was not until the 1960s that the revolution in long-range airlift began. We demonstrated in Exercise Big Lift, in 1963, that we could move the troops of an entire Army division from the central United States to Germany where their equipment—such as tanks and artillery—was already located. We did this in less than three days. The aircraft then available, however, could not move very many heavy or large items. If a real contingency had existed where such equipment was not already prepositioned, we could not have committed the troops of that Army division to combat until surface transportation had caught up with it.

By comparison, last year in Operation Eagle Thrust, the Air Force airlifted two brigades of the 101st Air-



Dr. Harold Brown, Secretary of the Air Force, speaks at the luncheon held in his honor on April 5, 1968, at the Twenty-second National Convention of the Air Force Association.

borne Division with their equipment from Kentucky to Vietnam. Our C-141 jet transports, with a few turboprop C-133 sorties, moved 5,300 tons of equipment and supplies in addition to the 10,000 troops involved. This operation required only 400 flights and—if total elapsed time had been a critical factor—could have been completed in a week.

Today we have a fleet of fourteen squadrons of C-141s—over 230 aircraft. By 1972 the strategic airlift fleet will have six squadrons of C-5s and be composed entirely of C-5s and C-141s. A new Operation Eagle Thrust would then require only 115 aircraft to deliver the force, including the same amount of equipment, across the Pacific in less than seventy-two hours—using about seventy percent of the C-5 fleet and twenty percent of the C-141s.

We have moved from token resupply by air to extensive resupply, to deployment of troops, to deployment of troops with much of their equipment. We will soon be able to deploy entire major units with all of the equipment needed for combat.

The C-5 will be able to transport almost every weapon in the Army arsenal, including the heaviest tanks. For the first time we will be able to airlift a regular infantry division anywhere in the world using approximately 500 C-141 flights, primarily for troops, and 270 C-5 flights to lift the equipment.

This article is adapted from an address given by Dr. Brown at the Air Force Association Convention, April 5, 1968, in Atlanta, Ga. He received his doctorate in physics from Columbia University and was Director of the E. O. Lawrence Radiation Laboratory at Livermore, Calif. Prior to becoming Secretary of the Air Force in October 1965, Dr. Brown was Director of Defense Research and Engineering.

With our programmed airlift force we could take the first brigade of such a division from mid-United States to the Far East in less than five days and the entire division in about ten days. The move by surface transportation would require about eight troop and twelve cargo ships of average size and would take about twenty-five days.

Quite obviously, these increased operational capabilities result from the large size of the C-5. What is not so obvious is the fact that we will also achieve lower operating costs. These benefits come from improvements in technology and from good management.

Progress in Engine Technology

The C-5 engines, for example, make possible a payload of 110 tons delivered over 3,000 miles. Soon after 1959 the Air Force and industry began a program to increase the thrust-to-weight ratio in jet engines. We were able to build improved fanjets, combining the efficiency of the propeller with the high speed and reliability of a turbojet. The engines on the C-5 are a very advanced model of this hybrid.

We have increased turbine inlet temperatures to well over 2,000°—compared to approximately 1,650° for the engines on our B-52s and the more advanced commercial airliners. The air bypass ratio—the ratio of air that passes through the propeller or fan part of the engine to that which goes through the jet portion—is eight to one. This is more than four times the ratio of fanjets in use on previous large military and commercial aircraft. Without these improvements in materials and design, the C-5 would need engines about twice as heavy and a third larger to generate the same amount of thrust.

Improving the speed, range, and capacity of our aircraft is only part of the job. We must also ensure



The first of thirty-seven UH-1 Iroquois helicopters arrives at Tan Son Nhut aboard a C-133 during Operation Eagle Thrust, when two brigades of the 101st Airborne Division and equipment were moved from Kentucky to Vietnam.

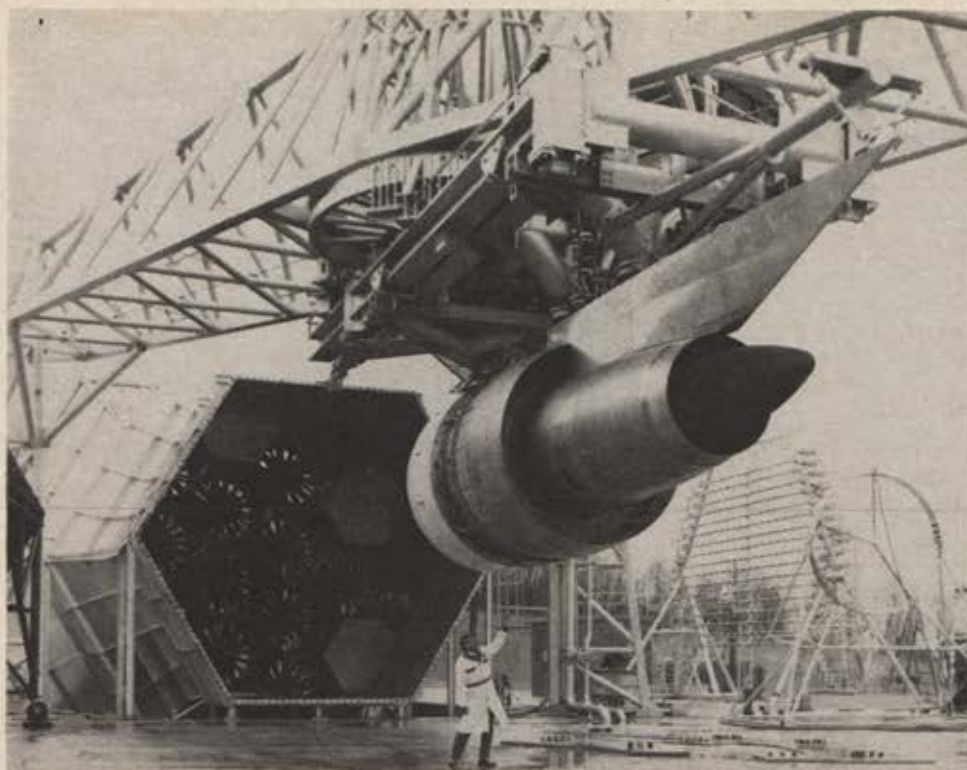
that our aircraft do not spend an unnecessary amount of time on the ground. In both cargo handling and maintenance we have made enormous improvements, and we will do even better.

The systems approach to cargo handling, our 463L system, is continually being refined. As we improve our capability to move by air, it will be increasingly important to achieve maximum compatibility between commercial air carriers and our military fleet and between air transportation and surface vehicles. For example, the size of pallets can reduce the usable cargo space of our C-141s by eleven percent if they are built with only truck and railroad boxcar dimensions in mind. Certainly this concern works both ways, and we

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A soldier from the 101st Airborne Division waits for his three-quarter-ton truck to be loaded aboard an Air Force C-141 StarLifter during Operation Eagle Thrust. The movement of two brigades of the division and their equipment was the largest deployment of a combat force from the United States (Fort Campbell, Ky.) to Southeast Asia ever undertaken. It involved 5,300 tons of equipment and supplies and 10,000 troops, requiring 400 flights.



Advanced engine technology, such as that incorporated in the General Electric TF39 at left, is a big factor in the tremendous payload and range of the C-5. The Air Force and industry have been able to increase engine thrust-to-weight ratio many times. Without the improvements in engine technology that have appeared in recent years the C-5 would need engines about twice as heavy and a third larger to generate the same amount of thrust.

cannot think only of how best to load aircraft. Standardization of cargo packaging and handling equipment, therefore, is becoming increasingly important. We do not want the time it takes to load and unload to be the limiting factor in a transportation system. If we do not stay ahead of these problems, I can foresee our aerial port squadrons facing cargo extending from horizon to horizon.

Importance of Management in Maintenance

Keeping any aircraft flying is largely a function of maintenance, and our managerial techniques are highly developed in this area.

The concept under which selected aircraft of a new type are flown at accelerated rates to "age" them prematurely has proved very useful in the case of aircraft such as the C-141. These "lead-the-force" airplanes are closely monitored. Parts that do not hold up or systems that malfunction in unexpected ways can be repaired throughout the fleet before serious troubles cause widespread interruptions in operations.

We will use this procedure with our C-5s. In addition, we will incorporate integrated data systems on *each* aircraft. This allows us to monitor subsystem performance and do in-flight maintenance. The same systems will give us continuous trend analysis so that we can make timely item changes. All of this will eliminate much of the extensive ground equipment usually required to check systems on aircraft and trace malfunctions.

Because of these advances, and the economies of scale we will achieve, we expect substantial direct cost reductions per ton-mile. For example, the C-5 should operate at about four cents per ton-mile under optimum conditions, compared with seven and a half

cents for the C-141, the current workhorse of strategic airlift.

Another measure of economy, and a very meaningful one, is pipeline time for top-priority items between the United States and overseas theaters of operations. In World War II this pipeline time was fifty to seventy days, and during the Korean War top-priority cargo took twenty-four to fifty-seven days. Today, from the source in the US to Southeast Asia, delivery time is only six to nine days. Transshipment and handling are reduced as are warehousing, breakage, pilferage, and inventory control. Since these effects decrease the overall cost of transportation, we can increase the amount we can afford to airlift.

The total cost of distribution is much more than just the ton-mile shipment cost. The fact that airlift ton-mile cost is still higher than that of surface transport does not tell the whole story. The total system's costs will often be less for airlift because of direct delivery to interior ports, lower inventory costs, and—most of all—the importance of early arrival of forces on the scene.

Surface transportation will continue to be extremely important for resupply, particularly of POL and most munitions. The competition that airlift is giving to surface transportation will benefit both modes of shipment. And where healthy competition exists, the customer will benefit most of all.

The Increasing Use of Airfreight

In civilian activities better transportation for the user is illustrated by the increasingly widespread use of airfreight. In 1966 North Atlantic air cargo increased twenty-five percent to about 200,000 tons. Military cargo to Southeast Asia was about 500,000 tons in 1967, but the North Atlantic air cargo is forecast to

exceed one and a half million tons in 1975. Another example is the increased use of airmail. Next month we celebrate the fiftieth anniversary of US airmail service. The initial "air" mail, 140 pounds scheduled from Washington to Philadelphia and New York in May 1918, actually went by train when the pilot of the Jenny became confused and landed in Maryland. Just fifty years later, in six months of 1967, nearly one-half billion ton-miles of domestic mail were carried by air.

In military activities, our strategic airlift is being used to carry priority cargo all over the world. In 1967 the Military Airlift Command fleet carried two and a half million passengers and troops and over 680,000 tons of cargo. Of this, four-fifths of the cargo and 1.6 million passengers were in support of our activities in Southeast Asia.

Within a theater of operations, tactical airlift enables us to move our forces rapidly and resupply them on a timely basis. During 1967 we airlifted, in an average month, 300,000 troops and 65,000 tons of cargo within Southeast Asia, and every month we fly approximately 31,000 support sorties in Vietnam. Of these, about thirteen percent are in response to high-priority or emergency requests. We have improved responsiveness to unscheduled airlift requests so that tactical emergency supplies are sometimes on the way in as little as thirty minutes.

Air Resupply in Vietnam

On many occasions, resupply by air has saved a beleaguered outpost. Our special forces camps, especially when under attack, depend almost entirely on airlift. Often the difference between success and failure in an operation is the aircraft available to move supplies in, move the wounded out, and redeploy the troops. In performing these missions, enemy gunfire is a constant hazard. In October and November of last year at Loc Ninh in [the] III Corps [area of South Vietnam], a very heavy attack was effectively repulsed because of airlift. We suffered thirty-two dead, US and South Vietnamese, and killed almost 1,000 Viet Cong. Two Army battalions were brought into the area before the main attack started, although the runway was located in no-man's land between the rubber trees harboring the Viet Cong and the camp. Whenever the

mortar barrages on the airfield lifted, the ground control party radioed to the C-130s and C-123s, orbiting a few miles away, that it was possible to land. Reports from Vietnam daily attest to very effective ground-air cooperation, in tactical airlift as in other missions.

Landing is not always possible in situations such as Loc Ninh, however, and other methods of delivery are used. Container delivery drops and low-altitude parachute extraction systems are very accurate. At Khe Sanh our pilots consistently deliver the supplies well within the 200-yard distance required in training, and they achieve Circular Error Averages as low as thirty yards. This accuracy is even more impressive when the amounts of supplies delivered and the conditions around Khe Sanh are considered. (See page 90.)

Air Force airplanes are delivering an average of more than 300,000 pounds of supplies and equipment each day to the Marines in Khe Sanh. By comparison, if ground resupply were possible, this would take a sixty-truck convoy each day for the cargo alone.

The airlift is being conducted in conditions which are very far from ideal. About ninety percent of the battle damage sustained by our airlift aircraft throughout Vietnam occurs on landing and takeoff, when [the aircraft] are closest to the ground. At Khe Sanh, this is also true, but the enemy shoots down on the airplanes from overlooking hills as they approach or leave the field. In bad weather, we continue to resupply, using ground radar and airborne doppler equipment to bring the C-130s to the drop zone. All of you, being associated with aircraft, will appreciate the pilot skills involved when, at the point of release, this large cargo aircraft is in a high pitch attitude, low airspeed, in the clouds, and just a few hundred feet above the ground.

In spite of this very impressive record (or perhaps because of it, since we will always demand of ourselves higher performance levels), future operations in military airlift will show great improvement.

Total Air Logistics System

Looking at the entire military air logistics system, the C-5 and C-141 will give us the potential of staging large loads rapidly into an area. We will need improved intratheater capability to move supplies from major air terminals to the troops in the field. For example,

(Continued on following page)

An example of the kind of job intratheater airlift can do is the resupply effort at Khe Sanh where, in spite of the fact that the enemy is able to shoot down on the C-130s and C-123s, more than 300,000 pounds of supplies and equipment are carried each day into the one airstrip. At right, a C-130 of the 315th Air Division lands with a load of supplies during the early days of the siege.





A method of delivering cargo that has greatly increased accuracy of delivery of supplies in the combat area is LAPEDS (low-altitude, parachute-extraction delivery system), which allows C-130s to put pallets of cargo exactly where they are needed for ground troops.

the aerial support of Khe Sanh has been done by aircraft that land under assault conditions and unload while in motion, paratroop in adverse weather, and—very importantly—deliver supplies in loads that the Marines can handle.

In any situation, airlift must move cargo as close to the battle lines as possible, in appropriate amounts, and with the most efficient use of our equipment (supplying a large fraction of a theater's requirements by parachute can be expensive). To complicate the problem, often the cargo is delivered to a fluid front line, and our supply system must expand and contract while it efficiently funnels cargo to the user.

We have under study a number of methods to accomplish initial deployment of units by air and then replenish them. For example, satellite supply areas can be established around a major airfield and serviced by new light intratheater transports—the LIT—with either a vertical or short takeoff capability. The FY 1969 budget has funds for contract definition, a major step in development of the LIT. This aircraft, to be available in the 1970s, will be able to make short takeoffs and landings, and may be capable of vertical takeoffs. We are considering a speed of 350 to 400 knots and over a 500-nautical-mile range—in ordinary use its payload may be as much as twenty tons. It would carry less in very short or—perhaps—vertical takeoffs and landings. As in the case of the C-5, our technology will result in a very advanced aircraft. Composite materials, for example, show great promise in both airframe construction and propulsion.

Technology is a Greek name for a bag of tools. This very powerful tool, this dramatic change in our airlift capability, will influence our national policies. Improved airlift will permit us to use our military power more effectively and at less cost. It provides us the choice of a smaller presence overseas in peacetime, reduces adverse balance of payments, and allows a central reserve of military forces to guard against any one of several contingencies.

Our ability to move faster, and with more force, to distant places in the world does not mean that we will be looking for additional commitments. It does mean that we will be better able to use military force when we must act in defense of our interests.

The Lessons of Korea

As we increase our ability to react rapidly, we can decrease the political and military risks and minimize

the cost in lives. For example, the speed of the ten-division Communist invasion of South Korea in June 1950 forced us to commit US units piecemeal. We had to trade space for time. Seven days after the initial enemy assault across the thirty-eighth parallel, two US rifle companies had been moved into position by air, train, and truck. They fought stubbornly [but] were forced to retreat with heavy losses. It was fourteen days before the first full US division [could be] moved in from Japan. Two more divisions based in the Far East were in action nine days later. The first division from the continental United States arrived on D+56. There is some evidence that the North Koreans were confident that they could capture all of South Korea before any outside power could intervene effectively. They came uncomfortably close, but were mistaken, and an aggressor will be even more foolhardy to gamble like that in the future.

By dual-basing some of our units, we will be able to move rapidly between home bases in the United States and overseas operational sites. In this way we can maintain much of our military power at home while fulfilling our overseas obligations. We plan, in 1968, to return about 34,000 military personnel from Europe. These forces will remain committed to NATO and be capable of extremely rapid return to Europe. One benefit of dual-basing is that our international expenditures are lessened by locating US military units, with their dependents, at home rather than abroad. In this particular redeployment of 34,000 troops, and more than 15,000 dependents, we expect to save \$75 million in gold flow per year.

An ability to stage more of our military forces from the US should not lead us to a return to the isolationism of the past. Our experience has taught us that a lack of preparedness and a reluctance to assume our responsibilities leads to a higher ultimate price. In the nuclear era no great power can afford to play ostrich. Isolationism is not the disposition of forces; it is a state of mind. We should adopt our national policies by choice, and technology provides an extremely wide range of choices.

Here in Marietta, at the C-5 rollout ceremonies a month ago, President Johnson quoted Franklin Roosevelt's final, undelivered speech: "Great power involves great responsibility." We have shown in the past that we will fulfill our responsibilities. In the future, we will be even better able to discharge the responsibilities of power. This is the basic significance of the revolution in airlift we are witnessing.—END

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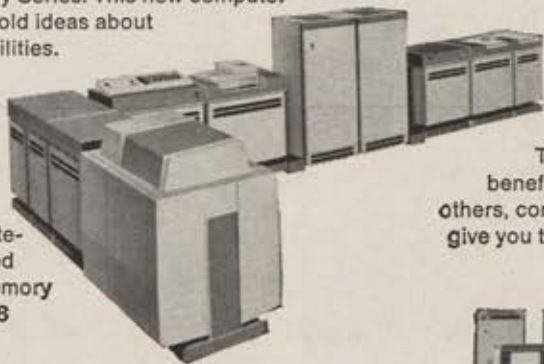
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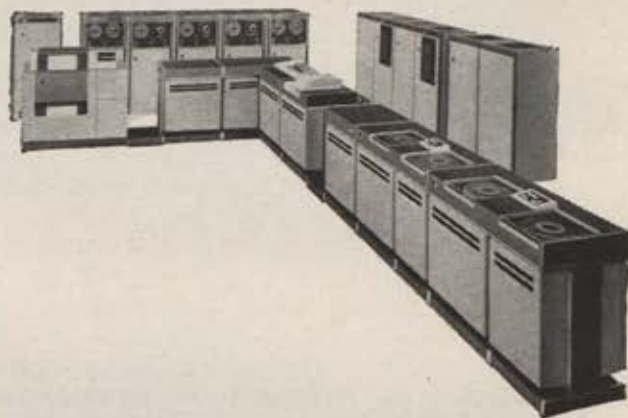


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More important than the fantastic size and payload of the C-5A is the fact that the aircraft creates a new order in over-all military capability. Military superiority is always established and maintained by such breakthroughs in operational capability, whether the result of spectacular scientific and technological discoveries or simply well-managed programs like the C-5A. The complacent position that nuclear missiles are the "ultimate weapon" is dangerous and untrue, for no one knows what seemingly minor development might be in progress that could give us or our adversaries a completely new magnitude of military effectiveness. Consequently, we must continue . . .

The Quest for New Orders of Military Capability

BY GEN. JOHN P. McCONNELL

CHIEF OF STAFF, UNITED STATES AIR FORCE

THE annual Conventions of the Air Force Association provide a most suitable platform for recognizing the contributions of organizations and individuals to the cause of airpower. Beyond such recognitions, however, the AFA Conventions offer the opportunity to engage in open discussions of important aerospace issues and problems which call for broad public understanding and support. I want to avail myself of that opportunity again today.

This year's AFA Convention is under the shadow of the C-5A Galaxy, literally and figuratively. It is the only galaxy that needs no powerful telescopes and light-years to observe, especially for this audience. But everything else about it certainly is astronomical—its payload, its performance, and its proportions. I will not dwell on the statistics of this great airplane, impressive though they are, because just about everything that can be said about it in that respect has already been said. Nor will I yield to the temptation to talk about the impact which the vastly increased mobility provided by the C-5A will have on our military strategy and national policy. . . .

But there is one significant aspect of this airplane on which I would like to elaborate. I am referring to



Gen. J. P. McConnell, USAF Chief of Staff, speaking at the Chief of Staff Luncheon at Marietta, Ga., on April 4, during the Twenty-second National Air Force Association Convention.

the fact that the C-5A represents not merely a major advance in its particular field—airlift—but, because of its far-reaching implications, will in effect bring about a new order of over-all military capability. I feel very strongly that the security of this country and, indeed, of the free world calls for such new orders of military capability across the entire spectrum of national defense.

Many of us have stressed the importance of so-called technological breakthroughs in preserving a safe margin of military superiority. There can be no doubt that such breakthroughs have been instrumental in helping us develop revolutionary weapons that have gained for us new orders of military capability. Nuclear munitions and ballistic missiles are perhaps the most often quoted examples in this respect. But the development of the C-5A demonstrates that higher orders of military capability can also be achieved *without* spectacular technological breakthroughs. It is true that, for in-

(Continued on following page)

This article is adapted from an address given by General McConnell at the Air Force Association Convention, April 4, 1968, in Atlanta, Ga. An experienced commander, with extensive firsthand knowledge of the Far East, General McConnell has been Director of Plans, a numbered Air Force commander, and Vice Chief of the Strategic Air Command; Deputy Commander in Chief, EUCOM; and Vice Chief of Staff before becoming Air Force Chief of Staff.



The Ling-Temco-Vought A-7 Corsair II aircraft, shown here in its A-7A Navy version, will soon be in use with the Air Force, providing it with significant new tactical capabilities, including a greater load-carrying capability and greater range than any other single-jet aircraft, all-weather/day-night attack capability, and probably the best maintenance-to-flight-time ratio of any jet in service.

stance, the development of the C-5A engine entailed some rather remarkable advances in materials and design techniques. But it was the painstaking and closely coordinated teamwork of science, industry, and the military, not major technological breakthroughs, that resulted in the C-5A.

Breakthroughs in Operational Capabilities

The point is that military superiority is established and maintained primarily through breakthroughs in *operational capability*, regardless of whether such breakthroughs result from scientific advances, exploitation of known phenomena, or just step-by-step, well-managed efforts. This does not mean that we should concentrate on higher orders of military capability at the expense of our current needs. We must continue to improve our present operational equipment and techniques, as we are doing so effectively now for our forces in Southeast Asia. But, at the same time, we must prepare ourselves for future contingencies, and breakthroughs in operational capability will help us assure an adequate measure of military superiority for the difficult years ahead.

To appreciate the importance of this requirement, we must understand that the traditional concept of "military superiority" has taken on a new meaning because our national strategy has taken a new direction. In addressing your annual Convention last year, I referred to that new strategy as a "National Strategy of Conflict Management." We gradually shifted to such a broad strategy because of profound changes, during the past two decades, in political, military, and technological factors which deeply affect our national security.

The loss of our atomic monopoly after World War II and the subsequent rapid rise of the Soviet Union as a nuclear power have encouraged the Communists to foment and support local crises and conventional conflicts in which our national interests as well as our international commitments have forced us to inter-

vene. To defeat the global objectives of the Soviet strategy, our national leaders have been endeavoring to achieve political solutions of the Communist-supported conflicts, using military power only to the limits required by prevailing conditions. This policy of restraint has been successful in bringing about political solutions in a number of crises during the past decade. And to pave the way for such a solution has been and still is the primary objective of our military operations in Southeast Asia.

Military's Role in Diplomacy

The role of the military as a fully and instantly responsive diplomatic instrument places far greater demands on the versatility and mobility of our armed forces than the capability to gain a decisive military victory in any type of limited conventional conflict. We certainly have the capability and power to destroy North Vietnam. But such a radical military solution could aggravate and multiply the many other problems in Southeast Asia and could well lead to global consequences that might gravely impair our national security.

It is for these reasons that our national leaders have decided to maintain a course of restraint in the hope that the measured application of military power will eventually lead to the political solution which they feel is needed to bring stability to all of Southeast Asia. I am confident that we will attain this objective. But the great sacrifices in men and materiel which we have made and are still making in order to achieve an equitable political solution should also serve as an incentive to heed the *military* lessons we have learned.

Airpower's Role in Limited War

The most important lesson perhaps that is coming out of the Vietnam War is the vastly expanded role of airpower in limited conflicts and, especially, in the type of counterinsurgency warfare being waged in Vietnam. There is no need for me to tell this audience

of the great variety of tasks airpower is performing in that war. As you know, these tasks include close air support of the ground forces, which often has saved the day for our troops; attacks on enemy concentrations and supply lines; aerial reconnaissance; and the little-publicized but vital accomplishments of our airlift, both to and within Southeast Asia.

The vital contributions of airpower in these and related areas can be evaluated fully only by the historian, long after the end of the Vietnam War, when sufficient data will have become available to permit an objective and fair assessment. But I believe that, even at this stage, several conclusions can be drawn, some of which I want to mention.

- First, if it had not been for the expanding and effective employment of airpower, our losses in men would have been far higher; we could not have maintained our operations at the required level; and it is, in fact, unlikely that we could have prevented a Communist conquest of South Vietnam to this date.

- Second, in the accomplishment of this mission, we have been evolving new equipment, new applications, and new tactics which will greatly enhance our ability to deal with similar conflicts in the future, both politically and militarily.

- The third conclusion I want to mention is that, because of the demonstrated importance of airpower in limited conventional conflicts, we must strive for dramatic new orders of military capability in tactical and strategic airpower just as the C-5A will achieve in the airlift field. The improvements which we have made during the past few years, and which we will continue to make on the basis of the lessons we are learning, are most gratifying and promising. But if our nuclear umbrella is to preserve its effectiveness in the years ahead and if our general-purpose forces are to remain superior to any quantitative and qualitative challenge on the part of potential aggressors, then we must endeavor to attain both step-by-step improvements and fundamental advances in strategic and tactical airpower.

Tactical Airpower

To illustrate my point, let me first turn to tactical airpower. One of the most vital tasks of tactical airpower in Vietnam, as well as in any similar conflict of the future, is close support of the ground forces. This task entails the delivery of firepower—rapidly, effectively, and accurately, and under any conditions of terrain, weather, and lighting. While this task in itself is not new, its scope in Vietnam has been greatly expanded, resulting in unprecedented requirements because of the unprecedented conditions of jungle and counterinsurgency warfare with which we have to cope.

During the past three years, we have made great strides in meeting these requirements by using or adapting existing equipment and components, and by developing new equipment utilizing on-the-shelf technology. Particular progress has been made in munitions and their delivery. There have been marked improvements in accuracy, in all-weather operations, and in night-time bombing and strafing. However, much work

remains to be done in each of these three areas. In my opinion, we will truly reach a new order of over-all military capability once we solve the manifold problems entailed in delivering aerial firepower right on the target, regardless of whether and to what extent the target may be obscured by clouds, darkness, and such obstacles as a dense jungle canopy.

Accuracy of bomb delivery is especially important in conventional warfare, for a variety of reasons. For one, close air support often requires bombing in very close proximity to friendly forces. The greater the reliable bombing accuracy we can achieve, the closer we can bomb an attacking force without endangering our own troops. Also, the highest degree of precision is desired in bombing military targets located in populated areas so as to minimize civilian casualties. Another compelling reason for the greatest possible accuracy stems from the fact that the destructive power of a bomb decreases with the cube of its impact distance from the target. This means that, for example, a bomb that explodes within 100 feet of a target has about eight times the destructive power of a bomb that hits only twice the distance, that is, 200 feet away.

'Unconventional Conventional' Munitions

I am confident that equipment now under test, development, or study will further enhance the gratifying progress we have made in this respect. The advantages to be gained from such improvements in accuracy would be augmented greatly by what I would consider a major breakthrough in operational capability, and that is a technological advance that would permit us to narrow the wide gap between conventional and nuclear munitions.

The largest bomb we are using in Southeast Asia weighs 3,000 pounds. A nuclear bomb of similar weight and size has roughly one thousand times more firepower. I see a great challenge in trying to develop a nonnuclear explosive that would give us ten or more times the power of the most potent conventional explosives we now have, thus narrowing the gap between nuclear and nonnuclear munitions. I don't know whether such a development is possible and feasible. But I do know that the development of a family of such "unconventional conventional" munitions would help us achieve a new order of military capability, especially in combination with further improvements in accuracy. This would be of tremendous advantage to us in fighting and, possibly, deterring any future conflict of the type and scope we are now waging in Southeast Asia.

Time does not permit me to discuss the many other areas of tactical airpower in which major advances would bring about new orders of over-all military capability. But I do want to touch briefly on similar considerations for strategic airpower.

Strategic Airpower

I have the impression that many people in this country take our still-existing nuclear superiority for
(Continued on following page)



The Sprint missile is one of the components in the Sentinel antimissile system now being built. This "thin line of missile defense" would protect us against a relatively small and unsophisticated attack such as Red China might launch.

granted and, in fact, place less and less importance on its preservation. The reason may be that our strategic nuclear strength has achieved its primary purpose of deterring nuclear aggression for so long that the threat of it has lost much of its initial frightfulness. In my opinion, such complacency is extremely dangerous because of the still growing nuclear strength of the Soviets and the nuclear potential of such aggressive nations as Communist China. I submit that there can be no more urgent task for the continuing protection of our national security than to maintain our margin of nuclear superiority in the face of any advances potential aggressors may make.

To remain as effective in the future as it has in the past, our nuclear deterrent must meet two requirements. First, we must possess a convincing capability to assure the destruction of any potential aggressor even after we have been subjected to a massive surprise attack. Second, we must be able to limit the damage to our strategic strike forces as well as to our political and economic structure to such an extent that we will prevail as a nation while the aggressor will not. As long as we can convince a potential aggressor that such will be the case, he will be strongly deterred from risking a nuclear attack on this country. And that is also the "nuclear umbrella," which permits our national leaders to take appropriate action in local crises and conventional conflicts, such as the one in Vietnam, without undue risk of nuclear war.

As for the first requirement—assured destruction of

an aggressor—we have made great advances in the quality and quantity of our nuclear arsenal, in which increasingly sophisticated missiles, both land- and sea-based, have been supplementing our manned bombers, many of which have been phased out in the meantime.

Improvements in Ballistic Missiles

Without going into any details, I want to emphasize that some of the recent and contemplated improvements in our ballistic missiles, such as multiple independent reentry vehicles, represent what I consider new orders of military capability. On the other hand, there has been no such progress in our aging and shrinking force of nuclear bombers. I believe very strongly that there will be a continuing and urgent need for a proper mix of manned and unmanned strategic weapon systems. Therefore, I hope that we will make progress in developing a highly advanced manned strategic aircraft to take the place of our obsolescent B-52s and thus help preserve a convincing two-pronged nuclear deterrent.

As I indicated earlier, our residual capacity for a decisive strategic counterattack in case of aggression must be complemented by a similarly effective capacity for keeping the damage we would sustain to a minimum. I am confident that our strategic defenses against a bomber attack will serve their purpose, especially with continuing improvements. But there is as yet no effective defense against ballistic missiles which, therefore, pose the most serious threat.

We have made and continue to make great progress in the *detection* of a missile attack. The warning we would get of such an attack, however brief, would suffice to launch most of our strategic counterattack forces and thus minimize the danger of their destruction before launch. If we had an adequate shelter program, the warning provided by our detection systems would also help save many lives. But, as of now, there is little we can do to keep the bulk of an aggressor's missiles from impacting on our soil.

Prospects for Missile Defense

As you know, much effort and money is being expended to cope with this grave problem. A so-called "thin line of missile defense," known as "Sentinel," is being built to help protect us against a relatively small and simple attack, which Communist China will be capable of mounting as it builds up its inventory of operational missiles. There are good reasons for not attempting a more extensive missile defense system at this time. The cost involved—scores of billions of dollars—is but one of these reasons. Even more compelling is the fact that, by the time such a system would become operational, the rapid advances in missile technology, both offensive and defensive, would render that system obsolete. However, the presently planned less elaborate and, therefore, less expensive missile defense system will permit us to incorporate and test technological advances which could be useful if it should prove feasible and desirable to deploy a larger ABM system at some future date.

(Continued on page 127)



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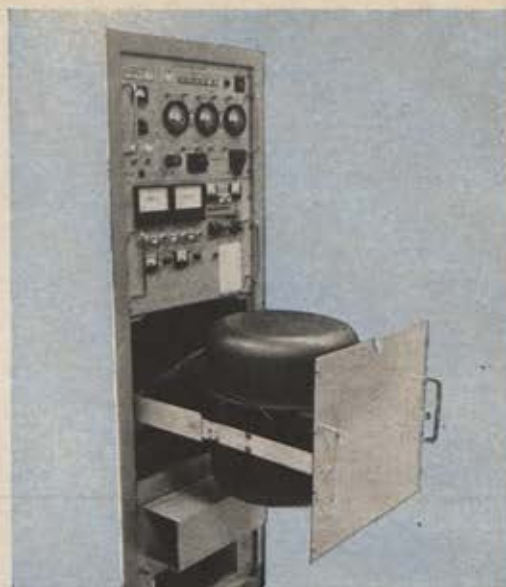
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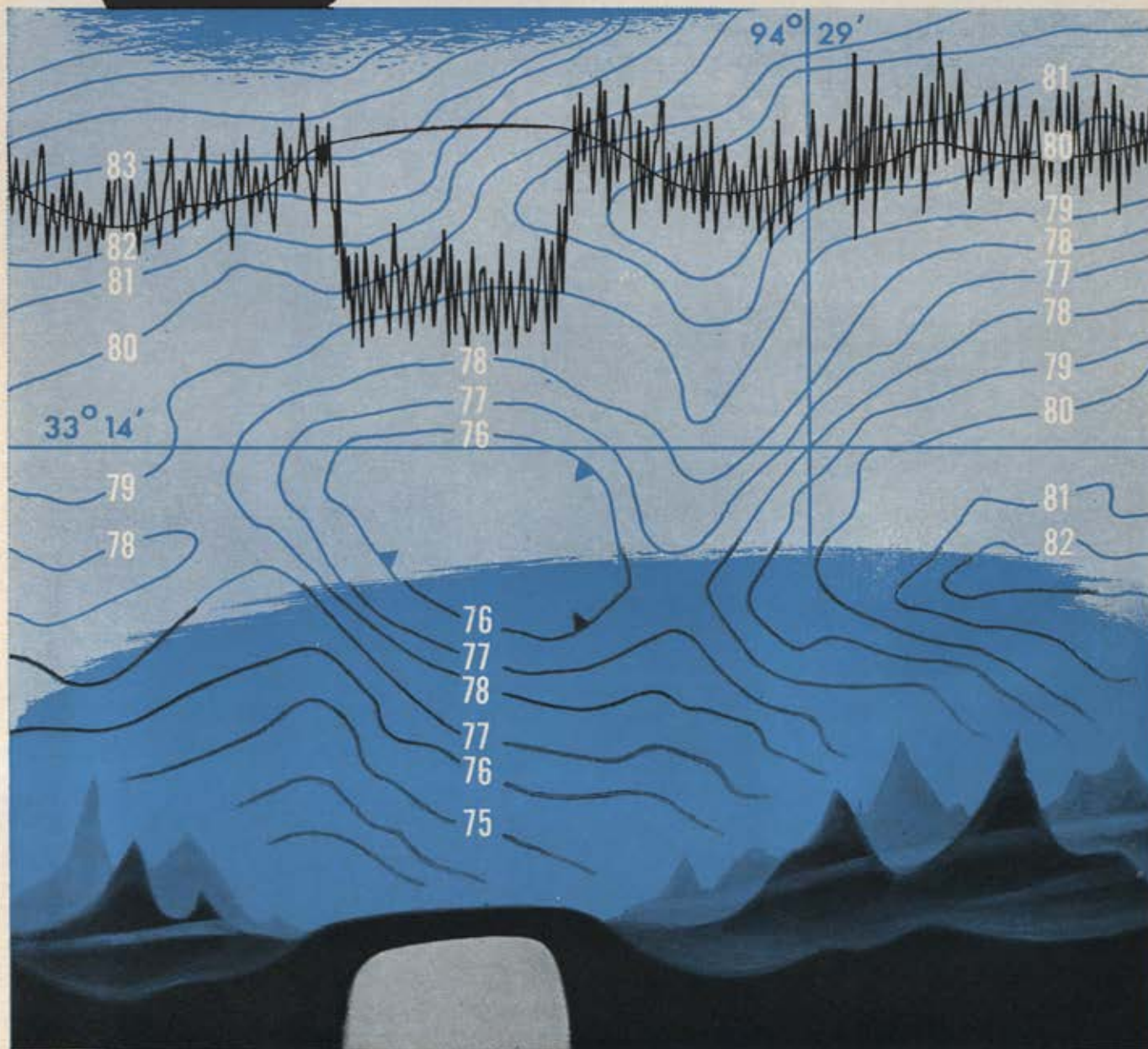
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We are continuously studying new approaches to missile defense. One promising approach would entail the use of an airborne platform, such as the C-5A, as a mobile missile defense system. Such a system could operate worldwide from existing airfields, as needed, and carry a dozen or more small antimissile missiles. It would have the on-board capability of detecting, tracking, and intercepting missiles at ranges of hundreds of miles from its cruise station.

This and other new approaches under consideration or study still depend on missiles to intercept and destroy an enemy's missiles which may carry multiple warheads and penetration aids. The challenge, therefore, is to develop a system which would destroy hostile missiles as soon as possible after launch, that is, before their warheads are separated from the boosters. An even greater challenge, however, is to find some means other than antimissiles for defense against ballistic missiles.

For instance, scientists have talked about an "electronic fence" which might use an advanced form of laser or similar beam to destroy any object that would penetrate this invisible radar fence and that would have been established as hostile by our detection systems. Such a development may seem fantastic today, but so did nuclear-tipped intercontinental ballistic missiles less than a generation ago! Whichever nation should be the first to develop a virtually impenetrable missile defense, provided such is possible, would achieve a new order of military capability comparable to the short-lived atomic monopoly we enjoyed after World War II. If this should ever come to pass, I surely hope we will be that nation.

Necessity for Operational Breakthroughs

I have given you but a few examples to illustrate my point that there are many areas where operational breakthroughs are desirable, if not necessary, in order to keep ahead of any advances in military technology which our adversaries may make. And while these examples pertain primarily to aerospace power, it should be obvious that the continuing need for major improvements and new orders of military capability applies equally to our operations on land, at sea, and under the sea. There is, of course, no sharp borderline between "major improvement" and "new order of military capability." But I would say that the latter would have to be an operational breakthrough of such magnitude as to greatly affect our over-all military strategy and tactics, if not our national policy.

Let me give you an example of a seemingly minor development that would fall within that category. Some years ago, there was talk about a "radar-absorbing" coating that would prevent radar beams from being reflected by any object on the surface, in the air, or in space covered with it. I can't tell you whether such a thing is within the realm of possibility or not. But let us assume, for a moment, that the Soviets should succeed in developing such a coating and would apply it to their aircraft and missiles. This would give them a new order of military capability which would be so far-reaching as to render most of our present detection, tracking, and interception systems useless.

And as long as we give our imagination free rein, let me go one step further. When airplanes were first used systematically for military purposes, they added a third dimension to warfare and thus helped achieve a new order of military capability. Since then, the evolution of airpower has witnessed an unending series of operational breakthroughs, each of which represented a new order of military capability, with the development of the jet engine and nuclear bombs topping the list. Then came the nuclear-armed ballistic missile, which was widely hailed as the "ultimate weapon."

No 'Ultimate Weapon'

But let me make it clear that there is no such thing as an "ultimate weapon," except man himself, whose limitless ingenuity will always find new and more effective ways to conduct warfare, be it for aggressive or defensive purposes. Therefore, we should ask ourselves, what will come after the ballistic missile? I am not talking merely about better missiles or space-based launching platforms and the like. I am talking about some revolutionary new techniques or family of weapons which are beyond our imagination today, just as jet engines, nuclear weapons, ballistic missiles, and man-made satellites were far beyond our imagination when I entered the Air Corps more than thirty-six years ago.

Scientists in some obscure laboratory, in the United States or in Russia or anywhere else, may be working right now with a strange new phenomenon, never suspecting that it is destined to revolutionize the entire art of warfare. Or, somewhere, an industrial concern may be spending its own money to develop a promising invention that may not only result in a best-selling product but also have military applications of unprecedented scope.

But be that as it may, I have little doubt that dramatic changes will come at an even faster and greater pace than they have in the past. And I consider it vital to our future security that we be the first to conceive and discover those fundamental principles that will lead to operational breakthroughs and new orders of military capability. We cannot afford to let someone else surprise us with another Sputnik and then hustle to improve on it.

We certainly do not lack the talent and initiative to pioneer in scientific realms so new and strange that no one has ever ventured into them before. And we are fortunate enough to possess the human and material resources to convert even the most ambitious ideas into operational reality. We have done so frequently in the past, and I am confident that we can and will continue to do so in the future.

The teamwork of science, industry, and the military that produced the C-5A is compelling proof of what can be achieved in our quest for higher orders of military capability. My challenge today to you and to all our fellow citizens is to help forge the superior weapons of tomorrow that will discourage aggression at all levels and thus bring us ever closer to our ultimate goal of a secure peace for all the peoples of the free world.—END



By Jackson V. Rambeau

AFA DIRECTOR OF MILITARY RELATIONS

Fifteenth Air Reserve Forces Seminar

The Air Reserve Forces are apparently receiving more action and attention at all levels these days than at any previous time in history. This fact was brought out at the Reserve Forces Seminar during the AFA Convention in Atlanta.

In his keynote remarks, Gen. Bruce K. Holloway, USAF Vice Chief of Staff, praised the caliber of Air Reserve Forces units recalled in January. (The April callup had not yet been announced.)

"In the last twenty-five years, either the National Guard or the Reserves, or both, have been mobilized for defense five times, and have been called on many times to help out with disasters and emergencies," he said.

"Each time you have been called for active duty, you have responded faster than before, with better-trained and -equipped units than the previous time. I don't see how you could do much better than you did in January, but no doubt you will find some way to do it because there is always room for improvement at every level from the top to the bottom in the Reserve Forces or the active forces."

General Holloway gave an extensive account of changes resulting from enactment of Public Law 90-168, the "Reserve Bill of Rights," with particular reference to establishment of the Office of the Air Force Reserve in the Pentagon, under Maj. Gen. Tom E. Marchbanks, Jr. (See photo, page 133.)

"Continental Air Command will become Headquarters Air Force Reserve, and it is likely that some spaces and functions will be transferred to General Marchbanks' office," he declared.

"His office is an integral part of the Air Staff that will participate in all planning connected with Air Force requirements. General McConnell will look to General Marchbanks on every issue related to the Air Force Reserve. The new office will give the Air Force Reserve a management system able to respond even more rapidly to the security needs of the nation than it has in the past. This is an important step in the integration of planning for the entire Air Force—active and Reserve."

Reserve Forces Seminar participants are, from left, Brig. Gen. I. G. Brown, ANG; Maj. Gen. Tom Marchbanks, AFRes; Dr. Ted Marrs, Office of AF Secretary; Frank Slatinshek, House Armed Services Committee counsel; Brig. Gen. George Edmonds and Maj. Gen. Bob Eaton, AFA Guard and Reserve Council leaders; General Holloway; and, at rostrum, AFA President Bob Smart.

Referring next to another innovation in the Reserve program, he reported that in March "we formally started the Associate Unit Program with ceremonies at Norton AFB, Calif. As most of you know, members of the Air Force Reserve assigned to the program will train as Reserve aircrew and support members of the 63d Military Airlift Wing, which is equipped with the C-141 StarLifter. This augmentation will allow the Wing to meet and sustain surge requirements without the need for across-the-board personnel augmentation from the active force.

"Three more Reserve tactical airlift groups will phase into the MAC Associate Unit Program this summer—one at Dover, Del.; one at McGuire AFB, N. J.; and one at McChord AFB, Wash.

"Whether the Associate Unit concept, which was tested first in Medical Service units, can be applied to other types of Air Force operating units is an open question. The answer will depend considerably on how the concept works out at Norton. I believe it to be a very promising idea."

On a subject near and dear to the heart of every Reserve Forces unit commander, General Holloway said, "We

In keynote address at Air Reserve Forces Seminar, Gen. Bruce K. Holloway, USAF Vice Chief of Staff, paid tribute to readiness of units recalled in January and others prepared to respond if needed.





AFA's award to the Outstanding Air National Guard Unit for 1967, the 141st Fighter Group (AD), Spokane, Wash., is accepted by its commander, Lt. Col. Lloyd A. Howard, from AFA President Bob Smart. "Bulletin Board" editor, J. V. Rambeau, assists in handing over the weighty trophy.

would like 100 percent manning and equipping with first-line aircraft. The payoff from that was demonstrated by the 'Combat Beef' units that were activated in January. It certainly is more effective, and in the long run cheaper, to man and equip 100 percent before mobilization, rather than after. This optimum situation will remain our goal. At the same time, we must continue support of the Reserve Forces on a total force concept. The active and Reserve Forces are looked at as one total force in deciding how our assets can best be allocated between the two components.

"In the long-range picture—seven to ten years ahead—no one can say with certainty what will be the mission assigned to any specific unit of the Reserve Forces. Some units have had three or four changes of mission in the past ten years, and they have responded magnificently. The future is going to be determined by a combination of technology, economics, and international stability—or the lack of it.

"We can be sure of one thing. There will be a continued need for the Air National Guard and the Air Force Reserve. You have proved again and again that defense dollars invested in the Reserve Forces buy a lot of security against the potential hazards of an uncertain future."

During the question-and-answer period a wide range of questions were handled by the panel members: Mr. Frank M. Slatinshek, Counsel for the House Armed Services Committee; Dr. Theodore C. Marrs, Deputy for Reserve Forces in the Office of the Secretary of the Air Force; Brig. Gen. I. G. Brown, Assistant Chief NGB for Air National Guard; and General Marchbanks. The co-moderators of the Seminar were the Chairmen of AFA's Reserve and Guard Councils, respectively, Maj. Gen. Robert E. L. Eaton, USAF (Ret.), and Brig. Gen. George W. Edmonds, Deputy Adjutant General for Air of the state of California.

Dr. Marrs stated, "It is hoped that General Marchbanks' office will give the Air Force Reserve the same type of entree at the Pentagon that the Air National Guard has, and I think it will."

In answer to a question about the possibility of a sharp reduction of the Reserve Forces in the near future, Mr. Slatinshek answered: "I can give you a reflection of what the feeling of the Committee on Armed Services is on that subject, and I think that it is best reflected in H.R. 2—the fact that it was the intention of the Committee that we do have in the future a strong Air Force Reserve, as well as an Air Guard. . . . Included in H.R. 2 is a modification



Outstanding Air Force Reserve Trophy went to the 349th Military Airlift Wing, Hamilton AFB, Calif., represented by its commander, Brig. Gen. Rollin B. Moore, Jr. The 349th was one of two Reserve airlift wings called to active duty in January for up to two years' service.

which will be used this year for the first time. Annually, we authorize the aircraft, missiles, and ships, and this year we will be authorizing the personnel strengths of the various Reserve components. It is this device that will give Congress a handle which it can turn to make sure that the Defense Department doesn't arbitrarily cut back on the strength of these components."

General Marchbanks was asked about expanding the Air Reserve Technician Program to other elements of the Air Force Reserve. "The Technician Program, as we know it, . . . [has] done a terrific job," he said. "I think without the technician program we wouldn't be where we are. Applying that as a measure of success, I would say that we should certainly consider the advantages of the technician program in as many phases of operation as we can."

Dr. Marrs, to a question on the usefulness of the RAND Study, commented: "The RAND Study is designed particularly for the '70 time period. However, in the development of the program changes which resulted in new missions for both the Air Force Reserve and Air National Guard, the guidelines and the concepts which were established and developed in the RAND Study were defined." (Continued on following page)



Accepting the President's Trophy, awarded annually to Air Reserve's outstanding flight crew, is Maj. Henry E. Sherrill, aircraft commander in 305th Aerospace Rescue and Recovery Squadron, Selfridge AFB, Mich. The 305th was also recalled to active duty with the Air Force in January.

nately applied, and this was even before the actual completion and presentation of the RAND Study to the Air Force. . . . The Chief of Staff has accepted the RAND Study and, in a very detailed response to memorandums from the Secretary's Office, has come up with some three and a half single-spaced pages of acceptance of specific conceptual presentations from the RAND Study.

"In addition to that, there have been general directives going out to all levels of the Air Force to apply the total force concept for Reserve Forces planning and active-duty planning concurrently. This is not quite as simple a thing as it sounds, and those of you who have available to you, particularly, the first volume of the ten-volume RAND Study, will do well to read it and become familiar with this total force concept as described by RAND. I think it will have a tremendous and lasting impact on force structure determination for the total forces—active, Guard, and Reserve."

A considerable amount of interest was indicated by the numbers of questions on proposed changes in the individual Reservist program. General Marchbanks, after discussing the program in some detail, summed up his comment by saying, "I identify it as the number-one problem in the Air Force Reserve today that needs attention, and it's certainly going to get it."

General Brown was questioned on the possibilities of further reductions in Reserve Forces airlift units. He expressed confidence that Congress will retain the units

Unable to attend the Convention, Sen. Richard B. Russell of Georgia, Chairman of Senate Armed Services Committee, accepts AFA Citation of Honor in his Senate office from AFA President Bob Smart.



that have been marked for elimination (*see below*). He further praised the Guard Aeromedical Airlift units, noting that "it is a very fine mission for the Reserve Forces. Both the Air Force Reserve and Air National Guard could expand considerably, for, whatever the requirements are, the active force and these units will do an outstanding job in this mission area as they have done in the past."

Association Mandates

New resolutions affecting people, emanating from throughout the Association, were adopted at the Atlanta Convention. These resolutions ask that:

- **Equalization of Survivor Benefits** be afforded military personnel by bringing them more closely in line with provisions of the Civil Service retirement plan.
- **Amendments to Dual Compensation Act** be effected by DoD requesting legislation to repeal the six-month waiting period following retirement, and to eliminate inequity in treatment of retired Regular officers.
- The Secretary of the Air Force seek an increase in the legal limit on Regular officers to provide greater oppor-



For exceptional service to Air Reserve Forces, Brig. Gen. Joe Meis, left, and Col. Charles Bock were awarded Special Citations during Reserve Forces Seminar. Both have recently retired. General Meis from National Guard Bureau and Colonel Bock as Secretary of ARF Policy Committee.

tunities for Regular commissions and thereby enhance officer retention.

- The Secretary of Defense authorize an immediate increase in military pilot training to ensure that a sufficient number of pilots are trained to meet long-range mission requirements. Further, it asks for enactment of legislation which will provide retention incentives to attract pilots to remain beyond their initial period of obligated service.

- DoD support an increase in government group life insurance for servicemen similar in amount to that established for Civil Service personnel.

- The Airmen Retention Program be improved by permitting advancement of many deserving airmen who are qualified and actually occupying jobs calling for higher grades, and by authorizing proficiency pay to airmen working in all critical skill areas. Further, that payment of greater reenlistment bonuses be permitted to personnel possessing vital technical skills.

- The (Civil Service) Annual Sick Leave Act of 1951 be amended to provide that accumulated sick leave be credited to the employee's length of service for annuity purposes. Further, if the employee dies while on the active rolls, his beneficiaries should receive retirement compensation predicated on unused sick leave added to his years of service before the computation of annuity.

- Congress expedite passage of legislation to provide an adequate retirement plan for all National Guard Technicians.

- USAF provide sufficient resources to make the Air War College seminar program available to Air Reserve Forces officers, and to initiate an Air Command and Staff College seminar program of the scope and quality now provided by the Army C&SC.

- The USAF Chief of Staff authorize adequate time in each professional military school's curriculum to present the organization, training, and capabilities of both Air Reserve Forces components.

- The Secretary of Defense enhance Reserve Forces retention by supporting proficiency pay and reenlistment bonus legislation for enlisted Reserve Forces personnel.

- DoD authorize additional General Officer requirements and urge Congress to take favorable action.

The delegates to the Convention reaffirmed the following as continuing resolutions of the Association:

(Continued on page 133)

- An increase in military housing;
- That military pay be comparable to industry and Civil Service;
- Liberalization of the Retired Serviceman's Family Protection Plan;
- Recomputation of retired pay based on active-duty pay scales;
- An increase in moving expenses incident to permanent change of station;
- A dental care program for military dependents;
- A complete combat-zone tax exemption for military and Civil Service personnel;
- Provide a medical scholarship program to reduce requirements for the Doctors' Draft;
- Authorize enlisted retirees to credit nonactive duty Reserve time for retirement purposes;
- Establish a pilot training program to provide direct input into the Air Reserve Forces;
- Extend Servicemen's Group Life Insurance benefits to Reservists and Guardsmen;
- Continue support for the Air Force Village;
- Modern equipment for the Air Reserve Forces; and
- Retention of Reserve Forces units programmed for inactivation.

FOCUS—On Officer Career Planning

Good news for future leaders of the Air Force: DCS/Personnel, Hq. USAF, recently announced development of a total officer program package called FOCUS, which stands for Formal Officer Career Utilization Structure. The program is keyed to future-oriented total mission requirements and emphasizes the role of programming as the process through which top-level management in the Air Force can respond to an evolving challenge—the need to prepare for and manage "change." This need, USAF states, is becoming increasingly self-evident in the complex process of managing people involving such dynamic programming factors as changing force levels and skill requirements, experience gaps, complex loss patterns, dynamic rated officer requirements, and high lieutenant procurement levels.

FOCUS is being developed as the officer personnel blueprint of the future Air Force. Eight primary program elements constitute the FOCUS "building blocks," with each program addressing a specific aspect or phase of officer development. Program elements include Total Force and Financial Program, Accessions, Skill Training, Force Distribution and Retraining, Advance Degree Career Management, Air Force Rated Officer Management, Professional Military Education, and Promotion.

FOCUS views career development and individual officer growth as end results of formal programs and a personnel management system designed to meet total mission needs while guiding the individual officer from early training and indoctrination through later stages of executive development. It is largely through these programs that the young officer can assess his own role in the future of the Air Force when making his career decision.

Program elements are translated into full-career management patterns in which education, training, and duty-tour phase points are positioned. Program career profiles are further developed from these broad patterns so that the full range of management options is defined for the Career Development Division at the Military Personnel Center in developing career progression guides for each utilization field.

The Air Force Rated Officer Management Program has recently been completed in an effort to establish a desired

rated-nonrated officer mix. This mix, USAF declares, will be conditioned in large measure by personnel management concepts and rated officer utilization philosophy which: (a) provides identifiable career phase points over a full thirty-year career for both rated and nonrated officers for education, training, and other specialized experiences; (b) provides continued and balanced rated expertise in mid- and higher-management levels; (c) precludes prolonged tours in line cockpit jobs; and (d) specifically pro-



Maj. Gen. Tom E. Marchbanks, Jr., left, Chief of the Office of Air Force Reserve in Pentagon, visits Air Reserve Personnel Center, Denver, Colo., for briefing by its commander, Col. Leland A. Walker, Jr., on operations of "Manpower Bank of the Air Force" in serving 415,000 Reservists.

vides a rated potential to meet initial and extended conflict requirements.

The FOCUS package has been under development for a year. It is being implemented as programs are developed with a target of full implementation by the end of 1969.

Parting Shots

Compensation Study. DoD, at long last, has made public the pay tables connected with the two-year effort led by Rear Adm. Lester Hubbell, USN. It is likely, however, that all of the thousands of man-hours that have gone into this effort will come to naught. The Administration is furnishing "information" copies of the study to the Congress but is not requesting any legislative action. With a new Administration assuming office next January, it will take a near-miracle to prompt prompt constructive action on the broad Hubbell proposals.

Reserve Forces Airlift Units. Based on the worsening world situation, and reacting to a considerable amount of pressure from the Congress, the Department of Defense has announced that it will retain, for at least another year, those units which were programmed to be phased out in FY '69. President Bob Smart of AFA has commended Secretary Clark Clifford for this action.

(Continued on following page)

Demolition of a Good Unit. Losses in combat units are not all incurred in combat. Some are lost to bureaucratic planners who don't understand the lasting impact of some of their decisions. The latest such casualty is the 113th Tactical Fighter Wing (DC ANG) which was recalled on short notice in January, supposedly to do battle against the Communists. From then on, indecision reigned as to what to do with the unit. After several abortive attempts to move the unit intact, someone made the decision to break up the wing, using part of it as a training organization, and making the remaining personnel available as fillers.

For years it has been the announced policy of the Air Force to organize and train Reserve Forces units "to be used as units." This phrase has been incorporated in several pieces of legislation and many DoD and Air Force directives. Reserve Forces recruiting brochures carry the promise: "Train with your buddies, fight with your buddies." It took many years to get over the broken promises to the Reservists in the Korean recall. If what is happening to the 113th Wing becomes more widespread, it's going to be increasingly difficult to rebuild units when they return from this callup.

July 1 Pay Raise. Still uncertain at this writing is the question whether military and Civil Service personnel will get the "automatic" pay raise scheduled for July 1, as voted by the Congress and approved by the President last year. If Congress enacts the ten percent income tax surcharge which the President recommended, chances for the pay raise may be improved. But Chairman Wilbur Mills (D-Ark.) of the House Ways and Means Committee is striving to link the surcharge with significant cuts in the federal budget. A pay raise which hasn't yet gone into effect offers a tempting target.

Increased Per Diem. As we went to press, the House had acted on two separate bills to increase military and Civil Service standard per diem rates from \$16 to \$20. Favorable action by the Senate seems assured. AFA has pressed for action on both the military and civilian rates for the last two years.

SENIOR STAFF CHANGES

B/G Robert A. Berman, from DCS/Comptroller, to Asst. DCS/Maint. Eng., Hq. AFLC, Wright-Patterson AFB, Ohio . . . B/G Roland A. Campbell, from Asst. DCS/Materiel, SAC, to DCS/Materiel, SAC, replacing M/G Richard O. Hunziker . . . B/G Robert L. Cardenas, from Cmdr., 835th Air Div., TAC, McConnell AFB, Kan., to Cmdr., USAF Special Air Warfare Center, TAC, Eglin AFB, Fla., replacing M/G Thomas G. Corbin.



Fourth star is pinned on Gen. Jack G. Merrell, new Commander of Air Force Logistics Command, by his wife and Gen. J. P. McConnell, USAF Chief of Staff. General Merrell, former Vice Commander, USAF, succeeds the late Gen. Tom Gerrity, who died of heart attack in February.



J. William Doolittle, left, former General Counsel of the Air Force, has been appointed Assistant Secretary for Reserve Forces, a new position created by enactment of the "Reserve Forces Bill of Rights." He was also named one of the nation's ten outstanding Civil Service personnel for 1967. Succeeding him as AF General Counsel is John M. Steadman, right, who had been serving as the Special Assistant to the Secretary and Deputy Secretary of Defense.

B/G Maurice F. Casey, from Cmdr., 60th Military Airlift Wing, MAC, Travis AFB, Calif., to Cmdr., 438th Military Airlift Wing, MAC, McGuire AFB, N. J. . . . M/G Thomas G. Corbin, from Cmdr., USAF Special Air Warfare Center, TAC, Eglin AFB, Fla., to Vice Air Deputy, Allied Forces Northern Europe, Kolsaas, Norway . . . Dr. David S. Crist, from Institute of Defense Analyses, to Special Advisor, Asst. C/S, Intelligence, Hq. USAF . . . M/G Joseph A. Cunningham, from Cmdr., 22d AF, MAC, Travis AFB, Calif., to Dep. Dir., Directorate of Civil Disturbance Planning and Ops, Hq. USAF . . . M/G Don O. Darrow, from Asst. C/S, Plans, US Military Assistance Cmd., Vietnam, to C/S, Hq. TAC, Langley AFB, Va., replacing M/G Robert R. Rowland.

B/G Buddy R. Daughtrey, from Dep. Cmdr., OOAMA, AFLC, Hill AFB, Utah, to Chief, MAAG, Tokyo, Japan . . . B/G John French, from Executive to Vice C/S, Hq. USAF, to DCS/Comptroller, Hq. AFLC, Wright-Patterson AFB, Ohio, replacing B/G Robert A. Berman . . . B/G James E. Hill, from Cmdr., 40th Air Div., SAC, Wurtsmith AFB, Mich., to Cmdr., 825th Strat. Aerospace Div., SAC, Little Rock AFB, Ark., replacing B/G Gerald W. Johnson . . . B/G Gerald W. Johnson, from Cmdr., 825th Strat. Aerospace Div., SAC, Little Rock AFB, Ark., to Vice Cmdr., 2d AF, SAC, Barksdale AFB, La. . . . B/G Winton W. Marshall, from Chief, European Div., J-5, Joint Staff, JCS, to C/S, 1141st USAF Special Activity Sq., HED-COM, Bolling AFB, D. C.

Gen. Jack G. Merrell, from Vice Commander in Chief, USAF, to Cmdr., Hq. AFLC, Wright-Patterson AFB, Ohio . . . B/G Willard W. Millikan, from Cmdr., 113th Tac. Ftr. Wing, TAC, Andrews AFB, Md., to Cmdr., 833d Air Div., TAC, Seymour Johnson AFB, N. C. . . . Mr. Nathan R. Rosengarten, from Supervisory Gen. Engineer (Recon Subsystems), to Technical Dir., Directorate of Recon Engineering, Aeronautical Systems Div., AFSC, Wright-Patterson AFB, Ohio . . . M/G Kenneth O. Sanborn, from C/S, Hq. AFLC, Wright-Patterson AFB, Ohio, to Cmdr., USAF Southern Command, Albrook AFB, Canal Zone, replacing M/G Reginald J. Clizbe . . . B/G James A. Shannon, from Dep. Dir. for Ops, National Military Command Center, J-3, Joint Staff, to Secretary, JCS.

B/G Donavon F. Smith, from Chief, Air Sec., MAAG, Saigon, Vietnam, to Vice Cmdr., 9th AF, TAC, Shaw AFB, S. C. . . . B/G August F. Taute, from Asst. DCS/Plans, ADC, Ent AFB, Colo., to Chief, MAAG, Oslo, Norway . . . Mr. John E. Whalan, from Dep. for Security Programs, Office, Deputy Undersecretary (Manpower), to Dep. for Security and Investigative Programs, Office of Admin. Asst., Secretary of the AF . . . Dr. Michael I. Yarmyovych, from NASA, to Dep. for Requirements, Office, Asst. Secretary of the AF (R&D).

PROMOTIONS: To General: Jack G. Merrell.

RETIREMENTS: M/G Reginald J. Clizbe, B/G Frederic C. Gray, B/G William S. Rader, M/G Robert R. Rowland, M/G James B. Tipton.—END

New: The only total package capability in large rocket motor hardware.

Rohr has won a major contract to manufacture all the inert hardware—motor cases, insulation and nozzles—for a large space launch booster series.

The basic reason is our unique space hardware "package capability." The ability to deliver a full series of components with all the inherent manufacturing efficiencies and customer economies.

Equally important is the battery of massive modern machines at our Space Products Division. Specialized equipment designed and built specifically for the fabrication and assembly of giant rocket motor components—equipment which includes some of the largest hydroclaves, autoclaves and turning machines in the world.

Space hardware jobs are getting bigger all the time. At Rohr the bigger the better.



Dedicated to the pursuit of excellence.



USE THIS GRADUATED FOR AFA FLIGHT PAY INSURANCE

*Maximum Benefits at Minimum Cost
for Flying Personnel of All Ages*

PREMIUMS ARE ONLY 1% OF ANNUAL FLIGHT PAY FOR FLYERS UNDER 30!

AFA's graduated premium schedule has made it possible to provide flight pay protection at realistic premium rates for flyers of *all* ages.

And rates are based on the most reliable facts—an actual analysis of Flight Pay Insurance claims over a ten-year period . . . an analysis which actually demonstrated the risk of grounding for a 50-year-old flyer was four times greater than the risk for a 25-year-old.

Regardless of your age when you apply for Flight Pay Insurance, *you pay only your fair share* of the risk for your age group.

NOTE: All policies are dated on the last day of the month in which the application is postmarked, and protection against accidents begins as of that date; protection against groundings due to illness begins 30 days later. Of course, coverage cannot be immediately extended to include illnesses which existed prior to the time at which you insured your flight pay, but after 12 months you are fully covered against *all* illnesses.

YOU GET THESE BENEFITS

AFA Flight Pay Insurance replaces 80% of your lost flight pay *tax free* (the equivalent of 100% of regular, taxable flight pay) for up to two years if grounding is caused by aviation accident . . . up to one year if caused by illness or ordinary accident.

- **PROTECTION IS GUARANTEED.** It is guaranteed even against preexisting illnesses after your policy has been in force for a one-year period.

- **PAYMENTS ARE RETROACTIVE.** Once your grounding exceeds the 90-day period (180 days for aircraft accidents) allowed by the Air Force for making up lost flight time, a retroactive indemnity check will be sent to you covering the entire period.

***Others Have Benefited—More Than \$3,500,000 Has Been
Paid In Indemnities Replacing Lost Flight Pay!***

"Thanks to AFA Flight Pay Insurance, I've been able to keep my head above water . . . it sure was a blessing."

Maj. William G. Ghormley

"I can't praise the service enough . . . always prompt, courteous, and completely lacking in red tape."

Capt. Charles N. Breisacher

"... a very, very great service for those of us who are on flying status."

MSgt. Allen H. Osnes

**INDEMNITY FOR JUST ONE 90-DAY GROUNDING CAN REIMBURSE YOU
FOR THE ENTIRE COST OF THIS PROTECTION FOR 20 YEARS (if taken out
up to age 30) AND FOR 5 YEARS EVEN IF YOU APPLY AT AGE 50.**

PREMIUM PLAN



PROTECT YOUR **TOTAL INCOME NOW!**

YOU Can Be Grounded and Lose Flight Pay!

EXCLUSIONS—The insurance under the policy shall not cover loss to any Member resulting in whole or in part from or due to any of the following:

Criminal act of the Member or from injuries occasioned or occurring while in a state of insanity (temporary or otherwise).

"Fear of flying," as officially certified by responsible authority of the Member's Service and approved by the head of the Service in accordance with applicable regulations.

Caused by intentional self-injury, attempted suicide, criminal assault committed by the Member, or fighting, except in self-defense.

Directly or indirectly caused by war, whether declared or not, if act of an enemy in such war is the direct cause of loss insured hereunder, hostile action, civil war, invasion, or the resulting civil commotions or riots.

Failure to meet flying proficiency standards as established by the Member's Service unless caused by or aggravated by or attributed to disease or injuries.

Inability of a Member to continue to meet physical standards for Hazardous Flight Duty because of a revision in those standards, rather than because of preceding injury or disease causing a change in the physical condition of such Member.

Mental or nervous disorders.

Alcohol, drugs, venereal disease, arrest or confinement.

Willful violation of flying regulations resulting in suspension from flying as a punitive measure, or as adjudged by responsible authority of the Member's Service.

Suspension from flying for administrative reasons not due to injuries or diseases, even though the Member may have been eligible or was being reimbursed at the time of the administrative grounding because of a previously established disability.

Loss of life shall not be deemed as loss for purposes of this insurance.

Primary duty requiring parachute jumping.

Voluntary suspension from flying.

A disease or disability pre-existing the effective date of coverage, or a recurrence of such a disease or disability, whether or not a waiver has been authorized by appropriate medical authority in accordance with regulations or directives of the service concerned, *unless the Member was insured under the master policy issued to the Air Force Association for 12 continuous months immediately prior to the date disability (grounding) commenced.*

RATE TABLE—AFA FLIGHT PAY INSURANCE

ANNUAL COST (by attained age)
(Calculated as % of Annual Flight Pay)

Annual Flight Pay	20-29	30-34	35-39	40-44	45-49	50 +
	(1%)	(1½%)	(2%)	(2½%)	(3%)	(4%)
\$1200	\$12.00	\$18.00	\$24.00	\$30.00	\$36.00	\$48.00
1260	12.60	18.90	25.20	31.50	37.80	50.40
1800	18.00	27.00	36.00	45.00	54.00	72.00
1920	19.20	28.80	38.40	48.00	57.60	76.80
1980	19.80	29.70	39.60	49.50	59.40	79.20
2040	20.40	30.60	40.80	51.00	61.20	81.60
2160	21.60	32.40	43.20	54.00	64.80	86.40
2220	22.20	33.30	44.40	55.50	66.60	88.80
2280	22.80	34.20	45.60	57.00	68.40	91.20
2400	24.00	36.00	48.00	60.00	72.00	96.00
2460	24.60	36.90	49.20	61.50	73.80	98.40
2520	25.20	37.80	50.40	63.00	75.60	100.80
2580	25.80	38.70	51.60	64.50	77.40	103.20
2640	26.40	39.60	52.80	66.00	79.20	105.60
2700	27.00	40.50	54.00	67.50	81.00	108.00
2760	27.60	41.40	55.20	69.00	82.80	110.40
2820	28.20	42.30	56.40	70.50	84.60	112.80
2880	28.80	43.20	57.60	72.00	86.40	115.20
2940	29.40	44.10	58.80	73.50	88.20	117.60

(If you plan to pay premiums semiannually, divide figures above by 2 and add \$1 for your semiannual payment.)

GIVE YOUR FAMILY TOTAL INCOME SECURITY! MAIL THIS APPLICATION TO AFA TODAY!

NEW AFA FLIGHT PAY INSURANCE PREMIUMS

(AS A % OF ANNUAL
FLIGHT PAY)

AGE	PREMIUM
20-29	1%
30-34	1½%
35-39	2%
40-44	2½%
45-49	3%
50 and over	4%

AIR FORCE ASSOCIATION FLIGHT PAY PROTECTION PLAN

Exclusively for AFA Members—Underwritten by Mutual of Omaha

6-68

I enclose:

☐ \$..... semiannual premium (one-half annual premium, plus \$1 service charge)

☐ \$..... annual premium

This insurance is available only to AFA members.

☐ I enclose \$7 for annual AFA dues (includes subscription (\$6) to AIR FORCE/SPACE DIGEST)

☐ I am an AFA member

Rank (please print)

Name

Serial Number

Address

City

State

Zip

\$..... Annual Flight Pay

Date of Birth

I understand the conditions and exclusions governing AFA's Flight Pay Protection Plan, and I certify that I am currently on flying status and entitled to receive incentive pay, and that to the best of my knowledge I am in good health, and no action is pending to remove me from flying status for failure to meet physical standards. I authorize AFA, or AFA representatives, to examine all medical records pertinent to any claim I may submit.

Signature of Applicant.....Date.....

APPLICATION MUST BE ACCOMPANIED BY CHECK OR MONEY ORDER

Send Remittance to: FLIGHT PAY, AFA, 1750 PENNA. AVE., N. W., WASHINGTON, D. C. 20006



By Don Steele

AFA DIRECTOR OF FIELD ORGANIZATION

AFA's twenty-second National Convention in Atlanta, Ga., culminated a highly successful and effective year, but, more important, it was the beginning of a new year of operation—a year in which, from all indications at the outset, AFA's mission will be more important than ever before. That the delegates sensed this was obvious as they engaged in serious discussion of all business presented to them.

The Convention's very colorful Opening Awards Ceremonies began with the music of the Bagpipers from the 581st Air Force Band, and posting of the colors by the color guard from the 2853d Air Base Group, both stationed at Robins AFB, Ga.

Maj. Gen. William C. Garland, Director of Information, Office of the Secretary of the Air Force, was the featured speaker of the evening. In his address, General Garland praised AFA's national and community leadership for its support of the Air Force and for the very effective contributions it has made to the education of the public as to the importance of aerospace power to our everyday life and security.

During the ceremonies, eighty-three

individuals and/or units received AFA "Family Awards" (Medals of Merit, Individual and Unit Exceptional Service Plaques, Presidential Citations, and Membership Achievement Awards) for their efforts on behalf of the Association's mission and membership objectives (see complete list on pages 140 and 142).

AFA President Robert W. Smart served as Master of Ceremonies, paid tribute to those being honored, and presented the three top awards of the evening. First, AFA's Unit of the Year Award for stimulating enthusiastic public support of US aerospace power and the United States Air Force through continuous and excellent statewide programs which mobilized public interest in all facets of the Air Force and attracted the participation of ranking state officials, including the Governor as well as top leaders of industry and the Air Force, went to the Utah State Organization and was accepted by Nolan Manfull, Utah State President.

Sam E. Keith, Jr., President of AFA's Texas State Organization, received the award designating him "AFA's Man of the Year," in recog-

nition of his outstanding effectiveness in leadership, programming, and membership development.

AFA's highest "Family Award," the Gold Life Membership Card, only six of which have been previously awarded, was presented to Jess Larson, Chairman of the Board of Directors, whose record as President of AFA over a period of thirty months is unexcelled.

The following morning, delegates from thirty-four states assembled for the first Business Session of the Convention. Before settling down to the business of electing National Officers and Directors, and adopting a Statement of Policy and resolutions, the delegates were favored with a most entertaining address of welcome by Atlanta Mayor Ivan Allen. Awards were presented to the three top civilian employees of the year selected in worldwide competition of the various Air Force commands and agencies. The recipients were: Lester J. Charnock, Technical Director, Systems Engineering Group, AFSC, Wright-Patterson AFB, Ohio; Ralph D. Marker, Chief, Aeronautics Laboratory, US Air Force Academy; and Dermot



AFA's 1968 "Man of the Year" award went to the President of the Texas State Organization, Sam E. Keith, Jr., for outstanding contributions to the USAF and AFA mission. Presentation was made during the Opening Ceremonies by President Robert W. Smart, far left, shown here with Mr. and Mrs. Keith.



AFA's 1968 "Unit of the Year" award was presented to the Utah State Organization for the continuous excellence and variety of its programs, which stimulated enthusiastic support of US aerospace power and the United States Air Force. President Robert W. Smart presented the trophy to Nolan Manfull, President of the Utah State Organization.

M. O'Neill, Chief, Combative Measures Department, Tactical Air Command's Special Air Warfare School, Hurlburt Field, Fla.

Then the delegates adopted, without a change, the annual Statement of Policy as recommended by the Board of Directors after thorough discussion at the Board meeting the previous day. Of the twenty-two resolutions presented to the delegates, twenty-one were adopted (only two

required any change before being adopted). Only one resolution—Limitation of Tenure of State and Chapter Presidents—was not adopted, and then only after a very lengthy debate.

The "Policy Resolutions" are covered beginning on page 108, and those dealing with military and civilian personnel matters are covered in "The Bulletin Board," page 128.

Three incumbent National Officers—Board Chairman Jess Larson, Presi-

dent Robert W. Smart, and Treasurer Jack B. Gross—were reelected.

Mr. Larson, a retired Air Force Reserve major general and a prominent District of Columbia attorney with a record of high government service, served the Association as National President for thirty months prior to being elected Chairman of the Board last year at the San Francisco Convention.

(Continued on following page)

AIR FORCE ASSOCIATION'S NEW LEADERS FOR 1968-69

SECRETARY

Glenn D. Mishler
Akron, Ohio

PRESIDENT

*Robert W. Smart
Santa Monica, Calif.

TREASURER

*Jack B. Gross
Harrisburg, Pa.

REGIONAL VICE PRESIDENTS

Central East Region
Walter E. Barrick, Jr.
Danville, Va.

South Central Region

Jack T. Gilstrap
Huntsville, Ala.

Midwest Region

Paul W. Gaillard
Omaha, Neb.

Southeast Region

*Martin H. Harris
Orlando, Fla.

New England Region

*Joe F. Lusk
Lexington, Mass.

Rocky Mountain Region

*Nathan H. Mazer
Roy, Utah

Great Lakes Region

W. M. Whitney
Detroit, Mich.

Northwest Region

*Warren B. Murphy
Boise, Idaho

Far West Region

Will H. Bergstrom
Davis, Calif.

North Central Region

*Dick Palen
Edina, Minn.

Southwest Region

*Jesse J. Walden, Jr.
Fort Worth, Tex.

Northeast Region

*James W. Wright
Williamsville, N. Y.

NATIONAL DIRECTORS

*Chairman of the Board—Jess Larson, Washington, D. C.

**John R. Alison
Beverly Hills, Calif.

*Joseph E. Assaf
Hyde Park, Mass.

*William R. Berkeley
Redlands, Calif.

John G. Brosky
Pittsburgh, Pa.

*Milton Caniff
New York, N. Y.

*Vito J. Castellano
Armonk, N. Y.

**Edward P. Curtis
Rochester, N. Y.

**James H. Doolittle
Los Angeles, Calif.

*George M. Douglas
Denver, Colo.

*Incumbent

*A. Paul Fonda
Washington, D. C.

**Joe Foss
Scottsdale, Ariz.

**George D. Hardy
College Heights Estates
Hyattsville, Md.

*Dale J. Hendry
Boise, Idaho

**John P. Henebry
Kenilworth, Ill.

Joseph L. Hodges
South Boston, Va.

*Robert S. Johnson
Woodbury, N. Y.

**Arthur F. Kelly
Los Angeles, Calif.

**George C. Kenney
New York, N. Y.

*Maxwell A. Kriendler
New York, N. Y.

*Laurence S. Kuter
New York, N. Y.

**Thomas G. Lanphier, Jr.
San Antonio, Tex.

**Curtis E. LeMay
Chatsworth, Calif.

*Joseph J. Lingle
Milwaukee, Wis.

**Carl J. Long
Pittsburgh, Pa.

**Howard T. Markey
Chicago, Ill.

*J. B. Montgomery
Van Nuys, Calif.

Martin M. Ostrow
Los Angeles, Calif.

*Earle N. Parker
Fort Worth, Tex.

**Julian B. Rosenthal
New York, N. Y.

**Peter J. Schenk
Arlington, Va.

*Joe L. Shosid
Fort Worth, Tex.

**C. R. Smith
Washington, D. C.

**Carl A. Spatz
Chevy Chase, Md.

*William W. Spruance
Wilmington, Del.

**Thos. F. Stack
San Francisco, Calif.

**Arthur C. Storz
Omaha, Neb.

**Harold C. Stuart
Tulsa, Okla.

**James M. Trail
Boise, Idaho

**Nathan F. Twining
Arlington, Va.

*Robert C. Vaughan
San Carlos, Calif.

Jack Withers
Los Angeles, Calif.

**Permanent National Director



Atlanta Mayor Ivan Allen was the featured speaker at the Convention Business Session. He extended the city's welcome to the delegates and stressed the importance of having AFA meet in Georgia, a state of ever-increasing aerospace orientation and the home of the Lockheed-Georgia Co.

Mr. Smart is presently Vice President for Governmental Affairs, North American Rockwell Corp., El Segundo, Calif., and is a retired Air Force Reserve brigadier general.

Mr. Gross, a prominent Harrisburg, Pa., businessman and civic leader, is a former Chairman of the Board and has served several previous terms as National Treasurer.

Glenn D. Mishler, Akron, Ohio, was elected National Secretary. Mr. Mishler, a Section Head in the Engineering Department of Goodyear Tire & Rubber Co., is a former Great Lakes Regional Vice President and Chairman of the 1967-68 Organizational Advisory Council.

Mr. Larson served the Convention as Chairman of the Business Sessions. Julian B. Rosenthal of New York City, a founder of AFA and a former National Secretary and Chairman of the Board, relieved Mr. Larson in the portion of the Business Session which saw the actual election of officers and directors.

Judge John Brosky, Pittsburgh, Pa., Past President of AFA's Pennsylvania State Organization, served as Convention Parliamentarian. Mr. Mishler served as Chairman of the Credentials Committee and was ably assisted by South Central Regional Vice President Jack T. Gilstrap, Huntsville, Ala., and Martin M. Ostrow, Beverly Hills,

Calif., retiring Vice President of AFA's Far West Region.

Martin H. Harris, Orlando, Fla., Vice President of the Southeast Region, served as Chairman of the Inspectors of Elections. Kenneth Banks, Jr., Akron, Ohio, Treasurer of AFA's Ohio State Organization, and Harold C. Bates, Brookfield, Wis., Treasurer of the Billy Mitchell Chapter, served as Inspectors of Elections.

The Inspectors of Elections were ably assisted in the tabulation of election votes by the following who served as Tellers: Charles Whitaker, Akron, Ohio; Taylor Drysdale, Orlando, Fla.; Marion Chadwick, St. Petersburg,

(Continued on page 142)

AFA UNITS AND INDIVIDUALS HONORED AT THE CONVENTION

AFA PRESIDENT'S TROPHY

To the Utah State Organization, designated "AFA Unit of the Year."

AFA PRESIDENT'S TROPHY

To Sam E. Keith, Jr., Fort Worth, Tex., designated "AFA Man of the Year."

AFA INDIVIDUAL EXCEPTIONAL SERVICE PLAQUES

George A. Gardner, Dayton, Ohio
 Marjorie O. Hunt, Mt. Clemens, Mich.
 Nolan Manfull, Roy, Utah
 Nathan H. Mazer, Roy, Utah
 Warren B. Murphy, Boise, Idaho
 Charles H. Whitaker, Akron, Ohio
 W. G. Vogel, Wichita, Kan.

AFA UNIT EXCEPTIONAL SERVICE PLAQUES

Community Relations Award—To the Colin P. Kelly Chapter, N. Y.
 Aerospace Education Award—To the Mount Clemens Chapter, Mich.
 Best Single Program Award—To the Santa Monica Chapter, Calif.
 Unit Programming Award—Wright Memorial Chapter, Ohio

AFA MEDALS OF MERIT

Harold C. Bates, Brookfield, Wis.
 Will H. Bergstrom, Davis, Calif.
 George Cornish, Warner Robins, Ga.
 Lester Curl, Melbourne Beach, Fla.
 S. Parks Deming, Colorado Springs, Colo.
 Lyle C. Freed, Bellevue, Wash.
 Jack T. Gilstrap, Huntsville, Ala.
 Jerome Green, Oak Park, Mich.
 Ben Griffith, San Antonio, Tex.
 Naomi Henion, Redlands, Calif.
 Robert L. Hunter, Springfield, Ohio
 Boyd E. Macrory, Montgomery, Ala.
 John A. Pope, Arlington, Va.
 Albert A. Poppiti, Wilmington, Del.
 Jack C. Price, Clearfield, Utah
 Charles E. Sharp, Jr., Erie, Pa.
 Chesley J. Smith, Wilmington, Del.
 Alden A. West, Newport Beach, Va.

AFA PRESIDENTIAL CITATIONS

Lt. Col. Stephen E. Harrison, Washington, D. C.
 Joseph L. Hodges, South Boston, Va.
 Maj. Hugo Marek, Hampton, Va.
 Glenn D. Mishler, Akron, Ohio
 Lt. Col. David Stiles, Springfield, Va.
 Lt. Col. James Wall, Maxwell AFB, Ala.
 David H. Whitesides, Layton, Utah

THIS IS AFA

The Air Force Association is an independent, nonprofit airpower organization with no personal, political, or commercial axes to grind; established January 26, 1946; incorporated February 4, 1946.

Membership

Active Members: US citizens who support the aims and objectives of the Air Force Association, and who are not on active duty with any branch of the United States armed forces—\$7 per year.

Service Members (nonvoting, nonofficeholding): US citizens on extended active duty with any branch of the United States armed forces—\$7 per year.

Cadet Members (nonvoting, nonofficeholding): US citizens enrolled as Air Force ROTC Cadets, Civil Air Patrol Cadets, Cadets of the United States Air Force Academy, or a USAF Officer Trainee—\$3.50 per year.

Associate Members (nonvoting, nonofficeholding): Non-US citizens who

support the aims and objectives of the Air Force Association whose application for membership meets AFA constitutional requirements—\$7 per year.

Objectives

• The Association provides an organization through which free men may unite to fulfill the responsibilities imposed by the impact of aerospace technology on modern society; to support armed strength adequate to maintain the security and peace of the United States and the free world; to educate themselves and the public at large in the development of adequate aerospace power for the betterment of all mankind; and to help develop friendly relations among free nations; based on respect for the principle of freedom and equal rights to all mankind.



PRESIDENT

Robert W. Smart
El Segundo, Calif.



BOARD CHAIRMAN

Jess Larson
Washington, D.C.



SECRETARY

Glenn D. Mishler
Akron, Ohio



TREASURER

Jack B. Gross
Harrisburg, Pa.

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William R. Berkeley
Redlands, Calif.

John G. Brosky
Pittsburgh, Pa.

Milton Caniff
New York, N.Y.

Vito J. Castellano
Armonk, N.Y.

Edward P. Curtis
Rochester, N.Y.

James H. Doolittle
Los Angeles, Calif.

George M. Douglas
Denver, Colo.

A. Paul Fonda
Washington, D.C.

Joe Foss
Scottsdale, Ariz.

George D. Hardy
College Heights Estates
Hyattsville, Md.

Dale J. Hendry
Boise, Idaho

John P. Henebry
Kenilworth, Ill.

Joseph L. Hodges
South Boston, Va.

Robert S. Johnson
Woodbury, N.Y.

Arthur F. Kelly
Los Angeles, Calif.

George C. Kenney
New York, N.Y.

Maxwell A. Kriendler
New York, N.Y.

Laurence S. Kuter
New York, N.Y.

Thomas G. Lanphier, Jr.
San Antonio, Tex.

Curtis E. LeMay
Chatsworth, Calif.

Joseph J. Lingle
Milwaukee, Wis.

Carl J. Long
Pittsburgh, Pa.

Howard T. Markey
Chicago, Ill.

J. B. Montgomery
Van Nuys, Calif.

Martin M. Ostrow
Beverly Hills, Calif.

Earle N. Parker
Fort Worth, Tex.

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Arlington, Va.

Joe L. Shosid
Fort Worth, Tex.

C. R. Smith
Washington, D.C.

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Wilmington, Del.

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Tulsa, Okla.

James M. Trail
Boise, Idaho

Nathan F. Twining
Arlington, Va.

Robert C. Vaughan
San Carlos, Calif.

Jack Withers
Los Angeles, Calif.

REGIONAL VICE PRESIDENTS

Information regarding AFA activity within a particular state may be obtained from the Vice President of the Region in which the state is located.



Walter E. Barrick, Jr.
P.O. Box 257
Danville, Va. 24541
(703) 793-1011
Central East Region
Maryland, Delaware,
District of Columbia,
Virginia, West Virginia,
Kentucky



Paul W. Gaillard
100 S. 19th St., Rm. 1250
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Midwest Region
Nebraska, Iowa,
Missouri, Kansas



Joe F. Lusk
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Lexington, Mass. 02173
(617) 862-1425
New England Region
Maine, New Hampshire,
Massachusetts, Vermont,
Connecticut, Rhode
Island



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Great Lakes Region
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Illinois, Ohio,
Indiana



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Davis, Calif. 95616
(916) 756-4870
Far West Region
California, Nevada,
Arizona, Hawaii



Jesse J. Walden, Jr.
P.O. Box 748
Fort Worth, Tex. 76116
(817) PE 2-4811
Southwest Region
Oklahoma, Texas,
New Mexico



Jack T. Gilstrap
10029 Camille Dr., S.E.
Huntsville, Ala. 35803
(205) 881-1907
South Central Region
Tennessee, Arkansas,
Louisiana, Mississippi,
Alabama



Martin H. Harris
Martin Marietta Corp.
P.O. Box 5837
Orlando, Fla. 32805
(305) 855-6100, ext. 4421
Southeast Region
North Carolina, South
Carolina, Georgia,
Florida



Nathan H. Mazer
5483 S. 2375 W.
Roy, Utah 84067
(801) 825-2796
Rocky Mountain Region
Colorado, Wyoming,
Utah



Warren B. Murphy
P.O. Box 4124
Boise, Idaho 83705
(208) 344-8146
Northwest Region
Montana, Idaho,
Washington, Oregon,
Alaska



Dick Palen
4440 Garrison Lane
Edina, Minn. 55424
(612) 926-0891
North Central Region
Minnesota, North Dakota,
South Dakota



James W. Wright
13 Devon Lane
Williamsville, N.Y. 14221
(716) 633-8370
Northeast Region
New York, New Jersey,
Pennsylvania



Featured speaker at the Convention's Opening Ceremony and Awards Program was the Director of Information, Office, Secretary of the Air Force, Maj. Gen. William C. Garland, who singled out several AFA units for outstanding programs.



Surprise event during Opening Ceremony was the presentation of Gold Life Membership Card, the seventh to be awarded in AFA history, to Chairman of the Board Jess Larson by AFA President Smart, for outstanding leadership.

Fla.; Harry Cleveland and Jack Price, Clearfield, Utah; Vera B. Wright, Santa Monica, Calif.; Kenneth C. Puterbaugh, Dayton, Ohio; and Lois Bergstrom, Davis, Calif.

Three new Vice Presidents were elected to head AFA activities in as many Regions, joining nine others who were reelected. The new Vice Presidents are: Will H. Bergstrom, Davis, Calif. (Far West); Paul W. Gaillard, Omaha, Neb. (Midwest); and W. M. Whitney, Jr., Detroit, Mich. (Great Lakes).

Four new Directors were elected to the Board. They are John G. Brosky, Pittsburgh, Pa., Past President of AFA's Pennsylvania State Organization; Joseph L. Hodges, South Boston, Va., former National Secretary; Martin M. Ostrow, Beverly Hills, Calif., former Far West Regional Vice President; and Jack Withers, Los Angeles, Calif., a Past President of AFA's California State Organization.

The four newly elected Directors join fourteen incumbent Directors who were reelected for another year, as well as all the Past National Presidents and Board Chairmen, other permanent Directors, and National Officers, to form a Board of fifty-seven. The full Board membership appears in the box on page 139 as well as in "This Is AFA," page 141.

The Convention's honored guests included twenty-two men, one from each major Command and separate Air Force agency, who had been selected as USAF's Outstanding Airmen for 1967. These, the top noncommissioned officers in the Air Force, and their wives opened their Convention stay by attending an elegant banquet in their honor Wednesday evening.

There, they were addressed by Gen. Bruce K. Holloway, USAF Vice Chief of Staff. Maj. William "Pete" Knight, X-15 pilot from Edwards AFB, Calif., served as Toastmaster.

The Outstanding Airmen were introduced by AFA President Bob Smart, and each received an AFA Citation of Honor. The names of the Outstanding Airmen are on page 107.

The final event on the Convention program, an Air Force Reunion Din-

ner-Dance, paid tribute to the Twentieth Anniversary of the WAF.

The Ladies' Program included daily tours of Atlanta that took in the city's elegant homes and lovely gardens, historic Stone Mountain Park, the Cyclorama—a three-dimensional panorama of the Battle of Atlanta—and an Old South Breakfast at Pitty Pat's Porch.

Other meetings held during the Convention included an AFA Board

AFA MEMBERSHIP ACHIEVEMENT AWARDS AT THE CONVENTION

REGIONAL AWARDS

Northwest Region
Rocky Mountain Region

South Central Region
Southwest Region

STATE AWARDS

Alabama
Alaska
Georgia

Nebraska
Texas
Utah

CHAPTER AWARDS

Air Force Mothers (Pennsylvania)
Ak-Sar-Ben (Nebraska)
Alamo (Texas)
Alexandria (Louisiana)
Altus (Oklahoma)
Anchorage (Alaska)
Badger State (Wisconsin)
Big Spring (Texas)
Bossier-Barksdale (Louisiana)
Central Utah (Utah)
Charleston (South Carolina)
Cheyenne (Wyoming)
Colorado Springs (Colorado)
Concho (Texas)
Dallas (Texas)
Del Rio (Texas)
Erie (Pennsylvania)
Garden State (New Jersey)

Lubbock (Texas)
Mobile (Alabama)
Montgomery (Alabama)
Mt. Clemens (Michigan)
Novato (California)
Ogden (Utah)
Panama City (Florida)
Plattsburgh (New York)
Portland (Oregon)
Pueblo (Colorado)
San Bernardino (California)
Pease (New Hampshire)
Seattle (Washington)
Sioux Falls (South Dakota)
Spokane (Washington)
Tennessee Valley (Alabama)
Ventura County (California)
Waco (Texas)
Wasatch (Utah)

of Directors meeting, meetings of the Junior Officers Advisory Council and the Airmen Council, and a State Presidents' Workshop. Meetings held in conjunction with the Convention included a USAF Worldwide Information Conference, an Air National Guard Commanders' Conference, a Continental Air Command Commanders' Conference, and a meeting and Awards Banquet of the American Fighter Pilots Association.

With deep gratitude, we acknowledge the support of the following: The Coca-Cola Co., for Coke furnished to Convention offices and the Business Sessions; Eastern Airlines, Inc., for registrants' briefcases; General Motors Corp., for courtesy cars; International Business Machines Corp., Federal Systems Div., for sponsoring the Outstanding Airmen Program, and the Office Products Div., for the use of typewriters; the Lincoln-Mercury Div. of Ford Motor Co., for courtesy cars; Ling-Temco-Vought, Inc., for sponsorship of the Press Lounge; University Sound Div., LTV Ling-Altec, for furnishing the public address system for the Chief's Luncheon; Lockheed-Georgia Co., for use of the C-5 facilities, for sponsorship of the VIP Lounge, and for providing staff airlift to Atlanta; and Motorola Communications & Electronics, Inc., for the portable radio system.

We gratefully acknowledge the magnificent contribution to our program by the personnel of the United States Air Force . . . far too numerous to list here . . . but represented by: Lt. Gen. Henry Viccellio (Military Host), Commander, Continental Air Command, Robins AFB; Brig. Gen. George H. Wilson (Military Host), Commander, 445th Military Airlift Wing, Dobbins AFB; and the following Project Officers, Col. David B. O'Hara and Lt. Col. David L. Stiles, Hq. USAF, Washington, D. C.; Col. Frank R. Tiller, Commander, and Lt. Col. Kiefer Tucker, Director of Operations, 2589th Air Base Group, Dobbins AFB; and Lt. Col. Clifford D. Lyon, Director of Operations, 918th Military Airlift Group, Dobbins AFB.

While it cannot be denied that the full impact of the Convention was considerably diluted by unexpected events of national importance and interest, the following excerpts from letters received after the Convention substantiate the fact that the Convention was a huge success and that through the importance of the Seminar material, and the impact on the Convention attendees, it will prove to

(Continued on following page)

collage 36



MIC A SMALL WONDER

Hey, we know how to build a complete S-band transmitter/receiver on a 1" square substrate! By complete we mean it has a mixer, local oscillator, transmit/receive switch and power amplifier for the transmitter. Now you probably think we'll try to sell you some.

Hah! How many times have we told you we're not in the business of selling I/Cs*? We're in the business of making elegant things out of them. So the way to get this tiny marvel of hybrid I/C is to place a contract with us to develop something like an advanced fuze, a guidance system or a radar system. The people at our Aerospace Center are dying to show you how good they are at this sort of thing, and they'll promise to put in a few of the little microwave sets if you want them to. When you write, refer to the microwave set as MIC. That stands for Microwave Integrated Circuit and our engineers cogitated for a long time before they came up with that name. They hope you'll remember it.

*Please don't confuse us with the Motorola Semiconductor Products Division. They *do* sell I/Cs, but not this one.

WHO'S AFRAID OF MR. MARX?

(you can buy your toys from us)

Are you the kind of person who becomes furious at those toy manufacturers who sell you what looks like, say, a simple little gas station, but when you open the box you find 4,000 pieces less than 1" square plus an instruction sheet written by Edward Albee? Well, do we have something for you! It's an entire tactical tropo-scatter radio set, complete with a lovely paraboloidal-reflector antenna, that you, with the help of but one person, can put together and have running in 40 minutes. Whether or not you'll ever have the joyous experience is still in doubt, however. We and a competitor who shall remain nameless are both building one for evaluation and acceptance by the Air Force. Should any of the evaluation team be reading this, though, please keep in mind that our tropo radio will be good for about 140 miles, is packaged for easy transportation in tactical situations, weighs but 500 lbs. (as opposed to a ton for the only other comparable system), requires only 2.3 kw,



doesn't suffer from tropo fading, is easy to maintain, and has a signal-to-noise-ratio of greater than 20 dB 99.9% of the time (and don't ask us about that remaining 0.1%). Our Chicago Center made a nice, detailed brochure on the unit that is yours for the writing for. Meantime, don't give up on that gas station. What kind of an engineer do you want your kids to think you are?

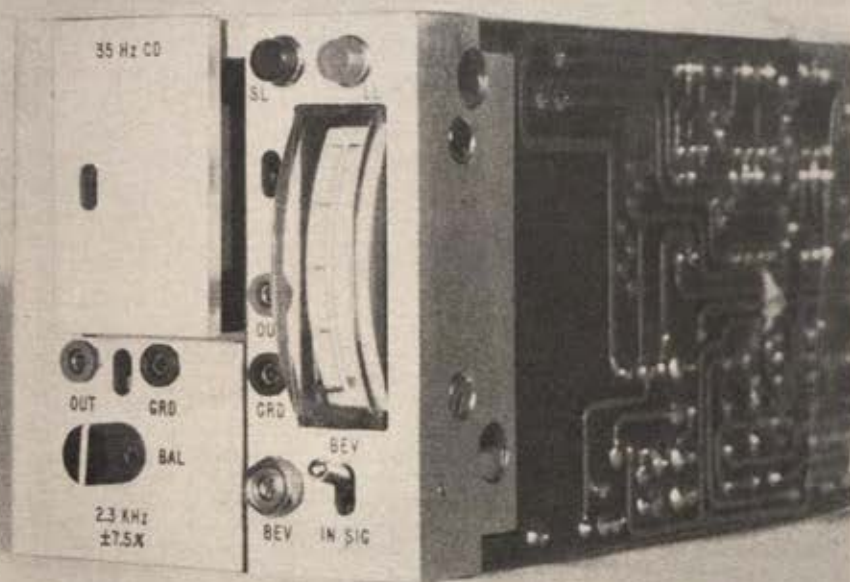
Aerospace Center Dept. 2008
8201 E. McDowell Rd., Scottsdale,
Arizona 85252, Phone (602) 947-8011

Chicago Center Dept. 985
1450 N. Cicero Ave., Chicago,
Illinois 60651, Phone (312) 379-6700



MOTOROLA
Government Electronics Division

The only thing this discriminator lacks is serious price competition



The SCD-5 phase lock loop discriminator represents the latest addition to the DEI F/M product line. Switchable loop filter bandwidths for operation within MI's of one and five are supplied as standard filters. Constant time delay input filter provides data distortion less than 0.3% at DR = 5.

The small size of the modules permits five discriminators to be installed in a standard 19-inch housing assembly with a panel height of only 3½ inches. Over 50 discriminators can be accommodated in a standard 72-inch rack.

Using all silicon transistor and IC circuitry, the SCD-5 is available with digital output and is priced under \$850.

For further information on what the SCD-5 has to offer, contact the DEI sales office nearest you.

Defense Electronics, Inc.

PRODUCERS OF
DEI AND NEMS-CLARKE
EQUIPMENT



DEI
RESEARCH
DEVELOPMENT
MANUFACTURING

ROCKVILLE, MARYLAND (301) 762-5700; TWX: 710-828-9783; TELEX: 089602 • LOS ANGELES, CALIFORNIA (213) 670-4815 • INTERNATIONAL: ROCKVILLE, MARYLAND • CABLE: DEIUSA; INTELEX: 64102 • Sales Representatives: Rome, Italy • London, England • Madrid, Spain • Tel Aviv, Israel • Bromma, Sweden • Rijswijk, Holland • Köln, Germany • Paris, France • Zurich, Switzerland • Oslo, Norway

AFA NEWS ————— CONTINUED

be the most successful, enjoyable, and effective Convention in the Air Force Association's twenty-two-year history:

"Each year the Air Force Association's annual Convention gets bigger and better and, in my opinion, this year's meeting topped them all. I enjoyed particularly Friday's Air War Symposium and personally consider forums of this type to be extremely beneficial for the USAF and the entire country."

"Please accept my sincere congratulations on a most fruitful and successful AFA Convention."

"I thought the highlight of the Convention was the Friday morning Air War Symposium. I know as an Air Force officer I feel proud to have such patriotic, dedicated professionals wearing the blue uniform."

"... I thought this was the best Convention yet held by AFA. It did more to wave the flag than anything I have seen in some time—and so needed."

"I felt the program was well balanced and the symposiums and panel discussions excellent. It was a real treat to see you and my other old friends. I guess that's one of the spin-off benefits of AFA Conventions."

"... you can be very proud of what the Air Force Association has accomplished in this last year, as I am proud to have a fine organization such as this one working to help improve opportunities in the Air Force for all our personnel. I for one am very appreciative of all you are doing for the enlisted men of the Air Force..."

"I was particularly pleased with the Reserve Forces Seminar both in the way it was handled and the results it produced. And, as always, the dinner honoring the Outstanding Airmen was one of the inspiring highlights of the week."

"... it was an occasion of meaningful communication and exchange of ideas and viewpoints, all carried on in an atmosphere of high professional standards."

"... you can't imagine what a shot in the arm it is to the airman's morale to have such a program as you conduct each year."

"The Airmen's Awards Dinner was a big hit. This recognition will have residual returns throughout the Air Force and is a most worthwhile endeavor."

"We need no thanks for our support of AFA. It's our duty to the ANG, USAF, and nation to give all support possible to an important watchdog for our country's defense."—END



Grumman to build the extraordinary Twin Otter

Through arrangement with the de Havilland Aircraft of Canada, Grumman will assemble and deliver the Twin Otter for potential U.S. military applications.

A remarkably versatile vehicle, the Twin Otter is ideally suited for a wide variety of utility roles, including Special Forces and Special Air Warfare applications.

The Twin Otter offers:

- Exceptional STOL capability—gets in and out of jungle clearings or makeshift strips.
- A capacity of 19 passengers or two cargo tons.
- Extremely low operational cost.

World-wide service is available through the facilities of de Havilland of Canada and Grumman of Bethpage, New York. Both companies have built substantial reputations for dependability and reliability throughout the world.



The de Havilland Aircraft of Canada, Limited



GRUMMAN

AIRCRAFT ENGINEERING CORPORATION

AIR FORCE ASSOCIATION MILITARY For Worldwide Protection.

**NO HAZARDOUS DUTY
RESTRICTION
NO WAR CLAUSE**

MORE THAN:

18,500 POLICYHOLDERS

MORE THAN:

**\$300,000,000.00
INSURANCE IN FORCE**

BIG BENEFITS! LOW PREMIUMS

Professionally Administered by AFA!

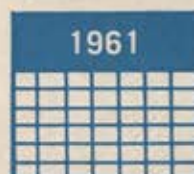
BIG BENEFIT SCHEDULE		
Age	Basic Coverage*	Extra Accidental Death Benefit
20-24	\$20,000	
25-29	20,000	
30-34	20,000	
35-39	20,000	
40-44	17,500	
45-49	13,500	
50-54	10,000	
55-59	10,000	
60-64	7,500	

*A flat sum of \$15,000 is paid for all deaths which are caused by an aviation accident in which the insured is serving as pilot or crew member of the aircraft involved. In this case, the accidental death benefit does not apply.

LOW PREMIUM SCHEDULE

\$10 per month gross premium (reduced by dividends each year since 1962) provides COMPLETE coverage.

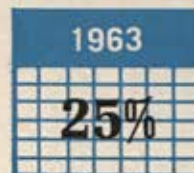
Policyholders Have Shared in
Dividends for Six Consecutive
Years—Plus Increased Benefits



Policy changed to permit policyholders to keep insurance at the low, group rate when leaving military service.



20% dividend paid to all policyholders.



25% dividend paid to all policyholders.

Coverage extended to include AF Ready Reserve and Air National Guard.



20% dividend paid to all policyholders.

Accidental death benefit increased to \$12,500. Coverage increased for flying personnel at no increase in premium.



9% dividend paid to all policyholders, a decrease reflecting AFA's decision not to limit coverage in combat zones.



10% dividend paid to all policyholders. Coverage continues to insure policyholders in combat zones with no restrictions.



8% dividend paid to all policyholders. Coverage continues to insure policyholders in combat zones with no restrictions.

YEARS
WAR
VIETNAM

GROUP LIFE INSURANCE... ..Everywhere, All The Time

NO WAR CLAUSE! NO HAZARDOUS DUTY RESTRICTION!

There is no war clause, combat-zone waiting period, other hazardous duty restriction or geographical limitation on AFA Military Group Life Insurance coverage. It is AFA's policy to continue to provide the broadest possible protection to all of our member-policyholders, including those in combat zones. We believe we can best fulfill our mission of service to the Air Force and to members in this way.

\$12,500 ACCIDENTAL DEATH BENEFIT

An additional benefit of \$12,500 is paid for accidental deaths—even those caused by aviation accidents—except when the insured is serving as pilot or crew member of the aircraft involved.

EXCLUSIONS — FOR YOUR PROTECTION

In order to provide maximum coverage at minimum cost for all participants, there are a few exclusions which apply to your coverage. They are:

Death benefits for suicide or death from injuries intentionally self-inflicted while sane or insane shall not be effective until your policy has been in force for twelve months.

The Accident Death Benefit shall not be effective if death results: (1) From injuries intentionally self-inflicted while sane or insane, or (2) From injuries sustained while committing a felony, or (3) Either directly or indirectly from bodily or mental infirmity or poisoning or asphyxiation from carbon monoxide, or (4) During any period while the policy is in force under the waiver of premium provision of the master policy, or (5) From an aviation accident, military or civilian, in which the insured was acting as pilot or crew member of the aircraft involved.

EQUAL COVERAGE — AT THE SAME LOW PREMIUM — FOR FLYING AND NON-FLYING PERSONNEL

All policyholders are insured for the same basic amounts, at the same low premium, whether or not they are on flying status. This eliminates the penalty of lower coverage for the man on flying status whose death is caused (as most are) by illness or ordinary accident. There is one exception* to this provision which is clearly stated below the benefit table on the opposite page.

PROFESSIONALLY ADMINISTERED

Military Group Life Insurance is administered by professionally trained insurance personnel within the Air Force Association. This provides efficient, thorough service at the lowest possible cost.

OTHER BENEFITS

**COVERAGE MAY BE
RETAINED AFTER
LEAVING ACTIVE
DUTY TO AGE 65.**

**GUARANTEED CON-
VERSION TO PERM-
ANENT INSURANCE**

**WAIVER OF PREMIUM
FOR DISABILITY**

**FULL CHOICE OF
SETTLEMENT
OPTIONS**

ELIGIBILITY

All active duty personnel of the United States Air Force (under Age 60) and all members of the Air Force Ready Reserve and Air National Guard (under age 50) are eligible for this insurance provided they are now, or become, members of the Air Force Association.

PAYMENT OF PREMIUMS

Premiums may be paid direct to AFA in quarterly (\$30), semiannual (\$60), or annual (\$120) installments. AFA will send statements 30 days before each premium due date. Active-duty personnel may also pay monthly by government allotment (\$10), thereby having their premiums paid automatically and preventing any possible lapse in coverage.

AF Active Duty, Ready Reserve & National Guard Personnel Are Eligible

MAIL YOUR APPLICATION TODAY!

OTHER FACTS ABOUT YOUR POLICY

All certificates are dated and take effect on the last day of the month in which your application for coverage is postmarked. Coverage runs concurrently with AFA membership. AFA Military Group Life Insurance is written in conformity with the Insurance Regulations of the District of Columbia.

The insurance will be provided under the group insurance policy issued by United Benefit Life Insurance Company to the Air Force Association. However, National Guard and Reserve members who are permanent residents of Ohio, Texas, Wisconsin, and New Jersey, will not be covered under the group policy, but will be eligible for individual policies providing somewhat similar benefits.

AFA MILITARY GROUP LIFE INSURANCE

(UNDERWRITTEN BY UNITED OF OMAHA)

Rank (please print) _____ Name _____ Service Number _____
Mailing Address _____
City _____ State _____ Zip Code _____
Date of Birth _____
Beneficiary _____ Relationship _____

This insurance is available only to AFA members:

☐ I enclose \$7 for annual AFA membership dues (includes subscription (\$6) to AIR FORCE/SPACE DIGEST).

☐ I am an AFA member.

I understand the conditions governing AFA's Group Life Insurance Plan. I certify that I am eligible for this insurance under the category indicated, that I am currently in good health, and that I have successfully passed, within the past two year period, the last physical examination required by my branch of service. (Reserve and Guard personnel not on extended active duty must include with this application a copy of their most recently completed SF88.)

Signature of Applicant _____

Date _____

Application must be accompanied by check or money order. Send remittance to:

INSURANCE DIVISION, AFA, 1750 PENNSYLVANIA AVE., N.W., WASHINGTON, D. C. 20006

Please indicate below the form of payment you elect:

☐ Monthly government allotment (I enclose \$20 to cover the period necessary for my allotment to be processed.)

☐ Quarterly (I enclose \$30)

☐ Semi-annually (I enclose \$60)

☐ Annually (I enclose \$120)

Category of eligibility (please check appropriate box)

☐ Active Duty, Air Force

☐ Ready Reserve, Air Force

☐ Air National Guard

Bob Stevens' "There I Was..."



Twenty-four years ago this month the invasion of "Fortress Europe" was launched. D-Day—June 6, 1944—saw the greatest armada of aircraft ever assembled. Gliders, transports, bombers, and fighters all rode shotgun for the great movement across the Channel. All in all, it was quite a show . . .

JUNE 6, 1944

ON THAT FATEFUL DAY, ALL AIRCRAFT WERE MARKED WITH BIG BROAD BLACK & WHITE "INVASION" STRIPES—"RECOGNITION," THEY SAID.

AND THOSE PHOTO RECCE PILOTS! ARMED WITH ONLY A .45 CAL. PISTOL, THEY FLEW SOME OF THE HARIEST MISSIONS OF ALL...



GLIDERS—LITTLE ADVANCED FROM THE WRIGHT BROS. DESIGN—CARRIED THOUSANDS OF TROOPS BEHIND THE ENEMY LINES...

IT WAS A LONG, LONG DAY IN JUNE AND MANY A DEBRIEFING OFFICER THAT NIGHT GOT A MONOSYLLABIC ANSWER—



Bob Stevens



Quick response on Ram Air Turbine Systems.

Garrett now has 30 types of RATS (Ram Air Turbine Systems) to choose from, and more standard designs are on the way. That's how we can promise quick response.

But what if we don't have a model that meets your exact needs? No problem—we can design and build one that does, and we'll do it quickly.

Take a look at our lineup:

Electrical RATS—power outputs from 500 watts to 40 KW.

Mechanical RATS—ratings up to 60 shaft hp at speeds from 600 to 60,000 rpm.

Hydraulic RATS—reliable power at pressures and flow rates compatible with current hydraulic designs.

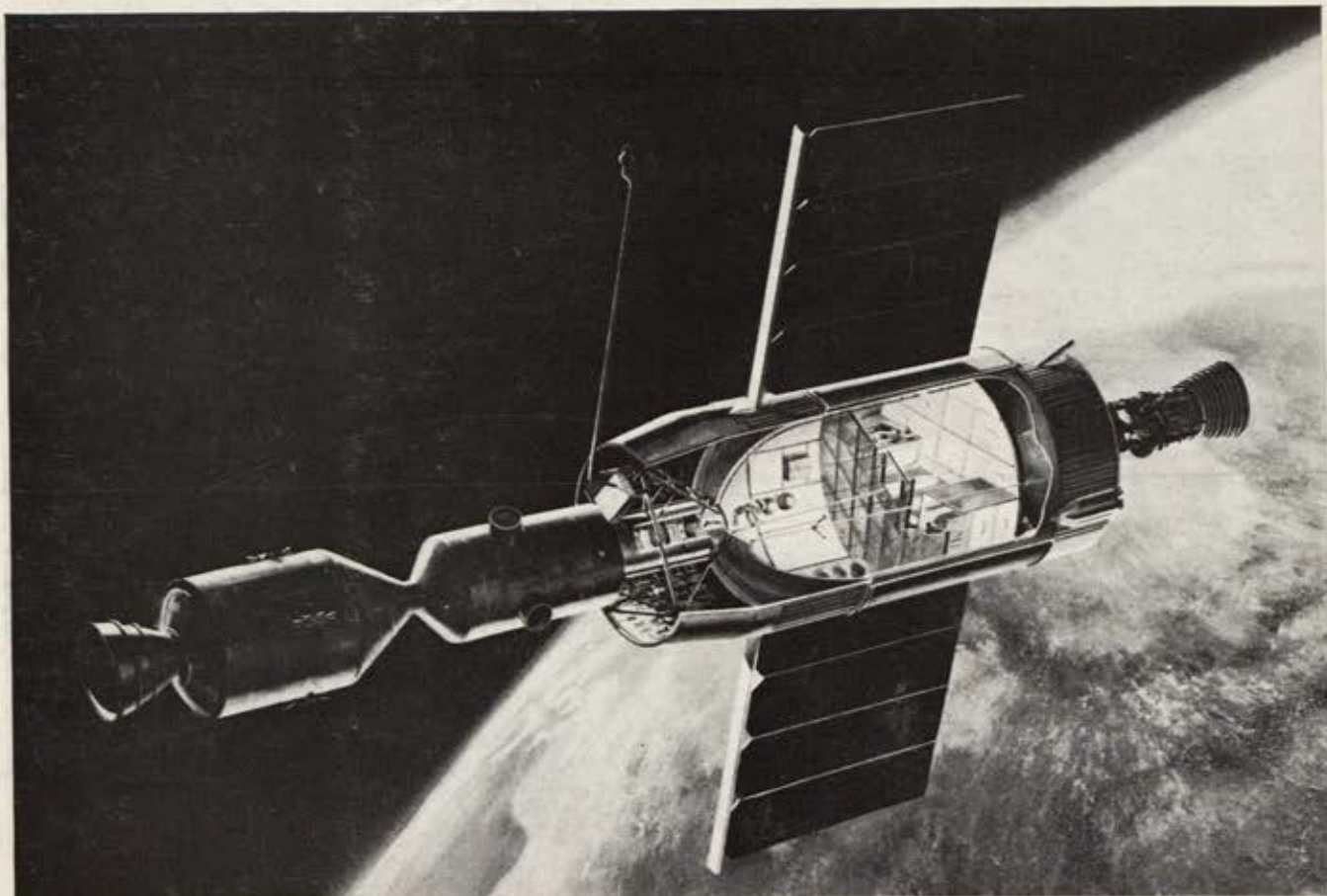
Combination RATS—versatile performance with any combination of electrical, mechanical, or hydraulic outputs.

We supply more than 90% of all Ram Air Turbines for externally-stored systems—applications that provide military aircraft with a mission flexibility unsurpassed by any other type of secondary power system.

Like to hear more about our RAT capabilities? Drop a line to AiResearch Manufacturing Division, 9851 Sepulveda Blvd., Los Angeles, California 90009.



AiResearch
Ram Air Turbine Systems



Space teamwork: orbital workshop.

The Orbital Workshop, a major project in NASA's Apollo Applications Program, merges the energies of two industrial engineering teams with earned reputations for dependable performance in space science and engineering.

The Douglas S-IVB rocket stage will carry a McDonnell

airlock with it into space. When the rocket's fuel is gone, the combination will become a workshop in which NASA astronauts can work in shirtsleeve comfort for several weeks.

These two space pioneers — McDonnell and Douglas — are now joined as one, with

greater-than-ever capabilities and facilities.

The McDonnell Douglas team is now planning advanced space labs, Mars and Venus landing capsules, missile systems, and re-entry spacecraft on which our nation can depend in the 1970s.

MCDONNELL DOUGLAS

