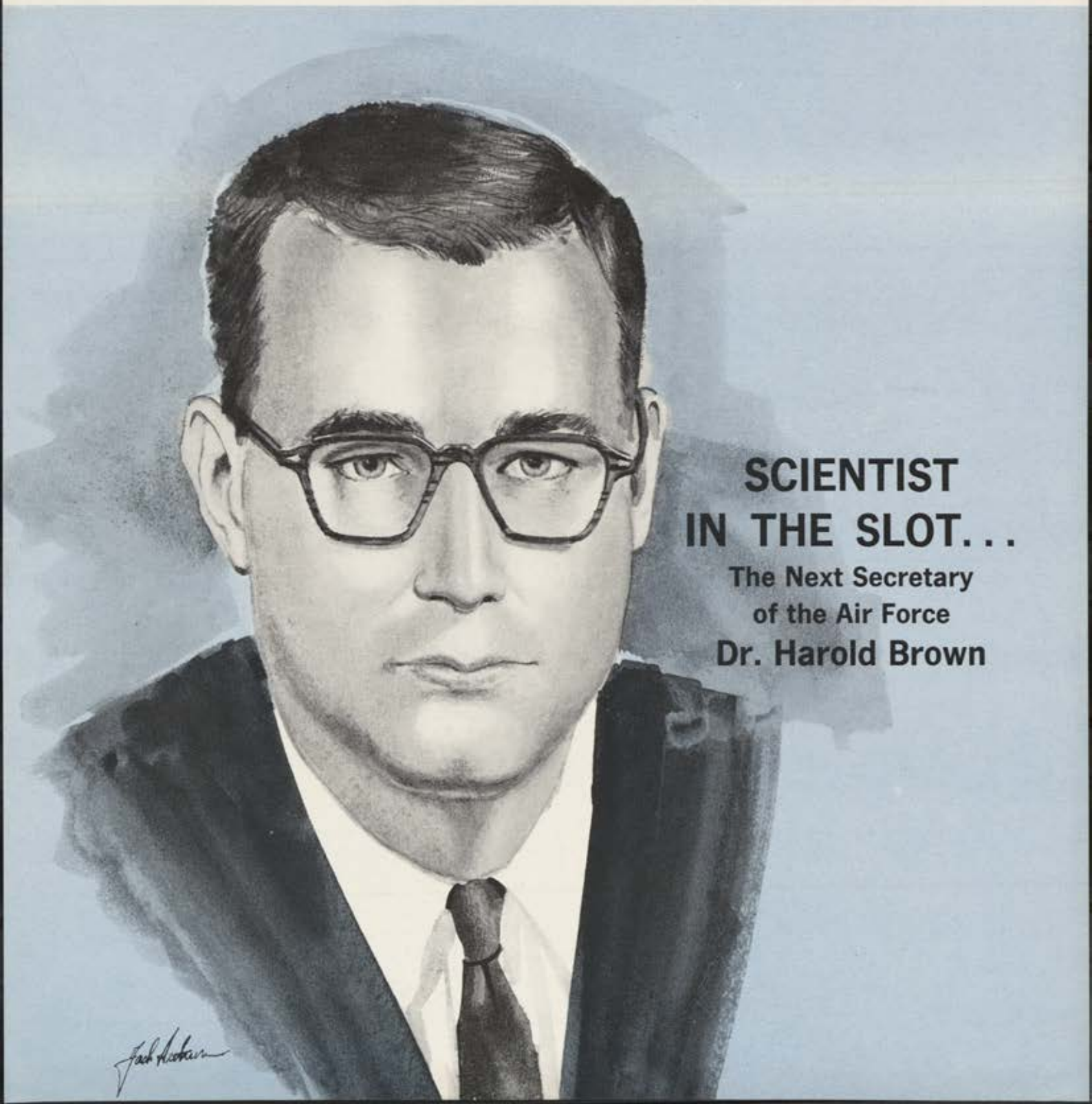
AUGUST 1965 / 50¢

AIR FORCE

and **SPACE DIGEST**

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



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Dr. Harold Brown

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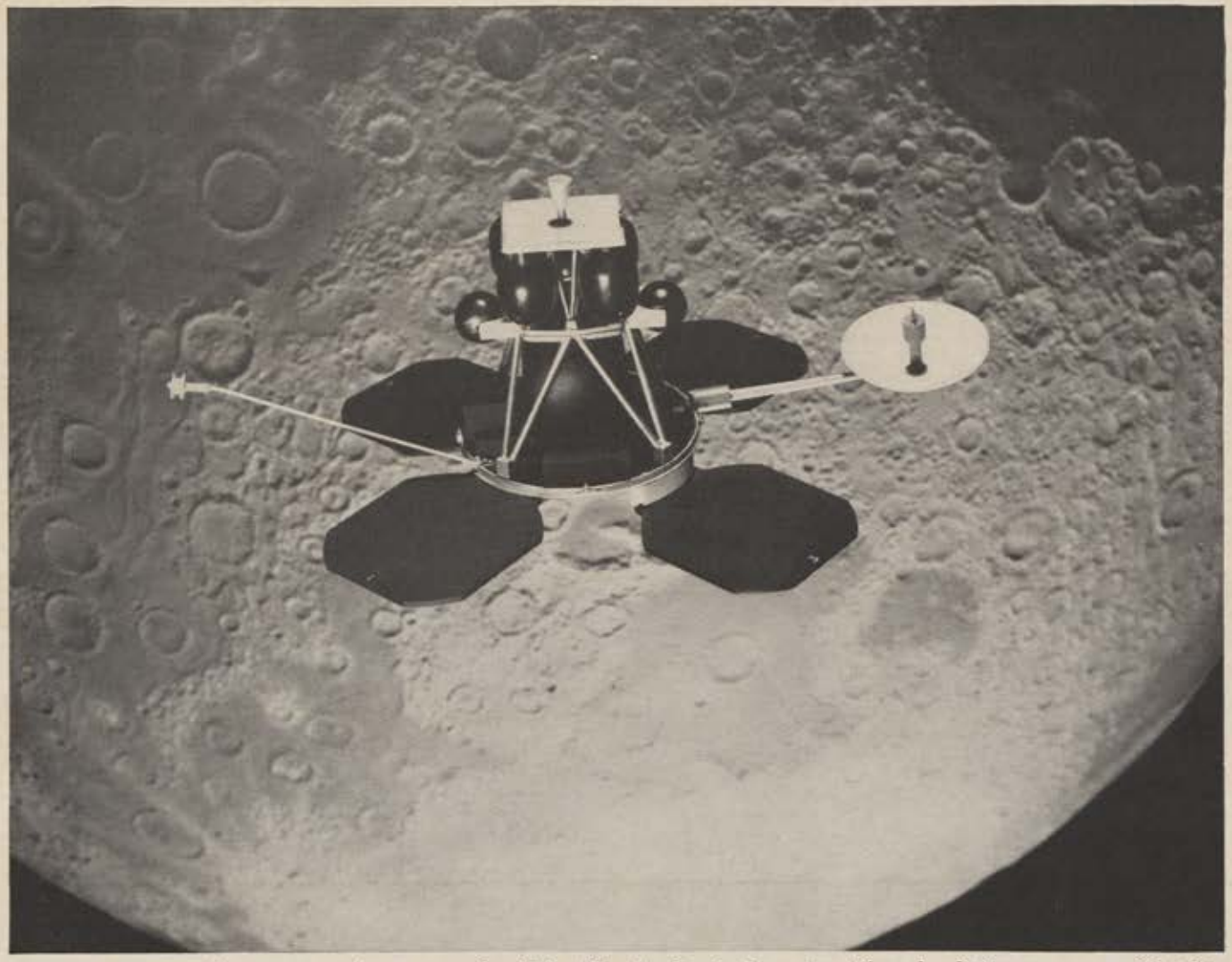
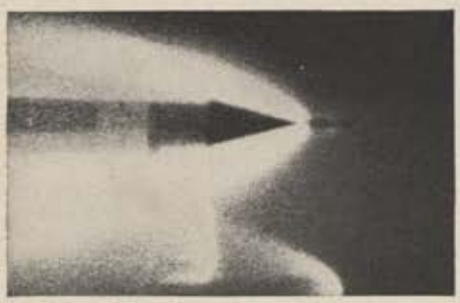


LUNAR ORBITER is camera-carrying spacecraft which will be launched into lunar orbit to photograph and transmit to earth pictures of large areas of moon's surface. Mission is to help locate best landing spot for astronauts, and to sense and report density of micrometeoroids and radiation near moon. Scientists will also track Orbiter to learn more about moon's gravity. Boeing is building 8 Orbiters for NASA, 3 for ground test, 5 for flight. First launch is scheduled next year at Cape Kennedy.

Capability has many faces at Boeing



BIG BLOW. Wind tunnel tests are used in air-to-ground missile studies. Boeing's vast missile, space booster and electronics experience in radar, guidance and penetration aids is helping to develop advanced attack missile system concept.

SUPERSONIC jetliner, under development by Boeing, could carry over 200 passengers across U.S. in two hours. Variable wing gives ideal sweep-back choices for supersonic and subsonic flight, plus straight wing for slow landings.

U.S. NAVY'S versatile new transport helicopter, UH-46A, built by Boeing's Vertol Division. UH-46A's replenish combat ships while underway (permitting maintenance of task force integrity), also perform search and rescue, personnel transfer, and other missions.

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TO THE USA FROM THE USAF

9 HISTORIC RECORDS IN ONE DAY

Flying the big black Interceptor YF-12A the U.S. Air Force recently established the greatest array of world aviation records in a single day, in history. ☐ Four of the records were held by the USSR. ☐ Today these international laurels are back in America, courtesy of USAF and the YF-12A. The four new Blue Ribbon records are: (1) SPEED OVER A STRAIGHT COURSE—2,062 MPH.

(2) SPEED OVER A CLOSED CIRCUIT—1,688 MPH. (3) SPEED OVER A 500-KILOMETER CIRCUIT—1,642 MPH. (4) SUSTAINED ALTITUDE IN HORIZONTAL FLIGHT: 80,000 FEET. ☐ Of the nine new records set in that gruelling day of flight, the USAF Interceptor also established important new speed marks for payload flights of 1000 and 2000 kilograms over 1000 kilometers. The record speed: 1,688 mph. ☐ The USAF YF-12A, designed and built by Lockheed Aircraft Corporation,* is helping demonstrate advanced technologies vital to the development of supersonic transports, future flag carriers of American leadership in commercial aviation.

LOCKHEED AIRCRAFT CORPORATION

*LOCKHEED WAS ACCLAIMED IN 1958 WHEN—FOR THE FIRST TIME IN MODERN AVIATION HISTORY—THE AIRPLANES OF ONE COMPANY HELD CONCURRENTLY ALL THREE MAJOR WORLD RECORDS—FOR DISTANCE, ALTITUDE AND SPEED.

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Imagine, if you will, an advanced weapons system that permits battle commanders of joint services and their staffs to conduct complete combat operations in a "see-for-yourself" situation from inside an electronic war room that works either from the air or from a strategic ground location. In short, view on television screens battle as it takes place, know at every moment exactly what the enemy is doing, make moves and counter moves, and have complete communications with all forces.

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There is just such an advanced weapons system currently undergoing evaluation It is known as ABC³ — short for Airborne Battlefield Command and Control Center. This vitally needed system is available for delivery in quantity immediately.

The first such system of its kind, ABC³ was produced and delivered to the Air Force by LTV Electrosystems, Inc. It was done from scratch in 98 days — well within the cost and time limitations of its contract.

Essentially ABC³ has two capabilities: (1) Through the use of sensor aircraft and television, SLR (side looking radar), infrared and photographic devices, ABC³ reconstructs reconnaissance information and provides it for near-real time display for the battle commanders. (2) Through HF, VHF, and UHF, battle commanders communicate with and control all strike forces, air, sea and ground, for total and maximum effectiveness.

An additional advantage to ABC³ is that as a self-contained unit, it is operational either from the air or on the ground, can be slipped in or out of a C-130 in two hours. With the ABC³ operating from the ground, the C-130 transport can be released for troop or cargo transport. Ground mobility for ABC³ is provided by special wheels or a flatbed truck.

Although originally developed for the Air Force, ABC³ can be an equally indispensable weapons system for joint Naval and Marine Corps operations.

To develop and produce such sophisticated systems as ABC³ represents only one example of LTV Electrosystems' unusual capability to produce the finest electronics systems available at reasonable cost and within time limitations.

LTV Electrosystems, Inc. / P. O. Box 1056 / Greenville, Texas / A subsidiary of Ling-Temco-Vought, Inc.

LTV ELECTROSYSTEMS, INC.

LTV Electrosystems, Inc., has achieved its enviable place as a leader in electronics through strong, aggressive and highly capable management. Its top management team (shown front to rear inside ABCs) includes D. L. Hearn and Carl Bentley, vice presidents, and Fred Buehring, president.

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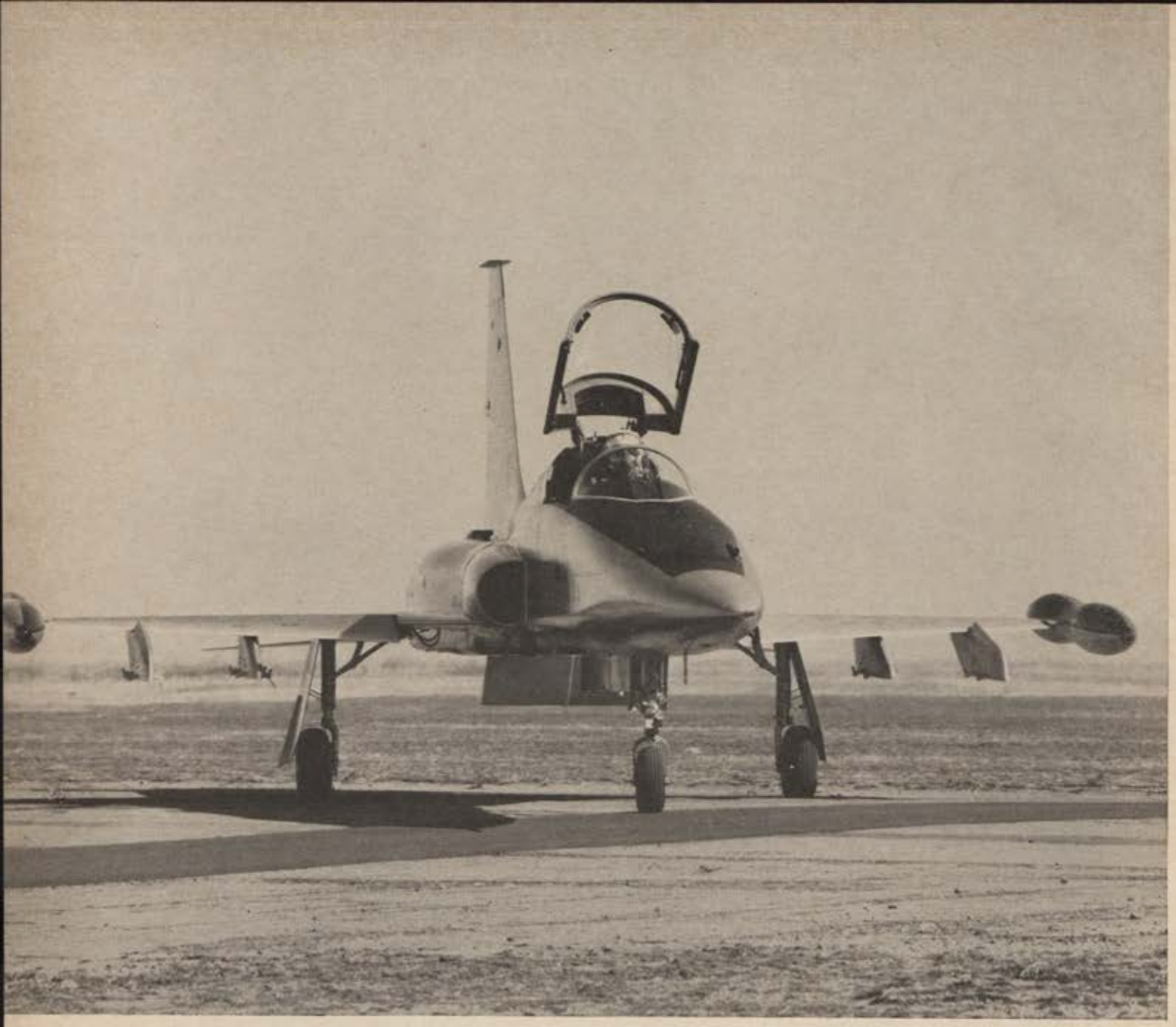
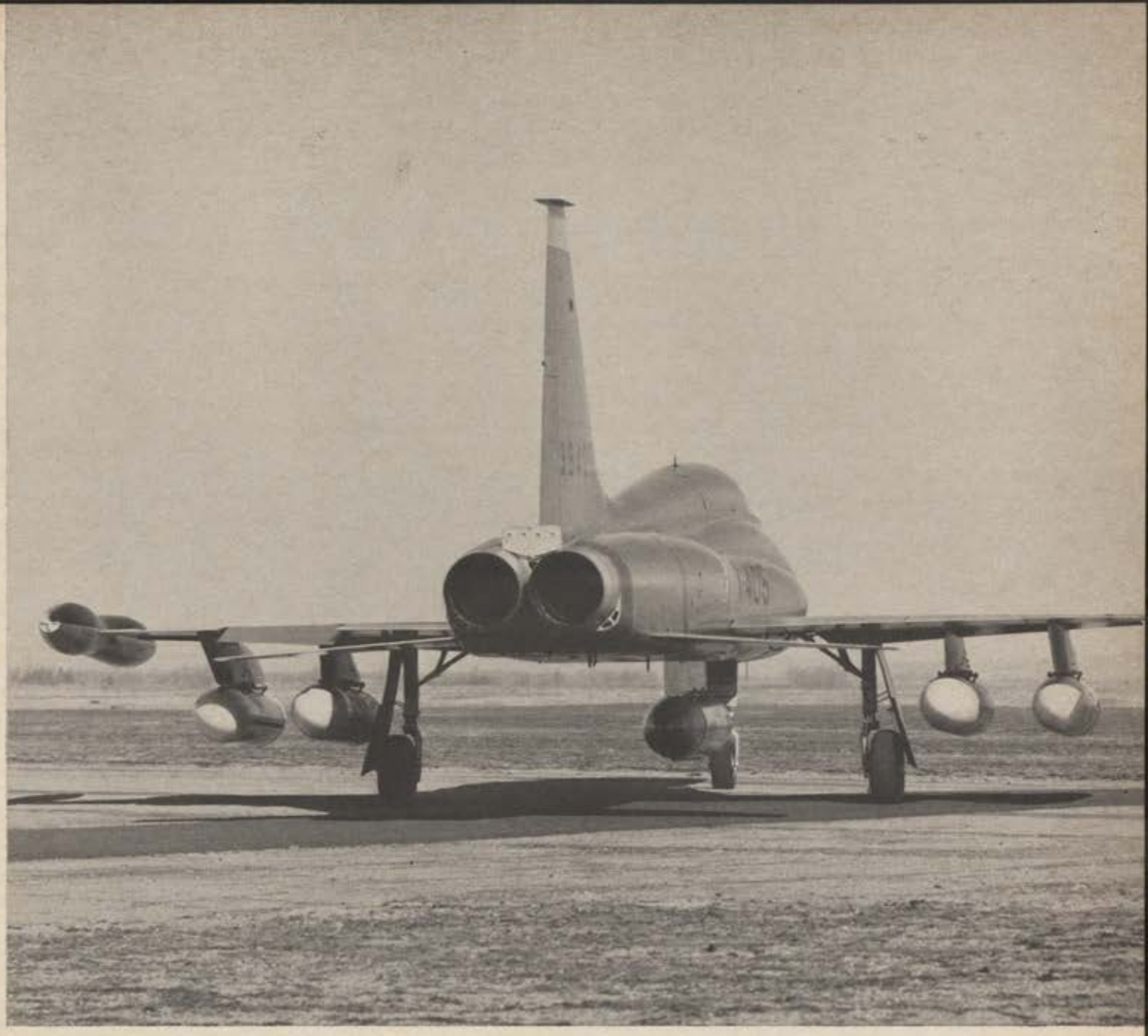


How long does it take



to turn an F-5 around?

Not long.

It takes very few minutes for any good crew to rearm and refuel an F-5 between missions.

The F-5 is an easy airplane to work on. It has single-point refueling. All systems and weapon stations are easy to reach without workstands or ladders. Several men can work on an F-5 simultaneously without getting in each other's way.

Example: In a recent test on a sod field, a crew of four airmen refueled an incoming F-5, hung two Sidewinders and a napalm dispenser on it and sent it away again in just 6 minutes and 40 seconds.

The F-5 is also a rugged and reliable aircraft that doesn't get mysterious ailments that are hard to diagnose. The maintenance index experienced on the F-5 in operation is far lower than that of any other supersonic fighter — lower than the best subsonic fighters.

What this means, of course, is a high sortie rate.

Example: On a recent demonstration tour of Europe and the Middle East an F-5 averaged 4.5 flights daily for 49 flying days. It made eight flights on one day, seven on three days, six on ten days, and five flights on each of seventeen days.

In peacetime, in a tactical environment, the F-5 can fly over 45 hours a month.

So nations with F-5's can plan to spend a lot of time flying them. F-5's are built to stay in the air.

NORTHROP F-5

In the right-hand photo the F-5A has been loaded with four LAU-3A 2.75-inch rocket pods, one BLU-1/B napalm dispenser, and 560 rounds of 20-mm ammunition — an ordnance load of 2,796 pounds. The F-5 is capable of carrying over 6,200 pounds of ordnance and external fuel.

An Editorial

Americans in Paris

By John F. Loosbrock

EDITOR, AIR FORCE/SPACE DIGEST

THOSE who came to the Paris Air Show expecting to see the latest developments in US aerospace technology went home disappointed. US participation this year was heavier than ever before, both on the part of the aerospace industry and the US government. Yet the picture conveyed of US capabilities and even of US policies was flat and out of focus, relieved somewhat by the spectacular impact of the sudden visit of Astronauts White and McDivitt and Vice President Humphrey.

What was wrong?

In the past the US government had been criticized by industry and press observers for lack of official support at the show comparable to that which other countries give their industry. Special pains were taken this year to remedy this lack. A combined effort by the Department of Commerce, the Department of Defense, and the State Department was mounted. A special Business Information Center was set up, in rented space, to handle inquiries and stimulate business contacts. Government public-relations people, civilian and military, coordinated the servicing of the press with news of US products and events. But, until the arrival of the astronauts, the impact of the US participation was little more than a dull thud.

"It's like we're not even here," was the bitter comment of one American public-information official.

From the standpoint of the commercial effort, the basic error lay in a misunderstanding, on the part of the government people involved, of the nature of the Paris Air Show. The Business Information Center was organized and staffed by capable, hard-working people. But they were set up in much the same way that they might service a trade fair for retail consumer products, where there are numbers of foreign businessmen—distributors, wholesalers, importers, and the like—who want to know how they can do business with American firms. The aerospace business is quite a different cup of tea. The result was that the government effort, while well intended, was largely ineffective because it was not geared to the market and the industry it was serving. Part of the blame must go to industry, as well, for failure to make its specific wants and needs known to the government.

On the public-information side, it was not a question of misunderstanding the problem. The US information effort was stymied largely because, in public-relations terms, it had so little to sell. There was no participation by the National Aeronautics and Space Administration, whose exhibits had been so successful at previous shows. US exhibits were overwhelmingly military in nature, and these—with the exception of the Lockheed C-141, the Northrop F-5, the Hughes OH-6A, and the Lockheed rigid-rotor XH-51A—showed little that had not been seen before at Paris shows.

In contrast, Russia's Vostok space capsule and pioneer Cosmonaut Yuri Gagarin were drawing capacity crowds even on the day before the show officially opened. On that day, Thursday, June 10, Gagarin autographed more than 1,000 copies of a four-color Vostok brochure, mostly for workers at the show—truck drivers, carpenters, waitresses, and the like, plus a number of American GIs. The arrival of the giant Soviet AN-22, which someone promptly dubbed "Daddybird," was the last straw insofar as the frustrated Americans were concerned. Mr. Humphrey and the astronauts helped save the day, but even this visitation was no substitute for more solid evidence of US advanced technological capabilities.

In our judgment, the US emphasis on military hardware need not have been a negative factor—had the latest in military equipment been available for display and demonstration. Any one of three advanced US aircraft, for example, could have stolen the show. The Ling-Temco-Vought XC-142 could have put on an impressive V/STOL transitional flight demonstration. Similarly, the General Dynamics/Grumman F-111 could have gone through its variable-sweepback paces before an influential and knowledgeable audience. And the Lockheed YF-12A could have given a preview of US supersonic-transport technology. An Apollo mockup, a Gemini, or even a Mercury capsule would have drawn huge crowds. In contrast, European companies and governments showed everything new they had and flew it if it was flyable (see "Letter from Europe," page 14).

What the Paris Air Show proved, from a US point of view, is that government support, on the mechanical and administrative side, is not meaningful (1) unless it is geared to the needs of US industry; and (2) unless it is supported by the kind of policy decisions that utilize the Paris showcase for what it is.

The Paris Air Show is not just another trade show. It has become a kind of international aerospace technological Olympic Games—with diplomatic and economic overtones. It is not necessarily a great marketplace, as many industry executives will privately admit, when the cost of participation is measured against that of other marketing methods. But it is there, it has grown in size and importance, and it cannot be ignored.

There is an old saying, "It doesn't cost much more to go first class." In the future, if the United States is not prepared to go first class at the Paris Air Show, we should stay home.—END

Communications Power:
Command and Control for SAC

At Strategic Air Command headquarters near Omaha is the hub of one of the world's most complex communications systems. Designed for rapid and secure operation, SAC's communications system depends on advanced equipment, much of it specially designed and manufactured by the Bell System. The system includes radio, teletypewriter and telephone networks converging in the underground control room. Here specialized Bell System push-button consoles and telephones supply instant contact with the White House, Pentagon, North American Air Defense Command, Joint Chiefs of Staff and all SAC commanders. At this command post Bell System people work constantly with their military teammates, modifying, improving, monitoring and servicing the communications system.

Modern communications: vital to our defense, and to our economy.

Bell System
American Telephone and Telegraph and Associated Companies

White Report

Gentlemen: I read William Leavitt's editorial in AIR FORCE/SPACE DIGEST, June issue, "Constructive Criticism," and wish to congratulate him upon the excellent summary and outline made of the White Report.

This is but another, albeit the most recent, illustration of the fine service your magazine, with its able staff, can render to keep the thinking of our citizens sound on all phases of their number-one problem—their security. . . .

LT. GEN. IRA C. EAKER, USAF (Ret.)
Washington, D. C.

General's Correct Name

Gentlemen: . . . Please send six copies of your June 1965 AIR FORCE/SPACE DIGEST. These copies will be distributed to the Commander in Chief of the Finnish Defense Forces, the Chief of the Finnish Air Force, and to key members of his staff. . . .

Your writer, Mr. Stefan Geisenheyner, did an exceptionally fine job in assembling the material for his article "Between East and West—Finland's Air Force." However, he named Jean [J. S.] Sibelius, Finland's most outstanding composer and musician, as Commanding General of the Defense Forces. I know the late Dr. Sibelius would be proud of this honor, but the true Commanding General is Gen. Jaakko S. Simelius. . . .

COL. EDWARD G. BUTLER
Air Attaché
American Embassy
Helsinki, Finland

● *Needless to say, we, too, are embarrassed and regret the error. The mistake was committed in the original manuscript and was perpetuated throughout the publishing cycle. It was probably a natural mistake, since the name of Sibelius is most likely the best-known Finnish name in this country, with the possible exception of Paavo Nurmi. It has also been called to our attention that on this same page 78 the article states that the Finnish Navy is restricted to 1,000 tons. The figure should have been 10,000 tons.* —THE EDITORS

The North Country

Gentlemen: Stefan Geisenheyner's article "Between East and West—Finland's Air Force" (June issue) cites Finland as being "after Iceland the most northerly country in the world."

I wonder if this isn't an incorrect statement. Iceland is bisected by the 65th parallel and the Arctic Circle just about touches the tip of its northernmost portions. Finland's northernmost section is well above the 70th parallel, and even Norway's northern tier lies above Finland. The USSR also extends further north than Iceland, not to mention Canada and even our own Alaska, which is above the 70th parallel. Jan Mayen and Svalbard, both far to the northeast of Iceland, belong to Norway. Or, does Iceland have island possessions north of these which I can't make out on my map?

ROBERT J. EVANS
Harrisburg, Pa.

● *The* whole *of Finland, and Iceland, lies north of the 60th parallel. It is true that other countries, such as Norway, the USSR, Denmark, etc., either extend further north or have possessions which extend northward, but their territory also runs far south of Finland's southernmost point.*— THE EDITORS

Bigger and Bigger Aircraft

Gentlemen: It is interesting to contemplate the "productivity of the proposed CX aircraft for transporting supplies and equipment." However, at the risk of seeming old fashioned I shudder at the prospect of encasing 600 of our servicemen in a metal can for possible annihilation by heat-seeking missiles that can be launched from enemy-controlled land, sea (including submarines), or air positions. Perhaps the DoD has found some way, yet unknown to the public, to defend our aircraft against such attack. To carry that many men in any one aircraft with any degree of military propriety means that the route would have to be over a militarily secure lane (land, sea, and air) fifty or more miles in width and unlimited altitude.

Even the prospect of building civilian aircraft for the purpose of transporting 500 or 700 passengers must create a stir among the insurance company actuaries. I am all out for progress, but it does seem to me there might be some common-sense limitations as to the number of servicemen or civilians we should expose at any one time to air accident or attack. For instance, perhaps it would be well for the United Nations and Geneva Conference to team up in establishing a 200-passenger limit per aircraft. This would seem to be a reasonable limitation, now that we are well over the 125-passenger per aircraft level. Certainly it should appeal to the various trade unions involved in the manufacture or operation and maintenance of aircraft.

Your comments are solicited if I have manifested any logic in regard to what seems to me to be a trend to exceed "horse-sense" limitations in the size of aircraft intended for transporting personnel—civilian or military.

MAJ. FREDERICK T. NEFF
Brunswick, Ga.

● *We must disagree. Every increase in the size of passenger-carrying aircraft probably met with the same objection. Who can say where the common-sense limit is? Why 200? As to vulnerability, moving many people quickly seems to make more sense than moving the same number less quickly and without the necessary support equipment. The number of planes would seem to be a more compelling vulnerability factor than the size of the airplane. Lastly, we don't think artificial restraints would work insofar as technical progress is concerned. If we don't build the big ones someone else will, with the obvious competitive overtones—a point dramatically brought home by Russia's introduction of their huge AN-22 "Daddybird" at the June Paris Air Show.*—THE EDITORS

Readers' Help Requested

Gentlemen: I am a member of the American Aviation Historical Society and am preparing a listing of aircraft

(Continued on page 12)

People keep stealing our stewardesses.

Within 2 years, most of our stewardesses will leave us for other men.

This isn't surprising. A girl who can smile for 5½ hours is hard to find.

Not to mention a wife who can remember what 124 people want for dinner. (And tell you all about meteorology and jets, if that's what you're looking for in a woman.)

But these things aren't what brought on our problem. It's the kind of girl we hire. Being beautiful isn't enough. We don't mean it isn't important. We just mean it isn't enough.

So if there's one thing we look for, it's girls who like people.

And you can't do that and then tell them not to like people too much.

All you can do is put a new wing on your stewardess college to keep up with the demand.

American Airlines

AIRMAIL—CONTINUED

on display or in storage at various museums and air bases throughout the world. This list is to be published in a ten-volume index of the *Journal of the American Aviation Historical Society* in the early part of next year.

I would appreciate your help in preparing this list. I realize that as an organization you do not have the staff or time to prepare such a list but if you could publish [this] request for the names and addresses of agencies, air bases, and/or museums displaying or storing aircraft your readers would be able to help me. My biggest problem is in locating small museums and single-plane displays.

STEPHEN MUTH
39-02 214th Pl.
Bayside, N. Y.

UNIT REUNIONS

Hump Pilots Association
The annual meeting of the Hump Pilots Association will be held at the Gramercy Inn, Washington, D. C., August 27-29. Those planning to attend should contact

R. V. Reynolds, Pres.
332 Leesburg Pike
Falls Church, Va.
or
James Noe, Secty.
4203 Woodberry St.
Hyattsville, Md.

22d Bombardment Group
The 16th Annual Reunion of WW II 22d Bombardment Group will be held August 6-7 at the Blockade Runner Motor Hotel, Wrightsville, N. C., near Wilmington. For further information contact

Walter Gaylor
650-2 Newark Ave.
Elizabeth, N. J.

81st Fighter Wing
The 1965 81st Fighter Wing reunion will be held September 17-19, at the Sheraton-Jefferson Hotel, St. Louis, Mo. Activities include tour of McDonnell Aircraft Corp., a Gala Banquet, Cardinal-Dodger baseball game, and entertainment in world-famous Gaslight Square. Interested personnel please contact

Maj. William S. Leidy, USAF (Ret.)
1019 Pine St.
St. Charles, Mo.

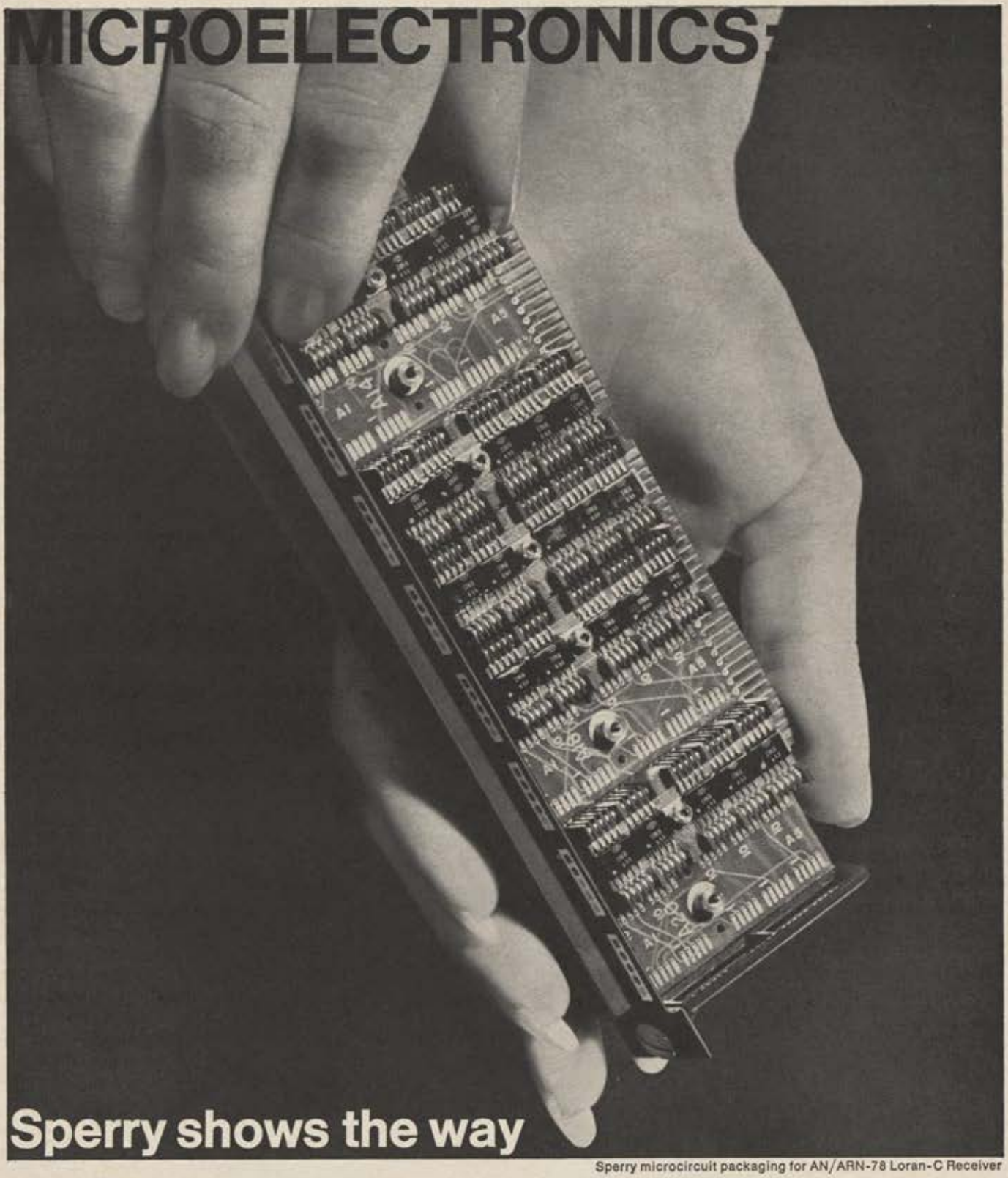
475th Fighter Group, Fifth Air Force
More than fifty of "Satan's Angels" have registered for the October 15-17 reunion in Los Angeles, Calif. Other "Angels" interested in attending should contact

H. N. "Pete" Madison
144 S. Mission Rd.
Los Angeles 33, Calif.

547th Night Fighter Squadron
A twenty-year reunion of the 547th Night Fighter Squadron will be held on Friday and Saturday, August 20 and 21, at the Holiday Inn of North Chicago, 2315 Green Bay Rd., North Chicago, Ill. Those who have not already registered should contact

Russell B. Chipman
133 Meetinghouse Rd.
Hatboro, Pa.

MICROELECTRONICS:



Sperry shows the way

Sperry microcircuit packaging for AN/ARN-78 Loran-C Receiver

Just keeping up with a technology has never been Sperry's practice. Sperry is consistently out front in imaginative development and application of new technologies. Take microelectronics. More than 25 Sperry products and systems have highly reliable, designed-in microcircuits, among them these FIRSTS: microcircuit airborne Loran-C receiver; sonar system; in-production, low-cost digital computer; instrumentation radar; commercial inertial navigation system. And advances in related production methods, such as the Sperry-developed automatic hot gas circuit soldering technique, and improved integrated circuit packaging, add to the capability. Research, begun with semiconductor substrate functional blocks, is underway on the next generation of microcircuits. For more data, see column. *GENERAL OFFICES: Great Neck, N.Y.*

SPERRY

DIVISIONS OF
SPERRY RAND
CORPORATION

Letter from Europe

By Stefan Geisenheyner

AIR FORCE/SPACE DIGEST EDITOR FOR EUROPE

The Paris Air Show

PARIS

The twenty-sixth Paris Air Show in June offered an unprecedented opportunity to see and discuss the products of more than 450 exhibiting companies. Compared with previous years, the show has grown to such an extent that only very selective viewing and visiting, centered around the most recent developments, were possible.

Some simple arithmetic proves this point. The air show was open to the public for ten days at nine hours a day. Ergo, the visitor had only ninety hours to visit a total of 450 exhibits. Herewith is a necessarily condensed report on the hardware highlights of the show.

Commercial Aircraft

This field was dominated by the Russian fleet of civilian airliners, some making their first appearance on this side of the Iron Curtain. Displayed and demonstrated were the Ilyushin IL-62, the Tupolev TU-134 and TU-124, two Antonov designs—the AN-12 and AN-24—plus the old IL-18. Only two of these designs were particularly interesting—the IL-62 and TU-134.

The short-haul liner TU-134, a rear-engine twin-jet type, was designed to replace the TU-124 on the domestic trunk lines of Aeroflot. The external configuration and the seating capacity put it in the same class as a DC-9 or the BAC-111.

According to a salesman from the Soviet export organization, Aviaexport, the TU-134 is available for export at a price of $2 million, including electronics, navaids, and spares for one year. The aircraft is powered by two Soloviev D-30 turbofans of 15,000 pounds thrust each and has seventy-two seats. The Russians claim that on concrete runways a takeoff run of only 2,500 feet is sufficient for liftoff. This takeoff performance, plus soft-field capability, are the main advantages of the aircraft.

The second Soviet aircraft of commercial interest was the Ilyushin IL-62. The layout closely resembles that of the British VC-10. The liner has a range which permits nonstop flights on routes such as Moscow to New York at speeds of 550-600 mph. A high economy factor is supposedly achieved by extremely low fuel consumption.

IL-62 designers apparently have run into some serious problems resulting from engine airflow deficiencies at low speeds. The original pictures of the IL-62 showed a straight leading edge on the wing. Now the wing has a sawtooth design. The experts believe that the rear-mounted engines ran into air-starvation problems when the aircraft was flown at high angles of attack during landing and takeoff. The section of the wing's leading edge in front of the engines is put further back by the sawtooth design, thus allowing an unobstructed airflow to the air intakes at all flight attitudes.

Shoddy workmanship was evident in riveting and fitting of wing and fuselage panels and the use of antiquated screws of a single-slot type, which were already rather frayed at the edges.

If Sud-Aviation of France had not demonstrated and displayed its Super Caravelle carrying the colors of Finnair, the West would not have been represented by a single civilian airliner. Conspicuous by their absence were the BAC-111, the DC-9, and the VC-10.

However, models of the Anglo-French supersonic Concorde were shown. A new proposal has been put forward to lengthen the Concorde's fuselage by four feet and to

Twin-engined Transall C.160 transport is being produced by combine of French and German aircraft firms. At least 160 will be built for armed forces of both countries, and civilian orders are being sought. Except that it has only two engines, C.160 resembles Lockheed C-130, carries comparable payload, and cruises almost as fast but covers only half the Hercules' range.

increase the gross weight by 10,000 pounds to 336,000 pounds, thus raising the seating capacity from 118 to 130 persons.

Nicknamed the "Concordski," a model of the Russian-designed TU-144 supersonic airliner was shown during the latter stages of the Salon. It closely resembled the Concorde, though slightly larger and a little faster.

Models of many proposed commercial aircraft were shown. Breguet exhibited three models based on the STOL 941 configuration. Of particular interest was Project 946, which, with a 250-passenger capacity, would be powered by four Rolls-Royce Tyne engines and feature STOL performance.

A commercial version of the assault transport Transall, now in production for the German and French Armies, is being developed to gain a share of the civilian market. The aircraft can seat about 100 persons and offers soft-field landing and takeoff performance.

German industry offered its VFW-614 project on the commercial market. It is meant to replace the DC-3s still in service, and can be used as a thirty-six-passenger feeder liner or can carry up to 10,000 pounds of cargo.

Military Aircraft

One of the biggest disappointments of the show was the scarcity of advanced US military aircraft designs. Certainly the Lockheed C-141, the Northrop F-5, and the Grumman Intruder and Hawkeye were new, or at least relatively new to the European scene, but each had been given extensive coverage by every trade magazine on the continent.

In contrast to the halfhearted American effort, the Europeans showed everything they had which was ready to fly at the time of the show. The Franco-German antisubmarine aircraft Breguet Atlantic, the VTOL Hawker 1127 (now the Kestrel), the VTOL Mirage Balzac, the Breguet 941, a military STOL transport, plus some lighter jet aircraft (originally built as trainers but now with ground-attack missions) could be appraised and performances judged during the flying display.

Most important, however, was the showing of several models of aircraft which will be built under the French-British cooperation program. One is the Breguet 121, a strike fighter and trainer now officially named the Jaguar. A French Air Force requirement exists for 150 of this type for ground-attack missions and as proficiency trainers for the pilots of the highly complicated Mirage III and IV weapon systems. A similar requirement seems to be taking shape in the Royal Air Force. In any event, the Jaguar will be simple and easy to maintain and still offer the advantages of supersonic flight and relatively sophisticated navigational aids.

The Fiat G-91, in service with the Italian and German Air Forces as a ground-support fighter and rapidly becoming obsolete, will get a new lease on life by replacing the single Bristol Siddeley Orpheus engine with two General Electric J-85 turbojets.

A reverse trend has made itself felt during the past few months, pointing toward highly efficient STOL aircraft instead of VTOL. The requirements seem to be fulfilled by the variable-geometry fighter-bomber type.

Dassault and BAC (British Aircraft Corporation) are working together on a variable-geometry venture. The preliminary designation is Mirage IIIG. Dassault claims that the Mirage IIIG can perform the F-111 mission. A ferry range of 3,000 miles is envisioned to fulfill the requirements of the RAF. To fill the gap until the Mirage IIIG is ready, France has offered its Mirage IV bomber.

The new military transports shown at Le Bourget were basically limited to three types. They were the Lockheed C-141, the de Havilland Canada Buffalo, and the Russian AN-22.

The latter, though displayed in Aeroflot colors, showed distinctly olive drab colors after cautious scratching of the paint, indicating that it must have worn a camouflage coat before it came to Paris. This gigantic aircraft, which can carry up to eighty tons of cargo, was surely developed as a military freighter for the transport of heavy machinery, rockets, tanks, or about 500 fully equipped soldiers. It arrived in Paris nonstop from Moscow on June 16. Flight time was reported to be five hours and ten minutes, making its average block speed about 350 mph. The prototype shown was the freight version of the aircraft.

A prototype under construction now is intended for use as a passenger transport with a capacity of 720 seats. Four turboprop engines, each driving eight-blade counterrotating propellers, were designed by Kusnetzov and deliver 15,000 hp each.

The giant rolls on a twelve-wheel main undercarriage featuring low-pressure tires that give a soft-field capability. The published figures, claiming a takeoff run of 4,300 feet and landing run of 2,600 feet, seem to point to the use of some advanced high-lift devices; however, no trace of these could be discovered on the aircraft as such. The AN-22 was obviously developed to meet specific Russian requirements, originating in the vast expanse of the Soviet Union and the necessity to ferry troops and machinery to parts of the country which do not have sufficient railroad or highway networks. It seems highly doubtful that

(Continued on following page)

—Novosti Press Agency

The West got its first look at the huge Soviet AN-22 Antonev four-engine transport at the Paris Air Show. This version had only a single passenger deck, but spokesmen say that with a double deck it could carry 720 passengers. Its Kusnetzov engines, rated at 15,000 horsepower each, and counterrotating propellers reportedly give it a cruising speed in excess of 425 mph.

the USSR will be able to sell this particular aircraft to any of the Western countries, especially in view of the upcoming C-5A transport, which will outperform the AN-22 in every respect under Western operating requirements.

Another much-discussed transport was the de Havilland Canada Buffalo. Its short takeoff and landing capability had the spectators gasping.

Helicopters

The two huge Russian helicopters, MI-6 and MI-10, by their sheer size dominated the helicopter display. Both designs have been in service with Aeroflot and the Soviet armed forces for five or six years. The MI-6 is powered by two shaft turbines with a combined power output of 11,000 hp and can lift loads up to 30,000 pounds. Sixty-five persons, with baggage, can be transported in the passenger version, which is for sale at $2 million each, with delivery in six months. The price includes spares for one year. The flying crane version, the MI-10, is cheaper at $1.8 million and can be delivered within twelve months.

A more modern helicopter design is the MI-8. The passenger transport version seats twenty-eight persons, and its large square windows ensure good visibility. The MI-8 cargo version can carry a payload of up to 8,000 pounds. With additional tanks, the ferry range can be increased to 435 miles from the normal operating radius of 280 miles. Two shaft turbines of 1,500 hp each allow a considerable power safety margin, permitting the helicopter to fly with one engine shut down. It is offered for only $600,000, with delivery in nine to twelve months.

The Lockheed XH-51A, a high-speed compound helicopter with stub wings and a turbojet booster, performed sensationally. Its flybys were at extremely high speeds and with almost fighter-type maneuverability.

The first appearance in Europe of the Hughes OH-6A, winner of the Army LOH competition, also created a lot of interest.

Sud-Aviation continued its tradition of showing a new helicopter at every Paris show. This year it was the prototype of the much-discussed SA-330 military assault helicopter. The twin-engined aircraft, selling for the relatively high price of $600,000, is again contending for the military helicopter market in Germany. It appears that Germany, in order to obtain the license rights for the Bell UH-1D, has to pay an extra $60 million above the cost of the helicopter as its share of the development costs.

Some time ago, Bölkow and Sud-Aviation concluded an agreement covering the development of a new rigid-rotor design featuring plastic blades, which would be mounted on an Alouette II with an Astazou engine. The result was demonstrated in flight, publicly, for the first time during the show. This helicopter, fitted with a small, streamlined cabin, could become the light observation helicopter of NATO. No official comments, however, were available and the standardization efforts between the German and American forces may dictate the buying of the Hughes OH-6A LOH.

Missed by many, including United Aircraft representatives, was the CH-53A heavy helicopter which, though originally intended to be displayed, did not get Navy permission to be shown at Paris. Thus Boeing Vertol, the competing company for the European market, had the field all to itself, brilliantly demonstrating the Chinook and the Sea Knight.

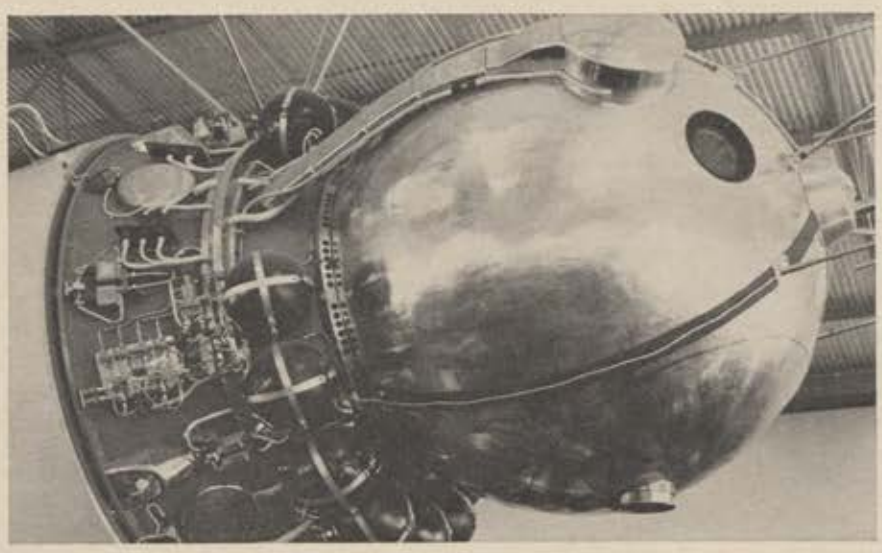
The Sud-Aviation Super Frelon in French Navy colors was demonstrated frequently. Although the German Army and Air Force will not buy this helicopter to fill their medium helicopter requirement, there is an excellent chance that the German Navy will acquire this aircraft for anti-submarine warfare purposes.

US Army's XH-51A compound helicopter, which recently set world speed mark for rotorcraft of 272 mph, made its debut at Paris show. The Lockheed rigid-rotor aircraft is thirty-two feet long, with a rotor thirty-five feet in diameter.

Missiles and Space

As compared to previous shows, the US space effort was represented rather poorly and in no way did justice to the achievements and future plans of NASA or the military. Instead, the Russian space exhibit, although it showed the completely outdated Vostok, caught the imagination of the public which was searching in vain for the Mercury or Gemini capsules or an Apollo mockup. A film of the Gemini-4 spaceflight finally was shown toward the end of the show along with the arrival of the two US astronauts,

Highlight of Germany's space exhibits was this third stage of Europa 1 booster, cooperative venture of ELDO and scheduled to become operational next year. Several German companies, led by Bölkow and ERNO, are the contractors.



Soviet Union displayed this Vostok I spacecraft, the type in which Astronaut Yuri Gagarin became the first human to orbit the earth. Gagarin himself was present at the Paris show, drew tremendous crowds, and autographed thousands of copies of a book describing his exploit. From Soviet accounts, lower collar carrying oxygen tanks and electrical circuits was exposed in space and jettisoned to leave sphere clean on reentry.

—Photo by Ralph Whitener

McDivitt and White. United Technology Center demonstrated a LEM-like model and the Air Force showed full-scale mockups of the Atlas, Titan, and Agena-B. Lockheed showed a model of a scientific satellite, a low-cost item which is compatible with the Scout rocket.

The space exhibits were unquestionably dominated by the French displays, showing clearly the endeavors of this nation to become the third power in space. The three stages of the French satellite launcher, Diamant, were on display, together with a test satellite built by Matra, which will be used to check out the performance of the rocket on early test flights. On display were models of the D-1 French satellite, which is planned to be launched next year via Diamant launch vehicle from Hammaguir in the Sahara. On the military side of the display, a four-nozzle solid-propellant rocket motor was shown. This may well be the engine for the French strategic missile.

The Germans showed some impressive work done with the third stage of the ELDO vehicle. Besides the full-scale mockups of the third stage, several models of government-funded space projects were exhibited. Dominating the model display was the RT-8 aerospace plane or Space Transporter, a cooperative venture by Junkers and Bölkow. The models of high-energy rocket engines intended for future ELDO programs were shown, together with models of scientific satellites.

Propulsion

In this field, the US offered two unusual engines, both manufactured by General Electric. The GE1, a basic gas generator, is the first design of its kind which can be adapted to many roles, using a so-called building-block approach. Components—such as turbofans, afterburners, or thrust-vectoring devices—can be added to the basic gas generator to provide performance and configuration tailored to specific aircraft missions and designs. The basic engine was developed for high gas horsepower and low specific fuel consumption. More than eight different applications are envisioned presently for this engine, of which two turbofan versions have already been bench-run. Several aircraft designers in the European market showed definite interest and the cooperative German-American V/STOL aircraft venture, commonly known as the ADO-12, may be fitted with two different versions of this same engine for lift and thrust.

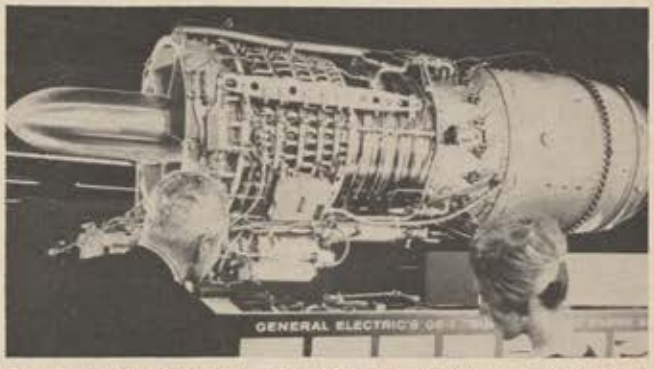
The GE4/J5 turbojet project was represented by a mockup which dwarfed all other engines by sheer size. It is seventy-one inches in diameter and 300 inches long and is in the 50,000-pound-thrust class. This engine is a direct competitor of the Pratt & Whitney STF-219B and L engines for the American SST. Whereas the GE4 is a straight turbojet, the Pratt & Whitney design is a turbofan engine likewise in the 50,000-pound-thrust class.

In the engine field, big strides have been made in cooperation among the major European engine firms. For instance, a Rolls-Royce turbofan engine, the RB.153, was displayed on the German MAN stand with a switch-in thrust deflector of German design in the exhaust duct. On the other hand, Rolls-Royce and Turbomeca of France showed mockups of the RB.172/T.260 turbofan engine, which is designed to power the Anglo-French Jaguar.

Bristol Siddeley and SNECMA showed, for the first time, their M-45 series of engines. The M-45 basic gas generator is rated at 4,620 pounds of thrust. Turbofan and afterburner versions of this engine are available. The M-45G turbofan will deliver 11,000 pounds of thrust with afterburner.

Also for the first time, a model of the engine combination of the German VAK-191-B V/STOL project was displayed. The main engine, the RB.193 vectored-thrust turbofan of 10,000 pounds thrust, is a joint product of Rolls-Royce and Bristol Siddeley. Two RB.162 lift jets will assist during vertical takeoff.

Another impressive engine was the Bristol Siddeley Olympus 593D, which is to power the Concorde supersonic airliner. It will deliver 32,450 pounds of thrust. The engine has been under test since the summer of 1964 at Bristol Siddeley and SNECMA.—End



General Electric showed its GE1, which can be adapted to many roles using building-block approach. Starting with basic gas generator, components are tailored to specific requirements. Engine offers excellent power-to-weight ratio.

AIRPOWER in the news

By Claude Witze
SENIOR EDITOR, AIR FORCE/SPACE DIGEST

Why We Need Road Signs

WASHINGTON, D. C., JULY 14

Do we have a National Security Policy?

There has been increasing evidence in the past few years that we do not have one in the formal, codified sense, and now the evidence is being documented. Credit for getting it in the public record goes to Senator Henry M. "Scoop" Jackson, the Washington Democrat. Mr. Jackson is chairman of the Subcommittee on National Security and International Operations of the Committee on Government Operations. What is being said before this inquiry in 1965 has the distinction of being the most important testimony of the year to be almost completely ignored by the Washington press corps.

Gen. Thomas D. White, USAF (Ret.), was on the stand. The former Chief of Staff had his memory refreshed by Senator Fred R. Harris of Oklahoma, who recalled that

General White

General White had written, a year ago, that the National Security Council "appears to have become less influential." In a column in *Newsweek* magazine, General White observed that now "national military policy seems to stem chiefly from speeches and statements by high-ranking officials."

The General has indicated that this "ill-defined" policy may be flexible but it leaves military men in a quandary. He thinks that an uncodified policy must surely "defy the mechanical perfection of computers as well as the considerable brainpower of our civilian and military planners."

General White told Mr. Harris that when he wore a uniform there was a whole series of national security documents. They were numbered and provided a basic national security policy. He expanded on this:

"We had policy statements for various contingencies around the world, in writing, and obviously highly classified, which did give the military something on which to go. . . . I am quite sure that the National Security Council does not operate as it did in those days. I know that the Planning Board does not operate. . . .

"It is true that very often when a crisis arose we would have a policy that would say just what we were going to do, and when we got right up and looked over the precipice, then we backed up and didn't do what the policy said at all.

"But at least we had a guide, and, while I can't say that I disagree in any sense—to my surprise—with what is going on today in the foreign policy field, nevertheless, I think that we do not have the same kind of formalized formulation of security policies that we have had at some times in the past."

The subject had been raised by the General in his prepared statement for the subcommittee. In that, he encouraged closer relations between the Departments of State and Defense. He said some observers believe the Secretary of Defense has too much influence, and if this is a possibility there is an easy way to ensure against it. That would be to revive the inactive Planning Board of the National Security Council and "operate in the manner and with the caliber of personnel of some years ago."

Introducing General White, Senator Jackson indicated he was chosen as a witness as a recognized and experienced military man. "The question now," the Senator said, "is whether we will continue to make major advances in military technology to maintain and improve our deterrent capability, and whether we will use our military power wisely to help protect and advance our enlightened national interests."

General White addressed himself to the problem with a statement that "the best insurance we can have against atomic war is great military strength. We must maintain armaments and forces of all types needed to successfully meet communism at all critical points. Most vitally, we must maintain decisive superiority in our strategic forces."

He emphasized that "stalemate" is only a transient state and that technology is certain to upset it. He warned that "the development of weapons in space or a positive defense against intercontinental ballistic missiles might be examples of the kind of technological advances that could destroy any temporary balance in strategic forces.

"Research and development is, therefore, the cornerstone of national defense. It is vital that we hold the lead in military technology at whatever cost."

Later, in cross-examination, Senator Jackson asked General White to comment on the contention of some experts that we have reached a "technological plateau" and that no major breakthroughs are expected in military technology.

General White replied that the experts he knows believe technology is going to advance at an ever faster rate. And he believes that the history of the past twenty to twenty-five years proves them right.

"There is no good reason to think that a curve of advancement such as we can trace today is suddenly going to level off," the witness said.

(Continued on page 20)

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"Space is a good example of where new things can develop that we don't even dream of. We didn't dream anybody was going to be floating in space hitched to an umbilical cord even five years ago.

"I am sure we are going to have men on the moon pretty soon. I don't necessarily say the moon itself is of strategic value, but the accomplishment—what we learn, the side contributions of that kind of technology to military technology—is certainly going to keep this curve moving.

"We have new kinds of energies such as the laser, and the maser, and other things that we haven't heard about coming along. The whole world is burgeoning with new technology.

"I am sure of one thing. If technology suddenly levels off, everything else in the world is going to level off. I think technology is going very fast and going faster almost than any other element of society."

General White was asked to expand on an old statement of his that "it seems a dangerous policy to forswear the first strike under any and all conditions." He said if he were very certain that we were going to be hit tomorrow, he would not be in favor of waiting until we got hit. Then there was an exchange with Senator Robert F. Kennedy of New York:

SENATOR KENNEDY: You mean if you were reasonably sure that the Russians were going to attack you tomorrow then you would be in favor of sending your missiles?

GENERAL WHITE: I would.

SENATOR KENNEDY: And in their retaliation which would lead to the death of probably sixty or seventy million Americans?

GENERAL WHITE: You would have to have a situation, it seems to me, where there is already tension to have that sort of thing—a buildup, where the odds are getting pretty high that something is going to happen, anyhow. Yes, I would not sit back and wait until I was struck, if I was reasonably sure, and reasonably sure means to me based on good reasons that appeal to the reasonable man as a reasonable probability.

SENATOR KENNEDY: May I just say as a member of this committee that I do not agree with that.

The difference of opinion can be just as wide in the highest councils of our government, where the decisions are made. It follows that General White's plea for a real and codified National Security Policy has considerable merit.

GAO Replies to Critics

Joseph Campbell, the Comptroller General, submitted his resignation early this month, for reasons of poor health. Chairman Chet Holifield of the Subcommittee on Military Operations of the House Government Operations Committee paid tribute to Mr. Campbell on the House floor and then turned back to his investigation of the General Accounting Office. The hearings now have been concluded with Frank H. Weitzel, the Assistant Comptroller General, appearing as a witness.

From Mr. Weitzel's testimony it is clear that GAO already has made some changes in its auditing procedures to meet the more obvious criticisms offered by the Defense Department and its contractors. The specifics were not made clear, but it is probable that they will be spelled out when the Holifield subcommittee makes its report. Mr. Weitzel said some revisions have been made and indicated that GAO expects to make some more as they appear imperative and practical.

At the same time, the auditing agency, or "congressional watchdog," disagrees firmly with many of its critics. It maintains that it is carrying out the mission given to it by Congress and that the law is specific in its requirements.

"We have tried to carry out our responsibilities to the best of our ability in a fair and impartial manner even though the results of our work may reflect unfavorably upon the agency or contractor under audit," Mr. Weitzel said. "We do not see how this result can be avoided if we are to carry out the duties we think Congress intended us to do."

Prior to his appearance, Mr. Weitzel's office had provided the subcommittee with an eighty-two-page rebuttal of the testimony offered earlier by Defense Department and industry witnesses. Some of these laments were summarized in this column last month. There is no space here to report in detail the GAO side of each argument. It must suffice to report that GAO does not agree with its critics and that it has offered a cool and unimpassioned statement.

Of more general interest is a GAO statement on the "matters of principle" which have been discussed before the Holifield investigation.

For example, Mr. Weitzel's office has examined the charge that GAO frequently substitutes its judgment for that of a government agency or its contractor in the area of management decisions. This is the case where there is an argument over contractor-furnished or government-furnished equipment (GFE). It was argued before the inquiry that GAO is not competent to judge decisions in this area.

The GAO now argues that "it is within our sphere of competence and responsibility to point out, as we have done, any opportunities for cost savings relating to a product that previously has been successfully furnished by the government or which the government has been procuring for replacement purposes at prices less than are being paid through the contractor's purchase of that item. Further, we believe we are justified in reporting on equipment bought through a prime contractor when the item was completely designed and manufactured by a supplier which had full responsibility for its reliability."

Here, at least, there is a clear-cut issue between GAO and the typical big contractor who maintains a proprietary interest in the quality and reputation of his product's reliability. The GAO says it is "fully aware of the technical considerations involved in this area."

Then, there is the question of a reasonable profit, and an unreasonable profit. GAO says its reports "do not attempt to set profit rates or to measure profit rates by preconceived standards." It says it has questioned the reasonableness of profit only when the cost estimates proved excessive by GAO's yardstick. And these costs, GAO says, should have been available to both parties when the contract was negotiated. In practice, of course, they are not always available and the Defense Department witnesses have said they frequently enter these agreements with "eyes open," knowing they are not available.

On the subject of GAO's concentration on a single contract, avoiding reference to a manufacturer's over-all performance, the testimony is equally adamant. Here the GAO presentation refers to the letter of the law. It says that the procurement regulations call for no consideration for "losses or profits realized or anticipated in the performance of other contracts." GAO says it approves of this policy and will follow it.

Chairman Holifield has said that his aim in the investigation has been to improve GAO procedures "in the interest of dealing fairly with people who do business with the government." Mr. Weitzel's rebuttal may provide the Holifield report with some promising material to ensure that kind of fair deal.—END

Dr. Harold Brown, who has been Defense Secretary McNamara's Director of Defense Research and Engineering since 1961, becomes next Secretary of the Air Force on September 30, replacing Eugene M. Zuckert. When Dr. Brown takes over the end of next month, it will mark the first time in history that the Air Force's civilian leader has come from the ranks of science . . .

Scientist in the Slot

Dr. Harold Brown, now thirty-seven years old, takes over on September 30 from Eugene M. Zuckert as Secretary of the Air Force.

FOR THE first time in its history, the US Air Force soon will have a civilian chief taken from the ranks of America's outstanding scientists.

The new Air Force Secretary, who will take office on September 30, is Dr. Harold Brown. As Director of Defense Research and Engineering since May of 1961, Dr. Brown already has a long and intimate knowledge of USAF operations and problems and has been deeply involved in recent technological decisions. He is known in the Pentagon as one of the key executives under Robert S. McNamara and one who enjoys the fullest confidence of the Defense Secretary.

Dr. Brown will replace Eugene M. Zuckert, who will retire with the distinction of having served as USAF Secretary longer than any other man. Mr. Zuckert has not announced his plans for the future.

Announcing Dr. Brown's appointment on July 10, President Lyndon B. Johnson also disclosed that Norman S. Paul, the present Assistant Secretary of Defense (Manpower), has been nominated as Undersecretary of the Air Force. He also is scheduled to take office at the end of September, replacing Dr. Brockway McMillan.

Other important personnel changes in the Pentagon include:

- Thomas D. Morris, who was Assistant Secretary of Defense (Installations and Logistics) from 1961 until 1964, will replace Mr. Paul as Assistant Secretary of Defense (Manpower).
- Robert N. Anthony, a Harvard professor, will replace Charles J. Hitch as Assistant Secretary of Defense (Comptroller).
- Alain C. Enthoven, formerly a Deputy Assistant Secretary under Mr. Hitch, will move to a position of higher stature as Assistant Secretary of Defense (Systems Analysis). He now will monitor and review all analytical studies and improve cost-estimating techniques.

Dr. Brown, the new USAF Secretary, is a physicist and former Director of the Lawrence Radiation Laboratory at Livermore, Calif. He was born in New York City on September 19, 1927, and graduated from Columbia College when he was eighteen years old. He also took his master's degree at Columbia and was awarded a Ph.D. in physics in 1949.

Remaining in the east as a lecturer in physics at Columbia and Stevens Institute of Technology until 1950, Dr. Brown then went to work at the University of California Radiation Laboratory at Berkeley until he joined the Livermore staff in 1952. His contact with USAF goes back at least to 1956, when he became a member of the Air Force Scientific Advisory Board, a post he retained until he joined the McNamara staff in 1961.

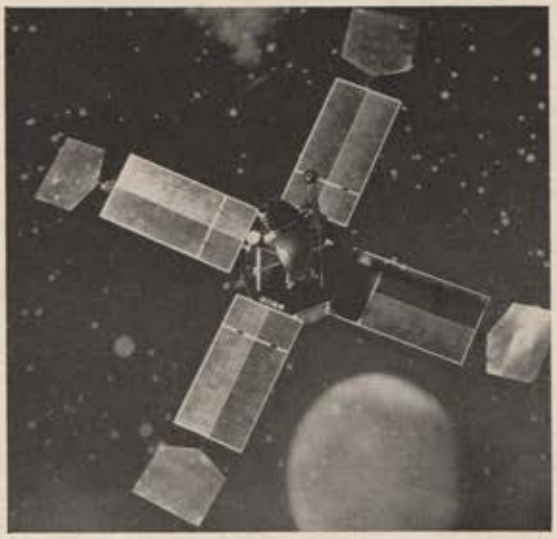
Mr. Paul, the new Undersecretary, was born in 1919 in Stamford, Conn. He graduated from Yale in 1940 and took a law degree at the University of Virginia in 1946. He served in the Navy in World War II. He has practiced law in New York and worked for the Economic Cooperation Administration, the Foreign Operations Administration, and the Central Intelligence Agency. He has been in the Pentagon since he was appointed an Assistant Secretary in July 1962.—END

Also at the end of September, Norman S. Paul, who has been Assistant Secretary of Defense for Manpower, will become the new AF Undersecretary.

News,
Views
& Comments

AEROSPACE WORLD

By Allan R. Scholin
ASSOCIATE EDITOR, AIR FORCE/SPACE DIGEST



Mariner IV succeeded in extraordinary mission to photograph Mars on July 14, adding new laurels to US space effort. Early Mars photos, laboriously transmitted across 134,000,000 miles of space, were released soon after mission, but final processing of complete set may take weeks.

WASHINGTON, D. C., JULY 16

When Viet Cong guerrillas succeeded in penetrating the US Marine and South Vietnamese defense perimeter at Da Nang to destroy two USAF C-130s and an F-102 and damage several others, their action set off a reaction in the White House to commit vastly increased men and equipment to the Vietnamese war.

President Johnson and defense officials, concerned that the most powerful military nation on earth is hard put to protect its Vietnam bases against relatively small and ill-equipped guerrilla forces, are apparently determined to launch a broad offensive to drive the Viet Cong out of South Vietnam.

To do this will take significant increases in manpower, probably more than the US is ready to divert from its other commitments around the world. Increased manpower requirements can be met in part by stepping up the draft—and this is being done. But equipment and personnel trained to operate and maintain it is another matter. The principal resources on which the military can draw are in the Reserve Forces. Thus it seems inevitable that some Reserve units will soon be called.

The Air Force, for instance, will need additional airlift almost immediately to handle the increased flow of men and supplies to Southeast Asia. It will also need more fighter aircraft, and more communications and radar control to guide and direct the heavier air traffic.

Perhaps a partial mobilization of US Reserve Forces will convince North Vietnam that it cannot hope to drive the US out of South Vietnam and bring Ho Chi Minh to the conference table. This strategy worked in the 1961 Berlin crisis.

But convincing Ho Chi Minh may not be enough. The question is whether the Chinese Communists, who have professed more belligerence toward the West than has the USSR in recent years, will contest the US challenge. If so, they might not confine their intervention to Vietnam, but might try to sweep into Laos, Cambodia, and Thailand as well.

On the more optimistic side, it should be noted that North Vietnam and other Southeast Asian nations, whatever their ideological leanings, have won their independence at heavy cost, and have no desire to return to the Chinese domination they endured for a thousand years. The US, by making very clear its full, continuing support to South Vietnam, may be counting on leaders of the other Southeast Asian countries to pressure Ho Chi Minh toward a settlement before the Chinese can apply their own brand of pressure.

☆

Mariner IV was eminently successful in photographing Mars when it

Nation's newest and youngest astronaut, USAF Capt. Joe Engle, 32, is congratulated by wife and children on Edwards AFB, Calif., flight ramp after he piloted X-15 research aircraft to fifty-three-mile height on June 29. Top speed for eleven-minute flight was 3,477 mph.

passed within 6,118 miles of that planet on July 14. But relaying its pictures back by radio, and interpretation of those readings, is proving a lengthy and complex procedure.

Mariner IV completed its photo assignment in twenty-four minutes, during which it took twenty pictures. But its scanning devices had to break each picture down into 40,000 dots or elements, each dot containing six bits of data classifying the dot as one of sixty-four shades of gray from white to black.

This information is being transmitted to NASA's Jet Propulsion Laboratory at Pasadena, Calif., at the rate of 8 1/3 bits per second, requiring eight hours to complete each picture, or almost a week for all twenty.

To offset possible errors in receiving Mariner IV's signals across more than 134,000,000 miles, JPL planned to order the spacecraft to repeat its entire tape reading at least twice. These parallel readings were to be played back simultaneously and processed to eliminate errors.

Thus, although NASA was able to release some preliminary photos within forty-eight hours of Mariner's contact with Mars, it may be weeks before the full portfolio is ready.

☆

The past month has seen almost an entirely new team selected for civilian leadership of the three services. Paul Nitze, who was appointed Secretary of the Navy in November 1963 after serving as an Assistant Secretary of Defense, will be the only holdover and the only man over fifty in the lineup of Service Secretaries and Undersecretaries, all of whom have now been handpicked by Secretary of Defense Robert S. McNamara.

Dr. Harold Brown (*see cover story, page 21*) and Norman S. Paul will move from their DoD-level posts to become Secretary and Undersecretary of the Air Force in September, succeeding Secretary Eugene M. Zuckert, who had served as long as Mr. McNamara himself, and Undersecretary Brockway McMillan. Brown is thirty-seven, Paul forty-six.

The Army's new Secretary is Stanley R. Resor, forty-seven, who replaced Stephen Ailes after serving less than three months as Undersecretary. His former post went to David E. McGiffert, thirty-nine, who had been McNamara's legislative assistant.

New Undersecretary of the Navy is Robert H. B. Baldwin, forty-five, an investment banker and Princeton alumnus. He replaced Kenneth E. BeLieu, who resigned suddenly after only four months in that post.

Along with the many other measures Mr. McNamara has instituted to centralize control of the services in DoD, he can now be reasonably sure that his Service Secretaries will be, if not completely responsive to his ideas, at least fully oriented to his objectives and procedures.

To replace Charles J. Hitch, Assistant Secretary of Defense, Comptroller, who leaves August 31 to become Vice Chancellor of the University of California, Mr. McNamara appointed a Harvard Business School professor, Robert N. Anthony. At the same time he elevated Alain Enthoven, who had been Hitch's Deputy for Systems Analysis, to the newly created post of Assistant Secretary for Systems Analysis.

No announcement had been made at this writing on who will succeed Dr. Brown as Director of Defense Research and Engineering. Thomas D. Morris, former Assistant Secretary of Defense (I&L), will succeed Mr. Paul as Assistant Secretary (Manpower).

Mr. McNamara also underlined his emphasis on youth by calling on his Service Secretaries to suggest revisions in the military promotion system to spotlight highly talented younger officers for accelerated promotion. A change in the present seniority system requires congressional approval.

☆

Plans for a head-to-head flying competition to evaluate North American's OV-10A counterinsurgency aircraft against General Dynamics' M-48 Charger have apparently been tabled.

The Charger, you may recall, was one of nine entries in the LARA (Light Armed Reconnaissance Aircraft) competition conducted by the Navy. When North American won a contract to build seven prototypes, General Dynamics went ahead on its own with its M-48 and had it flying last fall.

Robert W. Morse, Assistant Secretary of the Navy for Research and Development, had previously declared the two planes would be compared in flight tests. But at OV-10 rollout ceremonies at North American's Columbus, Ohio, plant on July 7, he commented that "We look forward to taking delivery of it soon, and to making it part of our forces."

Somewhere along the way, Mr. Morse seems to have been persuaded that a flying competition between the two candidates could prove embarrassing to the Defense Department. If Convair's Charger should have proven superior, it would have cast strong doubts on DoD's ability to determine the best model by computer and could renew pressure for a return to the World War II procedure of two-source development followed by flight competition before awarding a major production order. During the TFX investigation, several congressmen suggested that Boeing should have been allowed to build its TFX prototype for flight tests against the General Dynamics entry.

An ironic point in all this is that General Dynamics, which won the TFX contract without a fly-off, should now, in a comparatively minor competition, have been the one to suggest that DoD experts may be fallible, by pressing for a flying competition between their Charger and the OV-10A.

Some factual comparison may yet be possible between the two planes, for NASA has contracted for ten hours of flight tests on the M-48 in gathering research data on V/STOL characteristics. Undoubtedly NASA will get a chance later to test the OV-10A.

(Continued on following page)

General Dynamics may not get a chance after all to test its M-48 Charger against North American's OV-10A (right), winner among nine entries in Navy's COIN fighter competition.

—Wide World Photos

In rollout ceremonies for OV-10A at Columbus, Ohio, Robert Morse, Navy's Assistant Secretary for R&D, indicated he was withdrawing earlier offer to test it with Charger.

—Washington Post photo by Dick Darcey

USAF Chief of Staff and other notables attended Capitol Hill presentation of checks totaling $62,500 to AF Aid Society, Aerospace Education Foundation, and AF Village by AFA's Iron Gate Chapter of New York City, proceeds from Air Force Ball staged by chapter in February.

Will the British decide to order the F-111 from the US? British Aviation Minister Roy Jenkins promises a decision this fall, following a detailed study by a high-level interservice board on future military roles and missions. But there are indications the decision will be based as much on political as military considerations.

"If we need a plane of this type, we'll buy the F-111," Jenkins said on a recent US visit. "If we could sell you some of our wide range of air components, the decision would be easier."

This appeal for some sort of trade was accompanied by reports that France has offered Britain a special version of its Dassault Mirage IV nuclear bomber as a replacement for the canceled British TSR.2 tactical strike reconnaissance aircraft. The French suggested it might be fitted with Rolls-Royce Spey engines, as would the F-111.

The Mirage IV doesn't have the range or capacity of the F-111—but Britain is seeking closer ties with France, and the two nations are collaborating on the Concorde supersonic transport.

"Why not the Mirage?" asked Britain's *Flight* magazine in an editorial. "With Speys, and the 'R' equipment from the TSR.2, just how far short of the requirement does it fall? It would clearly have to fall short indeed to invalidate the political and industrial case for this aircraft."

Mirage IV, now entering operational service with the French Air Force, has an operational radius of 1,000 miles, augmented by air-to-air refueling for which France acquired a dozen KC-135s from the US. Powered by two SNECMA Atar 9K turbojets rated at 14,770 pounds' thrust with afterburner, it can reach Mach 2.2, but normally operates at about Mach 1.8 at altitude. Spey engines might increase these speeds. Its size and weight are close to those of the F-111, measuring 77 feet in length compared with 72 feet for the F-111 and a wing span of 39 feet 4 inches. F-111's sweptback span is 32 feet. The Mirage IV's maximum takeoff weight is just under 70,000 pounds, the F-111's slightly above.

Britain could probably buy the French bomber for less than the F-111, but the Mirage IV is no match for the F-111 in ability to operate equally effectively at high or low altitude, in general versatility, and in the most important factor of range.

The main question the British must resolve is whether it wants, or needs, a long-range strike aircraft capable of deploying swiftly from bases in Britain to its possessions and allies east of Suez. Britain's dilemma, as *Flight* puts it, is "how far the interests of national defense can be compromised to the interests of European industrial collaboration."

☆

The Mackay Trophy for 1964 has been awarded to the 464th Troop Carrier Wing of Pope AFB, N. C., for airlifting 1,500 hostages and refugees from rebel-held territory in the Congo last November.

Operating under direction of Gen. Paul D. Adams, Commander in Chief of US Strike Command and of MEAFSA (Middle East, Africa South of the Sahara, and Southern Asia), the 464th on November 24 airdropped and airlanded a battalion of Belgian paratroopers into Stanleyville, then under rebel control, to rescue and evacuate hostages and refugees. In subsequent flights it brought out 1,500 Congolese and foreign nationals of fifteen countries to a safe haven in Leopoldville.

The Mackay Trophy, awarded annually by USAF to a person or unit for "the most meritorious flight of the year," was established in 1911 by Clarence H. Mackey, a New York industrialist. First recipient in 1912 was Lt. H. H. Arnold, who became AAF Commanding General in WW II.

☆

News Notes—A second "Pentagon" to house overflow offices of the armed services in the Washington, D. C., area will be built at an estimated cost of $30 million, President Johnson has announced. To be named for James V. Forrestal, first Secretary of Defense, it will be located in downtown Washington near the Smithsonian Institution and will accommodate 6,600 per-

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CONTINUED

sonnel, giving it about one-fourth the capacity of the Pentagon. No completion date has been established.

Five squadrons of Mace A missiles are to be withdrawn from bases at Sembach and Hahn, Germany, by June 1966. Mace As are fired from fixed sites above ground, regarded as vulnerable to enemy attack. One Mace B squadron, at Bitburg, Germany, housed in concrete shelters, will be retained. Combat capability will be maintained, the Defense Department said, by assigning the Mace A targets to Pershing missile units now reaching Europe in increasing numbers.

North American's XB-70 was expected to reach its Mach 3 flight goal in mid-July, after hitting Mach 2.85 at 68,000 feet on June 30. Piloted by North American test pilots Al White and Van Shepard, it flew for 104 minutes, all but twenty minutes at supersonic speed, and covered 1,800 miles, its longest distance to date.

☆

SENIOR STAFF CHANGES . . . Brig. Gen. Richard S. Abbey, from Dir., Plans and Policy, J-5, NORAD and CONAD, Ent AFB, Colo., to Dep. C/S, US Military Assistance Cmd., Vietnam . . . **Maj. Gen. Milton B. Adams,** from Asst. C/S, Plans, J-5, US Military Assistance Cmd., Vietnam, to Dep. for Operations, TAC, Langley AFB, Va. . . . **Brig. Gen. Milton H. Ashkins,** from Dep. Cmdr., MOAMA, AFLC, Brookley AFB, Ala., to Inspector General, AFLC, Wright-Patterson AFB, Ohio . . . **Brig. Gen. Horace D. Aynesworth,** from Cmdr., Tactical Air Reconnaissance Ctr., TAC, Shaw AFB, S. C., to Dep. Dir. of Operations, Office, DCS/Plans and Operations, Hq. USAF . . . **Brig. Gen. William C. Bacon,** from Cmdr., 22d Strat. Aerospace Div., SAC, Walker AFB, N. M., to Asst. to Cmdr., 15th AF, SAC . . . **Brig. Gen. John W. Baer,** from Cmdr., 20th TFW, USAFE, to Asst. Dep. for Plans, TAC, Langley AFB, Va. . . . **Brig. Gen. Thomas H. Beeson,** from Cmdr., Goose Air Defense Sector, Goose AB, Labr., to Cmdr., 73d Air Div., Tyndall AFB, Fla., replacing Maj. Gen. R. W. Burns.

Brig. Gen. William Burke, Dir. of Plans, PACAF, Hickam AFB, Hawaii, assigned additional duty as Dir. of Operations, PACAF . . . **Maj. Gen. William B. Campbell,** from Cmdr., 4th Strat. Aerospace Div., SAC, Grand Forks AFB, N. D., to Dep. Inspector General, Office TIG, Norton AFB, Calif. . . . **Brig. Gen. Edwin S. Chickering,** from Dep. Project Manager, US Arms Control and Disarmament Agency, OSD, to C/S, US Element, NATO Standing Group . . . **Maj. Gen. Don Coupland,** Auditor General, Hq. USAF, Washington, D.C., to duty station at Norton AFB, Calif. . . . **Brig. Gen. Russell E. Dougherty,** from Dep. Dir. for Plans, J-3, US European Cmd., to

(Continued on following page)

Dir., European Region, OASD (ISA), Washington, D.C. . . . **Maj. Gen. John N. Ewbank, Jr.**, from Dep. for Operations, TAC, Langley AFB, Va., to Asst. C/S, Plans, J-5, US Military Assistance Cmd., Vietnam, replacing Maj. Gen. Milton B. Adams.

Dr. Frederick F. Fennema, from Dir., Operations Analysis, to Dir., Technical Programs, Office of Deputy for Programs and Requirements, Hq. National Range Div., AFSC, Andrews AFB, Md. . . . **Brig. Gen. John T. Fitzwater**, from Asst. Dep., to Dep. for Plans, TAC, Langley AFB, Va., replacing Maj. Gen. Walter B. Putnam . . . **Brig. Gen. William C. Garland**, from Cmdr., 12th Strat. Aerospace Div., SAC, Davis-Monthan AFB, Ariz., to Dep. Dir., Office of Information, OSAF, Hq. USAF, replacing Brig. Gen. Maurice F. Casey . . . **Dr. Kenneth Gayer**, from Dir., Manpower Studies, Institute of Naval Studies, Cambridge, Mass., to Chief, Operations Research Div., SHAPE Technical Ctr., NATO, Paris, France . . . **Maj. Gen. Alvan C. Gillem, II**, from Dep. Dir., to Dir. of Operations, SAC, Offutt AFB, Neb., replacing Maj. Gen. Harold E. Humfeld . . . **Maj. Gen. Gordon T. Gould, Jr.**, from Dep. Cmdr., AFCS, Scott AFB, Ill., to Dir. of Command Control and Communications, Office, DCS/Programs and Requirements, Hq. USAF, replacing Maj. Gen. J. Francis Taylor, Jr.

Maj. Gen. Victor R. Haugen, from Chief, MAAG, Germany, to Cmdt., AFIT, AU, Wright-Patterson AFB, Ohio . . . **Maj. Gen. Elbert Helton**, from Dir. of Data Automation, Office, AF Comptroller, Hq. USAF, to Dir. of Logistics Div., J-4, US European Cmd. . . . **Brig. Gen. George M. Higginson**, from Cmdr., African-Middle Eastern Communications Area, Germany, to Dep. C/S for Operations, AFCS, Scott AFB, Ill. . . . **Brig. Gen. William G. Hipps**, from Dep. for Materiel, TAC, Langley AFB, Va., to Dir. of Operations, AFLC, Wright-Patterson AFB, Ohio . . . **Brig. Gen. Everett W. Holstrom**, from Cmdr., 816th Strat. Aerospace Div., SAC, Altus AFB, Okla., to Cmdr., 12th Strat. Aerospace Div., SAC, Davis-Monthan AFB, Ariz., replacing Brig. Gen. William C. Garland . . . **Maj. Gen. J. Stanley Holtoner**, from Cmdt., Armed Forces Staff College, Norfolk, Va., to Vice Cmdr., CONAC, Robins AFB, Ga. . . . **Maj. Gen. Harold E. Humfeld**, from Dir. of Operations, SAC, Offutt AFB, Neb., to Dep. Cmdr., 15th AF, SAC, March AFB, Calif. . . . **Brig. Gen. Richard O. Hunziker**, from Cmdr., 821st Strat. Aerospace Div., SAC, Ellsworth AFB, S. D., to Dep. Dir. of Operations, SAC, Offutt AFB, Neb., replacing Maj. Gen. Alvan C. Gillem, II.

Brig. Gen. Arthur W. Kellond, from Cmdr., European Security Region, USAFSS, to Asst. to Cmdr., USAFSS, San Antonio, Tex. . . . **Brig. Gen. Richard T. Kight**, from Dep. Cmdr., 5th Allied Tactical Air Force, Vicenza, Italy, to SACEUR Representative to Joint Strategic Target Planning Staff, Offutt AFB, Neb., replacing Maj. Gen. Henry R. Sullivan, Jr. . . . **Maj. Gen. Joseph T. Kingsley, Jr.**, from Special Asst. for Military Assistance Affairs, The Joint Staff, Washington, D. C., to Asst. to DCS/Personnel, Hq. USAF.

Brig. Gen. Lawrence S. Lightner, from Cmdr., 813th Strat. Aerospace Div., SAC, Malmstrom AFB, Mont., to Dep. Dir., Legislative Liaison, OSAF, Hq. USAF . . . **Brig. Gen. Andrew S. Low, Jr.**, from Dep. Dir., Joint Test and Evaluation Task Force, US Strike Command, MacDill AFB, Fla., to Chief, USAF Gp., Joint US Military Mission for Aid to Turkey . . . **Maj. Gen. Charles M. McCorkle**, from Vice Cmdr., 5th AF, PACAF, Fuchu AS, Japan, to Asst. DCS/P&R, Office, DCS/Programs and Requirements, Hq. USAF . . . **Maj. Gen. Seth J. McKee**, from Dir. of Plans, Office, DCS/Plans and Operations, to Asst. DCS/Plans and Operations for JCS Matters, Hq. USAF, replacing Maj. Gen. John W. Carpenter, III.

Brig. Gen. John M. McNabb, from Cmdr., 3525th Pilot Training Wing, ATC, Williams AFB, Ariz., to DCS/Technical Training, ATC, Randolph AFB, Tex., replacing Maj. Gen. Nils O. Ohman . . . **Brig. Gen. William B. Martensen**, from C/S, 2d AF, SAC, Barksdale AFB, La., to Cmdr., 4th Strat. Aerospace Div., SAC, Grand Forks AFB, N. D., replacing Maj. Gen. William B. Campbell . . . **Brig. Gen. William J. Meng**, from Dep. for Personnel, TAC, to Inspector General, TAC, Langley AFB, Va., replacing Brig. Gen. Kyle L. Riddle . . . **Maj. Gen. Theodore R. Milton**, from DCS/Plans and Operations, PACOM, to C/S, TAC, Langley AFB, Va., replacing Maj. Gen. Walter B. Arnold . . . **Brig. Gen. William W. Mitchell, Jr.**, from Cmdr., 314th Air Div., PACAF, and Cmdr., Air Forces Korea, Korean Air Defense Sector, and AF Member, UN Military Armistice Commission, to Dep. Dir. for Operations, J-3, The Joint Staff, Washington, D.C. . . . **Brig. Gen. Edward H. Nigro**, from C/S, ATC, Randolph AFB, Tex., to Cmdr., Sheppard Technical Training Ctr., ATC, Sheppard AFB, Tex. . . . **Maj. Gen. Nils O. Ohman**, from DCS/Technical Training, ATC, Randolph AFB, Tex., to Vice Cmdr., ATC.

Brig. Gen. Robert W. Paulson, from Dir., J-6, US Strike Cmd., MacDill AFB, Fla., to Cmdr., European-African-Middle Eastern Communications Area, AFCS, with additional duty as DCS/Communications, USAFE, replacing Brig. Gen. George M. Higginson . . . **Brig. Gen. Jammie M. Philpott**, from Dep. Dir., to Dir. of Intelligence, SAC, Offutt AFB, Neb., replacing Maj. Gen. Robert N. Smith . . . **Mr. Elbert W. Piety**, from Senior Staff Scientist, the Bissett-Berman Corp., Santa Monica, Calif., and Consultant to the LTV Electrosystems, Inc., Greenville, Tex., to Scientific Adviser (Reconnaissance and Intelligence) Reconnaissance Gp., Directorate of Development, DCS/R&D, Hq. USAF . . . **Brig. Gen. Oran O. Price**, from Dep. Dir. for Construction, DCS/Programs and Requirements, Hq. USAF, to Civil Engineer, AFLC, Wright-Patterson AFB, Ohio . . . **Maj. Gen. Walter B. Putnam**, from Dep. for Plans, TAC, Langley AFB, Va., to Cmdr., Tactical Air Warfare Ctr., TAC, Eglin AFB, Fla. . . . **Brig. Gen. Kyle L. Riddle**, from Inspector General, TAC, Langley AFB, Va., to Cmdr., Tactical Air Reconnaissance Ctr., Shaw AFB, S. C., replacing Brig. Gen. Horace A. Aynesworth.

Maj. Gen. Jay T. Robbins, from Dir. of Aerospace Safety, Office, TIG, Norton AFB, Calif., to Cmdr., 313th Air Div., PACAF, Kadena AB, Okinawa . . . **Brig. Gen. John A. Rouse**, from Cmdr., 6486th ABW, and Cmdr., 326th Air Div., Hawaiian Air Def. Div., PACAF, Wheeler AFB, Hawaii, to Cmdr., Seattle Air Defense Sector, ADC, McChord AFB, Washigton . . . **Maj. Gen. Robert R. Rowland**, from Chief, Air Section, MAAG, Vietnam, to Asst. to C/S, PACAF, Hickam AFB, Hawaii . . . **Maj. Gen. Kenneth O. Sanborn**, from Chief, MAAG, Republic of China, Taiwan, to C/S, AFLC, Wright-Patterson AFB, Ohio, replacing Maj. Gen. H. C. Porter . . . **Mr. James D. Savage**, from Technical Adviser to the Dep. Cmdr. for Operations, 6901st Special Communications Gp., USAFSS, to Technical Dir., Special Communications Ctr., USAFSS.

Brig. Gen. Albert W. Schinz, from Cmdr., 836th Air Div., TAC, MacDill AFB, Fla., to Chief, Air Section, MAAG, Vietnam, replacing Maj. Gen. Robert R. Rowland . . . **Brig. Gen. Richard F. Shaefer**, from Dep. Dir. for Plans, Military Committee and Standing Group, NATO, Hq. USAF, to Dep. Cmdr., 3d AF, USAFE, South Ruislip, England . . . **Brig. Gen. Pinkham Smith**, from Dep. Dir. of Operations, Office, DCS/Plans and Operations, Hq. USAF, to Cmdr., 314th Air Div., PACAF, Osan AB, Korea, replacing Brig. Gen. William W. Mitchell, Jr. . . . **Maj. Gen. Robert N. Smith**, from Dir. of Intelligence, SAC, Offutt AFB, Neb., to Dir. of Plans, DCS/Plans and Operations, Hq. USAF.

Brig. Gen. Charles B. Stewart, from Dir., Nuclear Safety, Office, TIG, Kirtland AFB, N. M., to Dir., Aerospace Safety, Office, TIG, Norton AFB, Calif. . . . **Maj. Gen. Avelin P. Tacon, Jr.**, from Asst. to Cmdr., 13th AF, PACAF, Clark AB, P. I., to Dep. Cmdt., National War College, Ft. Lesley J. McNair, Washington, D. C. . . . **Brig. Gen. Lawrence F. Tanberg**, from Asst. Dep. to Dep. for Materiel, TAC, Langley AFB, Va., replacing Brig. Gen. William G. Hipps.

Maj. Gen. J. Francis Taylor, Jr., from Dir. of Command Control and Communications, Office, DCS/Programs and Requirements, Hq. USAF, to Cmdr., AFCS, Scott AFB, Ill. . . . **Maj. Gen. John W. Vogt, Jr.**, from Dir., Policy Planning Staff, OASD (ISA), Washington, D. C., to Asst. to DCS/Plans and Operations, PACAF, Hickam AFB, Hawaii . . . **Maj. Gen. Albert T. Wilson**, from Vice Cmdr., CONAC, Robins AFB, Ga., to Asst. to Cmdr., CONAC . . . **Maj. Gen. James W. Wilson**, from Dep. Cmdr., 15th AF, SAC, March AFB, Calif., to Cmdr., 13th AF, PACAF, Clark AB, P. I., replacing Maj. Gen. Sam Maddox, Jr.

RETIREMENTS . . . Brig. Gen. Robert S. **Brua**, Maj. Gen. Perry M. **Hoisington, II**, Brig. Gen. Robert B. **Miller**.—END

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AIR FORCE
AUGUST, 1965

On the morning of July 16, 1945, over the desert at Alamogordo, N. M., in the words of a witness 150 miles away: "Suddenly the mountains were illuminated by daylight for about three seconds. Then it was dark again. It was exactly like the sun had come up and then suddenly gone down again." In a cataclysmic moment, history's first atomic bomb had been detonated. Within weeks the awesome new weapon would be used against Japan. And the world would never be the same . . .

The Birth of the A-Bomb . . . And the Aftermath

By Maj. Kenneth L. Moll, USAF

ADMIRAL Leahy didn't think it would work. In the spring of 1945, when President Truman received his first detailed briefing on the atomic bomb project, the President's Chief of Staff observed bluntly, "That is the biggest fool thing we have ever done. The bomb will never go off, and I speak as an expert on explosives."[1]

During the Potsdam Conference three months later, Secretary of War Henry L. Stimson told General Eisenhower of the successful Alamogordo atomic test. Eisenhower recently reminisced about their conversation:

> We'd had a nice evening together at headquarters in Germany, nice dinner, everything was fine. Then Stimson got this cable saying the bomb had been perfected and was ready to be dropped. The cable was in code, you know the way they do it. "The lamb is born" or some damn thing like that. ["Babies satisfactorily born" was the actual wording.] So then he told me they were going to drop it on the Japanese. Well, I listened, and I didn't volunteer anything because, after all, my war was over in Europe, and it wasn't up to me. But I was getting more and more depressed just thinking about it. Then he asked me for my opinion, so I told him I was against it on two counts. First, the Japanese were ready to surrender and it wasn't necessary to hit them with that awful thing. Second, I hated to see our country be the first to use such a weapon. Well . . . the old gentleman got furious. And I can see how he would. After all, it had been his responsibility to push for all the huge expenditure to develop the bomb, which of course he had a right to do, and *was* right to do. Still, it was an awful problem.[2]

The solution to this problem has been a matter of controversy ever since. It has been called, more than once, "the most important decision of our time."

The Bomb Is Born

After twenty years as a theoretical curiosity, the idea of atomic fission began to receive serious attention just before World War II. In October 1939, Dr. Albert Einstein forwarded a letter to President Roosevelt urging that the free nations begin A-bomb studies. Roosevelt formed a Uranium Committee and, in late 1941, was told by the scientists that an A-bomb could be built within three years to five years for "several hundred" million dollars. Concerned about the possibility of German work on military atomic applications,

(Continued on following page)

[1]All references may be found on page 36.

Roosevelt decided, one day before Pearl Harbor, to join the race.

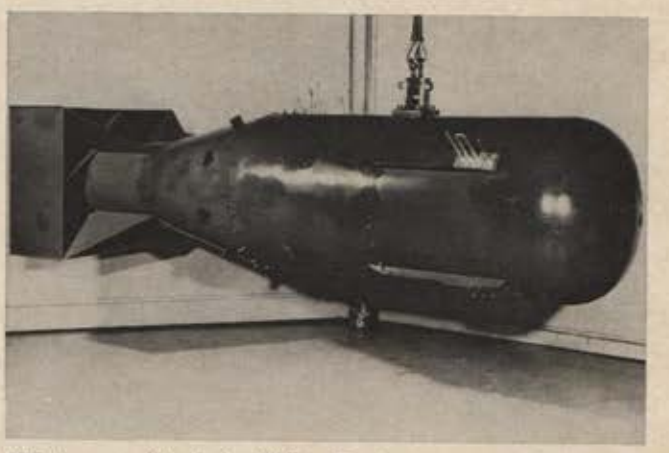
As the work expanded in 1942, over-all project direction was assumed by Brig. Gen. Leslie R. Groves, Jr., USA, who headed the supersecret Army Engineers "Manhattan District," created to build A-bombs. Starting the job, Groves was given an estimate by the scientists of the amount of material needed for an A-bomb. When pressed, they admitted it could turn out to be ten times more or ten times less than they estimated. "My position could well be compared with that of a caterer who is told he must be prepared to serve anywhere between ten and a thousand guests," Groves noted.[3]

Even the British, who at this point had done more development work than the Americans, had not been able to choose among several theoretical approaches for producing A-bomb material. Desperately concerned about German A-bomb progress, Groves decided to try everything. Three approaches for the mechanical separation of uranium were tried in the huge plants built at Oak Ridge, Tenn., while plutonium was mass-produced at Hanford, Wash. To "think big" became a habit, as when Col. Kenneth Nichols asked for 86,000 tons of government silver to use at Oak Ridge in lieu of war-short copper conductors. "Colonel," he was told by a flabbergasted Treasury official, "in the Treasury we do not speak of *tons* of silver—our unit is the Troy ounce!"

In the end, at a cost of $1.5 billion, all four methods —the three at Oak Ridge and the other at Hanford— worked. By September 1944, designs for both the uranium ("Thin Man") and plutonium ("Fat Man") bombs were frozen. That same month, Groves and Gen. H. H. "Hap" Arnold, Army Air Forces chief, agreed to begin training a B-29 unit—the 509th Composite Group—to drop the A-bombs.

But the project was still a great risk. Not until July 16, 1945, did Groves and the others at Alamogordo really learn their judgment was better than that of Admiral Leahy. Before sunrise that morning, as told by a woman who had been in a car in Arizona 150 miles away. "Suddenly the mountains were illuminated by daylight for about three seconds. Then it was dark again. It was exactly like the sun had come up and then suddenly gone down again."[4] The first nuclear device in the history of the world had been detonated atop a 100-foot steel tower in the remote desert of New Mexico. As calculated later, it released energy equivalent to 19,000 tons of TNT, more than the most sanguine estimates.

On July 16, 1945, on the desert near Alamogordo, N. M., the scientific-military team of the secret Manhattan Project detonated the first atomic bomb in history, the culmination of an intensive project started as insurance against similar efforts which had been considered possible in Nazi Germany.



This is a model of the "Thin-Man" type weapon detonated over city of Hiroshima with a yield equivalent to some 20,000 tons of high explosives. The weapon was twenty-eight inches in diameter, ten feet long, and weighed about 9,000 pounds. It marked a turning point in the history of warfare.

A-Bomb Policy Deliberations

General Groves and the scientists had done their jobs well. The question now was whether to use it against the enemy and, if so, how? At Hyde Park in 1943, Roosevelt and Churchill had agreed that the A-bomb "might perhaps, after mature consideration, be used against the Japanese." By May 1945, the aggressors of Pearl Harbor were still a mortal enemy even though Germany's defeat had eliminated the threat of an Axis A-bomb. Neither Roosevelt nor Truman had ever suggested that the A-bomb would *not* be used when available.

Yet there was a natural revulsion against using a new and more horrible weapon. The Hamburg fire raids had been bad enough. Still worse was the B-29 raid on Tokyo on March 9, 1945, in which incendiary bombs boiled the water in Tokyo's canals, killed 78,000 people, and burned out sixteen square miles in the heart of that city. Now a weapon a thousandfold more powerful was in prospect.

Even in 1944 Admiral Leahy had been against it. Scientist Leo Szilard, who had helped get America on the course to Alamogordo in the first place, sent Roosevelt a memo arguing against use of the A-bomb, but the President died before reading it. Not surprisingly, Roosevelt's attention had been directed toward more urgent wartime questions than the uncertain Manhattan Project.

Still, the question of A-bomb use deserved careful

A nuclear weapon of the "Fat-Man" type dropped over the city of Nagasaki in second and last atomic strike against tottering Japan. "Fat Man" bomb, sixty inches in diameter and 128 inches long, weighed about 1,000 pounds more than "Thin Man," but had about the same explosive yield.

consideration. Two weeks after Harry Truman became President, Stimson recommended that a committee be appointed to study all the A-bomb implications. The resultant Interim Committee met many times in May and June 1945 and considered the whole spectrum of atomic problems—political, military, and scientific. In his introductory remarks to the May 31 session, Stimson observed:

> Today's prime fact is war. Our great task is to bring this war to a prompt and successful conclusion. We may assume that our new weapon puts in our hands overwhelming power. It is our obligation to use this power with the best wisdom we can command. To us now the matter of first importance is how our use of this new weapon will appear in the long view of history.[5]

At lunch following this meeting, Stimson was asked if it might be possible to demonstrate the A-bomb in such a way as to induce Japanese surrender but not cause any casualties. Stimson, intrigued by the idea, asked the Interim Committee's Scientific Panel to try to outline such a technique. The Panel considered it from every angle and finally concluded that "we can propose no technical demonstration likely to bring an end to the war; we see no acceptable alternative to direct military use." Also in June, the Joint Chiefs of Staff considered a proposal for an A-bomb warning to the Japanese. Assistant Secretary of War John McCloy recalled that "not one of the Chiefs nor the Secretary thought well of a bomb warning, an effective argument being that no one could be certain, in spite of the assurances of the scientists, that the 'thing would go off.'"[6]

Meanwhile, on June 1 the Interim Committee had recommended to President Truman that the A-bomb be used as soon as possible against a dual Japanese target (a military target surrounded by other buildings), and that it be used without prior warning. Both Stimson and the Committee later considered a variety of proposals to modify this policy. But the Interim Committee recommendations, with which almost all the President's advisers concurred, remained the same except for a change in heart by member Ralph Bard on the "no warning" provision. In petitions and polls, atomic scientists made recommendations on A-bomb use—some were for it, some against. Only the now-famous Franck Report, which was against using the bomb, was received in Washington in time to be considered in the decision.

When the Alamogordo test succeeded on July 16—the day after Truman and the new Secretary of State, James Byrnes, had arrived at Potsdam—the use of the A-bomb seemed almost a foregone conclusion. Churchill had agreed on July 4 that the Americans could go ahead with their plans for dropping atomic bombs on four Japanese cities. The original target list included Kokura, Hiroshima, Niigata, and Kyoto. At Stimson's insistence, the cultural and religious center of Kyoto was replaced by Nagasaki. Meanwhile, from Tinian, the specially trained B-29 crews were already flying nonatomic operations.

That same day (July 16) the cruiser *Indianapolis* left San Francisco with most of the components for the A-bomb destined to hit Hiroshima. Four days after delivering its cargo at Tinian, the *Indianapolis* was sunk by a Japanese sub.

Japan Defiant

In mid-July, Japan's resistance was still ferocious though there were some Americans who correctly guessed she was near collapse. One of these was Capt. Ellis M. Zacharias, a naval officer who spoke Japanese fluently, knew many Japanese officials, and had spent several years in Japan. Feeling that their bombastic talk of a fight to the death was just talk, he urged a psychological warfare campaign to convince Japanese leaders to surrender. When his plan was approved in March 1945, Zacharias began a series of broadcasts to Japan's leaders which carefully played on their growing fears.[7]

The biggest difficulty was in defining "unconditional surrender" for the Japanese. The official unconditional-surrender policy promised absolutely nothing to the enemy. Yet the Japanese could not contemplate a surrender unless their Emperor was spared. Unable to promise this, Zacharias resorted to oblique references to the subject in his talks.

It was an uphill battle. Despite a growing pessimism among Japan's nonmilitary leaders as early as 1944, the military had held sway in Japan for years. They were not even considering surrender. On April 5 General Tojo, who had himself been Prime Minister until mid-1944, threatened an Army coup. On April 15 some 400 persons, including postwar Prime Minister Shigeru Yoshida, were arrested by the Army for end-the-war sentiments. On June 9 the new Prime Minister, Admiral Suzuki, told Japan to "fight to the very end." And on July 21 Foreign Minister Shigenori Togo, leader of the peace faction, said, "We cannot consent to unconditional surrender under any circumstances."

Early in June the Japanese Cabinet made the decision to continue the war to its bloody end, but two

(Continued on following page)

Gen. Hideki Tojo, left, a leader of the militarist faction that wanted to continue the war, threatened coup to prevent negotiations with US. Shigeru Yoshida, later postwar Prime Minister, was among hundreds arrested in April 1945 on charges of harboring end-the-war sentiments.

weeks later they accepted the Emperor's desire to simultaneously seek other means for ending the war. Half-hearted negotiations with the Russian ambassador were then stepped up, and in mid-July the Japanese began arrangements (never completed) to send ex-Prime Minister Prince Konoye to Moscow for direct talks with Soviet Foreign Minister Molotov. There were, however, no requests to still-neutral Russia for mediation. The Japanese hoped to make an alliance with Russia or at least to renew their Neutrality Pact, which was due to expire in 1946. While a few in the peace faction struggled for a way to end the war, the military tightened controls over the government and the people in preparation for the expected invasion. They promised a severe American setback to give Japan a favorable and face-saving peace.

America knew much of what the Japanese were proposing since the US had broken the Japanese code and was intercepting diplomatic messages. To all except those—such as Zacharias and former Ambassador to Japan Joseph Grew—who had an intimate knowledge of Japanese psychology, these messages were ambiguous at best. Along with the Joint Chiefs of Staff who estimated the war would continue until the fall of 1946, most of the diplomats thought that Japan was far from surrender. Almost a minority of one, Ambassador Grew urged President Truman in May and June to tell Japan she could keep her Emperor. Stimson advised waiting until the A-bomb was proven and the Japanese themselves had had more time to know they were beaten.

The real evidence of Japanese morale seemed to be on the battlefield, and this evidence pointed to continuing and even increasing American casualties. "There was as yet [in July 1945] no indication of any weakening in the Japanese determination to fight rather than accept unconditional surrender," Stimson was to write two years later.

Despite some opposition by Navy and Air Corps advocates who thought Japan could be defeated by blockade and bombing alone, and Army staff recommendations for concessions to the Japanese, plans were laid for an invasion of Japan. Gen. Douglas MacArthur, who was to command the invasion force, thought the landings were the only solution. He had not yet been told of the A-bomb. As it evolved, following Truman's approval in June 1945, the plan called for an invasion of the southern island, Kyushu, in November, followed by an assault on the Tokyo Plain on the main island of Honshu in March 1946. Up to a million American casualties were expected.[8] In Washington there was hope, but no certainty, that the A-bombs scheduled for Japanese cities would remove the need for the invasion.

The Potsdam Conference

This, then, was the way things stood in the latter half of July when the "Big Three" met at Potsdam: The Allies had no intention of basically changing their policy of unconditional surrender and were planning an invasion to force it; the Japanese were edging all too slowly and ambiguously toward a willingness to quit; the A-bomb had been proven in the "Trinity" test at Alamogordo, its use had been recommended, and the first bomb was on its way to the Pacific. It was at Potsdam that Truman told Stalin of the A-bomb and there that Russia reaffirmed her Yalta agreement to enter the war against Japan. But the most important item, so far as World War II was concerned, was the Potsdam Proclamation calling on Japan to surrender.

The Potsdam Proclamation resolved the questions of whether or not Japan should be told of the A-bomb,

The US Army officer who headed the $1.5 billion Manhattan Project that developed the world's first nuclear weaponry, Brig. Gen. Leslie R. Groves, Jr., at his desk in 1942.

When the Big Three of the Allies met in Potsdam for the second session of the last great heads-of-state meeting of World War II, the experimental A-bomb had been proved, an invasion of Japan was assumed, unconditional surrender reaffirmed, and Attlee had replaced Churchill at the talks.

and whether she should be told the Emperor would stay. She was told neither. The Proclamation did threaten the Japanese with "utter devastation" of their homeland if they didn't surrender, but there was nothing to hint that a new weapon was to be unleashed. The proposal for an A-bomb warning was not even discussed at Potsdam since this question had been thoroughly studied and rejected by the Interim Committee in June.

On the Emperor issue, the recommendations of Ambassador Grew were carefully considered by Truman. By July 24 Stimson, too, had decided it was time to give an assurance to the Emperor, and he so advised Truman. But it was too late. The earlier opposition of Stimson himself, former Secretary of State Cordell Hull, James Byrnes, and the Joint Chiefs of Staff had cast the die. The Potsdam Proclamation was approved and issued to the world on July 26.

One of the fears that Truman's advisers had felt about the Proclamation was that, if too lenient, it might arouse a terrible political storm in the United States while at the same time giving the Japanese militarists proof of their long-predicted softening of the American will to fight. There were no significant American political repercussions, yet the Japanese reaction to the Proclamation seemed to indicate that it had not been tough enough.

The Japanese Cabinet studied the document carefully, but Cabinet members were unable to agree on whether it should be accepted or not. Finally they decided to make no comment for the moment while trying to find out, through the Russians, what the Allied position on the Emperor really was. Unfortunately, on July 28, the Japanese press, in printing an expurgated version of the Proclamation, cited the official government reaction as *mokusatsu* (variously interpreted as "Take no notice of; treat with silent contempt; ignore"). This "mistake" was compounded by Prime Minister Suzuki who, under military pressure, issued a statement that same day saying, "The government does not regard it [the Potsdam Proclamation] as a thing of any great value; the government will just ignore [*mokusatsu*] it. We will press forward resolutely to carry the war to a successful conclusion."

Members of the crew of the B-29 that dropped the Hiroshima bomb, left to right, Maj. Thomas W. Ferebee, bombardier; Col. Paul W. Tibbets, CO of 509th Composite Group and pilot; Capt. Theodore J. Van Kirk, navigator; Capt. Robert Lewis, who was copilot on the *Enola Gay*.

This clear statement of Japanese intentions was all that President Harry Truman needed. He knew of the order to Gen. Carl A. Spaatz—who, fresh from victory in Europe, had taken over control of strategic air operations in the Pacific in July—to deliver an A-bomb "after about 3 August," and had told Stimson to go ahead with the bombing unless otherwise ordered. After the Japanese response to the Potsdam Proclamation, as Byrnes has written, "There was nothing left to do but use the bomb."

The Bombs Are Dropped

On Tinian a typhoon prevented much activity in the first days of August. Nevertheless, according to the 509th Group historian, there was "much off-the-record scurrying about, secret meetings, and conferences behind closed doors." On August 4 Gen. George C. Kenney, MacArthur's air commander and Commanding General of the Far East Air Force, flew to Okinawa to tell Lt. Gen. Ennis C. Whitehead, Fifth Air Force Commanding General, that an A-bomb would be dropped over Hiroshima on August 6. Whitehead was to keep all his planes at least fifty miles away. "These new-fangled gadgets are certainly raising hell with my operation," Whitehead grumbled.[9]

Some hell was raised in Japan, too.

At 0816 on the morning of August 6, 1945, a brilliant light flashed across the sky above Hiroshima, a huge incandescent cloud formed, capped with a purple glow, and the daylight faded as the now-dark cloud boiled upward over the city. As the city began to burn in a fire storm that lasted all day, Col. Paul W. Tibbets, Jr., and his crew of the *Enola Gay*—363 miles away at 25,000 feet, returning to Tinian—lost sight of the Thin Man's cloud in the haze. Hiroshima, an important Army headquarters and port of embarkation, had been destroyed. Nearly five square miles of the city were wiped clean by blast and fire. Caught in the open with no alarm, some 78,000 Japanese were killed—exceeding fourfold the American planning estimate.

Within twenty-four hours President Truman, aboard the USS *Augusta* in mid-Atlantic returning from Potsdam, had received word of the raid and had issued a prepared release to the world. Monitors in Japan thus learned of the A-bomb, but Japan's Army played down the damage and allowed press references only to a "new-type bomb." It was two days before they could organize and begin on-the-spot investigations at Hiroshima. The morning of the third day, the second half of America's one-two psychological punch was delivered.

On August 9 a shiny B-29 named *Bock's Car*, piloted by Maj. Charles W. Sweeney, took off from Tinian with twelve men and a "Fat Man" bomb, bound for Kokura. Short on fuel and finding the city overcast, which made it impossible to bomb visually as ordered, the pilot turned toward their secondary target, Nagasaki. Nagasaki also was overcast. In the last twenty-five to thirty seconds Capt. Kermit K. Beahan, the bom-

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bardier, was able to sight on a racetrack and drop the bomb. As soon as they landed, Commander Frederick L. Ashworth, USN, the weaponeer, worriedly told the Eighth Air Force Commander, Lt. Gen. James H. Doolittle, "We planted the bomb right here, about a mile and a half northeast of the target." General Doolittle looked at the map and then put his arm around Ashworth. "Well, son, I wouldn't worry a bit about that mission. I'm sure that General Spaatz will be much happier to know that the bomb went off up there in the industrial area instead of over the city of Nagasaki."[10]

Brig. Gen. Thomas F. Farrell, Groves's personal representative at Tinian, said to Captain Beahan, "Young man, you picked a better aiming point in thirty seconds than we did in thirty months of studying." Flustered, Beahan relied, "General, I didn't have a damn choice. It was the only thing I could see!"[11]

The blast over Hiroshima on August 6, 1945. Smoke billows 20,000 feet over the city and 10,000 feet across the base of the mushroom cloud that soon became the symbol everywhere of the deadly power of the newly developed nuclear weaponry.

Nagasaki escaped the fire storm that had engulfed Hiroshima and thereby suffered but half (35,000) of that city's fatalities. General Groves was relieved at the lesser damage but confident of its message. He suspended plans for a third A-bomb mission which was scheduled in another week, while in Japan a captured B-29 pilot fancifully told his frantic interrogators that an A-bomb was scheduled for Tokyo on August 12.[12]

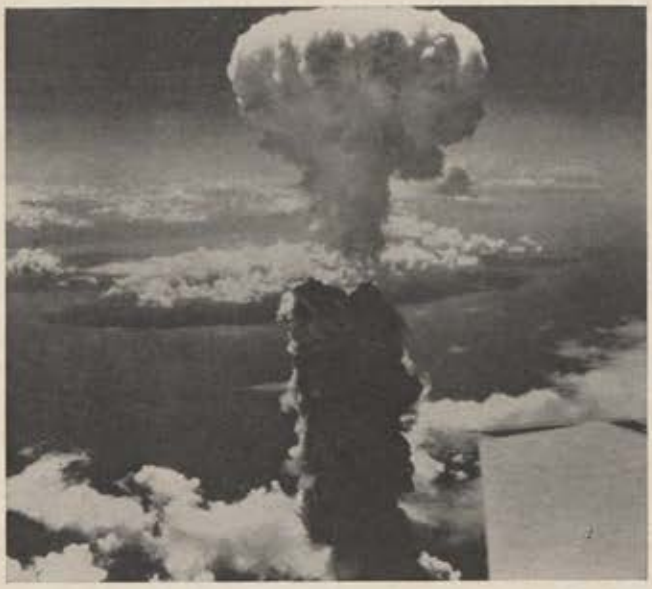
Top AAF commanders attended debriefing on Tinian after successful Hiroshima strike. Among those present, from left, Lt. Gen. Nathan F. Twining, Lt. Gen. Barney M. Giles, and Gen. Carl A. Spaatz. At far left is Colonel Tibbets, pilot of the *Enola Gay*, the aircraft that dropped the bomb.

The Nagasaki A-bomb, following by one day Russia's entry into the Japanese war and by three days the Hiroshima A-bomb, tipped the scales for peace. News of Nagasaki reached the Japanese Cabinet in the midst of an all-day argument on surrender. The Cabinet was irremediably split between the peace faction which wanted to demand only retention of the Emperor, and the military leaders who insisted on several other conditions which, in essence, would have allowed the military to save face and perhaps perpetuate itself. At midnight, while they still argued, the Emperor made an "imperial decision" to sue for peace with only the first reservation. The Emperor had never made a "decision" before, and this action was as wholly unprecedented as it was fortuitous.[13]

The appeal for peace went out August 10, and a hurried Allied answer was received two days later, stating that the Emperor would be subject to the orders of the Supreme Allied Commander in Japan.

Still the Cabinet argued while military fanatics neared rebellion; internal order was becoming chaotic. The situation reached its climax on the night of August 14 after the Emperor once again had forced the Cabinet to agree on surrender and had made a recording for announcement to the people the following day. That night a group led by a Major Hatanaka invaded the palace, killed the commander of the Imperial

Until its awesome mission of August 6, 1945, to Hiroshima, the *Enola Gay* was just another B-29. Today this historic aircraft is owned by the Smithsonian Institution, Washington, D. C.



The nuclear attack on Nagasaki, August 9, 1945. Nagasaki was the second-choice target. Poor visibility over Kokura, the prime target, and shortage of fuel aboard *Bock's Car*, the plane that flew the mission, caused Maj. Charles W. Sweeney, the pilot, to divert to an alternate target.

Guards, and unsuccessfully searched for the recording. The coup collapsed the next morning because of resistance by the War Minister (who then committed hara-kiri) and by other generals. On August 15 the Japanese people heard their Emperor's voice for the first time. He told them the war was over.

Twenty Years Later

For twenty years now these rapid-fire events have been studied and argued. Since the Japanese opposition seemingly ended so completely and suddenly, the initial Allied assumption was that the A-bombs were responsible. (The Russians, of course, maintained that their two-day campaign on the Asian continent was responsible.) Then a reaction set in. Reasoning that if the Japanese had surrendered so easily, some people began saying that perhaps they were ready to surrender anyway, *without* use of the A-bombs. Critics of the A-bomb began to advance all kinds of "real reasons" for the American employment of this new weapon. One alleged "reason" was to justify the bomb's great expense; another was to end the war before Russia could obtain a jugular grasp on Asia, as she already had done in Eastern Europe. These arguments have been decisively discredited and no longer are worthy of serious debate.

This is how Nagasaki looked after the bombing. Unlike the Hiroshima bombing, there was no fire storm at Nagasaki, and the number of casualties was about half as many as at Hiroshima. This is the residential area just east of ground zero. Catholic Cathedral ruins are in background.

Finally, a more complex and sophisticated view of the A-bomb and Japanese surrender has emerged. Today it is agreed that the A-bombs by themselves did not cause the surrender. The Japanese had already been beaten and had been talking seriously of surrender for at least two months. Most postwar analysts think the war would have ended by December 1945, no matter how the United States had decided the ostensibly vital questions of that year.

It is also agreed that the A-bombs served to force an indecisive and hopelessly divided Japanese Cabinet into early agreement with the "Imperial decision." The two A-bombs, along with the Russian entry, certainly shortened the war by several weeks or several months.

According to most, the American policy of unconditional surrender was justified initially, although it should have been amended by the summer of 1945. Home-front political resistance and the pending Potsdam Conference prohibited an American approach to the Japanese in early July. However, a proposal concerning the Emperor and a hint of the A-bomb in the Potsdam Proclamation might have caused the Japanese to handle the Proclamation more carefully, thereby delaying Truman's decision a week or two until the Emperor had his say. No one can prove the Emperor would have obtained a surrender acceptable to the Allies. Indeed, the evidence of Japanese military fanaticism and influence indicates otherwise. Yet if the US had known then what is known today, a modified proclamation probably would have been issued, if for no other reason than later peace of mind.

The A-bomb demonstration issue continues to be a lively subject of debate. Nevertheless, many years of hindsight and considerable study at the time have failed to suggest a scheme that would have offered any positive chances for success. The arguments against a demonstration included uncertainty that the A-bomb would work, fear of Japanese trickery, shortage of A-bombs, and, mainly, that only a combat drop possessed the psychological shock value needed to end the war. Only the first has been disproven by history.

While a majority concurrence with the A-bomb decision has always existed, the question of moral justification has been argued most of all. Clearly, the physical and psychological effects of the bomb had been underestimated. Ever since that time, the United States and the A-bomb have been accused of intensifying the ruthlessness typical of the twentieth century. America, it was said, had tried too hard to win.

Strangely, during the war none of the few opponents of using the A-bomb had considered the moral issue to

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be paramount. Admiral Leahy was against the bomb for technical reasons; it was only after the war that he introduced morality. Leo Szilard, a Hungarian refugee, had been in favor of the bomb for use against Germany but thought its use against Japan would be an international crime. The Franck Report did not even mention morality, opposing A-bomb use mainly because of the anticipated postwar difficulties in establishing international atomic controls.

Yet it cannot be denied that the moral issue was a common underlying factor in all these rationales. It was also, painfully, in the rationale of those who made the decision. As Stimson pointed out before he died, those responsible had to consider not only what would happen if the A-bomb were used, but also what would happen if it were *not*. Stimson had seen "too many stern and heartrending decisions to be willing to pretend that war is anything else than what it is. . . . This deliberate, premeditated destruction was our least abhorrent choice." [14]

Morally, this is an adequate justification of the decision. "War itself is immoral," observed Gen. Omar Bradley on this issue in 1949. If the bombs had not been dropped, it would have meant a longer war and the resultant death of many thousands or even millions of Japanese and Americans who are alive today. As some Japanese leaders said ironically after the war, the A-bombs turned out to be the real *Kamikaze* (Divine Wind) because they allowed Japan to save herself from further annihilation. Who can really say what would have resulted if the dominant military faction of the Japanese government had not been cowed as they were by those shocking explosions on August 6 and 9, or if the entire American invasion force had been ruined (as it might well have been) by the cataclysmic Okinawa typhoon of October 1945?

In sum, today's judgment is that although use of the A-bombs shortened the war and was justified, the United States should have tried harder at Potsdam to encourage Japanese surrender negotiations. But this mistake is relatively insignificant when considered within the over-all dimensions and decisions of the war, or when related to parallel German and Japanese mistakes. And perhaps, viewing the later cold-war history, it was no mistake at all. With more time to usurp a role in the Japanese occupation, the Russians might have prevented the successful postwar emergence of a democratic Japan. It is hard to argue with success. After all the arguments, the fact remains that the United States with the A-bombs ended the war in the Pacific long before anyone, including the Russians, really expected it.

Everybody regrets that the A-bombs were used, just as they regret the trend of civilization which produced World Wars I and II and, inevitably, the bomb itself. But there was no realistic alternative. Lacking a solution to the real causes of civilization's total-war trend, critics irrationally have focused on A-bomb "morality." Even at this level the weapon can be defended: It tipped the scales to end World War II. It has served well the postwar security of the United States and the free world. And by helping deter a third world war, America's A-bomb has arrested that very trend in civilization of which it is a part.—END

The author, Maj. Kenneth L. Moll, is presently assigned to the Directorate of Plans, Hq. SAC, Offutt AFB, Neb. He enlisted in the Navy near the end of World War II, was graduated from West Point in 1950, and subsequently served as a fighter pilot in Korean combat and, later, in the Air Defense Command. He entered SAC in 1959 and took part in the Thor missile program in England. Major Moll has been an Operations Staff Officer at Hq. SAC since 1961. He has had articles published in several military journals; this is his first for AIR FORCE/SPACE DIGEST. *It is adapted from the first chapter of his History Master's thesis, "American Nuclear Strategy, 1945-1948," which he is preparing at the University of Omaha.*

Footnotes

[1]Harry S. Truman, *Memoirs*, I, *Year of Decisions* (Garden City, N.Y.: Doubleday & Co., Inc., 1956), p. 11.

[2]*Newsweek*, November 11, 1963, p. 108. Lt. Gen. Leslie R. Groves, USA (Ret.) writes in a letter of June 1, 1965, to the author: "Stimson did not speak of this meeting to me when he returned to the United States, and neither did Eisenhower refer to it later when he was Chief of Staff of the Army. I, of course, have never seen any conclusive evidence that the Japanese were ready to surrender, and every evidence other than wishful thinking has been to the opposite effect."

[3]Lt. Gen. Leslie R. Groves, *Now It Can Be Told* (New York: Harper & Brothers, 1962), p. 40.

[4]*New York Times*, August 7, 1945, p. 5.

[5]Arthur H. Compton, *Atomic Quest* (New York: Oxford University Press, 1956), p. 219.

[6]Louis Morton, "The Decision to Use the Atomic Bomb," *Command Decisions*, Hanson Baldwin, ed. (New York: Harcourt, Brace and Co., 1959), p. 396. General Groves writes that this meeting "is news to me. I wonder who could have presented it [to the JCS]. According to this, Leahy did not object."

[7]Capt. Ellis M. Zacharias, *Secret Missions* (New York: G. P. Putnam's Sons, 1946), pp. 336-384. Zacharias didn't know of the A-bomb.

[8]Herbert Feis, *Japan Subdued* (Princeton: Princeton University Press, 1961), pp. 8-12.

[9]George C. Kenney, *General Kenney Reports* (New York: Duell, Sloan & Pearce, 1949), p. 568.

[10]Capt. Frederick L. Ashworth, "Dropping the Atomic Bomb on Nagasaki," *United States Naval Institute Proceedings*, January 1958, p. 17.

[11]Interview with Lt. Col. Kermit K. Beahan by author, May 5, 1964.

[12]*United States Strategic Bombing Survey*, "Japan's Struggle to End the War," July 1, 1946, p. 13. This hero has never been identified. Can any readers help?

[13]Robert Butow, *Japan's Decision to Surrender* (Stanford: Stanford University Press, 1954), pp. 161-177.

[14]Henry L. Stimson, "The Decision to Use the Atomic Bomb," *Harper's Magazine*, February 1947, pp. 106-107.

The Battle of Dong Xoai

Although it is difficult to tell victory from defeat in the confusing Vietnamese war, tactical airpower seems to be giving South Vietnamese and US ground troops the extra strength they need to make the Viet Cong pay heavily for their surprise attacks. A classic case took place in June at Dong Xoai, some fifty miles from Saigon. There napalm, bombs, and cannon fire provided the needed weight for ground troops to hold, though outnumbered, until help could arrive . . .

Tactical Air Support—
Balancing the Scales in Vietnam

By Kenneth Sams
HISTORIAN, 2D AIR DIVISION, PACAF

THE LINE between victory and defeat in the day-to-day fighting taking place in Vietnam is difficult to draw. The Viet Cong are able to concentrate forces so as to have numerical ground superiority at specific objectives and at times most suitable for attack. The government forces, in recent months, have been able to counterbalance this VC advantage by concentrating tactical airpower on specific targets. Thus, while the Viet Cong may be able to overrun a government position, napalm and bombs and cannon fire from the air can keep them from holding it and can make them pay a heavy price for their initiative. Air cover can also make it possible for relief forces to be flown in and can generally restrict the enemy's freedom of movement.

This was the case at Dong Xoai (pronounced "Don Swai"), a Special Forces camp about fifty miles northeast of Saigon in Phuoc Long Province, which the enemy overran early in June. The attack on Dong Xoai began twenty minutes after midnight on June 10, when an enemy force, estimated at regimental size, took advantage of low cloud cover to launch a major attack on this district capital. Armed with 81-mm. mortars, the VC closed in from the north and west of the Civilian Irregular Defense Group (CIDG) compound, defended by about 300 CIDG personnel, a Regional Forces company of some 100 men, a scout car platoon with four armored cars, and a platoon of 105-mm. howitzers. Twenty-eight Americans, made up of Special Forces personnel and a nine-man Seabee team, were also in the Dong Xoai compound. The VCs used automatic weapons, machine guns, recoilless rifles, and flamethrowers, as they threw themselves at the compound's defenses. They left strong supporting forces occupying roads and outlying buildings.

An immediate request was made for a flareship, and a C-47 was over the area in less than an hour dropping its flares. Twenty minutes later two VNAF A-1Hs were over the target. As these VNAF planes flew overhead, unable to attack because of low-hanging clouds, the Viet Cong overran the camp's airstrip and set up mortars, machine guns, and 75-mm. rifles to attack the American compound. The Special Forces camp was pounded with 200 rounds of 60-mm. mortar fire.

The situation seemed to be one of those hopeless ones where the enemy's advantages of surprise and initiative gave him the impetus of offensive action. He picked his time well to take advantage of the low overcast which he felt would paralyze air support, the only deterrent to this impetus.

A second C-47 arrived to take over flare duties at 3:50 a.m. and kept the area lighted up. By this time, the Viet Cong had taken half the compound and were maintaining control of a majority of the area. With a .50-caliber machine gun in a schoolhouse, mortars on the airfield, and the enemy forces surrounding the government camp, it seemed only a question of time. The camp's defenders, fighting in the eerie, diffused flarelight, were outnumbered, outgunned, and surrounded.

At 4:30 a.m., two USAF-piloted A-1Es, scrambled from Bien Hoa, arrived over the camp. Faced with a 500-foot ceiling, broken to overcast, they listened on their radios to the defenders' pleas for help. The 2d Air Division pilots—Capt. Richard Y. Costain of Huron, S. D., and Capt. Doyle C. Ruff of Orlando, Fla.—had to make a decision. They could go by the book and turn back or they could throw the book away.

There was no question in either man's mind. Descending into the top of the overcast, guided only by instruments, they plunged down into the intense and accurate automatic-weapons fire which started coming at them even before they broke through.

(Continued on following page)

Two A-1Es piloted by USAF pilots, armed with ordnance such as this, saved the day at Dong Xoai. By ignoring the minimum ceiling required for safely dropping their 260-pound fragmentation bombs and accurately dropping them even though there was a 500-foot ceiling, they hit the attacking Viet Cong hard and then followed up with strafing missions at 500 feet.

The minimum safety altitude for dropping 260-pound fragmentation bombs was 1,000 feet. Each pilot decided to level-bomb despite the hazards involved and the extreme skill required for accuracy. Using the burning fort as a bombing point, they delivered twenty-four fragmentation bombs right on target in a series of passes. As they were getting intense machine-gun fire on their runs, they elected to fly a rectangular pattern inside the cloud layer. Each time they descended to find their position, they met the concentrated fire of at least six automatic weapons plus a barrage of small-arms fire.

Costain made two dive-bomb passes from 5,000 feet, hitting close to the points directed by the Air Force Forward Air Controller, and then pulled out through the overcast. When the bombs were expended, the job was still not over. The Viet Cong had started pouring over the fort's walls in large numbers, and the defenders pleaded for 20-mm. cannon fire. This meant low-angle strafing attacks with the planes clearly silhouetted against the flare-lit clouds, easy marks for every Viet Cong gun.

The pilots started their strafing runs from patterns below 500 feet and before they were finished had poured 15,000 rounds of cannon fire into the Viet Cong ranks. The last passes were flown from high angles directly against the machine-gun positions, with the pullouts going into the overcast.

On one pass, Ruff nearly hit the ground after being disoriented by pulling seven Gs on instruments. On every pass, their airplanes drew intensive ground fire. On his last pass, at 400 feet, Costain took three direct hits—two .50-caliber bullets in the engine and a .30-caliber in the left wingtip.

These night A-1E attacks were followed at first light by continuous close-air-support runs, with twenty-four A-1Hs, thirty-five A-1Es, thirty-seven F-100s, and eleven B-57s hitting enemy positions inside and outside the camp. By 7:45 a.m., friendly forces pulled back into one building and the 5th ARVN Division commander asked for air strikes against anyone or anything moving outside the compound or on the roads. Between 6:00 and 8:00 o'clock, eight A-1Es smashed the .50-caliber machine gun in the schoolhouse and destroyed ten other structures from which the Viet Cong were firing. Starting at about 8:00 o'clock, B-57s dropped ordnance on the center of town where the Viet Cong had established firing positions. They destroyed six buildings housing VC automatic-weapon positions. One B-57 pilot was wounded when a bullet passed through the bottom of the aircraft into his buttocks.

At dawn on June 10, relief forces consisting of four battalions were prepared to go into Dong Xoai. USAF C-123s and VNAF C-47s airlifted one battalion from Tan Son Nhut to Phuoc Vinh, where they were to be

moved to the battle area by US Army helicopters. By 9:40 a.m., with USAF and VNAF Skyraiders providing prestrike air cover and close support, the 1st Battalion, 7th Regiment, was lifted by helicopter to a clearing surrounded by tall trees about two miles north of the town. The battalion was quickly exposed to intense fire by the enemy. USAF aircraft, including F-100s, flew close support, firing into VC positions and taking a heavy toll of the enemy. One F-100 flight reported seeing many bodies on the ground near the edge of a rubber plantation. However, the Viet Cong, with numerical superiority, smashed the battalion into ineffectiveness. Its four US advisers were listed as missing.

For one USAF A-1E pilot, the morning of June 10 was an initiation into the Vietnam war—his first combat flight—and he passed with flying colors. Maj. Oscar Mauterer of Gillette, N. J., was scrambled an hour before dawn with barely time for a briefing. Mauterer had never practiced theater daylight tactics, let alone night tactics and procedures. Nor had he ever flown before with the multiple bomb rack which was loaded on his A-1E. On his first dive-bomb pass, Mauterer was unaware that his master light switch failed to turn off his navigation lights, and as he went in he made a perfect target pulling out at 1,000 feet. On his second run, he put four 100-pound GP bombs directly on a gun emplacement located only fifty yards from the northwest wall of the fort, still with his plane lit up like a Christmas tree. After finally turning the lights off, he made two more bombing runs, then strafed the northwest wall of the fort since it was already overrun by the VC. On one strafing run, Mauterer turned directly into a .50-caliber gun and fired down its muzzle until he had to pull out a few feet above the trees. Although he took six rounds from automatic-weapons ground fire, Mauterer never wavered in his strikes.

Later in the day, Capt. Richard D. Head of Des Moines, Iowa, distinguished himself in leading a three-ship A-1E flight through rain and overcast, which was solid from 4,000 feet to 800 feet. Disregarding the 1,200-foot minimum for his type ordnance, Head rolled in to level-bomb his 260-pound fragmentation bombs from a bare 800 feet above the ground, taking hits as he flew in and out of the low clouds, his aircraft perfectly silhouetted. Despite a large hole in the right wing and a damaged right aileron, Head continued his strafing passes, attacking thirteen .50-caliber gun positions. Only after the other two planes were heavily hit by ground fire did Head lead them back to Bien Hoa.

All the A-1Es and F-100s in the fight were receiving numerous hits from .50-caliber guns as the aircraft faced some of the roughest antiaircraft fire of the war. A US Army UH-1B was hit by ground fire and crashed around 1:00 p.m. with its four-man crew reported missing.

In the ground action, the enemy proved too much for the district town's defenders. The Viet Cong force, estimated at better than three battalions, smashed into the compound shortly after US personnel had been airlifted out, and by 2:30 p.m. the compound and camp were left undefended.

Around 4:30 p.m., some 300 Rangers from Vietnam's 52d Ranger Battalion were landed at a soccer field southeast of town as tactical air covered them. An armed helicopter supporting the operation was shot down by a .50-caliber machine gun the enemy had hidden under a bridge, and its crew was listed as missing. Much of the landing unit was forced to return to Phuoc Vinh as a result of heavy ground fire.

USAF and VNAF aircraft during the daylight hours of June 10 showered the enemy with about ninety-five

(Continued on following page)

Although they were bombing very close to the fortress held by friendly South Vietnamese forces in order to hit the Viet Cong which had taken part of the Special Forces compound, including the schoolhouse, the A-1Es, B-57s, and F-100s dropped their napalm and explosives with pinpoint accuracy.

Lobbing napalm into small compounds that, even from low altitude, look like postage stamps is a tricky business. When half of the postage stamp is friendly and the other half the target, accuracy becomes even more critical.

tons of fragmentation and general-purpose bombs and sixty tons of incendijel, along with tens of thousands of rounds of cannon fire and hundreds of rockets. In this period, thirteen A-1Es, five F-100s, one B-57, nine UH-1Bs, and four UH-1Ds received hits from .30- and .50-caliber machine guns and suspected 20-mm. machine guns.

As darkness set in, the Viet Cong, pinned down by air during the day, regrouped and launched an attack against the 52d Ranger Battalion moving on Dong Xoai. In the darkness, two A-1Es provided close air support till 9:00 p.m. when the enemy broke off the attack. Though they sustained numerous casualties, the Rangers moved into Dong Xoai and remained in control of the area. The VC continued to harass them during the night of June 10-11, but four C-123s stayed overhead dropping 718 flares throughout the night. A-1Es and F-100s stayed over the battle area all night blasting VC elements every time they showed themselves.

The last VC-directed fire, coming from the west of town, was reported at 6:30 a.m. on the morning of June 11. USAF and VNAF aircraft continued to hammer at the Viet Cong. They also provided air cover, prestrike, and close air support for helicopter troop lifts. Under this air umbrella, medical personnel and supplies were helilifted into Dong Xoai along with ARVN ground troops. Three B-57s, nineteen A-1Es, twelve F-100s, and fourteen A-1Hs sent bombs and rockets smashing into enemy ground-fire positions. The heliborne troops were able to move in with only sporadic VC opposition. Before the day was over, USAF and VNAF pilots had dropped forty-five tons of bombs and forty tons of incendijel on the enemy along with 20,000 rounds of 20-mm. cannon fire.

In the carnage that was Dong Xoai, the USAF Forward Air Controller on the ground reported 300 enemy bodies, the bulk killed by the air strikes. A US Army adviser in another area estimated 400 more killed by air strikes in the vicinity of the helicopter landing zone south of Dong Xoai. An unknown number were carried away.

Friendly casualties were also very heavy at Dong Xoai. Reports showed a total of about 650 dead, wounded, and missing. About 150 civilians were killed during the VC mortar attack on the town. Eighteen US personnel were dead or missing, and seventeen wounded. This was the heaviest number of friendly casualties in a single Viet Cong attack and certainly an indication of the enemy's ability to concentrate forces against specific targets.

Tactical air was credited with breaking the enemy's attack and reducing friendly casualties. Aircraft operating night and day and in large numbers cut down the Viet Cong's freedom of movement, provided cover for heliborne landings, and took a heavy toll of enemy dead.

Gen. William C. Westmoreland, US Commander in Chief in South Vietnam, warmly commended US pilots for their role in the engagement in a message to Lt. Gen. Joseph Moore, USAF 2d Air Division Commander.

"The performance of your strike pilots in providing close air support for the Dong Xoai 9-11 June operations was singularly outstanding," he said. "Working under adverse weather conditions, your pilots displayed true professionalism and delivered their weapons with precision. They, in fact, turned the tide of the battle.

"The tremendous support by all in this operation should be a great source of pride. Please extend to all of your personnel my warmest congratulations for a truly superior performance."

From Washington, D. C., Gen. J. P. McConnell, USAF Chief of Staff, wired his commendation to Gen. Hunter Harris, PACAF Commander, and General Moore. "The air support which your airmen gave to the government forces during the battle for Dong Xoai on June 9-11 once again demonstrates the extreme importance of airpower in Vietnam," he declared. "There is no substitute for outstanding professional airmanship, and when that skill is demonstrated under most adverse conditions the success is even more gratifying.

"There is no more important job in the free world today than the mission which is being performed by our forces in Vietnam. Please express to your airmen my warmest congratulations for their superior performance."—END

A Vietnamese soldier watches a USAF F-100 take off for a tactical-support mission. Fighters such as this one kept the Viet Cong at bay at Dong Xoai until relief troops could be brought by helicopter to the besieged compound.

THE SPACE AGE IN PERSPECTIVE

SPACE DIGEST

VOLUME 8, NUMBER 8 • AUGUST 1965

Try-on room for space systems:

ESARS is a unique space simulator developed by Douglas to provide a means of tailoring space control systems to man's abilities.

It uses closed-circuit TV, computers, spacecraft models and other devices to simulate control problems in space. It is being used by Douglas researchers —young men conditioned by confinement in a simulated space cabin to approximate the physical and mental state of astronauts on an actual mission —to practice rendezvous in orbit, lunar and atmospheric landings and surveillance assignments.

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DOUGLAS

MISSILE AND SPACE SYSTEMS DIVISION

The ABC's of Space Navigation

Navigation in space should be considered as a logical extension of navigation in the air rather than as a wholly new science. Much of the experience gathered from air navigation can be applied to the solutions of admittedly larger problems in planning our paths to the moon and planets. A navigation specialist discusses . . .

Finding Your Way in Space

BY MAJ. WILLIAM A. COHEN, USAF

IN THE not very distant future, the Air Force may well be operating almost wholly in space. Space navigation, because of the distances involved and the relative complexity of navigating in the void from point A to point B, will be of great significance from the very outset. This fact is underscored when you consider that, in a flight to Mars, an error in launching angle of a single minute of arc would yield a final error of 30,000 miles. Similarly, a one percent error in initial velocity would result in a 500,000-mile error.[1]

Since it is nearly impossible to launch a spacecraft into a perfect trajectory to a target planet, navigational techniques must be employed to ensure the safe arrival of the space vehicle at its destination. This means that not only must the navigator be able to navigate in space but also all who are involved in any phase of manned or unmanned space activity must acquire an appreciation of the science of spatial navigation.

Unfortunately, with the advancement of an applied science such as navigation into a new medium such as space, there is a distinct tendency for the unfamiliar application to become somewhat divorced from the mainstream of the parent science from which it emerged. In the study of navigation in space, this has resulted in space navigation's being considered almost as a completely separate science, rather than as an evolutionary product having both air and sea navigation as immediate ancestors. Such an approach wastes much of the navigational knowledge already learned.

The three-dimensional aspect of space navigation, the speeds and distances involved, and the complexity of future spacecraft are among the reasons why certain basic facts concerning navigation in space tend to be obscured. Yet, there is no reason why the same principles that apply to navigation in the air will not have direct application to navigation in space. Certainly the navigator's job remains unchanged. His duties are to determine the vehicle's position and direct it to its destination. And celestial bodies precisely located in space by astronomers, and used routinely as "fixes" by earthbound navigators, have not changed their position. Speed, time, distance,

[1]Lt. Cmdr. Edward F. Oliver, USCG, "Interplanetary Navigation," *Navigation*, 10:373, Winter 1963-64.

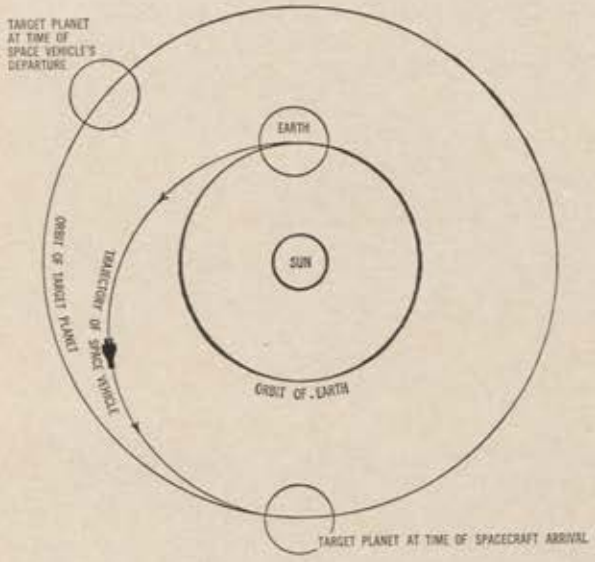


FIGURE 1 A SPACE VEHICLE'S DESTINATION IS ACTUALLY A POINT OF RENDEZVOUS IN SPACE

and direction will be as important to the navigator of a spacecraft as they are today to the navigators of aircraft.

Naturally, navigational techniques in space will be somewhat different from those practiced in the air. At the high speeds associated with spaceflight, a slight miscalculation in position or direction can cause enormous deviations. But even here there is an analogy to the problem the Air Force navigator had in transitioning from propeller to jet aircraft. As the saying goes: "Even though I get off course twice as fast, I return to course twice as faster." In space there will be infinite possibilities of getting "off course." A spacecraft can deviate "up" and "down" from course, as well as left and right. This, too, finds an analogy in certain missions flown by the Air Force, during which deviation from planned course in altitude can be just as disastrous as deviating from course in direction. But the space navigator also has the problem of getting to a moving destination. For example, a target planet is an object which itself is traveling at thousands of miles per hour around the sun. Destination is actually a point of rendezvous in space where planet and space vehicle will meet (Figure 1). Yet, both the fighter pilot who has flown pursuit curves and the navigator who has directed the rendezvous of his airplane with a tanker aircraft should find this problem a familiar one.

Just as air navigation borrowed heavily from earlier navigational experiences at sea, so will space navigation borrow heavily from earlier navigational experiences in the air. Therefore, any study of navigation in space should be done simultaneously with a firm mental grip on aerial navigation methods.

Consider the basic requirements for navigating from point to point—or from astronomical body to astronomical body in space. First, a general frame of reference within which to describe position or location is necessary. Next, a means of deducing probable space-vehicle position based upon performance in terms of speed and direction is required. Finally, a means of "fixing" the spacecraft's position in space at an exact instant of time is necessary so the navigator can check this against his probable position and desired trajectory and, if necessary, alter the spacecraft course to ensure his arrival at destination.

Location on earth is defined by parallels of latitude north or south and meridians of longitude east or west. The basis of latitude is a great circle drawn perpendicular to the north-south axis and known as the equator. The equator provides a natural starting point for the numbering of latitude. Considering the equator to be zero degrees latitude, degrees north or south up to ninety can be measured to the poles. In measuring longitude, we were not so fortunate as to the provision of a natural starting point for numbering. The solution was to select an arbitrary starting point. Numerous positions on the globe have in turn been used to mark such a starting point for counting longi-

tude, but, when the seafaring English began their explorations, their choice fell on the meridian passing through their principal astronomical observatory at Greenwich, England. This English choice prevailed, and today this meridian, known as the Greenwich Meridian or Prime Meridian, is the origin for counting longitude in most countries in the world. Longitude is measured east or west from the Greenwich Meridian through 180 degrees (Figure II).

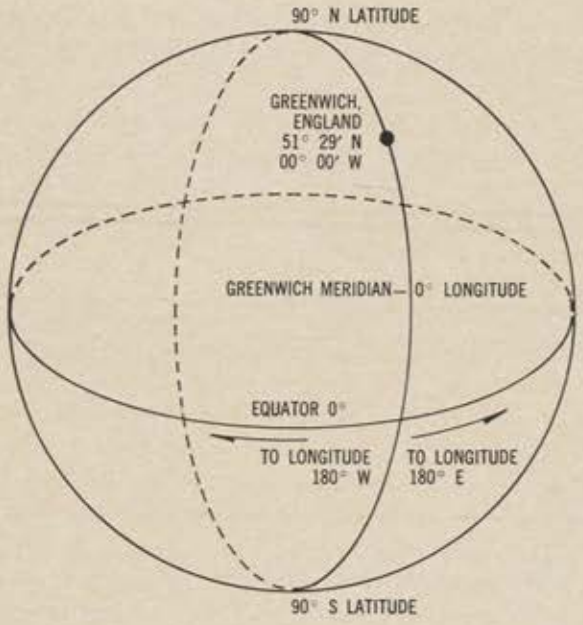


FIGURE II THE EARTH COORDINATE REFERENCE SYSTEM

Retaining our knowledge of the earth's coordinate reference system, let's carry our examination to coordinate systems for use in space. The most practical proposal for a reference system for use in space through the next decade is based on an imaginary sphere surrounding the earth—the celestial sphere. Just as position on the earth is stated in relation to the equator and the Greenwich Meridian, position of celestial bodies are located in relation to the celestial equator (equinoctial) and an arbitrary selected meridian (hour circle), on which is located the First Point of Aries. Declination is the angular distance of the celestial body in question north or south of the celestial equator. It corresponds to latitude on the earth's sphere and, like latitude, ranges from 0 to 90 degrees. Sidereal Hour Angle is the angular distance measured from the hour circle of Aries westward to the celestial body in question. It corresponds to longitude on the earth's surface, but unlike

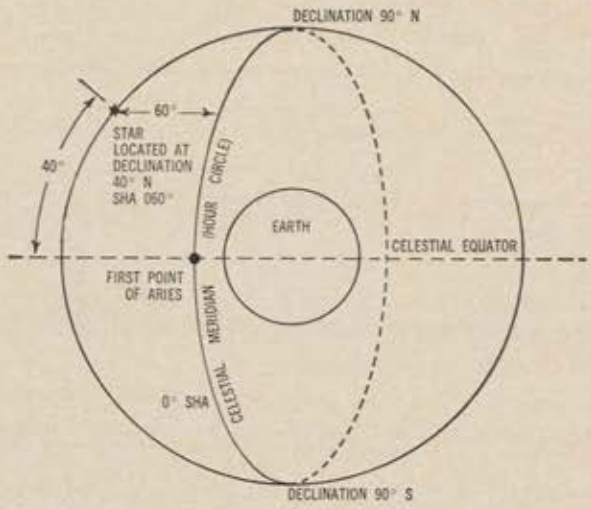


FIGURE III THE NAVIGATOR'S CELESTIAL SPHERE A GEOCENTRIC EQUATORIAL REFERENCE SYSTEM

longitude, is measured westward, never eastward, through 360 degrees (Figure III).

Since as yet we have no principal astronomical observatory located on the celestial sphere, it is of some importance to know how our arbitrary starting point for counting Sidereal Hour Angle was selected. The First Point of Aries is an unmarked point on the celestial equator. It is defined as the point on the celestial equator where the sun, moving through its plane of orbit, passes from south to north declination. Although it is not absolutely stationary in relation to the stars, the First Point of Aries changes position so slowly that it may be considered as fixed for a period as long as a year.

This coordinate system is known as a geocentric equatorial system because its origin is at the center of the earth, and the projection of the earth's equator on the celestial sphere defines the celestial equator. It is the most likely system for use over relatively short distances in space, such as the approximately 240,000 miles involved in the earth-lunar environment. It has a major advantage in that it is far from new, being currently used in the practice of celestial navigation by Air Force navigators. The only difference in its employment as a reference system for space navigation is that the navigator will locate himself, as well as other astronomical bodies, on the celestial sphere.

Over interplanetary distances, some of the advantage of having the earth serve as the origin for a coordinate reference system is lost. Since the sun, not the earth, is the center of our solar system, it would seem logical that a heliocentric ecliptic system, with the sun as the origin and

the earth's orbit as the reference plane, be used. A body's position would then be defined by means of heliocentric longitude measured eastward from the vernal equinox, and heliocentric latitude would be measured from the origin.

If we carry our imagination still further, it is not difficult to visualize a galactic coordinate system with the origin at the center of our galaxy. Regardless of how far this reasoning is taken, the principles remain the same and can be related to the latitude-longitude coordinate system already in use on and over our own planet, earth.

Another important aspect of describing a space vehicle's location in space can best be thought of in terms of an aircraft's altitude. However, there is a basic difference here between air and space aside from the units of measurement (feet vs. miles). An aircraft's altitude is measured above the earth's surface. The "altitude" of a space vehicle will be described in units from the center of the origin of the coordinate reference system used. Only at particular times, say for launching and landing, will the space navigator be interested in his actual altitude above the earth, moon, or the destination planet.

Although the different spatial coordinate systems needed—sometimes several of them, depending upon the various phases of flight—seem to complicate the space navigator's work, they constitute no really new problem. The aerial navigator, for example, must frequently change his reference system when transitioning from navigation in the subpolar to polar regions. Coordinate transformation in space, should it be necessary, ought to be just as readily accomplished.

Consider coordinate transformation from geocentric equatorial to earth coordinate. Since latitude measured from the equator and declination measured from the equinoctial correspond and are tabulated in the same units of measurement (degrees, minutes, and seconds), it follows that the values of the latitude of a point and the declination of its zenith on the celestial sphere are similarly the same. Since the relationship between Sidereal Hour Angle and longitude depend on the orientation of the earth with respect to its rotation, it is obvious that this is a function of time. If we can find the angle measured from the projection of the Greenwich Meridian on the celestial sphere westward through 360 degrees to the First Point of Aries on the celestial sphere, simple addition is all that is needed to convert Sidereal Hour Angle to longitude.

This angle, known as the Greenwich Hour Angle of Aries, is available in the navigator's almanacs for any particular time. Therefore, longitude west can be found by adding Sidereal Hour Angle and Greenwich Hour Angle. Longitude east is found (if SHA plus GHA is greater than 180 degrees) by subtracting the sum of Sidereal Hour Angle and Greenwich Hour Angle from 360 degrees (Figure IV).

Deducing probable space vehicle position at any time is made possible by the ancient navigational technique known as "dead reckoning." Dead reckoning consists of the application of direction and

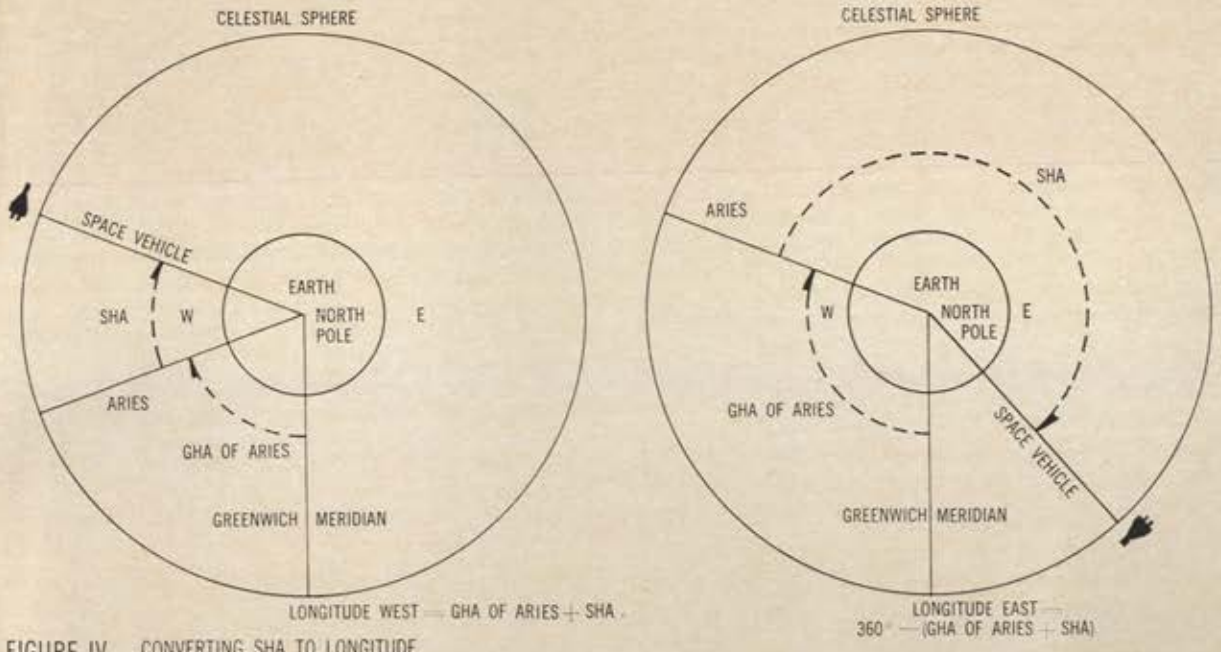


FIGURE IV CONVERTING SHA TO LONGITUDE

speed data from a previous position to determine a future position. Dead-reckoning navigation is the basis of most navigational techniques. It has been used successfully by such outstanding navigators as Columbus (who was a poor celestial navigator), and Lindbergh (who used only pilotage and dead reckoning for his Atlantic crossing in 1927).

Say, for example, that an aircraft is flying a true course of 090 degrees. The aircraft's ground speed is 500 mph. If the navigator desires a dead-reckoning position for thirty minutes in the future, he measures a point 250 miles from his present position on a course of 090 degrees (Figure V).

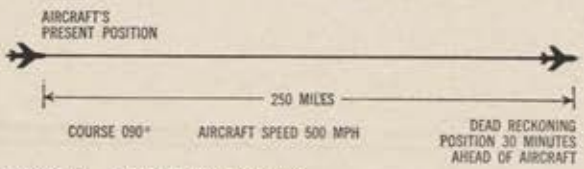


FIGURE V AIRCRAFT DEAD RECKONING

The navigator in space will make a similar computation. Instead of following a course, he will be attempting to make good a precomputed trajectory. Assuming he is traveling through space at 25,000 mph, in thirty minutes he has gone a distance of some 12,500 miles. The space navigator will measure this 12,500 miles along his estimated trajectory to arrive at his dead-reckoning position (Figure VI).

FIGURE VI DEAD RECKONING IN SPACE

It is important to realize that dead reckoning works equally well whether used on a ship traveling twenty knots or on a space vehicle traveling at fantastically greater speeds. What is required is that accurate sources of speed and direction be available to the navigator. For the aerial navigator, this information is made available in the form of magnetic compasses, gyrocompasses, drift meters, and the like. Navigators of more recent, highly complex aircraft have had the advantage of many of the aids to dead reckoning which will be re-engineered for use in space. These include doppler radar systems, inertial guidance equipment, and automatic astrotrackers.

The application of dead reckoning in space will be somewhat more complex due to the various effects of celestial mechanics. However, the basic similarities and the fact that dead reckoning in space will be used are far more revelent for the purpose of this discussion.

The ability of the navigator to fix himself in space is necessary both to check progress along his trajectory toward destination and to correct his trajectory as it becomes necessary.

Although man's early flights into space have depended and will continue to depend to a large degree on earthbound tracking techniques, as range from earth increases the space navigator will have to be able to navigate wholly with self-contained navigational means aboard the spacecraft.

Celestial navigation will be the primary means of fixing a position in space, with other supporting methods such as map reading and radar being used during the terminal phases of the mission. Although certain types of radio navigation will continue to be used, the range limitation imposed by the finite speed of radio waves narrows its uses for longer-range missions into deep space. It takes 2½ seconds for a radio signal to reach the moon and return, traveling at the rate of some 186,000 miles a second. Therefore, if a radio signal were sent to a space vehicle in the moon's vicinity, there would be a slight time lag before a navigational correction could be effected. But over interplanetary distances, this time lag would make navigation by radio signal impossible. The problem is fundamental and has little to do with inadequacies of current equipment. Unless some means is discovered to carry signals at a speed greater than the speed of light (which, according to Einstein's Theory of Relativity, is impossible), or some "backdoor" answer to the problem is found, navigation by radio signals will be extremely difficult if not impossible over great distances in space.[2]

What does the navigator require for a celestial fix in space? He requires the same sort of tools he needs to accomplish a celestial fix in the earth's environment. If a navigator has a space almanac, a watch, and some form of sextant, he is in a position to locate himself on the reference coordinate system of his choice.

To determine his position through the observation of celestial bodies, he must know the angle between the line of sights to at least three celestial bodies, *one* of which must be at a finite distance. Let's consider the earth or moon as such a body

[2]Arthur C. Clarke, *The Exploration of Space*, pp. 85-86.

at a finite distance. The Navigator must first determine his distance from the earth or moon. This is a relatively easy problem to solve with a stadimeter. The navigator observes the angle subtended by the earth's disc or the moon's disc with a sextant. By use of the appropriate table in his space almanac, he reads distance directly opposite the angle measured.

If no such table were available, the navigator could use the angle measured to solve the right triangle formed by the earth's radius and his line

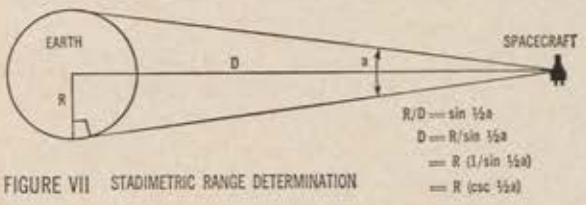


FIGURE VII STADIMETRIC RANGE DETERMINATION

of sight to the earth's center and rim. This triangle (Figure VII) is the basis of all such stadimeter ranging methods.

$$R/D = \sin \tfrac{1}{2} a$$
$$D = R/\sin \tfrac{1}{2} a$$
$$= R\,(1/\sin \tfrac{1}{2} a)$$
$$= R\,(\csc \tfrac{1}{2} a)$$

Where a = angle subtended by the earth's disc
D = distance from the center of the earth
R = radius of the earth

If the altitude above the earth (A) is required,[3] this would be given by:

$$A = D - R = R\,(\csc \tfrac{1}{2} a - 1)$$

Next, the navigator measures the angular distance between the earth's rim and at least two known navigational stars. He again checks his space almanac for the time of the fix and extracts the precomputed angles between the earth's center and the stars observed. If the observed angles plus an angle correction for the earth's radius (found during the ranging measurement) match those precomputed for fix time in the space almanac, the space vehicle is on planned trajectory and no further computation is necessary.

If the angles do not match, the navigator can obtain a fix by an application of solid analytic geometry where the coordinates of the centers, as well as the radii of three circles of the surface of a sphere, are given, and it is required to find their common point. This point is the same as the point common to the three planes determined by the circle. If **a, b,** and **c** are the direction cosines of the radial line passing through the center of one such circle, and **d** is the radius of the circle in arc measurement, then the equation of the plane determined by this circle in rectangular coordinates is:

$$aX + bY + cZ - \cos d = O$$

The direction cosines of the star can be found from its declination and Sidereal Hour Angle on the celestial sphere by the following equations:

$$a = (\cos DEC)(\cos SHA)$$
$$b = (\cos DEC)(\sin SHA)$$
$$c = \sin DEC$$

The intersection of three such planes are all sets of points (X, Y, Z) which simultaneously satisfy three linear equations similar to the foregoing. If a unique solution exists, the X, Y, Z coordinates of the unknown point of intersection can easily be converted to declination and Sidereal Hour Angles.[4]

The geometry of a celestial fix in space is shown in Figure VIII. The measurement of the angle sub-

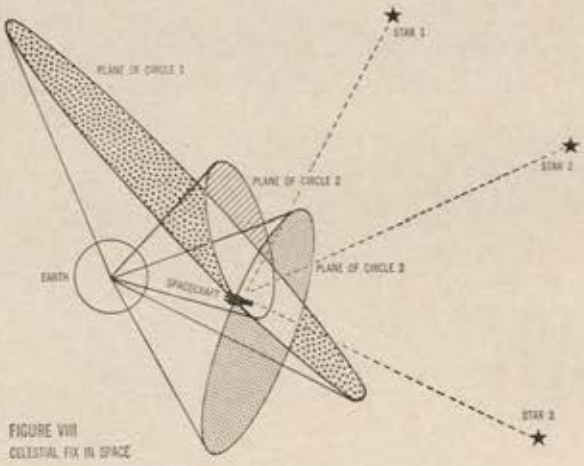


FIGURE VIII
CELESTIAL FIX IN SPACE

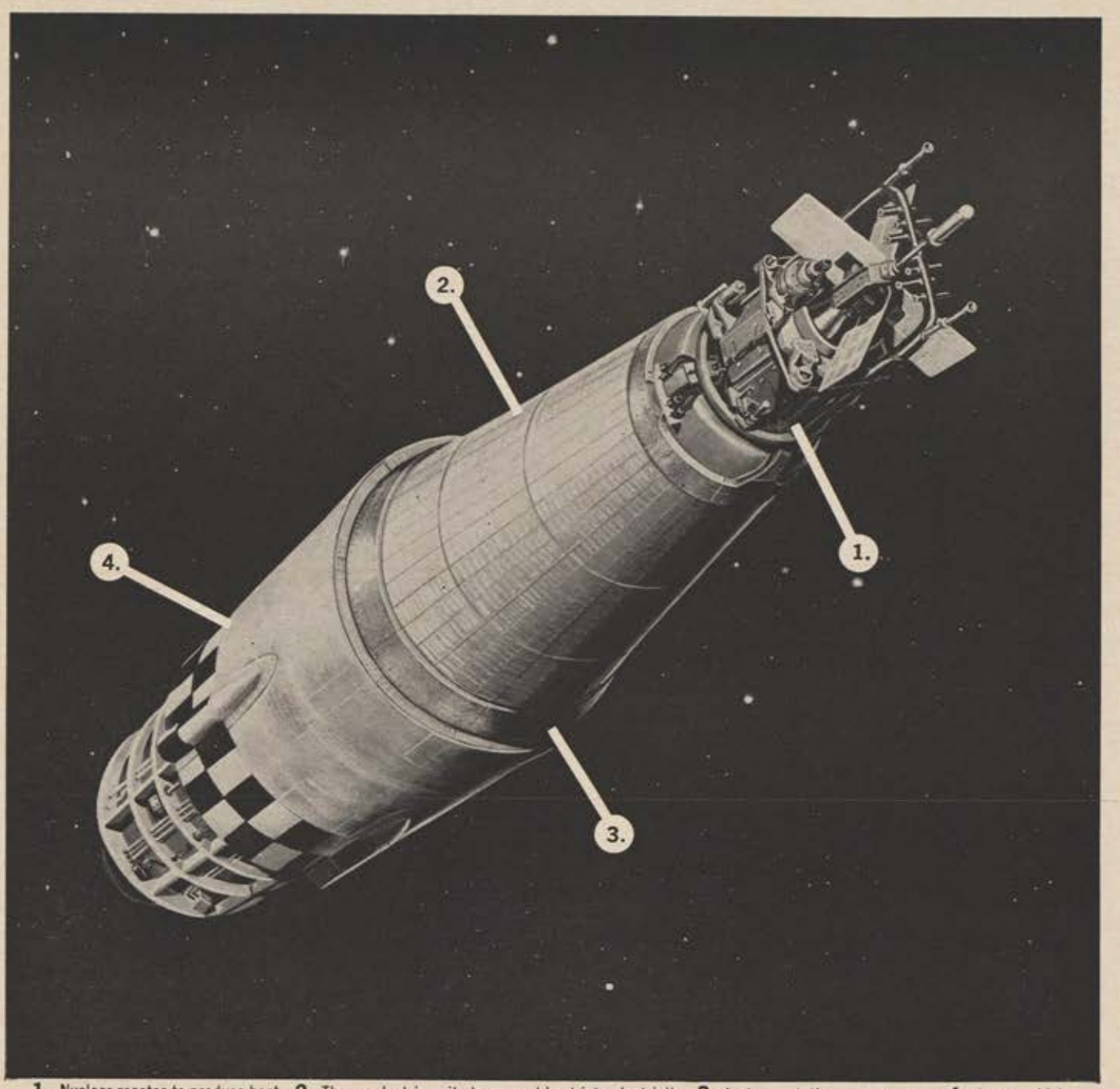
tended at the spacecraft between the line of sight to the earth and the line of sight to a star establishes the position of the spacecraft on the surface of a cone whose apex is at the earth. The axis of the cone is on a line of earth–star. The apex angle of the cone is twice the supplement of the measured angle.

Note that these methods require simultaneous observation and measurements of several bodies. This is impractical for even the most advanced of optical devices. It is therefore probable that the space navigator will need techniques and devices to advance or retard different observations to a common fix time in the manner of the aerial navigator.

Another means of celestial fixing in space which

[3]Pilot Class in Space Navigation, *Space Navigation Handbook*, pp. 58-60.

[4]*Ibid.* p. 61.



1. Nuclear reactor to produce heat **2.** Thermoelectric units to convert heat into electricity **3.** Instrumentation compartment **4.** Agena vehicle

This is SNAP 10A

the world's first nuclear reactor in space and the newest addition to America's space power from North American Aviation

SNAP 10A is more than 700 miles out in space... circling the earth every 112 minutes in a 4,000-year orbit. During its 43 days of uninterrupted, flawless operation, it produced over 500,000 watt-hours of electricity. SNAP reactor systems can provide power for observation and weather satellites, orbiting laboratories, electrical propulsion in space, and for communicating directly from space to ordinary antennas on the ground. The SNAP 10A system was designed and built by North American Aviation/Atomics International Division for the Atomic Energy Commission. NAA/Rocketdyne built the Atlas rocket engines that launched it. North American Aviation is a leader in electronics, aviation, life sciences, space flight, atomic energy, rocketry, and basic research.

North American Aviation

Atomics International, Autonetics, Columbus, Los Angeles, Rocketdyne, Science Center, Space & Information Systems

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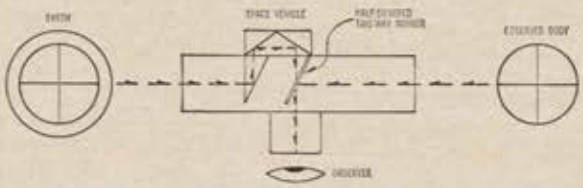

FIGURE IX CELESTIAL FIXING BY OBSERVING CENTER OF EARTH AND ZENITH STAR SIMULTANEOUSLY WITH BAZOOKA TELESCOPE

is worth examining requires observing the center of the earth and simultaneously locating a star or body at the observer's zenith. The location of the space vehicle in declination and Sidereal Hour Angle is the same as that of the star located. This is illustrated in Figure IX, in which a bazooka telescope is used to perform the operation.[5] Space vehicle location is determined by the axis earth-space vehicle-observed body. The body's declination and Sidereal Hour Angle (and therefore the space vehicle's position) are obtainable from the current Air Almanac.

[5]Captain P.V.H. Weems, USN (Ret.), "Navigating B-58 vs. Echo Satellite," *The Navigator*, VII: 7, May 1961.

The basic principles of space navigation have already been recorded and developed through air and marine navigation. While many of their applications to space navigation are still in the developmental stage, the general themes of celestial coordinate reference systems, spatial dead reckoning, and celestial fixing in space—in short, the heart of any space navigational system—have already been formulated.

Space represents a new medium in which the navigator will perform his traditional role of fulfilling the trust of human beings who place their lives under his skill, knowledge, and ability to take them safely to their destination.—END

The author, Major Cohen, is a 1959 graduate of West Point. He attended USAF navigation schools and is now assigned to the 11th Strategic Aerospace Wing, Altus AFB, Okla., as a B-52 navigator. He has written several articles, which have appeared in The Navigator, The RCAF Observer, The Proceedings of the US Naval Institute, *and* The Journal of the Institute of Navigation. *Several of his navigational inventions are being evaluated by USAF and the RCAF.*

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Keeping track of the number, size, paths, and life cycles of the ever-increasing number of objects fired into space since 1957 is the vital job of the Air Defense Command's SPADATS-Spacetrack Center at Ent AFB, Colo., an important space-age element of the North American Air Defense Command. Skilled personnel aided by modern computers are filling this important assignment . . .

A SPACE DIGEST Photo Feature

SPACETRACK . . . Keeping

Against the backdrop of the "menu board" listing all man-made objects in space, foreign and domestic, Air Force technician traces path of a deep-space probe on a celestial sphere often used in briefings for visitors.

ONCE empty, orbital space now is crowded —and getting more so—with hundreds of objects ranging from currently working scientific and military hardware to the remnants of spent satellites—American, Russian, and a few from other nations.

Keeping track of this ever-increasing cosmic inventory is the complex and computer-aided job of the USAF Air Defense Command's Space Detection and Tracking System (SPADATS)-Spacetrack Center at Ent AFB, Colo. The SPADATS-Spacetrack Center is an element of the North American Air Defense Command.

From small and relatively primitive technical beginnings, today's Spacetrack system has evolved into a highly effective operation capable of surveillance of man-made space objects as small as a pencil.

Spacetrack's job is to keep a fix on every single object, foreign and domestic, that has been sent into space since Sputnik, to report the decay of satellites and components as they reenter the earth's atmosphere, to predict trajectories, and to provide special surveillance of satellites of particular military interest to the Commander in Chief, NORAD.

Data on satellites flows in constantly from such varied sources as the Ballistic Missile Early Warning System sites in Alaska, England, and Thule, Greenland; high-powered Baker-Nunn optical cameras located at Edwards AFB, Calif., and the Smithsonian Astrophysical Observatory at Cam-

NORAD Space Duty Officer confers at Center with military and civilian colleagues on deployment and use of computers and sensors for surveillance operations. Up-to-date computer techniques are under constant review.

Tabs on What's Out There

bridge, Mass.; Mt. Palomar Observatory in California; and a host of other civilian and military systems around the country, including a Boston University-designed mobile sensor mounted on an antiaircraft truck and air-transportable around the globe. The capabilities of modern optical sensors are illustrated by such achievements as the Mt. Palomar photograph taken in 1962 of Mariner-II at a distance of 350,000 miles, or the Baker-Nunn observation of the Vanguard I six-inch sphere at some 2,400 nautical miles—the equivalent of photographing a .30-caliber bullet at 200 miles. A new Air Force electro-optical sensor, AN-FSR-2, which will detect satellites at 20,000-mile range, is nearing operational status at Cloudcroft, N. M.

More than 7,000 observations a day—one every twelve seconds around the clock—are received, processed, and categorized by the Air Force-Navy-civilian team manning Spacetrack.

The product of this incredible operation is threefold: a current catalog of all man-made objects in space, including probes in deep space; a space-object bulletin, with current and predicted orbital data; and a Sensor Look Angle List, which tells sensor stations around the world exact positions of space objects in relation to their own locations. All of this is for the aerospace-defense purpose of knowing what's up there.—END

Every effort is made to verify data received from sensors around the world ranging from radars to optical telescopes. Above, information is transferred to punch cards, will be fed into Philco 2000 computer.

Military-civilian specialists cooperate in Center's operation. Right, two members of the Spacetrack team confer as a new computer program is checked out on the Philco 2000. End product: enhanced aerospace defense.

Speaking of SPACE

BY WILLIAM LEAVITT
Associate Editor, AIR FORCE/SPACE DIGEST

A Time for Pause

WASHINGTON, D. C., JULY 14

This is a time for pause in the national space effort, civilian and military. Not that a great deal isn't going on. As this is written, the Mariner-4 Mars probe is in the last hours of its celestial glide toward a photographic rendezvous with the red planet. In a few days we may have a slightly clearer understanding of the nature of our planetary neighbor. "Slightly" could be a great enough improvement in our understanding to be what the scientists like to call an "order of magnitude" enhancement of our knowledge of Mars.

At the same time, the National Aeronautics and Space Administration is gearing up for the Gemini-5 eight-day manned orbital flight in August. And Air Force planners are hopeful that the long-delayed USAF Manned Orbiting Laboratory project will very soon receive a go-ahead signal from the Pentagon.

A few days ago, on July 9, the offices of the National Aeronautics and Space Council—top policy-advisory group on aerospace to the President—were the scene of an important meeting presided over by Vice President Hubert Humphrey. Among those present at the Space Council meeting were Secretary of Defense Robert S. McNamara and NASA Administrator James E. Webb. A major topic of discussion was the whole range of manned and unmanned military space activity, and it is understood that the Air Force MOL question got a close going over.

All indications still point to eventual implementation of the MOL project, although predictions that a specific announcement to that effect would emerge from the July 9 Space Council meeting proved to be without foundation. At this writing, it is expected that weeks may pass before a final announcement is made. Meanwhile, there remains $150 million in the Fiscal 1966 budget for the MOL, when and if it gets the green light.

Vice President Hubert Humphrey, Chairman of the National Aeronautics and Space Council, presided at July 9 meeting at which USAF MOL was discussed.

Adding to the mystery of the future of manned military space activity is last week's announcement of the appointment of Dr. Harold Brown as Secretary of the Air Force to succeed Eugene Zuckert. Dr. Brown, thirty-seven years old, has served since 1961 as Department of Defense Director of Defense Research and Engineering. In that post, he has helped make major decisions on an array of research-and-development proposals by the Air Force. In this connection it must be pointed out that it has been during the incumbency of Dr. Brown in the Defense Research and Engineering post that the MOL concept was accepted as a potential tool for the exploration of manned military utility in the space environment. Also, the development of the Air Force Titan III-C booster combination, which has already showed its 2,000,000-pound-thrust capability, plus a valuable versa-

This is a Gemini-4-eye's view, remarkably clear, from orbital altitude, of the sweeping Hadramawt Plateau, a major terrain feature located on the southern end of the Arabian peninsula near the Gulf of Aden.

The Earth from Space . . . As Seen from Gemini-4

Spaceborne photography was one of the important missions of the Gemini-4 orbital flight in June. Using modified 70-mm. Hasselblad camera equipment, the astronauts shot a series of excellent photos of various areas of the earth. Some of the results are shown on this page. NASA geologist Dr. Paul Lowman, Jr., directed what was called the Synoptic Terrain experiment.

Another shot of the Hadramawt Plateau, this time with some obscuring of the area because of cloud cover at time of overflight. Photos were taken by astronauts with specially modified 70-mm. Hasselblads.

This is northern end of the Gulf of California showing the mouth of the Colorado River. Note the linear feature outlined in white, considered a land fault. The space photos add data to existing air surveys.

PAUL THAYER, SECOND FROM RIGHT, DISCUSSES XC-142A PROGRAM WITH SOME OF HIS PROJECT PEOPLE.

"I Wouldn't Trade Jobs With Anyone in the Industry"

Paul Thayer wasn't exaggerating when he made this statement. He was simply stating a fact he firmly believes.

The question arose quite naturally — from a stockholder who wanted to know from Thayer as its president more about the current status of LTV Aerospace Corporation, its programs, its growth potential.

In the brief span of several minutes he outlined LTV Aerospace Corporation from the ground up.

He mentioned the company's divisions and the exciting projects they are engaged in, such as the *XC-142A* — the world's largest flying V/STOL, currently undergoing evaluation by the Air Force . . . the *A7A* — the Navy's new attack airplane that can go twice the distance, with twice the bomb load of any existing Navy light attack aircraft.

He talked about *Lance*, the Army's new battlefield missile that scored a bull's-eye on its first firing . . . about *M.M.U.*, the astronaut maneuvering space pack being used in Project Gemini . . . about *XM-561* — the highly versatile ground vehicle being developed for the Army . . . and about the *Scout* research rocket used by NASA . . . and about *Range* and *Launch* operations the company manages.

Finally, Thayer paused, then added, "When I think about all the projects we're involved in, the really outstanding people we have, the competitive spirit that exists, and our potential — well, I just wouldn't change jobs with anyone in the industry."

LTV AEROSPACE CORP.

DALLAS, TEXAS

A SUBSIDIARY OF LING-TEMCO-VOUGHT, INC.

Dr. Duane E. Graveline

Dr. F. Curtis Michel

Dr. Harrison H. Schmitt

Dr. Owen K. Garriott

Lt. Cmdr. Joseph P. Kerwin, USN (MC)

Dr. Edward G. Gibson

Newly chosen NASA scientist-astronauts represent an array of scientific disciplines. Graveline is a former Air Force physician; Michel an astrophysicist; Schmitt a geologist; Garriott an ionospheric physicist; Gibson an engineering physicist; Kerwin a Navy physician. These six were chosen from hundreds of applicants.

tility obtainable by adding or subtracting solid-fueled segments on the two first-stage solid "strap-on" rockets, has proceeded under the aegis of Dr. Brown.

A clue to Dr. Brown's thinking on space policy, from the technological point of view, is found on past pages of AIR FORCE/SPACE DIGEST. In an October 1961 article entitled "Bringing Astronautics Out of Adolescence," he wrote:

"We have spent an enormous amount of money on our space program . . . probably considerably more than the Soviets have spent on theirs. Yet we have lagged behind in a number of important achievements. Why?

"There are a number of reasons, some having to do with an earlier start by the Soviets, and with their earlier pursuit of large boosters. These are the results of decisions made ten or more years ago which gave us an initial handicap which explains some of our difficulties. Of course, this is partly a result of our earlier success with light thermonuclear warheads. However, there is another reason for our failures which extends over the past five years and which is even less forgivable.

"Without this failing, the enormous effort which we have put in on space, beginning in the period 1955 to 1957, would have produced very much more memorable results.

"This deficiency is the practice of building a separate vehicle for almost every payload, of building too many different stabilization systems for satellites, too many different power supplies into our satellites and space vehicles, and too many different telemetering systems. We have had over fifteen different prime booster upper-stage vehicle combinations with many significant model changes within this prime grouping.

"The reliability achieved in this way has been just what you might expect—not good. . . ."

Dr. Brown, writing from his then-new vantage point as Director of Defense Research and Engineering, went on to call for standardization and for the building-block approach to space boosters and systems.

"To do this will not be easy," he wrote. "It will take considerable restraint and self-discipline on the part of industry, because there is a natural temptation to offer an alternative booster or an alternative spacecraft which, by duplicating, doubles the development cost, and actually does provide five percent better performance. It will take equal self-discipline on the part of those in government who manage such programs."

The Titan III-C, ably developed by the Air Force and its industry contractors, follows this philosophy. An Air Force MOL development directed by Dr. Brown would doubtless follow the same philosophy. The MOL would also enjoy the unique advantages of being bossed by a man who, in his former role in DoD, examined MOL proposals from the Air Force. As civilian head of the Air Force, Dr. Brown will have the opportunity to guide projects according to the rules of the game which he has done so much to help write. This will be an important challenge to him and to the Air Force, too.

It is likely that the final go or no-go MOL announcement that had been expected after the Space Council meeting was delayed partially because of the Brown appointment. In his new role as incoming Air Force Secretary—and, quite significantly, as the first scientist to occupy the slot—Dr. Brown undoubtedly wants to examine not only the MOL question from the inside but also the entire array of problems the Air Force faces in this mixed age of twilight war and nuclear deterrence. Thus the pause.

The pause extends over to the civilian space agency. At this moment, representatives of the scientific community are gathered at Woods Hole, Mass., reviewing for NASA the scientific content of the agency's space program. This meeting, called the Second Summer Study, is a successor to a lengthy seminar held a few years ago in Iowa by the National Academy of Sciences to examine the scientific potential of the then-new Apollo moon-landing program. The Academy, through its Space Science Board, continuously provides counsel to NASA.

After the end of the current Second Summer Study, NASA is sponsoring another meeting at the same site, starting July 19. Some of the scientists attending the Second Summer Study will stay on for the NASA meeting.

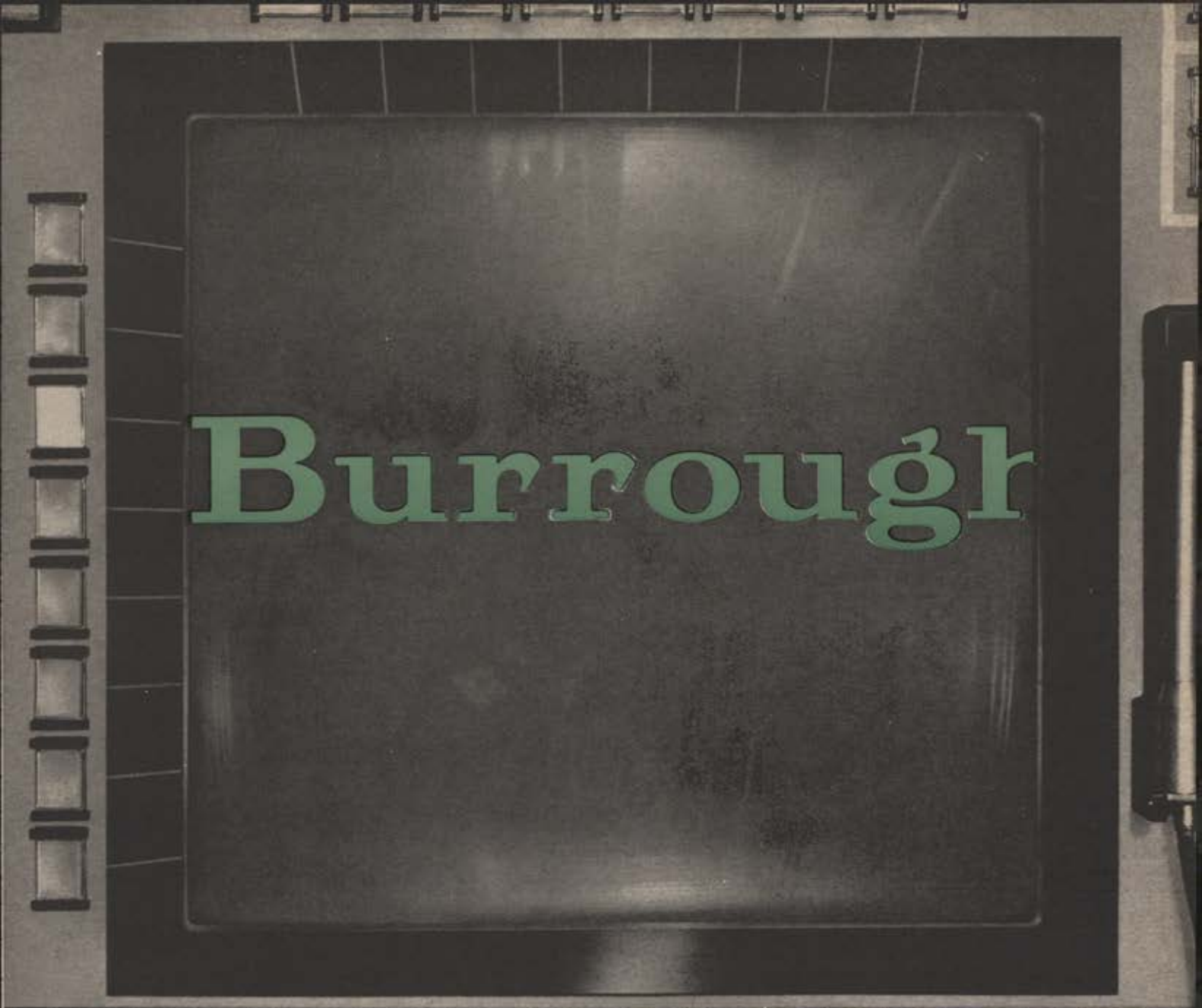
The NASA meeting is expected to last ten days. It is designed to explore ideas for what one NASA official called "a logical lunar exploration program after the initial landings." Some fifty scientists from outside of NASA and a dozen who work for the agency will be on hand. They represent the disciplines of geology, geochemistry/petrology, particles and fields, geophysics, biology, and geodesy/cartography. A panel on astronomy will meet elsewhere at the same time.

The NASA Woods Hole conference will produce a report for the space agency which presumably will eventually be made public. The fact that NASA is again soliciting a specific set of recommendations from the scientific community, through the media of the two meetings at Woods Hole, underscores the agency's continuing concern with the scientific solidity of its programs over the long run. NASA has taken a good deal of critcism over the past several years for the "hard-sell" approach used in pushing its programs. Some of the criticism has been justified. There has been too often an almost unbelievable air of hoop-la associated with the manned spaceflight program of NASA, which has been resented not only by the press but also by many scientists in and out of NASA, who have felt that the "pure-science" aspects of the agency's programs have suffered financially and in terms of publicity.

Yet it is hard to argue with success, and despite the technical and policy difficulties that have plagued NASA's manned spaceflight effort, it is proceeding well toward the Apollo moon-landing climax. The obvious utility of man in space, from a scientific and operational standpoint, is illustrated in no small way by the pictures on page 55, a selection from the photographs taken by Astronauts White and McDivitt during their Gemini-4 flight.

At this time of pause and evaluation, a further quote from Air Force Secretary-designate Brown is rather apt. In the 1961 article we quoted from above he also remarked:

"The space age is in the teen-age or adolescent stage. It is big, it has achieved a lot of growth, it is unpredictable, it wants to do more than it is ready for and at the same time in some areas it can do more than it thinks it can. In some respects it looks like a youngster; in others it is fairly close to maturity. How soon it matures is dependent on the way it is handled."—END



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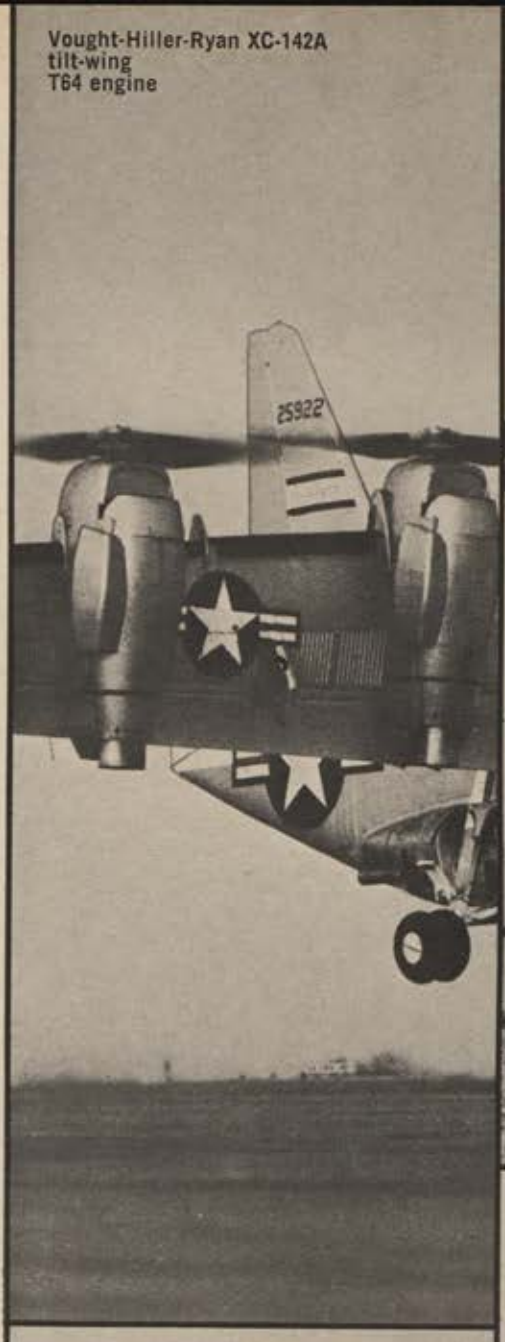
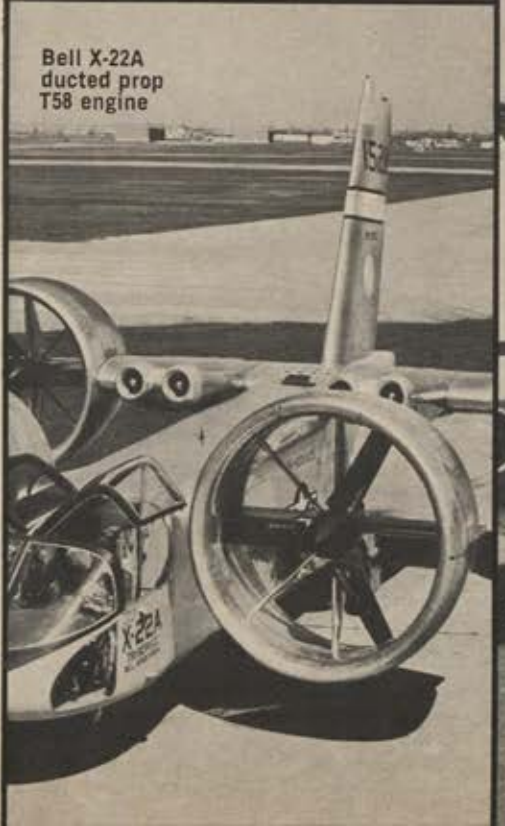


Vought-Hiller-Ryan XC-142A
tilt-wing
T64 engine

GE-Ryan XV-5A
lift fan system
J85 engine



Bell X-22A
ducted prop
T58 engine

Hughes XV-9A
hot gas rotor helicopter
T64 engine

deHavilland CV-7A
STOL
T64 engine

Kaman UH-2
boosted helicopter
T58 & J85 engines

Bell X-14A
deflected thrust
J85 engine

General Electric's flight propulsion capability is based on 19,000 people, 600 acres of manufacturing, test and research facilities at Lynn, Massachusetts and Evendale, Ohio and 23 years of jet engine experience.

T64—A versatile powerplant available in turboshaft, turboprop and gas generator configurations is rated at 2850 horsepower. Its exceptionally low fuel consumption over a broad range of power settings, and its ability to operate continuously through attitudes from 100° nose up to 45° nose down, make it particularly attractive for today's subsonic STOL and V/STOL aircraft. Its continuing availability to meet the power requirements of the new generation of aircraft is assured by a 3400 horsepower growth program already underway.

T58—Produces more power per pound of engine weight than any other engine in its class. It is the powerplant for many helicopters in service with the U.S. military and major helicopter airlines, as well as 55 users in 17 countries around the world. The initial growth program of the T58 to 1500 horsepower has been accomplished without altering installation features, and further growth to 1600 horsepower is underway.

J85—Production engines have 7 to 1 thrust-to-weight ratio, the highest now in service. The high thrust-weight and volume-weight ratios of the J85 engines make them very attractive for STOL and V/STOL applications. The unique J85 lift fan system, consisting of wing and nose fans powered by two engines, multiplies basic engine thrust by a factor of three for vertical takeoff and landing. J85 growth programs are underway for the next generation of aircraft.

In addition, larger engines are on test in the General Electric Flight Propulsion Division to accommodate the increased capacity of V/STOL's which will be flying in the next decade. New advanced lift/cruise engines and direct lift technology are well along in development.

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DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA

AIR FORCE
AUGUST, 1965

Instruments with numbers that unwind on tape instead of revolving is the newest concept in cockpit equipment. Already being used on the C-141 StarLifter and the F-106 Delta Dart, these rectangular instruments that give a flyer vital information at a glance constitute a . . .

REVOLUTION IN THE COCKPIT— Instruments That Don't Revolve

By Louis Alexander

WITH high-priority cargo and a brigadier general aboard, the pilot of the jet trainer was straining extra hard through thinning clouds to spot the rapidly approaching runway. The altimeter needle unwound on the dial in front of him as it followed the spiraling plane down.

The pilot watched the needle as he continued his glide until—suddenly—the runway appeared closer than he expected, and he had to pull up more sharply than he'd intended. The wheels bumped, and then he was down. "Overcorrection," sighed the pilot to himself.

Behind him a big C-141 slid down the glide path. As the trainer jockey pulled off onto the taxiway, he watched the final approach of the Air Force's huge new freighter. No signs of porpoising or overcorrecting. Not that the trainer pilot didn't wish the C-141 well, but he wouldn't have minded if the freighter pilot also had been confused by his altimeter a little bit.

But the pilot of the C-141 was using a new type of altimeter. It wasn't a round dial with a spinning needle. He didn't have to keep watching, mentally translating the circular movement into pictures of his height above the runway. In fact, the panel the C-141 pilot was watching was nothing like the familiar aircraft instrument panel. Instead, he was watching an altimeter and some other equipment that amount to a new concept in flying instruments—instruments without revolving pointers, whose numbers unreel on tape —instruments whose indicators move the way the airplane moves.

It's a new concept, evolving right now in operational aircraft as well as evaluation aircraft. But it is so new and different that it is almost a revolution—a revolution on tape.

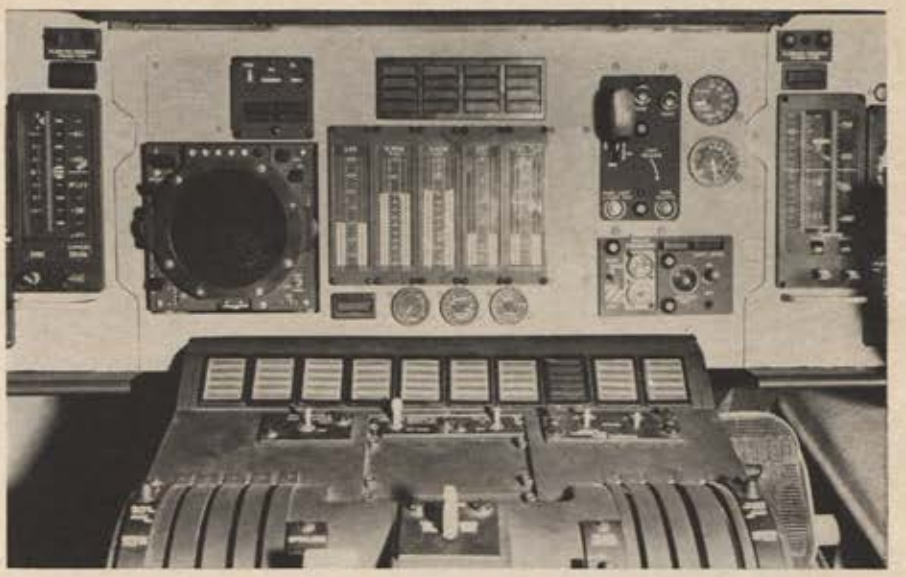
Two groups of tape instruments now are standard equipment on the C-141 and the F-106—a flight group and an engine group. The instruments are also being installed in the cockpits of the latest series of many other USAF planes.

Pilots in these aircraft report they now fly with more precision than possible before. The instruments enable them to keep pace with the high-speed, high-performance kind of flying their supersonic jets take them through. The Integrated Flight Instrument System (IFIS), of which the tape instruments are a major part, enables them to preplan their flights and then keep ahead of the airplane as it maneuvers, instead of watching instruments that force the pilot always to lag a critical little bit behind. Best of all, the tapes are more natural to read than the swirling, circling pointers and the crowds of numbers on the little round dials.

In the C-141, tall, narrow rectangles serve to tell the pilot the information he needs about vertical flight —altitude, rate of climb, Mach number, and a new and useful concept to a pilot whose weight-and-balance situation varies constantly his angle of attack. The pilot scans across one lubber line and gets a decision-making picture of all his flight information. One set of these rectangles faces the pilot and another the co-pilot.

Between these two men sits another group of rectangles, reporting the behavior of each of the four engines. Within a 1½-inch-wide display area, four white 3/16-inch tapes move up and down. They show fuel flow, percent of rpm, exhaust gas temperature, and engine pressure ratio. "It's like four thermometers on one indicator," says a flight engineer. "You can easily tell which engine has less rpm or which one requires more fuel flow."

(Continued on following page)

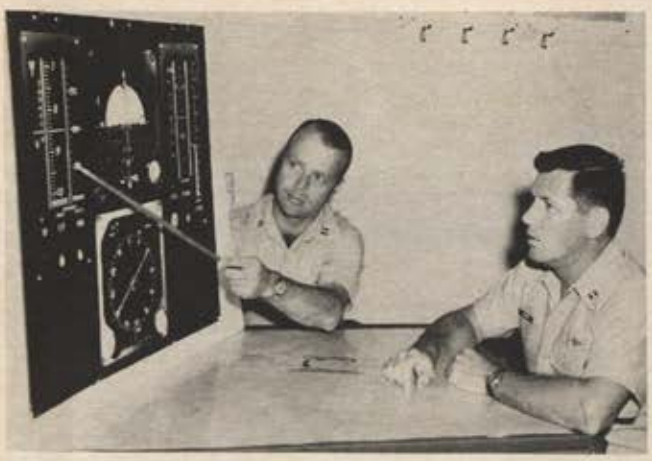


This closeup of the C-141 Star-Lifter instrument panel shows the tape instruments, center, that indicate the performance of each engine. At right and left are the tape flight instruments of the Integrated Flight Instrument System. This instrument panel is obviously much less complicated than those of older aircraft using dials.

At Randolph AFB in central Texas, the Instrument Evaluation Branch of the Instrument Pilot Instructor School has been flying a tape-equipped Convair T-29 and a T-39 Sabreliner for three years. They're evaluating various kinds of tape instruments and determining which presentations and what kinds of information are the most useful. Says the school commander, Col. Robert D. Williams, "As far as high-speed aircraft are concerned, this is the only answer. For the future, I don't see how we can do without them."

To appreciate this revolution-in-the-making in the instrument panels that face pilots, let's take off and fly for an hour or so at around 26,000 feet in the T-39. If you fly the right-hand seat, you'll see the familiar round-dial altimeter, with its three pointers, and the familiar airspeed indicator, as well as the slow-poke rate-of-climb indicator, among the instruments in front of you. Two large round ones are recent—the Flight Director System—but they're just improvements in the concept of conventional dial-display, plus a computer (out of sight somewhere in the innards of the plane) to furnish commands for radio navigation.

If you fly the left seat, you'll find yourself looking at a vertical rectangle on the left of the Flight Director System, with three columns of lines, and another vertical rectangle on the right, with three more columns.



Capt. Dick Goodall uses a large mockup to teach a student how to read the airspeed group of tape instruments. Lubber line at right is on 300 knots. Window at bottom shows command bar preset to 400 knots. Center lubber line is on Mach .85 and lubber line on the left is set for one G.

The rectangle on the left is the airspeed group. On the right is the altitude group. After engine runup, as you gather speed down the runway, one column on the left-hand side begins to unroll higher and higher numbers, showing your airspeed in knots. Your speed, each second, is the number directly under the lubber line directly in front of you. As you climb for altitude, the numbers on the right-hand-side column unroll past the lubber line. There's no question in your mind about the pointer reading, or which pointer to read—your altitude is directly at the lubber line. As you go up, the numbers at the lubber line increase.

"It's a natural way of reading instruments," says Capt. Dick Goodall, who's been flying and evaluating tape instruments for three years. "You don't have to pick out a number from a crowd and then think, 'What does it mean?' The instrument tells you."

Leveling off at 26,000 feet, you see a double bar line approaching the lubber line. Before you left the ground, you set the bar—the command marker—at your desired first altitude. You literally *fly to* the command bar, instead of thinking constantly, "What altitude have I reached? Is it time to level off?"

Use of the command bar enables the tape system's unusual *fly-to* method to take the guesswork out of cruising or changing altitude and airspeed. You preset the command bar to the airspeed or altitude you want, and then just fly the airplane to it—until the command bar matches the lubber line. This makes flying by tape instruments much more precise. Another factor that adds precision is the increased sensitivity, under normal conditions, of the tape instruments compared with the familiar round-dial instruments. The rate of climb (called the vertical velocity scale) reacts much faster than its predecessor; the pilot does less overcorrecting.

To pilots flying at Mach 1.2, or seeking to level out at, say, 69,900 feet in pursuit of a target, this quality of precision is an absolute necessity. At high speeds such pilots must switch their attention from

(Continued on page 67)

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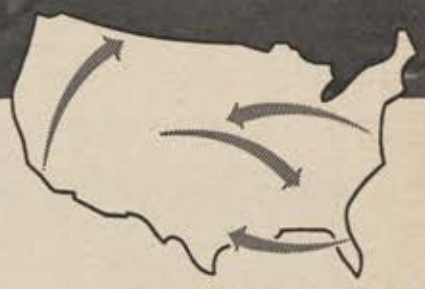

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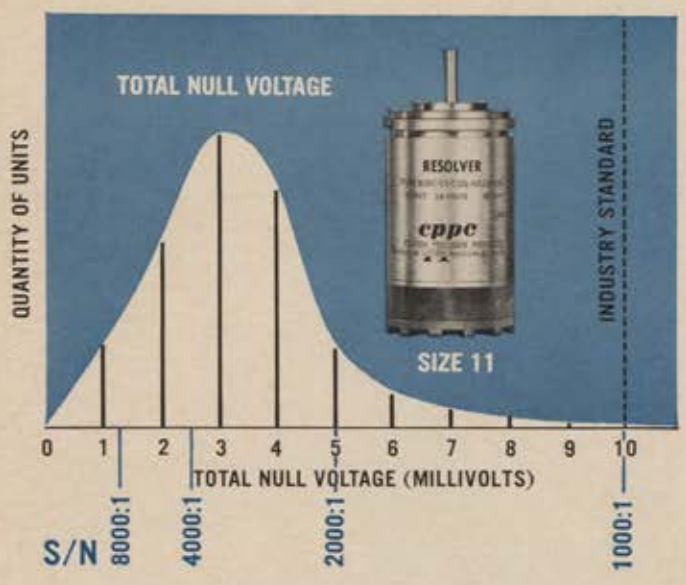

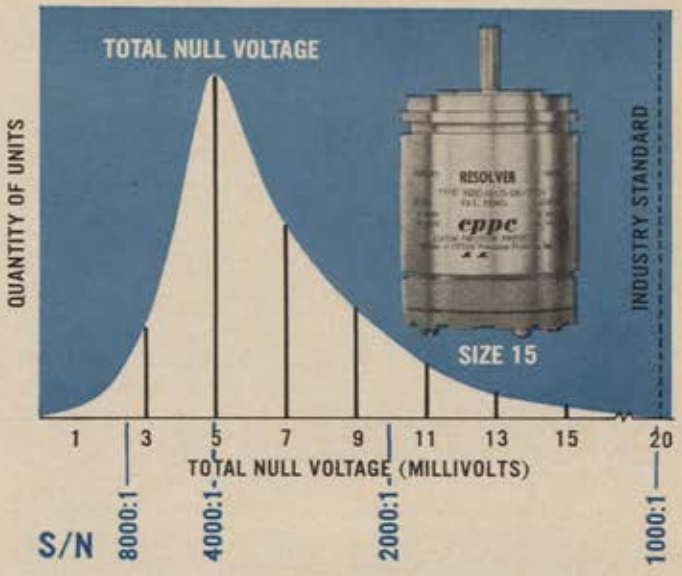

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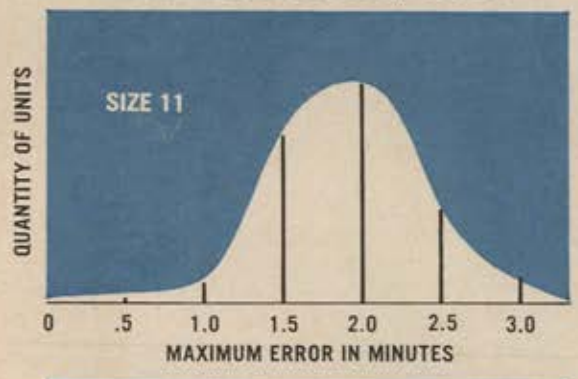

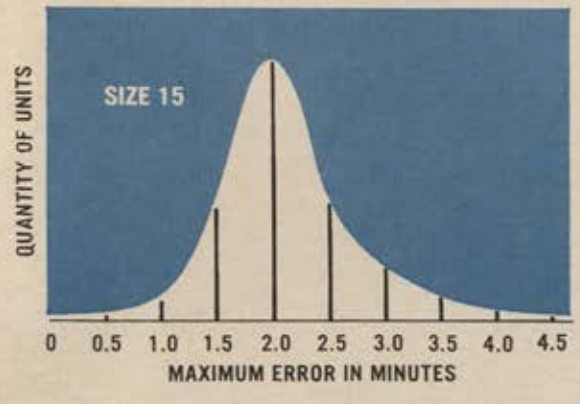

Clifton Precision continues to improve the nulls and accuracy on its Precision Computing Resolvers. A little close study of the curves shows that you are getting far better units than the industry standard and probably considerably better than your spec calls for. For instance, almost half of these production line units are exhibiting Signal to Noise ratios of 4000:1 min. About half of the units show max. errors of 2 minutes or less.

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the airspeed meter to the Mach meter and G-meter. In the tape system, all these are in that same vertical rectangle, allowing the pilot to complete maneuvers without waste motion, time, or fuel consumption. The Mach meter also has a command bar that the pilot can preset; and the G-meter has a readout at the bottom of the column, by which the pilot can note the G-forces acting on him and the plane at every moment.

Using the column furthest to the left, a pilot can improve his flying even more. A diagonally hatched red-and-black line indicates the aircraft's angle of attack. When the line touches the top of a triangle marked "Final," the aircraft is in the best possible combination of attitude and airspeed to carry out its final approach. Similarly, the angle-of-attack meter helps the pilot attain the best combination of airspeed and attitude for cruise and for other situations. It's likely to be very popular with transport pilots, whose loads vary from trip to trip and (on long trips) from zone to zone.

Transport planes like the C-141 use an instrument that shows the altitude in greater detail—a vernier altitude column in addition to the regular altitude column, in the vertical rectangle on the right.

Fighter pilots in the F-106 use a column that shows the plane's progress toward a target altitude. This improves their chances of making effective interceptions. Also, with the appropriate equipment installed in the plane, the target altitude can be set on the pilot's instrument panel by a controller sitting on the ground in the SAGE control room, where he is watching and measuring the movement of the enemy plane that is the target (or the refueling plane approaching the rendezvous).

This amazing, interconnected system for instrument flying has been under development for several years. The outcome of Air Force and contractor efforts is called the Integrated Flight Instrument System. To stretch the parameters, the numbers were calibrated on flexible rolls of tape that unroll in front of the pilot.

Integration is provided by what instructors call the "T-scan." The horizontal lubber lines on the instruments show the pilot his present situation—airspeed, altitude, rate of climb, Mach number, G-forces, angle of attack. Running across the Flight Director System in the center, the lubber line also shows the pilot his pitch attitude.

By following the line vertically in the center—the vertical bar of the T-scan—the pilot can also observe his bank attitude. And the Flight Director System even provides him a line to show whether he's on course to the next VOR or TACAN radio station (or on course from the last one), and which way to turn to keep on course.

This display is far easier for the pilot to follow than having to turn his attention in turn to each of a series of six round dials clustered in front of him. It's also more natural for him to observe that, if the command bar sits lower than the lubber line, he should lower the plane to bring it into line. It's more natural for the pilot to do that than to think, "What does the number on the round dial mean?" and "Which way must the airplane be adjusted to make the needle point to the correct number?"

If the pilot should need more numbers—as planes go faster and higher—manufacturers won't have to add another confusing pointer onto the dial or crowd in more numbers. They just add on to the tape, and it continues to be easy and natural to read.

A qualified military pilot can convert to the *fly-to* method, with tape presentations on his instruments, in five or six hours, Captain Goodall estimates. If the Flight Director System is also new to the pilot, add about three more hours; still, he'll be ready to use the new system in ten hours or less.

The tape instruments have one obvious disadvantage in comparison with conventional instruments: They report data processed from pilot and static sources to the cockpit through electrical sensors rather than directly. Malfunction warning flags come into view when the information processors from the computer detect an error, or when the indicator senses it hasn't followed commands, or when an error in excess of a predetermined trip-point is reached.

A break in this electrical link has brought on an occasional crisis in the cockpit. It's advisable to have ordinary instruments standing by, working directly from the pitot tube.

A veteran of the tape instruments was making a low approach to Ellington AFB in the rain when the control tower gave him the signal for "missed approach." As the copilot reached overhead to change the radio navigation signals he switched, instead, the power cut-off to the tape instruments in front of the pilot.

"Red flags popped out from all over, and that's all I could see," the pilot recalled later. "I leaned over and used the copilot's dials to fly the airplane. It sure seemed strange to be using the round dials."

Cost is another disadvantage. Not yet in volume production, the tape instruments are considerably more expensive than the conventional ones, by perhaps a factor of ten. In addition, more complex instruments cost more and take longer to repair than simple ones.

But when the pilot is seeking to level out at Mach 1.2, at 45,500 feet, and wants to conserve both fuel and seconds by not overshooting or undershooting, precision instruments are a must. It's then that Colonel Williams' opinion of the importance of tape instruments amounts almost to a forecast.

Several hundred military and civilian pilots, industry engineers, and pilots of allied countries have tried flying by IFIS tape presentations. They like it, every one—including a skeptical veteran of 15,000 hours and a virtual novice of 300 hours flying time. The Federal Aviation Agency has certified the concept for airliners. Tape instruments are part of the Boeing and Lockheed proposals for the supersonic airliner. A revolution in tape is indeed under way on the instrument panel.—END

Lou Alexander's byline has appeared frequently in AIR FORCE/SPACE DIGEST. *A veteran newspaperman, Mr. Alexander is an Air Force Reservist and an active member of the Aviation/Space Writers Association. He is a full-time free-lance writer now living in Houston, Tex.*

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A single B-17 playing many roles, chocolate syrup used for blood, simulated English countryside in Southern California—these are some of the elements of television's version of the wild blue yonder, according to this "combat veteran" of one season as technical adviser for the TV series "Twelve O'Clock High." The show, dealing with Eighth Air Force combat in World War II, now is ready for its second season, and everyone in this part of TV land is saying . . .

Filming the TV series "Twelve O'Clock High" is an exercise in teamwork between director and technical adviser. Here, Director William Graham and Sergeant Doherty, Technical Adviser, right, take a break.

Twelve O'Clock—and All's Well

By James Doherty

"WELL, I'll be go-to-hell!" he rumbled. "So this is where you fly?" The visitor, a lieutenant colonel and former B-17 pilot with the Eighth Air Force, was talking about the darkened sound stage we had just entered.

Beyond a tangle of cable runs, we ducked under a disembodied section of the B-17 *Piccadilly Lily*.

The colonel said, "Looks like the 'greenhouse' from a real B-17."

"It is," I replied, "with the front and side removed so the camera can eavesdrop on the crew."

The flight-deck section in front of us was minus everything forward of the control column, including the instrument panel.

The camera platform was crowded, but quiet. We listened as Director William Graham briefed the star of the television series "Twelve O'Clock High."

An actor's life is not always an easy one. Portraying the heroic Commanding General of the 918th Bomb Group, Robert Lansing insists on doing most of his own stunts. Here, Lansing "takes ten" before being dunked in a water set used in an episode that revolved around General Savage and his German nemesis sharing the same small liferaft.

"Next is the scene right after the fighter comes in and blows out the copilot's window. He's dead, and you've been cut by flying glass."

Robert Lansing, alias Brig. Gen. Frank Savage, Commander of the 918th Bomb Group, nodded.

Graham motioned to a makeup man with squeeze bottle in hand. "A little blood around the eyes, Ernie, not too much."

The visitor stiffened. "Chocolate syrup," Graham said. "Relax."

Lansing suppressed a smile. "One of our easier missions, Colonel." The makeup man went to work. In thirty seconds, Lansing was a candidate for his umpteenth Purple Heart of the current television season.

The director continued, "We'll polish off the bombardier and navigator this afternoon. This is a close shot, a 'rake,' looking across Bob and the dead copilot. Through the copilot's window we'll see the formation flying along in the background."

I explained to the puzzled colonel that when the camera rolled, a "process projector" on the far side of the stage would throw the image of a formation of B-17s on the background screen.

The arc lights came on, bathing the mockup in ersatz sunlight. Lansing settled himself into his seat; the "dead" copilot flopped across the controls.

Magically, a squadron of olive-drab Forts flickered to life on the screen. An ME-109 hurtled through the formation, firing as it came.

The mockup rocked and rolled. To simulate "hits" two husky stagehands bounced the cockpit on its bed of heavy steel springs.

Lansing ducked, grimacing in pain, clawing at the imaginary glass fragments battering his face. The background tilted sharply. The effect was chilling. General Savage's B-17 was plunging earthward!

But not for long—precisely on cue, Lansing threw out his right arm, freeing his jammed controls from the copilot's "body." As the mockup returned to straight and level the background followed suit.

(Continued on following page)

Piccadilly Lily **is the continuing star of "Twelve O'Clock High" and one of the biggest movable "props" in Hollywood. Here, painter prepares to decorate the B-17's fuselage with flak holes as the camera crew waits. The aging Flying Fortress is the property of California's Ontario Air Museum and is berthed at Chino Municipal Airport east of Los Angeles.**

The houselights came on and Lansing stepped nimbly from cockpit to platform. "Stick around, Colonel," he drawled. "After lunch we *really* get into trouble."

The visitor blinked. "It looks pretty confusing!"

The veteran's comment wasn't original. As technical adviser to "Twelve O'Clock High," the ABC network show based on the World War II exploits of the Eighth Air Force, I'd heard it often from uniformed visitors to the West Coast studios of 20th Century-Fox Television. And I couldn't agree more!

Consider a recent day's production schedule. In twelve hours, Lansing, in the role of General Savage, flew three combat missions, chewed out a subordinate or two in his office, was himself chewed out at Wing Headquarters, tossed a party at the 918th Officers' Club, and was shot at by a German spy—while having tea with his girl friend in a swank London hotel room. All this within the confines of three musty sound stages, a half block south of busy Sunset Boulevard in the heart of Hollywood.

Ironically, considering its Army wardrobe, the man responsible for all this is a thirty-seven-year-old Navy veteran, Quinn Martin, the show's executive producer.

Martin is riding high as head man at QM Productions. He is filming the successful "The Fugitive" and a new fall show for ABC, entitled "The F.B.I.," as well as "Twelve O'Clock High." Paul Burke is slated to replace Robert Lansing as the show's lead, and the program will move to a new time slot in its second season this fall.

QM's version of World War II in the air is no small-scale conflict. To commit a single episode to film takes what seems to be as much planning as the D-Day invasion. The show's producers only wish they had the budget to match.

"Twelve O'Clock High's" major prop, of course, is the B-17 Flying Fortress. In addition to the dismantled fuselage on the sound stage, there is a flyable airplane, berthed at the Chino Municipal Airport, forty-five miles east of Los Angeles.

Chino, with alfalfa bordering its runways, is perpetually smog-bound, a circumstance which delights

For the star, one day's production schedule may include everything from flying combat missions to sipping tea in a hotel suite. Here, General Savage (Robert Lansing) addresses a briefing held on the 20th Century-Fox TV lot. Sets are as authentic as intensive research can make them.

Production Manager Robert Huddleston. The smog conceals the towering San Bernardino Mountains—a frightfully non-English background. Alfalfa and fog, however, do add up to rural England.

QM's art director, Dick Haman, has converted a section of Chino into a cozy corner of "Archbury," home of the fictitious 918th Bomb Group. The set boasts exteriors of an operations building, control tower, base hospital, officers' club, and briefing room. A row of pyramidal tents has been erected to hide a bustling thoroughfare alongside the airport.

Beginning in September, Paul Burke, as Colonel Gallagher, will take over from General Savage, who, with his B-17, the *Piccadilly Lily*, is scheduled to be shot down in the new season's kickoff episode.

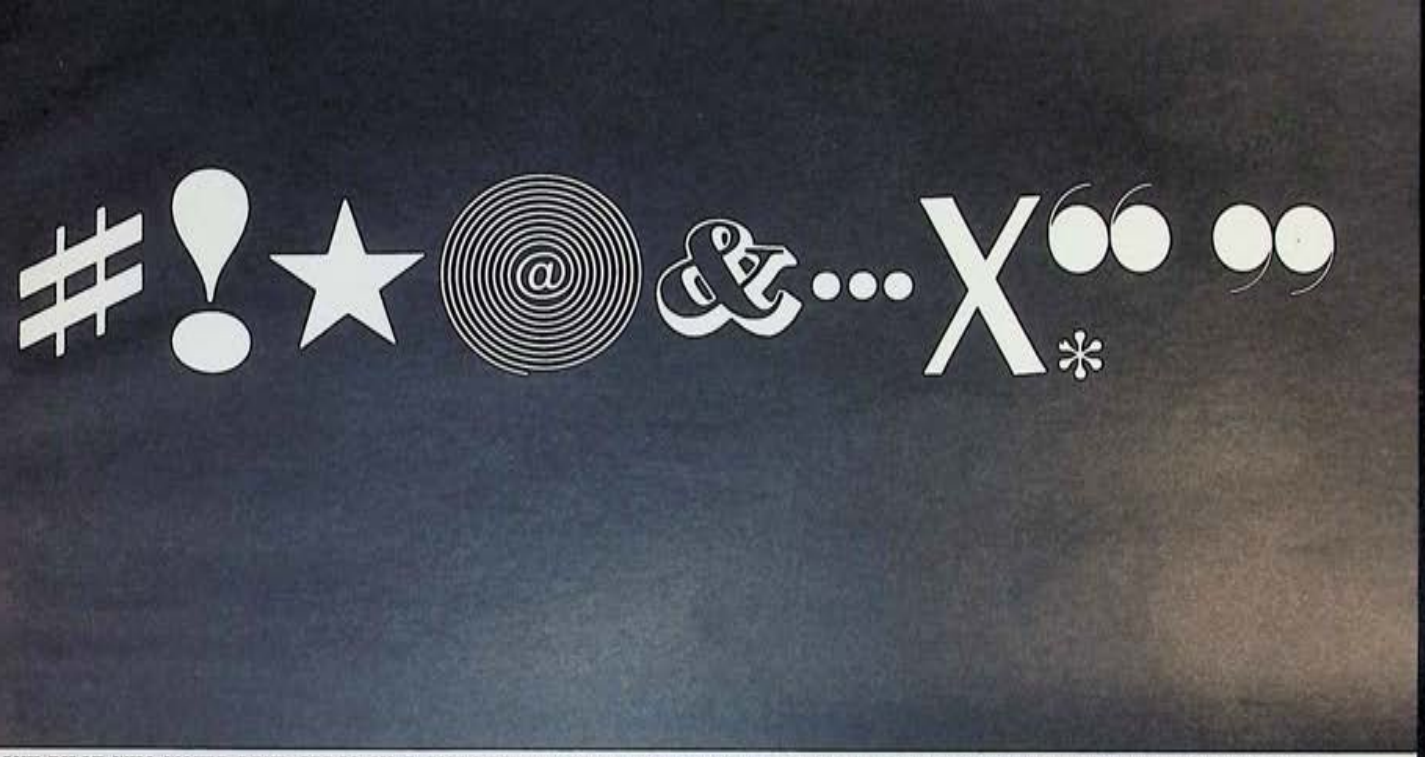
Burke formerly starred in the TV detective thriller "Naked City." He has made two guest appearances on "Twelve O'Clock High." In the second of these he went from captain to major. By September he'll be a full bull and CO of the 918th.

Regardless of what they call Burke's B-17, it will still be the same Fortress in which General Savage supposedly crashes.

"Twelve O'Clock High's" biggest prop is owned and

(Continued on page 73)

According to the script, General Savage is to be shot down during the new season's first show and replaced by Col. Joe Gallagher, portrayed by Paul Burke, right, who becomes the new star of the series.



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It will carry an astounding load externally—a truck, a plane, missiles or other material suspended from its 16,000-pound (7256 Kg.)—capacity cargo hook.

It will perform equally well at −65F or 115F. It has scaled peaks at 14,000 feet and, with its sealed-hull construction, it can take off and land on water.

Tandem rotors give the Chinook exceptional balance and stability; twin Lycoming T-55-L7 turbines give exceptional power reserve. It is the U.S. Army's standard "A" medium transport helicopter, in volume production.

The Chinook has just been shown in Europe for the first time. It was put through its paces at the Paris Air Show, and then displayed in action on a tour of U.S. and West German military installations. The Chinook is the product of creative engineering, forward thinking, weapons system management and the vast resources of the Boeing Company.

BOEING
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operated by California's Ontario Air Museum. It is one of two flyable B-17s in the US whose World War II configuration has been retained.

Last year, the aging warhorse's many roles necessitated changing the name on its nose thirty-two times—or whenever the show's writers needed a new and different four-engine "star." Yet it flew only once—when the Air Museum delivered it to Chino at the beginning of the season.

On TV, however, the 918th's taxi strips and runways seem to be crowded with Flying Fortresses. For this, the producers use the footage of the hundreds of cameramen who recorded combat action during World War II.

To QM editors and cutters, matching the action

General Savage checks in with his two-star boss, General Wiley Crowe, after a typically rugged and exciting mission. Cast and crew were stunned when, in mid-season, actor John Larkin, right, died of a heart attack moments after leaving the sound stage. He was a show business veteran, who starred for many years in radio, TV, and motion pictures.

and quality of twenty-five-year-old film from Air Force archives with freshly exposed footage is a daily challenge. They make it impossible for viewers to differentiate between scenes shot in the skies over Germany —or on an airfield "somewhere in England"—and action recorded on a Hollywood sound stage or in a Chino alfalfa patch.

Cutters, film librarians, researchers, and writers form but a single platoon in the army of technicians required to put "Twelve O'Clock High" on the TV screen.

To film a single episode takes the combined energies of nearly a hundred others—cameramen, electricians, set designers, builders, wardrobe and property men, studio grips, and special-effects wizards, to name but a few. All work a minimum of twelve hours per day, an average of seven shooting days (or nights) to get exactly forty-eight minutes of edited film "in the can."

For the TV audience, a new season premieres next month. But for the "Twelve O'Clock High" staff the new season began the first week in June when they started filming.

The standards of realism that impressed Air Force

Robert Lansing was bitten by the flying bug soon after he donned the Army uniform of General Savage. Recently he acquired his private pilot's license and became a member of the Air Force Association. Here, with his wife and son, he visits one of dozens of Air Force bases to which he is invited. Mrs. Lansing is star of daytime TV's "General Hospital."

viewers last season will continue in the new run. Uniforms, equipment, procedures, and dialogue will be as authentic as story limitations will allow.

But the story must come first and this sometimes means sacrificing realism. For, as any veteran of the air war against the Reich can testify, ninety percent of the average, long-range, combat mission was sheer boredom. What's more, crew members wore their oxygen masks, pilots observed radio silence, and conflict or panic among crew members was the exception rather than the rule.

But put that on the screen and you're dead.

Unfortunately for advocates of realism, all actors look alike in oxygen masks. So in its first season, the 918th flew more low-level missions than a near-sighted crop duster, fracturing radio silence at every turn. And more crew members ran headlong into each other than in all of World War II. The result was conflict, a necessary dramatic ingredient of commercial television.

"Twelve O'Clock High" is entertainment TV, not a series of documentaries. But it does help people remember that there is an Air Force, and that a bunch of Americans made a big contribution toward winning World War II.—END

The author, MSgt. James R. Doherty, a veteran USAF information specialist, is now assigned to the Air Force Office of Information in Los Angeles. During the 1964-65 television season he served as AF Project Officer and Technical Adviser for the TV series "Twelve O'Clock High," an experience he describes in the accompanying article. Sergeant Doherty has been a frequent contributor to AIR FORCE/SPACE DIGEST *in the past and has written extensively for other national publications. A native of St. Louis, Mo., he flew thirty-five missions as a radio operator-waist gunner with the Fifteenth Air Force in Italy in World War II. He was in the Coast Guard from 1950-53 and rejoined the Air Force in 1954. Among his assignments since then have been information duty at Hq. Alaskan Air Command and SAC.*

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The bold headline, BURLEY HITS ORBIT!, across the front page of the Burley, Idaho, *Herald Bulletin* is indicative of the impact on the area created by the Idaho AFA State Organization's **First Aerospace Day of Idaho.**

George Forschler, President of the State Organization, conceived and directed the program, and, with the help of an outstanding staff, staged one of the finest programs of its kind ever sponsored by an AFA unit.

Thousands, over a five-state area, were exposed to AFA and its objectives through special television programs which covered the highlights of the three-day event.

Idaho's **Governor Robert E. Smylie,** in an executive proclamation, declared Saturday, June 26, 1965, the state's Aerospace Day.

The program events were given names corresponding to the missiles, which were maintained in a static display on the grounds of the Ponderosa Inn. Titles such as "Hound Dog" Reception, "Bomarc" Luncheon, "Gemini V" Panel, "Minute-Man" Awards Banquet, and "Tight-An" Reception were used. Starting times for the events were listed as 2:01 p.m., 8:29 a.m., 6:29 p.m., etc., to call attention to the importance of being on time to the events as well as to imitate the exact time readings on missile launchings.

Panel discussions were moderated by AFA's Executive Director **James H. Straubel** and the **Rev. John Pickrell,** Pastor of the Burley Presbyterian Church and Chaplain of the Idaho State Organization.

Outstanding panelists presented the aerospace story from the viewpoint of education, industry, Air Force, government, and religion. The panels were composed of such distinguished personalities as **Governor Smylie; W. A. Roberts,** Vice Chairman of the Operating Committee of Phillips Petroleum Co.; **Maj. Gen. E. B. "Ben" LeBailly,** Director of Information, USAF; **Dr. Donald F. Kline,** head of the Department of Education at Idaho State University; and **J. H. Tippets,** Director of the Federal Aviation Agency's Western Region. Other distinguished panelists were **Max Ogle,** Director of Aerospace Education for the USAF Civil Air Patrol Liaison Office, Denver, Colo.; **Walter Lang,** Executive Director of the Bible Science Association, Inc., in Caldwell, Idaho; and **Earl H. Carlson,** who is the Bishop of the 5th Ward of the Church of Jesus Christ of Latter Day Saints and also the Principal of the Burley High School.

George Forschler, right, President of AFA's Idaho State Organization, accepts an executive proclamation from Gov. Robert E. Smylie in which the Governor declared Saturday, June 26, "Aerospace Day" in the state of Idaho.

Brig. Gen. James Trail, Idaho's Assistant Adjutant General for Air and former Chairman of AFA's Board of Directors, served as Master of Ceremonies for the morning program.

Maj. Gen. Irving L. Branch, Commander of the Air Force Flight Test Center at Edwards AFB, Calif., was Master of Ceremonies for the "Bomarc" Luncheon. **Joe Higgins,** well-known TV and motion picture actor and former President of AFA's Los Angeles Chapter, was Master of Ceremonies for the Awards Banquet.

Highlight of the Awards Banquet was a speech by **AFA President Jess Larson.** Other outstanding speakers at the various events were **William T. Piper,** Chairman of Piper Aircraft Corp.; **Capt. Joe H. Engle,** youngest of the X-15 test pilots at Edwards AFB, and now the newest and youngest US "Winged Astronaut"; **T. R. Wilson, Jr.,** Manager of the Safety Test Engineering Program for Phillips Petroleum Co. at the Atomic Energy Commission Reactor Testing Station, Arco, Idaho; and **Mr. Roberts** of Phillips Petroleum Co. They spoke on "Aviation Yesterday and Today," "Aerospace Today and Tomorrow,"

(Continued on page 77)

Above are the recipients of the awards presented at the Minute-Man Awards Banquet during Aerospace Day in Idaho. Left to right are General Branch, Sergeant Laurick, Sergeant Carpender, Mr. Stoltz, Colonel Lucas, and Mr. Forschler.

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For "time-sharing" and other applications where various computer systems must draw upon one large-capacity, central memory file designed for continuous and virtually instantaneous information processing, the Series L-4000 Large Scale Disc File produced by Librascope Group of General Precision, Inc., offers many remarkable new features. Consider the following before you buy or specify:

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Where an extremely large amount of data must be stored, the memory element of an L-4000 large-scale disc file has an initial capacity of 400 million bits of information with expansion capability to 6.4 billion bits on a single trunk line.

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Step 3. Consider Flexibility:
L-4000 large-scale disc files can be used with any data processing system, whether already in use or scheduled to be installed in the future to provide faster, more accurate, more reliable operation with greater storage capacity.

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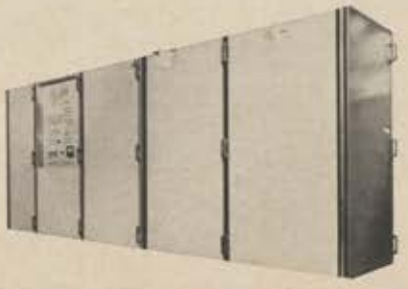

Step 6. Check The Equipment's Performance Record:
L-4000 disc files are a key part of a General Precision/Librascope data processing system in Headquarters USAF's 473L command-and-control system in the Air Force Command Post at the Pentagon. More than a million headbar hours have been logged without a single headbar failure. And, a scheduled installation for a scientific laboratory will provide a common data base for eight powerful computers, enabling many scientists and engineers to "share" the system on virtually a simultaneous basis. The L-4000, in this instance, will help replace magnetic-tape equipment twelve times more costly and which must now be manually monitored to provide the data base.

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At the Awards Banquet, Mr. Forschler presented Outstanding NCO Awards to **CMSgt. Marion W. Carpender** of the Idaho ANG, and to **SSgt. James E. Laurick** of the 9th Strategic Aerospace Wing at Mountain Home AFB, Idaho. Awards were presented to **General Branch** and to **Col. William R. Smith,** the former Commander of Mountain Home AFB, for their support, cooperation, and encouragement to the State Organization and the First Aerospace Day of Idaho. As Colonel Smith was unable to attend, **Col. Walter Y. Lucas,** the present Commander, accepted the award for him.

The Organization presented its "Outstanding Idaho AFA Member Award" to **Jack Stoltz** of Pocatello's McDougall Chapter for his outstanding work at the State and Chapter levels.

On behalf of the Idaho Chapter Presidents, **Joe Higgins** presented a plaque to **Mr. Forschler** in recognition of his outstanding leadership and initiative.

Entertainment for the Luncheon and Banquet was provided by Burley High School's Bel Canto Choir and the Burley Kiwanis Club's "Singing K's." Background music for the awards presentation was provided by the Black Hills Air Force Band from Ellsworth AFB, Rapid City, S. D. The band also presented a concert to more than 2,500 people in the Burley High School gym as a finale to the event.

Despite cancellation of the Sunday morning "Fly-In" due to weather conditions, more than thirty-five private aircraft showed up. Their pilots enjoyed breakfast at the Ponderosa Inn, a speech by Mr. Piper, and a sentry dog demonstration by the security teams from Mountain Home AFB at the Municipal Airport.

In conjunction with the program, the **Air University Presentation Team** from Maxwell AFB, Ala., commanded by **Lt. Col. Richard B. Olney** and including members **Maj. James S. Wall** and **Capt. Dennie R. Hoskins,** made appearances in Twin Falls, Rupert, and Burley, Idaho.

In the words of a local newspaper editor, "The First Aerospace Day of Idaho was the biggest thing to hit Burley since irrigation!"

• • •

AFA's newly chartered **Ark-La-Tex Belle Chapter** of Shreveport, La., recently held a testimonial reception and charter presentation ceremony at the Barksdale AFB Officers' Open Mess. World-famous aviatrix **Jacqueline Cochran,** who was named Honorary President of the Chapter, made the charter presentation to **Billie Hanrahan,** Chapter President. Other officers of the Chapter are **Barbara Cox,** Vice President; **Frances Seibert,** Secretary-Treasurer; and Council members **Pat deBerardinis, Virginia Lipscomb, Audrey Powers,** and **Edell Lafitte.**

Admiring the newly acquired Ark-La-Tex Belle Chapter's charter are, from left to right, Mrs. Jerry Correri, Membership Chairman; Mrs. Frances Seibert, Secretary; Mrs. Billie Hanrahan, President; and Kelley F. Womack, State Organization President.

Also present at the charter presentation were **Lt. Gen. and Mrs. David Wade, Maj. Gen. and Mrs. William E. Eubank,** and **Kelley F. Womack.** General Wade is Commander of the Second Air Force with headquarters at Barksdale AFB, and General Eubank is the Deputy Commander. Mr. Womack is President of AFA's Louisiana State Organization.

• • •

More than 300 AFA members and friends attended a recent **Tennessee Valley, Ala., Chapter** dinner meeting at the Redstone Arsenal Officers' Open Mess. The dinner honored **Brig. Gen. Edmund O'Connor,** Director of Industrial Operations at the George C. Marshall Space Flight Center, on his recent promotion; and **Col. W. Scott Fellows,** who was Chief, Cost Reduction & Value Engineering Office at the Center until his recent retirement.

The affair netted several hundred dollars for the Chapter's scholarship fund.

Maj. Gen. Sam Phillips, Director, Apollo Program, NASA, was the featured speaker at the dinner. **Chapter President John Wood** served as Chairman and Master of Ceremonies.

• • •

Wood County Airport, Parkersburg, W. Va., was renamed the **Gill Robb Wilson Field** recently in honor of this famous native son. Aerospace celebrities gathered to pay tribute to Mr. Wilson at the ceremony. Principal speakers, **Senator Jennings Randolph** and **Governor Hulett C. Smith,** hailed Mr. Wilson as aviator, writer, and aviation journalist. He is also a former President and Chairman of the Board of AFA.

Among the guests were Aviatrix **Jacqueline Cochran;** famed speed and stunt pilot **Roscoe Turner;** and two noted test pilots, **Joe Walker** and **Col. F. K. "Pete" Everest.** Other out-of-town guests included **Maj. Gen. Roger Browne,** USAF (Ret.), Commissioner of Purchase for New York City; **Maj. Gen. and Mrs. Robert L. Copsey,** USAF (Ret.); **Frank Kimble,** New York State Director of Aviation; and **Carl Long,** National AFA Director, and **Mrs. Long.**

To open the program, a squadron of F-101 fighters from Lockbourne AFB, Ohio, performed a flyover.

After being introduced by **Richard S. Cotterman,** President of the Greater Parkersburg Chamber of Commerce, Mr. Wilson expressed his deep appreciation for the honor bestowed on him.

(Continued on following page)

At the dedication of the Gill Robb Wilson Field at Parkersburg, W. Va., Mr. Wilson, right, poses with, from left to right, Carl Long, AFA National Director; Richard S. Cotterman, Parkersburg Chamber of Commerce President; and Parkersburg Mayor Dean T. Jackson.

Maj. Gen. Wilson V. Newhall, USAF (Ret.), right, former Chief of Staff of the Illinois Air National Guard, receives an award for his early contributions to the effective development of the Illinois Air Guard from Lee Cordell, Chairman of the Awards Committee, at a recent Illinois State Annual Awards Dinner. Other guests included, from left to right, Maj. Gen. Donald J. Smith, Chief of Staff, Illinois ANG; Maj. Gen. Winston P. Wilson, Chief of the National Guard Bureau, Washington, D. C.; and William Farina, AFA's Illinois State Organization President.

At its recent Charter Night Banquet, the **Altus, Okla., Chapter** paid honor to several persons for their contributions of time and effort on behalf of Altus AFB, during its reactivation and development.

The late **Senator Robert S. Kerr** was singled out for praise. Others honored were **Senator A. S. Mike Monroney**, the late **W. B. Gover**, the late **W. H. Luderson**, and **Harrington Wimberly**, publisher of the Altus *Times-Democrat*.

The tribute to Senator Kerr was accepted by two of his sons, Bill and Robert, both of Oklahoma City. Representing Senator Monroney was Jay Perry, his State Administrative Assistant. Mrs. Luderson accepted the citation in memory of her husband, and John Gover accepted the tribute in memory of his father.

Brig. Gen. Everett Holstrom, Commander of the 816th Strategic Aerospace Division, was guest speaker for the occasion. **Haskell Martin**, State AFA President, presented the charter to the Chapter.

In addition to citations presented at the Banquet, others were sent to **Gen. William F. McKee**, USAF (Ret.), new Federal Aviation Agency Administrator; **Brig. Gen. Glynne Jones**, USAF (Ret.), first commanding officer at Altus AFB following its reactivation in 1952; and **Harold C. Stuart** of Tulsa, former AFA President and Chairman of the Board, who was Undersecretary of the Air Force at the time of the reactivation of the base.

* * *

The **Catskill-Hudson, N. Y., Chapter**, in receiving its charter from State President **James Wright**, at a recent Charter Night Dinner in the Stewart AFB Officers' Open Mess, became the nineteenth active AFA unit in New York state.

In addition to presenting the charter to **Chapter President Wallace Corts**, Mr. Wright was the featured speaker of the evening. Among the guests present was **James Olley**, Mayor of Walden, N. Y.; and **Archie Stewart** of Newburgh, N. Y., whose grandfather donated the land for Stewart Air Force Base.

* * *

CROSS COUNTRY.... Congratulations to **Marjorie Beringer** who recently received her Doctorate of Education degree from UCLA. Marjorie is very active in AFA's California Organization, and her husband **John** is an AFA National Director.... Members of AFA's **New Jersey State Organization** are planning a special tour of Europe in late October.... **Altus, Okla.**, will be the site of the Southwestern Oklahoma Aerospace Educational Symposium on August 27.... AFA's **International Aerospace Education Symposium** and **Aerospace Development Briefings** will be held in Washington, D. C., September 15-17 .... **September 18**, the eighteenth birthday of USAF, will be celebrated as **Air Force Day** across the country. .... The **Michigan State Organization Convention** will be held in Grand Rapids on October 23.... The **New Jersey State Organization** will hold its convention in Asbury Park, October 28-29.... An **Aerospace Education Symposium** will be held at Louisiana Polytechnic Institute in Ruston, La., November 4-5.... AFA's **Southwest Region** will hold a regional convention in El Paso, Tex., November 11-13.

—DON STEELE

Pictured at the recent California State Convention are, from left to right, Jack Withers, newly elected State President; Bill Bergstrom, the State Treasurer; Gen. William H. Blanchard, USAF Vice Chief of Staff; Bob Lansing, star of the TV series "Twelve O'Clock High"; Dolly Foster, Orange County Chapter Vice President; and Dr. C. A. DeLaney, President of the Orange County AFA Chapter.

The American Ambassador to the Court of St. James, the Honorable David K. E. Bruce, center, was guest of honor and speaker at the recent meeting and first social function of the newly organized London Chapter. Shown with the Ambassador at left is Maj. Gen. John S. Hardy, Third Air Force Commander, and, right, Col. Edward Gray, USAF (Ret.), President of the new United Kingdom AFA Chapter.

Bob Stevens'

"There I was..."

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Substantial new benefits have been added to AFA Military Group Life Insurance at *no increase in premium.*

Equal coverage, up to $20,000, is now provided for both flying and nonflying personnel. This eliminates the penalty of lower coverage for the man on flying status whose death is caused by illness or ordinary accident.

The accidental death benefit has been increased to $12,500—a substantial increase in this benefit for every age group.

The only exception to these new provisions is that a flat sum of $15,000, regardless of age, will be paid for death caused by aviation accident *while the insured is serving as pilot or crew member of the aircraft involved.*

Policyholders may also keep their insurance in force at the low group rate after they leave the service, and until age 65—provided their coverage has been in effect for at least a twelve-month period prior to their date of separation.

Net cost of insurance has now been reduced by dividend payments for three consecutive years. Dividends amounting to 20% of the annual premium were paid to 1964 policyholders . . . in addition to the major benefit increases made in the policy.

Other benefits include guaranteed conversion privilege, waiver of premium for disability, choice of settlement options, and a choice of convenient payment plans, including payment by allotment for those on active duty.

All military personnel on active duty, in the National Guard, and in the Ready Reserve are eligible for AFA Military Group Life Insurance.

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CIVILIAN GROUP LIFE INSURANCE

This new program offers AFA's nonmilitary members $10,000 of needed insurance protection at the lowest cost we know of for any group term policy which offers equal benefits:

Double Indemnity is a unique feature of this plan, covering almost all accidental deaths, including death caused by aviation accident unless the insured is acting as pilot or crew member of the aircraft at the time of accident.

Coverage may be continued at low group rates to age 65, when it may be converted to any permanent plan of insurance then being offered by the Underwriter, United of Omaha, regardless of the health of the insured person at that time. Conversion prior to age 65 is also guaranteed, at the option of the insured.

The plan also provides many other benefits — waiver of premium for disability, a choice of settlement options, and a choice of convenient payment plans to fit most family budgets.

Any member of AFA, man or woman, who is not on active duty or in the National Guard or Ready Reserve, and who is between 20 and 60, is eligible, except for members who have left military status but still retain AFA Military Group Life Insurance at Group rates.

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The Family Plan provides insurance for each member of the family under one convenient policy. The wife of the policyholder is insured for 50% of his coverage. Each child, regardless of the number of children in the family, is insured for 10% of the AFA member's coverage.

Insurance is also provided for nonreimbursed medical expenses of over $50, up to a maximum of $500. Under the Family Plan, *every* family member receives this valuable extra coverage.

In addition, policyholders receive an automatic 5% increase in the face value of their policies *each year* for the first five years their insurance is in force. There is no extra premium cost for this increase.

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AFA *guaranteed* Flight Pay Protection is available to rated personnel on active duty. Protection is guaranteed even against preexisting illnesses after a policy has been in force for twelve consecutive months. This insurance protects active-duty members on flying status against loss of their flight-pay income because of injury or illness.

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8-65

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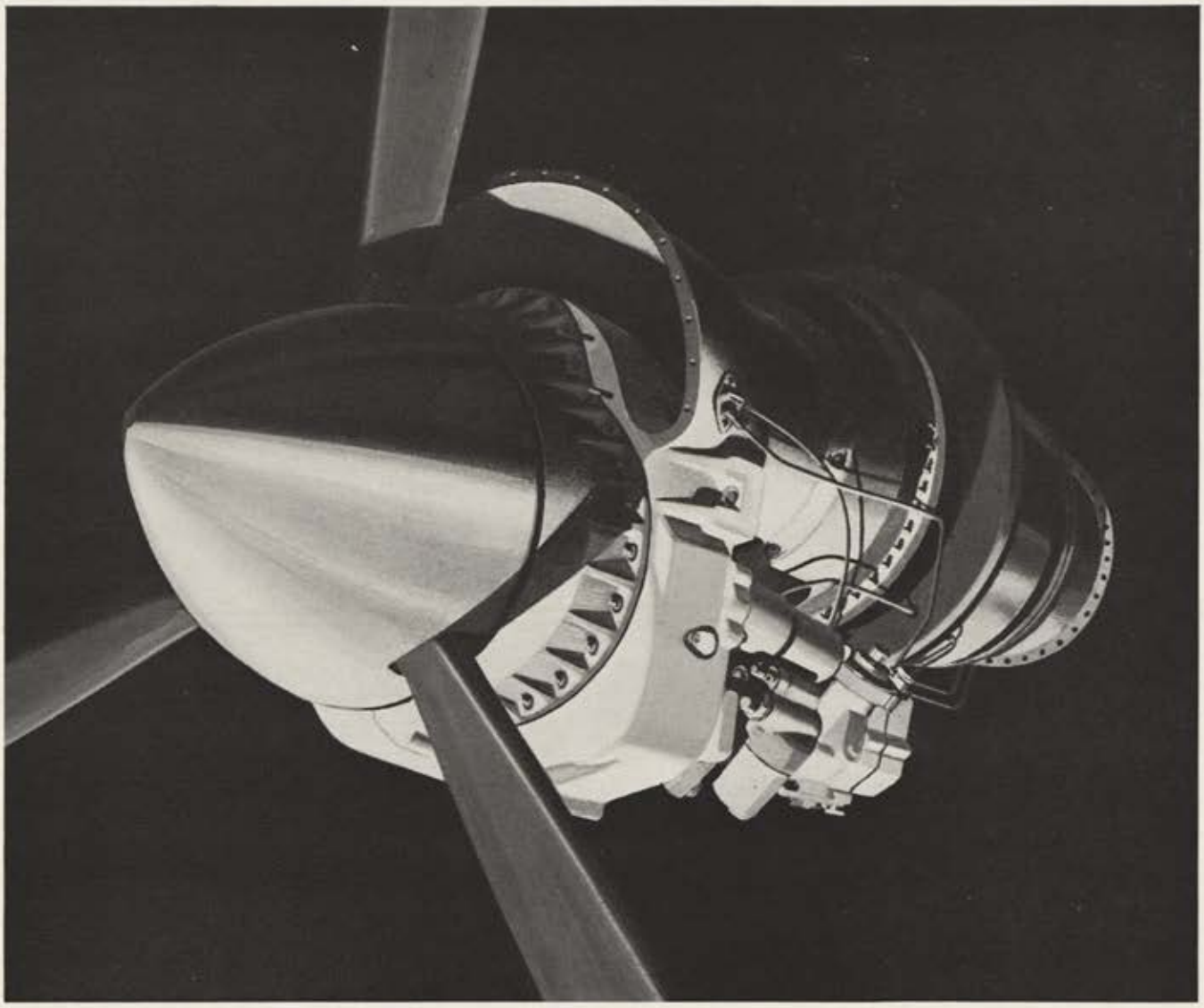

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