

MAY 1966

Air Force/Space Digest



International

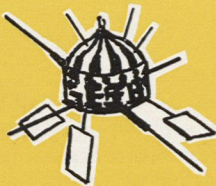
PUBLISHED FOR THE LEADERS OF THE FREE WORLD BY THE UNITED STATES AIR FORCE ASSOCIATION

INTERNATIONAL COOPERATION

SPECIAL REPORTS COVERING THE WAYS IN WHICH THE
UNITED STATES WORKS WITH NATIONS OF THE FREE WORLD. . .



DEFENSE



SPACE

CIVIL AVIATION



RESEARCH & DEVELOPMENT



AIRCRAFT PRODUCTION

PLUS . . . Picto-Guide of the German Aviation Show at Hanover



Overwater hunter of underwater mines

Minesweeping has taken to the air. Sikorsky's twin-turbine RH-3A brings helicopter speed, agility and hover capabilities to the mine countermeasures mission.

The RH-3A is a modified SH-3A, the U. S. Navy's proved anti-submarine helicopter. It can cruise to a station up to 60 miles from base, accomplish a 3-hour sweeping mission (including retrieval of gear) and return to base. The tow hook can be lowered 50 feet during transfer, permitting the air-

craft to fly safely above rough seas. There are bubble windows to enable the crew to observe sweeping operations, and rear view mirrors to aid both the pilot and co-pilot.

Like other helicopters in the Sikorsky twin-turbine S-61 family, the RH-3A can make water landings in an emergency. Nine of these aircraft are scheduled for delivery to the U. S. Navy, four of them for service aboard ships, including minesweepers.

Once again the helicopter demon-

strates its value in military uses. For more information, contact the United Aircraft International representative named below.

**United Aircraft
International**



**U
A**
SUBSIDIARY OF UNITED AIRCRAFT CORP.

EAST HARTFORD, CONN. 06108, U.S.A.

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REPRESENTATIVE FOR SIKORSKY AIRCRAFT PRODUCTS: UNITED AIRCRAFT INTERNATIONAL, HOHENZOLLERNRING 21-23, COLOGNE, GERMANY

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By Claude Witze, Senior Editor



More than 25 years ago the United States, in its first attempt at international military assistance, swapped 50 destroyers for the right to use military bases in British territory. Today, the U.S. Air Force alone is carrying on military sales negotiations with more than 70 countries. The Defense Department has organized this vast network of international dealings, mainly handled by USAF, into a military assistance sales program.

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Preventing a chaotic patchwork of duplicating air routes and incompatible navigation systems has been the job of the International Civil Aviation Organization, first established in 1944. In the forefront for many years in planning, proposing, and accomplishing the development of safe systems and facilities for air routes of the world have been the U.S. Government and its Federal Aviation Agency.

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AF/SD INTERNATIONAL Picto-Guide to U.S. Exhibitors

A panoramic map of the 6th German Aviation Show at the Hanover Airport shows the location of exhibit halls and layout of the show, listing U.S. exhibitors and giving their locations. The show, from April 29 through May 8, includes aircraft and product displays, daily flight demonstrations, and technical conferences.

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Modern nations cannot advance and meet the changing military requirements of a fast-moving era without a consistent program of technological research and development. Two powerful reasons for sharing the risks—and successes—of military research and development are cost—the price of developing complex weapon systems has risen dramatically—and technology—R&D jobs are best accomplished with the aid of the considerable expertise of other advanced nations.

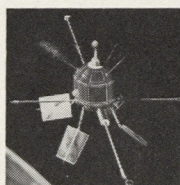
A STRONG DEFENSE AND A HEALTHY ECONOMY..... 26

By C. James Reeves

Free World nations were given an enormous boost in shifting from piston- to turbine-powered aircraft and into the broad field of avionics soon after World War II. Largely responsible was the infusion of U.S. aviation technology, first through grants of military equipment, later through licensing and coproduction agreements. The latter are continuing to expand, fostering cooperation in defense programs and economic growth.

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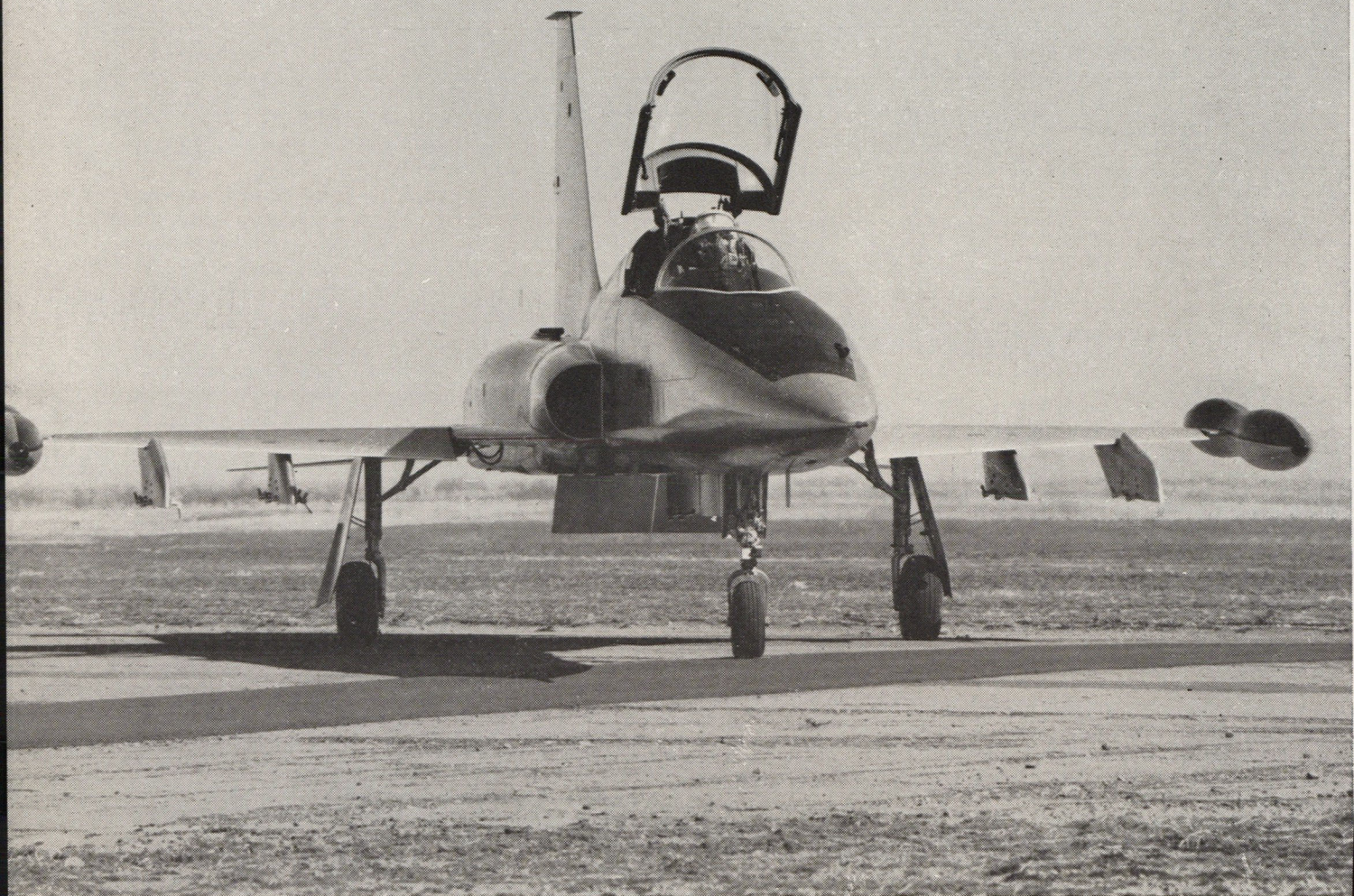


Most international space programs stem from the International Geophysical Year of the 1950s. Out of this international project grew the international Committee for Space Research (COSPAR), whose membership now numbers 30 national bodies and 10 international scientific unions. Against this background, the U.S. has undertaken cooperative efforts in space with other countries, stimulating constructive efforts abroad, supplementing its own technology, and forging a common bond in space.

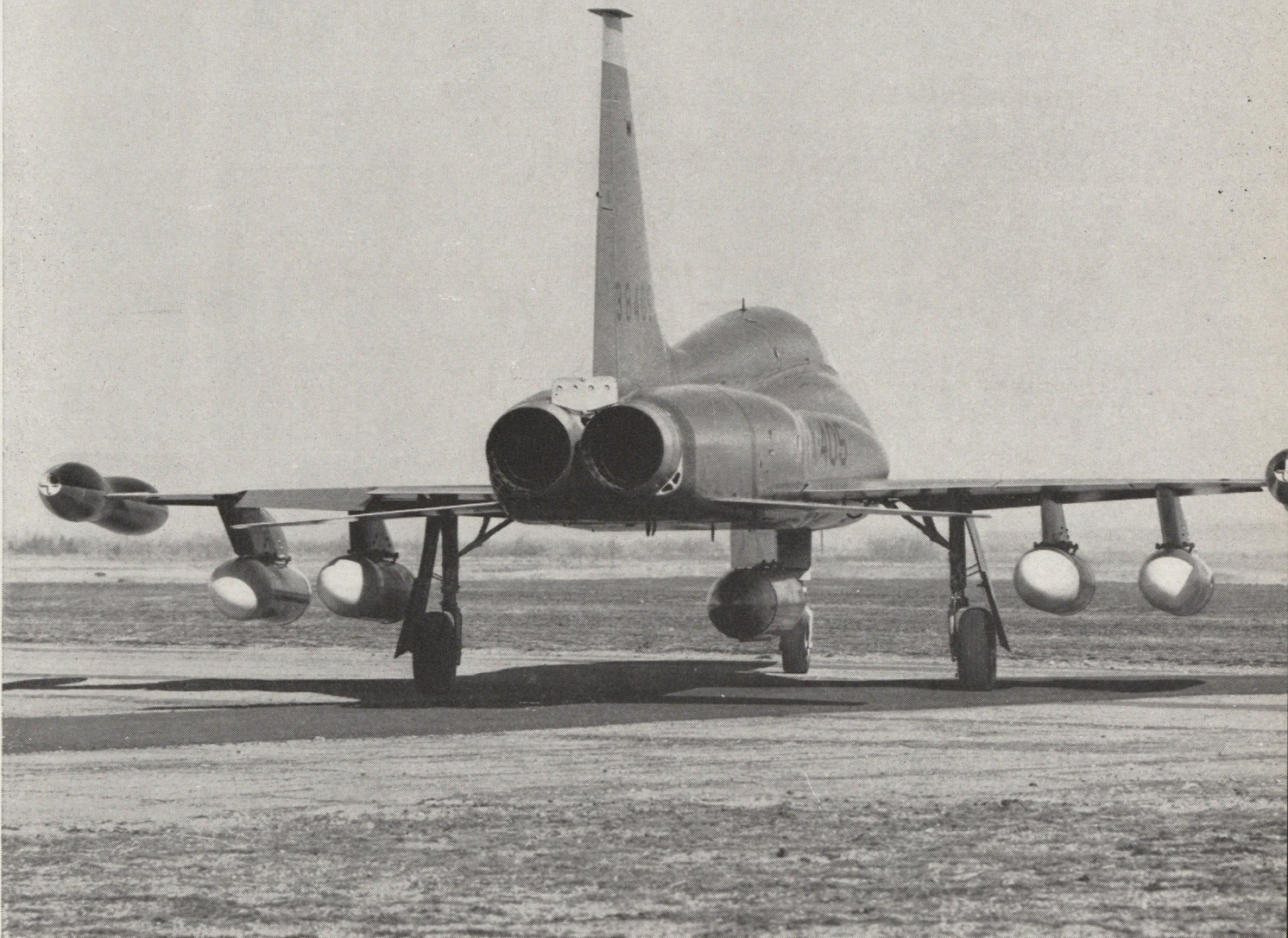
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By Judith Dawson

Two nations who have ordered the U.S.-built F-111 fighter—Britain and Australia—are experiencing the effects of inflation, U.S.-style; an aerospace industry capable of competing with the U.S. is the goal of Britain as she collaborates with other countries on aircraft design and development; the new HueyCobra helicopter will begin U.S. Army service; the U.S. Navy reorganizes; and nuclear-powered clipper ships to the moon may be in operation by 2000 A.D.



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: In Viet Nam 11 F-5's flew as many as 33 sorties per day. A U.S. Air Force crew set a record with a complete engine change in 55 minutes. In a two-week maximum effort, F-5's accounted for over 17% of all USAF missions flown in South Viet Nam.

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

NORTHROP CORPORATION, BEVERLY HILLS, CALIFORNIA, USA

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.

From a swap of 50 destroyers for base rights in British territory more than 25 years ago, the reliance of America's allies on its weaponry continues to grow. The U.S. Air Force alone supervises contracts worth \$1,200,000,000 and carries on negotiations with more than 70 nations. All of this is organized as part of the military assistance sales program, with valuable contributions being made to international aerospace security.

How USAF Participates In International Cooperation

BY CLAUDE WITZE, Senior Editor

It is more than a quarter century since the United States turned over 50 aging destroyers to Great Britain. No money changed hands. It was a barter, in which this country showed foresight by obtaining the right to use military bases on British territory. The ships were essential to England.

Volumes of history have been written in the years between the destroyer deal and today's situation, which finds Great Britain and more than three-score other allied nations relying heavily on American-built military equipment.

Back of it all is the requirement for continued vigilance against Communist aggression. The threat in Europe has not disappeared, although many believe it has eased. Even so, there certainly is an effort to subvert the emerging nations. About 50 new countries have been added to the roster since World War II. Communism covets them all.

The burden on Free World airpower is not destined to lessen under these circumstances. And the backbone of that airpower, the only organization operating on a truly global basis, is the U.S. Air Force. Its impact has been felt from Moscow to Hanoi, from Lebanon and Berlin to Cuba.

It is fully fitting, also, under these circumstances, that the United States should feel a responsibility, in keeping with its world stature, to keep its Air Force fully compatible with those of

its allies. In the event of a crisis, these forces must be complementary and help serve each other in critical missions.

Since 1960, military assistance sales under the supervision of USAF have increased from \$137,000,000 to a projected \$1,500,000,000 for the fiscal year ending June 30, 1966. At the beginning of this year, USAF was supervising contracts with foreign countries having a total value of \$1,200,000,000.

These sales of American-made aerospace equipment, supplies, training, and support are made as part of the Defense Department's over-all program that has been in existence since 1949, when it was started as a result of the Mutual Defense Assistance Act, passed in that year. In 1962, prompted largely by an unfavorable balance of trade, the effort was expanded by direction of President Kennedy and his Secretaries of Defense and State.

Today the Air Force is carrying on military sales negotiations with more than 70 countries. The swing to a business of this magnitude can be dated from 1962, rising steadily until this year when military export sales will far outstrip grant aid.

Under the terms of the 1949 law, mentioned above, the authorized military aid to our allies was called "grant aid." It was designed, at that time, for nations that did not have the ability to pay for their own defense needs, when the United States de-

cided that their security was vital to its own. Grant aid, the 1949 law said, could be used for machinery and materials to permit European nations to increase their own production of military items. Or the United States could simply give them equipment. In addition, provision was made to supply expert help in the production and use of this equipment.

Then, in 1961, there was passed the Foreign Assistance Act. It continued to provide for economic assistance, but the rules were made more flexible. Aid could be given by loan, by grant, or by outright sale. Also by lease, exchange, or any other means that appeared practical. It is under this law that more and more customers have appeared to seek outright purchase of American military goods.

Fundamentally, the Air Force is in charge of most aerospace sales under the Defense Department's top executive in this area, Henry J. Kuss, Jr., Deputy Assistant Secretary for International Logistics Negotiations. USAF officers say their sales job has grown "like a population explosion" since Mr. Kuss's office was created. The Defense Department offices are responsible for over-all "umbrella agreements," which are made after a careful study of a nation's requirements, how U.S. industry can fill them, the availability of credit, and other questions of a political or diplomatic nature.

From this point on, the bulk of aerospace sales is handled in Air Force channels. The top man in the civilian secretariat is Robert H. Charles, Assistant Secretary of the Air Force for Installations and Logistics. On the military side, the business falls under the Air Force Deputy Chief of Staff for Systems and Logistics, who is Lieutenant General Thomas P. Gerrity. General Gerrity has a Directorate of Military Assistance, which is the focal point for the arrangement of contracts and their fulfillment.

In this office there is a feeling that USAF is more than an agent or go-between. The Air Force holds that the relationship, at the practical level, is Air Force-to-Air Force and that the foreign customer must get the same protection and price consideration in his contracts that USAF demands in its own. Sales may be for entire major weapon-system packages or single small spares requirements, or a training film worth less than \$40.

It also is true that USAF has much to gain from a standpoint of its own combat and logistics missions. The program increases the standardization of equipment among allied air forces. It helps promote the acceptance of joint strategic and tactical doctrine, built around common hardware. It creates ground environments that are compatible with U. S. Air Force equipment and makes them capable of supporting our airplanes when they are sent abroad. It broadens the base for utilizing logistics and depot facilities. It reduces costs for everyone involved, because they are shared, from research and development to production.

On top of this, there is general concern about USAF's ability to continue to advise and guide other air forces. As the chart appearing on page 9 shows, the grant aid program has declined steadily as the military sales effort increased. For the next 10 years, USAF expects, the impact of grant aid will continue to go down, probably about 50 percent. The Air Force is apprehensive that unless the difference can be made up by a combined military assistance and commercial sales program, many gains will be lost. Here, the concern is about further standardization, modernization, and the ability to bolster the defense posture of our allies.

Paramount importance is placed on continued logistic support, such as the provision of spare parts. Soon there will be a new policy on this. It says that no grants or direct sales of defense equipment will be made to any foreign country unless there is provision for this support for the life of the system.

How Free World Countries Cooperate

There are many illustrations showing how foreign nations can and do buy American-made equipment, sometimes to mix it with vehicles or components from third and fourth countries. A substantial part of these contracts are made direct with the manufacturer.

For example:

The Royal Australian Air Force has awarded a division of International Telephone & Telegraph Corporation a contract for Tacan (tactical air navigation) airborne equipment.

ITT Federal Laboratories has announced that the RAAF has ordered AN/ARN-52 (v) equipment for its Italian Macchi trainer aircraft.

Tacan furnishes a pilot with his distance and bearing from a known ground beacon.

At the outset, the Air Force of a foreign country, working with the American Military Assistance Advisory Group (MAAG) must draft a force objective. This will show what weapon systems or modernization requirements must be provided for that air force in the projected time period. It does not matter, at this point, who will pay for the hardware. It can be an outright sale, or the funds can come from an aid grant. The process, of course, was originated many years ago when most of the equipment was not transferred by sale, but by grant. It is being continued under the sales program. Thus, USAF does not consider it is a selling agent, but is concerned with the normal Air Force-to-Air Force planning and programming.

Legislative authority for the military assistance sales program is in the For-

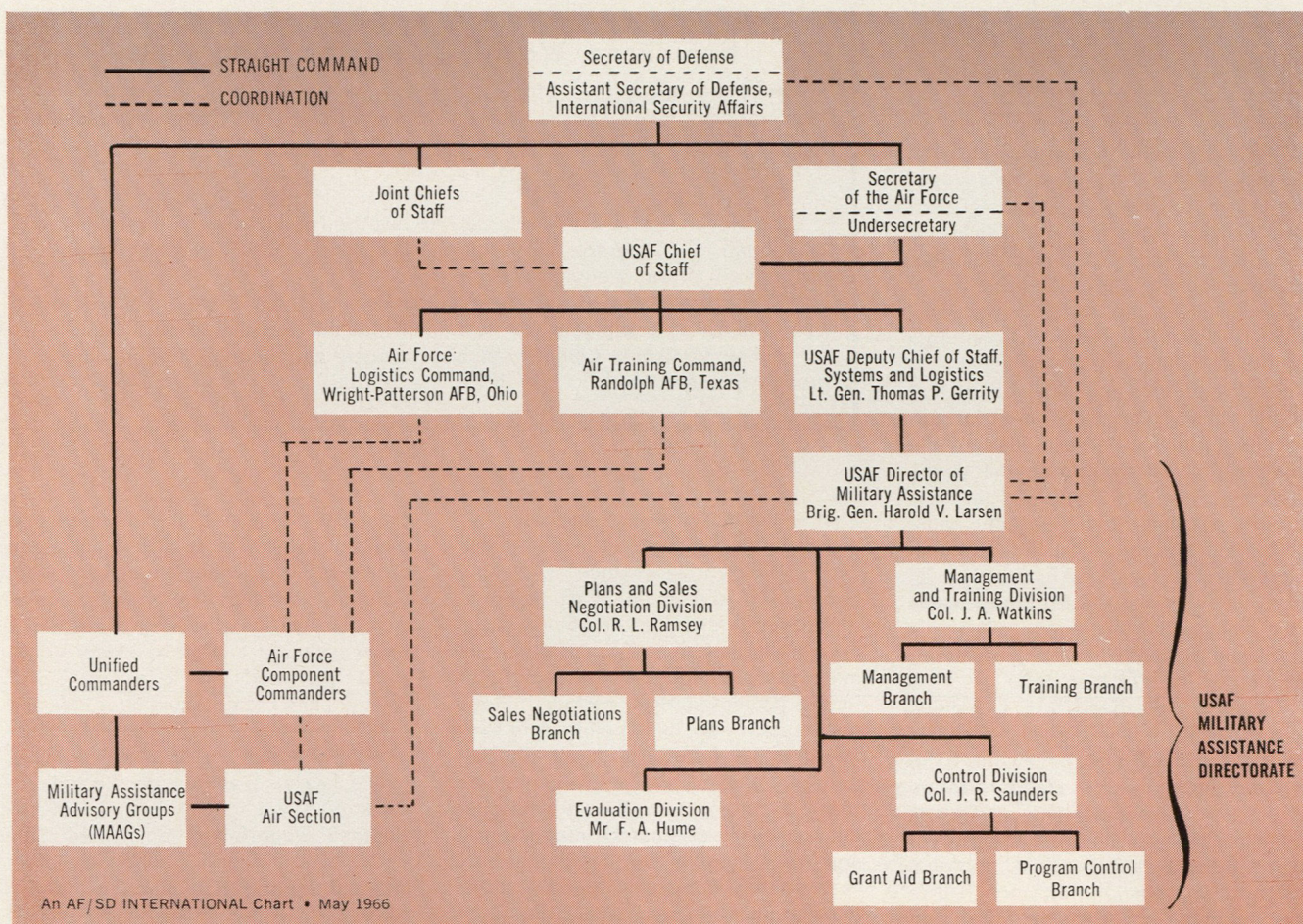
eign Assistance Act. There are several ways in which a foreign nation can obtain U.S. hardware. It may be a loan. Canada has borrowed radar equipment for use on the Pine Tree radar warning line. It can be by lease. Venezuela has used this to obtain USAF tooling and test equipment for an IRAN (Inspection and Repair As Necessary) program for its F-86F fighters.

The law also authorizes the sale of materiel direct from the stocks of the Defense Department, or Armed Services, to any friendly nation or international organization (such as NATO or ANZUS) if they pay for it in dollars. An example of this is the sale of 28 F-86Fs to Argentina. It was made out of USAF stocks.

This part of the law also provides for the purchase by USAF of equipment (Continued on following page)



The Air Force-to-Air Force relationship developing from sales of military hardware to U. S. allies not only increases standardization of equipment among allied air forces, but promotes acceptance of joint strategic and tactical doctrine. Here a U. S. Air Force crew is shown with Malaysian visitors after an orientation flight.



USAF Military Assistance Program channels of communication are depicted in this chart, headed by U.S. Secretary of Defense and extending through USAF Deputy Chief of Staff for Systems & Logistics and AF Logistics and Training Commands.

ment destined from the beginning for sale to a friendly power. This was true in the case of a Venezuelan purchase of 18 C-123B assault transports. The basic contract was between USAF and the contractor, Fairchild Hiller Corporation.

It is important at this point to make it clear that military assistance sales are not a substitute or competitor to normal commercial transactions. It is U.S. policy to encourage purchasers to buy their equipment on the open commercial market whenever possible.

When manufacturers do not have an item in stock, USAF furnishes a list of qualified bidders, noting for the customer country the last 2 or 3 successful contractors.

"We often get messages from MAAGs and missions expressing alarm over the fact that a foreign government is getting better terms directly from a U.S. manufacturer than we can offer through military assistance sales," comments a USAF procurement officer. "So much the better. The name of this game is increased sales of U.S. equipment—not neces-

sarily increased military assistance sales."

The Foreign Assistance Act has resulted in authorization of military assistance sales to about 80 foreign governments and international organizations. Under the law, the President has delegated authority to the Department of State to fix the terms and conditions under which sales can

be made. The State Department, in turn, has established 2 categories of eligibility:

- Some countries and international organizations may submit their purchase programs or requests directly to the military departments for action.

- Other countries and international organizations must submit their re-

(Continued on page 9)



Foreign visitors view production processes at American plant. Military assistance sales may take any of several forms, except that they are not a substitute to normal commercial transactions. U.S. policy stipulates that purchasers should buy equipment on the open market whenever possible.



The X-15

This is the amazing X-15 research vehicle—part missile, part airplane, part spacecraft.

In the atmosphere it flies like an airplane. At the edge of space, it is controlled by small reaction jets, like the Gemini spacecraft.

The X-15 has rocketed to a world record speed for winged aircraft: 4,104 mph. And attained a record altitude of more than 67 miles—above 99.999% of the earth's atmosphere. Three U.S. Air

Force pilots have earned their astronaut wings in it.

The most successful experimental aircraft in aviation history, three X-15's have completed more than 156 test flights in six years of service. The X-15 was built for NASA and the U.S. Air Force by North American Aviation. Together with the North American-built Mach 3 XB-70, it is a vital contributor to the Free World's future leadership in high-speed, high-altitude military and commercial flight.

North American Aviation 

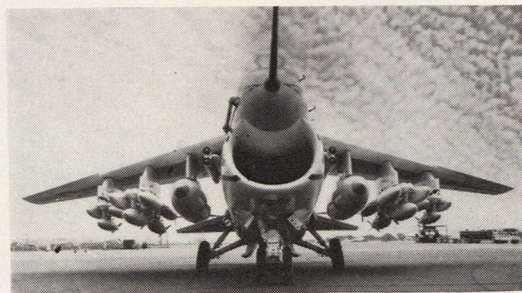
European Headquarters: North American Aviation S.A., 29 Rue de la Coulouvrenière, Geneva, Switzerland

WHEN IT COMES TO LIGHT ATTACK AIRCRAFT..



Specially designed divebrake adds substantially to the A-7A's attack maneuverability and mission accuracy.

THE A-7A EXCELS



With payload shown here, a Corsair II can deliver a greater bomb load than a B-17 of World War II fame.

Designed to achieve maximum cost effectiveness, the U.S. Navy's A-7A Corsair II is the kind of airplane battle commanders dream about.

★ It can carry larger bomb loads over longer distances than any existing jet light attack aircraft.

★★ It can carry at least 15,000 pounds of bombs and other armament, including rockets, cannon, missiles — virtually every store in the inventory. Heavier payloads can be carried for shorter-range mission requirements.

★★★ It can penetrate enemy defenses by hugging the ground at near-sonic speeds.

★★★★ Its "turn-around" time is minimum — due to unique built-in *maintainability* and *serviceability* features, including built-in bomb hoists.

★★★★★ Through armor and specific design features, it affords a high degree of pilot protection and aircraft invulnerability.

The A-7A Corsair II is currently in quantity production at LTV Aerospace Corporation's Dallas plant.

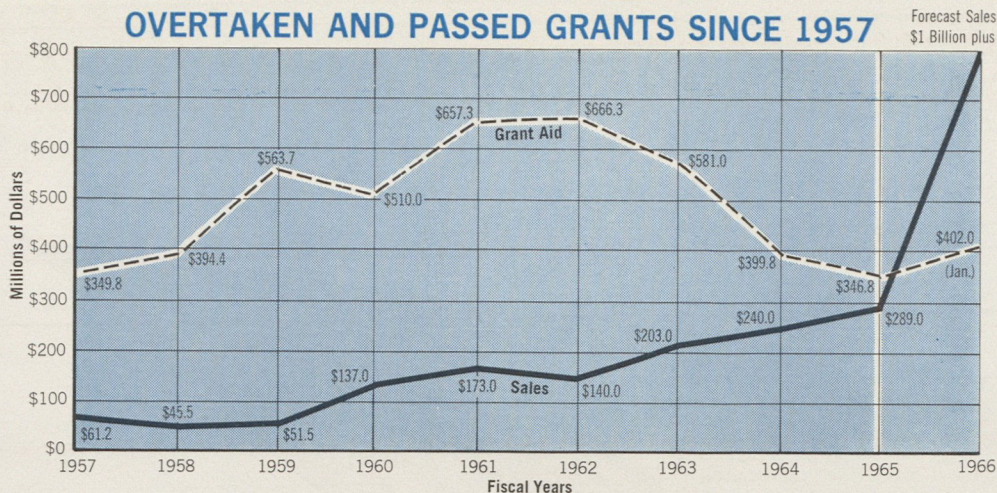
Paris Office: Ling-Temco-Vought, Inc., 15 rue de Remusat, Paris XVIe, France.

LTV
AEROSPACE CORPORATION
LTV VOUGHT AERONAUTICS DIVISION

DALLAS, TEXAS, U.S.A.

A SUBSIDIARY OF LING-TEMCO-VOUGHT, INC.

HOW U. S. MILITARY SALES HAVE OVERTAKEN AND PASSED GRANTS SINCE 1957



Grant aids ran well ahead of military assistance sales through most of the 1957-65 period, reaching a high point of \$666,300,000 in 1962. But by the end of 1965, dollar value of sales was approaching that of grant aid, and sales will far outstrip grants by the end of this year, with a forecast total of more than \$1,000,000,000 by the end of 1967.

quirements through diplomatic channels to the Departments of State and Defense for approval before action by the military departments.

Currently, of 69 individual nations, maintenance support items can be bought without clearance by all but 4. The 4 exceptions are Cambodia, Indonesia, South Africa, and Kuwait. If the purchase request is for major systems or capital end items, only 23 of the 69 nations are in the first category. The other 46 must go through diplomatic channels.

When a foreign country buys a major weapon system, such as a new fighter airplane or transport, it then starts to deal with various USAF commands, such as the Air Force Logistics Command (AFLC), the Systems Command (AFSC), or the Air Training Command (ATC). In the case of AFLC, responsibility for each system is assigned to an Air Materiel Area (AMA), which is a facility specializing in the procurement and logistical support for certain weapon systems. When price and availability are known and the purchaser accepts the offer, the money and shipping instructions are sent to USAF Headquarters for processing by General Gerrity's organization. A directive is issued by headquarters, ordering the proper command to supply the materiel. Money is handled by the Air Force Finance and Accounting Center in Denver, Colorado. Since the start of 1966, the burden on headquarters has grown to the point where the negotiation in several hundred cases has been shifted to AFLC for monitoring.

Sales may be made for cash or credit. Some customers are required to pay cash in advance. The State Department determines when credit may be extended. They do not have to pay in advance if credit is extended, but they do have to pay on demand by USAF to cover deliveries or progress payments.

Military attachés or purchasing missions are established in Washington to carry out the necessary business for foreign countries. They are essential to monitor deliveries and shipping, to get export licenses, make payments, and reconcile deliveries with billings. In addition, the attachés and missions provide an excellent contact between the allied nations and U.S. industry.

At the present time, for example, there are Australian representatives here to monitor purchases of the F-111 and C-130 aircraft. They do business not only in Washington but also at the General Dynamics Corporation and Lockheed Aircraft Corporation plants; at Robins AFB, Georgia, AFLC; and other commands. There is a German group in Washington concerned with the Lockheed F-104 project. They have set up their own data-processing system at Andrews AFB, Maryland, home of AFSC.

USAF is responsible for most of the foreign aerospace business. The Army and Navy take cognizance for a huge quantity of other types of materiel, including the bulk of sales of helicopters and light airplanes, along with tanks, tactical missiles, ammunition, and similar military equipment.

To the Air Force there has been an important cycle in the type of major systems provided other nations. Under the grant aid program, for years USAF was, in effect, running a secondhand store. It passed along to our allies many aircraft nearing obsolescence in our own hangars. The F-84, F-86, and F-100 were typical. Now, under the advanced military assistance sales program, there is more modern equipment, such as the F-104, the F-4, and F-111. Later, it is anticipated, more used airplanes will be placed on the block. It is expected that there will be a market for older aircraft such as the F-105, the C-130, and more F-100s, when they are available.

One current trend is that more for-

eign nations today are buying an equity in USAF's Depot Supply Support Plan (DSSP) to make sure they retain adequate logistics for new systems. This means they will be assured of spare parts from the same depots serving USAF and fast transportation of those parts to where they are needed.

Recently, Germany has invested in this service for aircraft-control-and-warning equipment; Spain for AC&W and the F-104; Norway for the F-104 and F-5; and Iran for the C-130, T-33, H-43, F-5, and F-86. New Zealand has the service to support the C-130. USAF encourages this approach and currently is negotiating further agreements with Italy, the United Kingdom, Japan, Denmark, and Australia.

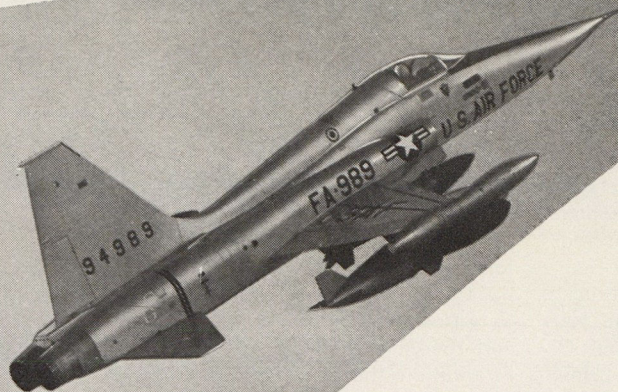
The USAF training program, under which foreign pilots and mechanics are prepared for their work at bases in the United States, has enjoyed wide publicity. Formal training costs are based on tuition that covers both direct and indirect costs. In some cases, it can be arranged for mobile training teams to visit a foreign country and give on-the-spot instruction to aircrews and ground personnel.

There are almost daily evidences that the allied customers are among the most satisfied of U.S. industry, which takes an active interest in the success of its products in the field. The technical representatives, who follow U.S. weapon systems and their components all over the world, offer a service that cannot be widely duplicated.

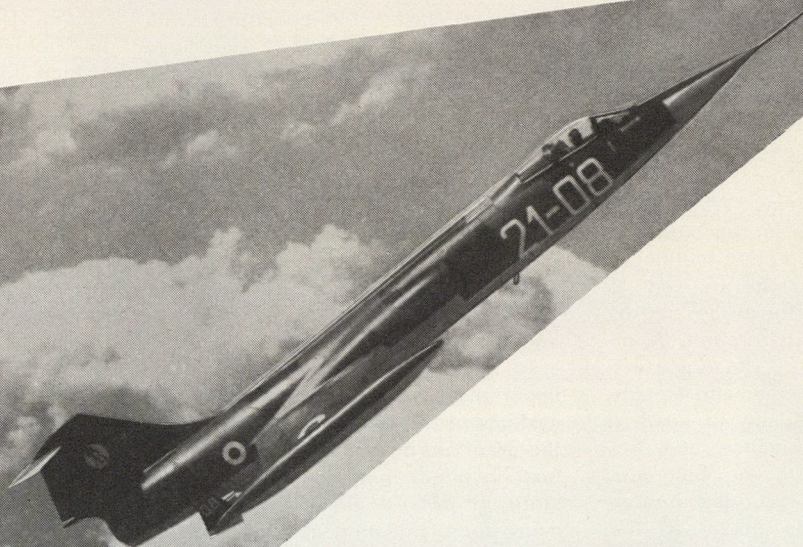
The interest of the Air Force and the Defense Department and the Executive Branch of the Government is just as keen. Congress also watches the program closely. All of these agencies and people are concerned first with the security of the Free World. So was Franklin Roosevelt when he bartered 50 destroyers to Great Britain.

☆☆☆

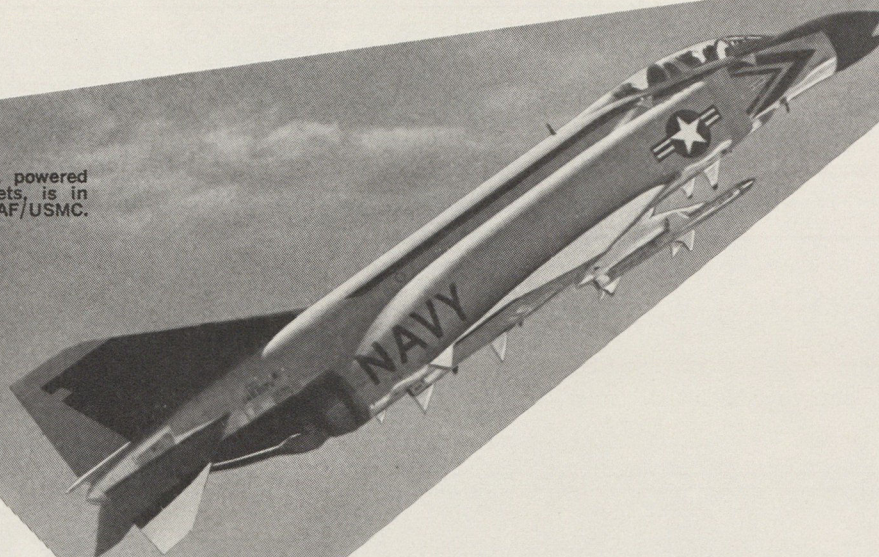
Northrop F-5, powered by twin G-E J85 turbojets, is programed for air arms of 9 allied nations.



Lockheed F-104 Starfighter, powered by single G-E J79 turbojet, serves Italian Air Force, USAF and air arms of 12 other nations.



McDonnell F-4 Phantom, powered
by twin G-E J79 turbojets, is in
service with USN/USAF/USMC.



***Nearly every fighter aircraft
can be powered by
General Electric jet engines***

... engines ranging from operationally proven designs to advanced concepts for future needs.

FLIGHT PROPULSION DIVISION

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205-15

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Interplanetary space is our beat

The exploration of deep space began with our Pioneer I in 1958. Later we put Pioneer V into orbit for NASA and helped send Mariner II to Venus and Mariner IV to Mars. Our six Nuclear Detection Satellites are still monitoring outer space for the Air Force. And our two OGOs continue to gather scientific data for NASA.

A few weeks ago we launched Pioneer VI into solar orbit. Now we're studying Voyager and manned Mars missions for NASA. We have built more kinds of spacecraft than any other company. And we have had a hand in 9 out of 10 U.S. space launches.

TRW SYSTEMS

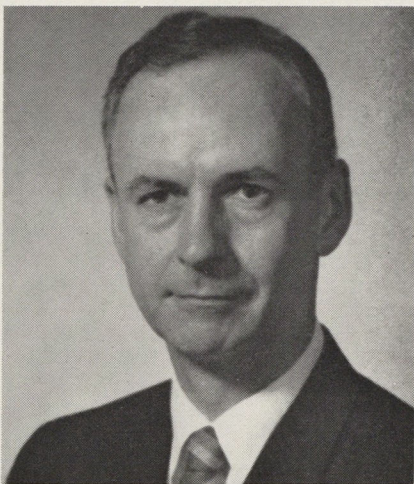
ONE SPACE PARK • REDONDO BEACH, CALIFORNIA 90278

The United States, and specifically its Federal Aviation Agency, has been in the forefront for many years in planning, proposing, and accomplishing the development of safe, practical systems and facilities for air routes of the world. Some 1,200 FAA employees are engaged in international aviation activities in the U.S. and throughout the world . . .

How the U.S. Serves International Aviation

BY CHARLES O. CARY

Assistant Administrator for International Aviation Affairs, Federal Aviation Agency



The author, Charles O. Cary, an alumnus of the Massachusetts Institute of Technology, began his aviation career with American Airlines in 1938. In 1944 he entered government service and 5 years later was appointed Executive Secretary of the Air Coordinating Committee, a subcabinet group which helped lay the foundations of present U.S. domestic and international aviation policy. He left the government in 1954 to become an electronics industry executive, but returned in August 1965 to take his present post, succeeding Raymond B. Maloy, who is FAA's Assistant Administrator for Europe, Africa, and the Middle East.

The U.S. Government's major entry into international civil aviation began in 1938 when the Congress created the U.S. Federal Aviation Agency's (FAA) predecessor, the Civil Aeronautics Authority (later the Civil Aeronautics Administration), and assigned it specific international responsibilities. Except for Pan American Airways' pioneer Clipper flights, however, there was in those days a singular lack of international aviation activity. International civil aviation responsibilities, consequently, remained largely honorary and dormant until the closing days of World War II.

By then it had become clear that the profitable international operation of aircraft had become a practical reality. It was also clear that the only way to avoid a chaotic patchwork of duplicating air routes and incompatible navigation, communication, and traffic-control systems was through international agreements that would standardize technical operating procedures and facilities throughout the world.

To bring these international agreements into being, the United States, in November 1944, convened a 54-nation conference in Chicago, Illinois, to consider and recommend actions to avoid these problems. From this conference came the treaty known as the "Chicago Convention" and the establishment of the international organiza-

tion of governments, which is today the 110-member International Civil Aviation Organization (ICAO). Since that time, the U.S. Government's role in international aviation has increased steadily. U.S. technical responsibilities and activities—managed largely by the Federal Aviation Agency—are now as widespread and complex as international aviation itself.

One of the international goals of the FAA is aviation's contribution to world peace. This role was described by President Lyndon B. Johnson in a speech to visiting foreign aviation officials. He said, "Aviation is diminishing to minutes and hours the separation between nations. This advances travel, and, thereby, the cause of peace, for acquaintanceship is the first requisite of friendship."

Another major international objective is helping establish a common worldwide system of safe, efficient, and reliable aviation facilities. This is done by contributing to the technical improvement of the world's air routes and by helping to bring together the aviation objectives and heighten the capabilities of all friendly nations—both in the air and on the ground.

While no single government or single organization can claim credit for the spectacular progress of world aviation, the United States and the

(Continued on following page)

Federal Aviation Agency have been in the forefront for many years in planning, proposing, and accomplishing the development of safe, practical systems and facilities for the air routes of the world. The FAA has continuously served as the technical representative of the United States on the ICAO Air Navigation Commission and has probably recommended more new aviation techniques and procedures for adoption than any other member nation.

Through ICAO, United States-developed air navigation and air traffic control systems have been internationally standardized along all major international air routes. It is no exaggeration to say that international civil aviation operations, as we know them today, could not exist without this standardization.

The U.S. input into ICAO is coordinated by the Interagency Group on International Aviation (IGIA). The FAA both chairs and serves as a member of IGIA and provides the Secretariat. The other U.S. Government depart-

ment and agency members of the group are the Departments of State, Defense, and Commerce and the Civil Aeronautics Board.

In addition to ICAO, the FAA participates in the activities of a number of other international organizations. These include NATO, the Central Treaty Organization (CENTO), the Southeast Asia Treaty Organization (SEATO), etc. We also have a full-time observer with EUROCONTROL, and we staff the position of airport director for Tempelhof Airport in Berlin.

FAA also provides direct support to individual nations. For many years the Agency has sent civil aviation experts and special teams to provide technical aviation assistance to other governments under formal agreements. We perform this function as technical aviation experts for the U.S. Agency for International Development (AID).

At the present time, FAA overseas deployment connected with foreign aid includes 18 single-country Civil Aviation Assistance Groups (CAAGs).

These are scattered throughout South America, the Middle East, and the Pacific. A Panama-based Regional Aviation Assistance Group (RAAG) serves all of Latin America. Another group is headquartered in Guatemala and provides help to the countries of Central America. We also are operating programs in Greece, Spain, and the Republic of China (Taiwan) for the U.S. Department of Defense, using Military Assistance Program funds.

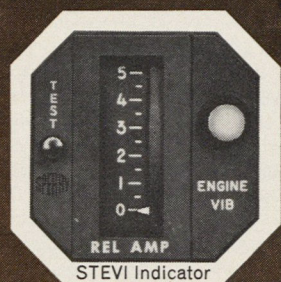
In any given year, the FAA will, in addition, give short-term help on special projects, conduct special field studies and surveys, provide consultative engineering services, and give procurement advice to as many as 75 foreign governments and to 10 or more international organizations.

Concurrently, FAA has for many years, principally in cooperation with AID, brought students from other Free World countries to the U.S. for classroom and on-the-job training in a wide variety of technical aviation specialties. Classroom training is conducted at the

(Continued on page 16)



Tremendous growth of international air traffic, as depicted in this busy airport scene, requires intergovernmental planning, adequate control facilities, and skilled operating personnel. U.S. works with other nations on all aspects of aviation development.



STEVI picks a loser...

In a test program recently concluded at Luke AFB, a Sperry Turbine Engine Vibration Indicator was installed on F-100F

No. 63866 to demonstrate the feasibility of such a system in fighter aircraft. □ About half way through the program pilots reported abnormally high readings although *no vibrations were felt in the cockpit* and there were *no unusual indications on any of the conventional engine instruments*.

On the recommendation of Sperry engineers the engine was removed and sent to the depot at Oklahoma City. □ There, an engine teardown revealed substantial foreign object damage and an out of

balance condition in both the N₁ and N₂ rotors which, to quote the report, "could have resulted in engine failure at any time." Engines seldom fail without giving minutes or even hours of warning. In most cases, however, the warnings are increases in vibration so slight that they go unnoticed by the pilot. □ At less than \$1000 per engine, wouldn't it make sense to let **STEVI** pick out the losers in your fighter operation well in advance of any catastrophic failure? Flight proven in over 5 million hours of operation, the **STEVI** system is now standard equipment on the Air Force C-141. For more information write

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SPERRY
DIVISION OF
SPERRY RAND
CORPORATION

FAA Academy at the Aeronautical Center in Oklahoma City, Oklahoma. To date, more than 3,500 foreign nationals have received training in the United States in virtually every technical aspect of aviation. Most of these men are now serving their own national aviation interests in many countries throughout the world. FAA is currently looking forward to expanding its international training.

FAA currently has about 1,200 full-time employees directly engaged in international aviation activities. These are backed up by a wide variety of experts who give their services to international programs as required. Of this total, 265 FAA personnel are presently assigned to overseas posts in 31 countries around the world. About half of these are directly engaged in aviation technical-assistance programs. The rest are primarily concerned with FAA's air safety operations. These safety programs include the inspection of U.S. flag airlines engaged in international operations, flight-checking the proficiency of U.S. airmen engaged in international air-carrier operations, flight-checking the reliability of air navigation aids, and inspecting the maintenance facilities certificated to perform work on U.S. registered aircraft operating overseas.

One fairly recent addition to FAA's international operation is the establishment of a Europe-Africa-Middle East Region which has headquarters in Brussels. This region is currently heavily involved in working with the British and the French on the Anglo-French supersonic civil transport, the Concorde. It is working with them to ensure that the Concorde will meet the airworthiness standards required by the FAA for all aircraft imported into the U.S. The certification of foreign aircraft intended for sale in the United States is a growing international function and responsibility of the FAA. Without this certification function and its consequent assurance of airworthiness standards, no foreign-built aircraft of any type, general aviation or air transport, can be sold commercially in the United States or be operated by a U.S. flag airline.

FAA also conducts many international functions jointly with the U.S. State Department. One of these is the development of bilateral airworthiness agreements with other nations. These agreements cover the export of foreign aircraft to the United States and the import of United States aircraft into overseas countries. Currently, 18 bilateral airworthiness agreements are in force.

In addition, FAA participates in international programs with the Department of Defense. Typical are the co-

operative agreements between our overseas groups and Military Assistance Advisory Groups for joint utilization of air navigation aids for the benefit of civil as well as military users.

The FAA is now faced with 2 new major problems—problems that have resulted from the steady development of civil aviation. The first of these is the tremendous increase in international flying by general-aviation aircraft. The second is the potential impact of supersonic transports, when introduced, on international air traffic control procedures and systems.

Until comparatively recently, a flight across the Atlantic by a general-aviation aircraft was a rarity, calling for comment by the world news media. Hundreds now make the trip each year unnoticed. Thousands of U.S.-based general-aviation aircraft fly into Canada, Mexico, and Central and South America each year, and the number is growing progressively larger. This non-commercial traffic has greatly expanded our international workload and created a number of new problems both for the FAA and for the operators of these aircraft. We are now examining a wide variety of new problems created by these general-aviation international flights to determine if any of our regulations, procedures, or responsibilities require modification or delegation.

The speed of the supersonic transports will put a passenger in New York almost 2 hours by the clock ahead of the time he takes off from London or Paris. This will require a complete reorganization of our entry procedures for passengers and cargo if we are to avoid ground-entry formalities that may take longer than the flight itself. We are working hard to solve problems of this kind. This was one of the areas recommended for Presidential action at the recent White House Conference on International Cooperation.

The variety, scope, and complexity of the FAA's international activities parallel those of its domestic activities, with added responsibility of representing the position of the United States in technical aviation matters to other governments and international organizations and, where possible, obtaining their coordinated action and cooperation for the adoption of international standards, practices, and procedures.

In summary, the FAA is responsible in the international field for aiding the safety and continued development of international aviation, and contributes, through aviation technology, to the attainment of U.S. security, political, and economic objectives.

To the Boeing Company, to Lockheed Aircraft, to Sud Aviation and British Aircraft Corp.; to the thousands of skilled technologists who already have or will contribute to the fulfillment of supersonic passenger flight—a Mach 3 salute.

From Weybridge to Seattle, from Burbank, California, to Toulouse St. Martin, the SST effort is well underway. Just a note about Hydro-Aire's potential contribution to *stopping* the SST. Since 1948 we have stopped more than 12,000 aircraft in millions of safe, sure landings—in all kinds of weather, all kinds of runway conditions. The name of our concept is HYTROL...a name that has become synonymous with braking control. In 1961, this concept resulted in HYTROL MARK II: the first operational, *fully modulated* brake control system. Since then, this advanced skid-control system has become standard equipment on Boeing's 707-320B, 707-320C, and 727; Douglas' DC-8F, DC-9; Convair's 990; American Airlines' BAC-111; and McDonnell's F4C. Hytrol Mark II has also been installed on the KC-135, the C-130B and the A5C.

Today, these leading airlines across the world are operating with the landing safety benefits of Hydro-Aire's Hytrol Mark II:

Pan American World Airways/Continental Air Lines/Air France/American Airlines/SABENA Belgian World Airlines/South African Airways/Trans World Airlines/Lufthansa—German Airlines/El Al Israel Airlines/Air-India/British Overseas Airways Corp./Northwest Airlines/P.N. Garuda Indonesian Airways/Transportes Aereos Portugueses/Irish International Airlines/Flying Tiger Line/Qantas Empire Airways/Olympic Airways/Braniff Airways/Pakistan International Airlines/Trans International Airlines/Trans Caribbean Airways/Capitol Airways/Air Canada/Canadian Pacific Air Lines/Varig Airlines/Airlift International/Philippine Air Lines/KLM Royal Dutch Airlines/Air New Zealand/United Air Lines/Eastern Air Lines/Trans-Australia Airlines/Ansett Trading Co. of Australia/National Airlines/British West Indian Airways/All-Nippon Airways/Japan Air Lines/Pacific Southwest Airlines/Hawaiian Airlines/Bonanza Air Lines/Delta Air Lines/Ozark Air Lines/Swiss Air Transport/Wardair Canada/Seaboard World Airlines/Alaska Airlines/Avianca/Iran National Airlines/Japan Domestic Airlines/Union de Transports Aeriens (U.T.A.)/Aerolineas Argentinas

As the SST goes from drawing board to reality, the leader in anti-skid braking technology is once again ready, able. And willing.

**To stop an airplane
there's nothing better
than HYTROL MARK II
by HYDRO-AIRE**

DIVISION OF

CRANE

3000 Winona Avenue, Burbank, California.

them, the best of luck from Hydro-Aire



Who's Who...and Where at the German Aviation Show

AF/SD INTERNATIONAL'S Picto-Guide to U.S. Exhibitors at Hanover Airport

Held in conjunction with West Germany's internationally celebrated Hanover Fair, the German Aviation Show at Hanover Airport is a prime marketing arena for the aerospace industries of the Free World nations. U.S. participation in such events has been increasing every year as the economic ties that connect the Free World grow stronger. Thus, it is appropriate that one of the methods by which international cooperation is furthered should be included in this issue of AF/SD INTERNATIONAL. Much credit for this increased U.S. participa-

tion must go to the U.S. Department of Commerce, which in innumerable ways has helped and encouraged exhibitors at the Show. This year's is the sixth Aviation Show and boasts an enlarged exhibit area of 100,000 square meters. Beginning on April 29 and lasting until May 8, the Show features, besides the exhibits, daily flight demonstrations and a number of technical conferences. The lists of U.S. participants below are based on the latest information available to us as of March 31. — THE EDITORS

OUTDOORS EXHIBITS

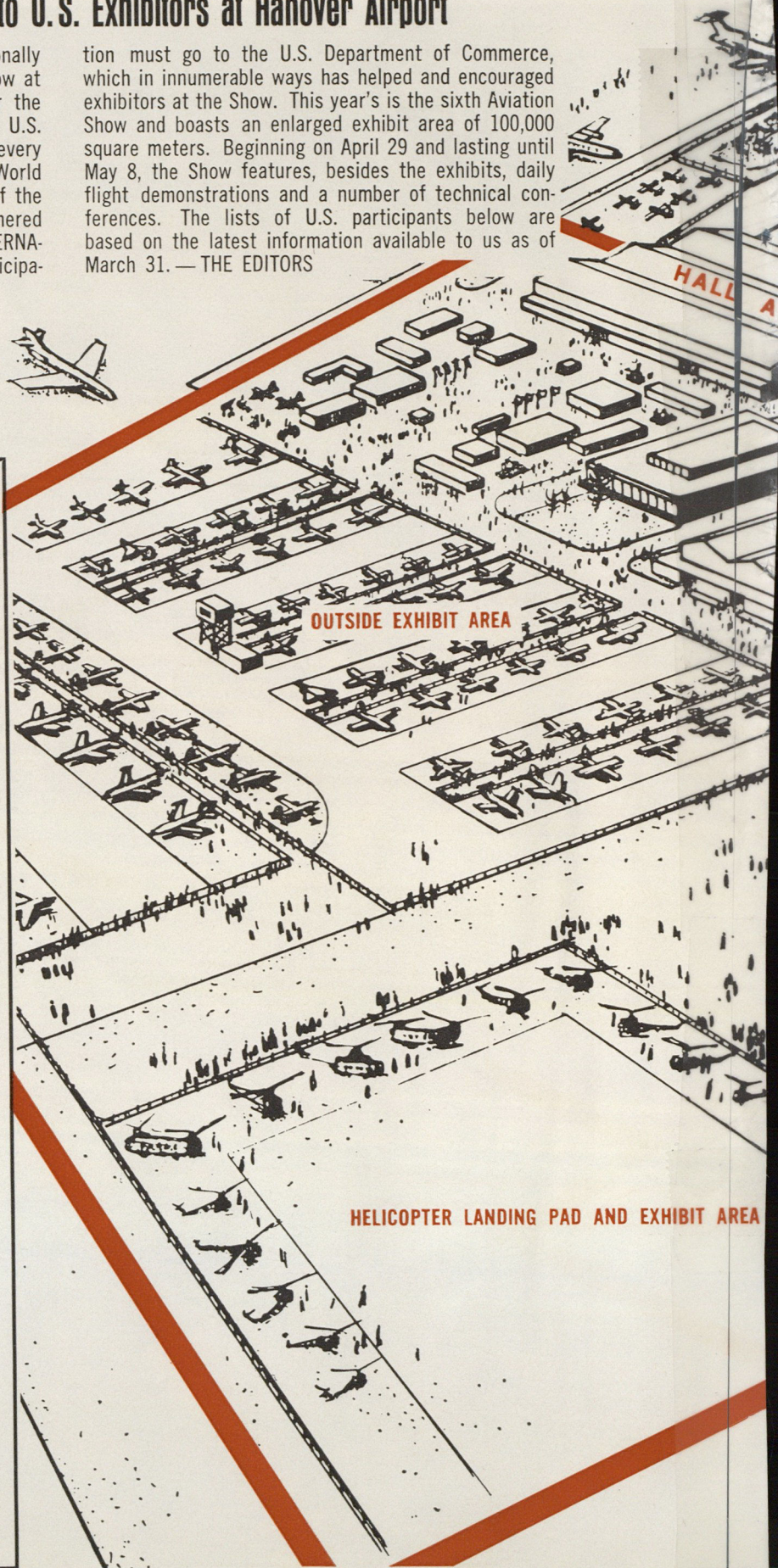
Aero Commander Div., Rockwell-Standard Corp. (Stand 9)
Beech Aircraft Corp. (Stands 25 and 31)
Cessna Aircraft Co. (Stands 29, 33, 33a, and 33b)
Hughes Tool Co. (Stands 35 and 36)
Lear Jet Corp. (Stands 11 and 29j)
Lockheed Aircraft Corp. (Stand 3)
North American Aviation, Inc. (Stand 23)
Northrop Corp. (Stands 29a and 34)

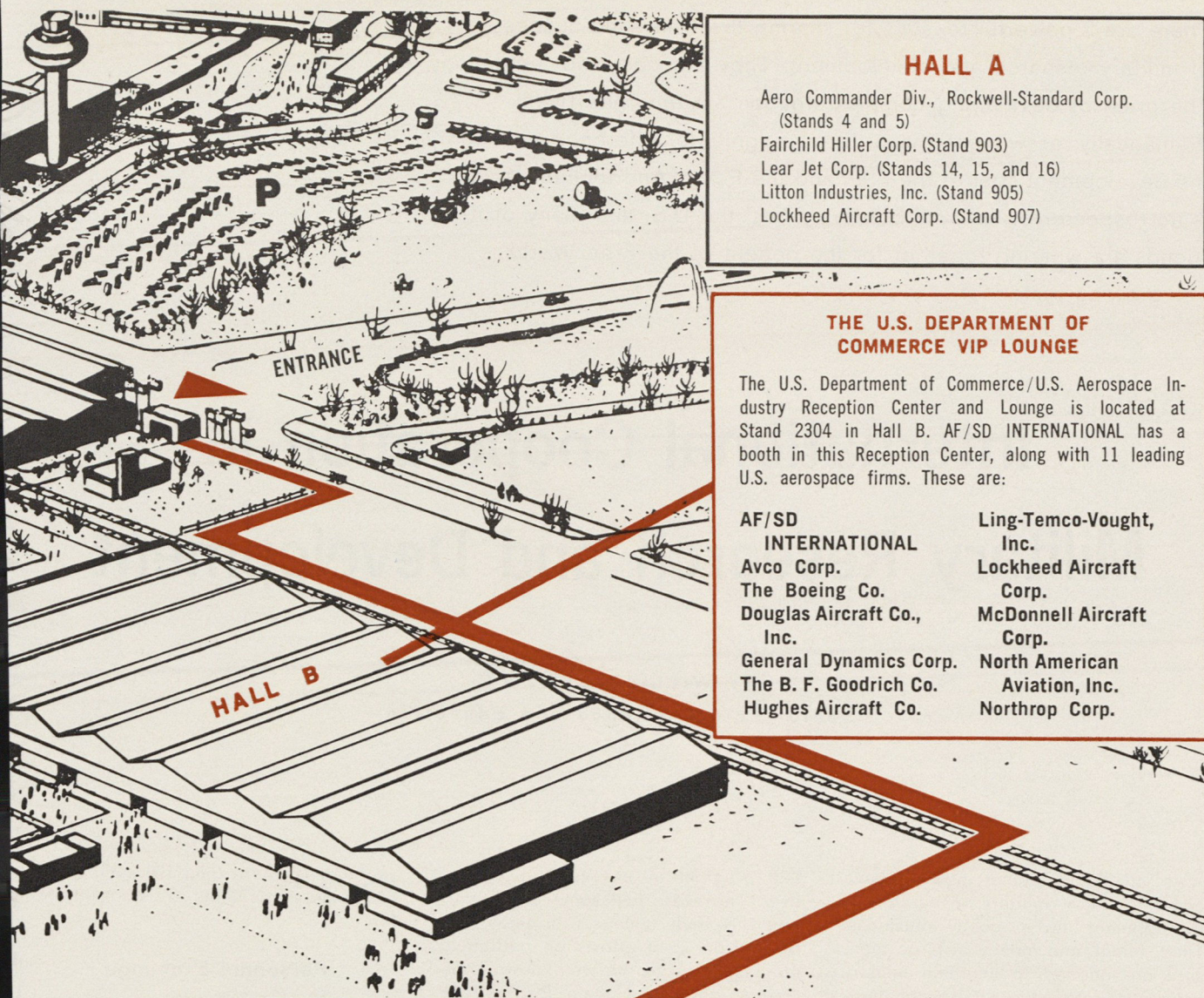
OTHER PARTICIPATING COMPANIES

AC Spark Plug Div., General Motors Corp.
American Avitron, Inc.
Brush Instruments Div., Clevite Corp.
Computing Devices of Canada Ltd.
Contimet, Continental Titanium Metals Corp.
Defense Electronics, Inc.
Edo Corp.
Electronics and Instruments Div., Humphrey, Inc.
Electronics Space & Systems Div.,
Packard Bell Electronics Corp.
General Dynamics Corp.
General Electric Co.
General Time Corp., Acronetics Div.
Gentex Corp.
Government Electronics Div., Admiral Corp.
GPL Div. of General Precision Aerospace Group
Haber, Inc.
Hayes International Corp.
Pioneer Parachute Co., Inc.
Steinthal & Co., Inc.
Systron-Donner Corp.
Texas Instruments Deutschland

HELICOPTER LANDING PAD AND EXHIBIT AREA

Hughes Tool Co. (Helicopter Stands A and B)
Hughes Tool Co. is providing a courtesy helicopter to transport U.S. Department of Commerce officials, air show officials, and others between the Aviation Show and the Hanover Fair itself, which is on the opposite side of the city.





HALL A

Aero Commander Div., Rockwell-Standard Corp.
(Stands 4 and 5)
Fairchild Hiller Corp. (Stand 903)
Lear Jet Corp. (Stands 14, 15, and 16)
Litton Industries, Inc. (Stand 905)
Lockheed Aircraft Corp. (Stand 907)

THE U.S. DEPARTMENT OF COMMERCE VIP LOUNGE

The U.S. Department of Commerce/U.S. Aerospace Industry Reception Center and Lounge is located at Stand 2304 in Hall B. AF/SD INTERNATIONAL has a booth in this Reception Center, along with 11 leading U.S. aerospace firms. These are:

AF/SD INTERNATIONAL

Avco Corp.
The Boeing Co.
Douglas Aircraft Co.,
Inc.
General Dynamics Corp.
The B. F. Goodrich Co.
Hughes Aircraft Co.

Ling-Temco-Vought, Inc.

Lockheed Aircraft
Corp.
McDonnell Aircraft
Corp.
North American
Aviation, Inc.
Northrop Corp.

HALL B

Bendix International (Stand 1506)
Collins Radio Co. GmbH (Stand 2605)
Conductron Corp. (Stand 1704)
Deutsche Goodyear GmbH (Stand 1302)
The Garrett Corp. (Stand 2609)
Honeywell GmbH (Stand 1202)
International Telephone & Telegraph Corp.
(Stands 1204 and 1304)
Bell Telephone Manufacturing Co.
FACE Standard
ITT Europe, Inc.
ITT Federal Laboratories
Laboratoire Central de Telecommunications
Le Materiel Telephonique
Standard Elektrik Lorenz
Standard Radio and Telefon
Standard Telephones and Cables
Kollsman System-Technik GmbH (Stand 2302)
Lear Siegler GmbH (Stand 2507)
Lockheed Aircraft Corp. (Stand 1800)
Lycoming Div., Avco Corp. (Stand 2711)
North American Aviation, Inc. (Stands 27, 28, 29,
30, 31, 2001, 2002, 2101, and 2102)
Atomics International Div.
Autonetics Div.
Columbus Div.

Los Angeles Div.
Rocketdyne Div.
Space and Information Div.
Northrop Corp. (Stand 2004)
Radio Corp. of America, Commercial Aviation
Equipment Dept. (Stand 1805)
Sperry Rand Corp. (Stand 1700)
Sperry Gyroscope Co.
Sperry Phoenix Co.
Univac Div.
United Aircraft Corp.
(Stands 25, 26, 1602, and 1702)
Hamilton Standard Div.
Norden Div.
Pratt & Whitney Aircraft Div.
Sikorsky Aircraft Div.
United Aircraft International
United Aircraft of Canada Ltd.
United Technology Center
Vector Div.
Westinghouse Electric International Co.
(Stands 32 and 2303)

U.S. Department of Commerce and U.S. Aerospace
Industry Reception Center and Lounge
(Stand 2304)

There are 2 powerful reasons for sharing the risks—and successes—of military research and development. They are cost and technology. The price of developing complex weapon systems has risen dramatically, as witness the order-of-magnitude difference between the development cost of the F-86 and the F-111. And technology is no respecter of national borders. Thus, the U.S. and many of its friends are working together for the benefit of the Free World in a growing system of . . .

International Cooperation in Military Research and Development

BY WILLIAM LEAVITT

Senior Editor/Science and Education

As all technological powers have come to know, military research and development is a costly business. Time, talent, and money in large measure are needed to maintain military initiatives, retain the vital technological base without which modern nations cannot advance, and meet the changing military requirements of a fast-moving era.

The U.S. Defense Department, which, since the end of World War II, has spent more money and energy on military research and development than any other power in history, understands these facts of life. It believes that much can be gained by working with other nations in the development of new military technology and hardware on a cost- and task-sharing basis.

This is the basic rationale for the Department's cooperative development program. Since 1963, cooperative development has built up to an investment of some \$250,000,000, half of this money from the U.S. and the other half from development-partner countries. The money has gone into such efforts as the current U.S.-German joint V/STOL design studies now nearing prototype decisions; the joint U.S.-British studies of beryllium applications for jet engines; the U.S.-British advanced V/STOL lift-engine project; and U.S. participation in the flight-

test program of the V/STOL Mirage III-V. These are just some of the current U.S. undertakings with allies, that range from joint efforts on battlefield radio systems to the well-known U.S.-German-developed Main Battle Tank for the 1970s.

Aside from the more complex feasibility studies and costly prototype developments that promise to lead to production systems, cooperative development also includes data-exchange agreements with about 15 countries and a useful scientist/engineer exchange program. The data-exchange program provides a 2-way flow of information between the U.S. and the cooperating country.

It works quite simply. In a relatively informal way, an agreement is made between the U.S. and the cooperative country under which both sides agree to keep each other informed of specific areas of technical progress in specific research areas or projects. A research-and-development officer in each country serves as the information exchanger. In some cases, it is agreed that researchers in the cooperating countries will concentrate on alternative approaches to a particular research problem. "Quid pro quo" is the rule. The agreements are reviewed annually to ensure that the 2-way exchange continues to be mutually ad-

vantageous. More than 100 such data-exchange agreements are currently in force.

Personnel Exchange

The scientist/engineer exchange program offers another cooperative path. This program enables mature scientists to spend 3 to 6 months in industry, university, and government laboratories in the U.S. and cooperating countries. In the same way, younger, talented engineers and technologists spend working tours in industrial facilities in the U.S. and cooperating countries.

Obviously the Defense Department has not committed itself to cooperative development and the complications such bilateral, and sometimes multilateral, programs entail, purely out of good will. Rather, the program represents a new milestone in the evolution of U.S. policy traced, in Senior Editor Claude Witze's article on page 4 of this issue, from direct military assistance in the interests of U.S. security to a process of working together in ways that will:

- Help provide the best military equipment available to the U.S. and its allies;
- Increase the effective use of the scientific and technological resources

of the U.S. and its allies by eliminating wasteful duplication of effort;

- Create closer military ties in the NATO structure; and
- Attain a maximum practicable degree of equipment standardization.

This last purpose is considered most important by the U.S. Joint Chiefs of Staff.

At the same time—and this is crucial to successful cooperative development—the funding of bilateral programs must be arranged so as not to affect in any appreciable way the gold flow between the U.S. and other nations. Thus, cooperative development programs are arranged on as close to an even funding basis as possible, although rigidity is avoided, so long as division of expenditure balances out over the long run.

Stripped down to basics, the U.S. purpose is to get Free World research-and-development jobs done in a way that takes advantage of the considerable expertise of other advanced countries, sharing costs and eventual products, thus enhancing the military security at lower cost of both the U.S. and cooperating countries.

Why the Program?

As Ronald M. Murray, Defense Department Assistant Director for International Programs in the Office of the Director of Defense Research and Engineering, put it recently:

"I believe [the reasons] for cooperation are indisputable. . . . In [the] field of military aircraft, I would like to offer 2 reasons for cooperation . . . technology and money.

"What do we mean by technology? While indeed the American aircraft industry has much to be proud of in its technology and its accomplishments, it certainly must acknowledge the very excellent technical work being done in other countries in recent years, resulting often in advances in fields in which we have been working and sometimes in fields which we ourselves have not been pursuing as hard as they. . . .

"Consider the field of V/STOL, which is one of those in which we are most active in cooperation with our allies. . . . Look at some of the unique developments of the other countries. For example, in Great Britain, the vectored-thrust P.1127 V/STOL fighter. In France, the high-performance Mirage III-V, using a combination of lift and cruise engines. In Germany, the supersonic VJ-101, with its excellent system of engine thrust modulation for attitude control in the transitional modes. And look at the work which Japan has done in the application of STOL techniques to seaplanes, an area, to my

U.S. COOPERATIVE DEVELOPMENT PROGRAMS

Completed Programs

- P.1127 V/STOL (U.S.-Britain-Germany)—joint evaluation of British design (initiated November 1962)
- Breguet Atlantic ASW Patrol Plane (France-Germany-Netherlands-Belgium-U.S.)—contributed to aircraft development program (initiated April 1964)

Programs Negotiated and Currently in Process

U.S.-Britain

- Beryllium Applications in Jet Engines—joint research and exploratory development project (begun June 1964)
- Advanced V/STOL Lift-Engine Project—joint development project (initiated October 1965)

U.S.-Germany

- Main Battle Tank—joint development project for 1970s tank (initiated August 1963)
- Miniature Inertial Navigation for Ships—joint development project (initiated November 1964)
- Advanced V/STOL Design Studies—joint design studies to enable selection of optimum advanced fighter configuration for joint development (initiated November 1964)

U.S.-Canada

- Lance Lightweight Launcher—Canadian-funded development as subcontractor to Ling-Temco-Vought (U.S. prime contractor for Lance missile) (initiated September 1963)
- XM-571 Articulated Track Load Carrier—Canadian development for U.S. requirement (initiated April 1961)

U.S.-France Joint Evaluation Projects

- AME 621 20-mm Helicopter-Mounted Machine Gun (French)—U.S. evaluation of French gun (initiated March 1964)
- Night Vision Tubes (U.S.)—French evaluation of U.S. night-vision tubes (initiated March 1964)
- Single Side Band Army Radio (French)—U.S. evaluation of French radio (initiated April 1964)
- MIRAGE III-V (French)—U.S. participation in French V/STOL flight-test program (initiated April 1964)
- Breguet 941 STOL Transport (French)—U.S. evaluation of prototype transport (initiated April 1964)

Projects under Negotiation

- NATO Hawk Improvement Program—possible exchange of improvement ideas and items between U.S. and European Hawk programs (Germany-Netherlands-Italy-U.S.)
- V/STOL Fighter Development Program (Germany)—possible joint development and evaluation of prototype aircraft

knowledge, not covered by those of us in the Western world."

As to money, Mr. Murray cited the rising costs of military research and development, pointing out that, for example, the F-86, which first flew in 1948, cost less than \$100,000,000 to develop while today's F-111, which first flew in 1964, is costing nearly \$1,000,000,000 to develop—an eloquent argument for cost sharing.

"Obviously," said Mr. Murray, "it is essential for each [country], regardless of how large our research-and-development budgets are, to economize as much as we can, and obviously one logical way of doing this is to share the load with other people who have similar interests and similar

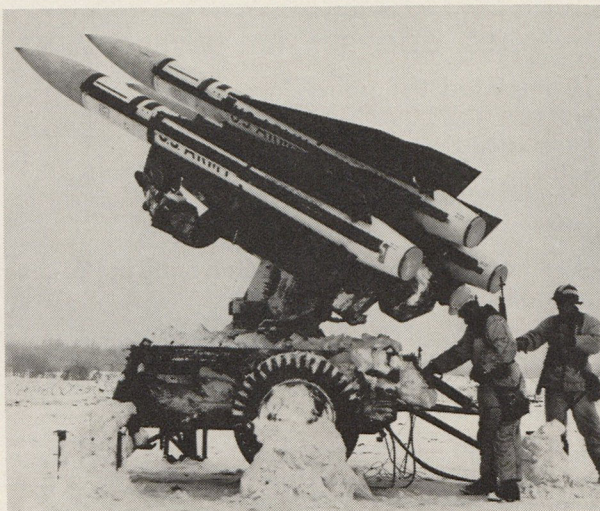
competence in the field. The whole is greater than the sum of its parts, if we cooperate—and the Free World must do this if we are to stay free."

USAF's Role

Although the Defense Department oversees cooperative research and development, it is the individual U.S. military services that actually run and fund the U.S. portion of these efforts. Aerospace development accounts for the major part of the program. The U.S. Air Force handles the aerospace development programs with cooperating countries. The Air Force's Deputy Chief of Staff for Research (Continued on following page)

Crew members from 32d Artillery Brigade carry out maintenance check on Hawk surface-to-air missiles.

The supersonic missile, designed for use against targets from treetop height to 50,000 feet (15,240 m) is deployed in Vietnam, Europe, Okinawa, and Panama and is being procured by Israel, Japan, and Sweden.



and Development, Lieutenant General James Ferguson, is responsible for over-all Air Force participation in the program, in consultation with the U.S. Joint Chiefs of Staff, and the Office of Defense Research and Engineering in the Defense Department.

This task includes ensuring maximum participation by all Air Force research-and-development agencies; recommending negotiations of agreements to the Assistant Director for International Programs in the Defense Department; the establishment of cooperative projects; and the negotiation of new and the cancellation of completed data-exchange agreements.

The 3 prime Air Force commands involved on the working level in cooperative research and development agreements and projects are the Air Force Systems Command, the Air Force Logistics Command, and the Office of Aerospace Research. Their jobs include the formulation of joint projects, plans, work statements, schedules, costs, and proposed cost-sharing estimates; contracting for approved proj-

ects under the guidelines of bilateral agreements; managing approved projects; investigation of potential areas of intercountry cooperation and making recommendations for specific projects; and review of U.S. and foreign projects and of U.S. military needs to determine possible areas for cooperation with other countries.

Some Ground Rules

The Defense Department's Mr. Murray has listed publicly some of the ground rules for the program. They are worth noting here. Not only must there be a U.S. need for the particular project to be undertaken, but the idea must be able to carry its own weight in the competition within the U.S. military services for research-and-development dollars. The project money must come out of individual service funds earmarked for research and development and testing—RDT&E in U.S. defense parlance.

"I stress the word 'need' here as contrasted to 'requirement,'" Mr. Mur-

ray said. "What it means is that there must be the same degree of firmness of application for a joint project that there is for a similar category of domestic project. The . . . 'need' varies from a technical need for an exploratory development project, to a hardware evaluation . . . from an advanced development project, to an approved military need for an engineering development project. The fact that a project will be cooperative doesn't change our own RDT&E ground rules."

Also, the U.S. must derive adequate value from the cooperative project.

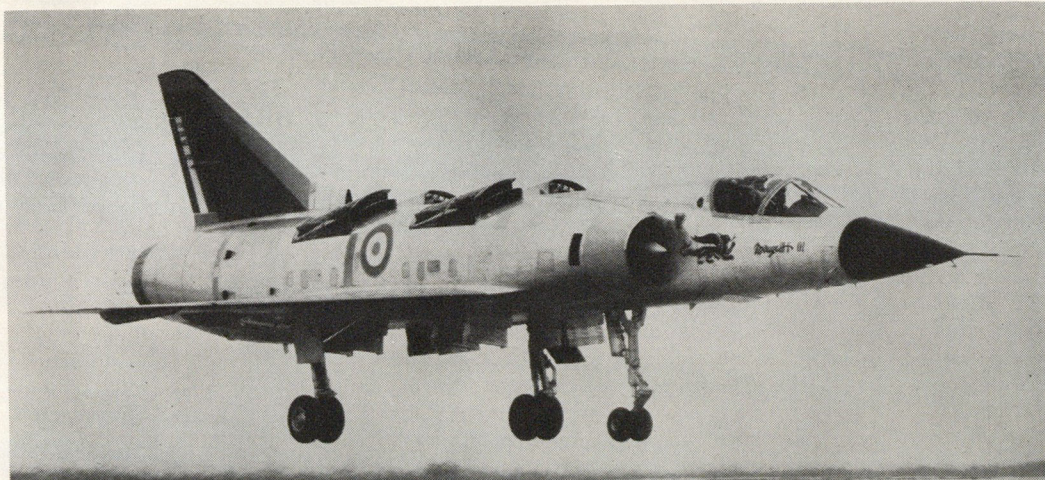
"These projects are not military-assistance projects in any way, and good business practice dictates that in these projects both we and our partner expect to get equivalent return; the only good contract anywhere is one that is mutually profitable."

As to design and production rights:

"The U.S. must obtain design and production rights equivalent to those of U.S. projects. This means that on jointly funded projects, we will end up with a complete technical-data package and with the rights that are necessary to implement . . . production. . . . For this, we agree to pay reasonable royalties on the background work performed in the other country before the joint project, but all work that is done under joint funding gives us our normal royalty-free license to use the project results for our own defense purposes. This includes our usual right to set up other contractors in the U.S. as alternative sources of supply, just as we normally have the right to set up second-source contractors."

On sales, Mr. Murray said:

"Sales of the production resulting from cooperative projects must remain competitive. This is in keeping with Secretary McNamara's belief in and work toward a common market for NATO defense, based on the principle (Continued on page 25)



France's Dassault Mirage III-V V/STOL fighter design has attracted interest of several nations, including U.S., which contributed funds and personnel to test program. This version is now virtually abandoned in favor of new design, Mirage III-F2, which in turn is interim project leading to Mirage III-G variable-sweep wing fighter.



Fast and Flexible

Combat proves the Douglas Skyhawk to be an outstanding close-support jet. It is highly maneuverable fully loaded at tree-top levels. It also has both strike and reconnaissance capabilities. Skyhawk demonstrates outstanding cost-effectiveness in carrying large bomb loads over long distances. And it can fly at low altitudes all the way. This versatile jet is qualified for Short Airfield Tactical System (SATS) operations and can be equipped for sod field capability. Its short take-off capability greatly enhances its military operational versatility.



Yet Skyhawk costs much less than comparable close-support jets, and it costs much less to maintain, too.

DOUGLAS SKYHAWK

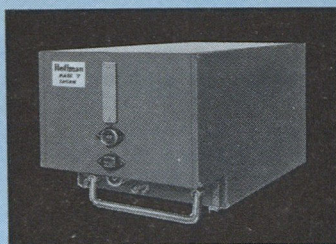
Aircraft Division, Long Beach, California, U.S.A.

INSTINCT
IS FOR
THE
BIRDS!



MARK V.

Hoffman's new ultra-reliable miniaturized solid state TACAN meets man's need for advanced navigational equipment in tomorrow's high-performance aircraft.



The all-new Mark V TACAN has been developed to the highest standards of reliability to meet the demands of aircraft that must range in altitude from below 100 feet to above 100,000 feet, at speeds from sub-sonic to many times the speed of sound. The Mark V offers size and weight reduction of approximately 50%, significant increases in operating performance, and levels of reliability and maintainability far beyond the equipments now standard in military aircraft throughout the world. Long a pioneer in designing and delivering military and space electronics with demonstrated reliability, Hoffman is uniquely qualified to achieve this next giant step in total electronic equipment performance.

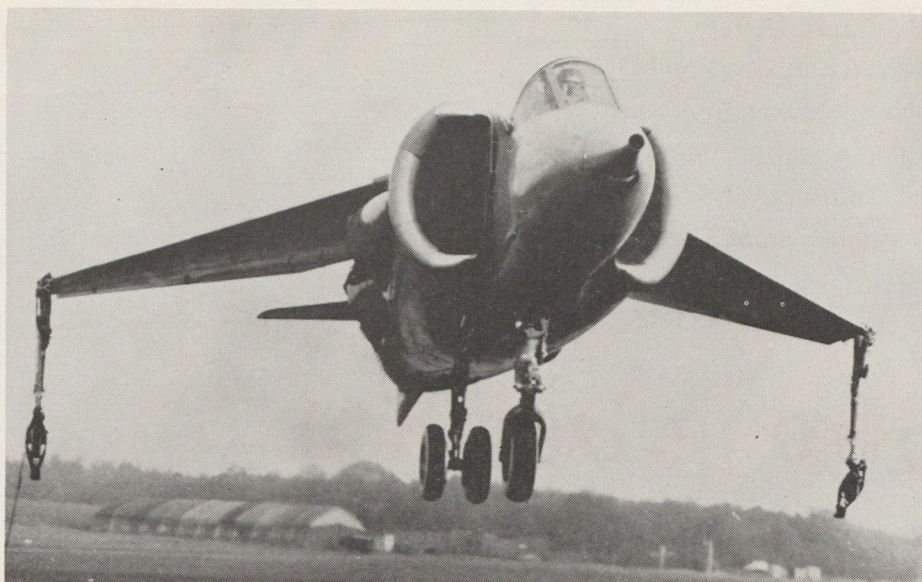
For information regarding services or equipment in areas such as electromechanical, radar, ASW, solar power, navigation, field services, countermeasures and systems management, write International Operations, Hoffman Electronics Corporation, Hoffman Electronic Park, El Monte, California.



Hoffman

World's foremost producer of

TACAN



All 3 U.S. services joined with Britain and West Germany in testing Hawker Siddeley P.1127 Kestrel VTOL fighter. Although U.S. apparently does not plan to buy P.1127 in quantity, 3 Kestrels are undergoing continued evaluation in U.S. in connection with other current and projected V/STOL projects.

ples of competition rather than allocation and arrangements."

On this last point, it is symbolic of the U.S. commitment to cooperative development that Defense Department planners believe that the \$250,000,000 investment since 1963 could develop into a \$3,000,000,000 to \$5,000,000,000 production and sales figure for the projects aimed at production.

Inter-European Effort

They point out that U.S.-foreign cooperative development is but part of the enlarging picture, since the sum of purely inter-European joint projects is probably even greater than U.S.-foreign joint efforts. European efforts include the British-French Jaguar aircraft and the Martel ASM missile projects; the French-German Roland SAM effort and the Milan and HOT antitank

missiles; the German-Italian VAK 191B close-support V/STOL aircraft; and the Dutch-British Sea Dart ship-defense missile system.

This technological teamwork across Free-World frontiers, the Defense Department believes, inevitably brings about greater military, political, technical, and industrial integration. Countries usually take on the jobs they do best, they are committed to the outcome of the project, a broader base is provided for more economical production, and, very importantly, ground rules have to be set in advance for production and sales that are mutually fair and satisfactory.

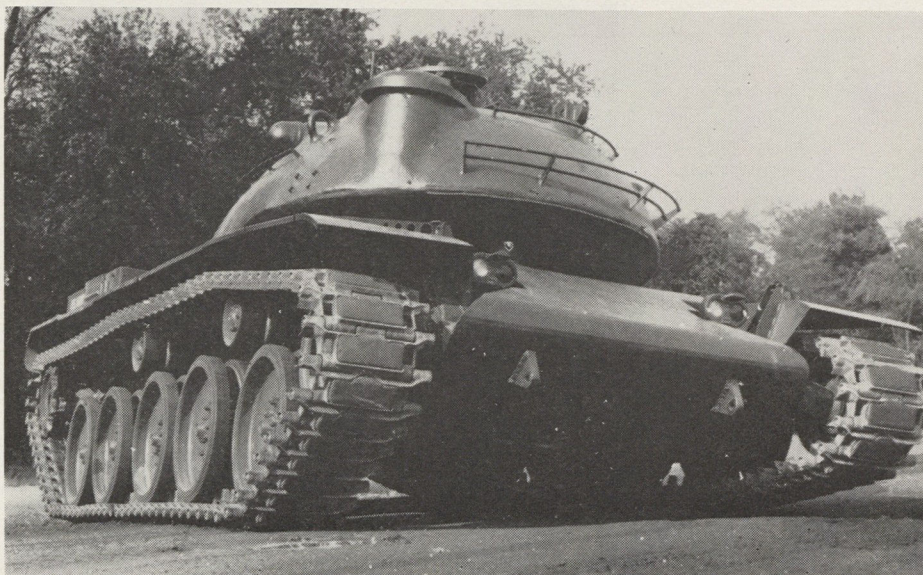
Mr. Murray illustrates this last point with the recently negotiated agreement on the U.S.-British lift-engine project by which both the U.S. and Britain get complete information and rights for national production of the

engine. The 2 particular contractors involved, Allison and Rolls-Royce, can each bid for production requirements of both countries as well as for third-country sales—either individually or jointly.

What's Ahead

Defense Department officials following cooperative development foresee important growth ahead. The reasons are evident—the high costs of going it alone and the advantages of sharing the sweat and the success, when it comes. Already it is likely that major cooperative-development programs in negotiation now could be as large or even larger than those already in progress. With all the problems of working together, the advantages are too obvious to be ignored—so long as each partner benefits. ☆☆☆

A U.S. Army development that may arouse interest in foreign countries is this 3-point suspension system for tanks, here undergoing tests. The device may be used on the new Main Battle Tank being built by the U.S. and Germany for the 1970s.



The infusion of U.S. aviation technology soon after World War II, largely through licensing and coproduction agreements, proved a powerful boost in helping Free World nations to shift from piston- to turbine-powered aircraft and into the broad field of avionics. Today the U.S. aerospace industry continues to expand its programs abroad to foster, through cooperative programs . . .

A Strong Defense and A Healthy Economy

BY C. JAMES REEVES

Director, International Service
Aerospace Industries Association

U.S. aerospace exports in 1965 were \$1,470,000,000, the highest since World War II.

The forecast for 1966 conservatively projects a \$100,000,000 increase. Impressive as these figures are, they do not include a substantial income accruing to U.S. manufacturers from foreign-license and technical-assistance

agreements, coproduction arrangements, and income from foreign subsidiary sales. An estimate of income from these sources increases the annual export totals for the past 5 years by 20 to 25 percent.

The years after World War II found the United States assuming enormous economic and technical responsibility

to assist in rebuilding the war-torn countries of the Free World. To feed, clothe, and house was not enough. The basics of the Marshall Plan were to establish an internal stability in those countries which had been drained by the costs of the fight for a free world.

In the late 1940s, reconstruction began. Massive grants of surplus, but highly usable, military equipment were distributed abroad in order that free nations recovering from military depletion could establish internal peace-keeping forces and protect themselves from undesirable external political threats.

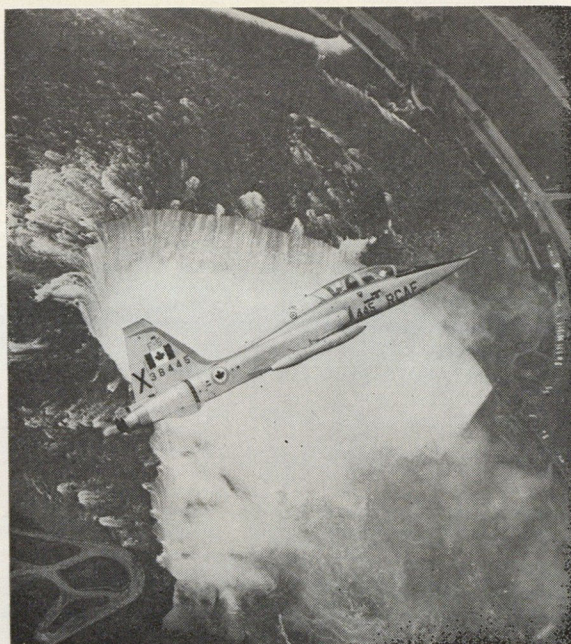
The technical skills of the prewar industrialized nations began to regain their former vigor. The demand for consumer and capital goods was immense, and the early 1950s reflected a sharp rise in the economies of free nations. But a void existed—a technical gap—with respect to supporting a realistic defense posture. The costs to struggling economies of reestablishing a defense industry was an awesome prospect. State-of-the-art knowledge was lagging. But a realistic and meaningful defense production base outside the U.S. had to be established.

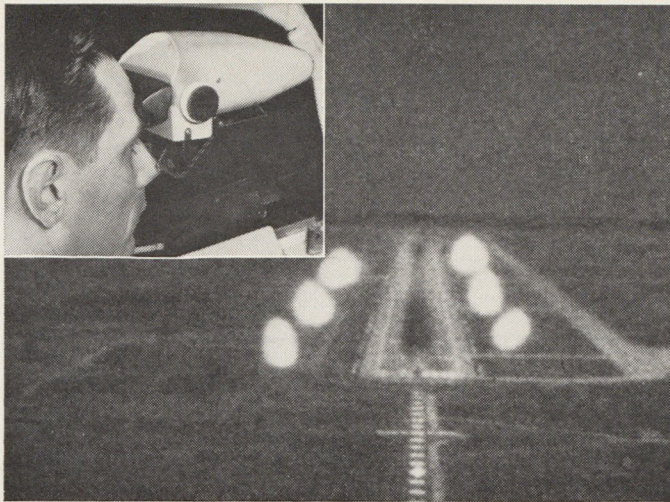
The U.S. aid budget was straining. With advice and help from the Government, U.S. private enterprise embarked on an unprecedented era of

(Continued on page 29)

Coproduction agreements for Northrop F-5 fighter, shown here in flight over Niagara Falls, have been concluded with Spain and Canada.

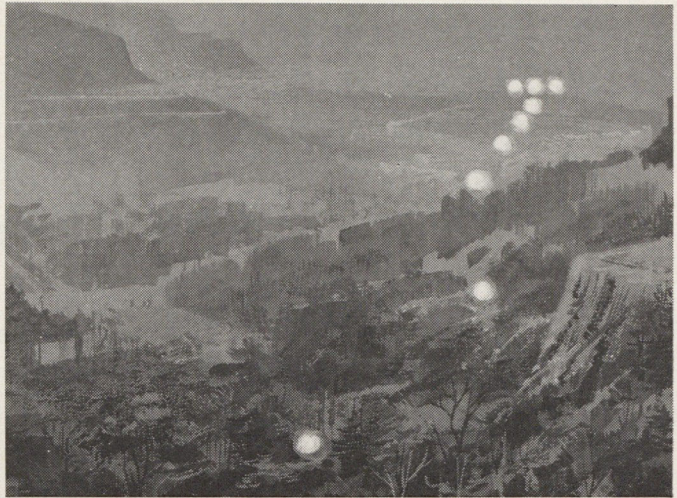
Construcciones Aeronauticas, S.A., near Madrid will build 70 planes, while Canadair Ltd. of Montreal will produce 125 for RCAF at cost of \$215 million. Latter deal calls for U.S. to buy equivalent amount of equipment from Canada.





Zero-visibility landings. Microvision's "heads-up" cockpit display defines a fog-bound commercial runway or blacked-out military landing strip. The pilot sees the radar "lights" directly in his field of view (see insert).

See...



Pathfinding. Unfamiliar routes or corridors safe from ground fire can be defined for planes overhead by means of microsecond interrogation which triggers microvision transmitters set up along the way.

see...



Formation flying. Pilot "sees" other aircraft by means of radar beacons mounted on the blades of other helicopters in the formation.

see...



Target marking. Portable microvision transmitters can be positioned by troops to pinpoint a target area shrouded in dense weather.

see...

how Bendix Microvision* breaks through zero-visibility with ground or airborne beacons.

Microvision is for use when normal viewing is impossible either because of adverse weather or for tactical reasons. The system receives signals from its airborne or ground-based radar beacon transmitters. Then processes these signals to appear as "lights" on a cockpit combining mirror in the pilot's line of vision. So what the pilot sees are true-perspective representations of what lies ahead.

Microvision's applications are broadly flexible. Included

are terrain marking, flight path delineation, aircraft identification, definition of ground-approach corridors and formation proximity. It can be used in various combinations with prime guidance, navigation or control systems.

For more information, write Dept. Q56-00, Bendix International Operations, 605 Third Ave., New York, N.Y. 10016, U.S.A.

*Trademark of The Bendix Corporation, U. S. A.

Bendix International Operations

Visit the Bendix exhibit at Stand 1506, Hall B of the Hanover Air Show, April 29-May 8.



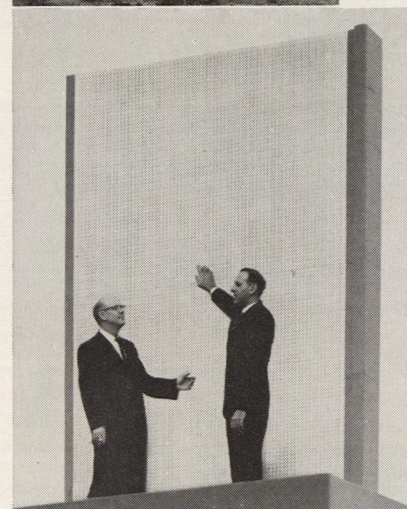
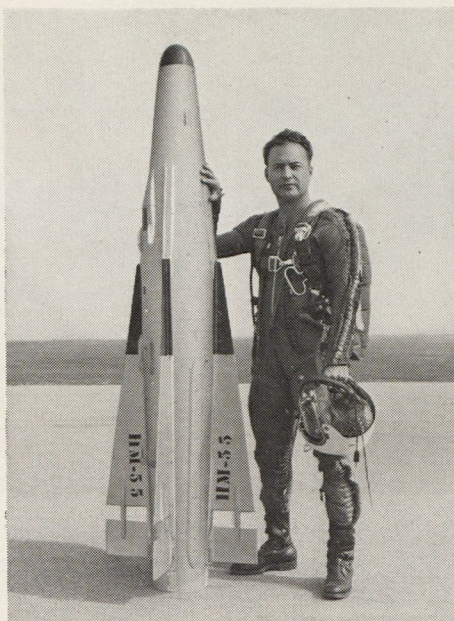
WEAPON SYSTEM CHECKER

Today's checkout systems must provide the "preventative medicine" that keeps defensive weapons in constant readiness. Hughes' advanced computer technology gives the U.S. Air Force VATE (Versatile Automatic Test Equipment) program the capability to check and evaluate complex inertial guidance systems—in less time, with greater accuracy, at less cost, with fewer people with lower skills.



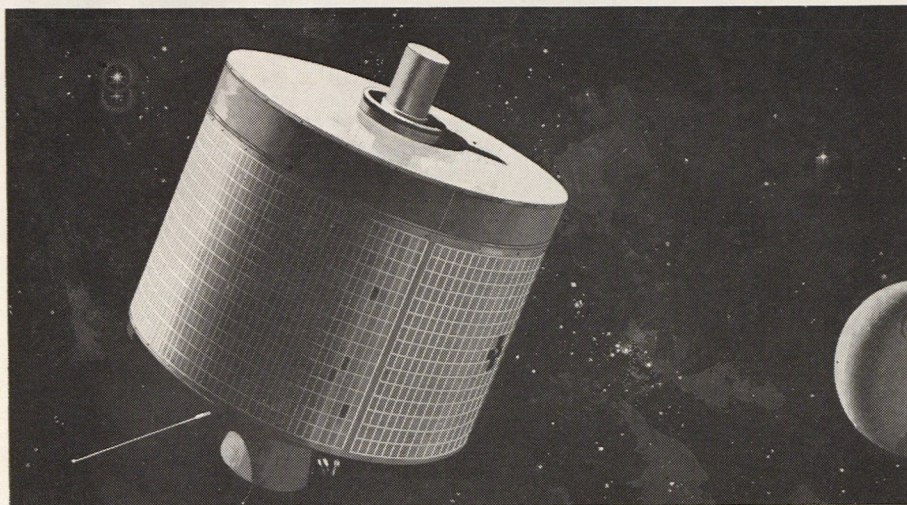
MODERN FALCONRY

Today's U.S. Air Force jets are equipped with Hughes advanced electronic weapon control systems, armed to fire Falcon missiles. Together, these devices have become the world's most potent air defense weapon. The most recent model, known as the HM-55, is now offered to nations of the free world. Hughes has delivered thousands of control systems and nearly 40,000 infrared and radar guided Falcons.



INSTANT 3-D RADAR

Capable of being airlifted by helicopter, Hughes' new lightweight, long-range 3-D radar system simultaneously displays range, bearing and height of airborne targets and can be set up and in operation in minutes. This system and its compact planar radar antenna has been demonstrated before tactical teams of the free world.



SATELLITE SWITCHBOARD

Early Bird, the stationary-type satellite built by Hughes for Comsat and the International Consortium, is now providing uninterrupted television and phone service 24 hours a day across the Atlantic Ocean. Three such satellites could link all the nations of the earth.

Turning theory into hardware

Technological breakthroughs are almost an everyday occurrence in electronics. Everywhere we see many new scientific discoveries being turned to the service of man.

Hughes is one of those companies whose obligation is not only to form these theories, but also to visualize how they might be applied.

Today, Hughes technology is being applied in over 500 projects, programs and studies.

A few are shown to illustrate: Completely new technologies which are creating new devices . . . Major improvements in existing technologies . . . Advanced manufacturing technologies which produce more reliable hardware for duty in this world—and out of it.

More than 5,000 Hughes engineers help create the theories. More than 20,000 skilled Hughes people help translate these into practical hardware.

HUGHES INTERNATIONAL
HUGHES AIRCRAFT COMPANY

CULVER CITY, CALIFORNIA, U.S.A.

U.S. AEROSPACE EXPORTS

For Calendar Years 1948 through 1965, in Millions of Dollars

Calendar Year	Transport Aircraft	Utility Aircraft	Engines	Rotary Wing Aircraft	Other and Under Security Restrictions	Total Aerospace Products
1948	\$ 37.4	\$ 4.2	\$ 0.3	\$ 1.9	\$ 109.8	\$ 153.6
1949	22.2	2.8	0.1	1.2	256.6	283.0
1950	40.4	2.2	0.3	0.9	198.6	242.4
1951	13.2	3.7	0.5	0.9	283.1	301.4
1952	18.2	5.6	0.9	1.4	577.1	603.2
1953	79.2	5.4	0.7	4.9	790.4	880.6
1954	93.0	4.5	1.5	4.0	502.9	618.9
1955	81.2	7.4	2.0	4.2	632.7	727.5
1956	132.9	11.0	3.5	3.7	908.2	1,059.3
1957	179.3	13.1	8.7	11.9	815.0	1,028.0
1958	146.4	12.1	4.3	9.6	799.1	971.5
1959	107.6	14.5	2.4	8.2	636.8	769.5
1960	480.1	23.6	3.7	7.7	814.4	1,329.5
1961	266.4	27.5	4.4	6.8	903.7	1,208.8
1962	254.9	23.1	4.5	8.8	1,144.2	1,435.5
1963	191.0	26.9	3.6	9.8	1,008.8	1,240.1
1964	211.0	33.3	5.3	14.6	948.2	1,212.4
1965	352.9	68.9	10.1	16.2	1,026.1	1,474.2

Source: Bureau of the Census, "U.S. Exports of Domestic & Foreign Merchandise Report."

Value of U.S. aerospace exports has increased 10 times from 1948 to 1965. Military aircraft account for most of the totals in column headed "Other and Under Security Restrictions." These figures do not include income to U.S. manufacturers from foreign-license and technical-assistance agreements, coproduction arrangements, and income from foreign subsidiary sales, which it is estimated would add another 20 to 25 percent to the total.

transfer of technical knowledge. To maintain the Free World, the defense production bases of Western Europe, Australia, and Japan had to be elevated to the jet age.

The infusion of U.S. technology, provided largely through licensing and coproduction agreements, permitted nations around the Free World to leapfrog from a piston-aircraft technology to an advanced turbine-powered technology. More important, it established a relationship of cooperation and trade that to date has remained unbroken.

Here are a few major examples of production cooperation:

- Australia—limited production of F-86s.
- Belgium—F-104s and tactical avionics.
- Canada—F-80s and F-86s produced in quantity, F-104s, tactical avionics, and engines.
- Germany—F-104s, tactical avionics, missiles, and engines.
- Italy—F-86s and F-104s, tactical avionics, and missiles.
- Japan—F-80s, F-86s, and F-104s, tactical avionics, and engines.

- Netherlands—F-104s and tactical avionics.

The U.S. companies worked out sound programs with their licensees; engineers were exchanged to interpret technical data; drawings were modified to meet the limitations of the licensees' tools.

In the first phases of the licensing agreements, the U.S. provided special tooling subassemblies. However, most of the licensees, through expansion of facilities and capabilities, later were producing the complete aircraft.

By the early 1960s the industrial capability and capacity and, more important, the engineering skill levels of these nations were rejuvenated.

Today there are coproduction programs with nations in Western Europe for air-to-ground and ground-to-air missiles. A whole new complex of electronic advances has been achieved in Europe and the Far East as a side product of licensing programs. Germany today is a technical leader in the design and development of vertical and short-takeoff-and-landing (V/STOL) aircraft. Italy has designed and produced a jet fighter and trainer. Japan is marketing a light transport for civil use and a jet trainer plane.

The list of licensees and subsidiary companies abroad today manufacturing U.S. aerospace products fills a volume. And it is growing.

The demand for space-exploration hardware is increasing. Exports of space equipment in 1965 amounted to an estimated \$4,650,000. U.S. companies provided, among other things, design and engineering services, subsystems, and satellite components to

(Continued on following page)

Most widely produced aircraft in the Free World is the Lockheed F-104 Super Starfighter, shown here on flight line at Chitose Air Base on Japan's northern island of Hokkaido. Several European manufacturers are now completing cooperative production of F-104Gs for NATO members on continent. More than 200 F-104Js have been produced by Mitsubishi in Japan. Italy has announced plans to build advanced model, designated F-104S.





Lieutenant General Mohammed Amir Khatami, Commander in Chief of Imperial Iranian Air Force, signs logbook after flying the first of a squadron of Northrop F-5A Freedom Fighters delivered to Iran under U.S. Military Assistance Program. Other nations acquiring F-5 include Greece, Korea, Nationalist China, Norway, Philippines, Thailand, and Turkey, with more in prospect.

Free World governments and industries embarking on space programs. Products contributed included sounding rockets, sounding-rocket payloads, and communications-satellite ground terminals as well as fuels and consulting services.

It is estimated that U.S. exports of space products and services in 1966 will approach the \$10,000,000 mark.

Accompanying this heavy involvement in reviving the engineering and production capability of friendly nations abroad, there has been growth in related fields.

A notable example is air transportation, largely due to the efficiencies of U.S.-built civil aircraft. Many Free World air carriers, having used World War II cargo aircraft for reestablishing competitive and profit-making communications systems, needed modernizing. U.S. transport manufacturers were ready. Financing sources were opened and the U.S. Export-Import Bank played a big role then, as it does now, in providing a source of credit to buyers and credit guarantees for manufacturers. Today, over 80 percent of the Free World's air carriers fly U.S. transport aircraft.

How does this relate to international cooperation?

The U.S.-manufactured transport is economical to operate and has an unrivaled record of dependability.

These aircraft provide world air carriers with the broadest possible range of equipment to meet requirements of any stage lengths. U.S. manufacturers have training programs for foreign air

carriers, and a network of service representatives in the field to ensure optimum operational time. This enhances the U.S. resupply position as requirements increase and as modernization is demanded.

It is international cooperation in the true sense since the overseas air carrier makes a profit because of these conditions and practices. The profit-and-loss statements of most overseas air transport operations are positive evidence.

Utility fixed-wing and vertical-lift aircraft manufacturers of the United States are supplying their equipment abroad in ever-increasing numbers for use in highly diversified ways.

Export markets for light aircraft and

helicopters are largely confined to engineering and construction projects, medical service and emergency evacuation, coast and geodetic surveys, oil exploration, pipeline surveillance, agriculture spray for both insect control and crop fertilization, police work and civil-action assistance, and a number of other practical chores that only these aircraft can perform. They have been sold to virtually every nation of the Free World. The chart on page 29 graphically shows the export growth of U.S. civil aircraft.

The U.S. aerospace industry seeks constantly to expand its programs abroad to create a healthy atmosphere of cooperation in defense programs and economic growth. ☆☆☆



Three Lockheed C-130 Hercules transports destined for Royal Australian Air Force fly past reviewing stand in delivery ceremony at Marietta, Georgia. Australian Ambassador Howard Beale was guest of Lockheed Vice President Carl Kotchian at the event.

Rohr builds

Rohr today is by far the largest subcontractor to America's aerospace industry. Our Antenna and Space Products Divisions are strong and successful... currently producing large, precision products in those fields.

large assemblies

However, large complex components for aircraft are still our biggest business... based on engineering and production advances developed over 25 years in this specialty at Rohr.

for every major

In addition to complete engine pod assemblies, Rohr's current aircraft production includes fuselage sections, stabilizers, elevators, thrust reversers, struts, ailerons, landing gear pods and doors, cargo doors, wing-to-body fairings, flight and ground spoilers, wing joint fittings and others.

multi-engine aircraft

Rohr is building large assemblies for every major multi-engine aircraft in production today... both military and civilian.

in production

For instance, we're producing complete engine pod assemblies for the Boeing 707, 720, 727 and 737 series; the Lockheed C-130, C-141 and C-5A Logistics Transports, P-3A Navy Patrol Aircraft and JetStar, Military Executive Transport; the Douglas DC-8 and DC-9 jet airliners; and Grumman's new Gulfstream Business Jet.

in America today

With the constant installation of numerically controlled equipment and conveyorized assembly operations, Rohr will continue to provide the experience, knowledge and facilities to build major aircraft components better, faster, and at lower cost. For full information, please contact Marketing Manager, Dept. 41, Rohr Corporation, Chula Vista, California.



MAIN PLANT HEADQUARTERS: CHULA VISTA, CALIF./PLANT: RIVERSIDE, CALIF./ASSEMBLY PLANTS: WINDER, GA.; AUBURN, WASH.

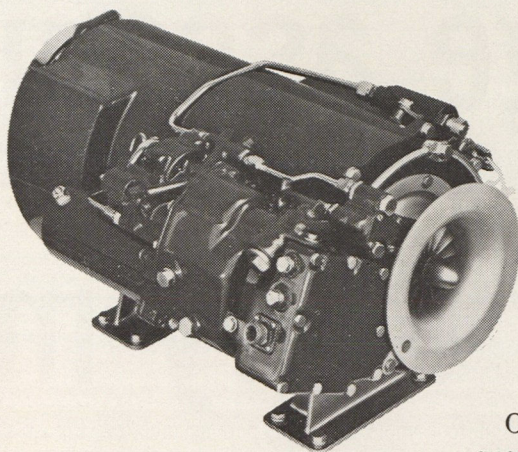
ROHR
CORPORATION

Since a jet fuel starter combines small gas turbine and jet engine starter technologies, isn't it logical to expect the best ideas in this type starter to come from the leading maker of small turbine engines and jet engine starters?

It takes the kind of experience Garrett-AiResearch has to produce a superior starter of this type. We've made over 12,000 small gas turbines since 1947; built over 50,000 jet engine starters to date, and are accumulating experience at the rate of over 20,000 starts per day. Total starts are now in excess of 30 million.

Now, from Garrett-AiResearch know-how, comes a Jet Fuel Starter (JFS) that is a self-sufficient gas turbine/starter combination which is mounted directly on the main engine. It operates on the airplane's own fuel, eliminating ground starting equipment and costly starter cartridges.

This proven Jet Fuel Starter incorporates full containment—an AiResearch feature which assures aircraft and personnel safety. The starter has the ability to contain *internally* all fragments of a maximum energy hub burst of any of



the turbine wheels, up to their maximum operating speed. This feature offers full protection under abnormal conditions, including overspeed, overtemperature, and blade failure.

Existing AiResearch JFS designs are optimized to handle any given engine starting requirement with only minor modification, and are packaged to fit every major military or commercial jet engine in use today, within present envelope configurations.

Our Jet Fuel Starter has already successfully started the J57, TF30 and CJ805 engines.

See the new Jet Fuel Starter and other Garrett equipment at Hanover Aviation Show April 29-May 8, Hall B, Stand 2609.

Garrett
is experience



AiResearch Manufacturing
Division • Phoenix, Arizona, U.S.A.

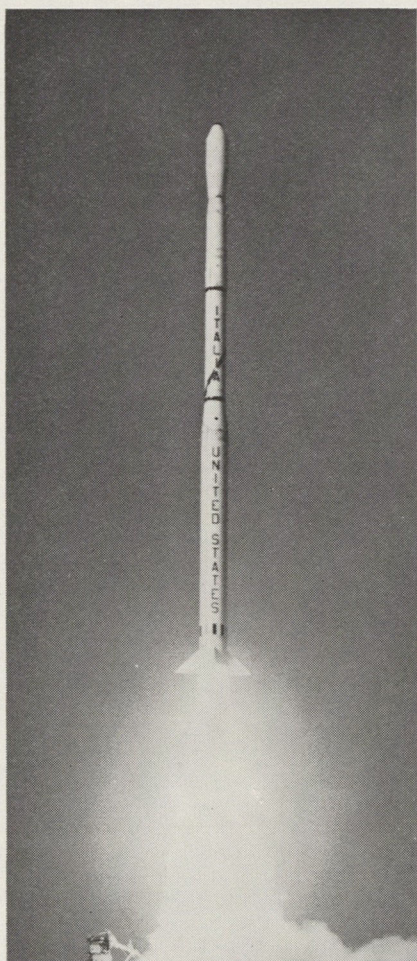


The space programs of the United States and other countries around the world are themselves historically rooted in the International Geophysical Year of the 1950s. The basic space law of the U.S. calls for international cooperation in the exploration of infinity. Against this background, the U.S. has undertaken cooperative efforts in space with many other countries and hopes particularly to enlarge U.S.-Western European cooperation in this great adventure . . .

International Cooperation in Space Exploration and Technology

BY JAMES E. WEBB

Administrator, U.S. National Aeronautics and Space Administration



The San Marco Scout I, carrying experiments designed by Italian scientists, was launched in U.S. by an Italian crew.

The word science means "to know." And what one man can know, another can know as well. Engineering is putting this knowledge to work. And what one man can do in putting knowledge to work another can too. This is to say that science and engineering are the province of mankind, and not of one particular nation.

Such is the international character of science and engineering. An advance in science or engineering may give one nation a momentary advantage in terms of industrial development or military strength, but it cannot assure that nation's security.

Because ideas have no national boundaries, scientists have long had a tradition of cooperation. Generally, this has meant an informal sort of exchange of ideas between individuals. And as long as science and engineering were in the hands of individuals this sort of private exchange knowledge was adequate.

Today, we are faced with a different sort of problem. The cost of scientific enterprise has taken research out of the small private laboratories and into large installations costing billions of dollars.

The size and expense of scientific investigations have put these endeavors on a national scale. Thus, government becomes a partner with private research. And once these investigations become national in character they also become part of the intercourse among nations.

The investigation of space has added
(Continued on following page)



James E. Webb has been Administrator of the U. S. National Aeronautics and Space Administration since February 1961, latest post in a distinguished career including high positions in both government and private industry. Born in North Carolina in October 1906, he is a graduate of the University of North Carolina and of the law school of George Washington University in Washington, D. C. He has been a military pilot, and holds a reserve commission in the U. S. Marine Corps. President Harry S. Truman appointed him Director of the U. S. Bureau of the Budget in 1946, and he subsequently served as Under Secretary of State. In private life he has been Vice President of the Sperry Gyroscope Company, Chairman of the Board of Republic Supply Company, and a Director of McDonnell Aircraft.



Vice President Hubert Humphrey, shown here with International Air Cadets at Washington dinner, stresses foreign cooperation measures as Chairman of National Space Council.

a further and enormously important dimension: A satellite cannot orbit within the boundaries of one nation. It must speed around our earth at 17,500 miles per hour (28,000 km/hr), and it must do so in a path determined by the physics of our universe, and not

according to political boundaries. To impose 19th century ideas of national sovereignty on a spacecraft would be to sound the death knell of the exploration of space.

One might as well ask the Cana-
(Continued on page 37)

Vice President Hubert H. Humphrey on International Space Cooperation

I believe it is virtually impossible to overestimate the interest of peoples throughout the world in the unfolding space age.

For example, a United States Information Agency-sponsored space exhibit [in February] in Rangoon, Burma—a place most of us might have imagined to be remote from the space age—drew over 250,000 visitors. Astronaut John Glenn was there, and Astronauts Walter Schirra and Frank Borman [have visited] the free Asian capitals, Australia, and New Zealand.

Many countries with little or no space experience are showing their interest in a very concrete and practical way. They have realized the need to engage in space programs to develop their own scientific competence, and we are helping them to do so. Already we are cooperating with about 70 countries, and the State Department and NASA are pressing forward with new initiatives in international cooperation.

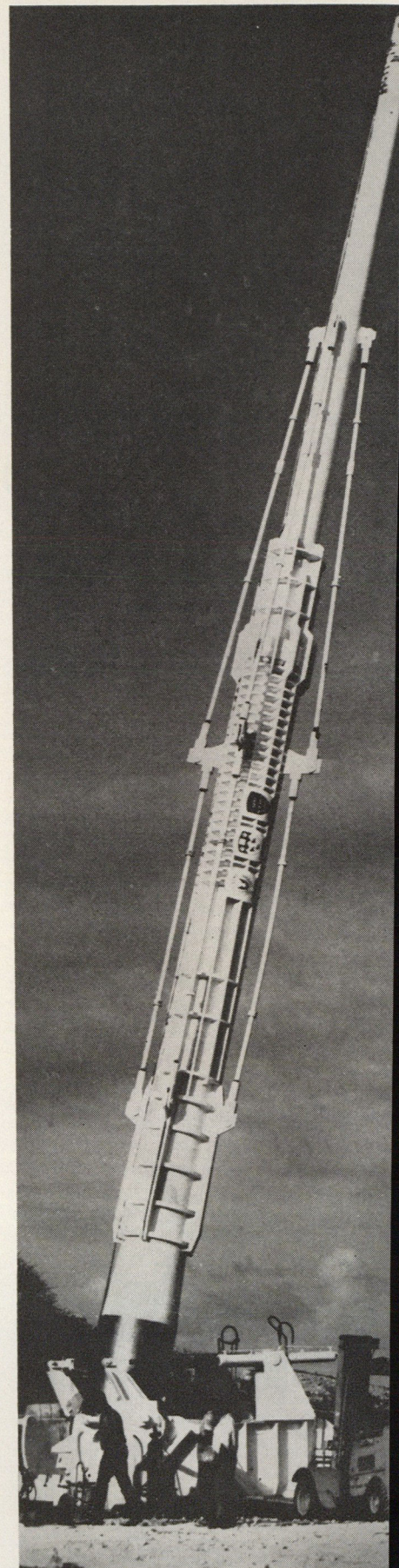
For what I now say I may be accused of being something of a visionary—but I am encouraged to do so by being in the good company of other visionaries.

I believe that the exploration of space will have a profound effect upon how we look at our life here on earth. It will put all our affairs in a wider and more wholesome perspective.

Ever since Copernicus, we have known that our earth is a small planet in an immense universe. But while we have known this intellectually and theoretically, most of us have not really taken it to heart, not really felt it in the marrow of our bones.

As the full significance of that fact is brought home to us by the actual exploration of space, it will seem increasingly absurd that we have not better organized our life here on earth.

(From an address by Vice President Hubert H. Humphrey at the Robert Goddard Memorial Dinner, March 16, 1966, Washington, D. C.)



Canada's McGill University is working with U.S. assistance on program to modify 16-inch (40.6 cm) naval guns to serve as boosters for space research vehicles.

Four factual reasons why...
**MAGNAVOX is the WORLD'S
LARGEST SUPPLIER**
of
tactical vehicular communications
equipment for the U. S. Army...

1. PERFORMANCE
2. RELIABILITY
3. COMPATIBILITY
4. ECONOMY

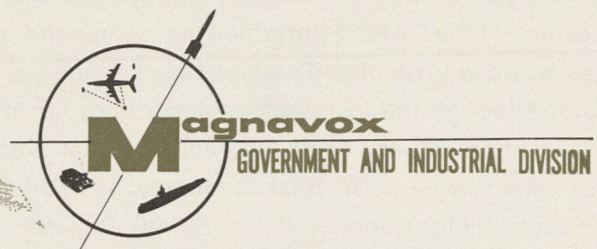
The rugged, lightweight, compact AN/VRC-12 . . . built by Magnavox for the U.S. Army and friendly countries . . . is adaptable to any space or mounting . . . vehicular, portable, or fixed-station FM radio. It is completely compatible with the man-portable PRC-25*, the airborne AN/ARC-54, and the Magnavox FM-622 Airborne Radio Set now under development.

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dian goose to avoid the United States on its yearly migrations or change its name to the American goose as it passed over U.S. territory. The goose cannot change its nature or its name for these refined notions of international politics, nor can our satellites or those of the Russians or the French or the British or any other nation.

In short, space is international by nature, and it is the business of nations to find the ways to accommodate the immutable needs of spacecraft.

The space age is not only a moving force for international scientific cooperation, but, indeed, grew out of projects laid down as part of such programs as the International Geophysical Year (IGY), a program of the International Council of Scientific Unions (ICSU). IGY offered such great promise that ICSU took steps to extend its benefits on a permanent basis by organizing the international Committee for Space Research (COSPAR). Today, COSPAR membership numbers 30 national bodies and 10 international scientific unions. At its 1964 meeting in Florence, 430 registered participants and observers attended: 130 from the United States, 58 from France, 50 from the United Kingdom, and 33 from the Soviet Union.

COSPAR is a nongovernmental body that brings scientists together in an environment that minimizes political considerations, yet permits authoritative planning.

Although COSPAR recommendations bind no governments, they reflect the opinion of space scientists throughout the world. COSPAR's endorsement in 1964 of a report by its consultative group on the potentially harmful effects of space experiments put to rest fears that the exhaust from large rocket boosters would contaminate the upper atmosphere and that Project West Ford's orbiting dipoles would interfere with optical or radio astronomy.

United States participation in international cooperation is part of its national policy. The National Aeronautics and Space Act of 1958, which established the United States space agency, states that one of the objectives of NASA is "Cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful applications of the results thereof."

International cooperation has, indeed, grown richly.

NASA's programs have involved 70 nations and touched every continent. Agreements already reached from past and future projects provide for:

- U.S. launching of 14 international satellites;
 - Accommodations of 18 foreign ex-
- (Continued on following page)

The U.S. Role in International Space Programs

It is the basic policy of the U.S. to encourage and promote international space activities and that these activities be devoted to peaceful purposes for the benefit of all mankind.

Since the beginning of its international program in space exploration, the United States has applied 4 criteria to determine the value and acceptability of cooperative arrangements in space activity:

- That in the case of scientific experiments, a cooperative project must have scientific validity.
- That any cooperative arrangement must be relevant to the U.S. space program and make a contribution to that program.
- That the cooperative programs must be conducted openly, and the scientific and technological data derived from them must be made freely available to the scientific community.
- That these arrangements must be carried out on the basis of mutual support.

NASA's international programs include satellites, individual satellite experiments, sounding-rocket investigations, and a variety of programs in which ground-based observations are coordinated with flight projects.

Existing bilateral agreements provide for the U.S. to launch 14 scientific satellites instrumented and, in all but 2 cases, engineered abroad. These satellites are contributed by the European Space Research Organization (ESRO) and 5 cooperating countries (United Kingdom, Canada, France, Italy, and Germany). . . .

Experiments include investigations of ionospheric, energetic particle, and atmospheric parameters.

Apart from launching the satellites of other nations, the U.S. has opened its own satellites, manned and unmanned, to foreign participation. In all cases, the respective national space authority has agreed to fund the preparation of experiments selected for flight. The average cost to the foreign sponsor is roughly a quarter of a million dollars per experiment, but this varies widely. The U.S. meets the cost of payload integration, launching, and data acquisition.

Some 16 countries have entered into agreements for 1 or more cooperative sounding-rocket projects. Experiments have come about from both U.S. and foreign proposals, they have been conducted from both U.S. and foreign ranges, and they have involved both U.S. and foreign rockets, payloads, and ground equipment.

In the Americas, an important new experimental meteorological sounding-rocket network is coming into being through cooperative projects with Brazil, Argentina, and, hopefully, Mexico.

In all, these cooperative sounding rocket projects account for roughly 250 launchings in a 5-year period. The rockets range widely in size and type, from boosted Darts and Arcas to Nike combinations, Aerobees, Shotputs, British Skylarks, and French Centaures. The projects themselves have brought into being a large number of ranges in scientifically significant regions of the world—auroral, equatorial, southern hemisphere—and these now make possible increasingly important programs in rocket astronomy, meteorology, aeronomy, and ionospheric physics.

Countries cooperating in ground-based programs made a substantial contribution to experimental communications satellite work by constructing and operating the overseas ground terminals which were used for transatlantic TV and radio demonstrations. Conventional weather observations in dozens of countries helped with the interpretation of cloud-cover photographs from weather satellites. The experimental communications work will go forward with the United States' Advanced Technological Satellite (ATS). The weather work enters a new stage with the increasing use of Automatic Picture Transmission (APT) equipment, which will bring operational data daily and *directly* from United States weather satellites to countries purchasing this equipment. . . .

From NASA's Fact Sheet on International Space Programs.

periments on various NASA satellites;

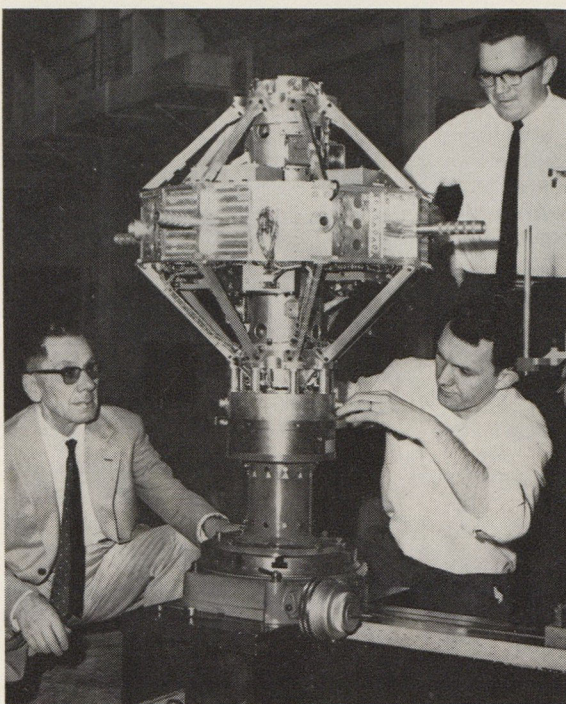
- Some 200 cooperative sounding-rocket launchings in every quarter of the globe;

- Ground-based experiments (coordinated with NASA satellite missions) by scientists in more than 50 countries;

- Support for the operation of tracking and data-acquisition stations in 18 countries; and

- Coordinated satellite launchings and data exchange with the Soviet Union.

A striking example of how the position the U.S. has achieved in space can contribute to objectives of the greatest importance in the international field was President Johnson's proposal to Germany's Chancellor Ludwig Erhard in January for a major new program of cooperation in space technology between the United States and the nations of Western Europe. The possibility is now open for the European nations to use the knowledge they have already gained, by their own efforts in the European Space Research Organization (ESRO) and through other cooperative efforts with NASA, to undertake large projects in spacecraft technology, which generally appear too big for any one nation. The idea under discussion is that through the development and production of a large spacecraft—perhaps a probe to Jupiter or a vehicle for solar research—other Free World nations could gain for their scientists an ability in the main fast-moving fields of science and technology to serve many



Giovanni Tarabra, left, of the Italian Space Committee, advises 2 members of NASA's Goddard Space Flight Center in Maryland on adjustments to the San Marco satellite payload before it was subjected to environmental tests. The U.S. has participated with other nations in some 200 cooperative sounding-rocket launchings throughout the world.

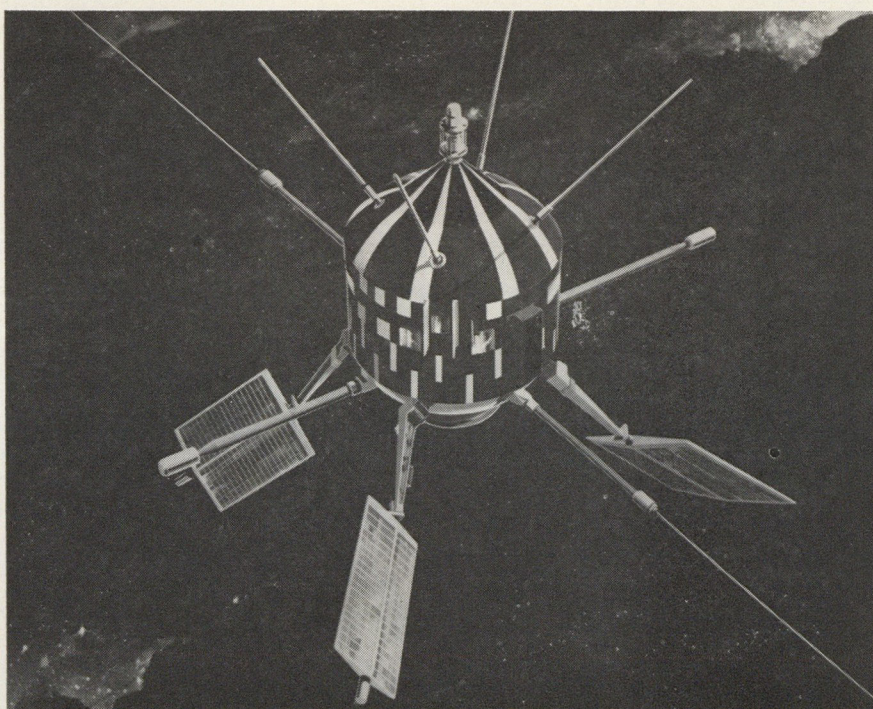
of their present and future needs. While we would launch this spacecraft for them, it would be at their expense.

An advance NASA-State Department team has just returned from preliminary discussions with the Germans, the British, the French, the Dutch, the Italians, and ESRO, and has made clear the opportunity which has been

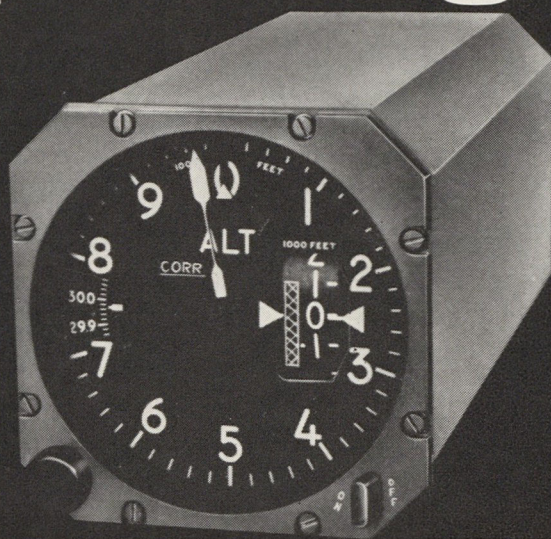
put before Europe. However, it is too early to know how the proposal will be received and acted upon.

Hopefully, our efforts will stimulate constructive activities abroad, supplement our own resources of brain and purse, further the common destiny in space, and reduce in some measure the political and economic strains that divide us here on earth. ☆☆☆

Seventy nations on every continent have participated in NASA's programs of international cooperation on space projects. Plans are in discussion stage between NASA and the European Space Research Organization (ESRO) on ambitious projects which are beyond the means of any single nation. Indicative of cooperative space projects is this artist's sketch of the second International Satellite, a joint United Kingdom-U.S. spacecraft designed to acquire information on the ionosphere and how it is affected by solar radiation.



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Great Britain and Australia, who have ordered the variable-sweep F-111, are feeling the effects of inflation, U.S.-style, with the rising costs of the aircraft . . . 11 countries are collaborating with Great Britain in design and development of various aircraft . . . U.S. Defense Secretary outlines the state of the country's airpower . . . The new HueyCobra helicopter will begin service in U.S. Army . . . U.S. Navy reorganization will change its bureaus to commands . . . Leading world airline officials are evaluating U.S. SST development, and nuclear-powered clipper ships may carry travelers to the moon by the year 2000 . . .

Rocketing Costs and Clipper Rockets

BY JUDITH DAWSON, Editorial Assistant

The cost of the F-111 fighter has risen at least two-thirds above the estimates initially submitted by General Dynamics Corporation, contractor for the aircraft. When the TFX contract was awarded to General Dynamics in 1962, U.S. Secretary of Defense Robert S. McNamara said he considered the firm's cost estimates "more realistic" than those submitted by the Boeing Company.

One indication of how costs have mounted is the comparison between the price first quoted to Australia in 1963 when that country placed an order for 24 F-111s and the amount Britain now expects to pay for 50 airplanes.

The original price for Australia's order was given as \$125,000,000 for its 24 aircraft, plus a year's supply of spares, ground-support equipment, and training. This would put the unit price at about \$5,000,000.

In the announcement in late February of Britain's decision to buy the F-111, the unit price was stated as \$5,950,000. Six days later, however, British Defence Minister Denis Healey told the House of Commons that the total cost of the order, which includes initial spares and support equipment, together with Britain's share of research-and-development costs, will be about \$420,000,000, averaging \$8,400,000 per plane.

On the same day that Healey disclosed the \$420,000,000 figure, Australia's Air Minister, Peter Howson, announced that his Government may have to pay 70 percent more for its F-111s than the price originally quoted. Thus, its contract with the U.S. appar-

ently requires Australia also to pay a share of R&D costs.

In response to queries about the Australian statement, the U.S. Defense Department said the original figure had been only an estimate and not part of the original agreement, although it was quoted in 2 DoD news releases late in 1963. Presumably, then, the current costs being quoted in Britain and Australia are estimates, too, subject to further increases until the stubborn development problems surrounding the aircraft are overcome or original performance specifications are compromised.

Last spring, Congress was told that DoD's long-range procurement plans called for 1,100 F-111As for the U.S. Air Force and 500 F-111Bs for the U.S. Navy, at a unit cost of \$4,500,000, including spares.

It would be interesting to know how the British and Australians' share of R&D costs is being determined. It may be that the steep rise in costs to

Britain and Australia results from an unannounced reduction in the total number the U.S. expects to buy.

* * *

Increased British aerospace cooperation with other countries is materializing in the form of agreements and negotiations between the British aerospace industry and companies in 11 other countries.

The international collaboration in aircraft, missile, and helicopter development and manufacture results from recent recommendations put down in the Plowden Committee's report on the state of the British aircraft industry and its current and future role in the country's economy. In its report, the committee urged the aircraft industry to collaborate on a wide scale with European countries in order to evolve an aerospace industry capable of competing with the U.S.

Of the 49 cooperative agreements in force at the first of this year, 30 are (Continued on following page)



Variable-sweep-wing F-111A fighter has run into stubborn development problems which have increased its cost two-thirds over General Dynamics Corporation's original estimates. Australia and Britain have ordered the F-111.



Northrop F-5A Freedom Fighter of the 4503d "Skoshi Tiger" Squadron in South Vietnam drops 3 general-purpose bombs on a Viet Cong target. Originally scheduled for a 120-day combat test, the F-5s will now remain in Vietnam indefinitely, USAF has announced. A plan to send additional Freedom Fighters to Vietnam, to be flown by a joint Air Force-VNAF unit under USAF control, is reported under study by U.S. military officials.

with European countries, including Belgium, France, Germany, Holland, Italy, Sweden, and Yugoslavia. Aerospace agreements are also in force with Australia, India, Japan, and the United States.

Types of agreements include licensed production, contracting, design and development, manufacture, feasibility studies, and technical liaison. They cover airframes, engines, space, missiles, hovercraft, and ramjets. These range from the "Entente Concordiale" with France for the building of a 1,450-mph (2,330 km/hr) supersonic airliner for the 1970s; to lift engines for vertical-takeoff jets in the U.S., Germany,

and France; to license agreements on the building of British hovercraft in the U.S. and Japan.

* * *

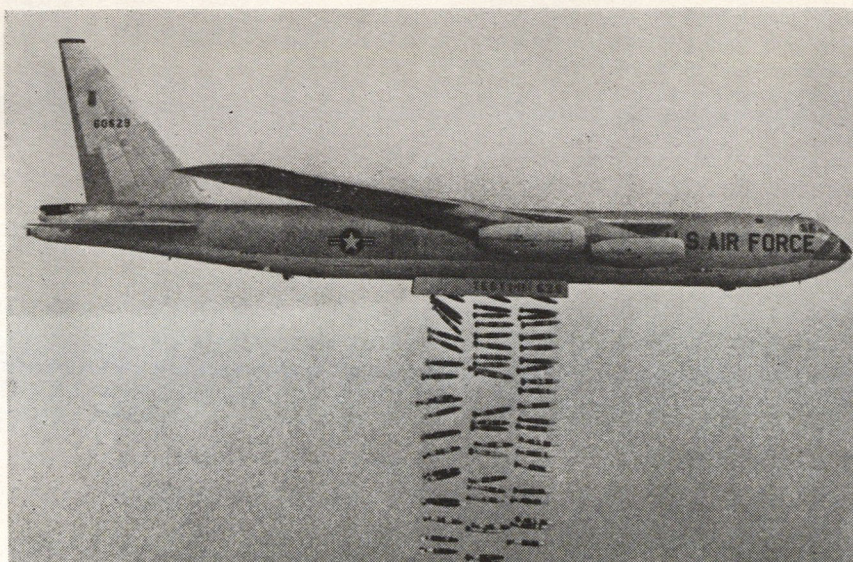
Improvements in USAF tactical forces to enable them to "engage in sustained combat over extended periods of time" have been outlined by U.S. Defense Secretary Robert McNamara before the U.S. House and Senate Armed Services Committees.

Aircraft utilization rates can be boosted by adding more aircrews and maintenance personnel per wing, and providing more ground-support equipment and spare parts, he said in his annual defense posture statement.

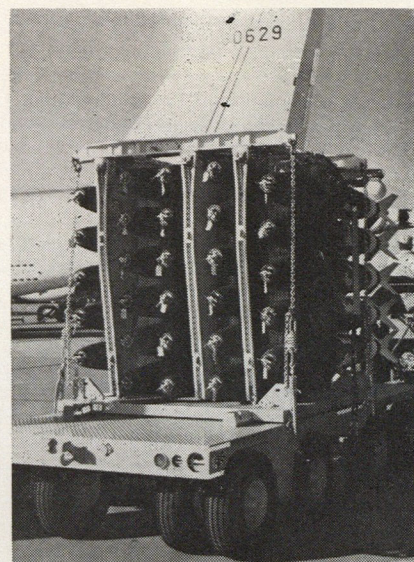
This will make it possible for training units to operate with fewer aircraft, freeing a greater percentage for use in combat, achieving a significant increase in effective combat airpower at relatively modest cost increases.

To train more aircrews will, however, require an increase in aircraft for combat crew training units.

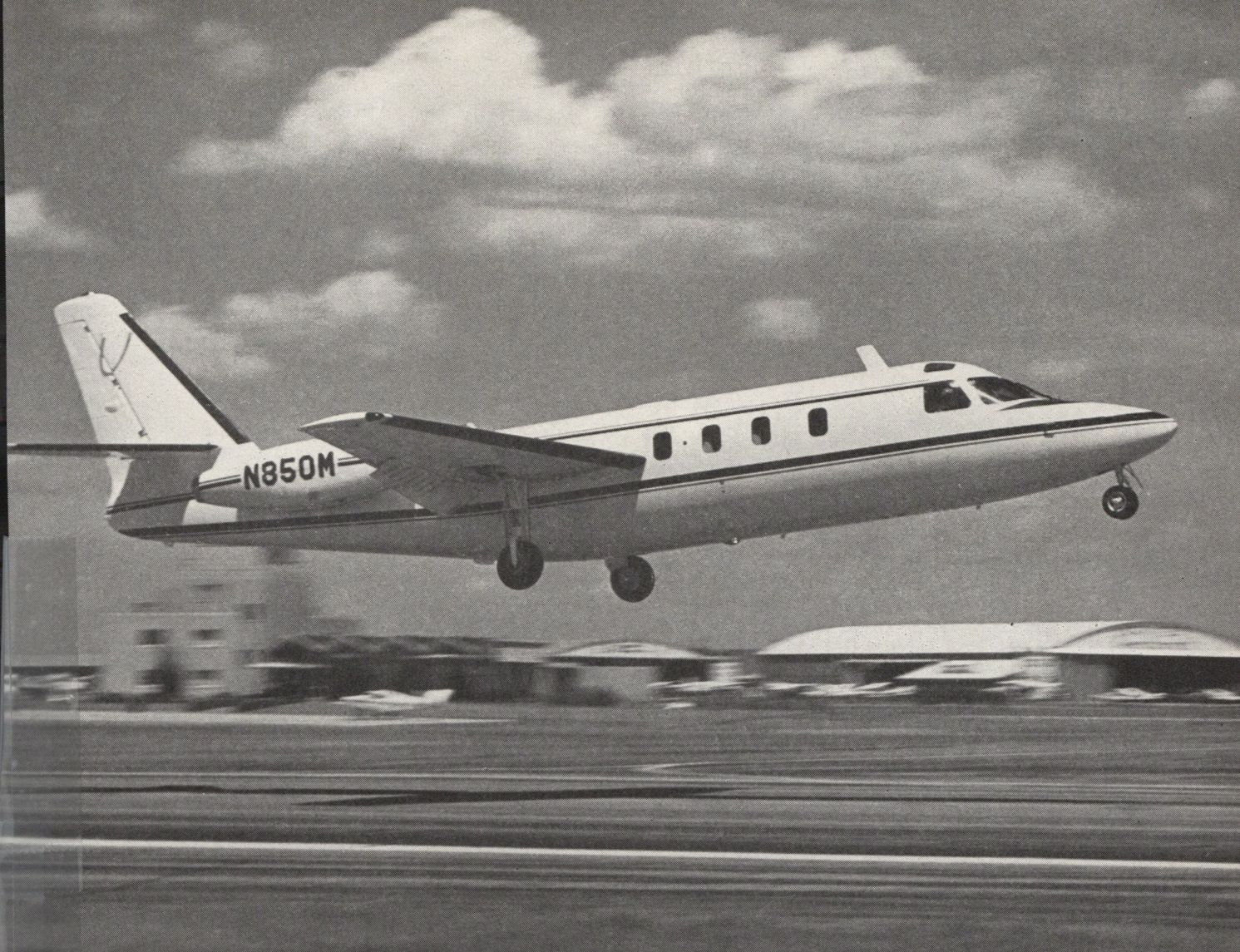
"We are undertaking a substantial expansion of the advanced flying training base for the active forces," he said, "to be accomplished initially by using aircraft previously scheduled for transfer to the Air National Guard and, later, by increased deliveries from (Continued on page 44)



B-52 Stratofort, modified at Boeing's Wichita, Kansas, plant to carry 57 percent greater conventional-power payload, releases 500-pound (230 kg) bombs in test at Eglin Air Force Base, Florida. Modified B-52 will carry 60,000 pounds (27,000 kg) internally and on wing racks, compared with present 38,250 pounds (17,350 kg).



Package concept, developed by Boeing, permits loading B-52s in one-third the time normally needed. Three pre-loaded racks like these will fill the bomb bay.



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Chairborne corps may yet become a reality, as demonstrated by Robert Courter, rocket-belt supervisor for Bell Aerosystems Company of Buffalo, New York. Courter sits comfortably in the chair while being propelled by rockets in controlled free-flight test. The rocket-propelled flying chair was designed to carry men and equipment on earth or over the moon's surface. The power pack is also employed on a "pogo stick" in which the operator stands up. The test pictured above was conducted recently at Niagara Falls, New York, International Airport.

new procurement. The total number of aircraft assigned to this role will be raised from about 280 as of June 30, 1965, to about 500 in the Fiscal Year 1967-71 period.

"To offset the delay in the transfer of aircraft from the active forces, we now plan to retain more [Republic] F-84s and [North American] F-86s in the Guard until the [North American] F-100s and [Republic] F-105s become available," Mr. McNamara explained. "The Guard will have about 570 tactical fighters during the FY 1966-71 period."

Tactical Aircraft. The active tactical fighter force will remain at 24 wings, but with certain changes within the force structure. Procurement of McDonnell F-4s will continue, to be joined by initial deliveries of production General Dynamics F-111s early next year. But tactical air forces need a "better balance" between multipurpose aircraft like the F-4 and F-111 and "more specialized aircraft" designed primarily for ground operations, he said.

"Accordingly, we now propose to procure the [Ling-Temco-Vought] A-7 as an attack aircraft for the Air Force. The subsonic aircraft offers several desirable operational features such as relatively long range, a large ord-

nance-carrying capability, long loiter time, and a good close ground-support capability."

Exactly how many A-7s USAF will get is still to be determined. Seven A-7s are being bought initially for test and modification to Air Force requirements, including addition of a small afterburner to the Pratt & Whitney TF30 engine. First production quantities will be purchased from Fiscal Year 1967 funds.

To cover attrition of the McDonnell RF-101 Voodoos in Vietnam and increased training needs, Douglas RB-66s will be retained in the inventory until they are replaced by RF-4C production, he said. A reconnaissance version of the F-111 is being developed for future replacement needs.

In summary, the Secretary said, "The Air Force will procure a total of 780 tactical, air control, and reconnaissance aircraft for the general-purpose forces in Fiscal Year 1966, at a total cost of \$2,175,000. For FY 1967, 485 aircraft costing \$1,572,000 are requested for these forces."

Air Defense. The "major phase-down" in the active fighter-interceptor force begun last year will continue, Mr. McNamara declared. The Air Guard interceptor force will remain at about its present level, with Northrop F-89

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Scorpions being replaced by Convair F-102s "on a somewhat faster schedule than projected a year ago." All F-89s will be retired by the end of the next fiscal year.

A "substantial deployment" of the Lockheed YF-12A interceptor would "greatly increase the effectiveness of our antibomber defenses," Mr. McNamara remarked, but its cost of about \$6,500,000,000 over the 1967-71 period would be justified "only if we were to decide to seek a very large and effective damage-limiting program, and then only if the Soviets were to increase their bomber threat in both numbers and quality."

Instead, DoD plans to continue the YF-12A flight-test program with the 3 aircraft now on hand. An interceptor version of the F-111, equipped with the Hughes AIM-47 missile developed for the YF-12A, is an alternative possibility.

Military Airlift. "[The Defense Department] is now proposing an expanded airlift program which will provide by FY 1973 an equivalent 30-day lift capability from West Coast airfields to Southeast Asia more than 10 times greater than that available in FY 1961. . . . This increase is to be achieved through 2 major changes in the program.

"First, we are now proposing a large increase in the [Lockheed] C-5A program. Second . . . we have substantially increased the planned utilization rate of airlift aircraft" with Military Airlift Command's Lockheed C-130s, Boeing C-135s, and Lockheed C-141s going to 8 hours per day and Tactical Air Command's C-130Es to 5 hours a day.

By July 1967, he said, USAF will have 30 squadrons of C-130s of about 16 aircraft each, of which all but 2 squadrons will be assigned to TAC. They will be augmented by Air Force Reserve C-119s, which will be retained at least until June 1968, when "we will have many hundreds of C-130s and C-141s in the active forces."

Douglas C-124s, which provide a "limited but valuable tactical airlift capability," are gradually being transferred to the Reserves, he said. "Later, as the new C-5As are delivered to the active forces, a large number of C-130s will be transferred to the Reserve Forces to replace the C-124s."

Eight C-5As will be bought in FY 1967, he said, with the first large procurement to be made in FY 1968. Military Airlift Command is now programmed to get 14 squadrons of C-141s (224 aircraft), with production being increased from 7 to 9 aircraft a month to meet anticipated attrition resulting from higher daily utilization rate.

Douglas C-133s and C-124s and



The U. S. Army has ordered Bell Helicopter's UH-1H HueyCobra, the world's first aerial-weapons-platform helicopter. A modified version of the UH-1B Iroquois, the HueyCobra will be deployed directly to UH-1-series field units.

Boeing C-135s will continue to be phased out of the active forces as new aircraft become available, although some C-124 Globemasters will be retained to sustain MAC's heavy airlift capability during initial phases of the C-5A phase-in.

* * *

The HueyCobra, the world's first helicopter developed as an aerial weapons platform, has been ordered by the U. S. Army. Bell Helicopter's UH-1H HueyCobra is scheduled for assignment to Army units for armed support missions.

Featuring functional streamlining, record-breaking speed, and extensive firepower capabilities, the HueyCobra was developed by Bell as a modified version of the Army's armed UH-1B Iroquois, which is now being used throughout Vietnam. It can be deployed directly from production to field units now equipped with UH-1 series helicopters.

The company-built prototype has demonstrated sustained level flight speeds of 200 miles per hour (320 km/hr) in company tests. The speed attainments are considerably better than the world's speed record for helicopters of the HueyCobra's weight class, 180.1 miles per hour (289.8 km/hr), set by the Bell UH-1D Iroquois in 1964.

The new helicopter was unveiled last September. Bell's vice president for military contracts, Hans Weichsel, said the UH-1H, in comparison with

armed UH-1Bs which are now in service, on missions of 50 nautical miles (92.5 km) will reach the objective area in about half the time, deliver twice the firepower to the objective, operate in the objective area 3 times as long, and provide substantially improved protection for the aircraft and crew.

The 2-place HueyCobra employs a Lycoming T53-L-13 gas-turbine engine. Armament consists of a high-rate-of-fire General Electric Minigun; other ordnance, such as automatic grenade launcher and aerial rockets, can be installed.

* * *

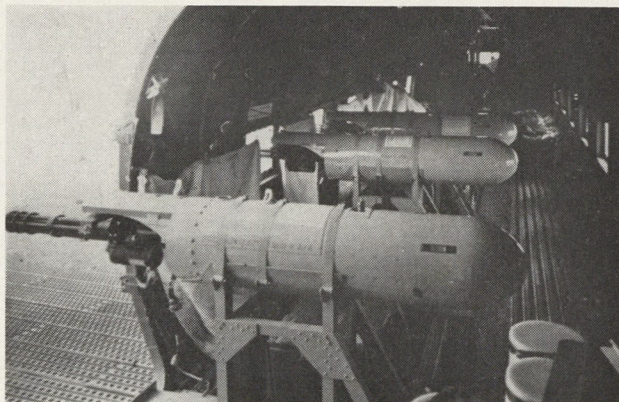
Technical officials from leading world airlines are being consulted throughout the development of the Lockheed supersonic transport (SST). The U.S. Federal Aviation Agency has emphasized this aspect of international cooperation on the U.S. SST program.

Lockheed-California Company in Burbank hosted technical officials representing 19 airlines outside the U.S. in early March, the largest gathering of its kind ever to study a proposed airliner. Similar meetings are being conducted with the 10 major U.S. airlines.

Under the chairmanship of Air Canada's J. T. Dymont, who also heads the International Air Transport Association SST Committee, the overseas airlines SST evaluation group studied the latest technical progress on the L-2000-7 double-delta-wing design.

(Continued on following page)

Miniguns, for use on the new UH-1H HueyCobra, to be procured by the U. S. Army, are shown here aboard an AC-47 aircraft recently assigned to Vietnam. The General Electric 7.62-mm Miniguns are capable of firing 6,000 rounds per minute.



Lockheed design engineers made available up-to-date information concerning SST performance, basic aerodynamics, environmental systems, airline operational requirements, fuel, flight control, electrical and hydraulic systems, and handling characteristics.

Airline engineering and pilot personnel coming to Burbank for the Lockheed SST meetings represented Australia, Britain, Belgium, Canada, France, West Germany, Ireland, India, Israel, Italy, Japan, Mexico, The Netherlands, Pakistan, Scandinavia, Spain, and Switzerland.

* * *

Malaysia will purchase 20 Canadian CL-41 jet-powered trainer aircraft from Canadair Ltd. in Montreal. This constitutes one of the country's largest sales of Canadian aircraft.

The selection of the CL-41, designated the Tutor, culminates a 2½-year study by Malaysian military authorities of competitive airplanes in the U.S., England, and Italy. The aircraft is the same as that used by the Royal Canadian Air Force.

Delivery of the aircraft will begin in the spring of 1967.

* * *

The U.S. Navy Department is reorganizing its material establishment in order to further centralize authority in the Office of the Chief of Naval Operations, the top military man in the Navy.

The Naval Material Support Establishment (NMSE) now consists of the Office of the Chief of Naval Material, the Bureau of Naval Weapons, the Bureau of Ships, the Bureau of Supplies and Accounts, the Bureau of

Airlifting an entire Army division anywhere in the world in 7 days will be possible with a mixture of C-141s, shown here, and C-5As employed by the U.S. Military Airlift Command. At right, a 105-mm howitzer is being raised to a loader which will roll it into the Lockheed fanjet during U.S. Army "operational readiness" tests at Fort Campbell, Kentucky.



Yards and Docks, and field activities associated with these bureaus.

The material bureaus, which are coordinated under the Chief of Naval Material, have reported through the latter directly to the Secretary of the Navy, the top civilian man in the Navy. Under the reorganization, the 4 bureaus will become 6 "commands" and will report through the Chief of Naval Material directly to the Chief of Naval Operations. NMSE will become Naval Material Command.

The 6 commands will include Air Systems, Ship Systems, Electronic Systems, Ordnance Systems, Supply Systems, and Facilities Engineering Commands. Although the titles of the

Bureau of Supplies and Accounts and the Bureau of Yards and Docks are changed by the new organization, there will be no major reassignment of the responsibilities of those bureaus, the Navy Department has emphasized.

Prior to the establishment of the NMSE in 1963, each of the material bureaus reported directly to the Secretary of the Navy and there was no coordinating authority for their efforts below the Secretarial level. At that time, the responsibilities of the Chief of Naval Material were broadened to include command over the previously autonomous material bureaus. The current reorganization is a further refinement which gives the Chief of Naval Operations authority over the NMSE as well as the Bureau of Naval Personnel and Bureau of Medicine and Surgery. Personnel and Medicine will retain bureau status.

* * *

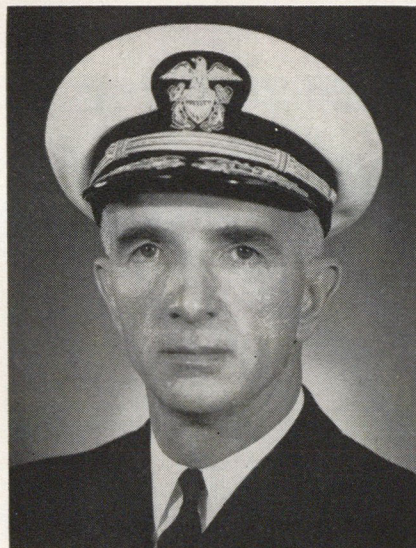
It may soon be possible for an entire Army division to be airlifted overseas in 7 days, as opposed to the 30 now required, according to the chief of the U.S. Military Airlift Command (MAC), General Howell M. Estes, Jr.

MAC plans to employ a mixture of the new Lockheed C-141 StarLifters and C-5As, eliminating stopovers now required for shorter-range propeller-driven aircraft.

Some island hopping has been eliminated with use of 60 of the fanjet C-141s being operated by MAC. The Command is now receiving C-141s at the rate of 9 per month. Plans call for 14 C-141 squadrons in Fiscal Year 1969, which will reduce division transportation to 24 days. C-5A procurement is expected in Fiscal Year 1971, allowing a greater carrying capacity, especially for oversized equipment such as heavy construction machinery.

CORRECTION

The biographical material describing the author of "The Navy and Limited Warfare" on page 22 of the April issue was incorrect. Our apologies to Admiral Miller. The correct biography, with Admiral Miller's picture, appears below.—The Editors



Rear Admiral George H. Miller, a 1933 Naval Academy graduate, served during World War II as Damage Control Officer and Executive Officer on the USS HOUSTON and was awarded the Navy Cross for extraordinary heroism during a Japanese attack off Formosa in late 1944. Admiral Miller commanded the USS HOLLISTER in 1950 and was Plans Officer for the Seventh Fleet during the Korean War. In 1952 he reported to CNO as head of the Strategic Studies Branch. He commanded a destroyer division in 1954-55, then returned to the Pentagon as a member of the General Planning Group. He later commanded Surface Striking Forces, Seventh Fleet, in the Pacific, until 1960 when he served on the Joint Strategic Survey Council. From 1962 until his present job as Director, Long Range Objectives, OCNO, in 1964, he was Chief of Staff, U.S. Forces, Japan.

General Estes said it would take all the C-141 squadrons plus about 6 C-5A squadrons to raise MAC capability to the 7-day goal. By 1971, the Air Force expects to have 3 C-5A squadrons, reducing the airlift time to 15 days. Another 3 would reduce the time to 7 days.

A typical Army division is described by General Estes as consisting of 21,042 troops, 28,720 tons (26,054 mt) of oversized cargo, and 6,930 tons (6,286 mt) of other cargo.

* * *

Self-folding tires to meet expected design demands of "the next generation of aircraft" have been developed by the B. F. Goodrich Company and the Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Dayton, Ohio.

The new tires take up only one-half to three-fourths as much space in the wheel well of a plane with the landing gear retracted, but unfold to standard size for takeoffs and landings. This saving in space will enable aircraft designers to utilize more of the gradually diminishing wing cavity for fuel or to allow more room for equipment or baggage within the fuselage.

The tires, which have passed preliminary tests, can be used on existing aircraft to increase the size of the tires without increasing the space they occupy. This would provide higher flotation on marginal landing areas or increase the load-carrying capacity of the plane. In some instances, the higher flotation provided by the larger-size tires will enable planes to land in previously restricted areas.

When the landing gear is lowered, the tire is automatically inflated and expands to its proper size. Smaller sizes increase in diameter by 30 percent, larger sizes by 50 percent.



Future aircraft may employ B. F. Goodrich self-folding tire which occupies one-half to three-fourths the space of conventional tire during flight, but inflates to full size, left, for takeoff and landing.

This development is a result of a new complex molding process in which the sidewalls of the tire are folded under the tread, which has a circumference only slightly larger than that of the wheel on which it is mounted.

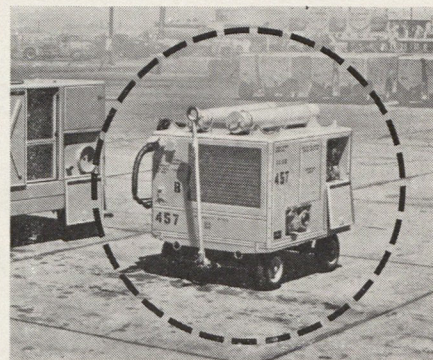
* * *

By the year 2000, nuclear-powered clipper rockets will permit travelers to make a 24-hour trip in orbit about the earth for \$1,250, or a 6-day voyage to the moon for \$10,000, Wesley A. Kuhrt, Director of Research at United Aircraft Research Laboratories, forecast recently.

He predicted a space budget of \$100,000,000,000 by Fiscal Year 2001 and said that "by the year 2000 we will be in a technical and financial position to travel extensively throughout the solar system."

(Continued on following page)

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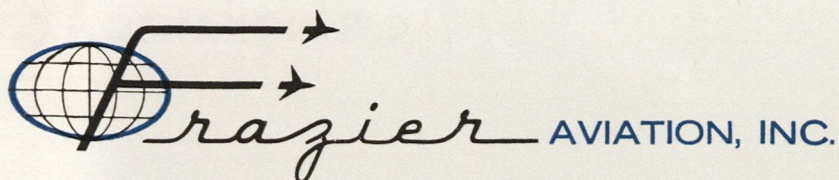
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Key to the nuclear clipper ship for travel to the earth's near neighbors will be introduction of a single-stage gas-core nuclear rocket, which he called the "nuclear light-bulb engine."

The gas-core rocket concept involves a controlled reaction of nuclear fuel in gaseous form at temperatures in the tens of thousands of degrees. The extreme heat is transferred to hydrogen propellant, which is expanded through the exhaust nozzle to deliver a performance level many times that now possible with chemical rockets. No nuclear explosion or contamination is involved. The walls of the rocket engine are protected from the otherwise destructive temperatures by a layer of cold gas. Investigations of the gaseous nuclear-rocket concept have been under way for several years at United Aircraft Research Laboratories, East Hartford, Connecticut.

"The space-style clipper ship will be fully adapted to commercial ventures by the year 2000 and will provide passenger service for well-to-do tourists and modestly financed scientists and explorers, as well as handling the day-to-day support of larger national programs involving space stations and near planet outposts," Kuhrt said. "The propulsion system will be as reliable as our present jet engines in transport operations."

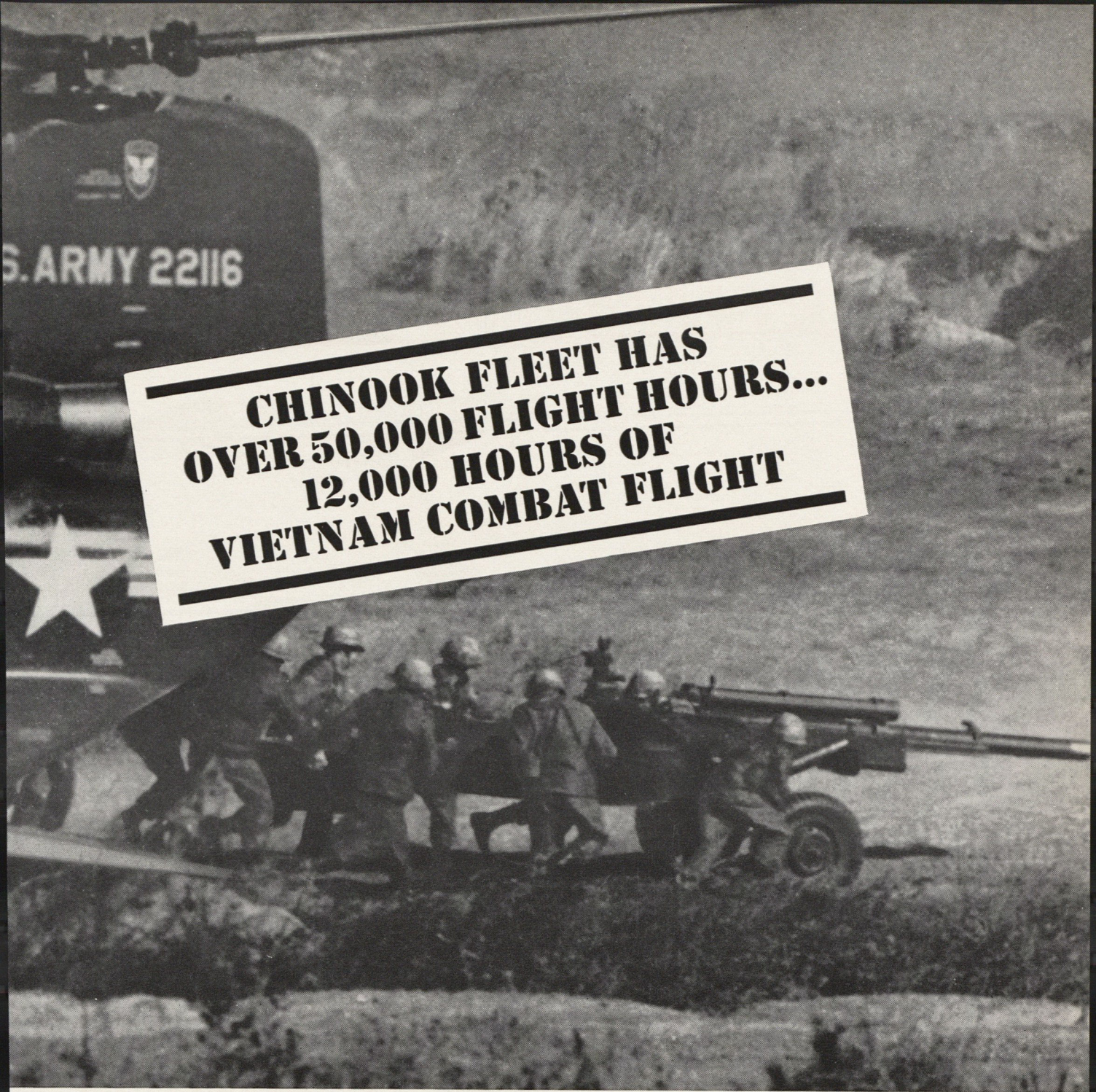
Because of the safety system which prevents release of any nuclear contamination during flight, the rocket would be able to take off and accelerate through the atmosphere.

Kuhrt pointed out that the ticket cost, computed in 1960 dollars, for a 24-hour earth-orbit trip for 200 passengers would be \$1,250 each. Round-trip tickets for a visit to the moon would cost \$10,000 each on the basis of 35 persons making the voyage. Voyages by 20 space travelers to neighboring planets would cost \$32,000 each for Venus and require a total trip time of 18 months; it would cost \$35,000 each for the round trip to Mars and involve 24 months of traveling time. A space clipper express to Mars in 11 months would cost a bit more—\$70,000.

The nuclear clipper ships would need to be refueled 2 or more times while in earth orbit before setting off for the moon or further destinations within the inner solar system.

As to interstellar transportation, Kuhrt doubted that it would be advisable even by the year 2000 to launch the first unmanned probe to the nearest star because the space vehicle would take about 260 years to reach its destination under the power of an optimum electric propulsion system, the type regarded as superior for extremely deep probes into space.





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To pin down the enemy, the Chinook can carry—into areas inaccessible to surface transport—a complete artillery section, including two howitzers, ammunition and gun crews. All in one load.

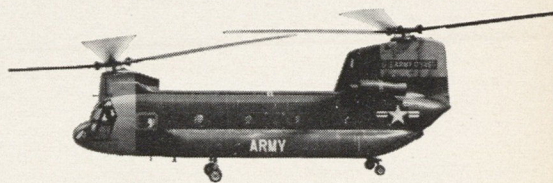
Hitting the enemy with troops where he least expects it, the Chinook can debark a fully-equipped combat platoon. And then lift away in seconds as the last man comes charging off the rear loading ramp.

Over 30 feet long and 7½ feet wide, the Chinook's cargo compartment can be loaded with Pershing Missile system components, or with infantry support weapons or the latest combat vehicles. Because of its large capacity, the Chinook reduces the number of helicopters needed for an air mobile mission, lessens traffic congestion and permits the use of smaller assault landing sites.

Now operating with the 1st Cavalry Division (Airmobile) in Viet Nam, the CH-47A Chinook has become the U.S. Army's standard medium transport helicopter.

The U.S. Army's foresight, guidance, and support, joined with the resources, man-

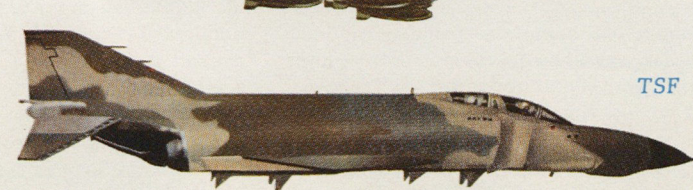
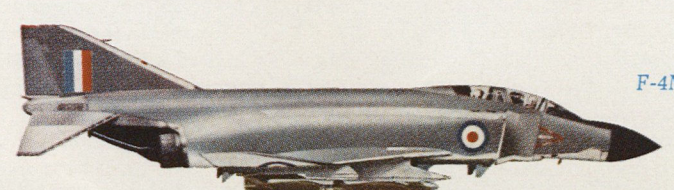
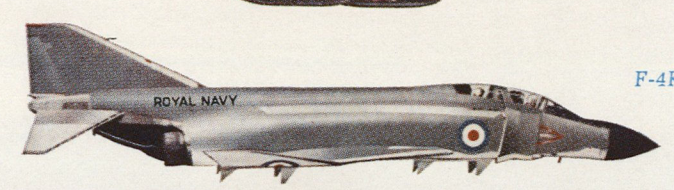
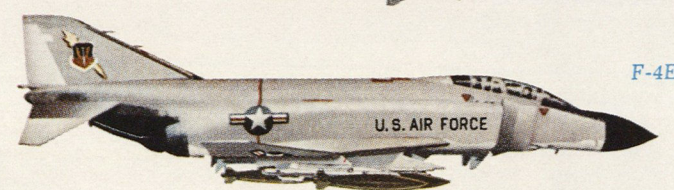
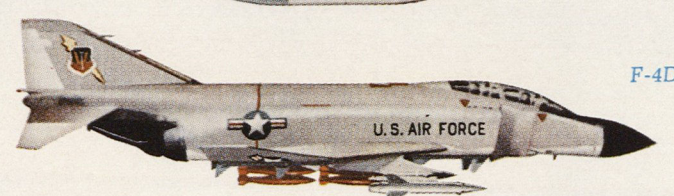
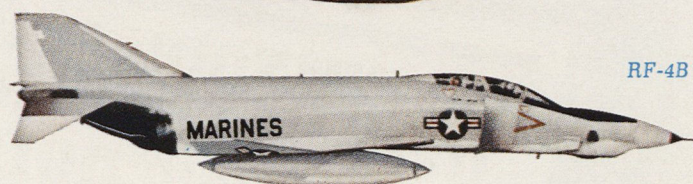
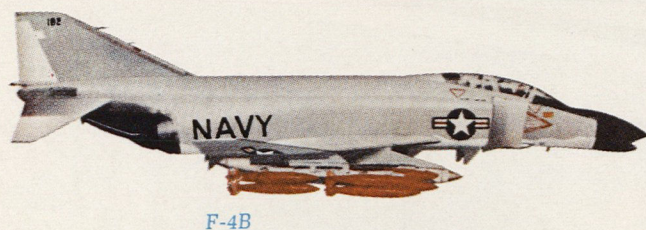
agement, and technical capabilities of the Boeing Company, have made the Chinook a performance-tested tactical transport.



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