February 1970 / 60c

AIR FORCE

and SPACE DIGEST

The Magazine of Aerospace Power / *Published by the Air Force Association*

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AIR FORCE and SPACE DIGEST

The Magazine of Aerospace Power
Published by the Air Force Association

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Computer programmers and USAF tactical air specialists have joined to create a new automated command and control system in Southeast Asia. It is a major step toward real-time, push-button warfare.

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Domestic Action—A New Challenge for the Air Force
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Air Force skills and facilities are being teamed with those of other government and private agencies in an attack on our social problems. And the Air Force itself reaps a rich return from the effort.

Meat-Ax or Common Sense on Space? / BY WILLIAM LEAVITT 58
Inflationary pressures have forced manned spaceflight stretch-outs just when unmanned "working satellite" programs are at the takeoff point in terms of vast payoff. It would be folly to decimate them for short-term budgetary reasons.

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The planes at the Military Aircraft Storage and Disposition Center at Davis-Monthan AFB, Ariz., constitute the major reserve of military aircraft strength of all the services. Men at the Center disdain any view that their operation is an "airplane boneyard," but regard themselves as charged with the task of keeping America's aircraft reserve in flyable condition, and saving many tax dollars in the process.

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It just broke all weightlift

What's so good about heavy? Simply that the C-5A, in regular flight testing, has more than met another U.S. Air Force requirement—it flew 14 tons heavier than it will in service.

On Oct. 16, 1969, the giant plane lifted off at 399 tons, about the same weight as 15 huge diesel trucks loaded to capacity. With that flight, the C-5A broke the record it had set only two weeks earlier.

Records like that put this country far ahead of the rest of the world in airlift excellence. For the C-5A isn't just a weightlifter. It's a defense system with the range, endurance, and incredible capability to change our entire military strategy.

Foreign military bases may no longer be as necessary, since a C-5A fleet can deploy an army across an ocean in hours. Not only the men, but also the tanks, artillery, helicopters, food, fuel, and ammunition.

And it can put them down where needed. As little as 4,000 feet of dirt or grass will do for an airfield. On short runways, the C-5A can touch down and stop within 1,200 feet—about five times its own length. On dirt surfaces,

records. For the fifth time.

8 huge tires spread the plane's weight
hile special landing gear struts
bsorb the shocks.

Electronically, this bird-of-burden
in good hands. Even in dense fog
nd driving rain, an automatic system
an land the plane in complete safety.
nd there's MADAR—the system
nat keeps watch over the C-5A's
ealth, spotting possible troubles and printing out maintenance directions.

The C-5A's military impact is undeniable. But it also promises new scope and range for flights of mercy.

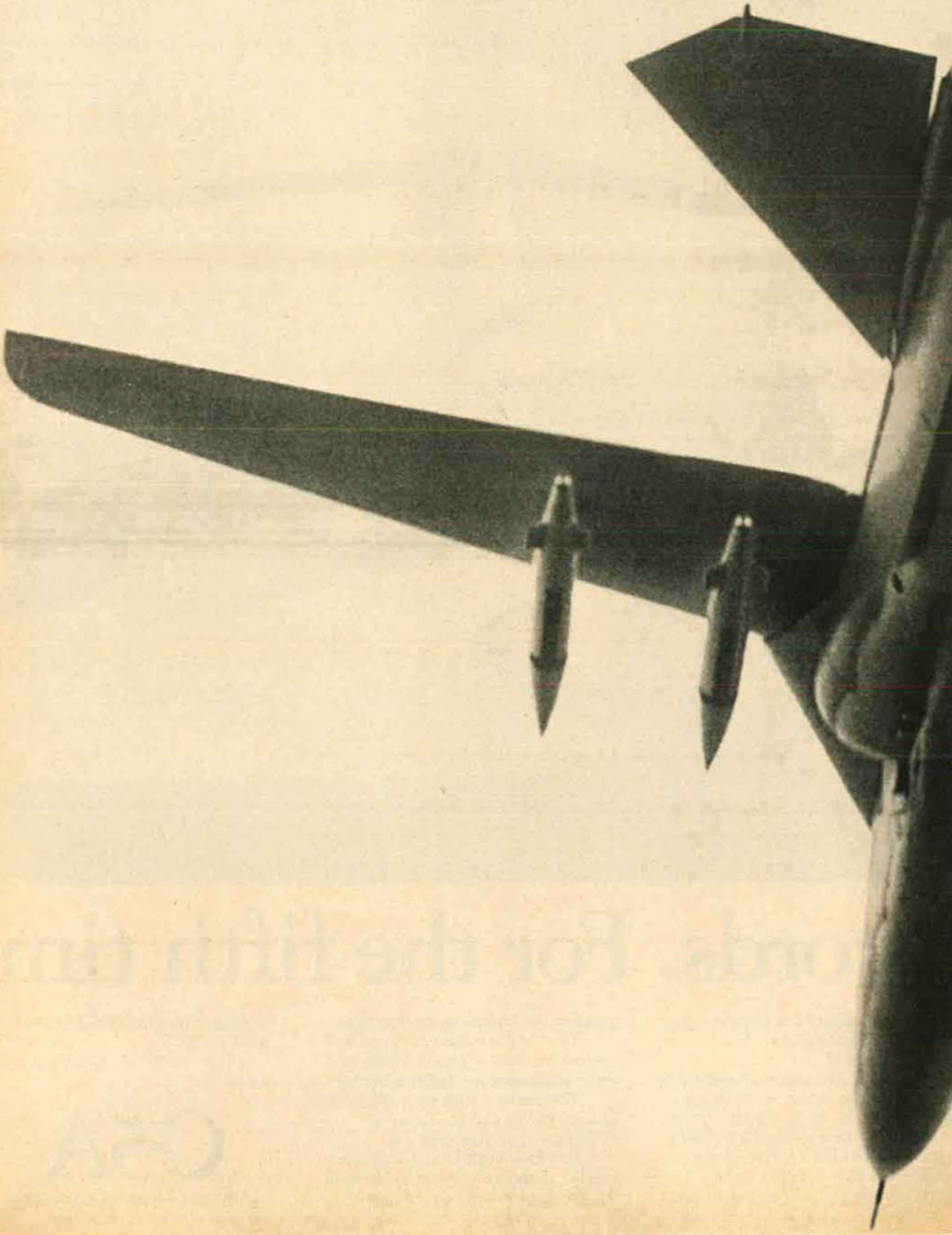
The Berlin Airlift took 300 aircraft to keep the city alive. Today 12 C-5As could do the same job.

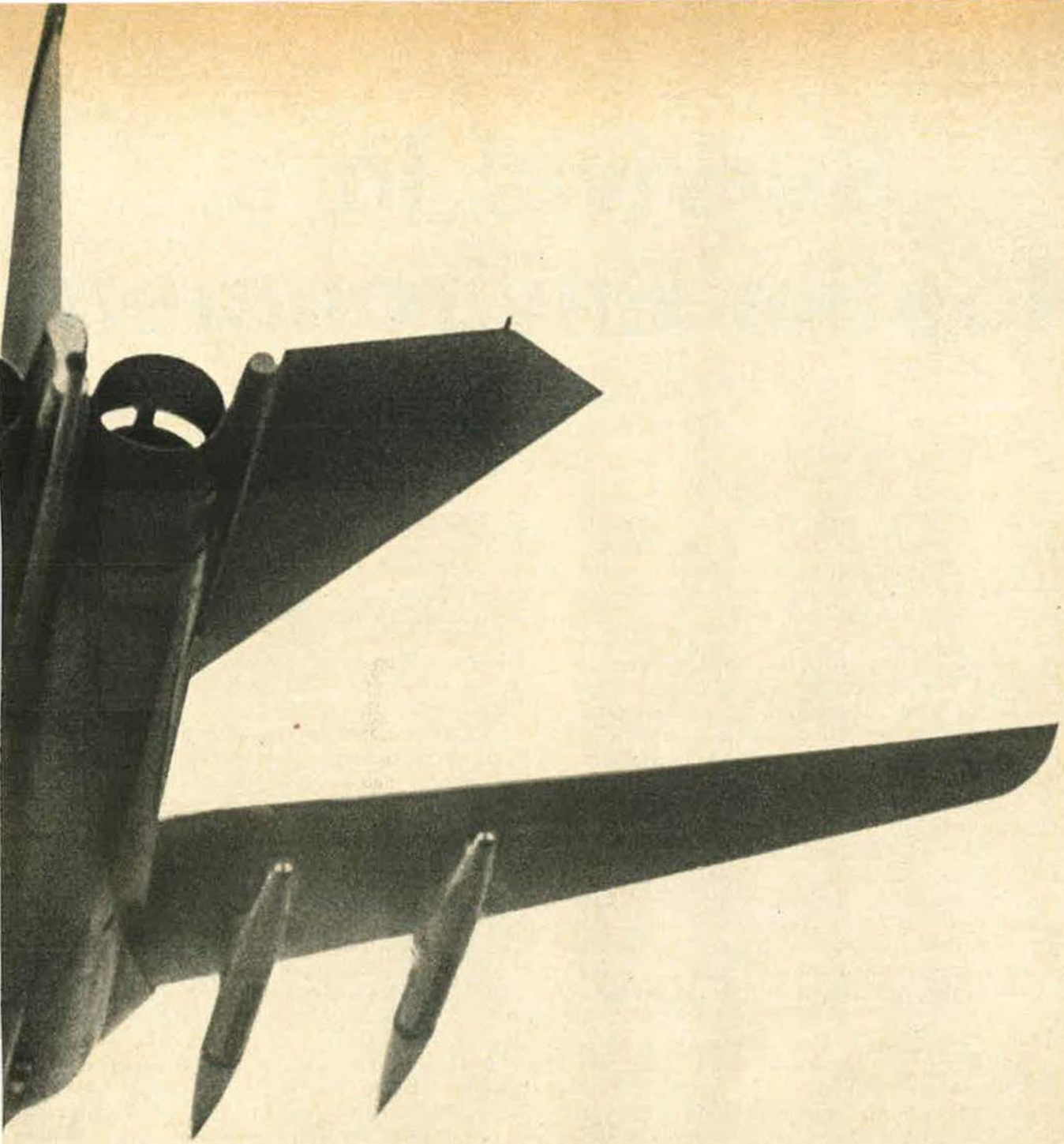
In 1964, seven large transports needed 10 days to deliver 952 tons of food to famine-stricken Pakistan. The same number of C-5As could do it in 18 hours.

With the C-5A, airlift has entered a new age.

C-5A

Lockheed Aircraft Corporation





The FB-111A is the U. S. Air Force's newest strategic bomber. It can fly high or low a lot faster than other bombers, penetrate enemy defenses undetected in good weather or bad, day or night, and strike more accurately with just about any weapon in the inventory. It's being delivered now to the Strategic Air Command. We've built more than 10,000 bombers over the past 30 years. And we're already planning for the next generation.

GENERAL DYNAMICS

An Editorial

Survival in a Hostile Environment

By John L. Frisbee
SENIOR EDITOR, PLANS AND POLICY

At the start of the 1960s, there was considerable discussion in the Air Force about what appeared to be an incipient leadership problem. It stemmed from the widely held belief that strategic nuclear superiority could indefinitely deter all forms of war.

The problem: How to maintain esprit, morale, and a keen fighting edge through years—perhaps decades—of deterrence without war? The situation was likened to that of a surgeon who spent his entire career practicing for an operation that might never have to be performed. Could he maintain his sense of mission? And in the clutch would his skill and fortitude in real life be equal to what he had practiced in a bloodless, artificial environment?

The problem never developed. Our nuclear superiority deterred nuclear, but not lesser kinds of, conflict. So the 1960s became a decade of crises—the last half dominated by the longest, most unpopular war in our history. The potential leadership problem was solved, if that is the appropriate word, by Vietnam.

But out of the conditions that solved one problem, another arose. Vietnam has been the major contributor to a tide of antimilitary feeling such as this country has not known in four decades. Ironically, a superbly professional Air Force, forged by five years of large-scale commitment in Southeast Asia, is being charged frequently—often irrationally—with professional incompetence. And so are the other military services. Equally disturbing, the military in general is accused of social irresponsibility at precisely the time it has developed a sense of social obligation unique in the history of military forces.

Although the proximate cause is Vietnam, the antimilitary reaction of today is associated more basically with the nation's domestic problems. It is widely assumed that poverty, urban rot, crime, and environmental pollution could be wiped out in short order if defense budgets were sharply reduced. A military profession, duty-bound to resist dangerously excessive reductions in its capabilities, finds itself labeled reactionary, self-centered, irresponsible, inefficient, out of touch with the times.

Reason tells us that even unlimited resources would not solve our domestic problems overnight. The ills of society are deep-rooted, persistent, and by no means confined to this country. At the same time, wisdom dictates that national defense should claim no more of the nation's resources than absolutely essential. The standard against which true military requirements must be measured is the magnitude of the external threat to our security, not the range and depth of domestic problems.

Lacking unequivocal evidence that the external threat is decreasing, no administration is going to endanger the nation by drastic reductions in the size and combat capabilities of the armed forces. Hence, the military is likely to be a target for the continued frustrations of a public rightfully concerned about the future of American life.

This poses a new leadership problem: How to compensate for reduced numbers by improving the quality -the dedication and productivity-of Air Force people in a public environment that ranges from grudging acceptance to downright hostility? Finding right answers will largely determine the degree of security we enjoy in the future.

Surely there is no single answer. Improvement of the material rewards for military service will help. AF/SD will continue to support vigorously those improvements that depend on legislative action. Another part of the solution is wholly in the hands of Air Force leaders who, through their own dedication, patience, and compassion must sustain esprit and the sense of corporate responsibility that has become an Air Force tradition.

Basic to the whole issue is a need for better public understanding that the Air Force profession is an equal of any other in social consciousness and dedication to the national welfare. Professional airmen have an obligation to help create that understanding, especially among the young and those who speak to youth.

It is doubtful that critics will be impressed by Air Force muscle—by its hardware. What is needed is an understanding of the heart and mind of a profession that shares the values our society is seeking to revitalize.—END

What on Earth do we do next?

Landing men on the moon is only a beginning. TRW is proud of its part in this great achievement. But now the nation will look ahead to other goals on other planets. On Earth, for instance.

It is right here on Earth that we will set some of the major goals of the next decade...goals to improve communication and navigation, to fight hunger and to end the pollution of our environment. And the sustained technological drive that took us to the moon has given us a good start.

For example, TRW's Intelsat III communications satellites are already bringing live TV and telephone service to millions around the world. Our successful OGO spacecraft are readily adaptable as Earth Resources Technology Satellites to help increase the world's food supply and locate new natural resources.

TRW is already proving that many of these same scientific and engineering advances are directly applicable to critical everyday problems. We are actively working on air and ground transportation and traffic control systems, air and water pollution control, city planning and development, hospital and medical systems and public safety programs.

But even as we seek solutions to our problems on Earth, exploration of space goes on. Project Viking is already underway to probe Mars. And TRW is prepared to help.

These are but a few examples of how more than 60,000 TRW employees around the world are applying advanced technology to products, systems and services for commercial, industrial and government markets.

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On the historic ***APOLLO*** *missions, TRW contributes in many ways, including the Lunar Descent Engines and Abort Guidance Systems, the S-4B Attitude Control Engines, and a variety of mission planning and software activities.*

AIRMAIL

Zealots' Victory, America's Loss

Gentlemen: William Leavitt's article on the apparent purging of Dr. Draper ["The Dethronement of Dr. Draper," December '69 issue] should arouse deep concern for the safety of our country. The immediate harm done to this rare individual is measured in terms of "energy conversion" from vital defense work to projects approved by those whose piety is self proclaimed, but whose motives are not as clearly expounded. The long-term damage to our defense posture is incalculable, but predictable.

If the need for dedication to defense activities is not recognized to be as vital to our longevity as the solution of our urban problems, then our nation will be overcome by any future aggressor. At that point it will be too late to develop a new Charles Stark Draper—except as a slave laborer for the new masters.

LEO NEWMAN
New York, N.Y.

New Language in the Making?

Gentlemen: The authors of "A Linguistic Look at Aerospace English," in the December issue, were about to affect my language pattern, verily, with the thoughts, "Another minor type of patterning is observable in the use of adjectival subordinate elements as adverbial modifiers," and "The assimilation of new meanings and the renascence of obsolete terms allows great elasticity of expression for conveying specifically chosen levels of technical meaning."

Luckily, these pieces of information gave only slight pause to my speed-reading perusal of the article, because further on I was cheered to note that, actually, ". . . the 'field' of language in which he moves will provide him with the basis for satisfactory comprehension." I hope this basis also works for linguists.

MAJ. H. M. DONAHOE
Little Rock AFB, Ark.

Flexibility for Security

Gentlemen: Colonel Boyes's plea for a new tactical aircraft in the November '69 issue ["Airmail," page 12] states some rather strong positions that should not go uncontested.

The arguments for the F-15 are certainly justified, but his opposition to other programs is "contraproductive." His judgment against the utility of the ABM as a pawn in arms-limitation talks is at least premature. A detailed study of disarmament activities indicates that meaningful disarmament will begin only when the participants believe that a balance of armament will exist after each round of disarming. Both ABM and AMSA may be required to provide the options needed to ensure these parities.

The Colonel's rhetorical question about whether the Communists ever willingly gave up anything significant is answerable. Dismantling their budding IRBM capability in Cuba was a willing decision on the Communists' part, *i.e.*, it's apparent they decided withdrawal was the best option available to them. Thus, they have demonstrated they will give up significant arms if they believe it is to their advantage.

Beyond our highly opinionated arguments on the relative merits of fighters, bombers, or missiles, however, is the divisive tenor of the Colonel's letter. It tends to draw us into a faulty dilemma: "either" fighters, "or" AMSA and ABM, when in practice there should probably be a flexible mix of a wide range of new systems. At a time when our country needs well-developed plans for security this either/or logic appears somewhat emotional.

Congress has demonstrated they will provide funds for well-justified programs. Statements that show such sharp disagreement among the military experts cannot build congressional confidence in our programs. We need to agree to not openly disagree and present united support for a broad range of systems that will allow the best flexibility in carrying out our national policy.

MAJ. ANDREW D. SETLOW
APO San Francisco

WW II Aircraft

Gentlemen: Photo caption on page 24 [December '69] of your excellent magazine refers to the use of the B-26 Marauder by the USAF during the Korean War. Not so! The Martin Marauder B-26 was used during World War II, *not* the Korean War. The Douglas Invader B-26 was used in the Korean War and World War II, although it was designated A-26 during WW II.

Bad slip for AF magazine—tsk, tsk!

H. S. COOK, JR.
Bedford, Tex.

• *You're entirely correct about the B-26* Invader, *as those of us who were in WW II and Korea know perfectly well. A "momentary" lapse on our part.*—THE EDITORS

Civilian-Military Relationship

Gentlemen: Although I am a strong supporter of our military in most instances, I must agree with *Time* Magazine ["The Army and Vietnam: The Stab-in-the-Back Complex," December 12, 1969, issue] that the "stab-in-the-back" complex is a particularly sorry development.

I call the above to your attention because I have noted that AIR FORCE/SPACE DIGEST editors frequently make rather pointed reference to political interference with military conduct of the Vietnam War. Your inferences that all military frustrations have been the result of political decisions is cry-babyish at best and outright un-American at worst. Let us not forget that the military has an elected (and hence political) commander in chief.

A. DANIEL ELIASON
Santa Barbara, Calif.

• *The successful outcome of any war—particularly one of limited objectives like Vietnam—rests on sound political decisions carried out through effective military operations. The Vietnam War has no precedent in American history. It has seen a testing of new strategies, new tactics, and new relationships between the civilian and military elements of government—between those who formulate and those who implement defense policy.*

It seems to us particularly important that the Vietnam experience be examined critically in all its aspects. There should be no search for scapegoats, but rather an effort to define the most effective civilian-military relationships, the optimum strategies and the best ways of applying military power. Where we have been critical

(*Continued on page 11*)

SCIENCE/SCOPE

A new launcher for the Phoenix missile now being built by Hughes has a fail-safe device that prevents accidental separation of missile from launcher during aircraft maneuvers. It uses no exotic or critical materials, weighs only two-thirds as much as an earlier model, and can be installed on either side of the fuselage.

A self-cleaning gas system makes it unnecessary to remove the launcher for maintenance after each mission. Hughes is building the launcher for the U.S. Navy's new F-14A fighter under contract to Grumman Aerospace Corp.

An imaging photopolarimeter for the Jupiter probe is being developed for NASA's Ames Research Center by Santa Barbara Research Center, a Hughes subsidiary, for the Pioneer F and G spacecraft to be launched in 1972 and 1973. Instrument will map the density and distribution of "asteroidal debris", measure the gas above Jupiter's cloud layers, and send back two-color spin-scan images of the planet.

Los Angeles has turned to aerospace technology for help in meeting the increasing demands for police, fire, and ambulance service. The city council recently chose Hughes to make a one-year study of the city's over-burdened services and to draw up a plan for a command-&-control system that would provide rapid pinpointing of field forces, computer dispatching, automated status displays, computerized information files, individual communications for hazardous-duty personnel, and automatic transmission and signaling for police vehicles.

NASA's Atmosphere Explorer satellite, now under study at Hughes, will carry a propulsion system that will enable it to climb to an apogee of 2500 miles in its variable orbit around earth. Every two hours it will dip back into the upper atmosphere for 10 to 20 minutes, swooping within 90 miles of earth.

The "yo-yo" satellite's scientific objectives will be to obtain data on the behavioral relationship of the upper and lower atmosphere, solar energy absorption, density of the atmosphere's charged-particle structure, and the diurnal bulge that appears to circle the earth as the sun heats the atmosphere.

A new crystal that is 100% efficient in converting visible light into infrared emission has been developed by Hughes research scientists. The crystal, a synthetic compound called calcium-erbium fluoride, is expected to find initial application in lasers. Single crystals several inches long have been prepared in a current laser program at the Hughes laboratories.

A laser proximity fuse and larger fins are being given to the U.S. Air Force Falcon in a program now underway at Hughes to make the air-to-air missile more effective against maneuvering targets. The proximity fuse's optically focused laser beam, which is reflected off the target, cannot be confused by electronic countermeasures and is virtually impossible to detect.

Because the laser gear is extremely compact, it can be tucked into a collar around the nozzle of the Falcon's rocket motor, leaving space in the missile for a larger and more powerful warhead.

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is the target for tomorrow – Firebee II – a superior breed of aerial target. Not a one-shot rocket, it's a supersonic, pilotless jet aircraft which maneuvers and performs to challenge even the new F-14 and F-15 fighter interceptors. Now in production, Firebee II hurls its supersonic threat from tree-top level to 60,000 feet and keeps coming back for more. Other examples of Ryan's Reach – an advance Doppler radar for the Lockheed/Navy S-3A subhunter and moon-landing radar for both the Surveyor and Apollo space craft. And the reach continues at Teledyne Ryan – for even more advanced pilotless aircraft and Doppler systems for both earth and deep space applications. For more information, write Teledyne Ryan Aeronautical, 2701 Harbor Drive, San Diego, Calif. 92112

our objective has been constructive. We will continue to raise questions and to suggest solutions that we believe useful to a continuous examination of defense affairs. This seems to us neither plaintive nor un-American, but rather in the tradition of American democratic practice.—THE EDITORS.

The Phantom Strikes Again

Gentlemen: I am a rated navigator and as such am not considered an expert on aircraft identification. However, I do feel that I have discovered an error in the "Airpower in the News" section of the November '69 issue of your fine magazine. . . . Knowing that fighter pilots are a rare and independent breed, I feel that they surely have swamped your desks with letters, soundly "red nosing" those responsible for the caption accompanying the picture that appeared on page 24. The picture shows a Russian TU-20 "Bear-B" being watched over by a "USAF F-4J Phantom." . . . This "USAF F-4J Phantom" is disguised as a US Navy F-4J—the "star and bars" being forward on the engine inlet and the "211" on the port nose, aft of the radome. If I am correctly informed, the "J" variant of the F-4 is not in the USAF inventory. . . .

CAPT. JAMES E. BRADLEY
College Station, Tex.

Gentlemen: . . . really now, who are you kidding? Granted, rivalry between fighter pilots is great, especially between those of the Navy and Air Force, but this is ridiculous!

The Air Force does not have an F-4J in its inventory, nor is the Navy obliged to call on the assistance of their F-4Ds or Es whenever our carriers experience attempted overflights by Soviet aircraft. We are eminently capable of providing our own fighter cover in these contingencies, as your photograph vividly depicts.

For your records, the F-4J pictured flying wing on the Russian "Bear" belongs to Fighter Squadron 33 based out of NAS Oceana, Va., and deployed on board the carrier *USS Independence* (CVA-62) during the NATO exercise last September.

I hope your fighter pilots fight better than your research department researches!

LT. MICHAEL D. MCGIBNEY, USN
FPO New York

• *For two reasons, we're particularly glad to have Lieutenant McGibney's letter. First, we're very pleased that members of the other services read* AF/SD. *Second, like Captain Bradley, the Lieutenant is right. Since the Phantom was unidentified when the picture arrived, it was assumed to be USAF since some of that service's Phantoms are now stationed in Europe. Apologies to Fighter Squadron 33.*—THE EDITORS

Reprise on the 90th

Gentlemen: The caption for the photo of the officer personnel of the 90th Aero Squadron, on page 24 of the December '69 issue, is incorrect. The 90th Squadron flew the Dorand A. R. during its training period in the spring of 1918, and, when it was assigned to the combat area, it received Salmson SAL-2A2 biplanes, which it used until the end of the war.

The accompanying pictures show the 90th Squadron's Dice insignia as applied to the Dorand, and the Salmson.

Bert Neidecker, above, stands by his Dorand, while Harold Greist, below, leans nonchalantly against his Salmson, each plane sporting the Dice.

These photos are from the album of Lt. Alan E. Lockwood, who is in the rear row in the 90th photo, third officer from the left. The CO of the Squadron, Capt. Bill Schauffler, is between the two men holding the squadron flag.

JAMES J. SLOAN
American Aviation Historical Society
Redondo Beach, Calif.

Gentlemen: Having been a regular reader of your publication since my Air Force days in the early 1950s, I was delighted to receive your December issue and find therein photos on the 90th Tactical Fighter Squadron celebrating its fifty-second birthday ["Aerospace World," by William P. Schlitz, page 24]. My father, then 2d Lt. Floyd H. Hart, was a member of the original squadron, both at Kelly Field and later as a pilot in France, and is third from the right in the lower picture.

I have in my possession a history of the 90th Aero Squadron published in 1920, covering its activities during its early years. The book includes the picture of the original squadron officers, which appears in AIR FORCE/SPACE DIGEST.

FLOYD H. HART
House of Representatives
Salem, Ore.

AFA News

Gentlemen: In your November issue, on page 104, there was a mistake in the caption accompanying the picture of Colorado Governor John A. Love signing the proclamation declaring "Air Force Week in Colorado." The error is ". . . A1C R. Shreve; Mrs. Ruth Shreve, President of the Silver Wings Chapter of Pueblo. . . ."

The caption should read ". . . Sgt. Jerry B. Shreve, just returned from two years in Japan; Mrs. Ruth Shreve, member standing in for Mrs. Mary Perkins, President of the Silver Wings Chapter of Pueblo, who was unable to attend. . . ."

MRS. RUTH SHREVE
Pueblo, Colo.

UNIT REUNIONS

8th Tactical Fighter Wing

The Sheraton Park Hotel, Washington, D.C., will be the scene of the 8th Tactical Fighter Wing's annual reunion, February 27-March 1, 1970. For further information contact

Lt. Col. Phil Combies
4307 Majestic Lane
Fairfax, Va. 22030
Phone: (202) OXford 5-6182

Class 40-A

Flying School Class of 40-A announces its 30th Anniversary Reunion in San Antonio, Tex., March 13-15, 1970. Headquarters will be the Menger Hotel, 204 Alamo Plaza, San Antonio, 78206 (phone: (512) 223-4361), where 56 rooms are being reserved for those attending. Each class member should bring any photos, memos, movies, diaries, etc., that he may have collected over the years. A class history is being prepared. For further information, contact

John P. Mizicko
624 — 17th St.
Denver, Colo. 80220

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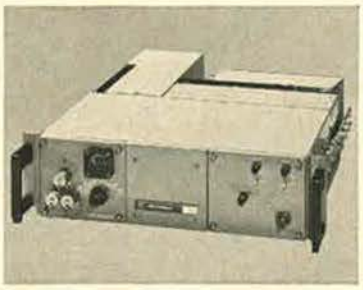
40 reliable watts without a tube. The CM-634 and CM-644 are fixed-tuned, single-frequency, crystal-controlled transmitters capable of being tuned from 110-155 MHz and 225-400 MHz respectively. Their all-solid-state stability is not subject to the gradual power degradation typical of transmitters employing tubes in their final output stages.

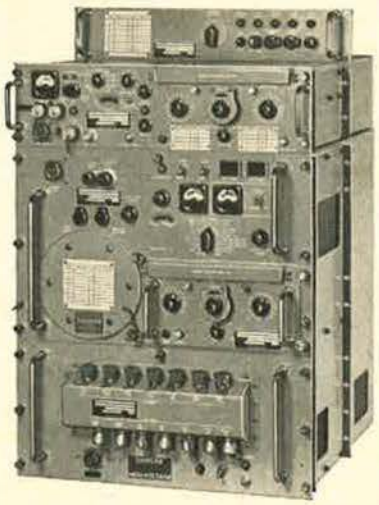


CM-634 VHF transmitter 40 watts, all solid-state, crystal controlled tuneable from 110 to 155 MHz 25 KHz spacing.

5000-hour MTBF. Both the CM-630 20 watt VHF transmitter and the CM-640 20 watt UHF transmitter are designed for minimum maintenance and tuning time. Channel changing is accomplished with units in rack-mounted position. An output filter limits all spurious radiation—including harmonics—to 80 dB below the carrier. Both are only 5¼ x 15 x 19 inches, weigh under 40 pounds.

100 watts, 3500 channels on-the-move. Motorola's advanced-design CM-Series emanates from the same technical group that produced the Air Forces' air transportable tactical UHF Communications Center, AN/TRC-87 and its offspring, the 100-watt, 3500-channel AN/URC-67 Automatic Receiver/Transmitter—a tested veteran of Vietnam jungles and Arctic tundra.

CM-610 VHF Receiver Single Channel-Compact-Lightweight (also available in UHF as CM-620).



CM-520 UHF Transceiver 3500 channels 50 KHz spacing 22 automatically tuned channels 20 watt output all solid-state.

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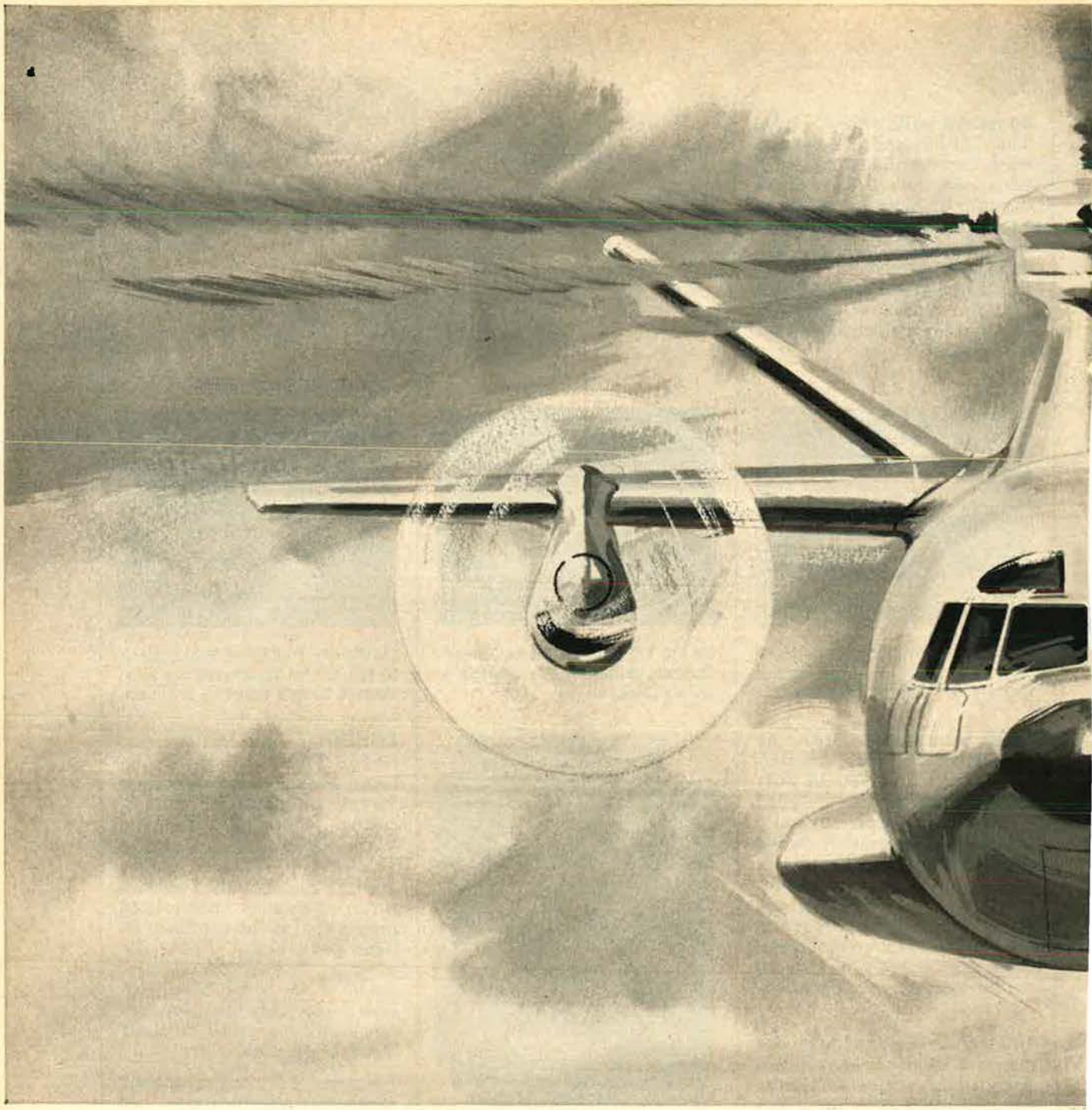

You are looking at 3

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AIRPOWER IN THE NEWS

By Claude Witze
SENIOR EDITOR, AIR FORCE/SPACE DIGEST

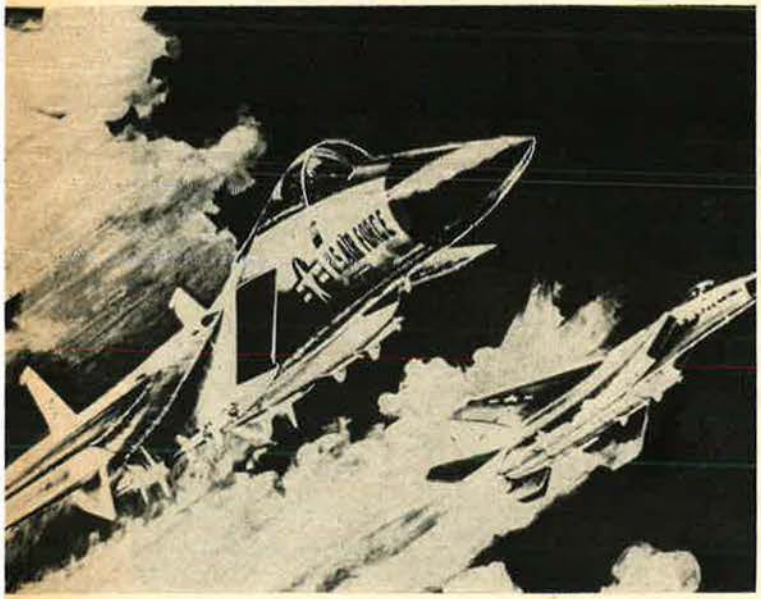
Back on the Track

WASHINGTON, D. C., JANUARY 13

On Christmas Eve, the Secretary of the Air Force set a new course that passed almost unnoticed, lost in the impact of the news that USAF is going to get a new fighter plane, designed for the USAF mission. The aircraft, of course, is the McDonnell Douglas F-15. Selection of the contractor was announced late in the day on December 23.

Dr. Robert C. Seamans, Jr., the USAF Secretary, told a press conference the following day that "the procedures we are setting up for the F-15 are going to be the bellwether for future procurements. We think we are making some major improvements. . . . In the simplest terms, you have got to get the right people and the most competent people and give them the authority and the responsibility to move ahead."

It was not necessary for the Secretary to add that this approach puts USAF back on the track it was following before Robert S. McNamara became Secretary of Defense in 1961. The young story of the F-15 already has some highly interesting chapters:



McDonnell Douglas version of the F-15, new USAF fighter, is depicted in artist's concept. Aircraft is designed to meet air-superiority challenge of the Russians in the mid-'70s.

• USAF's source-selection procedure was followed to its conclusion with no interference from the Office of the Secretary of Defense. Secretary Melvin R. Laird was credited with having approved the USAF decision, which was announced by Dr. Seamans.

• The contract is not a total package procurement deal. The manufacturer will get his costs plus an incentive fee for the engineering and design effort. From there on, it will be a fixed-price plus incentive fee contract.

• The F-15, from the outset, has been designed for one purpose. It is an air-superiority fighter and nothing else. Dr. Seamans said USAF "looked into the so-called multipurpose fighter and came to the conclusion that if we are going to be able to do the job required we have got go to single-purpose objectives. . . .

• There is no provision for the Office of the Secretary of Defense to monitor or interfere with USAF's management of the program. Basic responsibility has been given to Brig. Gen. Benjamin N. Bellis, who has a title as Deputy for F-15 in the Aeronautical Systems Division of the Air Force Systems Command, with headquarters at Wright-Patterson AFB in Ohio. General Bellis says his reporting line is direct to Gen. James Ferguson, AFSC Commander, and from there it goes to Gen. John D. Ryan, Chief of Staff, and Dr. Seamans.

• When progress reports are given, they will come from General Bellis—Dr. Seamans told the press corps it will be meeting with the General periodically—and not from the civilian secretariat.

• There has been no suggestion, at any time before or since the competition got under way, that anyone other than the men of the Air Force is making the decisions or that they will be superseded to any degree as managers of the project.

In all of these respects the F-15 marks a reversal of McNamara policies and practices. USAF's experiences with the General Dynamics F-111 program and the Lockheed C-5A transport emphasized the critical need for a redispersion of management responsibilities.

While the F-15 is proposed as a replacement for the McDonnell Douglas F-4, it probably is accurate to say it is the first plane designed for this mission, by the Air Force and for the Air Force, since the North American Rockwell F-100 Supersabre was programmed nearly twenty years ago. The F-4, after all, is an Air Force version of a Navy plane, welcomed into the Tactical Air Command at a time when modernization was imperative in the face of Russian aircraft capabilities.

The same argument holds, to a large extent, in the requirement for the F-15. It also explains why the F-15 is described as USAF's highest priority development program. The Air Force points out that Soviet-designed fighters have had superior maneuverability and acceleration ever since their appearance in the Korean War. USAF, it is true, has enjoyed better radius of action, firepower, avionics, and payload. It also has superior pilots. But what has happened, since Korea, is that our margin of air superiority has declined. The kill ratio in Korea was 12 to 1. Over North Vietnam, it was about 2.5 to 1.

Dr. Seamans points out that the Russians showed off a new family of fighters at the Moscow Air Show in 1967, and we know they set the pattern for what we will face in the late 1970s and the 1980s. By the mid-'70s, the basic technology of the F-4 will be twenty years old. The Secretary also feels sure, from following the Russian effort, that they are advancing their technology and new prototypes will be along in the future. We also know from experience that the Russians offer their aircraft for export; that's why we encountered them over North Korea and North Vietnam.

There was a clear and rugged competition for the F-15 contract. It started with a Request for Proposals that was given to eight aircraft companies in September of 1968. About three months later, three firms were selected to proceed with contract definition. They were the Fairchild Hiller Corp., Germantown, Md.; North American Rockwell Corp., Los Angeles, Calif.; and the final winner, McDonnell Douglas Corp., of St. Louis, Mo.

General Bellis has taken pains to explain how the USAF source-selection procedure was carried out. In a period of about six months, about 500 people took part in the review and evaluation of the three final proposals. Each was evaluated with respect to eighty-seven separate factors and basic scores compiled. Technical, operational, management, logistical, and cost areas were defined. The Source Selection Evaluation Board, with General Bellis as chairman, presented the data to the Source Selection Advisory Council. He did this by having, on the board, a chairman to cover each area of evaluation, and each of these men made his own presentation on the data for his own area, covering all three proposals. The board then was dismissed and the advisory council took over, applying weighting factors to the data presented by the board. These factors had been created before the proposals came in; they never were changed, and they never were made known to the Source Selection Evaluation Board. Dr. Seamans has emphasized that the weighting factors also were not given to the contractors, for the simple reason that, if they had been, the board also would have known them.

The advisory council's conclusions were given to Secretary Seamans in written and verbal form, but there was no recommendation favoring one contractor. The council evaluations were studied by the Air Force Logistics Command, the Tactical Air Command, the Air Force Systems Command, the Chief of Staff, and Secretary Seamans. They all came to the same conclusion. The winning contractor was evaluated number one in all four areas—technical, operational, management, and logistics. His price was the lowest.

The Office of the Secretary of Defense did not enter into the procedure, as it had in the McNamara regime, and there was no exercise of "rough judgment" from outside the Air Force.

McDonnell Douglas has been hired, in effect, to do the necessary engineering and design and to build twenty airplanes for development testing at a target price of $1.1 billion. This includes spares and equipment to support the test program. The first increment funded for this contract is $80.2 million. The "not-to-exceed" ceiling price for later production of the first wing of 107 aircraft is $936.6 million, which must include maintenance training, training equipment, and technical data.

Sometime in March, there will be another contract announced for the F-15's engines. Competition is going on between General Electric and Pratt & Whitney for the design of a jet that will be used in both the F-15 and the Navy's F-14B fleet defense fighter. It is a joint USAF–Navy program.

As for the F-15 itself, three years were spent defining its characteristics. On tactical missions, it must be able to perform fighter sweep, escort, and combat air patrol missions. It must be able to acquire, identify, engage, and destroy enemy aircraft even if the enemy controls the radar environment. There is major emphasis on maneuverability at high and low altitudes. This makes the key factors the aircraft's low wing loading, high thrust-to-weight ratio, and its weaponry.

The F-15 will be a single-place, fixed-wing, twin-turbofan fighter in the 40,000-pound weight class. While it is designed for maximum performance in the air-superiority role, it also will have, more or less as a by-product, a substantial air-to-ground capability. Speed will be in excess of Mach 2—from 1,400 up to 1,700 miles an hour.

The man with chief responsibility for the F-15's development and procurement is Brig. Gen. Benjamin Bellis, headquartered at Wright-Patterson AFB, Ohio. He has degrees in military and aeronautical engineering, as well as business administration, and is a West Pointer. He has been a pilot for twenty-four years. His last job as a system program director put him in charge of the Lockheed F-12/SR-71.

The aircraft will carry both medium- and short-range missiles, as well as an internal gun. Development is proceeding on these projects, with special effort to perfect caseless ammunition for the gun. The plane also will be all-weather, capable of finding and destroying enemy planes with electronic aids. Westinghouse Electric Corp. and Hughes Aircraft Co. are competing in the development of a new attack radar system. Contract award for the F-15 radar is expected in about six months. The gun development is another competition, between General Electric and Philco Ford.

Because of the deep concern over contract performance and cost overruns that grew out of the McNamara years, USAF is trying to demonstrate that this plight can be avoided. In hearings last spring before the House Defense Appropriations Subcommittee, Grant L. Hansen, USAF Assistant Secretary for Research and Development, and Lt. Gen. Marvin L. McNickle, Deputy Chief of Staff for R&D, were quizzed at length about their approach to the F-15.

They testified that a pure "fly-before-you-buy" policy is not practical. "The thing that is wrong with the complete fly before you buy is that you build up to make the test airplanes, then you shut down your production while you test, and you have to build it up again for production, which is not economical at all," Mr. Hansen told the subcommittee. "We want to try to pull testing and production enough together to minimize the cost of what would be a gap in production but still not get so much concurrency that we are heavily committed to production before we have enough test demonstration."

(*Continued on following page*)

In the F-15 contract, there is a requirement that McDonnell Douglas must successfully accomplish "development milestones" at the proper time and within the estimated cost before going ahead to the next step. The Air Force has identified these milestones during the negotiations and tied them to "dollar release points." It is the Air Force alone that will decide, unilaterally, whether or not the contractor has met the requirement.

"It is my personal conviction that the key to the control of costs on a program is not the type of contract," Mr. Hansen testified. "It is the matter of how well the program is planned, how visible that plan is, how good the status information is against the plan. By good, I mean accurate and timely. It then requires an analysis of any deviation from the plan and corrective management action either by the contractor or the government to bring the program back on course."

If the pattern of the past is followed, there will be some public discussion about the true nature of the F-15 competition. On this subject, the record shows that, for the first time, USAF has fully funded all three of the contractors submitting proposals.

Another subject prone to discussion is the spreading of the work. According to General Bellis, the McDonnell Douglas proposal contained forty-three pages of subcontractors or potential subcontractors, with their cost proposals. The company estimates there will be 4,000 subcontractors in forty-two or forty-three states.

—Wide World Photos

One witness before Senator Proxmire's one-man hearings was Gordon W. Rule, civilian director of procurement for the Navy. In addition to testimony on cost overruns, he offered advice on such items as the place of small business in defense and congressional headline-hunting tactics.

The Wayward Press (cont.)

Between Christmas and New Year's the news beats are pretty dull in Washington. Both Congress and the bureaucrats like to take a breather. Senator William Proxmire, the Wisconsin Democrat who heads the Subcommittee on Economy of the Joint Economic Committee, is an exception. Besides jogging to work every morning, he managed to take advantage of the lull by grabbing a lot of headline space on the eve of the new year.

On December 28, the leanest Sunday in the year for newspaper editors, he released his latest report on "The Military Budget and National Economic Priorities." On December 29, 30, and 31, he conducted a trio of hearings billed as an inquiry "on Navy shipbuilding programs and on problems of military purchasing policies and practices."

A veteran radio news reporter arrived at the press table one morning during these sessions and said, "Well, here we are. It's the only show in town." Which it was.

Mr. Proxmire sat alone at the big podium, designed with seats for each of his nine fellow committee members. Whether this was due entirely to the holiday or also to their fairly common distaste for Mr. Proxmire's methodology was not clear. At least four of them filed dissents from his December 28 report—one of them called it "puerile," and a magazine editor concluded that Mr. Proxmire is "the intellectual lightweight champion of the Senate."

In spite of this widely recognized credibility gap, the newspapers played the story straight, just as Mr. Proxmire anticipated they would. Part of playing it straight is to omit, from the daily accounts, any evidence that Mr. Proxmire may be wrong or motivated by anything but the purest intentions.

The prize examples are found in the testimony given on December 30 by Gordon W. Rule, Director of Procurement Control and Clearance for the Navy Material Command. Mr. Rule, as he was about to leave the stand, made a suggestion to the chairman, to wit, that he publicize something the Navy is doing right, and stop seeking headlines for his criticisms. The Senator dropped his guard.

"You know when you see something right and say it is right, it is not news. . . . I have praised Admiral [Hyman G.] Rickover."

"Why don't you find somebody else?" the witness snapped.

"What was that?"

"Why don't you find somebody else. . . . There is at least one other guy around as good as he is."

Mr. Rule earlier had referred to Admiral Rickover, somewhat sarcastically, as "the great unsung procurement expert." Mr. Proxmire holds Admiral Rickover in high regard.

Another item, also ignored in the papers, concerned small business. The chairman has been wrought up about the fact that small business does not get more prime defense contracts.

Mr. Rule told him, bluntly, "we are doing small businessmen a disservice when we give them a prime government contract. . . . They are much better off getting defense dollars as subcontractors." He added, a moment later, that a study of contracts that are terminated for default shows "they are almost all small business people that bid and didn't know what the hell they were bidding on and couldn't handle it. It is unfair to those people."

He bashed another Proxmire thesis with a comment that "formal advertising is overdone, and we strain to formal advertising in cases where we shouldn't. There are a lot of things that should not go on the basis of low price alone, and that is what formal advertising does."

Probably most important, Mr. Rule, in his testimony, did not blame industry by itself for cost overruns. His expertise is in the area of shipyard contracting. He told Mr. Proxmire, to the Senator's great distress, that he had settled one claim against the government for $96.5 million. The shipyard had sought $114 million. The Senator then wanted to know who was at fault. Mr. Rule said the arithmetic answered the question. Mr. Rule's reply wasn't news because he was saying the contractor was right.—END

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LETTER FROM EUROPE

By Stefan Geisenheyner

AIR FORCE/SPACE DIGEST EDITOR FOR EUROPE

First NF-5/15s Delivered to RNethAF

Two years ago the Royal Netherlands Air Force (RNethAF) decided to replace its obsolete F-84F fighter-bombers and T-33 trainers with the CF-5/15, the Canadian version of Northrop Corp.'s F-5 Freedom Fighter. Subsequently seventy-five CF-5/15A single-seaters and thirty of the B variant, a two-seater, were ordered from Canada. General Dynamics Corp.'s Canadair Ltd. subsidiary is now constructing the airframe, and Orenda Ltd. is producing the engines under license from the General Electric Co. The first four two-seaters arrived in the Netherlands last November.

The NF-5/15 (as the RNethAF version has been designated) is basically the same aircraft as the Canadian Air Force's CF-5/15, but differs considerably from the T-38 variant that is flown by USAF. The biggest difference is in the installation of a higher powered engine: The T-38 is equipped with the General Electric J85-5A jet engine of 3,850 pounds of thrust with afterburner, whereas the CF-5 and NF-5 use the GE J85-15, which delivers a maximum thrust of 4,300 pounds.

This considerable thrust increase is translated into a better combat load, greater speed, and good takeoff performance. This last feature is enhanced by a two-position high/low nose gear, which, when in the extended position, increases the aerodynamic angle of attack and thereby reduces the takeoff distance by twenty to twenty-five percent.

The airframe was modified slightly to handle installation of the more powerful engines. Special air-intake doors that are fitted to the rear fuselage supply the engines with additional air in the low-speed regimes. The aircraft can also be fitted with a reconnaissance nose housing up to four cameras.

The last of the 105 aircraft on order are to be delivered by late 1971. As they become available from the Canadian manufacturer, they will be ferried directly to RNethAF bases in Holland. This method of delivery of brand-new and therefore relatively untried aircraft over intercontinental distances is unusual, and the first flight of NF-5s to arrive in the Netherlands was greeted in November with enthusiasm by officials.

The fighters are flown by RNethAF pilots in the framework of a long-term program dubbed "Hi-Flite," which envisions regular ferry flights from Canada during a two-year period. The flight route was laid out for maximum safety, and is essentially the same as the one used by the USAF in ferrying fighters from the US to Europe.

Starting point for the RNethAF flights is Bagotville, Canada. Stopovers are made at Goose Bay, Labrador; Sondrestrom AB, Greenland; Keflavik Airport, Iceland; H.M.S. Lossiemouth, Scotland, a Royal Navy air station; and the final destination of Twenthe Air Base, Netherlands. Each ferry flight will entail four aircraft, with the program suspended during the midwinter period when the twenty-four-hour polar night descends on the northernmost part of the route.

Eventually, a total of four squadrons of the RNethAF will be equipped with NF-5/15 aircraft. The first unit to receive its full complement of fighters is TVO Squadron, the

The first four NF-5s built for the Royal Netherlands Air Force by Canadair Ltd. Here, in close formation, they cross the North Sea on the last leg of their journey from Canada to their initial duty station at Twenthe AB, Netherlands.

unit designated as responsible for the transition training. Most of the thirty two-seaters will go to this squadron. Its training aircraft are first on order from Canada so that fully trained and type-rated pilots will be available to operate the single-seaters in the three gradually growing attack squadrons.

Soviet Forces in East Germany

For nearly five years Marshal Piotr Koshevoi of the Red Army commanded the Soviet forces stationed in the German Democratic Republic (GDR). After distinguishing himself as reorganizer of those forces, he was recalled for a new assignment in the USSR. He was replaced by Colonel-General Victor G. Kulikov.

During Marshal Koshevoi's tenure, the forces in the GDR "excelled in high combat readiness and discipline," as an East European newspaper put it in a eulogy to the departing general officer. During a reception in his honor in East Berlin and in the news coverage given this event by the East German press, a number of hitherto unknown facts about the Red Army's activities behind the Iron Curtain came to light.

Within the relatively confined territory of the GDR, the USSR has nine tank divisions, one armored artillery division, ten armored infantry divisions, an unspecified number of missile brigades, and numerous support units. A sizable tactical air force composed of interceptors and fighter-bombers backs this strong land force. The present total strength of the forces is given at about 410,000 men.

The Commander in Chief, Soviet Forces Germany, is in direct charge of all forces, divided into armies, each consisting of three to five divisions and attached air force elements. More than 7,500 tanks are presently stationed in East Germany. It is estimated by some that this very large force is about thirty percent of the total tank force of the Soviet Union.

Under Marshal Koshevoi's direction, the heaviest emphasis was placed on attaining tactical and operational mobility. At present, each division deploys a large number of helicopters, and infantry units can be relocated by air on short notice. The Soviet airmobile concept also includes transport of multiple rocket launchers, armored artillery, and missile units. Each of the twenty divisions has a short-range missile battalion assigned to it.

The medium-range missile brigades also are highly mobile and are usually attached to the armies. The nuclear missile units are under command of Headquarters, Soviet Forces. The medium missiles reportedly have a range of 200 to 300 miles.

According to one report, the Soviet Air Force in East Germany is the biggest and best equipped of the USSR. This force, the 16th Tactical Red Air Force, can place approximately 1,000 aircraft in the air, of which about seventy percent are fighters and fighter-bombers. Under its jurisdiction come the air defense units, which consist of surface-to-air missile batteries and gun units.

The bulk of this force is stationed in the relatively small southern sector of the GDR. It represents the largest concentration of Soviet troops anywhere outside Russia proper. The troops are regarded as "Guard" forces in respect to their level of proficiency and equipment. (The USSR has "Guard" divisions and "Line" divisions. The "Guard" divisions have a higher percentage of professional soldiers.) It can be assumed that the units are considerably better equipped and trained than troops stationed in central Russia. They use—if the East European press reports can be believed—the most modern weaponry available in Russia's arsenal.

These elite troops form the core of the Ist Strategic Echelon, as the USSR and its allied forces along the Iron Curtain are called. They are the central group in the strategic setup of the Warsaw Pact defense line. The North Group, in place along the Baltic, currently is composed of only two Soviet divisions, while the South Group in Hungary has twice that number. This seemingly disproportionate deployment of Soviet troops does not affect the offensive or defensive capabilities of the Warsaw Pact to any appreciable degree, however, because East German or other satellite divisions represent the bulk of Warsaw Pact strength in these strategically less important regions.

These units are organizationally fully compatible with the equivalent Soviet units. Their command structure is the same, they operate with the same tactical philosophy, and they use the same communications and radar network. The commonality among Warsaw Pact forces is closely meshed with respect to leadership and armament. This is a goal so far eluding NATO, where the large variety of weapons used by the partner nations complicates the supply and support situation considerably. Even a moderate degree of commonality still remains a cherished dream of NATO's logistics planners.

RAF Reorganization Completed

On November 28, 1969, the RAF Strike Command became fully operational as a new force. Bomber, Fighter, Coastal, and Signals Commands were merged into a single organization to achieve greater flexibility under a more efficient command structure.

This fundamental change in the structure of the RAF had its origin in the early 1960s when it became obvious that the system then in use would not meet the requirements of modern warfare. Air Chief Marshal Sir Denis Spotswood, who today is CinC, Strike Command, mapped out the reorganization. As a result, two operational commands have now taken the place of four, and RAF's front-line forces are found either in Strike Command or Air Support Command.

Strike Command now controls the nuclear strike and conventional attack forces, strategic reconnaissance, air defense, the long-range maritime reconnaissance, in-flight refueling, and electronic-warfare units. Air Support Command controls those tactical-reconnaissance, close-support, and air-transport forces, which operate mainly in support of ground forces.

Basic thinking behind these changes stemmed from the fact that, in the past, bomber and fighter forces comprised a large number of stations, squadrons, and men, having simple and clear operational tasks to fulfill. Today, these tasks

(Continued on following page)

The man who drew up the blueprint for the reorganization of the RAF's command setup, Air Chief Marshal Sir Denis Spotswood, CinC of the RAF Strike Command.

Phantom of the RAF Strike Command fitted with a combined radar, infrared linescan, and camera pod undergoing flight tests. Hawker Siddeley, as sister design company to the aircraft's manufacturer, McDonnell Douglas, is responsible for the aerodynamic structure of the recce pod, scheduled to enter service with the RAF in 1971.

have to be met by a force significantly smaller in size than in World War II although the number and variety of missions to be flown remains the same.

Multirole weapon systems, consisting of versatile aircraft that give a commander flexibility previously unattainable, have been introduced to meet this need. Commands equipped with a small number of these complex aircraft increasingly sought the support of other commands to retain operational viability. To maintain functional commands with separate but overlapping responsibilities became functionally untenable.

The rationalization and centralization of the RAF Command structure has already led to greater efficiency and higher effectiveness, as well as achieving savings in manpower and financial resources. These advances, however, were not made at the expense of the high operational readiness maintained by the RAF.

NATO Defense Comsat Program

Nine participants—Belgium, Canada, Federal Republic of Germany, Italy, the Netherlands, Norway, United Kingdom, the US, and the SHAPE Technical Center—announced late in 1969 the signing of a memorandum of understanding that sponsors the extension of the NATO research and development program into the tactical satellite communications sector.

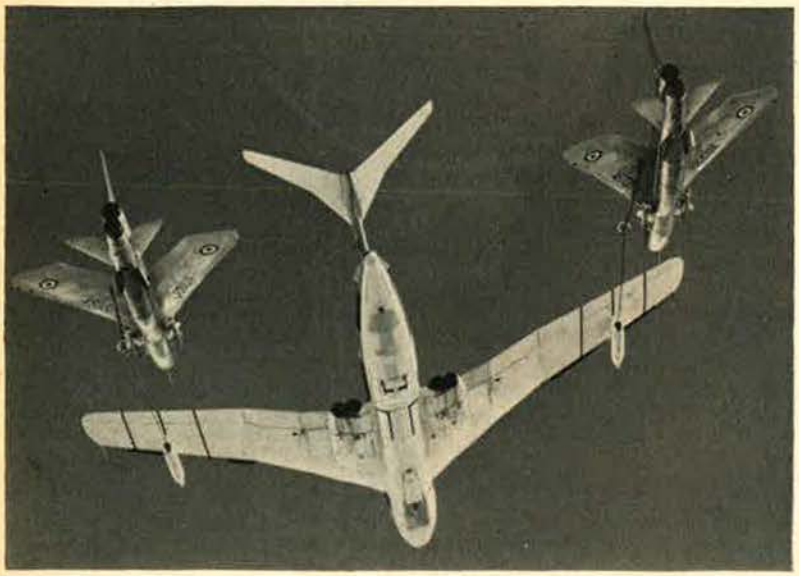
The system, called TACSATCOM, might become operational by the mid-1970s. Each participant is contributing some skill or hardware to the joint effort.

Britain, for instance, is offering the use of four experimental communication terminals. Two are ground-based, one is installed on a ship, and the fourth is aboard an aircraft. Whereas the Skynet satellite system (*see AF/SD, November 1969, page 36*) provides secure long-range communications, TACSATCOM is designed specifically for tactical communications needs.

Very-high-frequency (VHF) transmissions are blocked by the curvature of the earth or other geographic features of the terrain. At these wavelengths, communications beyond the line of sight are not always feasible. Field commanders consider it vital to keep in contact with their forces or aircraft out of range of VHF equipment. Communications on lower frequencies over very long distances are possible but can be intercepted too easily by the enemy. TACSATCOM would provide a solution to this problem since it serves as a relay point in space and its transmissions could be received by friendly forces on a continental scale.

The original TACSATCOM program was formalized under the auspices of NATO by a memorandum of understanding in 1967. The latest phase of the program is a cooperative test series using the Synchronous Lincoln Experimental Satellite LES-6, launched from Cape Kennedy in September 1968, and a network of small tactical satellite communication terminals built and operated by the participating nations.

It is hoped that the evaluation will lead to the definition of a system capable of meeting NATO's urgent communications requirements.—END



In a painstaking operation, two BAC Lightning interceptors are refueled simultaneously by a Victor tanker. Under the new RAF command structure, Strike Command now controls in-flight refueling, as well as nuclear strike and conventional attack forces, strategic reconnaissance, air defense, long-range maritime reconnaissance, and electronic warfare units.

AEROSPACE WORLD

News, Views & Comments

By William P. Schlitz
NEWS EDITOR, AIR FORCE/SPACE DIGEST

WASHINGTON, D.C., JAN. 12

It happened while on a mission over Vietnam, and Air Force 1st Lt. Woodrow Bergeron, Jr., of New Orleans is very happy to be alive to tell about it.

First off, he was forced to eject from his disabled F-4 Phantom over enemy-held territory. In the wind blast of the bailout his flight helmet gashed the bridge of his nose and blackened both eyes.

Half-blinded and with one parachute riser unattached, he realized that the enemy had opened fire on him with small arms.

Landing safely but with the enemy all around, Bergeron used his emergency radio to call for help, and so began a harrowing experience that was to last fifty-one hours. US helicopters under cover of A-1 Skyraiders and Phantoms made sixteen tries before bringing out the downed pilot.

Rescue helicopters almost got to Bergeron several times early in the game but were driven off by intense enemy fire.

Bergeron realized he was being used as bait to bring friendly aircraft within firing range. "I could see the skin coming off the helicopters," he said.

The friendlies were at work, however, and Skyraiders that day and the next continued to pound enemy positions with heavy ordnance. Bergeron helped by radioing compass headings of enemy-infested caves and bunkers and by directing air strikes near him. "One time they came within a foot of me on a strafing pass. That was kind of close," he said, "but effective."

In his nightmarish scramble from hiding place to hiding place Bergeron lost his .38-caliber pistol and found himself entirely defenseless in a very hostile environment.

Once enemy soldiers came to within fifteen feet of his hiding place. They also sprayed with automatic weapons a spot he had occupied a short time before.

When Bergeron's emergency supply of water ran out he was obliged to drink river water.

Finally on the third day a Jolly Green Giant rescue chopper lifted the weary pilot to freedom. Exhausted by having gone the entire time without sleep, but confident of rescue, the lieutenant had the presence of mind to collect a sample of the river water to be tested later for contamination.

It wasn't contaminated.

☆

And this item can be added to the list of bizarre situations produced by the Vietnam fighting: A USAF doctor treating a wounded Viet Cong detainee discovers that the man has a live grenade buried in his head.

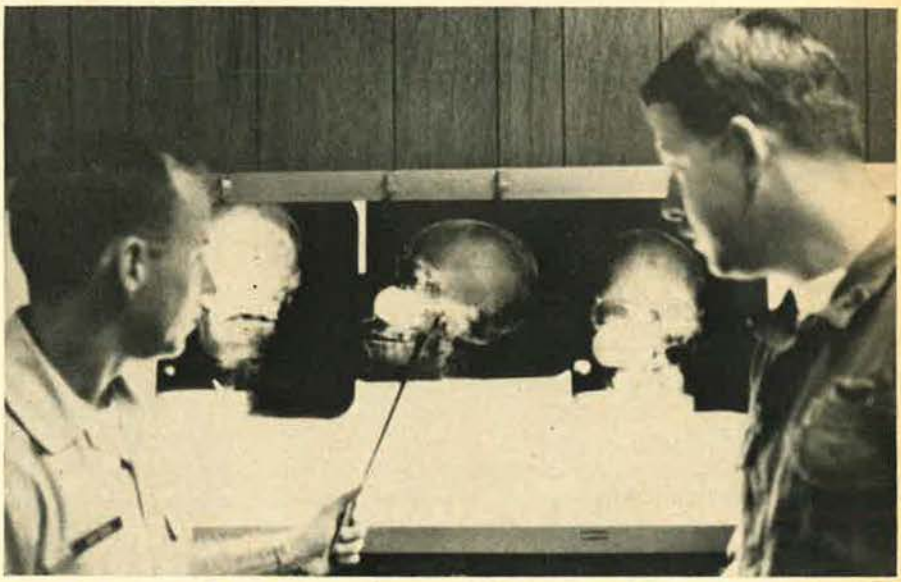
The man was bleeding severely from the head and face, and was breathing with difficulty when he was brought in. Maj. (Dr.) Alfred B. Watson, Jr., of Keystone Heights, Fla., ordered that a throat incision be made to aid respiration while the bleeding was brought under control. Routine X-rays also were taken.

Since the man obviously needed surgery, Dr. Watson made arrangements to escort him by helicopter to the 67th US Army Evacuation Hospital at Qui Nhon.

Meanwhile, lab technicians studying the developed X-rays became

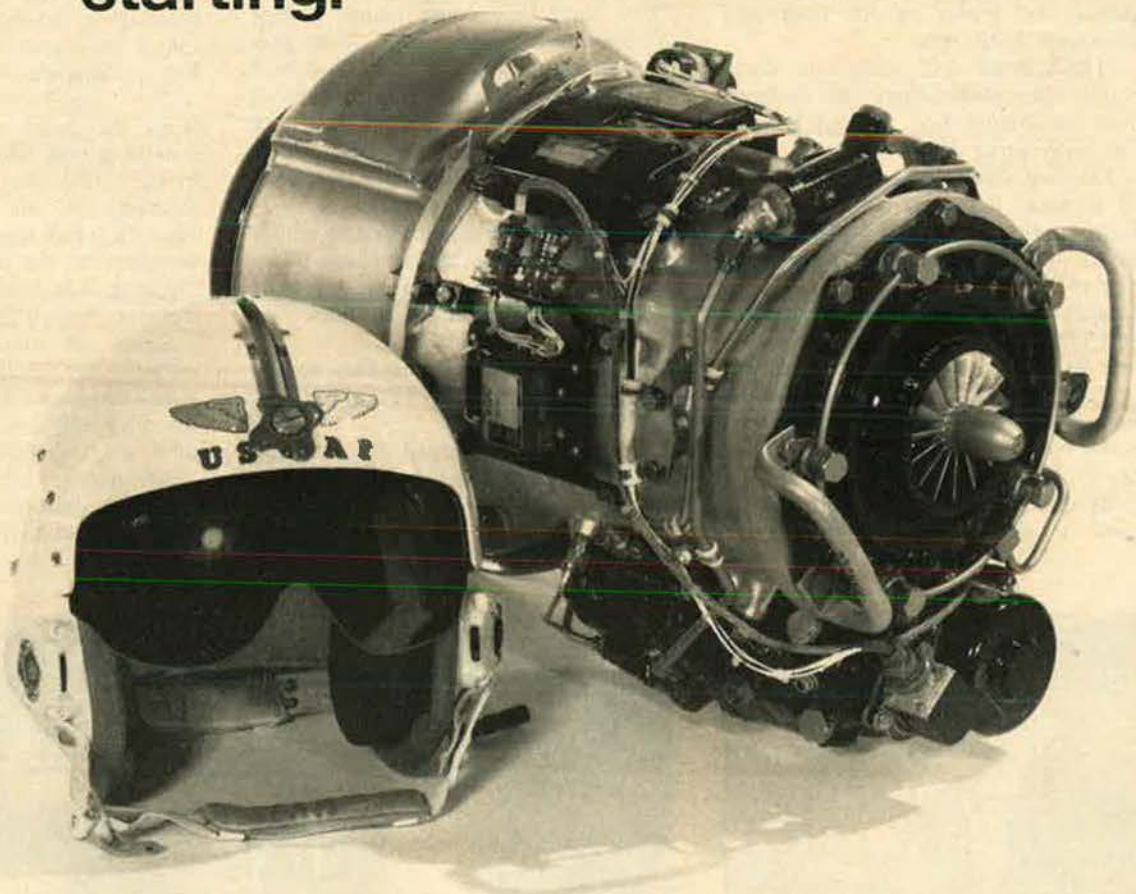
(Continued on page 25)

Tired but happy, Air Force 1st Lt. Woodrow Bergeron, Jr., steps down from the copter that rescued him from the enemy after he ejected from his disabled F-4. "I was just confident that they were going to get me out," commented the pilot about his jungle ordeal, which lasted fifty-one hours.



Maj. (Dr.) Alfred B. Watson, Jr., left, points out on an X-ray the location of a live grenade to Army WO Tommy L. Jeter, a medical evacuation helicopter pilot. The grenade was lodged in the maxillary sinus area of a VC detainee whom the two transported to a US Army hospital where an Army surgeon removed the grenade.

AiResearch jet fuel starter provides tactical aircraft with self-sufficient starting.



Self-sufficient jet engine starting used to take a cartridge for every start. But not anymore. Garrett/AiResearch has developed a self-contained, jet fuel powered, onboard system for starting jet engines again and again. We call it the Jet Fuel Starter—JFS 100. And it was flight tested on the A7D, F-101B, and is in production for the SAAB AJ37.

The JFS 100 is a small, lightweight gas turbine engine and turbine starter, which mounts directly on the engine starter pad. It burns the same fuel as the engine. And it eliminates the cost and logistics of cartridges. Jet Fuel Starters can help any tactical aircraft be self-sufficient.

The JFS 100 is a versatile machine which can also be adapted to provide continuous duty auxiliary power, in-flight emergency power, and other unique secondary power requirements. For information concerning your particular applications, write AiResearch Manufacturing Company of Arizona, 402 South 36th Street, Phoenix, Arizona 85034.

GARRETT **AiResearch**
Secondary Power Systems
one of The Signal Companies

Dr. Charles Stark Draper, right, who recently stepped down as head of MIT's famed Instrumentation Lab, is awarded USAF's Exceptional Civilian Service Medal by Air Force Secretry Seamans. In January Dr. Draper accepted a new post with the Florida Institute of Technology, located at Melbourne, Fla.

aware of the grenade and called in explosive ordnance (EOD) personnel for consultation.

Concluding that the grenade must have had time enough in flight to fuze itself, they immediately placed a call to Dr. Watson, in transit to Qui Nhon, informing him he had a human bomb on his hands.

The folks at the Army evacuation hospital were alerted. EOD specialist Army MSgt. Lee R. Miller of Healdton, Okla., and Army Lt. Col. (Dr.) Thomas H. Witschi of Wading River, N.Y., were on hand when the helicopter arrived.

A sandbag bunker put together inside an aircraft revetment became an operating room in a dramatic and hair-raising scene. While Sergeant Miller held the wounded man's head steady, Dr. Witschi, after some initial probing, used a pocketknife to enlarge the hole in the man's cheek and remove bone fragments. He gingerly pushed a finger through the perforated palate and dislodged the grenade from the maxillary sinus area without detonating it.

The detainee is reported in good condition.

☆

At the beginning, the sightings created curiosity, amusement, and excitement all around the world. But the phenomenon dragged on through the years. As with all things that last too long, it produced only boredom.

Now the Air Force has closed a thriller gone stale by terminating Project Blue Book, its investigation of unidentified flying objects (UFOs).

Secretary of the Air Force Robert C. Seamans, Jr., in a memorandum to Air Force Chief of Staff Gen. John D. Ryan, said that "the continuation of Project Blue Book cannot be justified either on the ground of national security or in the interest of science," and that further expenditures of resources were not warranted.

Over the past two decades the Air Force has investigated hundreds of UFO sightings and concluded that no evidence exists to indicate the presence of extraterrestrial vehicles or any threat to the nation's security.

After a look at Air Force's and other organizations' findings, the National Academy of Sciences concluded that "the least likely explanation of UFOs is the hypothesis of extraterrestrial visitations by intelligent beings."

Blue Book records will be retired to USAF Archives, Maxwell AFB, Ala.

☆

The Navy is steering a course toward development of a new advanced surface-to-air missile system known as Aegis.

It awarded a $253 million contract to RCA Defense Electronics Products Division to undertake engineering development of the missile.

Navy is looking toward Aegis as its major defensive missile system and plans to put it aboard the new guided-missile ships scheduled to join the fleet in this decade.

The new missile system will be designed to give naval fleets greatly increased protection into the 1980s. It is the Navy's answer to antishipping missiles since it will be able to destroy small, fast targets even under bad weather conditions or electronic countermeasures activity.

Two of the most interesting features of the new system are an electronic scanning radar able to "look" in all directions almost instantaneously, and a dual-purpose launcher that can fire rocket-propelled antisubmarine weapons as well as guided antiaircraft missiles. Navy hopes that this capability will greatly beef up its ability to protect carrier task forces and other fat targets.

(Continued on following page)

New Senior Editor for AF/SD

Col. John L. Frisbee, who retired from the Air Force in January, has joined the staff of AF/SD as Senior Editor for Plans and Policy. A native of New York state, he entered pilot training in January 1942. World War II assignments included duty as flight instructor, aide-de-camp, bomber pilot, and staff officer at SHAEF. In 1950, following two years of graduate training in international relations, Colonel Frisbee joined the USMA faculty at West Point. He later became the first head of the History Department at the Air Force Academy. In 1957, he moved to Hq. USAF as Assistant Chief, Long-Range Objectives Group. Subsequently, Colonel Frisbee served as DCS/Plans, 21st AF. In 1964, he was named Chief, Research and Analysis Division, OSAF. From 1967 to his retirement, he was assigned to the Vice Chief's office. Colonel Frisbee is a graduate of the Armed Forces Staff College and the Canadian National Defence College. He has coauthored a book on foreign governments and written for a number of periodicals. Colonel and Mrs. Frisbee live at McLean, Va., with two of their four sons, an Afghan hound, and two Great Pyrenees puppies. Mrs. Frisbee is the author of several children's books and many travel articles.

The Aegis radar and related subsystems also should be able to assist in controlling friendly aircraft and in locating targets for surface-to-air missiles. In the latter mode, a signal bounced off a target is picked up by the missile to guide it.

☆

Traditionally it is true that war and the threat of war help to accelerate scientific progress, but never before have so many discoveries by military laboratories been used to improve living conditions in the civilian world. This is not surprising, considering the large sums of money invested in military research and development.

The scope of such scientific spinoff extends from the production of better cookware to sharper and longer-lasting razor blades. This phenomenon is outlined in a six-page USAF information backgrounder entitled *US Air Force Scientific Spinoff.*

One well-known example described in the booklet is the commercial application of Air Force-pioneered flight hardware—jet engines, exotic metals, electronic equipment—without which modern commercial air fleets would be impossible.

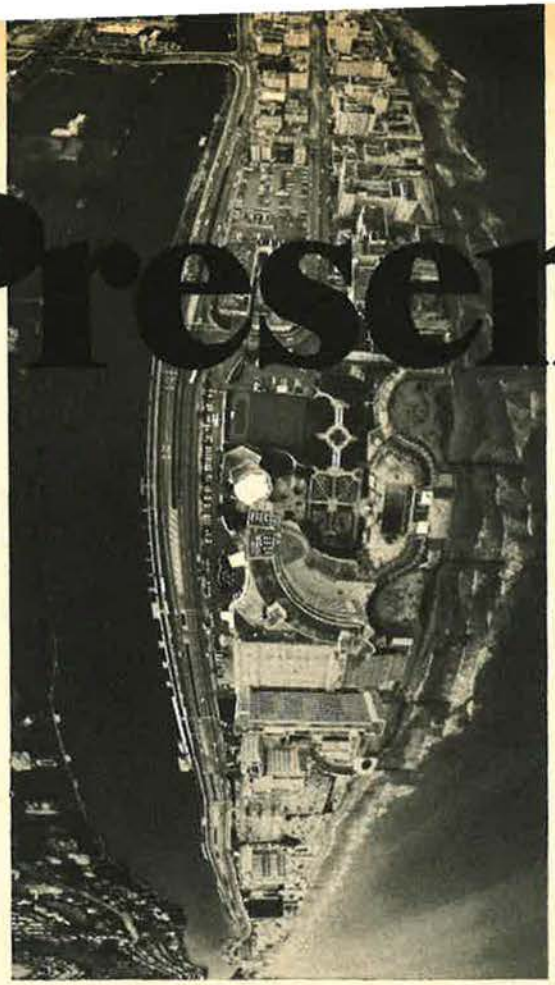
Not so apparent are the less-prominent software items—for example, those sunglasses that become increasingly opaque as sunlight brightens. And the compressed carbon lining developed for rocket propulsion fuel cases now is a boon to pipe-smokers, supposedly making pipes smoke cooler and last longer.

Even architecture has gotten a boost. Air-inflatable radomes that protect radar equipment from the weather have been applied in the construction of sprayed concrete buildings.

From surgery to tunneling operations, a whole new world is in prospect with the utilization of the laser.

(Another example, this time a spinoff of the space program, is the development of a fireproofing material, called "fluorel," that can be sprayed on to fireproof equipment against temperatures as high as 2,200 degrees. The sprayable paste offers such great potential that a major conference is being planned for late April or early May at the Houston Manned Spacecraft Center. To discuss its uses NASA, Army, and Federal Aviation Administration specialists who took part in the product's development, and organizations and individuals engaged in fire prevention will attend. For additional applications of space-

(Continued on page 28)



Aerial photo taken with a Fairchild rotating prism panoramic camera.

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An investigation into the crash of an F-111 in December near Nellis AFB, Nev., which brought about the grounding of all F-111s, has turned up the primary cause of the accident, the Air Force said. It was "structural failure of the left wing" from a "preexisting defect in the steel used in a pivot fitting where the wing joins the fuselage."

Just a few feet off the ground and the YF-12A already has begun to retract its landing gear during a takeoff. The Mach 3-plus aircarft is one of two that NASA and the Air Force are using at Edwards AFB, Calif., in evaluation flights. The trials among other things, are to provide data for such projects as development of the B-1 bomber.

program developments, see "The Giant Harvest from Space," beginning on page 30.)

One "scientific spinoff" on which the Air Force might look with misgiving was the development of frozen meals capable of being heated quickly by bomber crews on long missions. It's with us evermore—as the "TV dinner."

☆

The Departments of Commerce and Transportation announced jointly that the US will participate in the 1971 Paris Air Show.

Commerce will build, manage, and staff a US Pavilion at the show as part of its commercial exhibitions program. Transportation will coordinate an exhibition of US aircraft on the flight line at the show, now scheduled from May 27 to June 6, 1971.

The long lead time provided by this early announcement is considered necessary if US industry is to prepare properly for the show, which, since its beginning back in 1909, has grown into a major trade event for the international aerospace industry. As an example, it was estimated that at the 1969 show sixty-one US companies sold products off the floor valued at $554,000. Follow-up sales within a year were estimated at more than $26 million.

Besides the flight-line display of both civilian and military aircraft, the US Pavilion also will include a hard-sell area open only to those involved in the aerospace industry, where US products aimed at the international market, especially Europe, will be on display. In a similar area during the 1969 Paris show, two-thirds of the US participants showed their products. To serve the general public will be an industry-institutional area where the achievements of the aerospace industry and its suppliers will be on view.

More specific details concerning US participation in the show will be made available once the interested US government agencies, acting in concert with the US Embassy in Paris, have concluded arrangements with the Paris show's officials.

Also, in its effort to spur sales of US aerospace hardware and technology abroad, the Commerce Department has announced that it will participate in the Hanover Air Show in West Germany this coming spring, the first time the US government has done so. US emphasis at Hanover will be on avionics and ground-support equipment.

☆

Air Force Capt. John D. Ryan, Jr., 29, son of Air Force Chief of Staff Gen. John D. Ryan, was killed in mid-January when his F-4D Phantom crashed in San Pablo Bay on takeoff from Hamilton AFB, Calif.

His copilot, Capt. J. Travis Nelson, 29, also was killed.

The two were on a training flight from Holloman AFB, N.M., where both were stationed.

Captain Ryan leaves a wife, Martha Anne, and a two-year-old son, John D. Ryan III. His brother, Capt. Michael E. Ryan, is also stationed at Holloman.

Captain Nelson, who was unmarried, came from Cedar City, Utah, where his parents, Mr. and Mrs. James D. Nelson, reside.

☆

NEWS NOTES—Final negotiations

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to purchase twelve Hawker Siddeley **Harrier V/STOL light attack aircraft** for the **US Marine Corps** have been completed. The Marines want this type of aircraft because of its potential capability for operation from amphibious ships or forward-area sites close to ground troops ashore.

At the request of the **Libyan military government,** which seized power last September, the US has begun to dismantle **Wheelus AFB.** Some material used in Wheelus' training mission is being shifted to European bases, while talks between the two governments concerning Wheelus matters continue.

William M. Allen, chairman of the Boeing Co., was the 1969 recipient of the **Wright Brothers Memorial Trophy** for outstanding leadership in US aviation.

The Kitty Hawk Memorial Award, for "distinguished achievement in military aviation," was given to **Vice Adm. Thomas F. Connolly,** Deputy Chief of Naval Operations for Air.

National Guard pilot **Jim Moncrief** flew out in an F-102 and came back on a **surfboard.** Some surfers came to his aid off Waikiki Beach, Honolulu, when he parachuted from his flamed-out jet.

USAF pilot **Daniel "Chappie" James, Jr.,** has been promoted to **brigadier general,** the second Negro to become an Air Force general.

Dr. Ivan Selin, formerly Acting Assistant Secretary of Defense for Systems Analysis, tendered his **resignation** to DoD effective the end of January. He plans to offer professional planning, programming, and budgeting services to private and government clients.

USAF's new air-to-ground **Maverick** TV-guided missile successfully completed its first guided test flight with a **direct hit** on a target at Holloman AFB, N.M.

President Nixon redesignated **Secor D. Browne** as Chairman of the Civil Aeronautics Board for 1970, and **Whitney Gillilland** as Vice Chairman. Mr. Browne came to the CAB in October when he was appointed chairman; Mr. Gillilland has been with the Board since 1959 and assumed his present post last September.

Effective the first of this month was the merger of the Air Force Logistics Command's **Advanced Logistics System Center** with the **AFLC Comptroller.** The present commander of the ALSC, **Maj. Gen. Joseph R. DeLuca,** has been appointed Comptroller, replacing retiring **Brig. Gen. John French,** and will head the combined organization.—END

Boon to Mankind

AIR FORCE
FEBRUARY 1970

The US space investment to date is already paying handsome dividends, not only "hard" benefits of practical value but also a broad spectrum of little-understood advances in science and technology that include new techniques, processes, products, and ways of managing enterprises. These benefits are but the beginning of what can come in the years ahead in terms of capabilities that run the gamut from long-range satellite weather forecasting to spaceborne direct-broadcast television. Here is a special report, including important data on space fallout to industry, on . . .

The Giant Harvest from Space —Today and Tomorrow

BY JAMES J. HAGGERTY

"WHAT is space research doing for me?" John Jones, average American citizen, shrugs. "I was awed and thrilled by the moon landings. I had a great feeling of national pride that we, and not the Russians, had done it. But as for benefits, all I can think of offhand is international television. Maybe the moon rocks are important, but I don't understand that part of it."

John Jones's attitude typifies that of many people, but it is a myopic viewpoint. The US space investment is already paying handsome dividends, "hard" benefits of practical value as well as the little-understood gains in scientific knowledge and national prestige. The benefits include new techniques, new processes, new services, new products, even new companies formed to exploit the wealth of technological know-how accumulated in twelve years of concentrated space effort. Collectively, these innovations contribute to an improved standard of living and produce a concrete boost to the general economy running to tens of millions of dollars.

Substantial as it is, the current flow from the wellspring of space technology is only a trickle compared with the flood to come. And it is coming not in some nebulous, distant future, but *now*—within the decade just starting.

The transfer of technology from the realm of space science to the civil economy is not an overnight process; it takes years, sometimes a decade or more. Because the primary space-research thrust came with Apollo, which reached its technological peak in 1965 and 1966, a rapid acceleration of technology transfer is expected in the next few years. Space systems that promise enormous practical benefit to mankind have progressed from the theoretical to the "feasible" stage, and the National Aeronautics and Space Administration has initiated their development for near-future civil use. That these programs will get the requisite backing is clear from stated Administration policy, supported by congressional leaders, that aims to "increase utilization of space capabilities for services to man through an expanded space applications program."

Thus, the real payoff is about to begin. The evident benefits are tremendous in potential. They span a

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James J. Haggerty, author of this special report, is one of the country's leading aerospace writers. Now a prolific free-lance specialist on aviation and space, Mr. Haggerty has served on the staff of the old Collier's Magazine *and* Look Magazine, *and was for a number of years a reporter and columnist for the old* American Aviation Magazine *and* Aviation Daily. *He also wrote a regular space column for the* Journal of the Armed Forces. *He also has written extensively for encyclopedias. He is the author or coauthor of eleven books in the field of aerospace, and is editor of the* Aerospace Year Book. *He has won a number of awards for his aerospace reporting. Mr. Haggerty makes his home in Washington, D.C.*

To the man in the street, mystified by the scientific abstruseness of the lunar rocks, the spinoff value to society of the space program is often even more of a mystery, yet the "hard" benefits of the program are incalculable.

broad spectrum ranging from new levels of convenience to direct applications in the most pressing areas of global concern—food shortages in an overpopulated world, public health, air and water pollution, education, transportation safety, law enforcement, and urban development. They promise new levels of business efficiency, improved resources management, accelerated discovery of oil and minerals, and reduction of life and property losses from natural disasters.

And they offer economic returns of a very significant order. Existing estimates, admittedly conservative, warrant the prediction that, by the end of the decade, the direct economic benefits stemming from space-originated technology will far exceed the anticipated annual funding for space research.

Applications Satellites

Space benefits are grouped in two categories. "Derived" benefits are those, like new products and processes, derived from the general fund of technological knowledge. "Direct" benefits are those provided by orbiting spacecraft, or "applications" satellites, which do earth jobs better or perform tasks that cannot be accomplished by earth-based systems.

A type of spacecraft that has special utility in practical applications is the "synchronous" satellite, whose movement in space is synchronized with the earth's rotation. The satellite is directed into an orbit 22,300 miles high; at that altitude, its requisite speed is such that it remains stationary with respect to a point on the earth's surface. From its lofty perch, a single satellite can "see" approximately forty percent of the earth; three of them can cover the globe with considerable overlap.

The synchronous satellite is already in regular operational service in the global communications network operated by the sixty-nine-member International Telecommunications Satellite Consortium (Intelsat). It serves as a relay tower in the sky, picking up signals beamed from an earth station and transmitting them to another point on earth or to another satellite. Synchronous capability is now being extended to other applications satellites whose primary payloads will be a variety of earth-watching "remote sensors."

Sensor development was pioneered by the Air Force, as early as 1958, for use in surveillance and early-warning spacecraft. The technological foundation thus provided led to recent development of several types of highly sophisticated civil-use sensors, which can be used to monitor various conditions of the atmosphere, the surface, or the subsurface. Some sensors are detectors—for instance, instruments that take temperature readings of the atmosphere. Others are picture-taking devices, though not cameras in the ordinary sense; called "multispectral imagers," they photograph in both the visible and nonvisible bands of the light spectrum and show many features of the earth that the human eye cannot see. The combination of synchronous satellite and remote sensors opens up a fascinating new range of earth-surveillance capabilities, which promises concrete benefits of staggering dimensions.

The Communications Satellite

The communications satellite, or "comsat," owes its exceptional utility in long-distance message relay to the fact that, generally speaking, radio waves must travel in a straight "line-of-sight" path; they cannot bend with the curvature of the earth and, therefore, the distance that a radio signal can be transmitted through the atmosphere is sharply limited. Before the comsat came along, it was necessary to route long-distance radio signals either by cable or by means of tall relay

(*Continued on following page*)

Sensor and observational techniques that began to be developed in the late 1950s and during the 1960s in military programs such as Samos spaceborne reconnaissance are maturing and are expected to provide major capabilities for scanning the globe from space in the future.

The Giant Harvest From Space

towers, each in line-of-sight, or within about thirty miles of its neighbor. Either alternative is expensive, but the yearly cost of a satellite channel runs about one-sixth that of a circuit on a submarine cable.

The major benefit accruing from the comsat, of course, is international television. It is generally agreed that, without the comsat, overseas TV would still be a "someday" thing, because a single TV channel is equivalent to about 1,000 voice channels, and that imposes prohibitive cost and capacity considerations.

Television, however, constitutes only two percent of the Intelsat system's current workload. The broader benefit of the comsat has been in direct economic gain to world commerce, due to increased business efficiency by virtue of cheaper and more reliable long-distance communications. The comsat has also greatly increased the availability of circuits for transoceanic phone conversations. In 1963, there were only 500 such circuits and one could count on a lengthy wait for a connection. Today, the Intelsat system alone provides more than 3,000 simultaneously usable circuits; a single satellite already operational—Intelsat III—has roughly ten times the channel capacity of an in-service submarine cable.

The comsat paid an extra dividend to the US economy in stimulating the formation of Communications Satellite Corp., Intelsat's American member, which develops the space hardware and manages the global network for the consortium. Comsat Corp., a privately owned company that did not exist six years ago, now has 132,000 shareholders, total assets approaching $300 million, and annual operating revenues of about $45 million.

Impressive as are the benefits to date, the comsat has barely scraped the surface of the lode. Already in hardware development are new types of satellites that offer exciting potential for the near future.

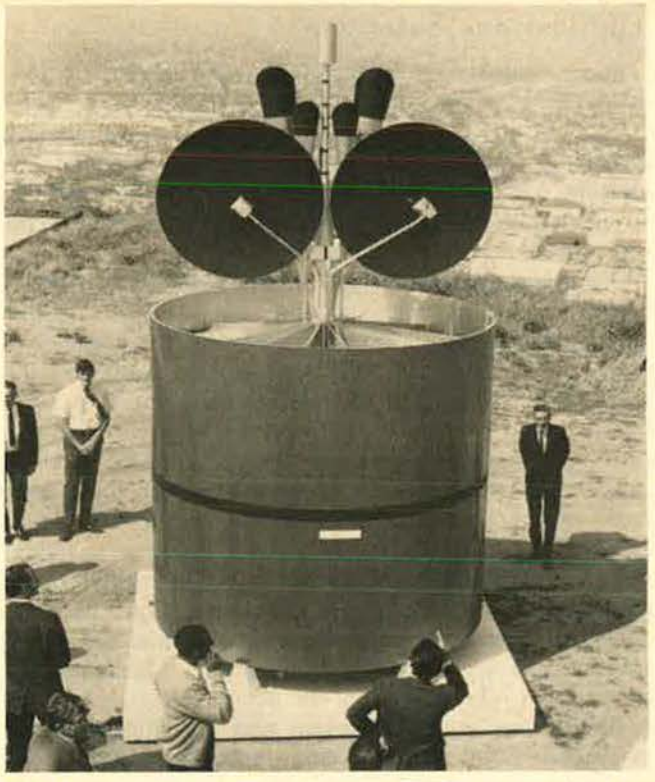
Channel capacity is the major key to further growth of the comsat network because higher capacity is directly translatable into lower costs, hence wider usage. The comsat is inherently a high-capacity system and advancing technology is widening the capacity gap between satellites and terrestrial cables. The most advanced cable, in development but not yet in service, has 720 channels. A new satellite called Intelsat IV initially will have some 6,000 two-way channels—a greater capacity than all currently operating satellites combined—and later versions may have as many as 10,000. Intelsat IV is a *now* advancement; it is already being fabricated and it is slated for regular service starting next year. Behind it, inevitably, will come even larger comsats.

Capacity of the order offered by Intelsat IV will spark a number of innovations. A probability, already proposed, is a domestic satellite system for the US, a single satellite hanging stationary over Los Angeles and linking the United States from Hawaii to the Virgin Islands. The system would supplement, not replace, the existing terrestrial system, and it would offer particular advantages to Alaska, where cities are widely dispersed and landline connections are inadequate.

Greater capacity will also stimulate increases in international TV programming, and direct-dialing phone calls to London, Hong Kong, or Tokyo may become as commonplace as the holiday long-distance call to the folks back home. And that long-awaited Buck Rogers device, the videophone, bids fair to become an everyday reality. Channel capacity has slowed its arrival, because it takes the equivalent of 100 telephone circuits to carry on a single two-way photophone conversation. But the new breed of high-capacity, low-cost comsats will bring the videophone into wide usage as a tool of international commerce. Since the videotube can carry charts, graphs, and other information presentations, as well as face-to-face long-distance conversation, it offers vast potential as a teleconference system for businessmen, capable of more than paying its way in travel expenses saved.

Some experts feel that the biggest impact of the comsat may lie neither in TV nor telephony, but in the rapid transmission of data from source to user, by linking together widely separated computers and other data-processing equipment. Such systems might have video channels, but in most cases video is not needed; the information can be sent in computer-language and teleprinted in readable form at the other end of the circuit.

A major example is transmission of management



The Intelsat IV communications satellite, shown in full-scale model that dwarfs human figures, has a greater channel capacity than all currently operating communications satellites combined. It is slated for service in 1971.

India, with its vast population of millions, is cooperating with the United States in an experimental program using space-relayed instructional television. Dr. V. A. Sarabhai of India (left) and NASA administrator, Dr. Thomas O. Paine, sign the pact. An ATS F satellite will be employed.

information—inventory and production-control data, for example—from a number of plants to a central headquarters. Another is transfer of the latest medical knowledge from research centers and great library complexes to outlying precincts where such information is not available. Services like these are not particularly new. Computer interconnection was pioneered by the military services in the 1950s, and it is now making inroads in commercial applications. But existing systems employ landline interconnections that, in most instances, are more costly. The coming generation of comsats can bring about a big boom in data transmission.

The Broadcast Satellite

From the standpoint of general benefit to the world, rather than direct economic benefit to the US, the most important project in the space communications field is a completely new type of comsat called the broadcast satellite. This is a system that can send its signal directly to the home TV set or to a community antenna, bypassing the intervening complex of ground facilities needed by the point-to-point comsat.

Existing comsats, designed with size and weight considerations in mind, operate at extremely low power levels; their small antennas can pick up only a very strong signal from a ground station, and their transmitting equipment sends only a very weak signal back to earth. This is no handicap in point-to-point communications, such as are being relayed around the world by Intelsat. Intelsat's ground complex has forty stations, which generate great power and have giant antennas, ranging in diameter from thirty to almost 100 feet, and capable of picking up the weakest transmission from space. The ground equipment amplifies the signals and directs them via landlines or microwave towers to local TV stations, whose own powerful transmitters beam the image to home TV sets.

In the broadcast satellite, a reverse technique is employed: the satellite, rather than the ground station, has the primary power source. This is accomplished by equipping the spacecraft with nuclear power, huge batteries, fuel cells such as those that supply electricity to Apollo, or with enormous "solar arrays"—banks of thousands of cells that draw energy directly from the sun. The broadcast satellite also has a very large antenna, as big as some of those on earth, and it can be sharply focused to increase signal strength.

This means that a space communications signal can be acquired by a simple, inexpensive ground station with a relatively small antenna, which can receive broadcasts directly, eliminating the necessity for the elaborate ground complex. If the satellite has enough power, the home TV can qualify as a ground station with slight modification, costing an estimated $125. An interim alternative for underdeveloped nations that have no TV is the community receiver, capable of displaying a large-screen picture in the local school, town hall, or the village elder's backyard.

Direct broadcast to the home tube can be available within the decade if demand is demonstrated. Community TV is much closer. The National Aeronautics and Space Administration is already developing the first spacecraft capable of such transmission. Called Applications Technology Satellite F (ATS F), it is a large, sun-powered craft with the biggest antenna ever designed for in-space use, a thirty-foot dish that is folded during launch and deployed automatically in orbit. In 1972, the governments of the United States and India will use ATS F in a joint space-benefit demonstration of extraordinary significance, a far-reaching experiment in satellite-relayed mass-instructional TV.

Soon after its launch in mid-1972, ATS F will be jockeyed into a stationary position over India where it can "see" the primary ground station at Ahmedabad in the west coastal state of Gujarat, several auxiliary transmitting stations, and low-cost receivers to be set up by the Indian government in some 5,000 villages. TV programs—focused initially on population control and improvement in agricultural practices—will be beamed from the ground stations to ATS F and retransmitted to hundreds of thousands of people in the receiver-equipped villages.

If the year-long experiment is successful, and there is every reason to expect that it will be, India can

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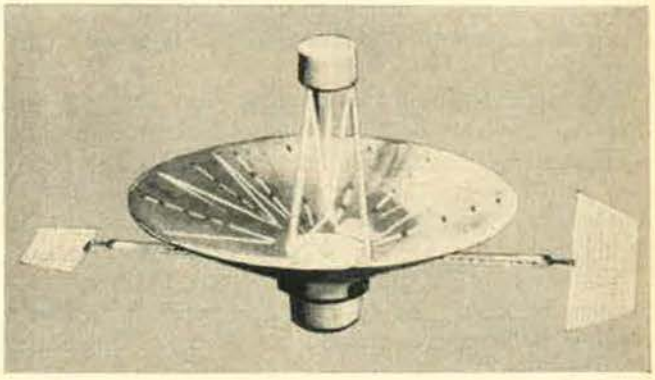

NASA is developing technology for direct broadcast television, a capability that is expected to be demonstrated in its Applications Technology Satellite F (ATS F). ATS F will deploy the largest antenna yet designed for space.

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move on to the next step, an operational, direct-broadcast system of its own. A study by one aerospace firm working on direct-broadcast satellites indicates that it is both technically and economically feasible to provide India, as early as 1974, with a single satellite capable of linking all of the nation's 560,000 villages. The potential is enormous. With a dearth of teachers and educational facilities, no interconnecting system of TV landlines and insufficient funds to build one, India can use the space satellite as an immediate instructional tool for the uplift of its 500,000,000 people.

The project has excited wide discussion in the United Nations, in other international forums, and in the executive chambers of developing nations all over the world. The low-cost aspects of direct broadcasting by satellite have implications of enormous dimensions. At a fraction of the cost and about one-tenth the time it would take to build a conventional communications network, a developing nation can acquire a nationwide communications network. The broadcast comsat can help knit a burgeoning country more closely together, speed the growth of commerce and technology, and bring entertainment to people who have known little. More importantly, it affords a direct attack on some of the world's most pressing ills through its use as an educational medium. India's planned targets, for instance—overpopulation and low yield per acre of tillable land—are examples of major problem areas susceptible to improvement by mass instruction.

The Weather Satellite

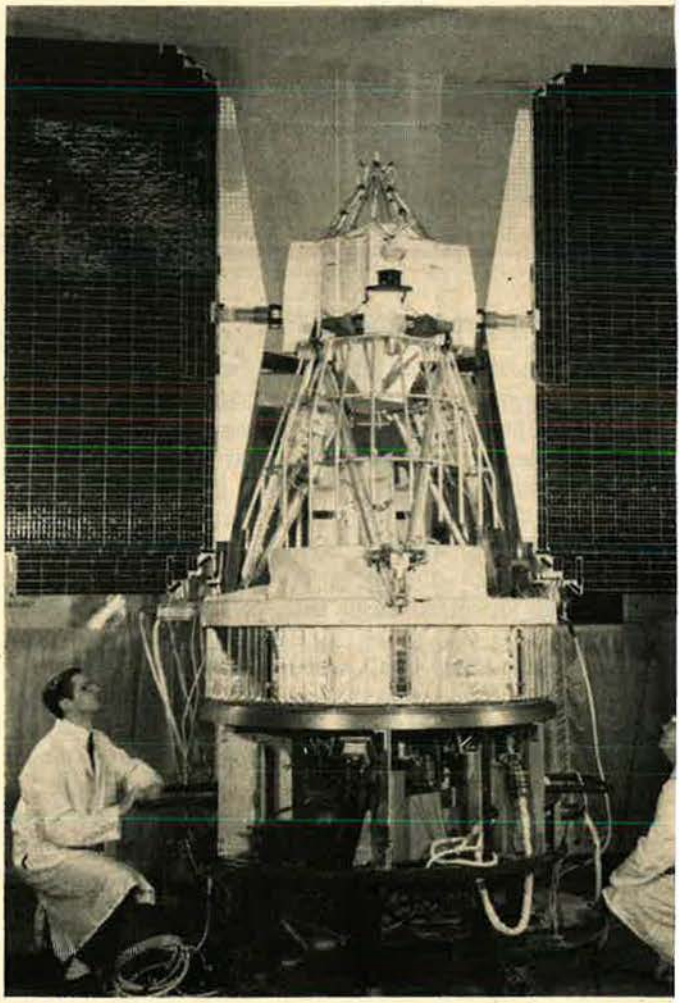
Last September, shortly after the launch of Nimbus III, NASA's most advanced meteorological satellite, there occurred an incident that received scant attention from the news media but had space scientists turning cartwheels. Orbiting 600 miles above Kingston, Jamaica, Nimbus III relayed to earth a complete "profile" of the temperatures at every altitude from the ground up to the top of the atmosphere. Later comparison showed the readings to be completely accurate; the profile coincided almost identically with one taken by a balloon launched from Kingston at the same time.

The achievement may not sound like much to the layman, who might think that temperature-reading equipment is standard on all weather satellites. It is not; until Nimbus III, the informational capability of the weather satellite, or "metsat," was confined to photographic coverage of the earth's cloud cover.

Nimbus III's accomplishment represented a very important breakthrough in metsat development. Made possible by a new instrument called SIRS (for Satellite Infrared Spectrometer), it pioneered a technique known as "vertical sounding," in which highly sophisticated sensors in the satellite measure the various conditions in the atmosphere that contribute to changes in the weather. These sensors, coupled with other metsat technological advances and concomitant improvement in the ground-based weather-analysis system, hold the key to accurate weather predictions two weeks or more in advance. Obviously, long-range weather forecasting is potentially one of the most productive areas for harvesting benefits from space technology.

The weather satellite system that the Environmental Science Services Administration (ESSA) has been operating for the past four years has proved the value of the metsat. The thousands of cloud-cover photographs being transmitted daily by ESSA's eight satellites have contributed substantially to upgrading the professional dignity of the weatherman, long the butt of the jokester. When the weatherman says "zero probability of rain tomorrow," it's pretty safe to get out the golf clubs; the metsat has made possible an accurate increase in predictions for up to forty-eight hours.

The satellite's most important utility has been in provision of storm warnings. From its vantage point in space, it can detect the buildup of a destructive storm, track it, estimate its force, and predict when and where it will strike inhabited areas. Metsat warnings have cheated many a hurricane or typhoon of its anticipated toll of casualties.



Nimbus-III, NASA's most advanced weather satellite, which has produced the "first" of a complete "profile" of temperatures from the ground up to the top of the atmosphere, will someday be considered primitive by weather experts, who are already thinking about climate control.

But the capability of the existing metsat system is limited. The satellites operate in relatively low-altitude orbits, circling the earth every two hours or so. In that way, they can photograph most of the earth in a twenty-four-hour period, but they observe no given area continually, as would be possible with a stationary satellite. Although cloud-cover photos are a valuable addition to the meteorologist's data file, they are just that—a supplement to conventional methods of gathering atmospheric data, rather than a primary system.

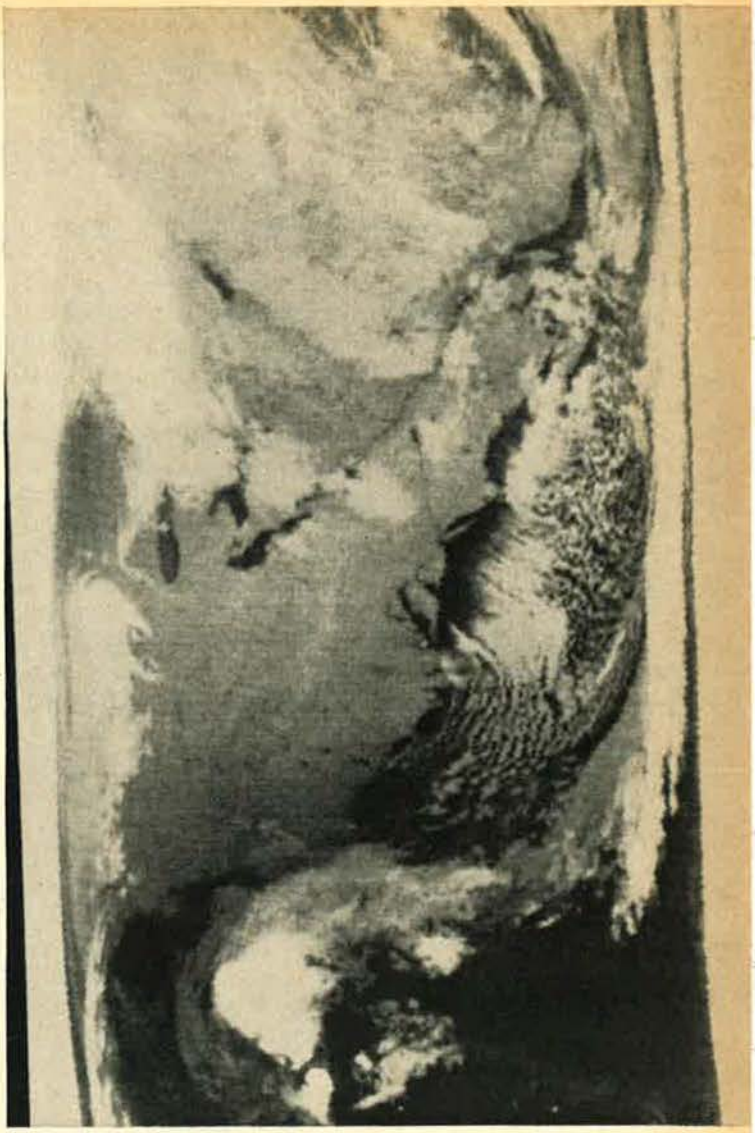
Reliable forecasts need more than cloud-cover input. The source of the earth's weather is energy radiated from the sun, which penetrates the atmosphere and triggers a variety of changing conditions. The primary clues to the distribution of solar energy, hence the type of weather that can be expected, are temperature, pressure, the movement of air masses, and the moisture content of the air. Such information is currently obtained from aircraft, ships, rockets, balloons, ocean buoys, radars, and visual observations from the ground. There are some 7,000 stations reporting the data, but even so they cover only one-fifth of the earth's surface and reports are periodic rather than continuous.

What is needed for a global, long-range weather-forecasting system? First, atmospheric measurements over the *entire* earth, by means of satellites equipped with vertical sounding sensors capable of providing all the data now acquired by other means. The space system will probably include low-altitude satellites for certain applications, but the main workload will fall to a network of synchronous, stationary metsats that can relay simultaneous and continuous information.

But the satellite segment of the system is "only one leg of the stool," as one space scientist puts it. The satellite simply acquires information; the information must be put to work by people. It must be collected from the satellites, transmitted to regional receiving stations, analyzed, translated into usable form, and delivered to weathermen all over the globe. This demands a system of interconnected, computerized data-transmission facilities far beyond anything in existence today.

An even more important requirement is what scientists call a mathematical model. This is a computerized numerical representation of the composition of the atmosphere, a basic reference point for determining what the weather will be like under a given set of conditions. One might think that in an explosive scientific era that has witnessed landings on the moon such a model already exists. But weather is a complex subject, and there are still major knowledge gaps to be filled.

Important steps are being taken toward realization of both the mathematical model and the worldwide data-relay system. More than 100 members of the World Meteorological Organization are pooling their resources in two massive projects called the World Weather Watch and the Global Atmospheric Research Program (GARP). The Weather Watch is an operational surveillance system, the major aim of which is the establishment of a worldwide, computerized telecommunications network for transmitting and processing meteorological data. GARP is an extremely broad research program from which scientists hope to attain a level of understanding of the dynamic processes of the atmosphere sufficient to develop the long-sought model.



From 700 miles above the earth, Nimbus III, observing the eastern seaboard of the United States, was able to take the best infrared shot ever made by a metsat, discerning the Great Lakes, rivers, and other features from Canada all the way down to Florida in one great scanning.

The pacing factor in two-week-plus weather forecasting is development of the requisite sensory devices. The outlook is promising. A variety of atmospheric sensors, based on photographic, infrared, microwave, radar, and laser principles, is already in or approaching flight status, and NASA will space-test them over the next few years with its Nimbus and Applications Technology Satellites. In addition, ESSA expects to have a degree of vertical sounding capability in its new generation of operational satellites, and the Agency plans to have stationary metsats in orbit by 1972. It seems very likely that the mid-1970s will bring forth the synchronous metsat with a full range of sensors and that at least a prototype of the global, long-range forecasting system—satellites and

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earth components—will become a reality by the end of the decade.

When such a system becomes fully operational, it can provide staggering benefits. Since everybody is a weather expert, one can conjure up his own vision of a world in which the weather is known two weeks, three weeks, even a month in advance. Some major examples of the advantages include better planning for all forms of transportation, particularly aviation; reduced loss of crops from weather changes; reduction of flood and storm damage; optimum scheduling of work force, machinery, and materials delivery at construction sites; and better management of public utilities through advance knowledge of load requirements and efficient scheduling of maintenance operations.

Among the broadest benefits, aside from general public convenience, are savings of life and property, a substantial gain in worldwide crop yield at a time when population expansion threatens the world food supply, and hard economic returns of tremendous scope.

Because of the myriad factors involved in a subject so broad, it is very difficult to make precise dollar-benefit estimates. There is, however, a generally accepted yardstick, an estimate made by a study panel of the National Academy of Sciences' National Research Council, which rated economic benefits of a long-range forecasting system at $2.5 billion a year. The figure, the Academy admits, is conservative, and it is for the United States alone. Further, it covers only the four broadest and most visible areas of benefit—agriculture, construction, transportation, and flood/storm control. There are hundreds of others—on-location motion-picture filming and programming outdoor sports events, to mention only a couple—whose individual dollar savings are less impressive but whose aggregate might run to additional billions. Applying even the most conservative estimates, the yearly economic return of the global system is potentially several times the amount of all the money expended on metsat research and operation since the first such "working" satellite went aloft in April 1960.

And, once the system is fully operational, man will be able to realize one of his oldest and fondest dreams —to "do something about the weather." With current and foreseeable advances in the art of weather modification, abetted by the vast encyclopedia of atmospheric knowledge provided by the mathematical model and the metsat reporting system, it appears not only possible but probable that weather conditions can be altered. Scientists feel that it will be possible to change the timing, amount, and distribution of rainfall; to take the sting out of destructive storms by reducing their intensity or directing them into harmless paths; to suppress hail and lightning; to clear fog; to prevent frost; even—though it is farther down the road—to effect large-scale changes of climate.

Crucial to the development of really meaningful weather forecasts—two-week forecasts—and someday, a measure of weather control, is a useful mathematical model of the world weather system, a truly global view of the weather.

Fantastic? Today it seems so. But what was more fantastic, only a decade ago, than the wild talk about landing men on the moon?

Navigation/Traffic Control Satellite

Another area in which the satellite offers great promise is in precision navigation and traffic control for aircraft and surface vessels.

Since 1964, the Navy has been demonstrating the utility of the navsat with an operational system used to pinpoint the location of fleet ballistic-missile (FBM) submarines. Before the advent of the navsat, the Navy frequently experienced navigational errors of two to three miles in good weather, and as much as fifty miles in bad weather. The network of navigational satellites makes possible position "fixes" with errors as small as the length of a submarine.

The Navy navsat, however, is oriented toward position determination for the individual boat rather than surveillance of a large number of craft, so it cannot be readily adapted to civil use. Using the Navy's experience as a departure point, civil agencies are working toward development of a combined navigation/traffic control system for both marine and aviation employment. It has sweeping potential for benefits in safety and in economic return.

The proposed system envisions a pair of stationary satellites over each of the oceans. Each satellite, its location in space known precisely, becomes in effect an artificial star, a reference point for fixing aircraft and ship positions. In operation, each of the two satellites sends a continuous radio beam which is picked up

by a receiver in a "mobile"—the term used to embrace both planes and ships—and triggered back to the satellites. Computer translation of the time it takes the signal to travel from mobile to satellite gives the exact distance between them, hence a line of position. The point at which position lines from the two satellites intersect is an exact fix, available simultaneously to the mobile's navigator and to the land-based traffic control center to which the information is relayed by the satellite.

Although it may someday be applicable, the navsat is not now a panacea for the problem of air traffic control in high-density areas. It can, however, be of significant value in overwater air movement, where there are no watchful radars along the flight path and where existing earth-based, long-range radio navigation aids do not provide the degree of precision needed for efficient air traffic control. The situation over the North Atlantic, the most heavily traveled overwater route, serves as an illustration of navsat benefits.

Because of navigational shortcomings, traffic control regulations demand a 120-mile lateral separation of aircraft as an anticollision measure. This means that, when a number of planes depart a terminal within minutes of each other, only one of them can take the direct, shortest-distance-between-two-points route. The second must move out 120 miles to one side of the direct course; the third, 120 miles to the other. The fourth and fifth airplanes must fly 240 miles off course, and so on.

For several years the Navy has operated a navigation satellite system originally called Transit, which in itself is not readily transferable to civil use but which offers a departure point for development of more versatile systems.

With the advent of such superjets as the Boeing 747, shown in an early test flight, there will be a need for putting satellite technology to work in air traffic control and as a navigation aid, especially over the North Atlantic.

Aside from longer travel time for the passenger, such directional inefficiency costs the airlines in increased fuel expenditure. It is estimated that extra costs run from $30,000 to $50,000 per year per airplane, which amounts to a very substantial figure for airlines operating large fleets. The satellite system can reduce required lateral separation to thirty miles at a dollar savings for the North Atlantic alone estimated at close to $20 million a year.

The new breed of airliners, like the Boeing 747, will have very accurate onboard navigational equipment, an inertial navigation system that is a direct spinoff from Apollo. This is not, however, a substitute for the navsat; effective traffic control demands an independent ground-monitored system to confirm the onboard position determination.

The navsat may find even greater utility in the field of surface shipping. There are some 3,000 ships of more than sixty countries reporting to the existing traffic control system and probably a greater number of nonreporting smaller craft, such as deep-water yachts and fishing boats. Ship traffic control is relatively new; it is subject to the vagaries of long-range radio transmission; position reports are not mandatory and those that are made frequently are suspect because only the largest and most modern ships have adequate all-weather navigational equipment.

Collision avoidance is, of course, the primary advantage of the navsat system, but there are other benefits, due to the fact that the navsat also doubles as a communications satellite, permitting voice linkage between ship and shore. This allows the transmission of up-to-the-minute regional-weather advisories so that ships can steer clear of storms. It also offers more reliable, lower-cost direct contact between company offices and ships anywhere in the world.

There are no concrete estimates as to the economic potential of the navsat as regards surface shipping, but it is clear that they are of a substantial order. Precision navigation is, in itself, a money-saver in fuel costs and reduced time at sea. Direct home-office-to-ship contact offers wider flexibility in scheduling and routing, an important factor in merchant shipping. And the prevention of even a minor collision offers corollary savings far beyond the cost of damages. Take, for example, the oil-shipping industry, where efficient operation entails tight coordination of ship dockings and oil flow. The removal of a single ship from service can cause a temporary shutdown of an oil field with losses running to a million dollars a day.

The real benefit of the navsat system, for both ships and aircraft, is in human safety, not only in collision avoidance but in post-accident rescue. All too frequently search-and-rescue craft experience delays—or complete failure—in their efforts to find a downed aircraft or a distressed ship, because the last known posi-

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The Giant Harvest From Space

This is an artist's conception from NASA of how a navigation satellite system might help to provide search and rescue agencies with precise locations of ships in distress. Such satellites might be used to track sea-life migration.

tion reported was miles from the real location. Through continuous monitoring, the traffic control centers will know the precise position of any troubled craft, eliminating the search period of a rescue mission wherein time is literally a life-or-death factor.

A major part of the effort needed to bring this important system into being involves development of onboard equipment cheap enough to be available to the smallest ocean-going craft. Fortunately, the mobile will not need elaborate and costly computers, since the computing function will be handled by the satellites and the land stations. Ships and planes need only a new-type receiver and antenna and a signal booster capable of reaching the satellite, orbiting some 22,000 miles high. It appears quite feasible to produce such equipment at relatively low cost.

Technology for the civil-use navsat is well advanced. With the Applications Technology Satellites I and III, NASA and a number of airlines have been conducting satellite-to-aircraft tests for several years, and the results have demonstrated the workability of the system. NASA and the Federal Aviation Administration are developing plans for the prototype, one-ocean air-traffic-control system, and the European Space Research Organization has expressed interest in joining the experiment. No major breakthroughs are required, and it is generally accepted that an operational system, for ships as well as aircraft, can be put in service by 1975.

Earth-Resources Satellites

Perhaps the greatest potential for realizing hard economic returns from applications spacecraft lies in earth-resources surveys, or keeping satellite watch on the globe's natural resources with the aim of better managing nature's bounty. This program can alleviate many of the world's paramount ailments, in that it can help to produce more arable land, more water, food, clothing, shelter, and fuel to meet the needs of a population that is growing at an alarming rate.

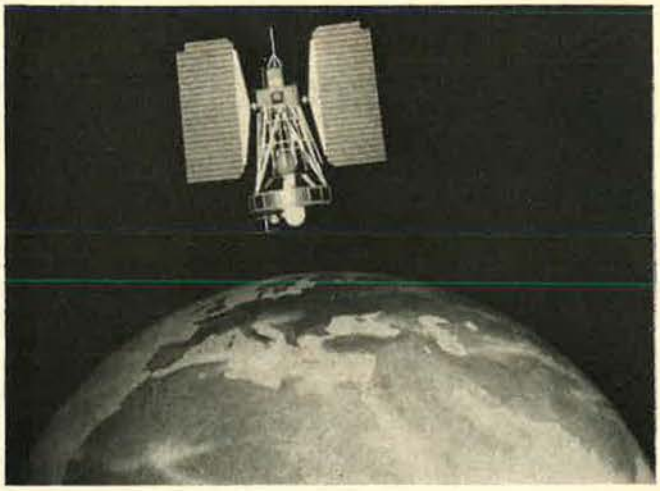
Like the advanced weather satellite, a close relative, the earth-resources survey spacecraft reaps its harvest of benefits by means of remote sensing devices. Generally, earth-resources sensors focus on the earth's surface and subsurface rather than on its atmosphere. An example is a crop-imaging sensor, designed to take advantage of the fact that various types of vegetation reflect light in different bands of the spectrum and in different degrees. This makes it possible to program an imager to "see" one particular kind of vegetation—wheat, for instance. From either a stationary or a "moving" orbit, the sensor can take a picture of a large region in which the total wheat crop is imaged in a given color. This provides the basis for predicting crop yield and planning its distribution, important factors in agricultural management.

The sensor provides an extra bonus in reducing crop losses, because the image would also pinpoint areas where the wheat crop is threatened. A slightly different coloration would indicate plant disease, and it would show up sooner because of constant surveillance. As is the case in human physiology, disease detected early can most readily be treated.

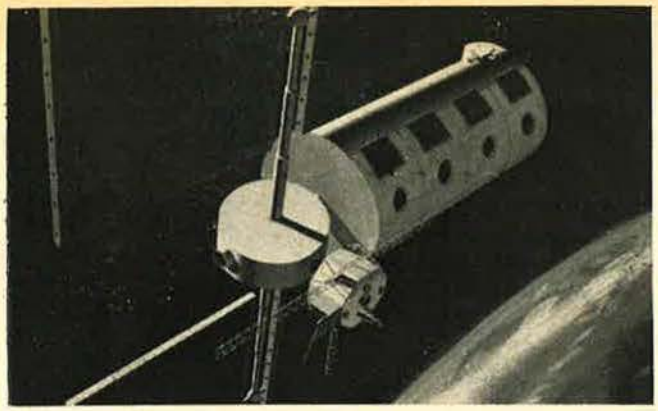
The information provided by the satellite's battery of sensors will be relayed to an earth-based, computerized data-handling and analysis network like that being developed for the global metsat system, perhaps the same one expanded to accommodate the additional input. Thus, regional data banks all over the world will receive daily volumes of information that can be put to work for man's benefit in three basic directions: The information will provide more of everything through far better management of the world's resources; it will uncover new resources; and it will identify trouble zones for earliest remedial action.

Here are some examples of what this information would mean to the world:

- In agriculture, besides controlling losses, it would



Earth-Resources Satellite, monitoring the planet, could bring in a huge harvest of data, using multispectral sensors, which could allow better resource management. This is an artist's conception of a General Electric ERS idea.



Although the current emphasis is on unmanned Earth-Resources Satellites, NASA has studied manned approaches too. This is how a module designed for hookup to a manned space station might look when such stations become reality.

facilitate national land-use planning—what to plant and when, where to build roads for movement of harvests, where to locate irrigation works, and a variety of other management considerations. Good land management is vital to agricultural output, as is evident in the high-yield nations of North America and Europe, each of which already has some sort of information-reporting system. Even for these countries, the earth-resources system offers a vast improvement in efficiency because of the rapidity with which the information can be obtained as contrasted with existing methods. But the real potential of the system lies in upgrading the management capability of the underdeveloped nations of Africa, Asia, and South America, many of which have never surveyed their land resources.

- In hydrology, the earth-resource system would detect water-pollution trends, provide a complete inventory of lake and reservoir levels, show rainfall and snow levels, allow quicker prediction of potential floods, and locate freshwater reserves in underground springs and streams, which collectively are believed to hold thousands of times more water than all the rivers.
- In oceanography, it would benefit the fishing industry by accurate location of fish schools, aid maritime commerce by better charting of sea conditions and wave profiles, and spot ice fields for iceberg warnings.
- In geology, it would allow continuous monitoring of glaciers and volcanoes, improve earthquake prediction and warning, and, most importantly, identify terrain features associated with oil and mineral deposits, particularly in those remote areas not explored by aircraft.
- In geography, it would produce a constantly updated "living" map, showing population densities and spread trends for use in urban development and transportation planning.

These are but a few of the more visible potential benefits. Experts have identified a great many more, and experience with the system undoubtedly will open up broad new ranges of application not yet considered. One space scientist sums it up with the statement that the earth-resources satellite system is applicable to "all the conditions of the earth's surface that are of economic or cultural interest to humanity."

What is such a system worth? Clearly, a subject so broad does not readily lend itself to accurate appraisal, and many of the benefits are humanitarian rather than economic. There is one study that serves as an indicator of the enormous scope of the potential benefits. NASA investigated agricultural losses in the United States and calculated that an earth-resources survey could reduce them by ten percent, an extremely modest gain. The resulting estimates showed savings approaching $400 million a year in reduced crop losses; increased meat output valued at $350 million annually due to early detection and correction of nutrient-deficient rangeland; and $100 million a year in agricultural land saved from floods.

From these guidelines, which embrace only a single area of benefit in a single country, even the most conservative assessor must assign to a global system an economic value running to billions of dollars a year.

Experience with the worldwide communications and weather satellite networks shows that the nations of the world are ready to band together to reap the advantages of space technology, but conclusion of the necessary international agreements leaves open the question of when the global system can become an operational reality.

The technology is now or soon to be available. NASA has already signaled the go-ahead for the first Earth Resources Technology Satellites (ERTS), experimental models whose assignment will be the evaluation of certain types of resources-monitoring sensors and other data-collection equipment. Design contracts for the ERTS were awarded last October, hardware

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—Wide World Photos

What many people don't understand, when they complain about the cost of the Apollo program, is that out of the program emerged a "new order of technology," which compressed several decades of technical advancement into just one, making possible previously undreamed-of boons.

The Giant Harvest From Space

fabrication will begin this year, and the first ERTS will be sent into orbit in 1972.

Although ERTS is purely a developmental program, it will have a limited operational capability. It will produce a land-use map of the United States, classify surface geological features as an aid to mineral exploration, identify soil features for agricultural purposes, and collect information from unmanned earth-based devices, such as river gauges. The ERTS spacecraft will provide the developmental base for an operational earth-resources survey system, which, technically speaking, is a "within the decade" probability.

Derived Benefits

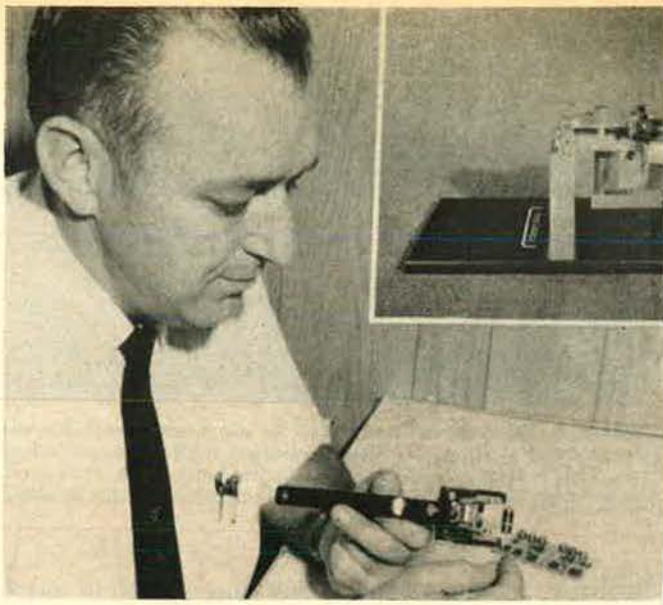
Less dramatic, less sweeping, not as easily understood, and in some cases practically unknown are space benefits of the "derived" category, those that stem from general technological advances rather than from the application of satellites to earth uses. The primary source of this class of benefits is the Apollo program, the broadest and most rapidly progressive technological undertaking ever attempted by man.

So extraordinary were the demands for performance and reliability needed to land men on the moon that the Apollo team had to create an entirely new order of technology and to compress several decades of normal technological gain into less than one. Advances in aerospace technology were not, by themselves, sufficient for the task; it became necessary to force progress in virtually every scientific and technological discipline.

The results of this monumental effort reach far beyond the ability to build better aerospace vehicles. The knowledge acquired affects many channels of man's way of life; its yield embraces thousands of new ideas, inventions, materials, and processes for the betterment of human existence.

On an ever-accelerating scale, the vast library of know-how is being put to work. Through its Technology Utilization Program, NASA is working hard to achieve maximum return on the space investment by transferring the know-how to nonaerospace applications.

The space agency is not simply waiting and hoping for technology transfers. It is actively pushing them by means of a well-managed program operated on a minimal budget. Specialists at field installations and in the plants of contractors scrutinize every research and development project, trying to find new applications, and report their "possibles" to the space agency's headquarters. Working with independent research institutes, the technology utilization staff sorts out the "possibles" and the "probables" and disseminates information on the latter to almost 7,000,000 potential users. So far NASA has identified some 2,800 probables, and about a third of those have already found their way into the civil economy.



New processes, new tools, new techniques—all these have enhanced American industry as a product, direct and indirect, of the space program. This is a wire-lead-bending tool developed by NASA. A commercial version followed.

Most familiar are the new products coming into the market. The list is far too lengthy to recount more than a random sampling: A hand-size, battery-operated TV camera, used to photograph rocket-stage separation, is being used to monitor industrial processes; spacecraft-coating research produced an ultra-long-wearing paint for home use; a device employed to find space capsules in the oceans, the "underseas pinger," has new employment in the plotting of ocean currents and in tracing the movements of fish schools.

The medical profession has been a particular beneficiary of technology transfer. For example, a lunar-gravity training device has become a tool for teaching crippled persons to walk again; a tiny space-sensor, so small it can be inserted into an artery without discomfort, has been adapted to medical use; a plastic-metallic spray for attaching heart electrodes to pilots makes it possible to radio ahead to a hospital an electrocardiogram of an ambulance patient.

Among the larger direct economic benefits of technology transfer are a great variety of new tools and processes that are bringing new efficiency to American industry. Examples: An electromagnetic hammer, invented for launch-vehicle construction, causes metal to flow like soft plastic, so that it can be smoothed and shaped without weakening; an electron beam devised for spacecraft construction can accomplish on one welding pass what might take fifty to 100 passes by earlier methods.

Still another area of transfer is new materials. An extremely thin, high-strength aluminum foil, a requirement for an unmanned satellite, is employed in packaging sensitive pharmaceuticals; pyroceram, developed for radar tracking domes, has brought increased durability for kitchen utensils; Apollo's spray-on foam heat-shielding has application as a home insulator.

For each of these examples, there are multiscore others. Some of them amount to little more than a

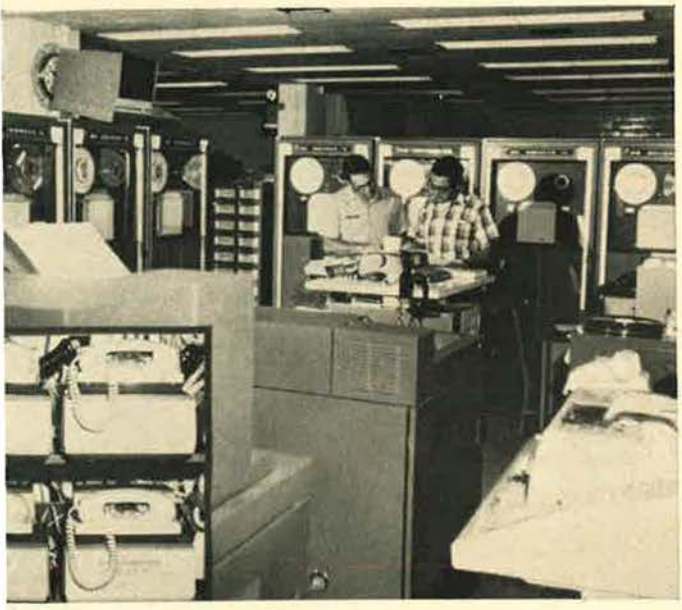
small increment of added convenience, but others represent economic benefits of a very substantial order, and in many instances new companies have been formed solely for their exploitation.

Data Banks

Taking the process of technology transfer a step further, NASA has set up six Regional Dissemination Centers, operated by universities and research institutes, to serve fee-paying industrial clients. NASA calls the Centers "knowledge brokers." Their stock in trade is a vast warehouse of some 750,000 technical documents whose contents have been abstracted, categorized, and computerized for ready access; NASA's own input is backed by reports from the Department of Defense and the Atomic Energy Commission.

Updated every two weeks, these great data banks contain the latest scientific lore in all of the many disciplines that space research encompasses. They are information gold mines to businessmen exploring new markets, looking for answers to operating problems, or simply seeking to keep their technical personnel abreast of developments in their fields. The system works this way:

A client is provided a librarian, to whom he spells out his needs. The librarian, an engineer or scientist skilled in the client's field of interest, prepares a computer query, narrowing as closely as possible the area the machine must search. The electronic search produces the titles of perhaps 150 technical reports that seem applicable. The librarian discards most of them, selects a score or more that seem most pertinent, and asks for brief summaries of the reports. The automated system provides printed briefs, or single-page abstracts, which the librarian digests and weeds out. The remainder are given the client, who may then order the complete reports.



Data banks, using computers to manage the vast store of information on new technology developed in the US space effort, are helping serve American industry in NASA's cooperative Technology Utilization Program.

A single search may cost $150 and bring a hundredfold return to the client. For example, a textile manufacturer in North Carolina, skeptical of any relationship between his own business and the exotic research being conducted in space, was persuaded to give the system a try. He went to the Center in his area and presented the librarian a quality-control problem. The old equipment he was using could not maintain desired yarn consistency—output varied from too thick to too thin. Was there a solution short of replacing the equipment? The computer search turned up details of an infrared scanner that could be adopted to keep an electronic eye on yarn thickness and warning when it slipped out of tolerance. It is now in service.

The proper information usually gives a client's own technologists a line of approach toward solving the problem but, where information is not enough, the Center goes a step further and locates, in its computerized file, the most authoritative consultant for a given task. Example: A California company specializing in products for the oil-drilling industry came up with a design for a tool long sought by drillers, a device that could monitor the direction of the bore and warn of deviation from the desired path. Key to the design was an accelerometer, or motion-sensor. However, prototype construction was snagged because the company's engineers could not find on the regular market an accelerometer capable of withstanding the broad temperature range and sharp jolts it would have to take in its drillhead mounting. The company's president went to the application Center where a computer search turned up a specialist in small, superdurable accelerometers. He solved the problem, and the monitoring device is now in pilot production.

Many firms subscribe to the service on a yearly basis, seeking a competitive edge by keeping their technical personnel up to the minute. For one large company, a Center screened 63,000 abstracts in a six-month period, submitting 4,500 as "possibly pertinent" to the company's interests. The company's own technologists selected 153 of them for follow-up investigation. Impressed by the results, the firm has appointed its own technology utilization manager to provide liaison between the data bank and its research engineers.

NASA can't afford the machinery needed to trace every transfer and estimate direct economic benefits, but reports filtering in from beneficiaries indicate it is of a very substantial order. One major research and development organization credits data-bank service with savings of $1 million a year. Few reports are that impressive, but a thumbnail poll of fourteen companies during one quarter of 1969 showed that, as a direct result of Center services, five companies had sales increases totaling $1 million, five effected production-cost savings amounting to $20,000, and four had labor savings totaling 1,000 man-hours.

By themselves, such gains don't seem very significant, but the Centers are now serving some 700 customers, and the list of regular clients is growing at the rate of twenty to twenty-five percent annually. The oldest Center, with fees of almost $300,000 in 1969, has virtually reached the self-sufficient stage, and others

(*Continued on following page*)

The Giant Harvest From Space

are approaching that level. When fees exceed the costs of maintaining the service, client charges will be reduced, increasing the attractiveness of the service and expanding its breadth. The biggest problem is spreading the word of the tremendous national resources stored in the data banks; many potential beneficiaries either are unaware that the service exists or believe, like the textile manufacturer, that space research is too remote from their operations to produce any concrete gains.

Software for Business

In this age of the computer, more and more business firms are automating their operations for increased efficiency in everything from complex machining to simple accounting. Time-sharing plans make the computer itself available even to very small companies at modest costs, but a larger cost factor is developing a computer program for a specific application. Space spinoff is helping industry to reach new levels of efficiency at low cost, by making available programs that can be adapted to a wide variety of business uses. In the course of twelve years of space research, NASA has developed thousands of programs, which are simply taped sequences of instructions telling a computer how to solve a problem or produce desired information from its stored input. Usually, a program can be converted from one computer "language" to another, or from one machine to another. Many of NASA's programs are too esoteric for general use, but a surprising number can be adapted to everyday business purposes.

At the University of Georgia, NASA has established the Computer Software and Management Information Center (COSMIC) for the benefit of the business community. From field installations, NASA contractors, DoD, AEC, and university research laboratories, COSMIC gets a continual flow of computer programs which are reviewed for their adaptability to uses other than those for which they were designed. The Center now has an inventory of about 1,000 such programs, and NASA issues a quarterly bulletin stating the types available.

The broad utility of space-developed software is illustrated by the example of a program used in the design phase of the rocket engine that powers the upper stages of the Saturn V launch vehicle. Engineers at Bonneville Dam employed the same basic program in their design of control circuitry. General Foods used it for food-preparation research. The University of North Carolina adapted it to public health studies. With modifications for their specific needs, more than 300 American businesses found a use for this one program.

So far COSMIC has disseminated some 20,000 software items, a munificent benefit to industry since NASA deliberately keeps the costs low to attract broadest interest. Prices run from $125 to about $1,200 per program and NASA estimates that a COSMIC customer can get a software package for from one-half to one-tenth what it would cost him to develop a similar program from scratch. COSMIC is still in its infancy—it was started in 1966—but early results indicate it may become one of the really big areas of return on the space investment.

Biomedical Application Teams

NASA's manned space programs, particularly Apollo, demanded a great deal of research in the biosciences. This, together with other areas of intense developmental effort—such as microminiaturization, instrumentation, and telemetry—made the world of medicine a natural prime beneficiary of space spinoff. Noting that medical systems constituted an exceptionally high percentage of the new products and techniques being transferred to the public economy, NASA concluded that medical research offered a particularly fruitful field for a more sharply focused thrust. As an adjunct to the continuing business of promoting product transfer, the space agency launched an assault on specific problems of medical research, on the premise that space knowledge and expertise might offer lines of solution where none existed otherwise.

At independent research institutes, NASA organized three Biomedical Application Teams (BATs). Each team is composed of a mix of space technologists and medical men, and it is "multidisciplinary" in nature,

A computer software program that was used in the design phase of the Saturn V launch vehicle's upper stages was adapted for the design of control circuitry for the giant Bonneville Dam. The same software has been adapted, according to NASA, for different purposes, by some 300 American firms. The COSMIC program in which this happened is only three years old.

meaning that a BAT is composed of a number of skilled specialists—physicians, surgeons, biologists, physicists, mechanical engineers, electronics engineers, information scientists, and so forth. Working with university medical centers and other medical research groups, the BATmen seek first to identify problems that appear susceptible to space-technology application. They prepare "medical problems abstracts," which are used to search NASA's data banks for relevant technology and for existing expertise in the problem area. The experts thus located are then invited to join the attack on the problem.

As an example, a medical researcher at Duke University Medical Center developed a technique for more precise monitoring of human heart action by measuring electrical signals simultaneously at fifteen points of the heart wall. The problem was how to ensure good electrical contact at so many points without damaging the heart wall in the process of insertion. The BAT in the researcher's zone, operated by Research Triangle Institute in Durham, N.C., prepared the abstract, searched the data bank, and turned up an instrumentation engineer exceptionally qualified for the task. He designed a safe, fifteen-electrode probe that could be inserted by an ordinary hypodermic needle; it was thoroughly tested, found to be the answer, and it is now in use.

The BAT operation is a form of technology utilization activity to which no economic value can be assigned but which is nonetheless a "hard" benefit to mankind. It also exemplifies the "nonvisible" type of benefit; the heart probe may help prolong the life of many a person who may be completely unaware that he is a beneficiary of space technology.

In three years of operation, the Biomedical Application Teams have chalked up a strikingly successful record. They have identified some 500 problems and found a solution for one out of every five. A .200 batting average does little for a baseball player's image, but in medical research it represents a high order of success. It has excited wide interest among the medical community and NASA anticipates snowballing growth in this vital area of space benefit.

Encouraged by the success of the BATs, NASA recently broadened the focus of the application team concept with the organization of its Technology Applications Teams (TATs). "Technology," in this sense, means technology applicable to "people problems"—broad areas of national concern such as air and water pollution, highway safety, law enforcement, urban construction, and a good many others. Like the BATs, the TATs are multidisciplinary groups, except that the nonaerospace input usually comes from other government agencies.

One of TATs' first problems, brought to NASA's attention by a metropolitan fire chief, involved the high number of casualties among firemen due to inhalation of smoke or toxic gases. It was established that existing protective breathing devices left something to be desired from the standpoint of efficiency, and the TAT at IIT Research Institute of Chicago was assigned the job of suggesting a new design approach. Interviews with a great many fire experts produced some tough requirements: The system had to be low-cost for widest acceptance; it had to operate for at least thirty minutes yet should weigh no more than ten pounds; for visibility, the face-mask visor should be fog-proof; and the backpack harness should not restrict the wearer's movement.

A technology search disclosed several areas in which NASA had done a lot of research. A space agency contractor had developed, for astronaut use, a "chlorate candle," which generated oxygen by the chemical decomposition of sodium chlorate, with high reliability and at considerable backpack weight-saving. Another contractor had developed a completely fog-free facepiece for full-pressure suits. Also available was a lightweight, nonrestrictive harness assembly originally designed for astronaut use. A bonus innovation was found in a liquid-crystal device incorporated in an astronaut's helmet to indicate the temperatures he is encountering. The Technology Application Team put them all together in a compact design, now being evaluated, that seems to be the answer to a fire fighter's prayer.

The TAT program, only nine months old, is moving into broader areas of problem-solving, in cooperation with such agencies as the Department of Transportation; the Law Enforcement Assistance Administration; the Department of Justice; the Bureau of Reclamation and the Federal Water Pollution Control Administration, both in the Department of the Interior; and the National Air Pollution Control Administration of the Department of Health, Education and Welfare. One current program, being jointly conducted with the US Bureau of Mines, aims at reducing the death toll in mining disasters. Here TAT personnel hope to be able to apply NASA's considerable expertise in rescue and survival technology, communications, sensors, and life-support devices. Under consideration is the use of such space-developed equipment as radar and sonic systems for locating trapped miners, chlorate candles for underground life support, sensors to identify mine sectors poisoned by carbon dioxide, and devices for restoring ventilation knocked out by explosions.

TATmen have identified a number of other areas in which space technology appears to have direct application to public problems. For instance, experiments in how much deceleration force an astronaut can sustain are applicable to minimizing injuries in auto accidents; sensor technology may prevent railroad train derailments; detection systems can measure the components of air pollution and existing mechanical devices can be applied to controlling pollution at the source; materials technology promises lower-cost housing construction; and a great variety of advanced communications systems are available for improved law enforcement, and space science techniques can be used to advantage by criminology agencies.

* * *

Space enthusiasts are fond of asserting that the people of the twenty-first century will look back upon the United States' venture into space and declare it to be the best investment in the future ever made by any nation. That seems very likely. But, from the evidence at hand, even those of us who cannot expect to see the next century may be able to say as much—within this new decade.—END

Computer programmers and USAF tactical air specialists have joined to create a new automated command and control system in Southeast Asia. It is a major step toward real-time, push-button warfare . . .

How USAF Is Putting Computers to Work

By J. S. Butz, Jr.

TECHNICAL EDITOR, AIR FORCE/SPACE DIGEST

THE Air Force has put into action in Southeast Asia its most sophisticated, most ambitious plan for using computers as the primary tool of military command.

By comparison, no previous computer programming package, including those for command and control of US strategic forces, has been able to provide real-time control of situations as dynamic and ever-changing as the tactical air operations in a major theater.

The new software package, called Seek Data II, now phasing into Seventh Air Force Headquarters in Saigon, is reducing the average time for planning day-to-day air operations from about two days to around two hours. If it meets the predictions of its designers, Seek Data II will evolve into a system allowing instantaneous appraisal and revision of all operations. It is a crucial step toward bona fide push-button warfare, which can never become a reality until computers take over the bulk of staff paper work, with all vehicles, all weapon crews, all supply units, and all headquarters bound together in a computer-communications network so complete that the top commander has the means to understand immediately the total effects of his decisions and to transmit new orders instantaneously.

In the short term, the automation provided by Seek Data II promises to improve significantly staff planning efficiency. It will be at least twelve months before a meaningful comparison can be made with 1969's pencil and pad planning procedures, but most studies indicate that the effectiveness of the Seventh Air Force in Vietnam will be boosted. For example, the airlift the Seventh AF now runs in Southeast Asia is more than twice the size of the Berlin Airlift by any measure—sorties flown, air miles covered, or tons carried. Seek Data II is expected to raise the output as if the available force of transports had been raised by twenty-five percent.

Historically, in man's efforts to apply computers to complex, dynamic problems, Seek Data II is expected to occupy an important place. According to Maj. Gen. Gordon T. Gould, Jr., Director of Command Control and Communications, Hq. USAF, it is an evolutionary extension of the Semiautomatic Ground Environment (SAGE) air-defense computer setup, and of the command and control system of the Strategic Air Command.

"SAGE," General Gould says, "was the first real-time system. It was the boldest thing in the computer business in the mid-1950s and got the industry going with on-line, time-sharing systems. Prior to SAGE, people had taken their work to the computer and had concentrated on statistical reporting and tabulating type jobs, such as inventory control and banking.

"The SAGE work," continues General Gould, "naturally attracted the attention of SAC and organizations with tasks that were even less definable than that of air defense. Many variables could affect SAC's alert posture and its attack plan, if ever called into action. These include: weather, the approved target structure and priorities, enemy defenses, operational status of all the command's aircraft, and the performance of the refueling force.

A key figure in automating USAF operations is Maj. Gen. Gordon T. Gould, Jr., Director of Command Control and Communications, Hq. USAF. He helped develop the Seek Data II software system for controlling tactical air operations in Southeast Asia.

Scenes such as the one above at Seventh Air Force Headquarters in Saigon, of officers manually preparing frag orders for tactical aircraft, will probably fade away as the Seek Data II computer control system takes over.

In the new automatic system, frag order preparation is conducted at an electronic display that allows access to large information-storage banks. After preparation, the order is put in the computer for transmittal to the field.

"Now, with Seek Data II," General Gould says, "we are working with an even more fluid situation. The tactical target structure is constantly changing. Information comes not only from a complex of radars, but from many more sources, including ground forces, aerial reconnaissance, and intelligence. Planning requires constant double-checking to make certain that we aren't overextending ourselves in terms of airspace, availability of runways, and support aircraft for forward air control, refueling, and electronic countermeasures. Shifting enemy defenses also are a prime consideration and often require that target-approach routes be changed even after a flight is in the air. And, finally, the field commander must have a rapid means of reporting to higher authority on the results of each operation, and the methods by which the results were achieved.

"To further complicate the problem," General Gould continues, "the software system must be highly flexible and easily changed. This is mandatory because major changes are inevitable in the years ahead. They can come from changes in national policy, the introduction of new weapons, changes in commanders, and simply experience with the system, which is bound to reveal ways to improve it.

"In the final analysis, the biggest selling point for any computer system is its flexibility. Machines certainly aren't ready to replace man's judgment, and they can't be useful in tactical situations if they force certain courses of action. It is the job of those of us Air Force people in the computer field to convince the operational commanders that we can give them the necessary flexibility for tactical control. I believe that we have taken a big step in this direction with Seek Data II as it stands now. Further improvements will come along. Eventually," says General Gould, "the techniques should be important in business and elsewhere in government for controlling very complex operations in real-time, just as the SAGE on-line, time-sharing techniques are widely used in a variety of applications today."

Close Contractor–User Relationship

An important management innovation is now employed to speed the development and operational deployment of Seek Data II, and to ensure maximum flexibility and response to tactical requirements. Under this innovation the contractor, Control Data Corp. (CDC), is working directly with the user commands, Seventh Air Force in Saigon and PACAF in Honolulu. Research and development organizations, and higher staff echelons, which normally would be directly in the management chain, now are monitoring the program.

Control Data has some seventy people at Hq. Seventh Air Force and about 180 at PACAF who are working directly with USAF personnel in these organizations to write the computer programs that comprise Seek Data II. Little new hardware development was required by the system. It operates with existing IBM computers.

While the final results aren't in yet, this direct contractor–user relationship appears to have wide support as a means of developing computer software rapidly and at relatively low costs.

General Gould contends that whatever management plan is used in the future, it is imperative that men with excellent operational backgrounds work directly in software development. He says, "We have two choices. Either take programmers and teach them the job, or take skilled men from the job and make programmers of them. So far we have had much more success with the second approach, and I believe that as we tackle more complex jobs, the programmers will need even better operational experience if we are to be successful."

Three Basic Computer Programs

Control Data has generated three major computer programs for Seek Data II and two very large data bases to support them since CDC was awarded the contract in May 1968. First of these programs automates

(*Continued on following page*)

Fourth-generation, microminiaturized computer equipment, such as the Control Data Alpha system at left, will allow the most elaborate command and control systems to be carried aboard a single transport aircraft. The modular systems will allow very large memory capacities, a variety of central processors, and many input/output units to be operated in a small vehicle with a limited power supply.

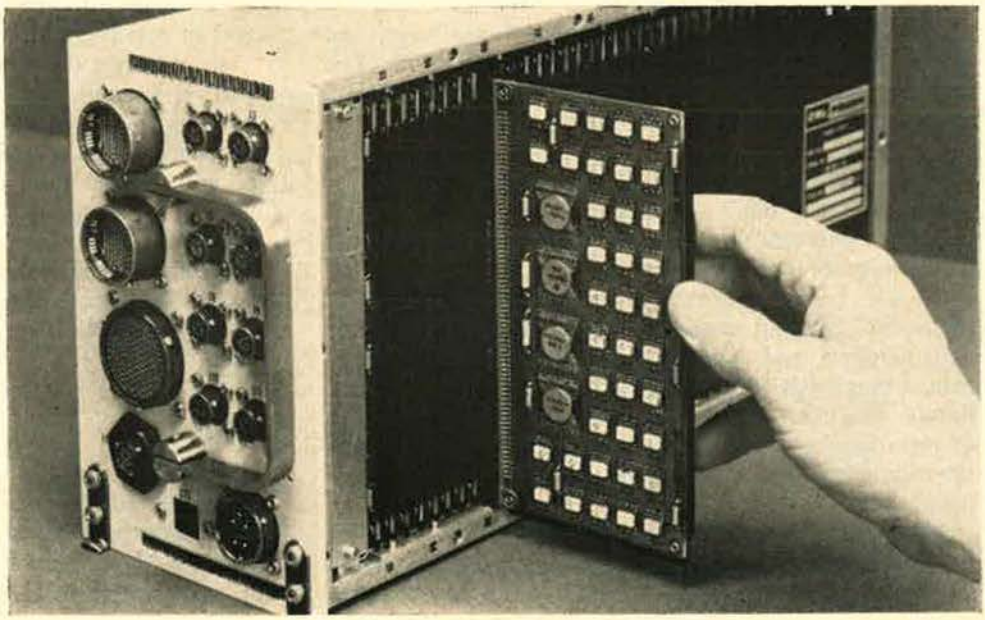
most of the steps needed to prepare fragmentary orders, or "frags," and is called Frag Prep. The frags produced by this program are the standard type and contain all of the instructions for a specific flight, including such information as time of departure; time over target; primary, first alternate, and second alternate targets; ordnance and fuzing; flight call signs; rendezvous with tankers and forward air controllers; and details on enemy defenses and electronic countermeasures.

Today this function absorbs a very large percentage of staff capability at Hq. Seventh Air Force. It is the task that has kept the average planning time for fighter air-support operations at about two days.

Under the new setup, each person preparing a frag order has access to a cathode-ray tube scope, typewriter keyboard, and a light pen for erasing information from the scope. All the information he needs to prepare the frag, from aircraft range characteristics with various weapon loads, through the current availability of ordnance at various airfields, changes in the rules of engagement (such as the addition of restricted areas), and the availability of specific altitudes, to the calling up of frags from previous missions, can be obtained from the data base through the keyboard. Once the complete frag order is constructed on the screen, it is double-checked automatically, and then either stored or transmitted immediately to the unit concerned.

The second computer software program is the Airlift Management System, called ALMS. It is designed to control the "in-country" movement of supplies and personnel in South Vietnam, and it automatically produces frag orders for transport aircraft. These include a complete itinerary of the fields at which an aircraft will stop during the day, condition of the fields, parking spaces available, the loads to be carried, and any special requirements of ground forces that will be transported.

The third of these software programs is called



One of the modular units of CDC's fourth-generation Alpha computer system is shown at right with a circuit board extended. Each circuit board is equivalent in electronic function to several thousand parts from the vacuum-tube era.

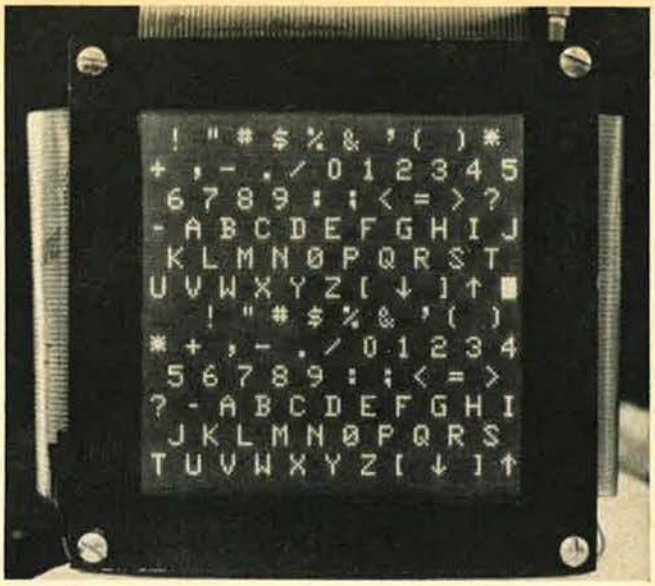
CREST, for Consolidated Reporting and Evaluating Subsystem, Tactical. This program builds on a foundation laid down with Seek Data I, which became operational in June of 1967 in Southeast Asia and which automated a portion of the Seventh Air Force's task of reporting to higher headquarters. This reporting responsibility is the most prodigious ever assigned to an operational air force.

To illustrate, in World War II the high-frequency radio net provided four voice channels across the Atlantic, four others to North Africa, and four to Hawaii. These were the only means Washington had of keeping in daily touch with the forces in the field. By contrast, in 1964 there were sixty voice channels on submarine cable alone, and all of these were saturated with military reports to the Pentagon and the White House. Since then the global communication capacity of the US military has increased spectacularly, and this new capacity has been used for still more detailed reporting.

Six Functions of Tactical Command

Command and control of tactical forces, by traditional definition, involves repetitive cycles of six separate functions. These are: (1) mission assessment or target selection; (2) mission planning; (3) execution, or the operation itself; (4) monitoring of the progress of the operation; (5) analysis of the results; and (6) reporting the results to higher authority. The three software programs of Seek Data II each contribute to the automation of one or more of these command functions, but they are not sufficient to allow computer control of the complete cycle.

The airlift management system has a mission-planning function for the preparation of frag orders, and a monitoring function. Any mission diversions or deviations that must be made to handle tactical emergencies are fed into the system immediately. The commander is provided with the means of constantly obtaining up-to-date reports on his units' progress in satisfying the total requirement as was laid down in the mission assessment portion of the cycle. At the end of the day, results are recorded and the system automatically provides data for a new mission assessment and for a new schedule of flights. The data base from which the planning and monitoring functions are operated also provides the means for automating a large portion of airlift reporting.



All elements of computer systems are being improved rapidly. Bulky cathode-ray tube displays soon will be replaced by thin, flat, "picture" type screens such as the CDC plasma panel (above), which has 16,000 addressable cells in a four-by-four-inch square. It has a memory capacity, and its displays do not wash out in harsh light.

Seek Data II, as it stands now, does not allow as much real-time control over strike units and other types of aircraft operations as it does over airlift. This is because the Frag Prep and CREST systems do not yet incorporate a monitoring function. However, these systems do make possible completely automated reporting. Some of these reports are programmed on a regular basis through various communication channels to Hq. PACAF, to the Joint Chiefs of Staff, and through them to DoD and the White House. Some reports are programmed on request, with changing formats, but these still can be extracted from the very large data base using the flexible CREST software.

Issuing daily orders to hundreds of aircraft in rough forward areas is a most difficult command and control task. Automation of this through Seek Data II system should significantly increase the efficiency of our tactical air.

Future Improvements

Two steps for improving the system are within sight, according to USAF planners. The first is to completely automate the planning and monitoring functions through a broadening of Frag Prep and the use of automatic air-to-ground communications. The second is much more difficult and involves computer evaluation of intelligence information and reconnaissance data from several sensors, including multispectral cameras, radar, and thermal, infrared, and microwave devices. It will require a completely new computer software program and a new data base. However, the foundations for such automatic evaluation were laid during the 1960s. It does not take much courage or foresight to predict that the complete tactical command and control cycle will be automated during this decade. —END

Gunships in Vietnam

Remember the faithful old Fairchild C-119 Flying Boxcar—the "Dollar-Nineteen"? Well, as part of a major reconstitution, that old-timer has been stuffed with rapid-fire Miniguns, sophisticated electronic and other gear to pinpoint targets, and has been armor-plated to protect the crews. The final product: an aerial weapon that packs an incredible punch. These planes are now serving in Vietnam as an important part of our tactical strike force . . .

AC-119

USAF's Flying Battleship

BY MAJ. WILLIAM R. CASEY, USAF

No, Virginia, that's not a pregnant P-38. Nor is it a Frankenstein monster created by the collision of a P-61 with the back end of a freight train.

It's The Shadow, the Fairchild Hiller AC-119G Gunship, the third generation of one of Tactical Air Command's newer concepts of aerial warfare. And the camouflaged and black Shadows revetted throughout South Vietnam are in the war to stay.

The South Vietnamese Air Force (VNAF) now has first-generation gunships—the AC-47 "Spooky," or "Puff, the Magic Dragon," as it was called earlier. All USAF AC-47 gunship units in South Vietnam were deactivated in the fall of 1969. In time the VNAF probably will graduate to the more sophisticated AC-119.

I distinctly recall my first experience with the old Fairchild C-119, or "Dollar-Nineteen," long before it was reincarnated as a gun-toting guppy. During my senior year in college, I was a delegate to the Arnold Air Society's National Conclave, held that year in San Francisco. Along with ROTC cadet delegates from other midwestern schools, I arrived at Chicago's O'Hare Airport in early February for an introduction to the Air Force Reserve C-119s that would carry us across the Great Plains and the High Mountains to Hamilton AFB, Calif.

In January 1970, the author, Major Casey, completed a tour as an AC-119 aircraft commander with the 17th Special Operations Squadron, Phan Rang Air Base, South Vietnam. His new assignment is as a B-52H pilot, with the 524th Bomb Squadron, Wurtsmith AFB, Mich.

I'm reasonably sure that it's against regulations to be comfortable in a C-119. We broke no regs on that trip. In the course of the long, cold, turbulent, and miserable flight over the mountains, twenty-three cadets retched all over the cargo compartment and each other. I vowed never to set foot in one of the ugly monsters again. Besides, weren't they all committed to the Reserve, anyway? The Air Force had moved into the jet age, and surely I'd never be flying anything like that!

And I didn't. For more than ten years, I didn't. But I hadn't heard of project "Combat Hornet" when I volunteered for duty as a fighter pilot in F-4 Phantoms. So where did I end up? As an AC-119 instructor-pilot holding night classes by flarelight over the dense, dark jungles of South Vietnam. Though my attitude toward this machine still is skeptical at times, I've learned tremendous respect for its capabilities. And "Charlie" has learned right along with me.

Shadow is a hybrid aircraft in the fullest sense of the word. The distinctive shell of the Flying Boxcar is remembered the world over as a reliable workhorse of the Korean War. The C-119 has more than twelve years of tactical airlift service with the Reserve Forces.

To step inside, however, is to suddenly lose any skepticism about making a fighting machine out of a fatigued and semiretired old cargo hauler. The AC-119 is an aircraft reborn to do battle. Around you are four fire-spewing Miniguns; sophisticated target-sensing and tracking devices; a brilliant target illuminator; automatic flare-launching equipment; ammunition to spare; armor plating around crew stations; and some of the latest navigational gear. The aircraft is a flying battleship with enough fuel to patrol large areas for

The AC-119 Shadow is currently supplementing AC-47 and AC-130 gunships in supplying heavy firepower in support of allied ground troops who are on the move or in such stationary positions as outposts. One important aspect of the AC-119 is its ability to remain on airborne alert for long periods.

hours at a stretch. Its ground-scanning electro-optical devices may detect enemy movement. A distress call may come in from a friendly concentration in need of support, or perhaps from an air base under rocket attack.

And when the target is located, the firepower is there.

Shadow's side-firing Miniguns are chambered for the new 7.62-mm NATO cartridge. For all you deer hunters, that's comparable to the US Winchester .308 caliber. The 7.62 bullet steps out of the barrel at nearly 2,760 feet per second and strikes its target with almost 1,000 foot-pounds of energy. Its impact is comparable to a .38 Special service load at about twelve feet. And man, that smarts.

From somewhere in the dusty archives of my mind, memory calls up a statistic. The average American center-fire rifle owner will, in hunting and target practice, squeeze off about 1,600 rounds in a lifetime. I've considerably upped my tally since sliding into the left seat of the AC-119.

Shadow's four Miniguns can whip out 1,600 rounds in FOUR SECONDS. Each gun is capable of 6,000 rounds a minute, and they may be fired singly or in combination for a maximum rate of fire of 24,000 rounds a minute. That's scarcely a gentle rain from heaven, as a lot of Charlies would tell you if they were still around.

Near year's end, a newer version of the AC-119, the K Model, nicknamed "Stinger," went into operation in Vietnam. Stinger has two small jet engines mounted outboard of the reciprocating engines. In addition to the four 7.62 Miniguns, the K has a pair of 20-mm Gatling guns and carries infrared ranging devices. This even deadlier version of the AC-119 is assigned to the 18th Special Operations Squadron (SOS), a unit of the 14th Special Operations Wing. The 18th SOS is headquartered at Phan Rang Air Base. Some of its aircraft are dispersed at forward operating locations. The K-model's greater electronic sophistication makes it especially effective against interdiction targets.

How is all the AC-119's firepower used in battle? The gunship's attack envelope is an orbit above the target. This maneuver allows nearly continuous, accurate delivery of ordnance from all points along a circular path completely surrounding the enemy's position. He has little recovery time. His flanks and rear are exposed unless protected by a 360-degree shield.

One of the most effective shields, the shield of darkness, no longer hides Communist ground-force activities. The AC-119's combination of advanced electronic and illuminating devices enables pilot and crew to detect targets and carry out strikes in pitch darkness.

For lighting, the old bird carries a supply of two-million-candlepower flares that can be released automatically at the touch of a button. In addition, there is a ground illuminator—a precision device unique to Shadow—that produces high-intensity illumination in either the infrared or visual spectrum. When operated at its full power of twenty kilowatts, the system's visual light beam is rated at about 425,000 lumens. The beam spread adjusts from twenty to forty degrees. If Shadow were flying over your head at 5,000 feet with its illuminator turned all the way up, you could read *Stars and Stripes* easily on the darkest night. With the beam spread to its forty-degree maximum, your buddy a half mile away could read his copy at the same time.

The lamphouse assembly allows movement of the light beam fore and aft or up and down. Any one of three crew members at three different stations can direct the light through a plus-ten-degree to a minus-sixty-degree roll angle, or through a yaw motion of

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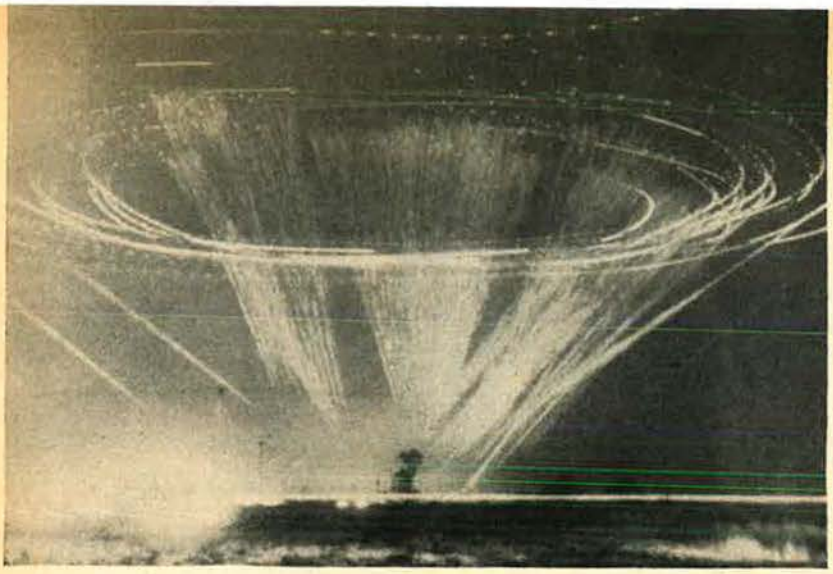
The smoke of battle rises as an AC-119K hoses down an area. Each Minigun aboard a gunship can fire at the rate of 6,000 rounds per minute. The Miniguns are chambered for the new 7.62-mm NATO cartridge, which leaves the barrel at a velocity of 2,760 feet per second. Its impact on a target is comparable to a .38 Special from twelve feet.



A cone of death illuminates the night sky near Phan Rang AB, Vietnam. This remarkable time exposure was made by an Air Force photographer when an AC-119 gunship was called in to suppress enemy mortar fire. The light pattern at the top was made by the aircraft as it circled. The descending lines are tracers from the sideward-firing Miniguns.

plus or minus fifteen degrees. This allows the light to be kept on target during varying degrees of aircraft bank or changes of attitude. It immeasurably improves search capability.

The advantages of continuous white light over the flickering, relatively brief illumination of flares is obvious. The light has proved its worth many times with troops in contact with the enemy, night-sweep operations, perimeter security, rescue operations, and other instances where dropping flares might endanger ground personnel. In a battle near Tay Ninh, Shadow stayed over the target area to provide light for a doctor doing surgery on a wounded Vietnamese soldier.

Shadow holds another large advantage over first-generation gunships. The AC-119's intricate fire-control system vastly improves the gunship's ability to identify and hit targets under cover of complete darkness. This system is made up of an analog computer, night light-intensifying observation sight (NOS), safety CRT-type display panel, optical gunsight, sight amplifier, sight control panel, and boresight box. Other interface units plus a variety of switches, circuit breakers, and conduits make up the integrated package.

Target identification begins with the four-power, telescope-like NOS, designed for night viewing in low-intensity light. When aimed at a prospective target, the NOS transmits data on angular line of sight between the target and the aircraft's lateral axis. The computer combines this information with aircraft magnetic heading and attack altitude to give the aircraft/target relationship and to position a moving reticle, representing the target, on the pilot's display.

Three modes of firing are available at the pilot's discretion. Of these, two use full system operation and require the pilot to align the moving reticle with the fixed reticle on his gunsight combining glass. The third mode is manual, and involves only the pilot's gunsight and fixed reticle.

With such an array of paraphernalia, Shadow's capability to cover a wide variety of targets is unquestioned, and the aircraft has developed inspiring confidence among ground troops it has supported.

Recently I overheard two "grunts" discussing gunships: "Don't compare Spooky (AC-47) to Shadow," chided one. "That's like comparing a Model-T to a Cadillac."

Who would have thought that the C-119, a Model-T among tactical transports, would ever become a Cadillac in any league, especially a hot-lead league?

Not bad, you guys at Systems Command and AFLC. Not good, eh, Charlie?—END

The canvas covering of a Minigun is removed by A1C Edwin Bryant of Waynetown, Ind. An AC-119 Shadow gunship's four Miniguns can be fired individually or in unison.

1st Lt. William C. Sawson, from Avenel, N.J., operates an AC-119's night observation scope that uses available light to single out targets for the gunship's awesome weapons.

Supersonic Transport

The stakes, costs, and difficulties involved are monumental. But the price for dropping out of the world's SST competition is likely to be far greater than for staying in, in terms of loss of trade, lost aeronautical prominence, loss of employment and revenues, and decline of the nation's technical and political prestige. For these and other reasons, the President and Congress have determined that . . .

The SST Is Vital To the National Interest

By Edgar E. Ulsamer
ASSOCIATE EDITOR, AIR FORCE/SPACE DIGEST

On December 17, 1969, the sixty-sixth anniversary of the Wright brothers' first flight, the Senate ended a two-year moratorium on construction of a US supersonic transport. The Senate's heavy vote in favor of authorization of funds to produce two flying prototypes assured continuation of what has been called the world's foremost aeronautical undertaking—the development and flight testing of a reliable, safe, and economical Mach 2.7 intercontinental jetliner.

Three consecutive Administrations have rated the SST program essential to continued US preeminence in aviation technology and a vital factor in the nation's balance of trade. Nevertheless, from the day of its inception six and a half years ago, the program has encountered many obstacles and suffered serious setbacks.

In his 1963 Air Force Academy graduation address, President John F. Kennedy announced the decision to "immediately commence a new program in partnership with private industry to develop at the earliest prac-

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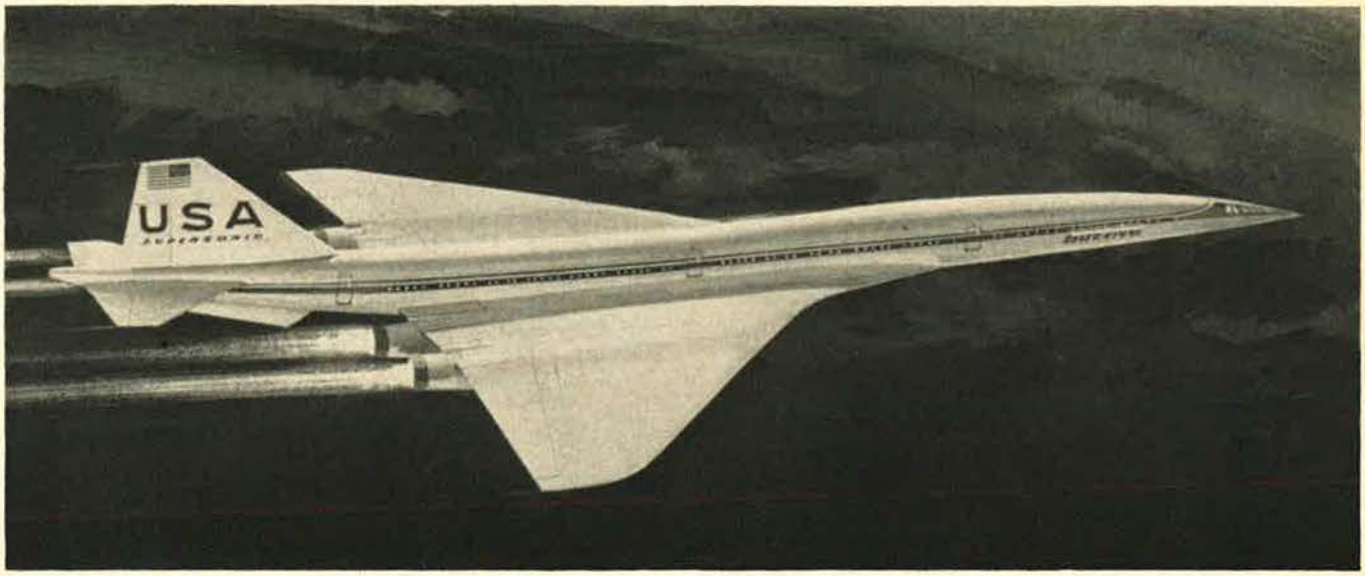


Artist's conception of the US SST prototype in flight shows movable nose in cruise configuration. The prototypes will be 280 feet long, have a wingspan of 142 feet, and be fifty feet tall at the tail. The SST's thin, sculptured wings, employing advanced high-lift devices, should give the aircraft excellent performance in its performance envelope.

tical date the prototype of a commercially successful supersonic transport superior to that being built in any other country." From that day forward, the SST program has been battered continually by public, press, and congressional antagonism, which at times bordered on paranoia.

Some conservative groups have questioned the prudence and probity of the federal government's underwriting development of a private, commercial jetliner. In truth, the government's expected $1.2 billion investment in the prototype program is to be repaid through royalties and is likely to net the government a profit of $1 billion. Others who view social problems as paramount inveigh against the allocation of federal funds to advance aerospace technology at this time. Still others question the societal value of further increasing the speed of air travel.

The sonic-boom issue has been another, often-exaggerated, stumbling block. In fact, no supersonic flights will be permitted over inhabited land areas until a solution to the sonic-boom phenomenon is found. While that solution is not in sight at the moment, recent tests of the Lockheed SR-71 in high-altitude cruise have yielded overpressures substantially below forecast values, which, at times, were so low that they escaped detection by human observers and special ground instrumentation. But because the SR-71 flies higher and weighs less than the SST, its sonic-boom characteristics do not necessarily apply to the SST.

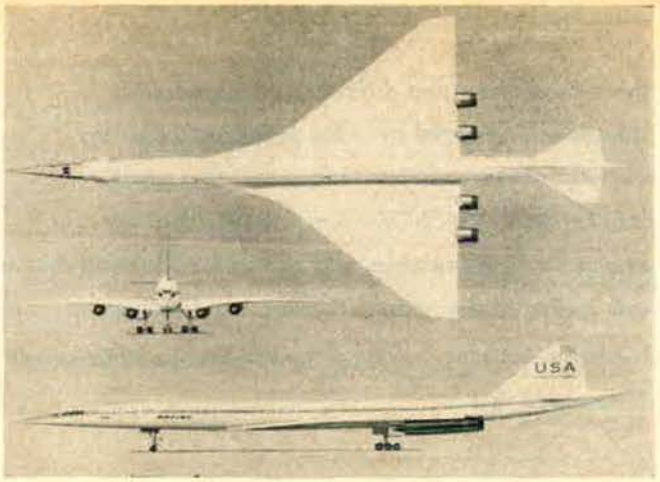
Problems and Solutions

The SST program probably reached its nadir in February 1968 when Boeing—which in December 1966 had been chosen to build the SST, with the General Electric Co. selected at the same time to build the engine—said it was giving up the variable-sweep-wing design known as the 2707 Dash 200. A variety of reasons caused Boeing to discard a design technique favored not only by its own scientists and engineers but also by a majority of the 235 experts (including many USAF representatives) on the government's blue-ribbon technical evaluation committee.

The practical effect of the Dash 200's technical shortcomings was a payload-range reduction to roughly half the government's specified requirement of 4,000 statute miles with full payload.

According to H. W. Withington, Boeing's vice president in charge of the SST program, the swingwing's advantages tend to be negated on large, multiengine designs because of the need to move the wing pivot outboard, beyond its optimum location. Also, a host of associated problems were generated by "fixes" that proved more detrimental than curative.

A year and three million engineering hours after the abandonment of the swingwing configuration, Boeing submitted to the government a completely new, fixed-wing-plus-tail configuration, distantly related to the company's losing entry in the B-70 supersonic-bomber design competition of a decade earlier. The main characteristics of the new design are simplicity, high aerodynamic efficiency in supersonic and subsonic flight, and good stability and control. Its only unorthodox feature is the 50.5-degree wing-sweep angle,



The US SST, the Boeing 2707 Dash 300, is a fixed-wing design constructed principally of titanium alloy and powered by four General Electric GE4 turbojet engines with afterburners. Three times faster than present jetliners, the Boeing SST will be the world's most productive aircraft.

modest compared to the more than sixty-degree sweep of the British-French Concorde SST, the Soviet TU-144 SST, and most high-performance military aircraft.

Boeing's engineers are convinced that the new design will substantially improve subsonic performance without significantly affecting the supersonic lift/drag coefficient. Two years of intensive examination and windtunnel testing by government and industry have confirmed the original calculations, with some evidence that performance will be slightly better than expected. The SST's engine, not affected by the airframe change, has already achieved a thrust output of 69,900 pounds, or almost 7,000 pounds more than required for the prototype.

In February 1969, another government panel of 100 leading technical experts from the Air Force, NASA, and the other military services accepted Boeing's redesign, an action also bearing the cachet of the engineering experts of the user airlines.

Meanwhile, the then-new Nixon Administration ordered an in-depth review of the program, involving all major government departments, to determine its impact on the national interest. The Department of Defense was represented by Secretary of the Air Force Robert C. Seamans, Jr. While Dr. Seamans' evaluation of the SST's military utility has not been revealed, a recent communication from Dr. John S. Foster, Jr., DDR&E, OSD, to the Department of Transportation presumably reflects some of these findings.

Dr. Foster termed the potential SST contribution to Defense R&D "indirect but not insignificant," by "reinforcing the technological base upon which defense will be drawing for the development of military systems." He listed as areas of potential benefit to the military the SST's advances in flight controls, fly-by-wire and the stability augmentation control systems, high-temperature sealants and seals, environmental control systems, and high-temperature metals and alloys. SST program officials have reported that SST developmental work is reducing the man-hours required to produce titanium by almost two-thirds.

On September 23, 1969, at the conclusion of the gov-

HAP stands for Housing Authority of Portland. Judging from the smiles on the faces of counselors, campers, and mascots, it could also stand for HAPPY. (We think the mascot at the left is smiling.) The summer camp, a joint effort of the Oregon Air National Guard, the Oregon Military Department, and the City of Portland Housing Authority, gave eighty-two underprivileged boys an experience in leadership and group cooperation that could produce untold long-term dividends.

domestic distress. He aired his opinions in a September 1968 speech and afterwards solicited proposals from the service Secretaries. He wanted ways to implement Defense Department responsiveness to social needs—without adversely affecting the traditional roles of the services.

The Air Force answer was enthusiastic. All commands participated, and more than 2,500 ideas flowed from the field into Hq. USAF. At about the same time that these suggestions were being sifted and weighed, Richard Nixon was in the process of being elected. Shortly after his Administration took office, the momentum toward DoD involvement with our domestic problems was increased. With the blessings of the President, Secretary Laird established the Domestic Action Council. It was directed to work with other federal agencies as well as interested private organizations. Its goal: to assure the best use of all our resources in meeting the challenges that confront our society.

Though perhaps seeming incongruous at first glance, DoD activity on this front is now seen to be completely natural. Touching most of our citizenry in one way or another, DoD has unique capabilities to help, influence, and lead. Furthermore, these capabilities do not rise simply from the scope of DoD activity. Instead, they also frequently reflect advanced facilities and techniques in special areas where our society needs help.

For example, USAF does much work in education and training. Last year, as a matter of fact, the Defense Department spent one out of every five *federal* dollars that were expended on education—and this did not include specialized military instruction. It would be surprising and disappointing if we couldn't find valuable areas of overlap here, areas rich in benefits for both the services and the civilian community.

In our society, education is surely the first rung on the ladder of success. Thus, the individual exposed to service schooling learns skills, and develops the confidence and personal traits that can be the impetus for continued progression either in or out of the military. In addition, the teaching techniques used by service schools and our programmed learning devices can be studied, and in some instances copied, by interested civilian institutions.

Perhaps, by using our help, it may be easier and less expensive for the civilian educational community to meet its particular responsibilities. Such exchanges of knowledge are not restricted, of course, to this field. We feel we can also contribute significantly in other areas, such as inexpensive housing.

One of the nation's greatest needs is a low-cost housing unit. In fact, the Housing Act of 1968 set as a national goal the construction of 26,000,000 new homes during the 1970s. While the myriad of problems facing the housing industry is not restricted solely to methods of construction, we do have to improve upon traditional building practices. Otherwise, we cannot do the job. Because we have not concentrated on developing new production techniques, new designs, and new materials, construction today is still slow and costly.

As the biggest single federal user of housing, it seems logical to us that the Defense Department should provide leadership in this critical area. Until recently, however, DoD had failed to use its capacity for housing research and development. Now, though, we have begun to remedy this shortcoming. With the construction of a 200-unit project at George AFB, Calif., we are unveiling the AF-OSD approach to the industrialization of housing construction techniques.

Here we are using original materials, preassembly of components, and semiskilled mechanics for much of the construction itself. Through these means we anticipate saving fifteen percent over conventional construction techniques. Should the project measure up to our optimistic expectations, we will improve our military cost-effectiveness, and the lessons we learn will be passed along. This should result in savings for the private sector of the economy and could go far toward attacking the low-income housing problem in our cities.

Since this particular project involves only components of the Defense Department, however, it has not encountered most of the difficulties the Domestic Action Council will face as it links up with other federal and private agencies. Each program we seek to act on, for

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Maj. James R. Rogers, 171st Aeromed Airlift Wing, Pa., ANG, explains the cockpit of an F-102 to members of an area 4-H Club during their visit to Greater Pittsburgh Airport. In civilian life he is a high-school principal.

example, not only must pass the test of noninterference with our primary mission, but must also involve scrupulous cooperation with any other concerned departments. Paradoxically, therefore, we shall move cautiously in what is basically a program of innovation. Matters of propriety, legality, and jurisdiction will all have to be resolved before we break any new ground.

Old ground, on the other hand, can still be reworked and reemphasized. And we need look no further than the Air National Guard and the Air Force Reserve for pointers in this area. The boys' camp I mentioned in my opening paragraphs is typical of the domestic action with which the Guard has long been involved. It is also typical of the individual enthusiasm without which these programs will not work.

In this case, the catalyst was Maj. Fred Rosenbaum. Personnel Staff Officer of Oregon's 142d Fighter Group, as well as Chairman of the Housing Authority of Portland, Major Rosenbaum stimulated his group into undertaking this particular recreational project. The 142d not only administered precamp physical and dental exams; it transported the boys to the site, provided food service support throughout the period, and also enlisted the financial help of twelve Portland businesses.

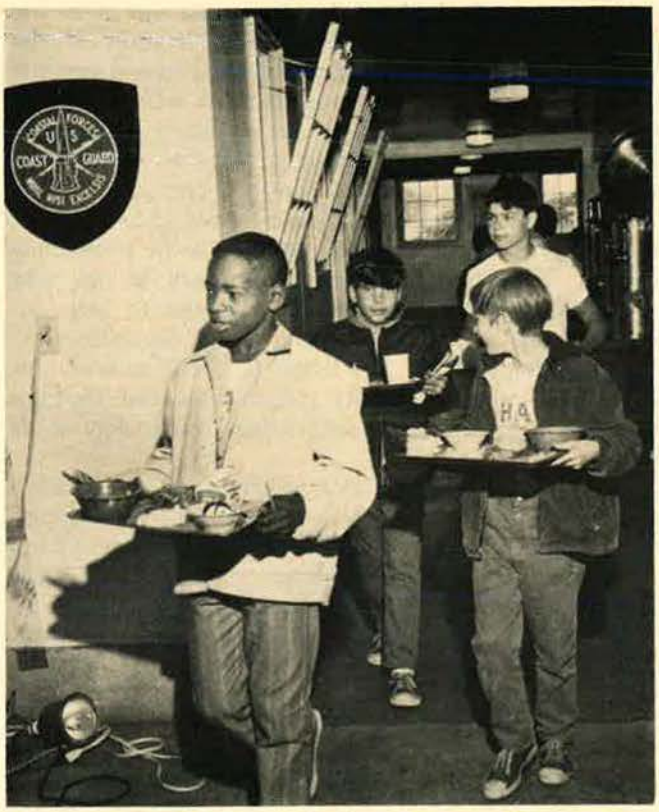
Though single actions such as this one involve only moderate numbers, the aggregate is impressive. Experienced in running camps of their own, Air National Guard units across the country are becoming increasingly involved with the youth of their regions. At Buckley Field, Colo., day camps are set up for Denver-area children, while at Volk Field, Wis., it's the encampment of the state wing of the Civil Air Patrol. Each of these programs promotes identification, leadership, and an invaluable sense of community.

For older boys who have dropped out of school, certain vocational programs established by service units may provide an alternative road to productive citizenship. To cite one example, the 911th Military Airlift Group, USAFR, at the Greater Pittsburgh Airport, is cooperating with a local high school to establish training courses in clerical work, aircraft maintenance, and accounting and finance. The students, about one-quarter of whom are black, are selected by the school counseling staff. Once enrolled, they attend half-day sessions for six weeks. Upon completion of the program they are then given help in finding jobs.

Also, in Pittsburgh, as well as Louisville, Philadelphia, Cleveland, Cincinnati, and New York, Air Reserve units have set up information squadrons and flights. These groups are now trying to curb local drug abuse. Firmly believing that much drug activity springs from ignorance of the hazards involved, Air Force Reserve units have used the film "Hang Up" as a graphic portrayal of drug dangers and also enlisted the help of local Narcotics Bureau personnel. To date they have presented this program to more than 3,000 persons at schools, churches, and various civic groups.

In the future, USAF hopes to help both Air National Guard and Air Force Reserve units become more deeply involved in domestic problem-solving. Notwithstanding these efforts, however, our main thrust will be applied to the active force. For a lot of reasons this seems to be the most practicable approach. One hardly need say that the regular Air Force is bigger, is spread out over a larger area, and has more extensive facilities than either the Air Guard or the Air Force Reserve. It is also likely that the active force has not been as heavily involved in community work as these essentially local units.

For that reason, and to add specific service direction to the guidance of the DoD Domestic Action Council, we have established a separate Air Force



Youngsters at the City of Portland, Oregon ANG encampment at Camp Rilea form a parade guaranteed to warm the cockles of a cook's heart. Last for firsts is first for seconds. The photo was made at summer camp last year.

Domestic Action Policy Council. An idea of the importance attached to this program can perhaps be gleaned from a quick glance at those present for the first meeting. Included were: Secretary of the Air Force Robert C. Seamans; myself; Gen. John C. Meyer, Vice Chief of Staff; Curtis W. Tarr, Assistant Secretary of the Air Force (Manpower and Reserve Affairs); Lt. Gen. Austin J. Russell, Deputy Chief of Staff (Personnel); and the Director of the Office of Information, Brig. Gen. Henry L. Hogan.

At that first meeting we didn't present a solid front on all issues discussed, but we were united in the belief that, since any actions taken in this area could be done best by the individual service, the most effective direction would come from a council representing that service.

Perhaps the most publicized programs in the domestic action area are Project Transition and the earlier-mentioned Project 100,000. With Project 100,000, DoD brought into the services more than 220,000 previously unqualified men. They became productive servicemen, and we feel that those who returned to civilian status are now better qualified to be good citizens than they would have been had they not come on active duty.

Furthermore, to help guarantee success upon their return to civilian life, we have also operated Project Transition. During the last eighteen months, 55,000 men from the USAF have participated in some phase of Transition. They have received either career advisory service, education, training, job-placement assistance—or a combination of these.

Also of particular importance to the disadvantaged youth of our country are such programs as: Project Value, Youth Opportunity, and a plan we have for intensified recruitment in city areas that have a high concentration of unemployment.

Project Value was conceived as a means for training and employing ghetto youth. At the risk of oversimplifying the program, let me say that it is one where the Defense Department locates job-training openings at military facilities close to metropolitan areas, then works with the Civil Service Commission and the Departments of Labor and Interior to train and fill these openings with individuals whose environment has earlier denied them employment opportunity. The Department of Labor handles not only the recruitment of personnel in this program, but also pays the cost of salaries and whatever remedial education is needed. The Air Force has thirty-five bases and other units participating in Value.

Another instance of Air Force involvement in domestic action is the Youth Opportunity summer hire program. This past year we were able to provide work and training for almost 13,000 young people (about 11,000 of whom were disadvantaged).

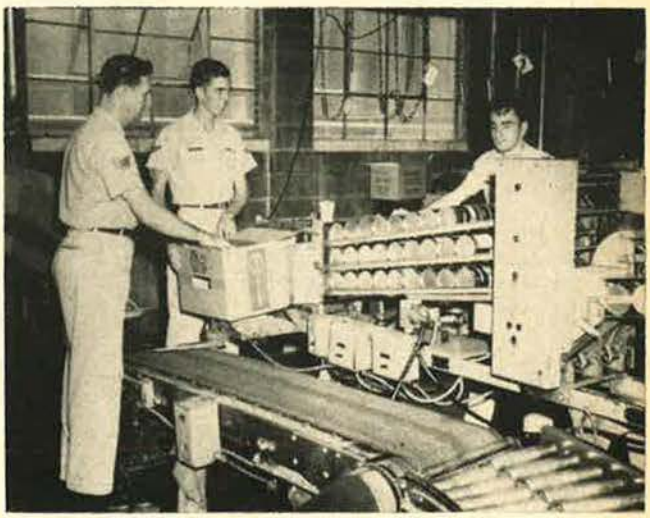
Further underlining the Air Force's intentions in this general area is the intensified recruitment program. We have identified forty-three areas in the United States where higher than normal rates of unemployment exist. In these areas we have almost tripled normal recruitment quotas. By giving these particular young people the chance to enlist, the Air Force has provided the short-term benefit of immediate employment and the long-term benefits that a well-trained separatee will give to the community. Certainly the confidence and skill these men take with them should be an asset when they leave the service and return to their former neighborhoods.

This same skill development applies to training available in the Air National Guard and the Air Force Reserve. There, too, we are accelerating our recruitment efforts among less-privileged youngsters who, on a part-time basis, can increase their skills or learn new talents to assist them in the civilian world where they earn their living.

However, I would prefer not to leave the impression that the Domestic Action Program is completely one-sided, and that the Air Force is in a position of constantly giving. The return is rich from programs such as those I've mentioned. In a direct sense, all of our jobs are made easier as we deal with a public well aware of our mission and sensitive to our viewpoints. When we encamp young boys, we create a reservoir of good will and, we like to think, a pro-Air Force attitude. When we train and employ ghetto youth we *frequently* get unusually dedicated service from the individuals involved and we *always* narrow the gap between the haves and the have-nots. And when we fight the housing problem, we are also picking up the load for our own personnel.

There is much more to the Domestic Action Program than I have spelled out in these few pages. Under other guises, community-related activity has always been part of Air Force life. Wives' Clubs have given unstintingly in this area as have organizations such as the Air Force Association. Simply, what we are trying to do is concentrate our diverse energies and give them the strength of official sanction.

As John Gardner, the former Secretary of Health, Education and Welfare, has so wisely noted, "Today the first duty of responsible citizens is to bind together rather than tear apart. The fissures in our society are already dangerously deep. We need greater emphasis on the values that hold us together." Perhaps the Domestic Action Council can help provide this emphasis. —END



In preparation for their return to civilian life, these Air Force Project Transition students learn about packaging methods at a Humble Oil and Refining Company plant.

Inflationary pressures have forced manned spaceflight stretch-outs just when unmanned "working satellite" programs are at the take-off point in terms of vast payoff. It would be folly to decimate them for short-term budgetary reasons . . .

Meat-Ax or Common Sense on Space?

By William Leavitt

SENIOR EDITOR/SCIENCE AND EDUCATION

AS James Haggerty points out in his comprehensive report on space spinoff elsewhere in this issue of AIR FORCE/SPACE DIGEST (*see "The Giant Harvest from Space—Today and Tomorrow," beginning on page 30*), the earthly benefits from space technology that could accrue to the country in the decade we have just entered seem almost limitless. They range from long-range weather forecasting to television broadcast from enormously powerful satellites directly to home receivers.

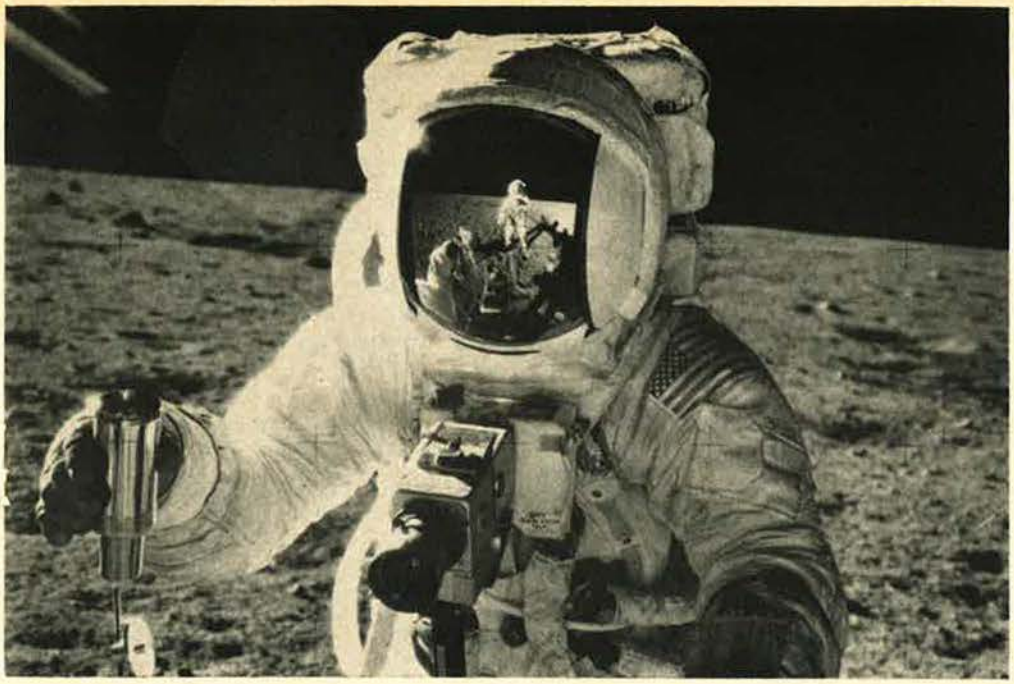
The question is whether or not the Nixon Administration will push policies to bring these potential boons to fruition. In the face of the inflationary pressures brought on by the Vietnam War, the task will not be easy. But there are at least some indications that Mr. Nixon and his space planners are trying. So far, most of their decisions have a negative cast. But in the long run the policies they seem to be shaping could make possible the rich returns from space technology described in much detail by Mr. Haggerty.

The Administration, for the moment, appears to be deemphasizing manned spaceflight, at least so far as the Apollo moon-landing program is concerned. And the purposes are simple: to cut costs and, indirectly, to defuze vocal opposition to the huge outlays involved in each manned mission to the moon. That opposition comes not only from critics who decry such expenditures while the urban and environmental crises fester, but also even from "establishment" scientists who have been publicly complaining that science has been shortchanged in the Apollo program.

Already, under pressure from the Administration, NASA has announced a stretch-out of the Apollo manned lunar-landing mission schedule into 1974. The tail-end mission, Apollo-20, has been eliminated to save money for such oncoming programs as the Apollo Applications earth-orbital prototype manned space station and the space shuttle. Also, the plan to land an unmanned Viking probe on Mars has been delayed from 1973 to 1975. These and other cutbacks are expected to cost some 50,000 space agency and industry jobs. Also, the space agency is picking up the pieces after the sudden December 1969 closing of the NASA Electronics Research Center (ERC) at Cambridge, Mass.

The ERC, a spanking new facility, was just about to go into business. Its history, from beginning to end, was particularly ironic. Only a few years ago, NASA, then riding high, had insisted on the need for its own center of electronics expertise and had persuaded the city of Cambridge to make available the land for such a facility. There was a furious public battle over the site, with considerable resistance to establishment of the ERC from local businessmen who were to be displaced. Now, after all the struggle, the place is stillborn. NASA's Administrator, Dr. Thomas O. Paine, flew up to New England to break the bad news to the more than 800 ERC people. The city of Cambridge was angry about the closing, and NASA headquarters was infuriated. Not surprisingly, there were bitter suggestions that the Nixon Administration's action in closing the Center had political content. After all, Cambridge is in Massachusetts and Massachusetts is Kennedy country.

The ERC closing was apparently part of a compromise worked out between NASA and the President's Bureau of the Budget. In late 1969, the Bureau



The Nixon Administration is cutting back on the Apollo moon-landing program. The originally scheduled last flight in the series, Apollo-20, has now been eliminated. Its booster is expected to be used instead for the launch of an Apollo Applications Orbital Workshop prototype manned space station. The rest of the Apollo flights to the moon will be launched, after an April Apollo-13 launch, at six-month intervals.

of the Budget was reported to have told NASA chief Paine of its wish to cut sharply into NASA spending for Fiscal 1971. Three FY '71 figures have been bandied about: $4.025 billion, $3.9 billion, and $3.8 billion. Dr. Paine communicated to the Bureau of the Budget his annoyance at such a prospect and reminded Budget Director Robert Mayo of the enthusiasm for the space program exuded by President Nixon after the successful Apollo-11 flight. A conference took place, some compromises were made, NASA fought hard for the retention of the ERC, offering to cut costs elsewhere, but was turned down, and ERC died.

So far, the Nixon space policy seems no more than budgetary meat-ax wielding. But the present round of cost-cutting may represent a prelude to the development of a rational plan to begin extracting sizable economic and societal payoffs from the space program.

That payoff could come if the Administration really gets down to planning and selling the kind of investment in *unmanned* applications-satellite programs that will bring earthly returns, not in terms of spectaculars but rather in day-to-day benefits.

The unglamorous truth is that the unmanned side of the space program will produce the payoffs, at least for the foreseeable future, and certainly until manned spaceflight costs are sharply reduced by the development of the space shuttle.

This is not to say that manned spaceflight need go out of business. Nothing of the sort. Indeed, many of the functions now performed by unmanned satellites will probably eventually be done even better from large manned orbital stations. But for the decade we've just started, it is the *unmanned* hardware that promises the most.

It seems sensible for the Nixon Administration, which describes itself as pragmatic, to build its program for the 1970s on that premise. Concurrently, Administration planners should concentrate during the 1970s on reducing the costs and improving manned capability so that in the 1980s even more sophisticated hardware can be operated and monitored routinely by skilled men in orbit.

At this writing, the Nixon Administration's Fiscal Year 1971 budget proposals have not been released. So it is not yet clear whether the President and his space advisers are actually thinking in these terms. It is true that the President's Space Task Group Report, released last year, did dwell on applications satellites and their present and potential yield. But that thrust of the report was blunted by preoccupation with manned Mars mission options. In any case, until the details of the President's NASA budget proposals are available, we will not know whether something approximating a realistic payoff policy for space in the 1970s is shaping up, or whether we will see nothing more than indiscriminate cost-cutting.

It would be a tragedy if the Administration, in its

(*Continued on following page*)

This was NASA's Electronics Research Center at Cambridge, Mass., as it looked during construction in late 1967. Concerned Massachusetts officials are currently looking for new ways that industry could use the Center.

The space-policy question for President Nixon is whether he will wield a meat-ax on the entire space budget or create policies designed to extract maximum societal spin-off from space technology during the 1970s.

understandable zeal to curb inflation, hacked away across the board at NASA. It is one thing to stretch out the series of manned flights to the moon. Out of that decision, as frustrating as it is to those whose lives and careers are tied up with manned spaceflight, could come an even better thought-out set of scientific and engineering goals. But it would be another, and most unwise, thing to throttle the unmanned applications-satellite program at the very time it is really ready to take off.

Earthly Roles for NASA?

A subject that's getting increasing attention in Washington, and properly so, is the environmental crisis. Scientists are issuing terrifying warnings about the dangers of overpopulation and the potential destruction of the world's air and water supply by pollution. The President himself has indicated his concern.

This swirl of warnings and expressions of alarm have stirred some observers to suggest that NASA, the agency that put America on the moon, ought to consider bidding for a role in the life-or-death problem of restoring the environment as well as helping with certain other pressing public dilemmas.

Circulating quietly in Washington is a report prepared by Dr. Leo S. Packer, an engineer who served a stint as a special assistant to NASA's Associate Administrator for Advanced Research and Technology in Washington. A former Assistant Postmaster General for Research and Engineering, he is now a vice president of Recognition Equipment, a technical firm in Dallas, Tex.

Dr. Packer started his NASA tour under former NASA chief James E. Webb and stayed on into the regime of current NASA Administrator Tom Paine. Dr. Packer spent several months, with a charter from Mr. Webb, visiting NASA installations and talking with NASA people about the agency's potential contributions to the solution of public problems.

After his forays through the world of NASA, Dr. Packer produced an eighty-seven-page document that was remarkable, in this age of governmentese and gobbledygook, for its cogency and urbanity.

In a future issue, we hope to report on Dr. Packer's study in greater detail. But capsulized here are some of his observations and recommendations:

"It is a fact that NASA is held up as a model of spectacular achievement in the 'what' and 'how' of space exploration, but has not been as articulate or successfully communicative with the 'why' of space exploration. Similarly, there is inadequate understanding of the impact that NASA has had and is causing in technology, the economy, and [on] the quality of life, although some perceptive observers have recently begun to understand this [impact] in its truly dramatic sense."

As to new roles for NASA, Dr. Packer observes that today NASA has unique talents and experience that are "relevant to technology needs of public problems, either directly or with minor modification . . . generally in the categories of specific technology, systems engineering, and organization and management."

He indicates, on the basis of his study, that "there is a reservoir of potential support among NASA people, based on response to challenge and social sensitivity and altruism." He asserts his belief that "an overt [NASA] organizational step toward social application of technology, no matter how restricted and cautious, would generate considerable enthusiasm." He allows too that "there would also be opposition based on resistance to change, administrative obstacles, and dislike of unfamiliar, difficult, and frustrating problems."

Dr. Packer says he finds "no difficulty in extending NASA's technology charter to include direct participation in civil problems of national scope.

"NASA," he remarks, "does study, penetrate, and exploit unconventional and hostile environments for man, such as zero gravity, undersea, radiation, aeronautical flight conditions, closed life cycle, extreme temperatures, vacuum, etc.

"Since hostile environments can be natural or social," he notes, "we can also include crowding, malnourishment, air and water pollution, noise pollution, violence and insecurity, fear, economic dislocation, resource depletion, earthquakes, and destructive storms.

"One can go on as far as one wishes to include most of the social ills of our time," he notes.

Dr. Packer is not proposing that NASA enter all of these thickets. He believes that NASA's primary jobs should be space exploration and operations, and aeronautical research and development. But, he says, "the Apollo achievement provides an appropriate time to propose that technology transfer to serve public and social purposes is now a major concern of [NASA],

At a January news briefing, NASA chief, Dr. Thomas Paine, said NASA had no plans for major involvement in public problems. But that could change if the Administration wanted the space agency to shift its focus.

[and] it will be pursued with the same mission-oriented concentration that characterized the space program.

"This new policy," says Dr. Packer, "does not preclude a careful approach to unfamiliar application environments. We have to structure as favorable [a policy] environment as possible in order that [NASA's] technology contributions have a maximum impact."

He urges that NASA state publicly and clearly its "unequivocal determination to continue primary work in space exploration and aeronautics" and at the same time provide a "persuasive summary of NASA's impact on science, technology, the nation's economy, and the quality of life in this country."

He believes NASA should state what it is doing now to help solve social and civil problems. It should also declare its intention to "develop new areas for NASA participation in solving civil systems problems, with an outline of organizational and policy steps taken or to be taken."

He recommends that "in selecting technology areas [for NASA] to work on, primary emphasis should be placed on those that derive from space capabilities in a rather direct manner. Then [NASA] should consider those that require talents and technology unique to NASA. Then [NASA] should consider minor modifications and conversions of NASA technology. Following that, [NASA] should consider major modifications of NASA technology and significant investments in applying NASA technology to new needs. Finally, [NASA] might consider the generation of new technology that does not exist, that no one is working on, and where we have reason to expect a high probability of success.

"I use the term 'technology' to include both hardware and software as well as organizational, management, procurement, legal, personnel, and leadership skills residing within NASA," Dr. Packer says.

Some of the problem areas NASA should be doing more in, or entering, are, in Dr. Packer's view: air traffic control, with its high urgency; aeronautical research and development, where a revitalization of efforts is needed; new community design, with its challenge and public interests (*see "An Idea for a City—Born of the Space Age,"* AIR FORCE/SPACE DIGEST, *January 1970*); earth-resources survey satellite programs, which need higher priority than they currently have; city traffic control; urban and interurban underground tube transport; systems approaches to auto and highway safety; V/STOL development; crime control technology, which everyone agrees is necessary and about which little has been done; spaceborne educational television systems; food technology; oceanology; control-theory applications, with high potential payoffs across the economy; and pollution, an area in which NASA has already done some good work but which needs, in Dr. Packer's view, a "unifying structure."

Nixon Administration, please note.—END

The gigantic airplane park at Davis-Monthan AFB, Ariz., constitutes the major reserve of military aircraft strength for all the services. Disdaining any view that their operation is an "airplane boneyard," the men of the Military Aircraft Storage and Disposition Center at Davis-Monthan regard themselves as charged with the essential task of keeping America's aircraft reserve in flyable condition while at the same time conserving those precious taxpayer dollars . . .

Davis-Monthan's MASDC— A Going Concern

BY LAWRENCE C. RAILING

WHAT is probably the largest collection of aircraft in the world stands in row upon orderly row on the sunbaked earth of the Arizona desert.

To the imaginative, it resembles a vast aircraft museum assembled by the Titans, or perhaps a monolithic moving-picture set created by some flamboyant Hollywood producer. In reality, however, the Military Aircraft Storage and Disposition Center (MASDC) at Davis-Monthan AFB is a direct reflection of America's past and present military muscle and constitutes the bulk of the US's reserve airpower.

Nothing irritates MASDC personnel more than to have their 4,000-plus aircraft inventory referred to as an "airplane boneyard." They regard MASDC as a going concern, charged by the Air Force Logistics Command with the important task of storing and maintaining the enormous fleet of excess aircraft turned in by all the services. A major corollary of this is to supply flyable aircraft and usable parts to a slew of

At first glance the orderly rows of aircraft at Davis-Monthan AFB, Ariz., might be taken for some huge collection of model planes. These aircraft are the real thing, however, and constitute the bulk of America's reserve airpower. Here, from front to rear, are KC-97s and C-97s; B-47s; and a US Navy air fleet of retired P2Vs.

ernment's SST study, President Nixon announced program go-ahead "...because I want the United States to lead the world in air transport. And it is essential to build this plane if we are to maintain that leadership." He added that it "had been a very difficult decision," preceded by a spirited debate within the Administration. The President asked for new appropriations totaling $662 million over a five-year span. An equally spirited debate in both houses of Congress preceded actual allocation of funds for the current fiscal year. It should be noted that Boeing, General Electric, and the airlines have committed $382 million of their own money to the SST program.

The SST's Prospects

With about $125 million in federal funds currently in hand and some $314 million earmarked for allocation in FY 1971, the SST program is sufficiently "healthy" to permit first prototype flight in 1972. Certification of the production version of the US SST is expected either late in 1976 or mid-1978. James H. Beggs, Undersecretary of Transportation, predicts the timing of certification and first operational service of the production aircraft will be affected by how well the Concorde and the Soviet TU-144 do in the world market.

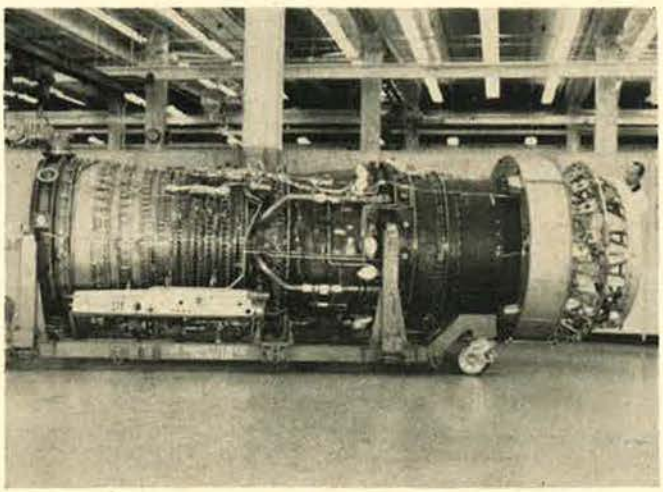
Both the TU-144 and the Concorde made successful supersonic test flights in 1969. While they are smaller, slower, and less productive than the American SST, US officials view with considerable apprehension the prospect of growth versions of these aircraft, which could be available at the time the US SST is to enter into service.

The Soviet SST is something of an enigma to Western observers. Some US experts have observed that the Soviet prototype is technically inferior to Soviet military aircraft, especially in inlet and wing design. A more advanced SST, possibly of titanium construction, may be waiting in the wings.

If either or both foreign SSTs score sales beyond present expectations, Mr. Beggs told this magazine, an accelerated development schedule of the US SST can be instituted. It would involve development of the production aircraft before the prototype's flight testing is completed. Such a "high-risk" schedule "would make financing of the production phase through private channels more difficult," he conceded.

The SST program's next crucial decision point will be reached in June 1972 when Boeing is to submit to the government its plans for financing production of the SST. Both Mr. Beggs and Mr. Withington believe it may be possible to finance the multibillion-dollar-production phase without direct federal assistance.

The possibility of the government's underwriting the basic investment or arranging financing through government bonds is under consideration, however. According to Mr. Beggs, federal participation "may prove palatable to Congress," assuming that no technical problems are encountered by the prototypes. Total cost of the production phase is pegged at about five times the 747 superjet investment of $750 million.



The SST's powerplant, the General Electric GE4 afterburning turbojet, has already produced 69,900 pounds of thrust during static-test runs, making it by far the world's most powerful aircraft engine. The GE4 is a single rotor design with a nine-stage compressor and a two-stage turbine.

Two Different SSTs

According to Mr. Withington, Boeing's market research indicates the desirability of two different SST models with high commonality of all major components. One model would have a wide-body fuselage with a total length of 296 feet six inches, and could transport up to 321 passengers over a distance of about 3,700 miles (New York to Paris) to serve North Atlantic as well as the Hawaii-West Coast gateway traffic. The other variant is likely to be a 253-passenger aircraft, 286 feet long, with a range of about 4,700 miles, tailored to operate from and to inland cities as well as over the longer route segments of the Pacific. Both aircraft would have an initial gross takeoff weight of 750,000 pounds but could grow to 800,000 pounds without structural or landing-gear changes. The large-capacity model would cost about $1 million more than the $40 million (1970 dollars) smaller model.

Boeing believes it will be able to sell a minimum of 515 SSTs by 1990, each one returning about $4 million to the government in royalties.

Two hundred seventy aircraft are likely to be bought by foreign airlines. The negative effect on the US balance of payments of not producing an SST is estimated at more than $16 billion. Also, the SST program will employ about 50,000 people during its peak production phase, and yield some $3 billion in direct and indirect tax revenues.

Because of its great speed and short turnaround time, the SST will yield extraordinarily high productivity. Present industry calculations indicate that total SST operating costs per seat-mile will be equal to, and eventually lower than, those of the 440-passenger subsonic 747.

Many considerations in addition to obvious economic and technological benefits persuaded the present Administration to continue the SST program. One, according to Undersecretary Beggs, stood out: The SST's ability to bridge rapidly the distances that separate the United States from the countries of South America, the Far East, and Africa. This "will prove invaluable to the United States politically as well as in terms of increased trade," he said.—END

Air Force skills and facilities are being teamed with those of other government and private agencies in an attack on our social problems. And the Air Force, itself, reaps a rich return from . . .

Domestic Action—A New Challenge for the Air Force

By the Hon. John L. McLucas

UNDERSECRETARY OF THE AIR FORCE

THE reaction of the two youngsters differed in emphasis and grammar, but they shared a common enthusiasm. The first, for example, looked back at his summer camping experience and said: "I think this is a real good thing because most of the kids in the camp would go around and get in trouble otherwise, and when they are here at camp they have something to do." The second boy said: "I like camp Rilea because of the cownsalrs, the food, and expachaly the stof we did all week. . . ."

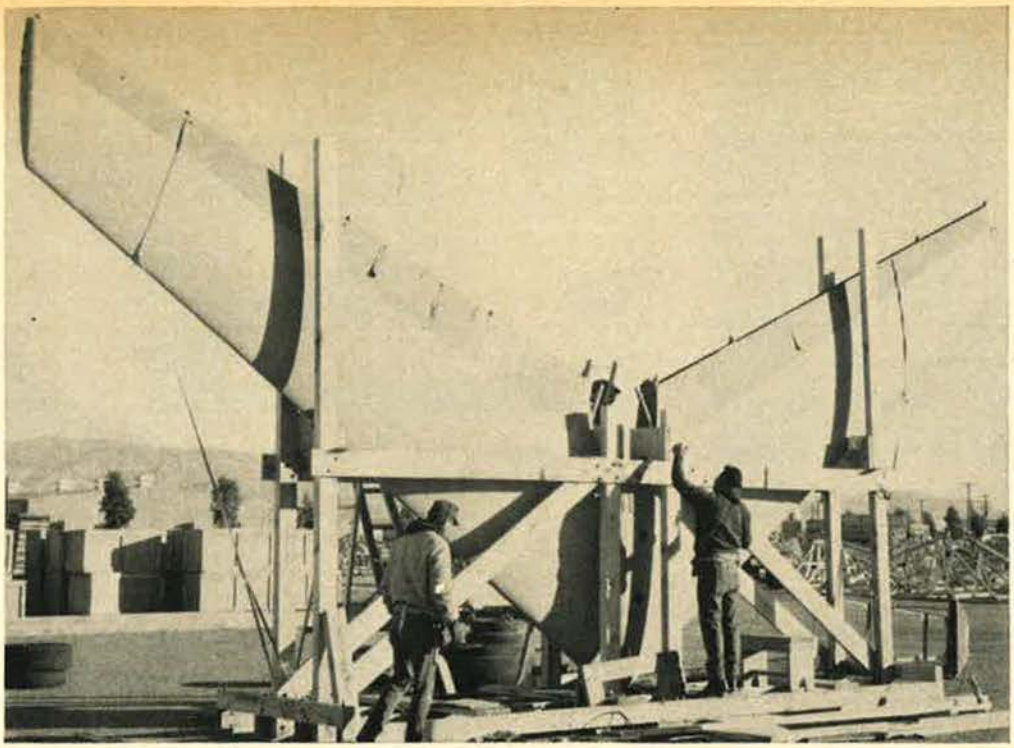
The "stof we did all week . . ." was a program made possible by the combined efforts of the Oregon Air National Guard, the Oregon Military Department, and the City of Portland Housing Authority. It allowed eighty-two boys to spend a week at camp, children who probably would not otherwise have had this opportunity. The program was called HAP (short for the sponsoring Housing Authority of Portland), and it was an outstanding example of how military and civilian interests can be combined profitably.

Gathering these interests together will be one of the tasks of the recently established Department of Defense Domestic Action Council as it seeks to deal with some of the growing domestic pressures. Due perhaps to the historically close relationship between America's civilian and military populations, and the fact that the services have always responded to civil emergencies, the April 1969 inception of the Domestic Action Council by Secretary of Defense Melvin Laird has probably not been seen for what it actually is: the first planned attempt to apply DoD resources to domestic difficulties.

Local attempts to apply service strength are as old as the nation. Servicewide projects are new, however, and their primary impetus seems to have come from our Defense Secretaries. The groundwork for the current emphasis was well laid by former Secretary of Defense Robert S. McNamara. Speaking to the New York City Veterans of Foreign Wars in late 1966, he stressed the cause-and-effect relationship between poverty, poor education, and social unrest. Then he announced that the Department of Defense was not going to stand idle when it could help. Instead, it was going to involve itself in the broader aspects of national security through Project 100,000. In line with this project, the services lowered their entrance requirements and began accepting thousands of men who would have been rejected earlier. Secretary McNamara felt that the armed forces could train these men, and thus contribute toward improving a portion of the nation's youth. Certainly the evidence to date justifies his faith.

When Clark Clifford became Secretary of Defense, he also became convinced early that DoD could provide more help than it was giving then to alleviate

Dr. McLucas became Undersecretary of the Air Force on March 17, 1969. He came to the Air Force from MITRE Corp., which he had headed since July 1966. Earlier, Dr. McLucas served as NATO's Assistant Secretary-General for Scientific Affairs (1964-66) and as the DoD Deputy Director of Defense, Research and Engineering for Tactical Warfare Systems (1962-64). From 1950 to 1962, Dr. McLucas held several positions in the electronics industry, including the presidency of HRB-Singer, Inc. He is a graduate of Davidson, College and holds a doctorate in physics from Pennsylvania State University. The Undersecretary is a recipient of the Distinguished Public Service Award, the holder of ten patents, and author of many scientific articles. During World War II, Dr. McLucas served with the Navy as a radar officer.



Dwarfed by the horizontal stabilizer of a once-proud B-47 Stratojet, MASDC personnel prepare the vee-shaped giant for shipment. It replaced a damaged counterpart on an operational aircraft at Kirtland AFB, N. M. This method of cannibalization saves millions of taxpayer dollars every year.

organizations and activities, the foremost of which is the effort in Vietnam.

Davis-Monthan, near Tucson, was picked at the conclusion of World War II initially as a storage site for excess B-29s and C-47s, and many an old warbird found its final roost there. The base was considered ideal for such a role because of dry climatic conditions and absence of acidity in the desert soil.

Even now, an essential project of a chronic nature is research into better methods of controlling corrosion and more efficient preservation techniques.

MASDC's mission has evolved since the 1940s and currently, with the many types of aircraft being flown in Vietnam, the Center has a high-priority role in keeping them flying. Frequently, it is the only source of a component vital to the operational life of an aircraft.

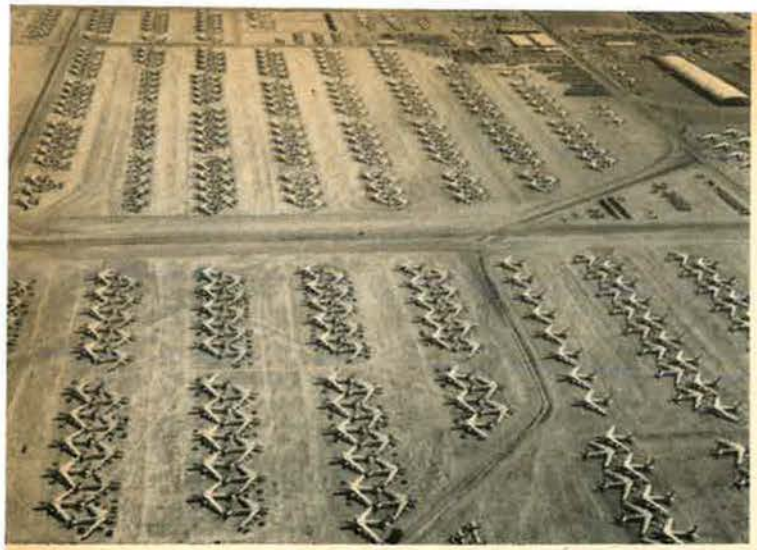
Into MASDC's inventory go countless "save list" items methodically stripped from nonflyable aircraft. These are tested, catalogued, and warehoused. They are dispensed in line with interservice support agreements arrived at by the Army, Navy, and Coast Guard.

This immense task requires a force of about 950 civilian and 100 military personnel, including thirty Navy personnel. Many of the civilian technicians were formerly in the Air Force or Navy and are able to utilize the experience garnered during their service careers.

MASDC is commanded by USAF Col. R. P. Collins, who took over in September 1967 following duty at Cam Ranh Bay, Vietnam. Colonel Collins is a veteran World War II combat pilot credited with 133 missions. During the Korean conflict he had charge of maintenance of some 500 military aircraft used in pilot training. Deputy commander for materiel of the 483d Tactical Airlift Wing in Vietnam, Colonel

(*Continued on following page*)

A once-deadly but now deactivated firing squad, a long line of AGM-28 Hound Dog missiles stands in the quiet desert that comprises Davis-Monthan, at which some 3,000 acres are utilized by MASDC in aircraft-preservation activities.



Looking eastward over an armada of grounded B-47s, this picture reveals only a minor part of the reserve force. Note huge reclamation shelter in upper right-hand corner.

Many of the aircraft residing at Davis-Monthan have had distinguished careers. The B-52 pictured above is a veteran of over fifty bombing missions in Southeast Asia.

Collins was responsible for providing intertheater airlift of supplies and materiel that could not be serviced by larger aircraft. The Army turned over six squadrons of CV-2 Caribou aircraft, renamed C-7As by the Air Force, to provide airlift into forward areas from Cam Ranh Bay and eight other locations.

MASDC's operation involves some interesting money. With about $8 million in payroll plus another $1.5 million for supplies and facilities, the impact on Tucson's economy is significant.

But MASDC people are quick to point out that the dollar savings achieved by the reuse of parts and components that are fed into the active aircraft inventory far outweigh MASDC's annual budgets.

MASDC estimates that in Fiscal 1969 it returned $31 in value for every dollar in its budget. This is considered conservative arithmetic since the figures are based on the original cost of the equipment, which would certainly be much higher at today's inflated prices.

The Center also concludes that in the previous three-year period it returned more than $947 million against a budget total of $24 million, for an average return of $38 per budget dollar.

But along with the not inconsiderable saving in tax dollars, MASDC men are extremely proud of being able to turn up vitally needed material on an "instant" basis to supply the military for use in Vietnam.

In its role as aircraft cornucopia, MASDC processed and shipped to Southeast Asia in 1968 alone B-52 Stratofortress engines valued at nearly $40 million to replace mission-worn counterparts.

Another valuable contribution was the return of C-47 Skytrains to the functioning inventory for a variety of uses in Vietnam. These venerable two-engine prop-driven aircraft have been pressed into service not only to provide airlift but to perform dramatic missions such as "Spooky" gunships, delivering great firepower at minimal speeds and altitudes.

And in jungle warfare the A-1E Skyraider, renovated and beefed up by MASDC to carry 10,000-pound bomb loads, has again proved its usefulness as a single-engine bomber and ground-support aircraft.

In its current inventory, MASDC has about sixty-three different aircraft types valued at about $5 billion at yesteryear's prices. The aircraft verge from operational planes to stripped-down hulks. About sixty-five percent of the aircraft parked on MASDC's 3,000 acres are in flyable condition and are kept that way by an eighteen-step process of preservation.

Missions for MASDC-supplied aircraft range from NASA's space program to the Department of Agriculture's effort to exterminate insects. MASDC also is permitted to provide planes and parts to friendly foreign governments under terms of the various military-assistance agreements.—END

A basic coat of preservative is applied to the fuselage of an A-26 being prepared for extended storage. Eighteen separate operations are undertaken to ensure a thorough job in preparing aircraft for retirement. The dry desert air is an important factor in keeping the stored planes in a condition from which they could be returned to active duty if needed.

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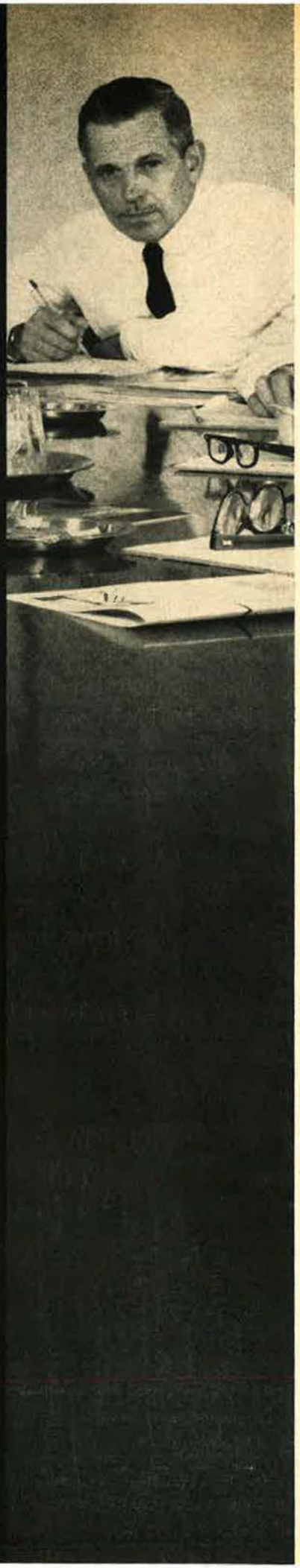

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LETTER FROM LOS ANGELES

By Irving Stone

WEST COAST EDITOR, AIR FORCE/SPACE DIGEST

Kitty Hawk to Tranquility

More than six decades of aerospace achievements initiated by the Wright brothers at Kitty Hawk, N.C., in 1903 put those two pioneers, in spirit at least, on the moon with Apollo-11 Astronauts Armstrong and Aldrin. Not many Americans know that some Wright brothers' gear went to the moon and back with Apollo-11.

At the Los Angeles Area Chamber of Commerce Wright Brothers Memorial Banquet commemorating the sixty-sixth anniversary of manned, powered flight, Apollo-11 mission commander Neil Armstrong presented to a representative of the Air Force Museum a framed and inscribed memento of man's first landing on the moon at Tranquility Base.

The gift included a patch of fabric from the upper wing of the Wright 1903 Flyer and some small wood chips from its propeller, carried to the moon in Armstrong's personal bag. They are among the most historic and significant artifacts in the collection at the Air Force Museum, Wright-Patterson AFB, Ohio *(see March 1969 AF/SD, page 102).*

Advanced Lunar Shelter

NASA's Langley Research Center is scheduled to support a baseline study of a shelter system to provide two-man crew accommodations during a fourteen-day operational mission on the moon. The study also will investigate designs modified to extend the stay for thirty- and ninety-day operational missions, and to accommodate a third crew member. Changes to the baseline system that would provide ninety-day emergency survival for two crewmen also will be determined. In an emergency, crew activity would be limited to most efficient use of consumables, and extravehicular activity (EVA) would be minimized or eliminated.

Two parallel contracts for the system study and preliminary design have been scheduled to be supported by the Langley Research Center. Each effort would require about seventy man-months. Total funding will be close to $500,000. About twenty-five companies have been solicited for proposals.

Meanwhile, a lunar module derivative, the extended lunar module (ELM), presently is under study. It would provide minimum accommodations for a three-day stay by a two-man crew. Thus, the inclusion of a lunar shelter system in the lunar-exploration program could provide improved crew living quarters during extended operational missions, assurance of crew survival in the event of an emergency, and be a precursor for lunar surface bases.

Shelter concepts might include rigid, expandable, or combination units, and supporting subsystems that would offer a reasonable probability of satisfying the guidelines and design constraints established by NASA. Shelters for the fourteen-, thirty-, and ninety-day stay times would provide crew accommodations for sleeping, eating, and personal hygiene facilities; space to don and doff backpacks (portable life-support systems); suits for shirtsleeve environment; and storage facilities for shelter units, tools, and supplies.

Total weight of the two-man baseline shelter system for a fourteen-day operational mission on the lunar surface is not expected to exceed 3,000 pounds, including stores and consumables.

The packaged baseline lunar shelter system would fit in a cylindrical envelope nine feet in diameter and seven feet high. No volume is specified for the derivative shelter systems that would provide additional stay times, but minimum volume would be a design goal.

The shelter system would be capable of a ninety-day quiescent storage in packaged condition on the lunar surface. Automatic deployment and checkout would be the primary mode of setup. A manual backup system to be operated by the pressure-suited crew also would be incorporated. However, crew participation requirements and time would be minimized for manual shelter deployment.

Shelter hatch locking mechanisms would allow operation from both inside and outside. All sealable joints would be designed for easy operation and, where possible, for internal pressure to help maintain the seal. If an airlock were used, provision would be made to pressurize it from inside the airlock and from the shelter, with communications between airlock and shelter.

Consideration must be given to micrometeoroid penetration, extremes of temperature (plus 250 to minus 300 degrees Fahrenheit), solar flare and electromagnetic radiation, and lunar vacuum and surface conditions. The mechanical properties of materials selected would have to be corrected for temperature, vacuum, and other environmental effects.

Space Shuttle and the Boom

Development of a space shuttle to support a space station/space base involves a variety of problems for NASA's Marshall Space Flight Center. Among them is prediction of sound-intensity levels including sonic-boom effects during test, launch, and reentry of space vehicles. Although the request to industry to submit proposals for such a study has been canceled, the philosophy and planning underlying the projected effort included these considerations:

* Prediction techniques and procedures have been developed for making sound-intensity estimates associated with static test and launch operations up to approximately a fifty-mile radius from the launch or test site.

* Predictions and estimates of overpressures or sonic booms are not included in these procedures because a vertically rising source seldom if ever propagates sonic booms back to earth.

However, with a vehicle returning to earth, this effect must be taken into account, as well as propagation effects from an approaching or passing vehicle. The reentry and landing pattern of future shuttle vehicles will require sound-propagation predictions over very large areas, and the effects of increased engine-thrust levels will also have to be considered.

The proposed study included development of an atmospheric acoustical model for making sound and sonic-boom-intensity estimates of the levels that could be expected from the reentering space shuttle. The model, with current state-of-the-art techniques, including identification and estimates for focal zone, would have been amenable to computer programming.

Estimates were to be determined from atmospheric measurements collected by the Department of Commerce's Envi-

ronmental Science Services Administration (ESSA) upper-air measuring program, and would have been made along predetermined entry corridors and flight paths. The model would have used classical ray-tracing techniques to estimate atmospheric propagation effects from altitudes exceeding nine miles down to the surface. The overall study was to have extended from about nine months to one year and likely would have involved 2,500 man-hours of effort. The study probably will be reactivated as the shuttle program itself gets going.

Shuttle Landing Control

The study of automatic and manual terminal guidance and control systems for horizontal-landing space shuttles will be a sizable effort in NASA's preparation for development of a ferry system to supply a space station/base. This study, scheduled to be performed by industry for NASA's Ames Research Center, should span one year.

Space-shuttle configurations capable of trimmed hypersonic flight and having sufficient subsonic lift-to-drag (L/D) ratio to perform a horizontal landing have been studied for a number of space-vehicle applications. Experience has shown that unpowered, low L/D vehicles (for example, a lifting body) can be guided manually to the landing point when there are unobstructed visual conditions in the terminal area.

But efficient use of the lifting body, as well as variable-geometry vehicles and winged vehicles, in future space missions will require the ability to return to a base of operations under conditions of restricted visibility, including darkness or cloud cover. Under these conditions, automatic aids must be available either to fully guide and control the vehicle to the landing point, or to help the pilot manually control and guide the vehicle to a landing.

The guidance- and control-equipment instrumentation, both airborne and ground-based, would be defined for a flight condition beginning with an approximately 4,000-foot-per-second speed at an altitude of 100,000 feet down to the ground. Under mission-objective guidelines established by NASA, it is assumed that the shuttle will be used for resupply (with on-orbit stay of seven days) of a space station orbiting at an altitude of about 300 miles and at an inclination of thirty to sixty degrees. It should also be capable of short-duration flights to altitudes up to 800 miles and orbital inclinations of ninety degrees (polar). Capability for a large number of mission cycles would be desirable, and for as many as 200 cycles with a minimum of maintenance.

The vehicle will have a two-man crew but may be flown by a single crewman. The vehicle controls will be aerodynamic for all axes, augmented by reaction controls where necessary to provide suitable handling qualities. If automatic-landing-system information were not available, manual landing would have to meet the minimum Federal Aviation Administration certified requirements, *i.e.*, landing characteristics and handling qualities that would not require skills more demanding than those of operational land-based aircraft. There would be provisions for safe mission-termination in the event of major malfunction following takeoff.

Entry Procedure

With the terminal guidance and landing approach begun at 100,000 feet, the system would provide for a 360-degree turn before reaching 35,000 feet, when a straight-in approach would be initiated. The pilot would visually monitor the approach from "break-out" to the landing point.

Use of speed brakes for approach control and engines for the flare maneuver and for go-around will be analyzed by the study contractor.

Such available ground aids as the Instrument Landing System (ILS), Ground-Controlled Approach (GCA), or automatic instrument landing system would be considered part of the approach system if their performance were compatible with the landing-approach requirements of the shuttle vehicle. The shuttle would have maximum onboard autonomy so that ground mission operations could be minimized to reduce mission cost.

Maintainability, Repair in Space

A program to establish design criteria for in-flight maintainability and repair concepts applicable to space-base fluid systems in general, with primary emphasis on reaction-control systems, will be sponsored with industry by NASA's Houston Manned Spacecraft Center. The program will be a one-year effort. The baseline will be a ten-year, earth-orbiting space base with resupply intervals of thirty days as a minimum and 180 days as a maximum. The study funding may run about $100,000.

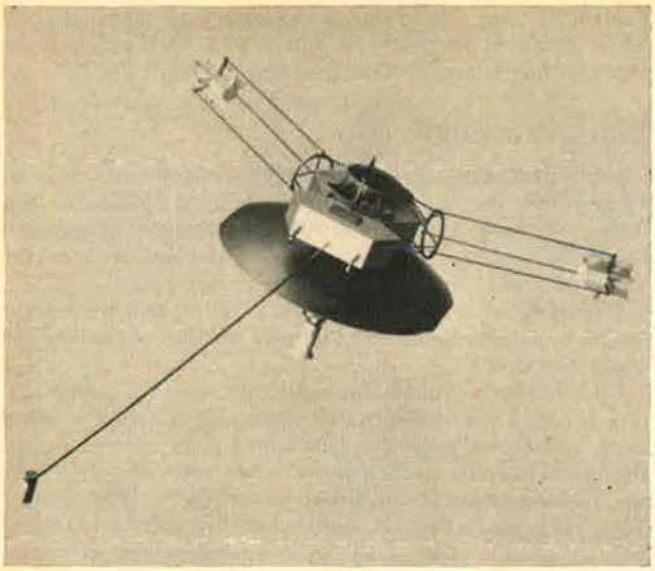
Significant effort has been expended on the two concepts of inherently high systems reliability and component redundancy. But relatively little effort has been devoted to a third concept: in-flight maintainability through repair and replacement of components, or to the associated onboard monitoring and checkout systems. For long-term manned missions of up to ten years, redundancy and high reliability alone will be insufficient to ensure mission success and crew safety. To achieve required systems reliability over such an extended duration, a combination of reliability, redundancy, and in-flight maintenance concepts will be required.

The study is expected to result in detailed design criteria and recommendations, together with operational requirements, for in-flight maintainability of spacecraft reaction-control systems. Tradeoff studies will be performed to determine the feasibility, adequacy, procedures, and impact

(*Continued on following page*)

The ninth C-5 Galaxy off the assembly line at Lockheed-Georgia Co.'s Marietta facility takes off on a flight to its initial duty station at Altus AFB, Okla. The giant C-5 became the first of its kind to join the Air Force's operational fleet of transport planes.

—Wide World Photos



Pictured here is a model of the first spacecraft now under development for a trip to Jupiter. NASA's Ames Research Center is negotiating with TRW, Inc., to build two of the craft for Jupiter flybys in 1972 and 1973. The probes are scheduled to send photos of the planet back to earth.

on spacecraft and subsystems of redundancy, spares, standardization of components and modules, and cannibalization methods (both within and between fluid systems) to increase the success probabilities for long-duration missions. Also required will be detailed descriptions of typical in-flight monitoring, checkout, malfunction detection and isolation, and repair activities, including crew participation and requirements for checkout and maintenance equipment.

Ground rules governing the study will include the following:

* No single failure will result in loss of life or mission termination.
* Redundant components or systems will be provided for all critical items.
* All maintenance operations will be simple, requiring little or no previous specialized training.
* Crew safety and human factors will be prime considerations in all procedures.
* All procedures will have to be performed in or out of a gravitational-type force field and by a crewman in a pressure suit.
* Requirements for special tools and test equipment will be minimized.
* Maintenance operations will require no cutting, soldering, welding, or brazing.

Management Skill Cited

Hughes Aircraft Co.'s Missile Systems Division has chalked up a significant achievement with its management-control system for the Air Force Maverick air-to-surface missile program. On the first demonstration of the Air Force Cost/Schedule Planning and Control System (C/SPCS) for the design, development, test, and evaluation (DDT&E) phase of Hughes' Maverick, the Hughes system has been accepted by the Air Force without modification.

This is the first time a C/SPCS proposal has been validated by the Air Force on the initial submittal by the company. Other contractors have required several demonstrations of C/SPCS before validation. The complexity of the C/SPCS effort is evidenced by the DDT&E effort for the Maverick, extending to about January 1972 and valued at about $100 million. The overlapping production phase is programmed to extend to the fall of 1974. The test program already is well under way.

In effect, the C/SPCS is a check on cost and scheduling performance versus money spent: "What have you accomplished for the dollars?" The implementation of the control system is based on large work packages representing multimillion-dollar costs, with breakdown into smaller packages involving allocations of thousands of dollars.

For the Maverick DDT&E phase, the planning required construction of approximately 2,500 work packages and took at least six months. Average size of the work package was approximately $30,000. Most of the packages were for discrete tasks and required about three months from conception to completion.

Leading to the final C/SPCS demonstration were three preliminary meetings with military personnel: one in May 1968 while Hughes was engaged in the competitive contract-definition phase; a second after contract award to Hughes in August 1968; and a third meeting in October 1968 for a so-called "mini-demonstration."

The final demonstration of the C/SPCS consumed six weeks starting in February 1969. The validation team consisted of ten members: one from Air Force Systems Command (AFSC) Headquarters, one from AFSC's Aeronautical Systems Division (ASD), three from the Systems Program Office (SPO) at ASD, three combined from the Air Force plant representative (AFPR) at Hughes and the Defense Contract Audit Agency (DCAA), and one representative each from the Army and the Navy. The last two acted both as observers and as contributors to the validation function. Formal notification of the C/SPCS validation from AFSC came in October. Another validation exercise—for the Maverick manufacturing C/SPCS—is scheduled for mid-1970.—END

First photo released by USAF of the new Maverick missile shows a cluster of three of the air-to-ground weapons, designed for use by F-4 and A-7 aircraft against tactical targets. With the full-scale mockup is James Drake, program manager at Hughes Aircraft Co., Maverick's developer.

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THE BULLETIN BOARD

News and Comment about Air Force People . . .

By Jackson V. Rambeau
AFA DIRECTOR OF MILITARY RELATIONS

An All-Volunteer Force?

In Washington the most widely discussed subject pertaining to military personnel is the prospect of an all-volunteer military force. President Nixon has stated this is one of his aims and has appointed a commission, headed by former Secretary of Defense Thomas S. Gates, to explore the subject. A report by the commission is expected momentarily. AFA was asked to give its thoughts on the subject, and the following letter was delivered to the commission in early January:

Dear Mr. Gates:

The Air Force Association appreciates the opportunity of providing you some recommendations for consideration in your pursuit of the objectives of an all-volunteer armed force. In achieving these objectives, we believe the following issues to be fundamental to a sound national policy:

a. While cost considerations necessitate that the number of military personnel in our armed forces be kept at a minimum, national security must be the paramount criterion in determining force size in the decision to move toward a volunteer military system.

b. We believe that a viable Selective Service System must be retained in law for standby use, and that transition to a volunteer force be in phased, cautious steps to ensure that national security is not jeopardized.

c. Force-level changes should recognize the contribution of the thousands of dedicated officers and enlisted men who comprise the career force. Reductions in the post-Vietnam era and transition to an all-volunteer force should be timed to avoid involuntary release of experienced personnel, whose contributions as cadre will be vital to the effectiveness of the developing all-volunteer force.

We consider the following items significant to the process of successfully progressing toward a volunteer force:

a. The military-compensation system should be revised to establish a system of salaries competitive with civilian industry. This pay system may have to be supplemented with a system of differential enlistment bonuses to attract personnel with special skills, needed aptitudes, or high educational achievement who otherwise might not enlist. Also, the feasibility of ten-year "concentrated career" packages should be explored. Such tours, for personnel with critical skills, might attract people with plans for second civilian careers to start in their mid or late thirties. The compensation system should include an extension of entitlements such as movement of household goods, dependent travel, etc., to first-term personnel. Increased numbers of ROTC scholarships and full medical scholarships may be necessary in order to provide a sufficient number of officers.

b. In addition to compensation, the quality of military life needs improvement. Both the quality and quantity of bachelor and family housing should be improved. Whenever possible, bachelor personnel

Key officials of the US Civil Service Commission and DoD were present at the December meeting of AFA's Civilian Personnel Council in Washington. Shown here with Donald S. Dawson, Council Chairman (third from right), are Carl W. Clewlow, Dep. Asst. Secretary of Defense (Civilian Personnel Policy); Commissioner James E. Johnson; Commission Chairman Robert E. Hampton; Commissioner Ludwig J. Andolsek; and Maj. Gen. John L. Locke, Asst. Dep. Chief of Staff/Personnel, Hq. USAF.

Since ground was broken for Air Force Village last May (*see July 1969 AF/SD, page 22*), work has gone right along on the project. Shown here, in a photo taken late in 1969, is a panoramic view of the partially completed Village—the high-rise, garden apartments, and shopping center. As a retirement home for USAF career officers, their widows and dependents, the Village, which will include a community center and health and recreation facilities, should be ready for occupancy late this year.

In a recent Pentagon ceremony, the honorary rank of Air Force Super Sergeant was bestowed on Dr. Theodore C. Marrs, AF Dep. Asst. Secy. for Reserve Affairs. Dr. Marrs received the tribute in recognition of his interest in matters affecting enlisted personnel. Shown presenting the plaque on behalf of the Air Force Sergeants Association is USAF's Chief Master Sergeant Donald L. Harlow.

should be allowed to live off base if they so desire.

c. Past experience with civilian substitution indicates that lasting change in the military versus civilian mix is difficult to maintain.

d. A viable Reserve Force capable of supporting the active force on short notice must be maintained. The role of the Reserve Forces during times of national crisis should be reviewed. A program of compensation and incentives that is proportionally comparable to the effort expended to support a voluntary active force is the minimum considered necessary.

Apart from the desirability or undesirability of a volunteer force, the feasibility of achieving complete independence from conscription seems improbable. The pressures of national problems on the budget make it unlikely that sufficient dollars will be available for cost-of-living increases, a visible salary system, and major pay increases for first-term personnel, all of which are needed to achieve the objectives of a volunteer force.

Again, we appreciate the opportunity to comment on an all-volunteer armed force and wish the commission every success in its difficult undertaking.

Sincerely,

GEORGE D. HARDY, President

Civilian/Military Per-Diem Increases

The President has approved legislation to increase maximum allowances for official travel by civilian employees and military members. The new laws provide a $25 maximum per-diem rate for travel within CONUS. Under the new laws, the maximum allowance when payment of actual expenses is authorized will be $40 per day for travel within CONUS and $18 per day plus the applicable locality per-diem rate for travel outside CONUS. Implementing regulations are being issued.

Eighth Air Force to Guam

SAC's Eighth Air Force, headquartered at Westover AFB, Mass., and scheduled to be inactivated in April with its units divided between Second and Fifteenth Air Forces, will not completely disappear.

Plans are under way to transfer the Hq. Eighth AF designation to a smaller organization and retain the famous World War II name in an active-duty unit. Air Force expects to inactivate Hq. 3d Air Division, currently on Guam, and reactivate that unit as Hq. Eighth AF.

The administrative change will take place officially in April. The name change will not affect personnel currently in 3d Air Division, nor will any change occur in the unit's mission. There will be no increase or movement of personnel and equipment.

At some future date the Air Force plans to return the Eighth AF designation to an organization based in the United States. Under consideration is Second AF, a World War II training command. Headquarters of Second AF currently is at Barksdale AFB, La.

This action would give SAC two numbered air forces in the United States, the Eighth and the Fifteenth, both with colorful service histories.

Civilian Optional Retirement Statistics

Of 15,110 Air Force employees eligible to apply for optional retirement by October 31, 1969, 1,262 (8.3%) applied between October 20 and October 31 to take advantage of the five percent cost-of-living adjustment and the other annuity computation benefits of Public Law 91-93. Normally, about 200 Air Force employees retire each month.

By pay system, 696 GS employees, 553 Wage Board employees, and thirteen employees in other pay systems retired. A higher percentage of GS-11 through GS-14 eligibles retired than did eligibles in GS-3 through GS-10; a higher percentage of eligible wage leaders (12%) and foremen (8.6%) retired than did eligible Wage Board nonsupervisory employees (7.6%).

Revamped AF Reserve Regions

A reorganization of the USAFR regions has been approved and is being implemented. Basically, a reduction from five regions to three is called for, with headquarters

(Continued on following page)

Brig. Gen. John O. Gray, USAFR, Assistant Executive Director of the Air Force Association, is congratulated upon receipt of the Legion of Merit on his retirement after twenty-nine years of active and Reserve service in the Air Force. The presentation was made at the Pentagon in December by Brig. Gen. H. L. Hogan, Director of Information, Office of the Secretary of the Air Force. Additional honors bestowed on General Gray include the Meritorious Service Medal and Certificates of Appreciation from AF Secretary Seamans, Chief of the Air Force Reserve Maj. Gen. Tom E. Marchbanks, Jr., and Maj. Gen. Donald S. Dawson, Chairman of the Air Reserve Policy Council.

at Dobbins AFB, Ga., for the Eastern Region; Ellington AFB, Tex., for the Central Region; and Hamilton AFB, Calif., for the Western Region.

Each region headquarters will be manned primarily by full-time Air Reserve technicians (ARTs), plus a few active-duty personnel, and augmented by part-time Reservists. The region commander will be a Reserve major general in a full-time ART status, with a part-time Reserve brigadier general as deputy commander, and an active-duty colonel as chief of staff. Region headquarters will be given greater command responsibilities and increased manning. Announcement of the new region commanders is expected in the near future.

Improvement of USAFR Individual Program

Several major changes in the management of the Air Force Reserve individual program are being implemented. An Individual Program Division will be established in the Office of Air Force Reserve, with responsibility for policy and programming actions relative to USAFR individual programs. Responsibility for all individual training, with the exception of the Air Reserve squadrons, will be transferred from Hq. AFRES to the Air Reserve Personnel Center (ARPC) in Denver, Colo. Hq. AFRES will retain responsibility for training of the Air Reserve squadrons.

Individual mobilization augmentees will continue to be trained by the gaining commands, with ARPC providing recruiting and programming support. The approved plan calls for greater involvement of the major command Section 265 Reserve Affairs Officers in the mobilization-augmentee program, and increased field supervision of the individual augmentation program in the commands by mobilization augmentee general officers.

Awards Program During FY '69

The Air Force has been commended by the Office of the Assistant Secretary of Defense (Manpower and Reserve Affairs) for having attained first place among the military departments in several important aspects of the awards program during Fiscal Year 1969. The Air Force achieved the highest submission rate for civilian suggestions (24.4 suggestions per 100 employees).

The quality of the adopted suggestions is evidenced by the fact that an average of over $3,100 in first-year benefits was realized from each one adopted. The program produced benefits averaging more than $180 for each direct-hire civilian employee.

The Air Force program also attained the highest benefits (over $70) per award dollar spent during the year. In the military suggestion program, the Air Force maintained its position of predominance, producing over $65 million in benefits for the fiscal year from a total of approximately $90 million for the entire Department of Defense.

Reserve Controlled Retirement Board

At its forty-eighth meeting in April 1969, the Air Reserve Forces Policy Committee recognized the necessity for a Controlled Retirement Board to reduce the existing overages of lieutenant colonels and majors in an active reserve status. However, the committee expressed the hope that it would not be necessary to convene subsequent boards.

In view of the programmed reduction of active-duty personnel under Project 703, and after an analysis of the revised strength projections for the Air Reserve Forces, the Secretary of the Air Force has determined that it is no longer necessary to mandatorily remove additional officers from active reserve status. Those officers who either resigned voluntarily, submitted requests for transfer to the retired reserve, or have informed the Air Reserve Personnel Center of their intent to do so in lieu of Controlled Retirement Board action, will be given the opportunity to either remain in, or return to, active reserve status.

Review of ROPA

The Office of the Secretary of Defense has approved a recommendation that the Reserve Officer Personnel Act (ROPA) be reviewed in its entirety, since the basic legislation is now fifteen years old. The first phase of the review will be limited to the collection of data and consideration of previous studies on this subject.

Parting Shots

★ The Bootstrap Commissioning Program quota has been increased from 200 to 300 beginning in 1971. This will increase the opportunities for deserving and qualified career airmen to earn a commission. Airmen who have enough college credits through off-duty study to qualify for their final year of college leading to a baccalaureate degree are encouraged to seek admission to the program.

★ The Reserve General Officer Selection Board was scheduled to convene at Randolph AFB, Tex., on January 28 to select officers for promotion to major general and brigadier general in the Air Force Reserve. We hope that the Board's selections do not set off another flap in the Senate, as has been the case in most past years.

★ The Civil Aeronautics Board has proposed a new regulation which would wipe out low-cost transatlantic flights for servicemen and their families. Fares from New York to London now available to the military community are as low as $60 one way. The Defense Department and several military-oriented organizations, such as AFA, are opposing this change.

★ The Air Force Reserve had an accident-free flying record for calendar year 1969—another outstanding Reserve achievement.

★ In August 1969, Air Force Logistics Command conducted a command-wide Junior Officer Council Conference, in conjunction with the AFLC Commanders' Conference. Holding the JOC Conference in conjunction with

US Rep. Jim Wright, center, of Texas' Twelfth District, is shown with Sid W. Roche, left, manager of the General Motors Assembly Plant in Arlington, Tex., and Brig. Gen. John W. Hoff, Commander of the 512th Military Airlift Wing at Carswell AFB, Tex. The three hold the Air Reserve Outstanding Support Award given to the firm.

At the White House in December President Nixon addressed members of the Reserve Components of the Armed Forces of the US. During the ceremony the President issued a proclamation in recognition and appreciation of the Reserve components of the US armed forces.

—Wide World Photos

the Commanders' Conference added a new dimension to the program, accorded prestige for the junior officer representatives, and provided them a chance to become better acquainted with their commanders and supervisors.

★ Did you know that the Veterans Administration is the largest independent government agency? It employs more than 147,000 full-time people, with about eighty-seven percent of this staff assigned to the Department of Medicine and Surgery.

★ The Air Force has approved upgrading the position of the Director of the Air National Guard of the United States from brigadier to major general. The job is presently held by Brig. Gen. I. G. Brown.

★ Some time ago, the Junior Officer Advisory Council of the Air Force Association recommended the elimination of the Regular Officer Commissioning Program for Distinguished AFROTC/OTS Graduates. They felt that officers should have at least two years of active duty before being considered for Regular status. The Air Force has recently announced that it will phase out Regular commissions for these two categories by 1972.

SENIOR STAFF CHANGES

Dr. Petras V. Avizonis, from Research Physicist (Optics), GS-15, to Technical Dir., Laser Div., GS-16, AF Weapons Laboratory, AFSC, Kirtland AFB, N.M. . . . **L/G Lucius D. Clay, Jr.,** from DCS/P&O, Hq. USAF, to Vice CinC, PACAF, Hickam AFB, Hawaii, replacing L/G James V. Edmundson . . . **B/G Rexford H. Dettre, Jr.,** from Asst. DCS/Plans, to DCS/Plans, ADC, Ent AFB, Colo., replacing M/G George V. Williams.

M/G Joseph L. Dickman, from Cmdr., 1st AF, ADC, Stewart AFB, N.Y., to DCS/Ops, ADC, Ent AFB, Colo. . . . **M/G (L/G Selectee) Russell E. Dougherty,** from Asst. DCS/P&O, to DCS/P&O, Hq. USAF, replacing L/G Lucius D. Clay, Jr. . . . **Mr. Donald R. Eastman, Jr.,** from Technical Dir., P.L. 313, to Chief Scientist, P.L. 313, Arnold Engineering Dev. Center, AFSC, Arnold AFS, Tenn.

L/G James V. Edmundson, from Vice CinC, PACAF, Hickam AFB, Hawaii, to Dep. CinC, US Strike Cmd. and Dep. US CinC, Middle East, Southern Asia, and Africa South of the Sahara, MacDill AFB, Fla., replacing L/G Benjamin O. Davis, Jr. . . . **L/G Francis C. Gideon,** from Cmdr., 13th AF, PACAF, Clark AB, Philippines, to Vice Cmdr., AFLC, Wright-Patterson AFB, Ohio, replacing L/G Robert J. Friedman.

M/G (L/G Selectee) Otto J. Glasser, from Asst. DCS/R&D, to DCS/R&D, Hq. USAF, replacing L/G Marvin L. McNickle . . . **L/G Gordon M. Graham,** from Vice Cmdr., TAC, Langley AFB, Va., to Cmdr., US Forces in Japan, and Cmdr., 5th AF, PACAF, Fuchu AS, Japan, replacing L/G Thomas K. McGehee . . . **M/G William D. Greenfield,** from Cmdr., 10th AF, ADC, Richards-Gebaur AFB, Mo., to Special Asst. to Cmdr., ADC, Ent AFB, Colo. . . . **L/G Thomas K. McGehee,** from Cmdr., US Forces in Japan, and Cmdr., 5th AF, PACAF, Fuchu AS, Japan, to Cmdr., ADC, Ent AFB, Colo., replacing L/G Arthur C. Agan.

L/G Marvin L. McNickle, from DCS/R&D, Hq. USAF, to Cmdr., 13th AF, PACAF, Clark AB, Philippines, replacing L/G Francis C. Gideon . . . **Mr. Harry P. Rietman,** from Supervisory Civil Engineer, GS-15, Directorate of Civil Engineering, to Assoc. Dep. Dir. for Civil Engineering Ops., GS-16, DCS/Programs & Requirements, Hq. USAF . . . **M/G (L/G Selectee) Jay T. Robbins,** from Cmdr., 12th AF, TAC, Bergstrom AFB, Tex., to Vice Cmdr., TAC, Langley AFB, Va., replacing L/G Gordon M. Graham. . . . **M/G (L/G Selectee) James C. Sherrill,** from Cmdr., 22d AF, MAC, Travis AFB, Calif., to vice Cmdr., MAC, Scott AFB, Ill., replacing L/G James W. Wilson.

PROMOTIONS: Nominated to **Brigadier General:** John F. **Albert;** Louis O. **Alder;** Winston P. **Anderson;** William H. **Best,** Jr.; Frederick C. **Blesse;** Marion L. **Boswell;** Arnold W. **Braswell;** Robert E. **Brofft;** John J. **Burns;** Kenneth R. **Chapman;** Harry N. **Cordes;** Darrell S. **Cramer;** William A. **Dietrich;** Clarence J. **Douglas,** Jr.; Frank W. **Elliott,** Jr.

Kelton M. **Farris;** James M. **Fogle;** Frank L. **Gailer,** Jr.; Walter T. **Galligan;** Robert H. **Gaughan;** John H. **Germeraad;** Morton J. **Gold;** John F. **Gonge;** John J. **Gorman;** James V. **Hartinger;** Richard J. **Hartman;** William R. **Hayes;** Erwin A. **Hesse;** John R. **Hinton,** Jr.; Roger **Hombs;** Thomas B. **Hoxie;** Eugene L. **Hudson;** Guy **Hurst,** Jr.; George J. **Iannacito.**

Daniel **James,** Jr.; Harold F. **Knowles;** Joseph E. **Krysakowski;** Carlton L. **Lee;** Oliver W. **Lewis;** John J. **Liset;** Harrison **Lobdell,** Jr.; George G. **Loving,** Jr.; Herbert A. **Lyon;** William C. **McGlothlin,** Jr.; Leroy J. **Manor;** Robert T. **Marsh;** Abner B. **Martin;** Edward O. **Martin;** William T. **Meredith;** Otis C. **Moore;** James E. **Paschall;** Cuthbert A. **Pattillo;** John W. **Pauly;** Wesley L. **Pendergraft;** John D. **Peters;** Bryce **Poe** II; Edward **Ratkovich;** George **Rhodes.**

Jack B. **Robbins;** Ray A. **Robinson,** Jr.; William M. **Schoning;** Robert R. **Scott;** Bryan M. **Shotts;** William Y. **Smith;** Eugene Q. **Steffes,** Jr.; Lawrence W. **Steinkraus;** George H. **Sylvester;** Kenneth L. **Tallman;** Roy M. **Terry;** Walter R. **Tkach;** Hamilton B. **Webb;** Edwin J. **White,** Jr.; Robert M. **White;** Geoffrey P. **Wiedeman;** Charles E. **Williams,** Jr.; Thomas B. **Wood.**

Nominated to **Lieutenant General:** Russell E. **Dougherty;** Otto J. **Glasser;** Jay T. **Robbins;** James C. **Sherrill.**

RETIREMENTS: L/G Arthur C. **Agan;** L/G Benjamin O. **Davis,** Jr.; L/G Robert J. **Friedman;** L/G James W. **Wilson.**—END

ORGANIZATION OF THE MONTH

THE ANTELOPE VALLEY, CALIF., CHAPTER
cited for very effective programming in support of the mission of the Air Force Association.

The Air Force Honors and Awards Banquet recently sponsored by the **Antelope Valley Chapter** of Lancaster, Calif., was such an outstanding success that Chapter President **William V. Ralston** announced the function would be held each year to honor the outstanding officers, airmen, and civilians from the Air Force Flight Test Center (AFFTC) and Air Force Rocket Propulsion Laboratory (AFRPL) at Edwards AFB.

Joe Higgins, movie-TV personality and "Toastmaster General of the Air Force," was the principal speaker. **Mrs. Elizabeth Waugh,** President of the Lancaster Chamber of Commerce, in her remarks of welcome said the people of Antelope Valley look forward to continuing cooperation between the community and the personnel at Edwards AFB. **Col. Jesse P. Jacobs,** C-5 Test Force Director, was master of ceremonies.

Lt. Col. William Trigg, Chief of the Foreign Technology Branch, AFRPL, received the Chapter's AFA "Man of the Year" award. Award recipients from the Air Force Flight Test Center included **Capt. Byron W. Theurer,** Outstanding Officer of the Year; **MSgt. George Moses,** Airman of the Year; and **Laurence P. Colburn,** Outstanding Civilian. Recipients from the Air Force Rocket Propulsion Laboratory included **Capt. James A. Hintz,** Outstanding Officer of the Year; **MSgt. James A. Beecham,** Airman of the Year; and **Lee G. Meyer,** Outstanding Civilian.

Civil Air Patrol recipients included **Lt. Thea E. Bollinger,** Senior CAP Member for 1969; and Squadron Cadet Commander **MSgt. Michael R. Bettzer,** Outstanding CAP Cadet.

Chapter President Ralston read the citations accompanying each award, and California AFA President **L. Eugene DeVisscher** presented the plaques to the honorees.

Special guests included **Col. William W. Gilbert,** AFFTC Vice Commander; **Col. Howard M. Estes, Jr.,** Director, AFRPL; **Donald M. Ross,** Deputy Director, AFRPL; and **Floyd P. Damman** and **Barbara Rowland,** California AFA Vice President and Secretary, respectively.

We're proud of the efforts of this

Lt. Col. William Trigg, center, recipient of the Antelope Valley Chapter's AFA "Man of the Year" award, proudly displays his plaque to California AFA President Gene DeVisscher, left, and Chapter President William Ralston, right.

Attendees at AFA's H. H. Arnold Chapter Annual Military Ball in New York included, from left: Capt. G. L. Bliss, USN, Navy Plant Representative, Sperry Gyroscope Co.; Col. W. L. Weitner, USAF, Garden City; F. X. Battersby, Chapter President; Col. J. K. O'Brien, USA; and Capt. A. Yates, USN, Navy Plant Representative at Grumman.

Officers of the Alabama AFA, reelected at the State AFA Convention, are shown at installation ceremonies. From left: Cecil Brendle, Secretary; Jack T. Gilstrap, South Central Regional Vice President and Installing Officer; Dr. Boyd E. Macrory, President; Jack Haire, Treasurer; and the Vice Presidents E. M. Steiner and B. A. Reynolds.

fine unit and are happy to recognize the Antelope Valley Chapter as AFA's top unit of the month.

* * *

The **Alabama AFA's Third Annual Convention** was held at the Huntsville Sheraton Motor Inn, October 2-4, 1969, and was hosted by the **Tennessee Valley Chapter,** with Chapter President **Jack Haire** serving as General Chairman.

The program included a golf tournament, a dinner dance, a business session, a President's luncheon, a briefing on the Air Reserve Forces, a banquet and ball, and a ladies' program.

In his address to more than 300 members and guests at the convention banquet, guest speaker **Sen. Barry Goldwater** (R-Ariz.) rapped those he called "Hanoi's helpers," who advocate complete withdrawal of American forces from Vietnam but offer no alternative to a complete Communist takeover. He said those who advocate a massive American withdrawal from Vietnam destroy any incentive for a settlement of the war at the conference table.

"North Vietnam has no reason to quit fighting if they know we will be out by a certain date," Senator Goldwater said. "The French lost at Dien Bien Phu. We may lose in New York and Washington."

Senator Goldwater was introduced by **Dr. Theodore C. Marrs,** Deputy for Reserve Affairs, Office of the Assistant Secretary of the Air Force (Manpower and Reserve Affairs).

At the President's luncheon, Dr. Marrs presented two State AFA awards. The Alabama AFA's "Man of the Year" award went to **Dr. Boyd Macrory,** President of the State AFA; and **Jack Haire,** President of the **Tennessee Valley Chapter,** accepted the Chapter of the Year award for his Chapter.

At the same luncheon, the AFA charter for the newly organized **Saturn Chapter** of Huntsville was presented to its President, **Scott Fellows.**

The program on the Air Reserve Forces was moderated by Dr. Marrs and included presentations by **Maj. George K. Feather** and **Maj. Albert J. McGill,** both from the Office of Air Force Reserve at the Pentagon.

At the business session, delegates reelected the State AFA's incumbent officers. They are: **Dr. Boyd E. Macrory,** President; **E. M. Steiner** and **Judge Bernard A. Reynolds,** Vice Presidents; **Cecil G. Brendle,** Secretary; and **Jack Haire,** Treasurer. Also, delegates adopted two resolutions: one **in support of captured American fighting men** and those missing in action; and the other calling on the President and the Congress of the United States to establish a **National Day of Prayer** for peace, the safety of our fighting men, and the immediate release of all prisoners resulting from armed conflict—past, present, and future.

Shown at the Langley Chapter's Annual Civic-Military Reception and Dinner Dance at the Langley AFB Officers' Club are, from the left, AFA President George D. Hardy; Gen. William W. Momyer, Commander, Tactical Air Command; and Chapter President Kenneth B. Chase. More than 300 people attended the affair honoring military and civic leaders in Virginia's Tidewater.

The ladies' program included a tour of NASA's Marshall Space Flight Center, and a luncheon and fashion show. Husbands and other guests also were invited on the tour of the Space Flight Center, which was conducted by South Central Regional Vice President **Jack T. Gilstrap** and hosted by the **Saturn Chapter.**

Special guests, in addition to those already mentioned, included **Rep. William L. Dickinson** (R-Ala.); **Maj. Gen. Reid Doster,** Commander, Alabama Air National Guard; **Brig. Gen. Jonas L. Blank,** Commandant, Air Command and Staff College, Air University; Huntsville Mayor **Joe W. Davis; James R. Record,** Chairman, Madison County Board of Commissioners; Arkansas AFA President **Alex E. Harris;** Tennessee AFA President **Enoch B. Stephenson;** and **H. John McGaffigan** and **Toulmin H. Brown,** Louisiana AFA President and Vice President, respectively.

Dr. Macrory, Jack Haire, and all

(*Continued on following page*)

Joseph King, center, President of the newly organized South Georgia Chapter, receives the AFA charter from Georgia President William Kelly during the Charter Night Program. Other program participants, from left: AFA National Director M. H. Harris; Maj. Gen. L. F. Dusard, Vice Commander, ATC and guest speaker; and Col. C. S. Parker, Commander, 3550th Pilot Training Wing.

Participants in the Twenty-second Annual Convention of the New York AFA included, from left, Northeast Regional Vice President, Judge John G. Brosky; Lt. Gen. John W. Carpenter III, USAF Asst. Vice Chief of Staff; George Jessel; AFA National Treasurer Jack B. Gross; and New York AFA President William C. Rapp.

their committee chairmen and committee members are to be congratulated on a most enjoyable and very effective convention.

* * *

New York City's McAlpin Hotel was the site of the **New York AFA's Twenty-second Annual Convention,** October 3-5, 1969.

Highlight of the convention program was the "Apollo" Aerospace Banquet, which featured an address by **Lt. Gen. John W. Carpenter III,** Assistant Vice Chief of Staff, USAF, and, as master of ceremonies, the very entertaining "Toastmaster General of the United States," the well-known **George Jessel.**

In his address, General Carpenter warned the more than 200 members and guests that if present trends in Soviet military preparedness continue, we will "soon reach a point of military inadequacy. We had better get busy."

General Carpenter was introduced by **Judge John G. Brosky,** AFA's Northeast Regional Vice President. AFA National Director **Maxwell A. Kriendler** introduced Mr. Jessel.

During the banquet, a number of State AFA awards were presented. They included an Exceptional Service Award to **James W. Wright,** Past State President and a former Northeast Regional Vice President; the Harry Copeland Aerospace Education Award to CAP **Maj. Anna Mary McCann;** an Aerospace Outstanding Accomplishment Award to the **Iron Gate Chapter;** the Aerospace Achievement Award to the **Grumman Aerospace Corp.;** and the New York AFA's Chapter of the Year award to the **Colin P. Kelly Chapter** of Rome, N.Y.

For his patriotic contributions to the American way of life, Mr. Jessel received the **New York AFA's Special Service Award.** The award was presented by State President **William C. Rapp** and Convention Chairman **Howard J. Eichner.**

During the business session, delegates reelected President Rapp. Other incumbents reelected are: **Irene Keith** and **G. V. Hasler,** Vice Presidents; **Robert E. Sieloff,** Treasurer; **Lloyd H. Schloen,** Recording Secretary; and **Richard Waring,** Corresponding Secretary.

Joe Higgins, movie-TV personality, here costumed as the Sheriff of Seat City, entertains airmen at Sheppard AFB Service Club prior to his address at a program sponsored by the Faith Chapter honoring Maj. Gen. and Mrs. Jerry Page and Sheppard AFB. (See accompanying story for more details.)

Out-of-state AFA leaders who attended were National Treasurer **Jack B. Gross;** New Jersey AFA President **James Grazioso;** New Jersey AFA Secretary **Lloyd Nelson;** and Hudson, N.J., Chapter President **Joseph Bendetto.**

New York AFA President Rapp, Convention Chairman Eichner, and Cochairmen Irene Keith, Ruth Stern, Dorothy Wadsley, Dick Adams, Bill Birnbach, Bernie Ciotti, Arnold Leibowitz, and John Adams are to be congratulated on a very effective convention.

* * *

More than 450 people attended a Texas-style barbecue sponsored by the **Faith Chapter** of Wichita Falls to honor **Maj. Gen. and Mrs. Jerry Page** and **Sheppard Air Force Base.** General Page is Commander of the Sheppard Technical Training Center.

Following the barbecue, the program featured an address by **Joe Higgins,** TV and movie actor, and star of a popular TV commercial in which he is featured as an overbearing rural sheriff. Mr. Higgins is well known to AFAers as a Past President of the **Los Angeles Chapter** and frequent master of ceremonies at national, state, and local AFA functions across the country.

In his address, Joe praised the efforts of AFA in supporting US airpower and the principles of a free, democratic society. He urged membership in AFA, stating that, by becoming AFA members, those present could aid AFA's efforts to seek release of Americans held prisoner by the North Vietnamese.

—DON STEELE

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

George D. Hardy
Hyattsville, Md.

BOARD CHAIRMAN

Jess Larson
Washington, D.C.

SECRETARY

Glenn D. Mishler
Akron, Ohio

TREASURER

Jack B. Gross
Harrisburg, Pa.

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San Francisco, Calif.
Arthur C. Storz
Omaha, Neb.

Harold C. Stuart
Tulsa, Okla.
James M. Trail
Boise, Idaho
Nathan F. Twining
Hilton Head Island, S.C.
Robert C. Vaughan
San Carlos, Calif.
Jack Withers
Dayton, Ohio
Rev. Henry J. McAnulty, C. S. Sp.
(ex-officio)
National Chaplain
Pittsburgh, Pa.
Charles P. Azukas (ex-officio)
National Commander,
Arnold Air Society
New Orleans, La.

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.

A. Paul Fonda
1730 K St., N.W., Suite 905
Washington, D.C. 20006
(202) 338-8282
Central East Region
Maryland, Delaware, District of Columbia, Virginia, West Virginia, Kentucky

O. Earl Wilson
10651 Roanna Court
St. Louis, Mo. 63128
(314) 421-0200
Midwest Region
Nebraska, Iowa, Missouri, Kansas

Edward T. Nedder
1176 River St., Room 22
Hyde Park, Mass. 02136
(617) 361-1113
New England Region
Maine, New Hampshire, Massachusetts, Vermont, Connecticut, Rhode Island

W. M. Whitney, Jr.
708 Francis Palms Bldg.
Detroit, Mich. 48201
(313) 821-7000
Great Lakes Region
Michigan, Wisconsin, Illinois, Ohio, Indiana

Will H. Bergstrom
655 Bridge St.
Colusa, Calif. 95932
(916) 458-2179
Far West Region
California, Nevada, Arizona, Hawaii

Sam E. Keith, Jr.
P.O. Box 5068
Fort Worth, Tex. 76108
(817) 738-0321
Southwest Region
Oklahoma, Texas, New Mexico

Jack T. Gilstrap
10029 Camille Dr., S.E.
Huntsville, Ala. 35803
(205) 453-2340
South Central Region
Tennessee, Arkansas, Louisiana, Mississippi, Alabama

Lester C. Curl
217 Surf Rd., Box 265
Melbourne Beach, Fla. 32951
(305) 723-8709
Southeast Region
North Carolina, South Carolina, Georgia, Florida

Nolan W. Manfull
4880 So. 2575 W.
Roy, Utah 84067
(801) 487-0731, ext. 41
Rocky Mountain Region
Colorado, Wyoming Utah

Clair G. Whitney
1535 - 79th Pl., N.E.
Bellevue,, Wash. 98004
(206) 237-5871
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

John G. Brosky
712 City County Bldg.
Pittsburgh, Pa. 15219
(414) 355-5424
Northeast Region
New York, New Jersey, Pennsylvania

AFA'S BOLDEST, NEWEST

EXTRA INCOME

THREE PLANS TO CHOOSE FROM

☐ MEMBER ☐ MEMBER & SPOUSE ☐ ENTIRE FAMILY

WHAT IS AFA EXTRA INCOME HOSPITAL INSURANCE?

For every day you (or members of your family, if you have elected family coverage) are hospitalized AFA sends you money for up to 365 days . . . money you can use as you wish, without restrictions of any kind.

WHO IS ELIGIBLE?

Any United States citizen under the age of 60 who is or becomes a member of the Air Force Association is eligible to apply for AFA Extra Income Hospital Insurance for himself, his spouse, and unmarried children more than 14 days and less than 21 years of age.

HOW ARE BENEFITS PAID?

Once AFA receives verification that hospitalization has taken place, you will receive a benefit check within seven days with additional checks thereafter on a weekly basis upon AFA receiving certification of your continued hospitalization.

FIRST TIME OFFERED TO ACTIVE DUTY MILITARY PERSONNEL

HOW MUCH EXTRA INCOME DO YOU NEED? CHOOSE THE BENEFIT AMOUNT YOU REQUIRE FROM THIS FLEXIBLE GROUP PLAN!

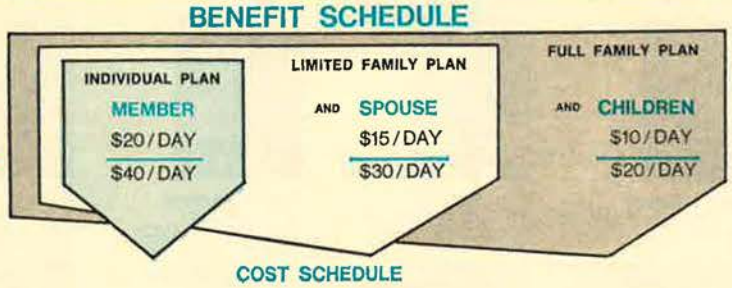
1. You are the key to family finances. How much extra money would your family need if you were hospitalized? Check Plans A-1 and AA-1.

2. Does part of the family income depend on a working spouse? Would a cook, or maid or housekeeper be needed during a wife's hospitalization? How much would this, and other expenses cost? Check Plans A-2 and AA-2.

3. If you have a family, you should consider providing extra income for children's hospitalization. Accidents involving whole families *do* happen, especially with military families living around the world. Check Plans A-3 and AA-3.

And remember: Benefits are paid up to 365 days of hospital confinement for *each* accident or sickness for *each* insured person while the patient is under the care of a legally qualified Doctor of Medicine.

BENEFIT SCHEDULE



COST SCHEDULE

Member's Age	INDIVIDUAL PLAN A-1 (Member: $20 per day) Annual	Semi-Annual	LIMITED FAMILY PLAN A-2 (Member: $20 per day; Spouse: $15 per day) Annual	Semi-Annual	FULL FAMILY PLAN A-3 (Member: $20 per day; Spouse: $15 per day; Children: $10 per day) Annual	Semi-Annual
Under 40	$ 29.00	$15.50	$ 59.00	$ 30.50	$ 74.00	$ 38.00
40-49	$ 37.00	$19.50	$ 72.00	$ 37.00	$ 86.00	$ 44.00
50-59	$ 53.00	$27.50	$103.00	$ 52.50	$118.00	$ 60.00
60-64	$ 76.00	$39.00	$147.00	$ 74.50	$162.00	$ 82.00

Member's Age	PLAN AA-1 (Member: $40 per day) Annual	Semi-Annual	PLAN AA-2 (Member: $40 per day; Spouse: $30 per day) Annual	Semi-Annual	PLAN AA-3 (Member: $40 per day; Spouse: $30 per day; Children: $20 per day) Annual	Semi-Annual
Under 40	$ 54.00	$28.00	$107.00	$ 54.50	$134.00	$ 68.00
40-49	$ 68.00	$35.00	$132.00	$ 67.00	$159.00	$ 80.50
50-59	$100.00	$51.00	$195.00	$ 98.50	$222.00	$112.00
60-64	$147.00	$74.50	$284.00	$143.00	$312.00	$157.00

WHY DO YOU NEED EXTRA INCOME HOSPITAL INSURANCE?

Hospital costs for Non Military Families are climbing out of sight!

In 1966, according to the American Hospital Association, average *total cost* per hospital admission was $380.39 — *up 412%* in just 20 years.

Average 1966 cost per hospital day, over an average hospitalization of 7.9 days, was $48.15 — a figure which includes only basic costs.

And costs are going higher. Other authorities estimate that average cost per hospital day may reach $100 by 1980.

Would your present hospital benefits begin to cover this cost? Do they even cover today's costs?

Military Families Can Have Severe Money Losses Caused By Hospitalization

Military families as well as civilian families can be financially hurt by the indirect expenses of hospitalization and serious illness.

Even if every cent of direct hospital cost is covered by government benefits (or hospital insurance) there may be hundreds or thousands of dollars in indirect losses. For example:

Loss of income, especially when more than one member of the family works

Extra travel expense (sometimes for long distances) for other family members

Cost of housekeeper or "sitters"

Special diets, sometimes for long periods

Expense of special home care.

AFA EXTRA INCOME HOSPITAL INSURANCE PROVIDES THIS MONEY. BENEFITS ARE PAID DIRECTLY TO YOU — AND YOU USE THIS MONEY TO BEST SUIT YOUR NEEDS.

NSURANCE PROGRAM

HOSPITAL INSURANCE

Pays CASH benefits up to $40 per hospital day for each insured person!

All AFA members — military and civilian — and their families are eligible.

OTHER BENEFITS

Protected AFA members may continue their coverage at the low, group rate to Age 65, or until they become eligible for Medicare, whichever is earlier. Hospitalization for **all** sicknesses and accidents is covered, except for a few standard exceptions listed under "Exclusions."

LIMITATIONS

Hospital confinements separated by less than three months for the same or related conditions will be considered continuations of the same confinement.

Coverage will continue through the life of the master policy unless terminated for whichever of the following reasons occurs first for the protected person: (a) attains age 65; or (b) becomes eligible for Medicare; or (c) AFA membership dues are due and unpaid; or (d) a premium payment is due and unpaid. For dependents, coverage will continue through the life of the master policy unless terminated for whichever of the following reasons occurs first: (a) such dependent ceases to be an eligible dependent; or (b) the protected person's insurance terminates hereunder; or (c) the dependent spouse either attains age 65 or becomes eligible for Medicare; or (d) any required dependent premium payment is due and unpaid.

EXCLUSIONS

The plan does not cover losses resulting from (1) declared or undeclared war or act of war; (2) service in the armed forces of a country *other than the United States;* (3) acts of intentional self destruction or attempted suicide while sane or insane; (4) pregnancy (including childbirth or resulting complications); (5) confinement in any institution primarily operated as a home for the aged or engaged in the care of drug addicts or alcoholics; (6) illnesses for which the insured has received medical treatment or advice or has taken prescribed drugs or medicines within 12 months prior to the effective date of his insurance. Coverage for such pre-existing illnesses will begin after 12 consecutive months during which he is covered under the policy and receives no such medical treatment or advice and takes no such prescribed drugs or medicine; (7) hospital confinement commencing prior to the date the protected person or eligible dependent becomes insured under this policy.

HOW TO APPLY

Fill out the attached application and mail it to AFA with your first premium payment. You may elect to pay premiums either annually or semi-annually.

APPLICATION

AFA EXTRA INCOME HOSPITAL INSURANCE

Underwritten by ***Mutual of Omaha Insurance Co.*** *Omaha, Nebraska.*

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

DATE OF BIRTH _____ CURRENT AGE _____ HEIGHT _____ WEIGHT _____ SEX _____

PLAN OF INSURANCE

MEMBER ONLY	MEMBER & SPOUSE	MEMBER SPOUSE & CHILDREN
☐ PLAN A-1	☐ PLAN A-2	☐ PLAN A-3
☐ PLAN AA-1	☐ PLAN AA-2	☐ PLAN AA-3

METHOD OF PAYMENT ☐ Annual ☐ Semi-Annual

This insurance coverage may only be issued to AFA members. Please check the appropriate box:

☐ I am currently an AFA member.

☐ I enclose $7 for annual AFA dues (includes subscription ($6) to to AIR FORCE/SPACE DIGEST).

I enclose my initial premium in the amount of $_____ (Refer to premium table to determine correct premium amount.)

Please complete this section only if you are requesting coverage for dependents (Limited Family or Family Plan) and list only those persons for whom you are requesting coverage.

FULL NAME	RELATIONSHIP TO AFA MEMBER	SEX	DATE OF BIRTH
	WIFE (HUSBAND)		
	child		
	child		
	child		
	child		
	child		
	child		

In applying for this insurance coverage, I understand and agree that:

1. coverage shall become effective on the last day of the calendar month during which my application together with the proper premium amount is mailed to AFA.
2. only hospital confinements commencing after the effective date of insurance are covered, and
3. any condition for which I or any of my eligible dependents received medical treatment or advice or have taken prescribed drugs or medicine within twelve months prior to effective date of the insurance coverage will not be covered until the expiration of twelve consecutive months of insurance coverage without medical treatment or advice or having taken prescribed drugs or medicine for such condition.

DATE _____ SIGNATURE _____

Application must be accompanied by check or money order. Send remittance to:

INSURANCE DIVISION, AFA, 1750 PENNSYLVANIA AVE., N.W., WASHINGTON, D.C. 20006

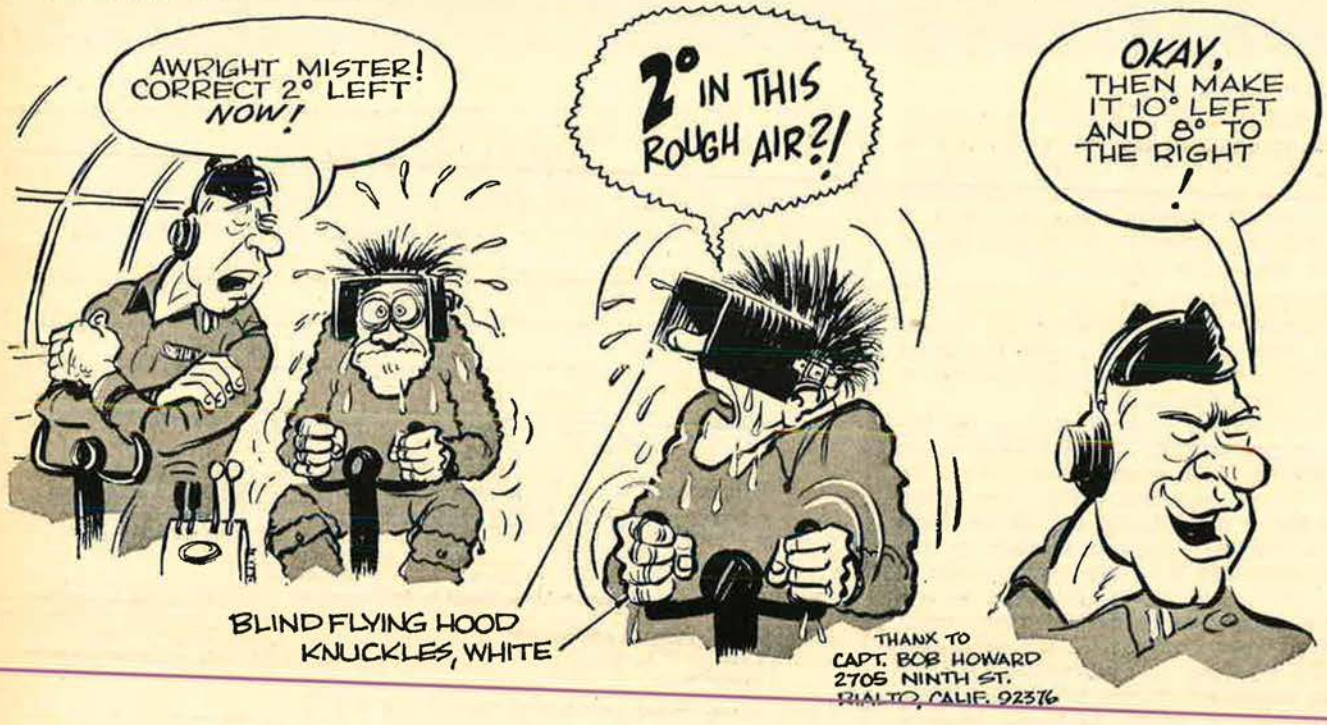
Form 2332MGC App. 2-70

Bob Stevens'

"There I was..."

Instructors who live and keep their sanity
Are often lacking in urbanity.
The student—duller than a hoe—
Is the guy who makes it so . . .

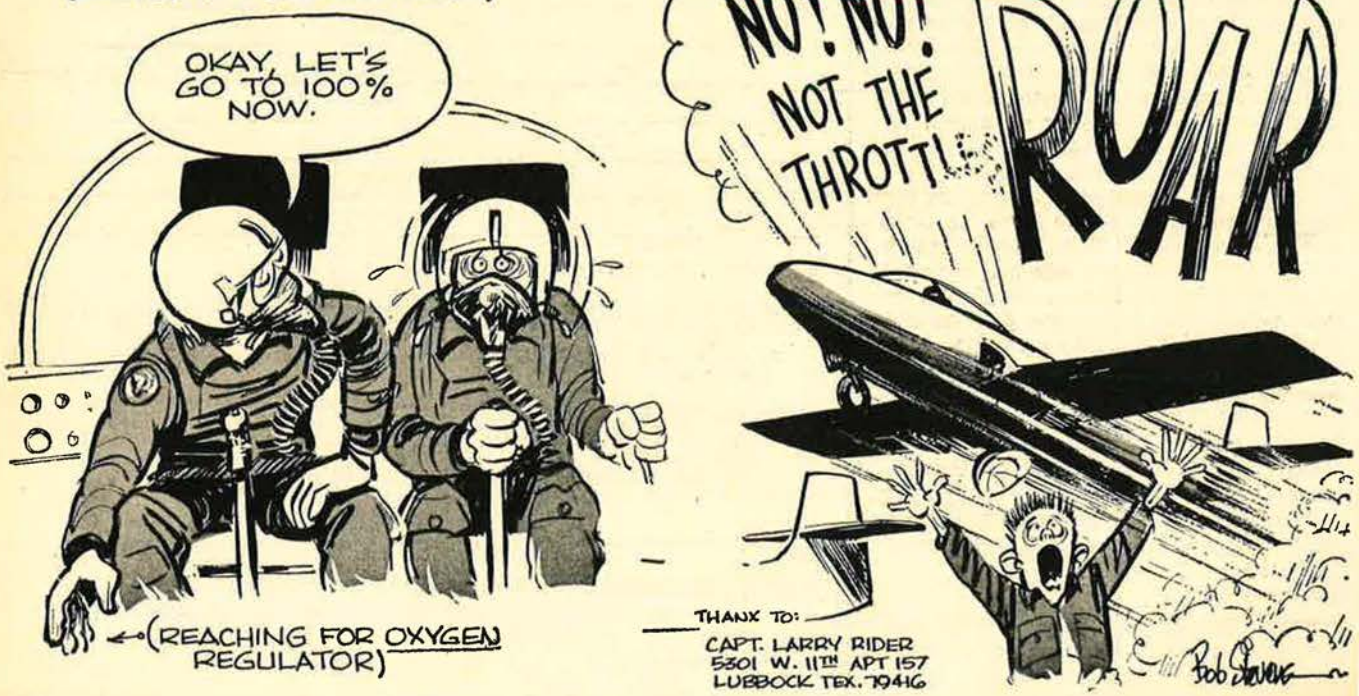
SCENE: INSTRUMENT FLIGHT CHECK WITH A PARTICULARLY SNOTTY INSTRUCTOR-



THANX TO
CAPT. BOB HOWARD
2705 NINTH ST.
RIALTO, CALIF. 92376

SCENE: A PRIMARY JET TRAINING BASE; A DUAL RIDE, INSTRUCTOR TO NEW T-37* STUDENT TAXIING OUT FOR TAKEOFF:

*AFFECTIONATELY, CALLED THE 'TWEETY-BIRD' OR 'CONVERTER' (CONVERTS FUEL INTO NOISE)



THANX TO:
CAPT. LARRY RIDER
5301 W. 11TH APT 157
LUBBOCK TEX. 79416

Pilots are keeping an eye on their own special television program at Sperry. They're watching with interest the developmental program on our flicker-free electronic display system. From simulator evaluations at major aircraft manufacturers to actual performance tests in our own aircraft, they're taking a critical look at our advanced method of displaying flight data on the panels of next generation planes. If you haven't yet tuned in on our exciting program, contact Sperry Flight Systems Division, Phoenix, Arizona 85002. Phone: (602) 942-2311, Ext. 1398.

Good show!

The Phantom with a nose gun gives you Mach 2+ at no extra cost.

You get all the performance of the world's finest point defense fighter behind a 20mm Gatling gun when you order the low-cost Phantom. □ This slimmed-down version of the F-4E responds with the same Mach 2-plus speed that means "air superiority" wherever Phantoms fly. Even if you also choose to equip it with a full array of ordnance, there's no sacrifice in maneuverability. □ No other aircraft can match the F-4's time-to-climb records. No other plane in its class can deliver the power reserve available at the Phantom's twin tailpipes. □ Add to all this the economies of production experience totaling more than 3,600 F-4s, and the options offered to meet specialized missions. □ There really is no other choice in a first-line fighter.

MCDONNELL DOUGLAS