

FEBRUARY 1966

Air Force/Space Digest



International

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

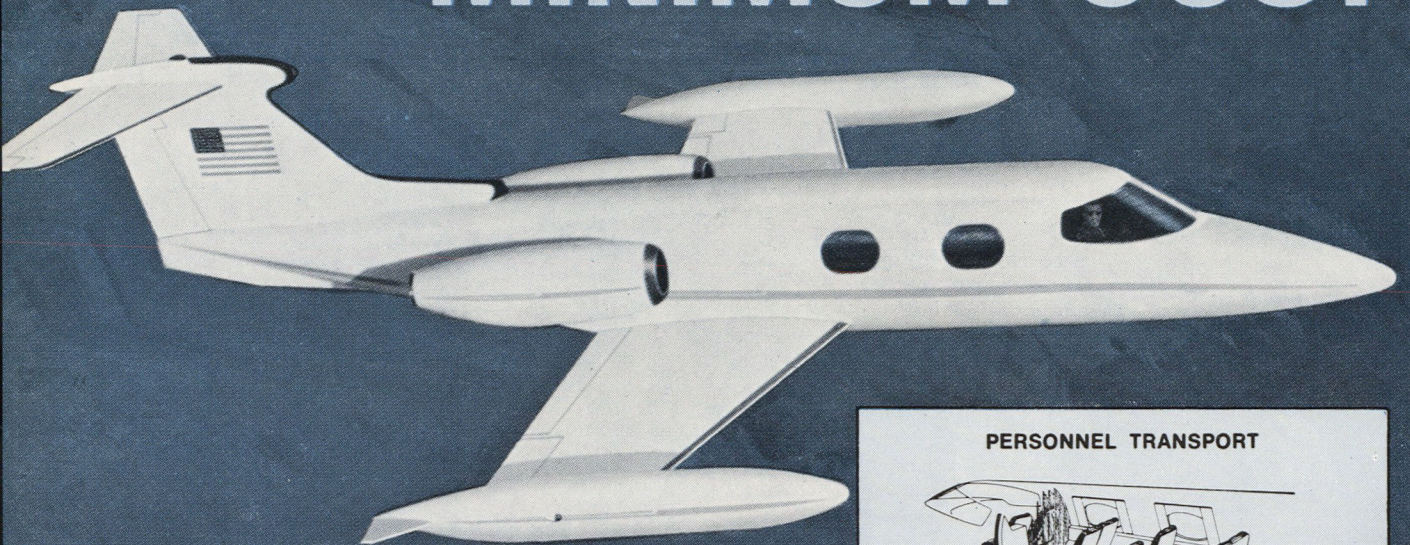


**SPECIAL
ISSUE**

BUSINESS AIRCRAFT

Design and sales of jet-age corporate aircraft are on the rapid rise to meet the expanding market represented by the hundreds of thousands of business firms that can profitably use fast executive transport. Above, Beechcraft Queen Air Model 80 over the Grand Canyon. Inside, a special report on what's new and coming in this burgeoning field.

MAXIMUM EFFECTIVITY MINIMUM COST

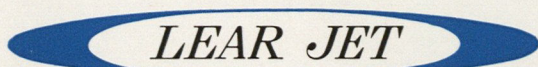


HIGH PERFORMANCE MULTI-PURPOSE AIRCRAFT

MODEL 24 PERFORMANCE

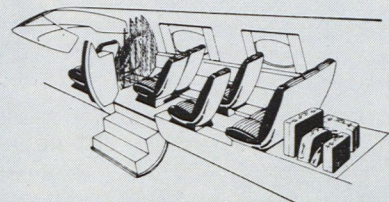
Maximum true air speed (Mach = .81 @ 25,000 ft.)	488 kts.
Normal cruise speed	455 kts.
Stall speed (landing with crew, 6 passengers, baggage and 45 minute reserve)	85 kts.
Range with 45 minute reserve	1,660 nm
Service ceiling (gross weight)	45,000 ft.
Engine out service ceiling (gross weight)	25,000 ft.
Time to climb to 41,000 ft.	16 minutes
Time to climb to 35,000 ft.	10 minutes
Rate of climb	6,100 fpm.
Sea level single engine rate of climb	1,675 fpm.
Take-off over 35' obstacle	2,800 ft.
Landing distance over 50 ft. obstacle	2,850 ft.

Write for CAPSULE REPORT AND MILITARY INFORMATION GUIDE

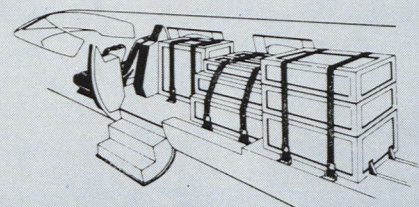


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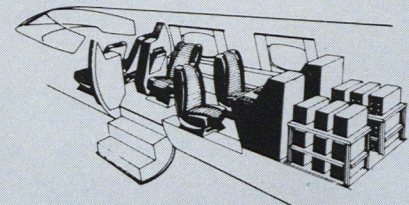
PERSONNEL TRANSPORT



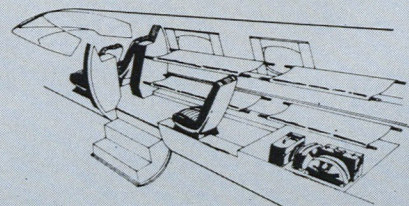
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Air Force/Space Digest International



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By Claude Witze, Senior Editor

This month's "Letter from Washington" covers the White House Conference on International Cooperation, the U.S. contribution to International Cooperation Year. The meeting was called by President Johnson and was attended by some 5,000 U.S. leaders, scholars, and industrialists. Their assignment was to search out every avenue that could lead to peace, with emphasis on joint projects already under way or planned in space.

U.S. GENERAL AVIATION—BUSY HIGHWAY IN THE SKY..... 7

By Robert Reynolds, Asst. Administrator for General Aviation Affairs, FAA



The U.S. Government organization responsible for overseeing the regulation and coordination of aviation in the United States, the Federal Aviation Agency, defines general aviation as air transport of all kinds except military and commercial operations. The man responsible for this activity, which accounts for an amazing 82.7 percent of all aviation in the U.S., says it is still a sleeping giant, with great potential for aiding the advance of underdeveloped areas in the U.S., as well as in the "emerging world" overseas.

JET-AGE BUSINESS AIRCRAFT—AN EXPANDING MARKET..... 13

By Russell Hawkes

Although by authoritative estimate 390,000 U.S. companies are prospects for the purchase of corporate aircraft, only 40,000 are now using some sort of executive transport. Consequently, the top talent of U.S. and other Free World manufacturers is being put to work designing and selling a large assortment of business aircraft, with heavy emphasis on large turbine-engine transports that equal the airlines in speed and comfort.

A GALLERY OF GENERAL AVIATION..... 18

By John Pope

This necessarily selective gallery lists and provides information about most models of the more than 30,000 aircraft registered to business corporations in the United States. Ranging from single piston-engine aircraft to high-powered pure jets, and manufactured by organizations from all over the Free World, they make up the most dynamic and sophisticated segment of civil aviation in the United States.

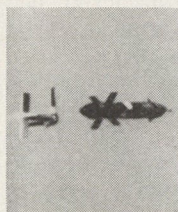
SPEAKING OF SPACE..... 34

By William Leavitt, Associate Editor

Satellite direct-broadcast of television programs teaching basic skills could help peoples of the emerging countries to enter the twentieth century. The U. S. Administration is quietly studying the potential of sponsoring such a spaceborne educational video system. The idea underscores the enormous utility of space technology, married to television and education techniques, for advancing the human condition.

AEROSPACE REVIEW..... 39

By Judith Dawson



Economy is taking its toll of the USAF bomber force, but in prospect is a "dual-purpose" bomber replacement for the outgoing B-58s and older B-52s—the FB-111 . . . Satellite communications, with transmitting power 3 times that of Early Bird, will soon be established in the Pacific . . . The XB-70 research craft sets another speed record . . . Fiberglass-reinforced plastic may eventually replace heavier metals in airframe designs . . . And rocket-powered mail delivery is another topic that is examined in this month's report.

Letter from Washington

ICY stands for International Cooperation Year. President Johnson's contribution was the calling of a White House Conference on International Cooperation, with what he called "the assignment of the century." About 5,000 American leaders, scholars, and industrialists took part in the meeting, to search out every avenue that could lead to peace. Prominent attention was given to the joint projects already under way and planned in space. There was a call for the United States to launch more ambitious programs, using the talents and facilities of both this country and Europe. President Johnson reacted at once, proposing to Chancellor Erhard . . .

Let's Explore Space Together

BY CLAUDE WITZE, Senior Editor

Washington, D.C., Dec. 22

President Lyndon B. Johnson made headlines a few days ago by offering West Germany a role in pioneering space research. It was the kind of gesture that is characteristic of Mr. Johnson and has resulted in an immediate flood of speculation.

The President was talking to Chancellor Ludwig Erhard, in a toast at a state dinner climaxing the West German's official visit to Washington. Mr. Johnson first noted that the two Governments had agreed on launching a German-built satellite rocket to study radiation belts in space. Then he proposed further cooperation on probes to Jupiter and the sun.

First reaction was that Mr. Johnson was using the more or less virgin area of space as a substitute for this earth in meeting the West German demand for a role and voice in tomorrow's technology. Chancellor Erhard came here to discuss his nation's hopes for a greater nuclear role in NATO, among other things. It is reported that the results of his effort will be "minimal."

On the other hand, Mr. Johnson's offer to share the exploration of the heavens is interpreted as a bid to give European science and industry a useful and peaceful field of exploitation.

There is, in the immediate background, the recent White House Conference on International Cooperation. This was a 3-day meeting, held at the beginning of December. It was called by President Johnson more than a year ago to carry out what he called "the as-

signment of the century." This precise mission was "to search and explore" every "avenue of cooperation that could lead to peace."

The origin of the conference goes back a couple of years to a suggestion by Prime Minister Nehru of India for an International Cooperation Year (ICY). This was approved by the United Nations, and President Johnson followed up with his program for the White House Conference.

At the outset, an attendance of 2,000 American citizens and Government officials was predicted. Actually, more than 5,000 persons flooded the huge hotel where the meeting was held in Washington. Most of the American press described the session as a "town meeting." Like that old American institution, the meeting produced a great deal of talk, some controversy, and few results.

The organization, set up more than a year ago, provided for 30 working committees, each dealing with a different aspect of international cooperation. The subjects ranged from agriculture and aviation to population problems and the conservation of natural resources. The committees met all through 1965 and prepared recommendations. These were disclosed and discussed at separate panel meetings during the conference. They offered both a review of the present situation and a preview of the next steps needed to strengthen international cooperation.

The persons appointed to serve on these committees were representative

of the most competent Americans, drawn from industry, the universities, government agencies, and welfare organizations. Speakers at the conference included Vice President Hubert H. Humphrey, Secretary of State Dean Rusk, Special Presidential Assistant McGeorge Bundy, and Arthur S. Goldberg, U.S. Ambassador to the United Nations.

Each of the 30 committee reports was discussed at a panel meeting during the conference. Among the prominent persons taking part in these sessions were Chief Justice Earl Warren of the U.S. Supreme Court, Vice President Humphrey, and John D. Rockefeller. Also, there were Isidor I. Rabi, the famous physicist, and David E. Bell, the AID Administrator.

It was the report of the Committee on Space that President Johnson had for background when he made his offer to share projects with West Germany during Chancellor Erhard's visit. The committee was headed by Joseph V. Charyk, President of the Communications Satellite Corporation. This is the organization set up by Congress to operate America's pioneer venture in commercial communication through space.

The Charyk committee clearly set the stage for Mr. Johnson's bid.

It said that in order to realize the full benefits of international space cooperation, the United States must initiate more ambitious joint enterprises to fulfill human needs in the fields of commerce, communications, health, and scientific knowledge. It

pointed out that nations like France, Canada, and Japan are rapidly gaining competence in space technology. This was viewed as a challenge to American leadership in the promotion of more cooperative efforts.

Increased national space activity abroad "will make possible either new opportunities for cooperation or a repetition of ancient patterns of competition," the committee said. The report suggested a series of new projects ranging from improved communications, navigation, and meteorological satellites to joint exploration of the far planets. The latter was picked up by Mr. Johnson in his mention of Jupiter and the sun.

The committee on space pointed out that international cooperation in this field actually has been growing "richly and rapidly." The United States opened its launch facilities for the use of foreign scientists in 1959. Other governments, private industries, and scientific organizations have taken advantage of the opportunity.

What has been done is impressive:

- The National Aeronautics and Space Administration has agreements with 69 nations. It has already launched 4 of 14 planned international satellites, has flown 16 foreign experiments aboard NASA satellites, and has taken some part in 200 cooperative sounding-rocket launchings. Ground-based experiments involving NASA satellites have been conducted in more than 50 countries. NASA tracking and data-acquisition stations are being supported in 18 foreign countries. There is a NASA agreement with the Soviet Union, calling for the exchange of scientific information and the coordination of weather satellites.

- Among other nations, there are other cooperative efforts. One is the European Space Research Organization (ESRO) and another the European Launcher Development Organization (ELDO). One is building the booster to put the other's satellite into orbit.

- The United Nations is taking part. It has a Committee on the Peaceful Uses of Outer Space that has sponsored the Thumba Equatorial Launching Site in India. The UN General Assembly has laid down legal principles to govern national liability in space. It has prohibited the seizure of celestial bodies by nations.

- There is the International Committee for Space Research (COSPAR), established by the International Council of Scientific Unions. There are now 30 national organizations holding COSPAR membership as well as 10 scientific unions. It provides a forum for reporting and the exchange of information.



Vice President Hubert H. Humphrey on podium at White House Conference on International Cooperation. The meeting was held at a hotel in Washington. Mr. Humphrey, also Chairman of the National Aeronautics and Space Council, gave the keynote address.

- The Communications Satellite Corporation, sponsored by the U.S. Government and financed with private capital, has set up an international consortium of 48 nations. The participants are the joint owners of the Early Bird satellite, put in orbit last April for communications. There will be a space network to give global coverage by 1968.

- The export of American space hardware and services now amounts to \$10,000,000 a year. This helps improve the technical competence of other countries and promotes commerce in the technical areas.

- During the 1965 International Cooperation Year, the United States launched a Canadian-built Alouette B satellite. It is studying the ionosphere. A French FR-1 satellite will be launched to measure very-low-frequency radio emission. NASA has joined in 8 sounding-rocket ventures. They range from Norway to the Indian Ocean. There are a number of new projects under way, including a West German satellite to study the Van Allen radiation belts.

The committee on space then looked into the future, and this is what the members found:

"Foreign scientists and engineers will find increasing opportunities in their own national and regional pro-

grams for space research of the sort our cooperative projects have thus far supplied.

"We must therefore be alert to possibilities for more considerable and more advanced cooperative efforts, going beyond the appeal of national programs, if we are to extend the technical and political advantages of cooperation, for others as well as ourselves."

The committee recognized that there is a limit on the money available, but suggested some projects that could be carried out, if several nations shared the expense. They listed 5 ideas:

1. New launching sites on the equator. These would make it easier to put satellites in synchronous or "stationary" orbits, taking advantage of the earth's rotation.

2. Orbiting of multipurpose navigation satellites. These would assist marine and aircraft navigation, control traffic, relay distress calls, and help in rescue operations.

3. Building a satellite that could collect meteorological data from a system of buoys at sea, ground stations, and constant-altitude balloons. This would provide a better watch on the world's weather.

4. Coordinate synoptic sounding-

(Continued on following page)

rocket launchings around the globe to probe the high atmosphere, 50 to 100 miles (80 to 160 km) up.

5. Expansion of communications satellite facilities to stimulate commerce. The possibilities here are almost unlimited. Worldwide television circuits will be possible for public, government, and industrial use. The use of distant computers would be made easy for business, government, and international agencies.

The committee on space then moved to the obvious use of space to improve the international control of aviation traffic.

And there is the potential in a linkage of American television broadcasting with that of other countries.

Direct broadcasting from satellites to homes, eliminating local transmitters, promises to be "the most revolutionary change" in the 1970s, the committee said. When this comes about, the report continued, "it will present in acute form the conflicting claims of the desire for freedom of information—the freedom to see and hear—on the one hand, and the desire of organized society to impose some degree of control over the dissemination of spoken and visual material to their own people."

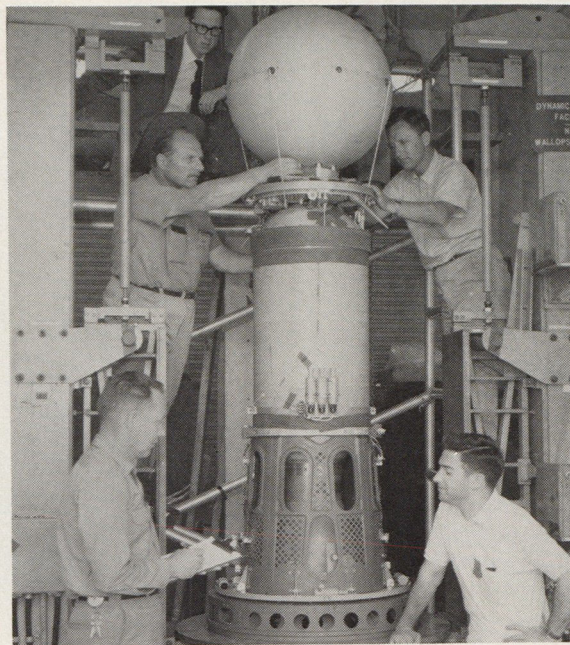
So far as the Johnson-to-Erhard proposal is concerned, the committee said that the increasing competence of foreign nations may permit the pooling of talent and resources to probe beyond Mars and Venus to more distant planets. The committee suggested, to Mr. Johnson and the entire nation, that the U.S. might supply the rocket boosters and ships, and other countries would supply the experiments and spacecraft systems.

Some of this program, a more specialized part, won support from another committee of the White House Conference on International Cooperation. There was a Committee on Meteorology. This group said that reliable weather forecasts up to 2 weeks or more in advance now are possible. In addition, it predicted eventual control of the weather.

The requirement here is for a World Weather Watch and for more complete scientific understanding of the globe's atmosphere.

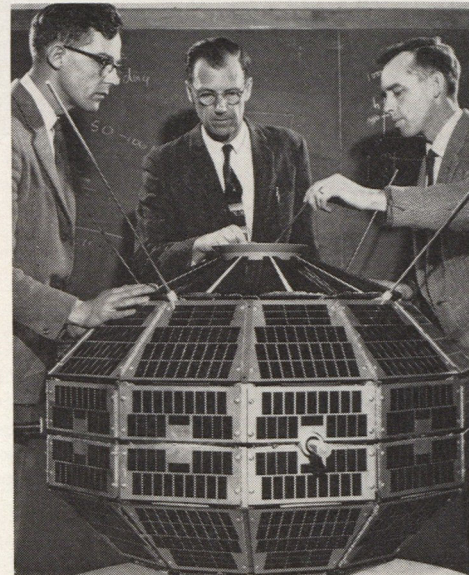
According to the committee, the major obstacle to good large-scale weather prediction is the lack of adequate information from all over the world. Today, weather data is collected from only 20 percent of the world's surface.

The World Weather Watch may be the answer. It is being planned by the World Meteorological Organization and 126 member nations. It will be an international system, designed to bring



One example of international cooperation already in practice by the National Aeronautics and Space Administration (NASA). This is the second stage of the Shotput rocket, used to put the San Marco satellite in orbit. San Marco is a program in which NASA works with the Italian National Research Council. Photo of engineers conducting check was taken at NASA facility at Wallops Island, Virginia.

These scientists are Canadians. They are examining a model of the S-27, a swept-frequency "topside sounder" that is being used in the Alouette program. This is a satellite to investigate the ionosphere. It was built in Canada but has been launched by NASA. The American space agency already has taken part in 200 cooperative launchings of sounding rockets, has flown 16 foreign experiments on NASA satellites, and is deep in a program for the future.



the atmosphere of the entire globe under surveillance. The tools of modern technology would be used. These include satellites, computers, and high-speed communications, using space.

Washington and Moscow already have centers to work on worldwide weather. There will be a third in Melbourne, Australia. Next year, there will be the Tiros satellite system to help gather and process more information.

The White House Conference on International Cooperation came up with recommendations on many other subjects.

There was a report on nuclear programs and how more safeguards are needed because atomic power is being used, or will be used, for everything from insect control to the desalination of seawater. There was a report on Science and Technology, holding

that the hope for lasting peace will become more real only with further cooperation in this area.

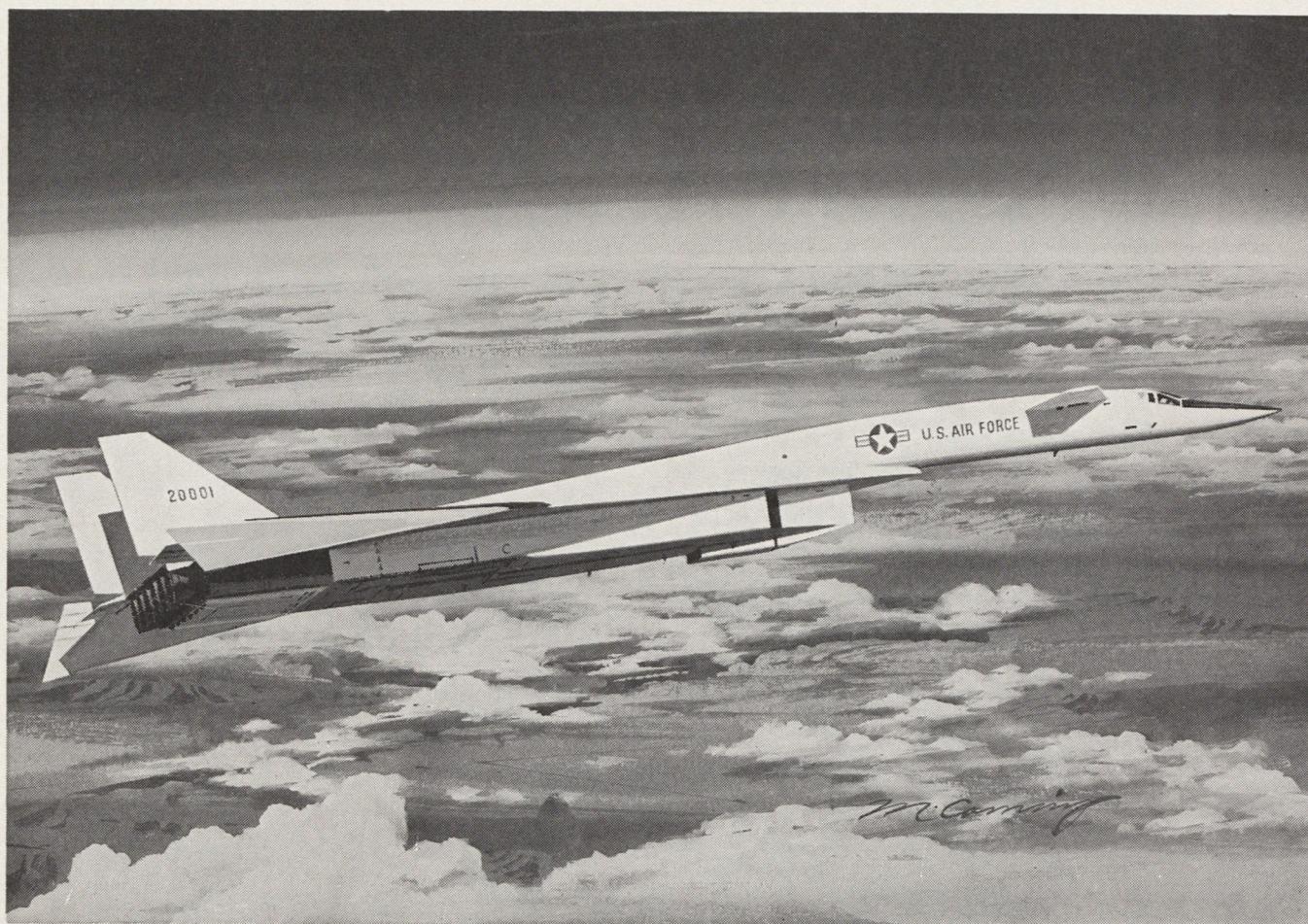
And there was a plea for lower trade barriers and another for a better system of commercial law with improved methods of granting patents and trademarks. The Committee on Aviation found an urgent need for greater cooperation along the world's air routes.

Vice President Humphrey, who spoke to the conference delegates, set a keynote when he said in the opening address:

"The devices of our computer-gear, technologically interconnected world society leap over international frontiers. Space vehicles, communication, medicine, meteorology—art and ideas—pay little attention to the imaginary boundaries men have drawn between themselves."

☆☆☆

The Mach 3 XB-70



The XB-70—250 tons of man and machine that moves faster than a one-ounce projectile fired from a high-powered rifle.

It has flown 2,000 mph—three times the speed of sound—at 70,000 feet.

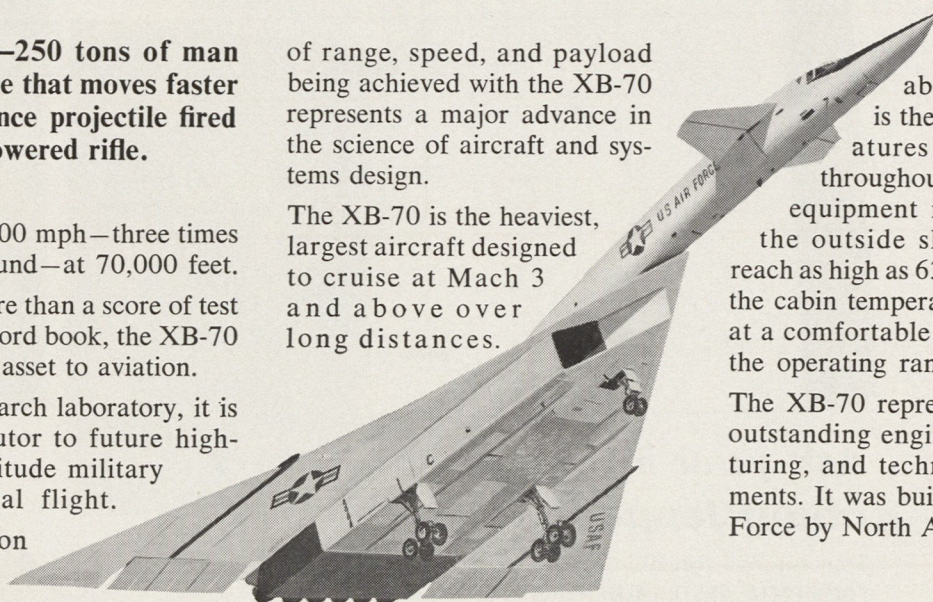
Today, with more than a score of test flights in the record book, the XB-70 is an important asset to aviation.

As a flying research laboratory, it is a vital contributor to future high-speed, high-altitude military and commercial flight.

The combination

of range, speed, and payload being achieved with the XB-70 represents a major advance in the science of aircraft and systems design.

The XB-70 is the heaviest, largest aircraft designed to cruise at Mach 3 and above over long distances.



Another remarkable accomplishment is the control of temperatures within safe limits throughout the structure and equipment installations when the outside skin temperatures reach as high as 630°F. For example, the cabin temperature is maintained at a comfortable 80°F. throughout the operating range of the aircraft.

The XB-70 represents a number of outstanding engineering, manufacturing, and technological achievements. It was built for the U. S. Air Force by North American Aviation.

North American Aviation 

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

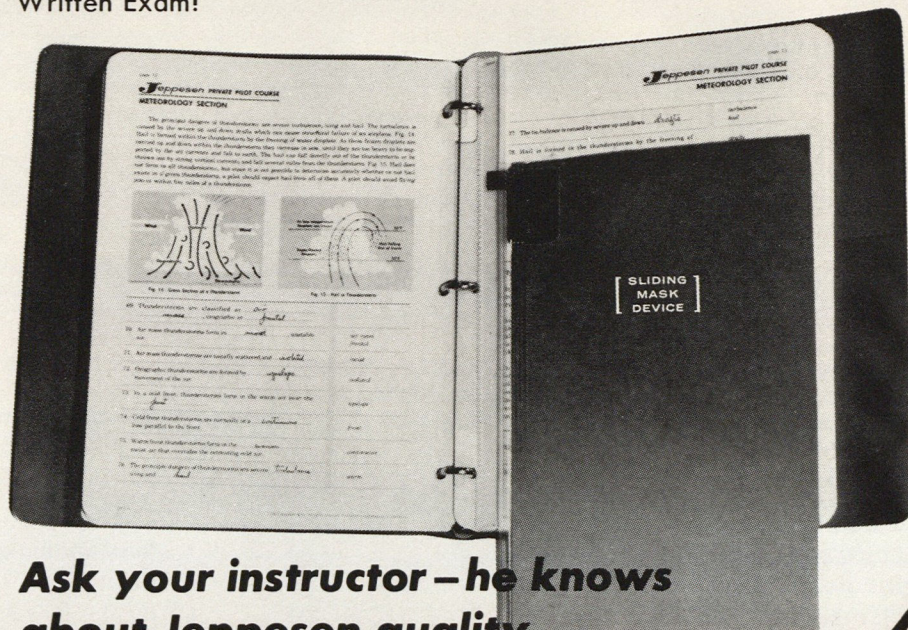
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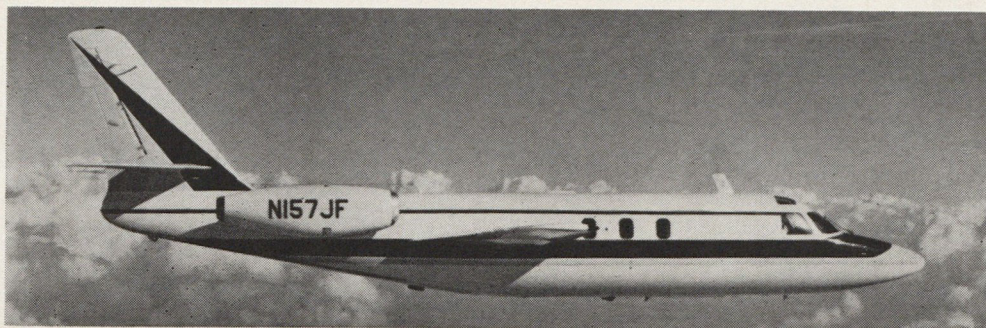
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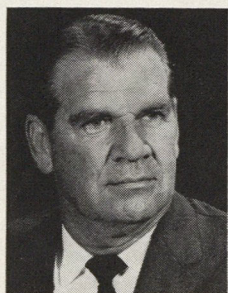
America's busy highway in the sky is active with business aircraft such as this Aero Commander Jet Commander, shown in flight. General aviation in the U.S., which includes business aviation, comprised more than 80 percent of all American aviation during 1965, reports the FAA.

General aviation—which includes aviation of all kinds except military and commercial operations—accounts for an amazing 82.7 percent of all aviation in the United States. And in the words of the author, it is still but a sleeping giant, with great potential for aiding the advance of underdeveloped areas not only in the “emerging world” overseas but also in the U.S. itself. Here is a special report on U.S. general aviation from the Assistant Administrator for General Aviation Affairs of the Federal Aviation Agency . . .

U.S. General Aviation— Busy Highway in the Sky

BY ROBERT REYNOLDS

Assistant Administrator for General Aviation Affairs, U.S. Federal Aviation Agency



The author, Mr. Reynolds, has been Assistant Administrator for General Aviation Affairs, FAA, since July 1965. He has 30 years of experience in general aviation. In his present position, he serves the growing needs of general aviation in the United States, serving as the Federal Aviation Agency's principal adviser on the progress and development of general aviation.

“Washington Center, this is Jet Commander one five seven, Juliet Foxtrot, over.”

“Jet Commander one five seven, Juliet Foxtrot, this is Washington Center, squawk ident code one zero zero zero and verify climbing to flight level two three zero.”

“Jet one five seven, Juliet Foxtrot, radar contact.”

“Jet one five seven, Juliet Foxtrot, turn left heading two two zero, vector around traffic. Report leaving one five thousand.”

“Roger, turning left to two two zero.”

“Jet one five seven, Juliet Foxtrot, leaving one five thousand.”

“Roger, one five thousand.”

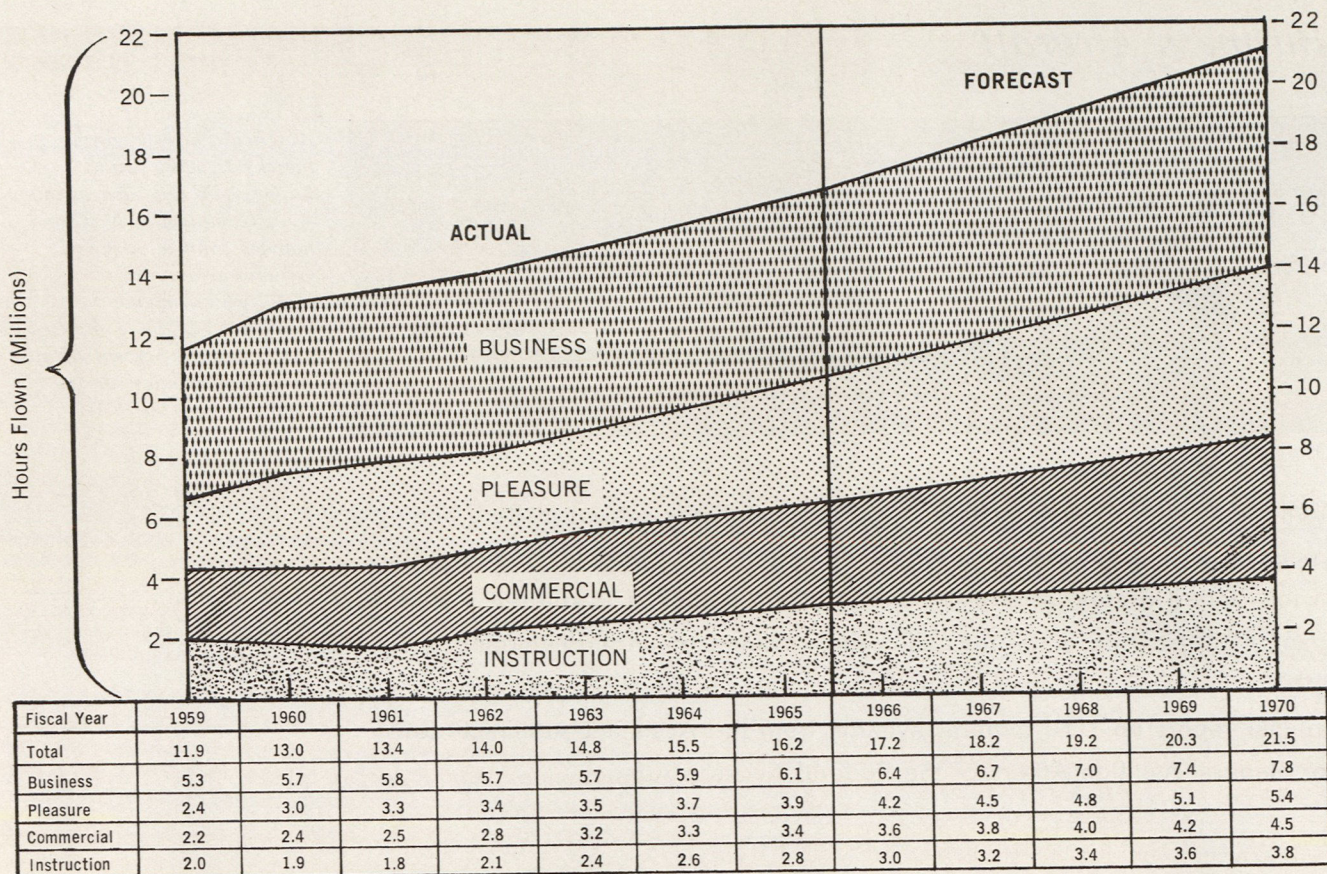
“Jet one five seven, Juliet Foxtrot, climb and maintain flight level three five zero, report leaving flight level two zero zero.”

This exchange of information between a modern high-performance general-aviation jet and the ground-based Federal Aviation Agency Air Route Traffic Control Center illustrates the present capabilities of general aviation. This is a verbatim account of part of a clearance delivered to a general-aviation aircraft on a recent flight from Dulles International Airport, Washington, D. C., to Cincinnati, Ohio.

What Is General Aviation?

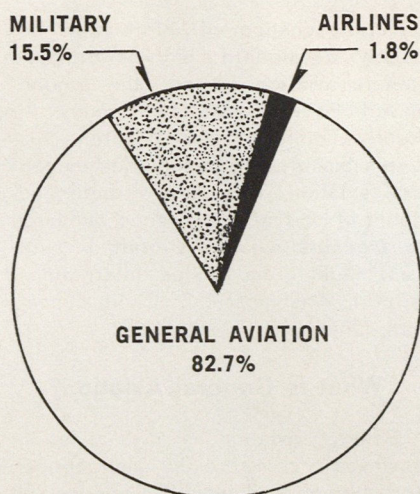
General aviation is civil aviation: business, commercial, instructional, and personal flying. It includes all aviation except military and air carrier (airline). The mix of military, airline, and general-aviation aircraft in the nation.

(Continued on following page)



tional aviation system is: Military (18,251 aircraft, estimated for calendar year 1965), 15.5%; Airlines (2,100 aircraft), 1.8%; and General Aviation (97,300 aircraft), 82.7%.

The relationships between business, pleasure (personal), commercial, and instructional hours flown, along with growth in general aviation since 1959



AIRLINES	2,100
MILITARY	18,251*
GENERAL AVIATION	97,300

*ESTIMATED FOR CALENDAR YEAR 1965

and forecasts to 1970 are shown in the accompanying chart, above.

Airports, Aircraft, Airmen

The basic ingredients of an air transportation system are airports, aircraft, airmen, and air navigation and traffic services. Historically, aircraft were built by imaginative airmen and airports were developed later. If aviation is to attain its full measure of utility, a total system approach must be made in relating the basic aviation ingredients, one to the other.

• **AIRPORTS**—The air transportation system of a nation is no better than its system of airports. Our military and air-carrier airports are generally well known. Air carriers serve about 600 airports in the nation. General-aviation aircraft have access to more than 9,000 airports. This enhances the flexibility and utility of general-aviation aircraft.

In addition to the airports that are recorded, many aircraft land in areas that are used mainly for agricultural purposes such as grazing and only incidentally by aircraft. For example, in the states of Michigan and Texas there are over 1,000 landing areas in addition to those that are recorded for public use. These are in addition to the more than 9,000 airports of the nation.

• **AIRCRAFT**—General aviation is characterized by an impressive array of aircraft ranging from experimental and home-built models through the high-performance jet aircraft that fly and perform in the same environment as air-carrier and subsonic military aircraft. (See "Gallery" on pages 18-33 showing various general-aviation aircraft.) Civil-aircraft production is establishing new records with almost every passing month.

The following table shows the steady



A Hawker Siddeley DH-125, one of many thousands of general-aviation aircraft in the U.S., parked at Dulles Airport.

growth of general-aviation aircraft production along with forecast figures for the next few years:

Fiscal Year	General Aviation Aircraft
1961	7,186
1962	7,133
1963	7,388
1964	8,944
1965	10,861
1966*	11,400
1967*	11,800
1968*	12,200
1969*	12,700
1970*	13,200
1971*	13,700

*Forecast. FAA Aviation Forecasts—1966-1971
Office of Policy Development

• **AIRMEN**—In the final analysis, the machine and the landing area are ineffective without the man. General-aviation manpower includes pilots, ranging from students through those carrying an air transport rating and maintenance and other related ground personnel. These categories make up the airman population.

The total U.S. civil airman population includes the following:

Active Airman Certificates Held as of 1/1/65	
Category	Number
Pilot	431,041
Student	120,743
Private	175,574
Commercial	108,428
Airline transport	21,572
Helicopter (only)	1,058
Glider (only)	1,227
Other pilot	2,439
Nonpilot	195,396
Mechanics	130,131
Parachute rigger	4,226
Ground instructor	30,801
Dispatcher	3,961
Control tower operator	14,304
Flight navigator	1,625
Flight engineer	10,348
Flight instructor certificates	32,158
Instrument ratings	84,442
Total	743,037

There is a continuing need for pilots, mechanics, and maintenance personnel in general aviation as well as in the air-carrier field. Every segment of general aviation use is in a period of growth.

Air Navigation and Traffic Services

Airmen flying in the National Airspace System in the United States utilize a variety of navigation aids and air traffic control services that are unique in the world. This system includes hardware located in facilities at the 29 domestic and international air route traffic control centers handling IFR traffic of military, air carrier,



This is the Beech assembly line at Wichita, Kansas, one of the manufacturing sites of the famed general-aviation firm. The company is one of the industry's leaders, and its aircraft fly the American general-aviation airlines, carrying businessmen about the U.S.

and general aviation; 873 VOR-VORTAC facilities; 284 airports with tower service; 333 flight service stations; and 13 international flight service stations.

These facilities are manned and maintained by some 27,000 FAA personnel who help assure a system of radar equipment and other aids to give added benefits to those who fly either VFR or IFR. The largest segment of FAA's resources in both manpower

and money go to make up the navigation aid and air traffic and related services. These are all available for use by the general-aviation pilot, and they help to account for the flexibility and utility of general-aviation aircraft.

Aviation Weather Services

The finest system of airports and
(Continued on following page)



Federal Aviation Agency air traffic controllers "talk in" an incoming Jet Commander. The largest portion of FAA money and manpower goes for navigation aid, air traffic control, and related services. All such FAA services are available to the general-aviation pilot flying nation's airspace.



Pair of Piper Comanches in flight symbolizes the increasing use of general-aviation aircraft for business and pleasure purposes in the U.S. Foreign pilots visiting the U.S. are often surprised by the easy access afforded them to busy metropolitan airports.

navigation facilities requires accurate aviation weather information for the fullest and most effective utilization. The Federal Aviation Agency, in cooperation with the aviation weather personnel of the Environmental Science Service Administration (ESSA), constantly seeks methods of improving weather observation and information dissemination. On a worldwide basis,

weather information is shared for the benefit of all aviation.

General-Aviation Definitions

From a statistic-gathering point of view and in assessing growth trends and utilization, the Federal Aviation Agency categorizes and defines general aviation uses as follows:

- **Executive transportation**—Any use of an aircraft by a corporation, company, or other organization for the purposes of transporting its employees and/or property not for compensation or hire and employing professional pilots for the operation of the aircraft.

- **Business transportation**—Any use of an aircraft not for compensation or hire by an individual for the purposes of transportation required by a business in which he is engaged.

- **Personal**—Any use of an aircraft for personal purposes not associated with a business or profession, and not for hire. This includes maintenance of pilot proficiency.

- **Aerial application**—Any use of an aircraft for work purposes which concerns the production of foods, fibers, and health control in which the aircraft is used in lieu of farm implements or ground vehicles for the particular task accomplished. This includes the distribution of chemicals or seeds in agriculture, reforestation, or insect control; it excludes fire-fighting.

- **Instruction**—Any use of an aircraft for the purpose of formal instruction with the flight instructor aboard, or with the maneuvers on the particular flight(s) specified by the flight instructor.

- **Air taxi**—Any use of an aircraft by the holder of an Air Taxi Operating Certificate in which the operation is authorized by that certificate.



This is the Federal Aviation Agency's Air Route Traffic Control Center, located at Leesburg, Virginia, not far from Washington, D.C. It serves as an important nerve center for the complicated job of air traffic control along a large section of the U.S. East Coast. It uses many of the most modern devices available to accomplish its important aviation mission.

• **Industrial/special**—Any use of an aircraft for specialized work allied with industrial activity; excluding transportation and aerial application. (Examples: pipeline patrol, survey, advertising, photography, helicopter hoist, etc.)

• **Other**—Any use of an aircraft not specified in the preceding uses. This includes research and development, demonstrations, sport parachuting, and ferry flights.

The distribution of active general-aviation aircraft by use shows:

Aircraft Use (CY 1965)*	Number	Percent
Executive transportation ..	12,900	13.3
Business transportation ..	10,500	10.8
Personal	51,200	52.7
Aerial application	5,500	5.7
Instructional	7,180	7.4
Air taxi	5,600	5.8
Industrial/special	2,020	2.1
Other	2,400	2.2
TOTAL	97,300	100.0

*Estimated

Air Traffic Control Tower Utilization

Accurate measures of general-aviation growth are shown by study of the aircraft operations at FAA-operated air traffic control towers. Using the 3 categories of air carrier, general aviation, and military and the decade from 1961 with forecasts to 1971, significant and steady growth in general aviation is readily noted. Today in the United States most of the air traffic control tower operations are in the category of general aviation (see accompanying chart below).

Air Taxi

One of the growing services of general aviation that provides increased benefits to travelers and to regional

FUEL CONSUMED BY UNITED STATES DOMESTIC CIVIL AVIATION

(In millions of gallons)

Fiscal Year	Jet Fuel			Aviation Gasoline			Total Jet Fuel And Aviation Gasoline
	Air Carrier 1	General Aviation 2	Total	Air Carrier 1	General Aviation 2	Total	
1961	1,250	10	1,260	925	238	1,163	2,423
1962	1,875	15	1,890	745	232	977	2,867
1963	2,250	25	2,275	635	245	880	3,155
1964	2,561	36	2,597	615	255	870	3,467
1965	3,058	46	3,104	557	267	824	3,928
1966*	3,790	55	3,845	460	280	740	4,585
1967*	4,780	70	4,850	300	295	595	5,445
1968*	5,460	90	5,550	220	315	535	6,085
1969*	6,040	115	6,155	150	340	490	6,645
1970*	6,650	145	6,795	130	370	500	7,295
1971*	7,170	175	7,345	120	400	520	7,865

*Forecast.

1. Partially estimated for Fiscal Years 1961-1965.

2. Estimates only are shown for Fiscal Years 1961-1965; actual fuel consumption by general aviation aircraft is not reported.

Note—Domestic civil aviation is defined for purposes of this table to include all civil aircraft flights which originate and terminate within the 48 states, within Hawaii, and within Alaska. Fuels consumed by airframe and aircraft engine manufacturers, whether for flight testing or ground testing, are not shown here because they are not available for the domestic industry as a whole and cannot be estimated with any assurance of accuracy. Estimates of fuel consumed by the supplemental, contract, and intrastate air carriers are included in the "Air Carrier" columns.

and trunk air carriers is the air-taxi segment of the general-aviation industry. FAA records list 2,928 certificated air-taxi operators. Of these 1,233 hold multiengine authorizations; 809 have IFR authorization.

Our latest survey shows that by the end of 1965 air-taxi operators were using aircraft ranging from Ford Tri-Motors to today's modern high-performance, single-engine, light-twin, turbo-prop, and jet aircraft. The load factors of these air-taxi operators are steadily increasing. Also, the scheduled air carriers recognize increasingly that the air taxi is a valuable adjunct to their transportation services. There is more and more teamwork between the certificated air carriers and air-taxi operators.

During the first 11 months of 1965, the number of scheduled air-taxi op-

erators in the contiguous United States increased from 51 to 78. These scheduled air traffic operators use 361 aircraft, 4 or more place, including:

- 236 multiengine under 12,500 pounds;
- 13 over 12,500 pounds;
- 1 turboprop;
- 6 rotorcraft.

Fuel as an Index of Growth

A good indication of the rate at which civil aviation is growing is found in studying the data available on air-carrier and general-aviation jet-fuel and aviation-gasoline consumption. The economic impact of this consumption is significant. These expenditures of fuel represent a very large amount of transportation service (see accompanying chart, above).

Itinerant Aircraft Operations at Airports With FAA Traffic Control Service (In Millions)

Fiscal Year	Total	Air Carrier	General Aviation	Military
1961	17.9	7.0	9.1	1.8
1962	18.8	7.1	9.9	1.8
1963	19.7	7.1	10.9	1.7
1964	21.6	7.4	12.4	1.8
1965	22.9	7.5	13.7	1.7
1966*	25.0	8.0	15.5	1.5
1967*	26.9	8.4	17.0	1.5
1968*	28.5	8.8	18.3	1.4
1969*	30.3	9.2	19.7	1.4
1970*	32.1	9.6	21.2	1.3
1971*	34.0	10.0	22.7	1.3

*Forecast.

Note—An aircraft operation is defined as an aircraft arrival at or a departure from an airport with FAA traffic control service. A local operation is performed by an aircraft that: operates in the local traffic pattern or within sight of the tower; is known to be departing for or arriving from flight in local practice areas; or executes simulated instrument approaches or low passes at the airport. All aircraft arrivals and departures other than local (as defined above) are classified as itinerant operations.

General Aviation and Undeveloped Areas

Many people refer to parts of the world as being undeveloped, thinking of some place far from home. In the United States, there are still areas that can be called undeveloped, which general-aviation aircraft now serve and will serve even more effectively in the years to come.

Areas in Maine, Texas, Montana, Idaho, and Alaska, for example, regularly depend on general-aviation air transportation for access for business, agriculture, administrative, and recreational uses.

Many parts of the world are literally moving from the early stages of surface transportation directly into the air age. These nations are skipping the

(Continued on following page)

historically traditional water, rail, and highway modes of transportation. In Australia there are plans under way for serving parts of that great land with air transportation provided by general-aviation type aircraft.

The general-aviation industry on a worldwide basis can be the limbs, the branches, and the leaves of the air carrier trunk system that now serves the world. Those communities and those nations which develop airports that are suitable for general-aviation aircraft will be on the shore of the worldwide ocean of air that knows no aerodynamic boundaries. In the United States we have developed general aviation to a fairly high degree of utility and performance with safety. Yet there are many of our communities that are unaware that general aviation is, indeed, a sleeping giant of economic development. Areas of the world that have made less progress in developing surface transportation have both a challenge and an opportunity to solve some of their transportation and communications problems by adapting general-aviation aircraft to their needs.

General-aviation pilots from foreign lands who fly in the U.S. are often surprised to find the freedom of access they have to airports in metropolitan areas that are used by air carrier aircraft, including intercontinental jets, business aircraft, and aircraft flown by citizens for personal reasons or for pleasure.

Our airport plans call for providing



FAA Chief William McKee may hold Washington-New York downtown-to-downtown air record. Recently he boarded chopper on his Washington office roof, above, flew to airport, jetted to New York, and flew by chopper to downtown New York in about an hour.

satellite-type airports to serve general-aviation needs in our metropolitan areas. From a purely economic point of view, many U.S. communities have learned that decentralization of industry is placing a premium on the availability of an airport.

Geography is no longer a problem

in terms of location of industries as long as a suitable airport is available. In fact, many parts of the nation have learned that a good general-aviation airport is an economic asset because it attracts industries, provides job opportunities, and adds to the air accessibility of the community on the shores of the worldwide ocean of air.

On a global basis, general aviation offers undreamed-of possibilities. The day is not too distant when more citizens throughout the world might experience the benefits of general-aviation transportation such as those described by FAA Administrator William F. McKee during a recent talk before the Wings Club in New York City. General McKee reported his experience in his talk as follows:

"Just a little more than an hour ago, I was at my desk in my office in Washington. It was time to go. I climbed the one flight of stairs to our rooftop heliport, boarded a helicopter, and then zipped across the Potomac to Washington National Airport. I flew by jet to Kennedy where another chopper waited. Flying time from Kennedy to the New Pan Am heliport—7 minutes. Then down the elevator and through the tunnels to the Biltmore, and here I am.

"It may be that I now hold the speed record from downtown Washington to downtown New York.

"This is truly the transportation of the future! Downtown to downtown by air!"

☆☆☆



Aircraft from all over the Free World are now being seen in the general-aviation marketplace. Above is the HFB Hansa 320, produced by Hamburger Flugzeugbau GmbH, Germany's contribution to U. S. business aviation. It will be available in the U. S. in late 1966.

The top talent of U.S. and other Free World manufacturers is being put to work designing and selling turbine-engine executive transport aircraft. The intensity of the current effort was visible in the wide assortment of airplanes on display at the recent meeting of the U.S. National Business Aircraft Association in Los Angeles, California. An important reason for the effort in the United States is the fact that there are some 390,000 American companies who are prospects for the purchase of corporate aircraft . . .

Jet-Age Business Aircraft —An Expanding Market

BY RUSSELL HAWKES

A rule of thumb in highly competitive businesses reads: "Never let a competitor have a segment of the market to himself even if you might till richer fields elsewhere."

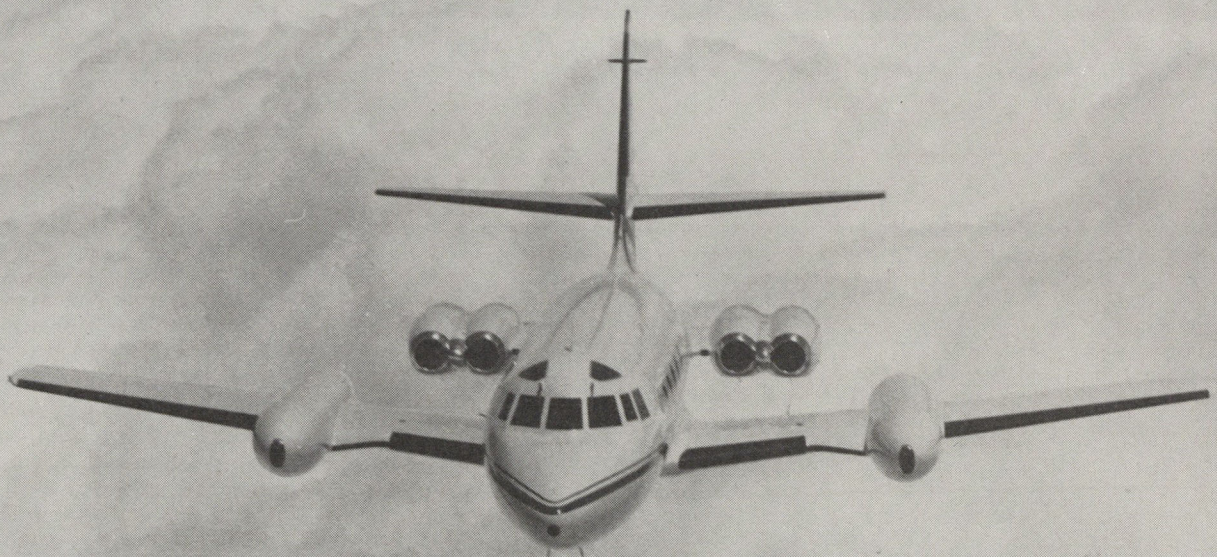
The rule seems to be at work in the general-aviation field where the best talent of manufacturers all over the world is being brought to bear on the objective of selling turbine-engine executive transports to corporations. The result is a crop of the most costly,

most efficient, most truly splendid aircraft ever offered the nonairline, non-military buyer. Meanwhile, the development of single-engine civilian aircraft is being held back slightly, while manufacturers collect the returns on their investments in the last round of development.

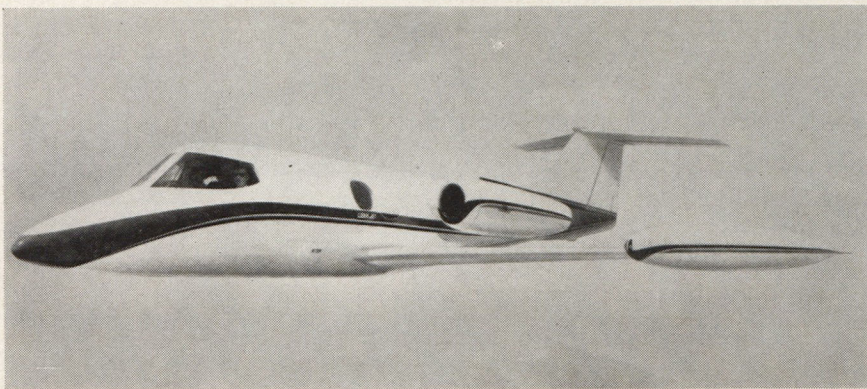
The intensity of the drive for the big corporation dollar was visible in the assortment of aircraft displayed at the 1965 Convention of the National Business Aircraft Association (NBAA),

held in Los Angeles, California, on October 12-13-14. Fast, sophisticated, turbine-powered aircraft have been shown in earlier years, but never have they dominated the manufacturers' displays to such an extent.

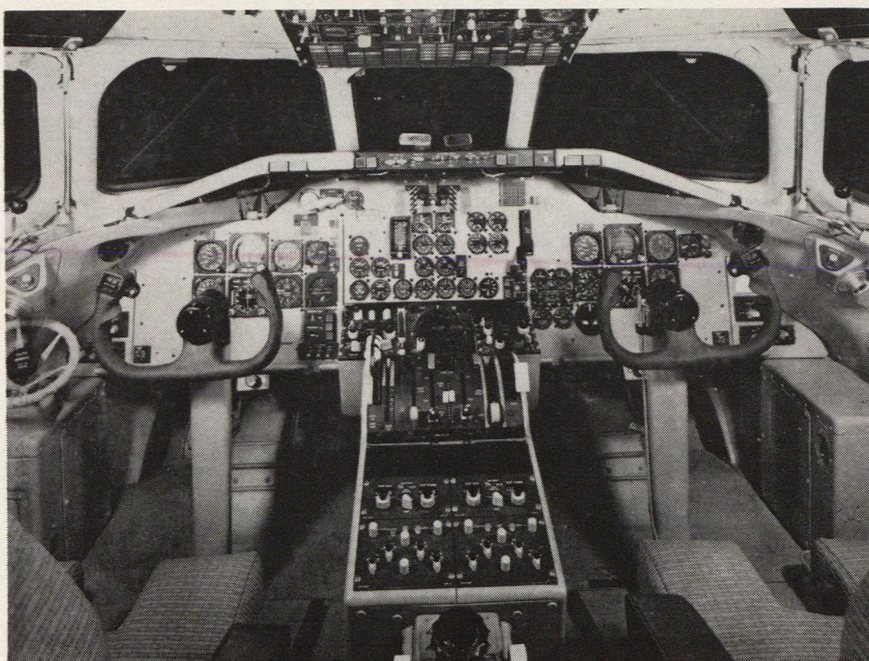
It seems to indicate that many executives in the business-airplane field agree with an observation made a few years ago by Bill Lear, president. (Continued on following page)



The Lockheed Aircraft Corporation's JetStar had the advantage of military backing when it entered the business-aviation market. The JetStar, shown in flight above, was originally manufactured for the U.S. Air Force and is still extensively used to transport top military executives, under the designation C-140. It is powered by 4 turbojet engines and has a seating capacity of 10 to 12.



Lear Jet Corporation, with its president, Bill Lear, has been a pioneer in building large jet aircraft for the business aviation market. Lear Jet Model 23 was one of the first to enter the market, and it has been a great commercial success all over the Free World.



Airliners are also entering the corporate market. The Douglas Aircraft Company's new twinjet, short-to-medium-range DC-9 already is being ordered by large corporations. The cockpit, shown above, is designed with dual controls for 2-man flight-crew operations.



Other Free World aircraft manufacturers are entering the U.S. business aircraft market with several large, high-performance offerings that will give American industry a run for its money. One of these is the Hansa HFB 320 from Germany, being refueled above.

dent of Lear Jet Corporation. He warned that the multiengine business-aircraft industry was sure to be wiped out unless it could offer airplanes as fast as jet airliners, while still not exacting too much of a premium in cost per passenger-mile. He proceeded to build his Lear Jet Model 23 with that in mind, and it has been a commercial success.

The Utility Airplane Council of the Aerospace Industries Association estimates that 390,000 U.S. companies are prospects for business aircraft, and only about 40,000 now actually own airplanes. Obviously, there is a rich vein yet to be tapped. The surprising thing is the large fraction of the industry's resources devoted to designing large, fast airplanes.

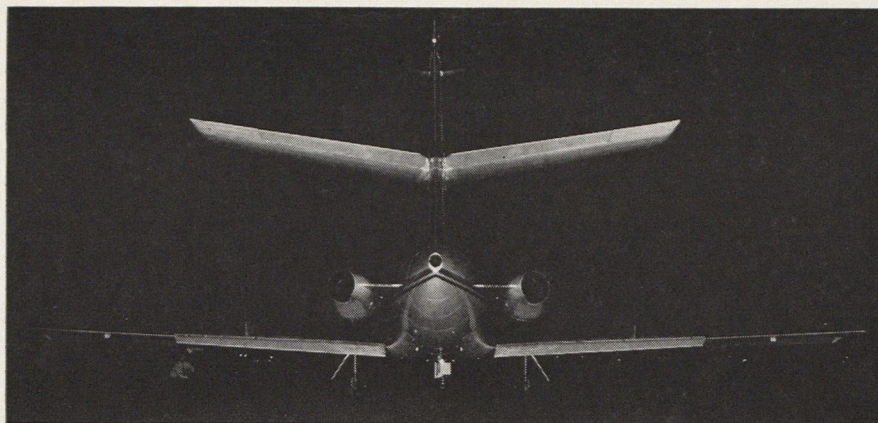
Of the 350,000 unsold business-aircraft prospects, it is certain that only a small minority can afford turbojet, near-sonic technology. For those who can't quite make it, the industry is also producing a rich variety of turboprops with prices in the vicinity of \$300,000.

In the very top corporate brackets, the distinctions between airliners and business aircraft have practically disappeared. In fact, 2 of the stars of the 1965 NBAA show were a Douglas Aircraft Company DC-9 wearing Trans World Airlines paint and the French Nord 262 turboprop with the insignia of Lake Central Airlines. In addition, brochures on the executive version of the Boeing Company's 737 were stirring interest. All 3 manufacturers are optimistic about the corporate market, and Douglas has a few orders on the books.

Once it was admitted that airlines and business aviation were competing for the same fare, it became inevitable that the antagonists would use similar tools and would grow to resemble each other. Airlines have consciously been trying to acquire the attractive features of business aircraft for years.

Representatives of U.S. aircraft manufacturers at the NBAA convention were officially unconcerned about foreign penetration of the domestic market for large, high-performance business airplanes. However, other Free World aircraft manufacturers are offering everything from technical ingenuity (HFB 320 Hansa), to low price (Mitsubishi MU-2), to sheer beauty (Dassault Mystère 20 and Hawker Siddeley DH-125). It would be surprising if such appealing machines failed to win a respectable portion of the U.S. trade.

Mitsubishi and Dassault are selling in the U.S. under the well-established American names of Mooney Aircraft, Inc., and Pan American World Airways, Inc. The Mystère, renamed the "Fan Jet Falcon," is being marketed by Pan American's Business Jets Division, and



The Fan Jet Falcon, here shown landing at night, is one of the business jets manufactured by a country other than the U.S. but marketed by a U.S. corporation. The Falcon, based on the French Mystère, is being sold by Pan American's Business Jets Division.

it is unmistakably an extensive operation.

Pan American has ordered the first jet aircraft simulator ever built especially for the purpose of training business-aviation pilots. It is a General Precision Systems 3-axis moving-base system, and it will be used to train a pilot and a copilot for every Fan Jet Falcon customer. The economy, safety, and quality of this kind of training make it a consideration of some weight to potential buyers. Companies that buy executive versions of airline equipment get similar treatment. They are permitted to use simulators built to train airline crews. Pan Am's imaginative merchandising and customer service had produced at least 5 sales, with deliveries by the end of 1965.

Mitsubishi enlisted Mooney Aircraft, Inc., of Kerrville, Texas, as U.S. distributor and uses a maximum number of American-built subsystems and components, including engines and avionics. Since these systems are major cost items, any U.S. complaint because of the gold-flow problem is weakened. The Mitsubishi-Mooney MU-2 will be facing successful and proven American competition. The precision-built little airplane ought to make a good fight of it, even though its football-shaped fuselage, negative dihedral, and underslung engines are not lovely compared to the elegance and grace of the Turbo Commander or the efficient, racy look of the Beech King Air. For one thing, it is being offered at a price of \$260,000, com-

pared to \$299,000 for the Turbo Commander and \$320,000 for the Beech King Air.

The MU-2 is likely to prove to be the kind of fine machinery the Japanese are becoming noted for. It is the product of 2 top designers, K. Ikeda and Yoshitoshi Sone, designer of the World War II Zero. Evidence of their thoroughness is the fact that the pressure cabin was test-cycled 75,000 times under load, the cabin door 40,000 times, and the wing spoilers 200,000 times. These figures are many times the U.S. Federal Aviation Agency test requirements—at a time when U.S. builders are trying to get the requirements eased.

Mitsubishi Heavy Industries expects 90 percent of MU-2 sales to be in the U.S. The airplanes will be shipped from Japan in 4 sections for final assembly at Mooney's Kerrville plant. The TPE 331 turboprop engines will be shipped directly to Kerrville by the builder, AiResearch Division of Garrett Corporation. The MU-2 received its U.S. Airworthiness Type Certificate in November, and deliveries began in January after a 3-month demonstration tour. Thirty-six aircraft will arrive from Japan during 1966.

The British are also faring quite well in this country without the benefit of a Trojan horse. By last fall, Hawker Siddeley could report the sale of 71 DH-125s of which 37 will go to North America. By the end of the year, 34 had been delivered.

Beech Aircraft Corporation, Cessna Aircraft Company, and Piper Aircraft Corporation—the richest of the busi-

(Continued on following page)



The Hawker Siddeley DH-125, shown above, has been sold to 37 North American companies without the benefit of a U.S. name. It is the first foreign business-jet plane to enter competition in the U.S. market in this way. It carries 6 to 10 people and is powered by 2 Bristol Siddeley Viper 522 turbojet engines. Apparently, the gold-flow problem in the U.S. is not affecting the sale of the DH-125.

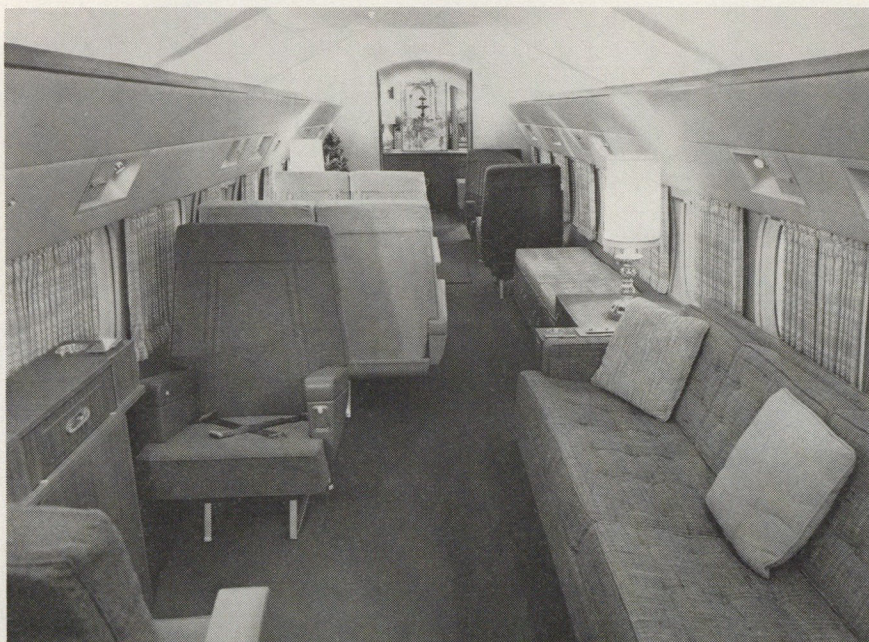


The Lear Jet Model 23 has gone a long way toward proving that there is a large market for the 5- to 9-passenger business jet. The Lear Jet is the smallest in the field, carrying 5 or 7 people. It is derived from a fighter design and is an outstanding performer from an aeronautical point of view, with a roomy and luxurious interior style.

ness-plane makers—are offering turboprop versions of piston-engine designs in the 5- to 9-passenger class, but are not admitting any immediate intention to design jets. This may reflect the aphorism that only the rich can afford to be conservative and only the poor can afford to gamble.

However, judging by the sales claims made for the Jet Commander and the Lear Jet Model 23, the 5- to

9-passenger jet has proved to be a pretty good gamble. The Lear Jet is the smallest in the field, carrying 5 or 7 people. The airplane is derived from a fighter design and is an outstanding performer. This is undoubtedly a major factor in its leading sales record, which had passed 120 orders and 60 deliveries by autumn of 1965. In view of this success, it would not be surprising if one or more of the Big



A large portion of the business-aircraft purchase price goes for interiors, which range from standard airline-type seating to expensive, custom interiors with offices and bars. Above is the interior of a Fairchild Hiller Corporation F-27 turboprop. Seating in the F-27, originally designed by Fokker, can be arranged for 12 to 24 passengers.

Three business-plane makers rolled something out during 1966.

Caught up in the thick of the twin-turbine-engine executive-transport competition, the Aero Commander Divisions of Rockwell-Standard Corporation have managed to enter the single-engine airplane field for the first time, and yet reserve most of their in-house design talent for the Jet Commander and Turbo Commander programs. They did it by the expedient of buying the manufacturing rights to a pair of respected single-engine airplanes, developed by shops that were too small to exploit them effectively against entrenched competition. Sales efforts on behalf of the Jet and Turbo Commanders had resulted in orders for more than 15 of the jets, which had been delivered by the time of the NBAA convention.

It appears that there is a market that has scarcely been touched for million-dollar-plus, multiengine jets carrying 20 to 50 passengers. The late start is probably due partly to the success of turboprop conversions of aircraft like the Convair-Liners and original turboprop designs like the Grumman Gulfstream I and the Fairchild Hiller F-27. Grumman Aircraft Engineering Corporation and Fairchild Hiller Corporation will try to hang on to their respective size categories with the Gulfstream II and the F-28.

Bill Lear, with his usual talent for generating excitement, managed to steal the spotlight at the NBAA show with his announcement of plans for the 28-passenger Lear Liner Model 40. Lear estimates the sales potential for the new design at about \$72 million per year, and the industry has learned to take his market forecasts seriously.

The price tag is \$1.5 million with take-it-or-leave-it interiors and avionics. The customer can accept standard Lear equipment or bare aluminum. In this highly competitive market, this is an astute policy. As in airliners, a big slice of the business-airplane purchase price goes for custom interiors and avionics. There are now plenty of overhaul-and-modification shops around the country that can do this work better and more cheaply than the manufacturers, because of the advantages of specialization.

Lear is demanding a \$300,000 deposit with each order for the new airplane. The reason for this impressive sum is that he intends to finance development entirely out of the deposits. Lear said he will begin cutting metal as soon as he has 10 firm orders. He had 1 order before he left the room the night of the announcement.

The Lear Liner is to be powered by 2 Rolls-Royce Spey Junior turbofans.

Lear took the occasion of his announcement to castigate the U.S. engine industry for failing to develop a competitive propulsion unit. The Spey Junior was first projected for the Fokker F-28 and will be fully certificated early this year. First flight of the Lear Liner is scheduled early in 1967.

The attitudes of members of the business-aviation community attending the NBAA convention toward single-engine V/STOL aircraft were, for the most part, surprisingly tepid. Companies with back-country operations, for which such airplanes are tailored, generally seem to prefer 2-stage journeys from the city with the last stage being made in a locally based helicopter.

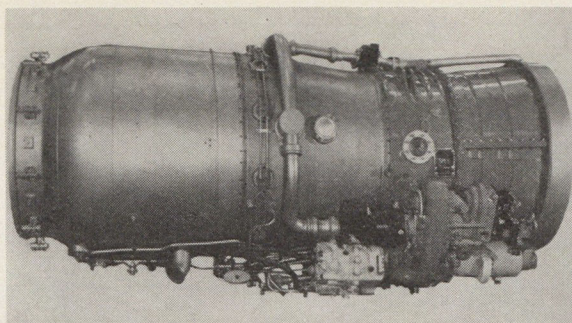
A number of businessmen interviewed at the NBAA convention concluded that civilian helicopter operators may be the chief beneficiaries of the U.S. Army's costly and controversial Light Observation Helicopter program. A few still contend that there is no proof of a genuine military requirement for a vehicle with so little carrying capacity. However, no one doubts that the competitive designs are excellent aircraft. Many civilian customers are ready to buy the Hughes 500 and the Fairchild Hiller FH-1100.

Bell Helicopter Company displayed a mockup of the handsome Jet Ranger at the NBAA convention. According to the company, the Jet Ranger is an all-new design, but technical opinion at the convention inclined to the belief that it has LOH blood in its veins.

The narrowing of the technological gap between common carrier airlines and business aviation fleets was illustrated when an FAA official announced at the convention that the "Category II" program, originally intended for airlines, will also be extended to business aircraft. The program permits takeoff and landing in weather below normal Instrument Flight Rules minimums, if the airplane and the airport are both certified as meeting technical standards for the category.

In requesting the extension, NBAA argued successfully that the avionics and professional crews of the heavier business aircraft often compare favorably with those of airliners. Under the new ruling, Category II is open to qualified, privately owned aircraft over 12,500 pounds (5,670 kg) gross takeoff weight, and the FAA representative said the agency is willing to discuss its extension to even lighter aircraft.

A panel of nonpilot executives was brought together at the NBAA convention to discuss what management wants from business aviation in the next few years. Among their comments were these:



At left is a mockup of the Rolls-Royce Spey Junior bypass jet engine, which will power the Lear Jet Model 40 Lear Liner. First flight of the Lear Liner is scheduled early in 1967.

Although Bell Helicopter Company claims its Jet Ranger civilian helicopter is all new, technical opinion is that it resembles the Bell entry, right, in the U.S. Army LOH competition.



Though it lost in final round of the LOH contest, Fairchild Hiller Corporation is offering its turbine-powered light helicopter in a commercial version. The 4-place Hiller FH-1100 is identical to the OH-5A it designed for the U.S. Army.

- "A company is wise to plan its aviation personnel needs 10 years into the future so it can train its own people to its own standards of technical competence and safety. Training should recognize the important effect that the company airplane and its crew have on customers and the public. Crews must be company- and management-oriented. This thorough personnel planning for the aviation department is no more than what we provide for other key executives to maximize their future value. A company is constantly developing new talent for the president's job."

- "NBAA ought to make a 'profile' of the average corporate pilot and another of what he should be in 10 years so we can begin preparing the right kind of man. Obviously, he will have to have more administrative ability than is now the rule."

- "It doesn't make sense to regard the company aircrew as mere chauffeurs. The chief pilot has authority over larger funds and more valuable equipment than the heads of many large manufacturing departments, not to mention his responsibility for the

safety of the company's most essential men."

- "Many top executives are becoming very communications conscious. Directives and employee newsletters are no longer enough; they want face-to-face contact and this increases the demands on business aviation."

- "Business pilots must not shy away from fiscal responsibilities. They should learn company budgetary procedures and the company ought to have a system of incentives and controls for effective budgeting. It should be brought especially to the attention of young pilots running 1- or 2-plane operations that management cannot afford to ignore the cost of these operations and their effect on the tax bill."

- "NBAA should ally itself with the Aircraft Owners and Pilots Association in unraveling red-tape delays in foreign countries. Border formalities are denying full utilization of business aircraft."

- "Our pilots must know a lot about our company's business. Otherwise how can they give us realistic equipment plans for the future?" ☆☆☆

A GALLERY OF



Ranging from single piston-engine aircraft to high-powered pure jets, the more than 30,000 aircraft registered to business corporations make up the most dynamic and sophisticated segment of civil aviation in the U.S. Here is a necessarily selective listing of these aircraft from all over the world, with information concerning their capabilities and performance . . .

GENERAL AVIATION

BY JOHN POPE

American business aviation, the most dynamic and sophisticated segment of civil aviation in the United States, is without counterpart in any other part of the world.

More than 30,000 aircraft are registered to business corporations and provide private transportation of personnel or cargo in conjunction with the company enterprise. Ranging from single piston-engine aircraft to high-powered pure jets, these aircraft offer a multitude of individually tailored services and prove their value as an economic tool of industrial management.

Today, aviation industry observers view business aviation as ready to cross the threshold from rapid to phenomenal growth and cite a variety of interrelated contributing factors.

The geographical width and breadth of the U.S., industrial decentralization, and the fast pace of American business dictate the need for instant transportation to solve time and distance problems.

Almost 10,000 airports offer air accessibility to cities across the continent, but fewer than 600 are served by commercial air carriers on a scheduled basis. Approximately 40 percent of these U.S. airports served by carriers

are on a once- or twice-a-day schedule.

The introduction of high-speed, turbine-powered aircraft created new concepts of operation, along with tremendous improvements in hourly aircraft utilization and engine reliability. Replacement of such old work-horses as the DC-3, the Lockheed Lodestar, and the Convair became practicable. The size and types of new aircraft, all with short-field capabilities, expanded possibilities for their use.

Piston-driven aircraft, however, continue to be used extensively by business aviation, primarily for short flights and where economy is involved.

This gallery of business-aviation aircraft covers those aircraft in most common usage and provides a glimpse into the future of this constantly growing segment of American aviation.

Turbojet Aircraft

The Lockheed Aircraft Corporation's **JetStar** pioneered the way for pure-jet operations in business aviation. Originally manufactured for the USAF as the C-140, the JetStar received its civil certification in August 1961, and entered the market with a price tag of about \$1.5 million. Powered by 4

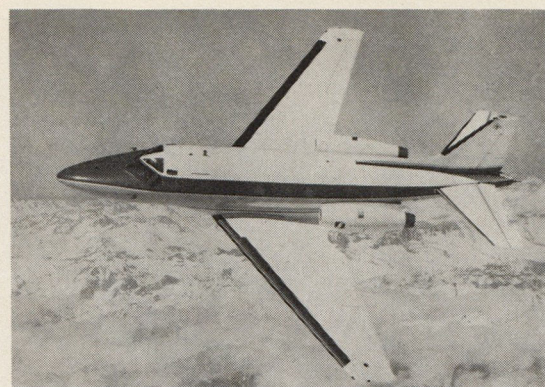
Pratt & Whitney (Aircraft Division of United Aircraft Corporation) JT12A-6A engines of 3,000 lb. (1,360 kg) thrust each, the JetStar has a range of 2,185 mi. (3,516 km), with maximum fuel (2,660 gal. or 10,069 l) at optimum cruise speed at 25,000 ft. (7,620 m). At maximum takeoff weight of 40,921 lb. (18,560 kg) and a payload of 3,000 lb. (1,360 kg), top speed is Mach 0.82 above 22,350 ft. (6,812 m). Economy cruise speed at reduced gross weight, 40,000 ft. (12,200 m), is 430 knots. Seating capacity is 10 to 12.

Following a similar military-civil pattern was the North American Aviation, Inc., **Sabreliner**, which was designed and sold to the U.S. Air Force as the T-39. Certified for civil use in 1963, the Sabreliner has 2 aft-mounted Pratt & Whitney JT12A-6A engines of 3,000 lb. (1,360 kg) thrust each. Basic airframe cost is \$795,000. Up to 7 passengers and 2 pilots can be accommodated. Maximum gross weight is 18,650 lb. (8,460 kg) and fuel capacity is 1,063 gal. (4,024 l). Cruise speed at 35,000 ft. (10,668 m) is 420 knots. Maximum range with IFR reserves is 1,500 n. mi. In 1966, the Sabreliner will be equipped with Pratt & Whitney JT12-8A engines with 3,300

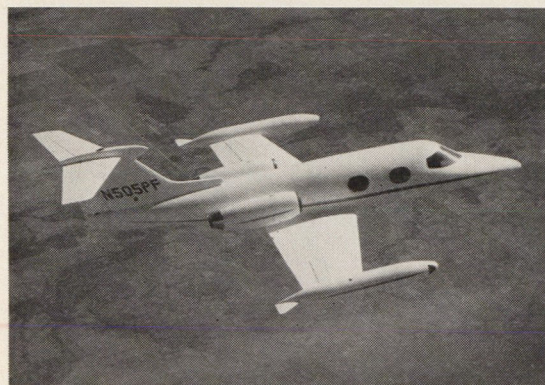
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Lockheed JetStar



North American Sabreliner



Lear Jet 23



Hawker Siddeley DH-125



Aero Commander Jet Commander



Dassault-Pan American Fan Jet Falcon

lb. (1,497 kg) thrust, which will increase the Sabreliner's takeoff and climb performance.

The **Lear Jet 23**, produced by the Lear Jet Corporation, was certificated in July 1964. At \$595,000, complete with electronics and interior, the Lear Jet offers the least expensive initial dollar outlay for a pure-jet aircraft. This 8-place, low-wing, T-tail jet has a maximum gross weight of 12,500 lb. (5,670 kg) and fuel capacity of 840 gal. (3,180 l). Powerplants are 2 General Electric CJ610-4 engines of 2,850 lb. (1,293 kg) thrust each. Cruise range at 450 knots, 41,000 ft. (12,497 m) is 1,420 n. mi.

England's entry, the **Hawker Siddeley DH-125**, is the first foreign jet to enter competition for a share of the U.S. market. Certificated by the

Federal Aviation Agency in September 1964, the 6- to 10-place DH-125 carries a U.S. price tag of \$900,000, fully equipped. Two Bristol Siddeley Viper 522 engines of 3,360 lb. (1,524 kg) thrust each power the DH-125. Maximum takeoff weight is 20,500 lb. (9,299 kg), and fuel capacity is 1,230 gal. (4,656 l). Maximum range with 45 minutes reserve at 38,000 ft. (11,582 m) and 92 percent power is 1,340 n. mi. With no reserves, range is 1,520 n. mi. Economy cruise speed at 38,000 ft. (11,582 m) is 364 knots.

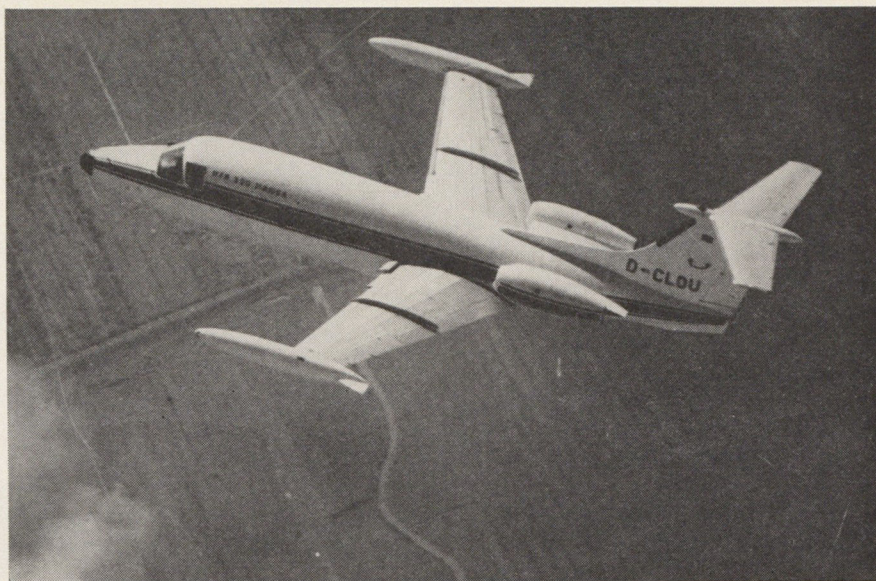
Aero Commander received FAA certification for the **Jet Commander** in November 1964. This 6- to 9-place aircraft has 2 aft-mounted General Electric CJ610-1 turbojet engines of 2,850 lb. (1,293 kg) thrust each. Maximum takeoff weight is 16,800 lb. (7,600 kg)

and fuel capacity is 926 gal. (3,505 l). At economy cruise, 410 knots, 39,000 feet (11,900 m), maximum range is 1,260 n. mi. with a 45-minute reserve. Sale price for the standard aircraft is quoted at \$595,000.

France's entry, manufactured by Generale Aeronautic Marcel Dassault, and originally introduced as the **Dassault Mystère 20**, was renamed the **Fan Jet Falcon** by its U.S. distributor, Pan American Airways. Approved for U.S. use in late spring 1965, the 8- to 10-place Falcon is powered by 2 General Electric CF700-2B engines of 4,200 lb. (1,905 kg) thrust each, and represents the only turboprop aircraft in this group. Maximum gross weight is 24,750 lb. (11,227 kg), and fuel capacity is 1,252 gal. (4,739 l). At economy cruise speed of 405 knots, 40,000 ft. (12,192 m), with

reserves for 175 mi. (282 km), plus 45 minutes holding, range is 1,460 mi. (2,350 km). Seating capacity is 10 to 14. Standard aircraft price is \$995,000.

The **HFB Hansa 320**, produced by Hamburger Flugzeugbau GmbH, is Germany's contribution to American business aviation. U.S. certification was delayed as a result of a mishap to the prototype aircraft, and the Hansa 320 is now anticipated to be available in late 1966. This 9- to 14-place aircraft has the only forward-swept wings in this category. Powerplants are 2 General Electric CJ610-1 engines of 2,850 lb. (1,293 kg) thrust each. Maximum gross weight is 18,740 lb. (8,500 kg) and fuel capacity is 1,053 gal. (3,986 l). Cruise speed at 32,800 ft. (9,997 m), 95 percent power, is 435 knots. Maximum range, with VFR reserves, at 39,400 ft. (12,009 m) and economy power is 1,420 n. mi. Fully equipped price is quoted at \$750,000.



HFB Hansa 320

Superjets

The international expansion of American business activities, corporate reliance on its own aviation department to satisfy executive travel requirements, and the demand for larger aircraft with substantially greater range may give birth to a second-generation jet aircraft. Built-in requirements are long-haul capability of 3,500 miles (5,633 km) or better, short-field capability of 5,000-ft. (1,524 m) runways, elimination of ground-support equipment, and high landing weights to allow for short intermediate stops without the necessity to dump or take on fuel.

Three aircraft designed for airline use—the **BAC 111**, **DC-9**, and **Boeing**

737E—can be adapted into desirable corporate versions by adding additional fuel storage in the fuselage. The **Grumman Gulfstream II** is being developed exclusively as a corporate aircraft and will carry all its fuel in the wings. Executive interiors can provide seating for 24-30 passengers in any of these aircraft.

British Aircraft Corporation's BAC 111 is in production and is in the lead on the American market with 2 models offered for 1966 delivery at about \$3 million. The BAC 111, 200 series, has 2 Rolls-Royce Spey-3 Mark 506-14 turbofan engines of 10,410 lb. (4,722 kg) thrust each, and a maximum gross

weight of 76,800 lb. (34,836 kg). The 400 series is about 10,000 lb. (4,536 kg) heavier and uses 2 Rolls-Royce Spey-4 Mark 511-14 turbofan engines of 11,400 lb. (5,171 kg) thrust each. Maximum cruise speed is quoted at 0.78 Mach. Range (IFR) will be 2,578 n. mi. Fuel loads will be 3,685 gal. (13,949 l). Maximum gross weight for the 400 series BAC 111 is 76,500 lb. (34,700 kg) and 87,000 lb. (39,463 kg).

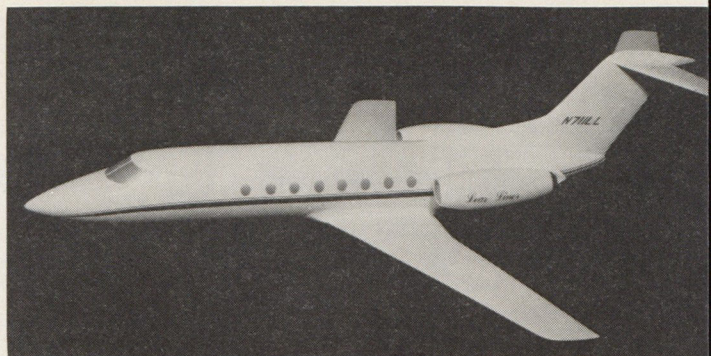
The **Douglas Aircraft Company's DC-9** will enter the market a year behind the BAC 111 and will also be offered in 2 models. The -5 version will carry 2 Pratt & Whitney JT8D-5 turbofan
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BAC 111



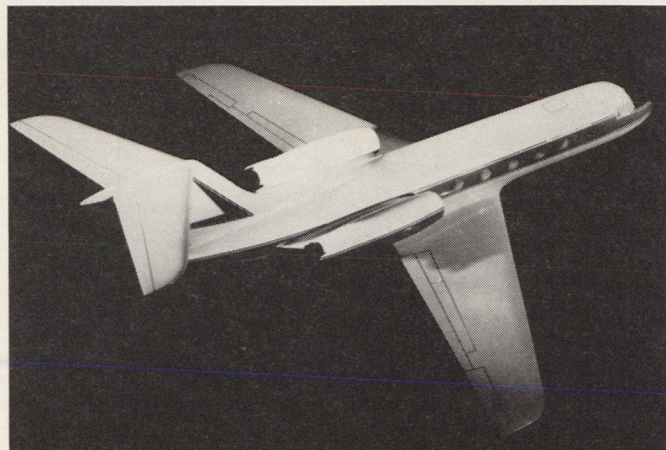
Douglas DC-9



Lear Liner 40



Boeing 737E



Grumman Gulfstream II

engines of 12,000 lb. (5,443 kg) thrust each, and the -1 model will be powered by Pratt & Whitney JT8D-1 turbofan engines of 14,000 lb. (6,350 kg) thrust each. Maximum gross weight is 90,700 lb. (41,141 kg). Range is quoted as 2,875 n. mi. with 15 passengers. Maximum speed is 0.83 Mach. Price tag is \$3.3 million.

The BAC 111 and DC-9 are somewhat similar in design with aft-mounted engines and a high T-tail. The **Boeing Aircraft Company's 737E** departs from this configuration. Plans call for conventional wing-mounted engines and a low horizontal stabilizer, which will be an original design in this group.

Deliveries are doubtful until late 1968 or early 1969. The 737E will have a maximum cruise speed of 0.82 Mach. IFR range (20 passengers, basic fuel) will be 2,800 n. mi. Powerplants will be 2 Pratt & Whitney JT8D-7 turbofan engines of 14,000 lb. (6,350 kg) thrust each. Maximum gross weight will be 97,000 lb. (43,998 kg) and fuel capacity, 4,670 gal. (17,677 l) or 6,420 gal. (24,300 l) (optional). Cost of the Boeing 737E is presently pegged at \$3.3 million complete with interior and electronics.

The **Grumman Gulfstream II** is now in production by Grumman Aircraft Engineering Corporation. First flight is scheduled for spring 1966, and first deliveries are anticipated in 1967. The Gulfstream II is the only aircraft in this group not specifically designed for air carrier use, and costs will run about \$1 million less than the larger aircraft, or about \$2.25 million. Two aft-mounted Rolls-Royce RB Spey-163-25 turbofan engines of 11,400 lb. (5,171 kg) thrust each will power the Gulfstream II. Maximum gross weight will be 54,000 lb. (24,494 kg) with a useful load of 51 percent. This would include 21,500 lb. (9,752 kg) of fuel, 2,100 lb. (952 kg) for 10 passengers and baggage, 3-man flight crew, and 3,900 lb. (1,769 kg) for furnishings. Range will be 2,640 n. mi. Maximum cruise speed is quoted at 0.83 Mach at 30,000 ft. (9,144 m).

Announced in late 1965 for future delivery is **Lear Jet's Lear Liner 40** which will be powered by 2 Rolls-Royce Spey Jr. turbofan engines of 8,750 lb. (3,969 kg) thrust each. Maximum gross weight will be 36,250 lb. (15,989 kg) and fuel capacity, 1,864 gal. (7,056 l). Maximum cruise speed is quoted at 0.94 Mach at 41,000 ft. (12,497 m). IFR

range with 15 passengers will be approximately 1,800 n. mi. Approximate price, equipped, is \$1.5 million.

Turboprop Aircraft

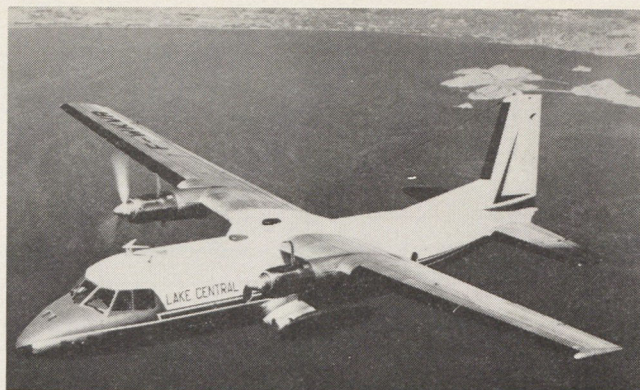
The first turboprop aircraft entered business-aviation service in 1959 with the introduction of the **Grumman Gulfstream G-159** and **Fairchild F-27** in the \$1 million price range. France added a challenger to this market in 1965 with the **Nord 262**.

With the exception of the Nord 262, newer turboprop aircraft are designed to exploit a much larger market for 5- to 12-place aircraft in the \$200,000-\$300,000 bracket. As business aviation needs vary, mission requirements will play a greater part in the selection from this group.

The **Grumman Gulfstream G-159** is powered by Rolls-Royce Dart RDa-529E turboprop engines (2,190 eshp each). Propellers are Dowty Rotol, 4-blade, constant speed. Maximum take-off weight is 35,100 lb. (15,921 kg) and maximum payload 4,270 lb. (1,937 kg). Fuel capacity is 1,550/1,794 gal. (5,867/6,791 l). Seating can be arranged for 12 to 24 passengers. Cruise speed at



Beech King Air



Nord 262

25,000 ft. (7,620 m) is 315 knots and cruise range with 500 lb. (227 kg) reserve is 2,280 n. mi. Sale price is \$1.1 million, complete with interior and electronics.

The **F-27**, originally designed by **Fokker** in Holland, is built in the U.S. by **Fairchild Hiller Corporation**. Powered by 2 Rolls-Royce Dart 7 Mark 532-7 turboprop engines (2,250 eshp each), the F-27 has a cruise speed of 256 knots at 20,000 ft. (6,096 m), 38,000 lb. (17,237 kg). Fuel capacity is 1,364 gal. (5,163 l). Seating up to 48 passengers in airline configuration, the F-27 has a maximum takeoff weight of 42,000 lb. (19,051 kg) and a maximum payload of 11,881 lb. (5,389 kg). Range with 45 minutes fuel reserve at optimum altitude, 240 knots, is 1,500 n. mi. Price tag is about \$1 million complete.

France's answer to the DC-3 replacement, the **Nord 262**, has 2 Turbomeca Bastan VIC turboprop engines (1,065 eshp each) driving 3-blade Ratier-Figeac FH.146 propellers. Airline seating configuration is 26-29 passengers. Maximum takeoff weight is 22,700 lb. (10,297 kg), fuel capacity is 528 gal. (2,000 l) and useful payload, 9,770 lb. (4,432 kg). In executive con-

figuration, the Nord 262 will have a 1,000-mi. (1,609 km) range and a cruise speed of 210 knots. Executive version, complete with electronics and interior, will run about \$575,000.

The **Beech Aircraft Corporation's King Air** is a 6- to 8-place pressurized aircraft powered by 2 United Aircraft of Canada PT6A-6 turboprop engines (500 eshp each). Propellers are Hartzell, 2-blade, constant speed. Maximum takeoff weight is 9,300 lb. (4,218 kg) and fuel capacity is 384 gal. (1,453 l). At maximum-range power settings, 20,000 ft. (6,096 m), the King Air has a range of 1,360 n. mi. at 200 knots. The King Air will sell for \$320,000 for the standard aircraft.

Marrying the pressurized Grand Commander to the AiResearch TPE 331 turbine engines (575 eshp each), Aero Commander gave birth to the **Turbo Commander**, a 5- to 10-place aircraft priced at \$300,000. Hamilton Standard 3-blade propellers are full-feathering and reversible. Maximum takeoff weight is 8,500 lb. (3,855 kg), useful load 3,400 lb. (1,542 kg), and fuel capacity is 282 gal. (1,067 l). Cruise speed at 16,500 ft. (5,029 m) is 248

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Fairchild Hiller F-27



Grumman Gulfstream G-159

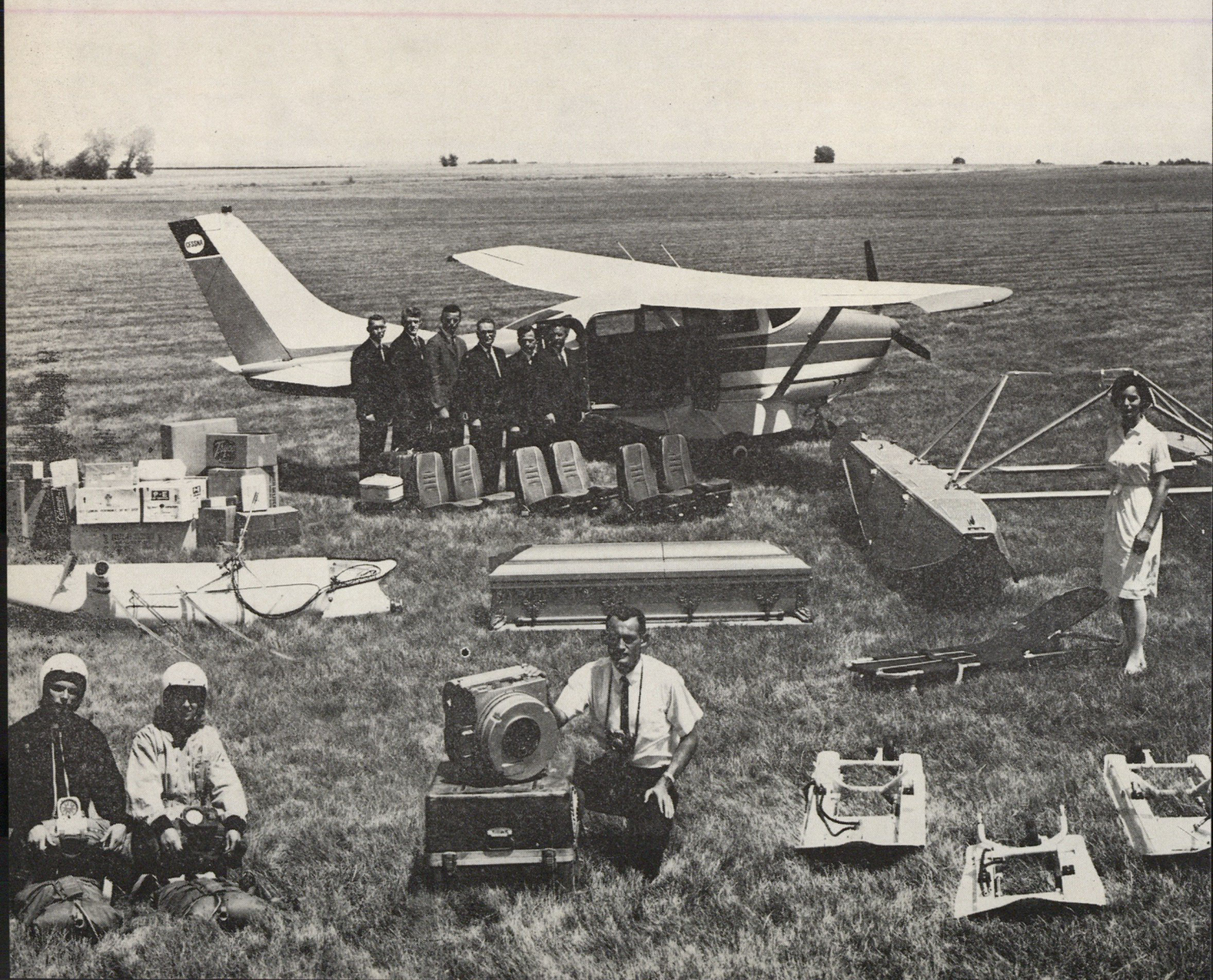


Aero Commander Turbo Commander

Convertibility

Any Cessna Utililine airplane can be converted within minutes into either a Passenger Carrier (with room for six adults and a generous amount of baggage), or an Air Cargo Truck. This unique double-duty capability permits maximum flexibility of operation and thus more "air time."

How should "fly anywhere" airplanes from the Cessna Utililine be serving your area?



Cessna UTILILINE

Cessna aircraft are in military and commercial use in every free country of the world. The versatility and convertibility of Cessnas make them the most accepted aircraft in the world.

Whether the mission is to fly passengers or cargo — in remote areas or out of major terminals — the best performance is found in the versatile Cessna Utililine.

Three 6-passenger models — Cessna 180, 185 Skywagon, and Super Skywagon — feature fast convertibility that allows *double-duty* service. With minimum effort, a cargo carrier becomes an attractive air taxi with ample luggage space; a passenger arrangement is turned into a husky freighter. One airplane does the work of two!

Convertibility Kits . . . In addition to usual passenger/freight use, Cessna-Crafted convertibility kits permit specialized services: ambulance stretcher and casket delivery . . . spraying . . . open-door air drops . . . photography and mapping. A belly-mounted Cargo-Pack that carries 300 pounds can be installed on the Skywagons. Most floats and skis are designed specifically for Utililine airplanes.

Cessna Features . . . Utililine airplanes have flat floors best for passengers or cargo. High wings cradle the load at center of lift, increase stability, and give more clearance. Other standard Cessna features include Para-Lift flaps for steeper, slower approaches and improved short-field performance . . . wide-view windows (360° Omni-Vision on the Super Skywagon) for all-around visibility . . . rugged spring steel landing gear (full Land-O-Matic on the Super Skywagon) for smoothing out rough fields . . . retractable tie-down cargo rings.

Professional Panels . . . Instrument panels are glareproof, functionally grouped, and well lighted. Nav-O-Matic autopilots and VFR or complete IFR navigation and communications equipment are Cessna-Crafted for compatibility.

Special Interiors . . . Utililine cabins are finished in attractive, rugged materials and trim. All upholstery is pretested to make certain it is durable, fade resistant, and washable.

Nothing on wheels, floats, or skis equals a double-duty, quickly convertible Utililine airplane for delivering a profit. The local Cessna dealer can arrange a convincing demonstration of the Utililine model of your choice.

For more information on any of the 13 Cessna models, write to Cessna Aircraft Company, Military Division, Dept. TRU-SD16, P. O. Box 1977, Wichita, Kansas, U. S. A.

Wing Hard Points . . . Optional Wing Hard Points are available on all Utililine airplanes.

*More people buy Cessna airplanes
than any other make*

CESSNA



CESSNA 180

230-hp engine . . . speeds up to 170 mph . . . 1285 lbs. useful load . . . carries six plus baggage. \$16,250 F.A.F., Wichita, Kansas, U. S. A.



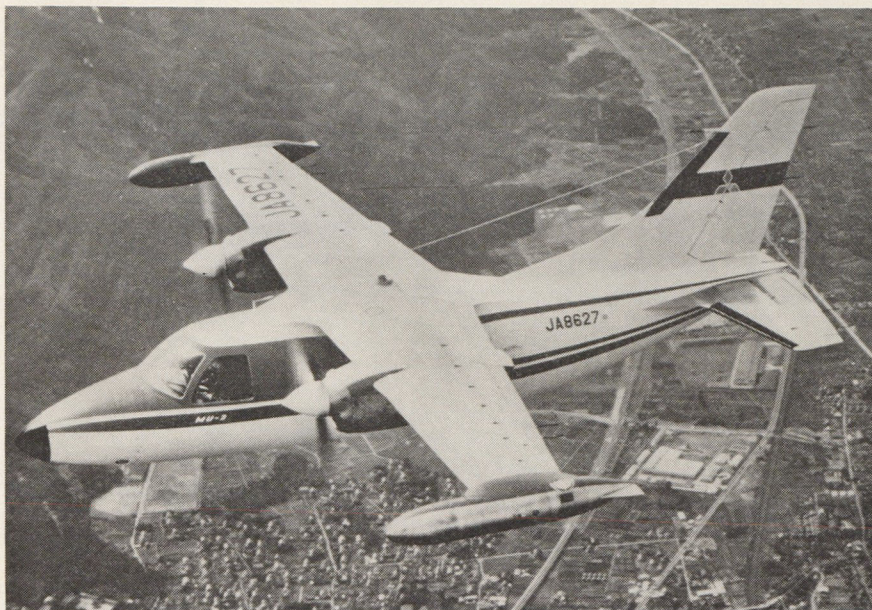
CESSNA 185 SKYWAGON

260-hp engine . . . speeds up to 172 mph . . . (optional 300-hp engine . . . 178 mph) . . . 1740 lbs. useful load . . . carries six plus baggage. Floats optional. \$19,795 F.A.F., Wichita, Kansas, U. S. A. (U. S. Military designated U17)



CESSNA SUPER SKYWAGON

285-hp engine . . . speeds up to 174 mph . . . (optional Turbo-System engine gives greater climb, more speed and higher altitude) . . . 1840 lbs. useful load . . . carries six with ample baggage space. Double wide 42-inch cargo doors; tops for room and comfort. Three-blade propeller optional. Note the handy Cargo-Pack (optional). \$22,950 F.A.F., Wichita, Kansas, U. S. A.



Mitsubishi-Mooney MU-2B



Aero Commander 500U



Aero Commander Grand Commander

knots with a range of 960 n. mi. The Turbo Commander is pressurized to 4.0 psi (.28 kg/cm²).

Mooney Aircraft, Inc., will assemble and distribute the **MU-2B**, built by **Mitsubishi Heavy Industries Ltd.**, Tokyo. The MU-2B is a 7-place pressurized aircraft priced at \$260,000. The U. S. version will use AiResearch TPE 331-25A engines (605 eshp each), with Hartzell constant-speed, full-feathering, 3-blade propellers, which are reversible. Maximum takeoff weight is 8,710 lb. (3,951 kg), 2,390 lb. (1,329 kg) useful load, and fuel capacity, 295 gal. (1,117 l). Maximum cruising speed at 20,000 ft. (6,096 m) is 258 knots, and maximum range with 45 minutes reserve is 1,000 n. mi. The MU-2B is pressurized to 4.0 psi (.28 kg/cm²).

Piston-Engine Aircraft

In spite of the increasing numbers of turbine-powered aircraft, piston-engine aircraft will continue to dominate the U.S. skies in the foreseeable future. Offering distinct price advantages, the light and medium twin-engine business aircraft will be powered by technologically improved piston engines.

Turbocharged and pressurized aircraft will provide higher altitude and performance capabilities. This market is expected to increase.

With speeds in the 200-mph (322 km/hr) range and minimal runway requirements for takeoffs and landings, these aircraft give the American businessman unmatched utility in short-range operations.

The **Aero Commander 500U**, a 4- to 8-place aircraft, is powered by 2 Lycoming IO-540 engines (290 hp each) and priced at \$94,500. Propellers are Hartzell, 3-blade, full-feathering. Maximum takeoff weight is 6,750 lb. (3,062 kg), useful payload 2,435 lb. (1,104 kg), and fuel capacity 156 gal. (590 l). Cruise speed at 8,000 ft. (2,438 m), 55 percent power, is 170 knots and maximum range with 30 minutes reserve is 1,090 n. mi.

The **Grand Commander**, by Aero Commander, is available in standard and pressurized versions at \$146,900 and \$199,950 respectively. Pressurization is at 3.2 psi, sea-level cabin to 6,500 ft. (1,981 m), 10,000-ft. (3,048 m) cabin pressure at 19,500 ft. (5,944 m). Both are equipped with Lycoming IGSO-540 engines, Hartzell 3-blade, constant-speed, full-feathering propellers, and can accommodate 5 to 11 passengers. Both Grand Commanders have a maximum takeoff weight of 8,500 lb. (3,855 kg). Useful payload in standard model is 3,300 lb. (1,374 kg). Pressurized model payload is 2,900 lb. (1,315 kg). Cruise speed, standard

model, 70 percent power, 10,000 ft. (3,048 m), is 215 knots. Maximum range, 22,000 ft. (6,706 m), 45 percent power, is 1,250 n. mi. Pressurized Grand Commander cruise speed, 70 percent power, 14,000 ft. (4,267 m), is 215 knots and maximum range, 22,000 ft. (6,706 m), 45 percent power, is 1,250 n. mi.

Beech Aircraft Corporation has 5 twin piston-engine models in this category, the **D95A Travel Air**, **B55 Baron**, **65 Queen Air**, **A80 Queen Air**, and **Super H-18**. Recently introduced is the **88 Queen Air**, a pressurized version of the standard Queen Air. Representative aircraft of this manufacturer are:

- The **Beech Baron B55**, a 4- to 6-place aircraft equipped with Continental IO-470L engines (260 hp each) and McCauley constant-speed, full-feathering propellers, is priced at \$59,950. Hartzell, 3-blade propellers are available for \$1,275 additional. Maximum gross weight is 5,000 lb. (2,268 kg), useful load, 2,005 lb. (909 kg), and fuel capacity, 112/142 gal. (424/537 l). Cruise speed, 7,000 ft. (2,134 m), 75 percent power, is 196 knots with a cruise range of 710 n. mi. Maximum range with 142 gal. (537 l), 50 percent power, 10,000 ft. (3,048 m) is 1,060 n. mi.

- The **Queen Air A80**, a 6- to 9- place aircraft equipped with Lycoming IGSO-540 AIA engines (380 hp each), with Hartzell, 3-blade, constant-speed, full-feathering propellers. Basic aircraft cost is \$140,000 and auxiliary wing tanks are available for \$2,800 additional. Maximum takeoff weight is 8,500 lb. (3,855 kg), useful load 3,600 lb. (1,633 kg), and fuel capacity 214 gal. (810 l). Auxiliary tanks add 50 gal. (189 l) for a total of 254 gal. (999 l). Cruise speed, 15,000 ft. (4,572 m), 70 percent power, is 200 knots with a range of 765 n. mi. With maximum fuel (264 gal. or 999 l), range is 1,000 n. mi.

- Workhorse of the medium twin fleet has been the **Beech Model 18**, whose military counterpart is the C-45. Basic airframe has also been found adaptable to modification and conversion into trigear and turboprop models. The **Super H-18** is a 7- to 9-place aircraft with 2 Pratt & Whitney R985-AN-14B engines (450 hp each), and Hartzell, 3-blade, constant-speed, full-feathering propellers. Basic cost is \$135,000. Maximum takeoff weight is 9,900 lb. (4,491 kg), useful payload 4,220 lb. (1,914 kg), and fuel capacity, 318 gal. (1,204 l). Cruise speed, 10,000 ft. (3,048 m), 66.7 percent power, is 192 knots and range (318 gal. or 1,204 l) in this configuration is 1,095 n. mi.

The **Cessna Aircraft Company** produces 4 twin-engine aircraft in this category, the 411, 337 Super Skymaster, 310J,

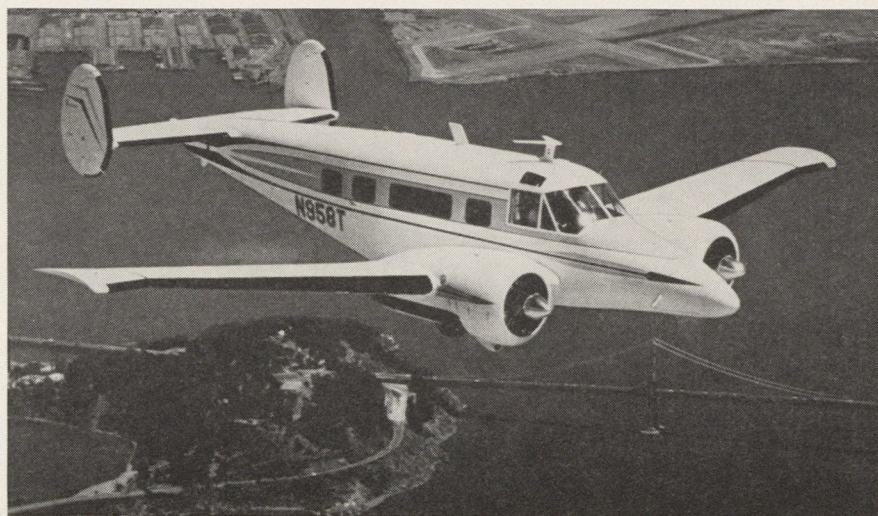
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Beech Baron B55



Beech Queen Air A80



Beech Super H-18



Cessna 411



Cessna Super Skymaster

and 320 Skyknight. The 411 and Skyknight feature turbocharged engines.

The **Cessna 411** is powered by 2 Continental GTSIO-520-C fuel-injection engines with turbochargers (340 hp each). Propellers are McCauley, 3-blade, constant-speed, full-feathering. Maximum takeoff weight is 6,500 lb. (2,971 kg), useful load 2,680 lb. (1,216 kg), and fuel capacity 175/202 gal. (662/752 l). Cruise speed at 20,000 ft. (6,096 m), 75 percent power, is 220 knots, and range, with 175 gal. (662 l), is 965 n. mi. Cessna 411 basic aircraft cost is \$108,950.

Featuring centerline thrust, the **Cessna Super Skymaster** is a 4- to 6-place aircraft powered by 2 Continental IO-360 C/D engines (210 hp each) mounted fore and aft of the fuselage. Propellers are McCauley 2-blade, constant-speed, full-feathering. Maximum

takeoff weight is 4,200 lb. (1,905 kg), useful load 1,585 lb. (719 kg), and fuel capacity is 93/131 gal. (352/496 l). Cruise speed at 5,500 ft. (1,676 m), 75 percent power, is 165 knots and cruise range with 93 gal. (352 l) is 662 n. mi. Maximum range with 131 gal. (496 l), 10,000 ft. (3,048 m), is 1,210 n. mi. Skymaster is priced at \$59,950.

The **Cessna 310J** has also been purchased off the shelf by the military as a mission-support aircraft (the U-3). This 4- to 6-place aircraft is equipped with Continental IO-470-D engines (260 hp each), McCauley 2-blade, constant-speed, full-feathering propellers, and costs \$62,950. Maximum takeoff weight is 5,100 lb. (2,313 kg), useful load, 2,006 lb. (910 kg), and fuel capacity, 102/133 gal. (386/503 l). Cruise speed at 6,500 ft. (1,981 m), 75 percent power, is 194 knots and cruise range with

102 gal. (386 l), is 680 n. mi. Maximum range with 133 gal. (503 l), at 10,000 ft. (3,048 m), is 1,100 n. mi.

The 4- to 6-place turbocharged **Cessna Skyknight** is equipped with 2 Continental TSIO-520-B engines (285 hp each) and McCauley 2-blade, constant-speed, full-feathering propellers. Maximum takeoff weight is 5,200 lb. (2,359 kg), useful load 1,940 lb. (880 kg), and fuel capacity, 102/143 gal. (386/541 l). At maximum recommended cruise, 75 percent power at 20,000 ft. (6,096 m), 140 gal. (530 l) (no reserve), range is 1,032 n. mi. at 224 knots.

Piper Aircraft Corporation manufactures the Aztec C, PA-23 Apache 235, and PA-30 Comanche B in the light twin category. The Aztec and Comanche are available in turbocharged and standard models.

(Continued on page 31)



Cessna 310J



Cessna Skyknight



INTERNATIONAL AEROSPACE / DEFENSE COOPERATION
the May Issue of
AIR FORCE / SPACE DIGEST INTERNATIONAL

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Piper Aztec C



Piper Twin Comanche Bs

Piper Apache



The 6-place **Turbo Aztec** is equipped with 2 Lycoming TIO-1540-J4A5 engines (250 hp each) and Hartzell constant-speed, full-feathering propellers. Purchase price, which includes turbochargers and oxygen system, is \$68,615. Maximum takeoff weight is 5,200 lb. (2,359 kg), useful load 2,147 lb. (974 kg), and fuel capacity, 144 gal. (545 l). Cruise speed at 24,000 ft. (7,315 m), 75 percent power, is 203 knots. Cruise range, at 75 percent power, 7,500 ft. (2,286 m), is 1,060 n. mi.

The **Piper Aztec C** is powered by 2 Lycoming IO-540-C4B5 engines (250 hp each) and Hartzell propellers. Maximum takeoff weight is 5,200 lb. (2,359 kg), useful load 2,267 lb. (1,028 kg), and fuel capacity 144 gal. (545 l). Cruise speed at 7,500 ft. (2,286 m), 75 percent power, is 179 knots with a range of 920 n. mi. Basic aircraft cost is \$54,990.

The 4- to 6-place **Piper Apache PA-23-235** has 2 Lycoming engines, O-540-B1A5 (235 hp each) and Hartzell propellers. Maximum takeoff weight is 4,800 lb. (2,177 kg), useful load 2,064 lb. (936 kg), and fuel capacity 144 gal. (545 l). Cruise speed, at 7,000 ft. (2,286 m), 75 percent power, is 168 knots with a range of 960 n. mi.

Two Lycoming TIO-320-B turbocharged engines (160 hp each) power the 4- to 6-place **Piper PA-30 Turbo-Twin Comanche B**. Maximum takeoff weight is 3,725 lb. (1,690 kg) with tip tanks, useful load 1,317 lb. (597 kg), and fuel capacity, 90/120 gal. (341/454 l). Cruise speed at 24,000 ft. (7,315 m), 75 percent power, is 196 knots, and range with 120 gal. (454 l) is 1,235 n. mi. Turbo Comanche is priced out at \$45,680, which includes tip tanks, oxygen, and turbochargers.

The standard **PA-30 Twin Comanche B** is equipped with Lycoming IO-320B engines (160 hp each) and Hartzell propellers. Maximum takeoff weight is 3,600 lb. (1,633 kg), useful load 1,440 lb. (653 kg), and fuel capacity 90 gal.

(Continued on following page)

(341 l). Cruise speed, at 8,000 ft. (2,438 m), 75 percent power, is 168 knots with a range of 812 n. mi. Twin Comanche is priced at \$34,900.

Single-Engine Aircraft

Single-engine aircraft offer swift, reliable, low-cost transportation for American businessmen and, equally important, the flying qualities do not tax the skills of the pilot/businessman. Limiting factor, besides a single powerplant, is a low useful payload, which restricts passenger/fuel weight. While utilized for specialized missions (pipeline patrol, etc.), this class aircraft is the favorite of the executive who acts as his own pilot and generally provides an introduction for a company to the advantages of traveling in a personal aircraft. There are more than 30 single-engine aircraft manufactured in the U.S. in fixed- or retractable-gear models at prices ranging from \$9,000 to \$30,000. Representatives of this group are:

- The **Cessna 185 Skywagon**, a 1- to 6-place, fixed-gear aircraft equipped with a Continental IO-520-A engine (285 hp) and McCauley propeller. Purchase price is \$19,795. Maximum takeoff weight is 3,200 lb. (1,451 kg), useful load 1,640 lb. (744 kg), and fuel capacity, 65/84 gal. (246/318 l). Cruise speed, at 7,000 feet (2,136 m), 75 percent power, is 145 knots with a range of 610 n. mi.

- The 4- to 6-place retractable-gear **Beech Aircraft Corporation Bonanza S-35** is powered by a Continental IO-520B engine (285 hp) and McCauley propeller at a cost of \$28,750. Maximum takeoff weight is 3,300 lb. (1,497 kg), useful load 1,415 lb. (642 kg), and fuel capacity 50/80 gal. (189/303 l). Cruise speed, at 7,000 ft. (2,136 m), 75 percent power, is 162 knots with a range of 538 n. mi. with 50 gal. (189 l).

- **Mooney Aircraft, Inc.**, produces the **Mark 21**, a 4-place aircraft driven by a Lycoming 360-AID engine (180 hp) with a Hartzell propeller. Purchase price is \$16,450. Maximum take-

off weight is 2,575 lb. (1,168 kg), useful load 1,050 lb. (476 kg), and fuel capacity 52 gal. (197 l). Cruise speed, at 7,500 ft. (2,281 m), 69 percent power, is 148 knots with a range (normal cruise) of 712 n. mi.

- The **Piper Aircraft PA-24-400 Comanche** is a 4-place aircraft powered by a Lycoming IO-720-AIA engine (400 hp) and a Hartzell, 3-blade propeller. Purchase price is \$28,750. Maximum takeoff weight is 3,600 lb. (1,633 kg), useful load 1,490 lb. (676 kg), and fuel capacity 100/130 gal. (378/492 l). Cruise speed at 8,000 ft. (2,438 m), 75 percent power, is 182 knots. Cruise range at 65 percent power is 940 n. mi.

Engines

General Electric Company and **Pratt & Whitney Aircraft Div. of United Aircraft Corporation** dominate the American jet-engine market and power all but one of the small business jets
(Continued on following page)



Beech Bonanza S-35



Cessna 185 Skywagon



Mooney Mark 21



Piper Comanche 400

presently available. The DH-125 is the exception and is equipped with the Viper 522 manufactured by **Bristol Siddeley Engines Ltd.** The **Rolls-Royce Spey** engines will make their appearance on the superjets—the BAC 111 and Gulfstream II, as well as the Lear Liner.

General Electric's 2 commercial axial-flow turbojets were derived from the successful J85 powerplant used on the Northrop T-38 and F-5. The **CJ610** is fundamentally the J85 minus an afterburner, and the **CF 700** is the J85 gas generator section with an added aft fan.

The **CJ610-1** is found on the Jet Commander and HFB Hansa. The **CJ610-4** drives the Lear Jet 23. Both are axial-flow turbojet engines capable of delivering 2,850 lb. (1,293 kg) thrust on takeoff and maximum continuous thrust of 2,700 lb. (1,225 kg). Thrust-to-weight ratio is 7 to 1 on the -1 and 7 to 3 on the -4.

The **CF700-2C** was introduced on the Fan Jet Falcon and is flat-rated to hold 4,125 lb. (1,871 kg) of thrust from sea-level standard conditions up to hot-day temperatures or at high-altitude airports.

Pratt & Whitney's JT12A-6A, an axial-flow turbojet, with 3,000 lb. (1,361 kg) takeoff thrust and maximum continuous thrust of 2,750 lb. (1,166 kg), powers the Lockheed JetStar and North American Sabreliner JetStar engines are equipped with thrust reversers. Thrust-to-weight ratio is 6:7.

Bristol Siddeley's Viper 521, also an axial-flow turbojet, which powers earlier versions of the Hawker Siddeley DH-125, is rated at 3,120 lb. (1,415 kg) thrust. Later models employ the Viper 522, capable of delivering 3,360 lb. (1,525 kg) thrust. The Viper 522's thrust-to-weight ratio is 4.44 to 1.

AiResearch Division of the Garrett Corporation with its **TPE 331** turboprop engine and **United Aircraft of**

Canada with its **PT6** turboprop engines vie for the top sales positions in the 600-hp category. Both have military orders and major business aircraft production orders.

The 2 engines appear to be interchangeable, and some airframe manufacturers are offering the buyer his choice. Distinctly different in design, the **PT-6** is a free-turbine, and the **331** is a connected-turbine or direct-drive engine. On a free turbine, the power-recovery turbine which drives the propeller is separated from the gas generator and rotates independently.

Proponents of the direct-drive type say the advantage is simplicity in design, which results in greater reliability and longer life. Power response is quicker and air starts are simplified as the propeller can windmill the engine.

Proponents of the free-turbine engine claim quieter operation and that both engine and propeller can rotate at optimum design speeds with greater efficiency. While air starts cannot be made by a windmilling propeller, electrical starting loads are lower.

The **AiResearch TPE 331** engine has an official rating of 575 shaft horsepower (605 eshp) for takeoff and 500 shp (526 eshp) for maximum continuous operation, sea level, standard day. It entered service with a time between overhauls of 600 hours, but is expected to go to 800 hours shortly, with an ultimate goal of 4,000 hours. Thrust-to-weight ratio is 2.04:1. The 331 will power the Mooney/Mitsubishi MU-2, Turbo Commander, Turbo Porter, Helio Stallion, and Volpar Beech 18 conversion.

The **PT6A-6**, by **United Aircraft of Canada Ltd.**, has official ratings of 550 shp (578 eshp) for takeoff and 500 shp (525 eshp) for maximum continuous operation at sea level on a standard day. Thrust-to-weight ratio is 2.14:1. Time between overhauls started at 600 hours, but was almost immedi-

ately increased to 800 hours. An increase to 1,400 hours is expected by the end of 1966. The Beech King Air is the primary American user but the **PT6A-6** can be selected at buyer's option for the Turbo Porter and Helio Stallion. The Tradewind, a Pacific Air-motive Corporation conversion of the Beech 18, will also carry the **PT6A-6**.

The Grumman Gulfstream and Fairchild F-27, the larger turboprop aircraft, are equipped with **Rolls-Royce Dart FDa7 Mark 529**, a centrifugal compressor engine capable of delivering 1,910 shp for takeoff and maximum continuous operation. Thrust-to-weight ratio is 1.7:1 and time between overhauls is 4,400 hours.

This group of turbine engines is by no means indicative of the entire market availability either by manufacturer or types of engines, but is representative of those predominantly in use at this time. **Continental Aviation & Engineering Corporation**, **Allison Division of General Motors**, and **Turbomeca** (France) also have turbine engines available.

Biggest technological breakthrough in piston engines has been the turbocharger. The Cessna 411 is powered by the **Continental 340-hp GTSIO-520-C** with a turbocharger manufactured by the **AiResearch Division of the Garrett Corporation**. The Mooney Mustang, a single-engine pressurized aircraft, utilizes a 310-hp **Lycoming TIO-541** with an AiResearch dual-scroll unit turbocharger, which supplies altitude boost and cabin pressurization.

Also available is the **Rajay Corporation** turbocharger, which appears on the 8-cylinder **Lycoming IO-720** engine to provide 400 hp on a Riley Dove conversion.

The heavy price advantage of piston engines assures a market for powerplants from 500 hp down, made up of approximately 90 percent of all U.S. general-aviation aircraft.

Continental Aviation & Engineering Corporation and **Lycoming Division of AVCO Corporation** dominate the market for light aircraft with **Pratt & Whitney** showing up in relatively few small aircraft.

Continental engines, also built by Rolls-Royce in England, are on all Cessna aircraft and Beech's S-35 Bonanza, C33 Debonair, B55 Baron aircraft.

Lycoming engines power all Piper aircraft, the Helio Courier, all Mooney aircraft, the Beech D95A Travel Air, 65 and 80 Queen Air, and Aero Commanders.

Pratt & Whitney engines are on the Beech Model 18 series and conversion models, the Howard 250, 350, and BA 400 and executive conversions of the military B-26.

☆☆☆

The U.S. Administration is quietly studying the potential of American sponsorship of spaceborne direct-broadcast educational television systems for the countries of the emerging world. The idea is truly a revolutionary one. It underscores the enormous utility of space technology, married to television and educational techniques, for human advance. Backers of the concept urge that, if such a program is undertaken, it be so designed that participating countries create their own programming in their own cultural contexts . . .

Spaceborne Video and the Revolution of Rising Expectations

BY WILLIAM LEAVITT, Associate Editor

Quietly being analyzed in Washington this dreary winter of the escalating Vietnamese War is the truly explosive potential of spaceborne television for use in countering Cold-War propaganda by the Communist powers among the emerging nations.

For it is a fact, and a painful one, that the Chinese Communists, using every communications medium at their disposal, including radio (which requires no ability to read), are attempting to convince the backward millions of the world that mindless revolt is the path to utopia.

In their more sophisticated way, the Soviets are engaged in the same campaign, encouraging "wars of national liberation" while proclaiming adherence to peaceful coexistence.

With their advanced technology, the propaganda capability of the Russians represents a major threat to both the West and to the underdeveloped world. That the Soviets see clearly the potential of propaganda on a worldwide scale, using the most modern technology, is underscored by their current effort to enlist European Communist satellite nations in a Communist-bloc communications-satellite system, designed to rival the global system

proposed by the U.S., to which more than 40 nations have already adhered.

In early December, an unpublicized meeting of high officials was held at the White House to discuss the feasibility of United States sponsorship of educational-television communications-satellite systems for the underdeveloped areas of the world where poverty, illiteracy, and unchecked population growth could in combination bring on chaos and major threats to the peace of the world.

The idea is truly revolutionary, and if it could be implemented in the face of all the negotiating difficulties it would entail, such an imaginative worldwide approach to meeting what has been called "the revolution of rising expectations" could cut deeply into the jungle of ignorance, abject poverty, and despair in which so much of the non-Western world is entangled. It would do so by teaching the skills without which men cannot live decently in the twentieth century.

The key to economical operation of educational television on a nationwide, regional, and perhaps, someday, worldwide basis by satellite systems is the oncoming capability for direct-broadcast from orbit, an advance that

only a few years ago seemed much further in the future than it does now. Until that technical possibility existed, many experts argued that despite its many advantages of wide coverage, satellite television was more costly than ground-based instructional systems using prepared video tapes, films, and the like.

As late as 1963, for example, Leland Johnson of the RAND Corporation at Santa Monica, California, a specialist in television economics at the USAF-sponsored research institute, wrote: "In general, then, with respect to television, it appears that satellites have little to offer in the field of educational services; a major cost is the home television receivers themselves, which satellite technology cannot affect. And in the long-distance transmission of programs, the use of tape and film are so inexpensive that the substitution of satellites for them could hardly be expected to generate revolutionary benefits; even if satellite transmissions were literally free, the cost savings over film and tape would be trivial compared to the over-all cost of the educational television service."

But as Laurence C. Rosenberg of the George Washington University

Program of Policy Studies in Science and Technology, Washington, D.C., points out in a quite recent paper, "Johnson's analysis was based on a satellite relay, not direct-broadcast to village or school receivers, although he recognized the possibilities of such developments. [Johnson] wrote in an ancient time as far as satellite technology is concerned—the time when booster capability and satellite power were not developed sufficiently to support a synchronous satellite direct-broadcast system. Today, a bare 2 years later [in 1965], responsible parties claim that the technology has developed to the point where such systems can, in large measure, be assembled from 'off-the-shelf' hardware. . . ."

The GW group for which Mr. Rosenberg works has contributed, under the leadership of Vincent Rock, a veteran social scientist with extensive experience in foreign-aid programs, much of the conceptual background for the current White House study of the possibility of U.S. sponsorship of satellite direct-broadcast educational television.

Also the Hughes Aircraft Company, developers of the Syncom satellite which provided the first demonstration of synchronous communications satellite capabilities, has been studying possible costs of such a system, as are other firms.

Hughes has produced estimates that give direct-broadcast television advantages over ground-broadcast systems, partially because satellite direct broadcast eliminates the need for a proliferation of ground stations.

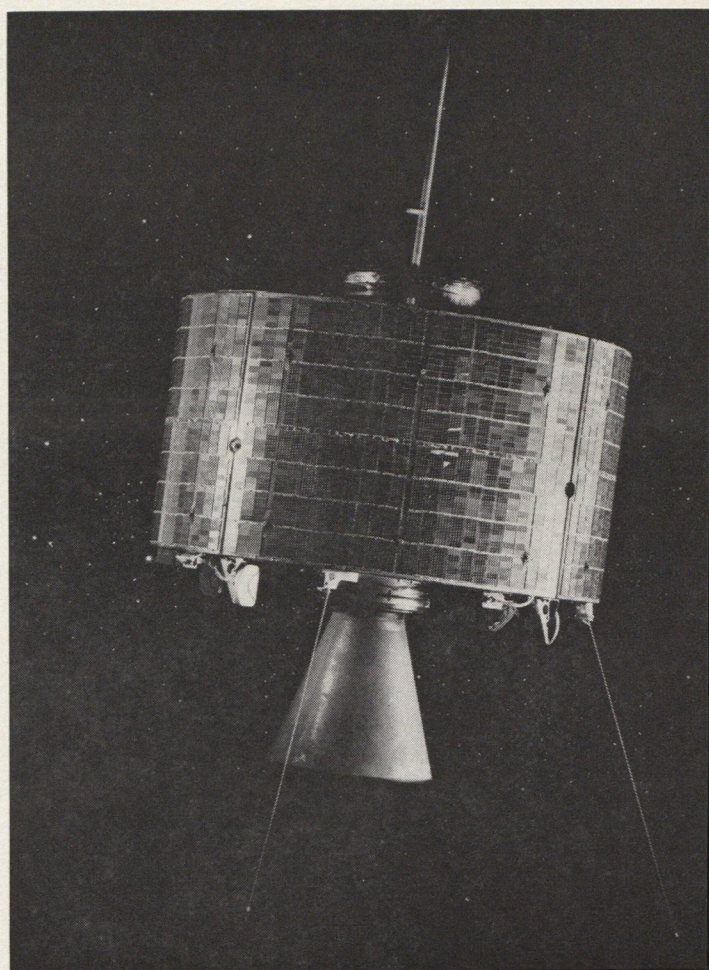
This advantage is shared by airborne broadcast systems, in which an airplane flying in a figure-8 pattern over a wide area serves as the transmitter of videotapes. There is such a system operating in the American midwest, covering school systems in parts of Ohio, Illinois, Indiana, Michigan, Kentucky, and Wisconsin.

The cost advantages of satellite television begin to emerge, according to the Hughes studies cited by Mr. Rosenberg, when the desired area of coverage is somewhere between 300,000 and 500,000 square miles (777,000 and 1,300,000 km²).

India is used as a case study by the Hughes analyzers. They suggest that costs of receivers for the large groups in villages that would watch the educational television program would go down from \$5,000 per set for 1,000 produced to \$250, if production went over the 1,000,000 mark.

Assuming set costs and programming expenses were about the same for ground-based, airborne, and satellite systems, with 100-percent coverage of India, the satellite system

Direct-broadcast spaceborne educational television has enormous potential for helping to bring deprived masses in the non-Western world into the twentieth century and a program of U.S. sponsorship of such systems is being quietly studied in Washington. At right, a model of Hughes Syncom III synchronous communications satellite, which despite its advanced nature, is just the beginning of enormous progress to come.



would be some \$5.9 million less expensive per year than the airborne system. And although satellite systems would, of course, have some reliability problems, the more or less competitive airborne system would have its own set of operating difficulties, particularly "down time" in the monsoon seasons that plague parts of India and Southeast Asia.

Although practically all specialists in the field of educational television agree that the technique is very much in its infancy, most of them agree, too, that its potential is enormous for dissemination of basic knowledge—literacy, public health, agricultural techniques, and the like—in areas where poor communications and the lack of school buildings and well-trained teachers prevent adequate instruction and relegate rural populations to permanent ignorance.

Far from the so-called developing countries—in Italy, for example—a program called Telescuola is already being described as a "classic example" of the potential of educational television for "crash programs of education where schools are primitive or nonexistent." "Telescuola," reports Carol Horning Stacey, another mem-

ber of the GW group, "began on a large scale without a great deal of planning; this was possible because Italy was already covered by a national television system and about 1,000,000 receivers. The immediate purpose was to provide middle school education—3-year prevocational and professional courses for children just out of elementary school—to villages where neither school buses nor school buildings had been provided. . . . In the peak year (the program started in 1958), over 18,000 students were registered in some 1,172 groups. . . ."

Although the program has now been curtailed, thanks to construction of new school facilities, during its heyday Telescuola showed its worth in the academic performance of participating youngsters who came from the villages, after their television instruction, to take examinations in the towns.

But especially significant, Mrs. Stacey points out, was that quite early in the Telescuola experiment it became apparent that many adults were taking courses designed for youths aged 11-14. Here was an ideal tool in the fight against adult illiteracy.

(Continued on following page)



NASA astronaut, Neil Armstrong, veteran civilian X-15 test pilot, is command pilot of Gemini-8 mission in March. Crew will try to dock with Agena vehicle.



Major David Scott, USAF, is copilot on planned Gemini-8 mission. If the docking attempt is successful, major milestone in U. S. space program will be reached.

Telescuola opened a "drastic and effective attack on adult illiteracy" with a television series called "It's Never Too Late." There was group viewing with a monitor and special reading materials were made available. The contrast with earlier, conventional literacy campaigns was striking. They had been "frustrated by the unwillingness of too many adults to make the effort," Mrs. Stacey writes.

"Pride was a stumbling block. Grown men feared the ridicule of their children and friends; grown women found excuses in household chores. [But] watching the village or union-hall television set . . . was a socially acceptable activity since it was entertaining, the programs were addressed to adults, and the content was immediately useful. Soon the 6-month course in reading and writing was supplemented by a course for semiliterates designed to reinforce the new skills. It provided further instruction at a primary school level: an organized survey of Italian history and geography, elements of natural science and hygiene, and an extensive treatment of civics. Civics included practical knowledge for citizens in the villages and useful information for those migrating to the city, such as how to address an envelope.

"A third course was designed for new literates and treated practical matters of many kinds, such as traffic rules, first aid, union news, news about emigration, how to use a bank, a telephone, or a telegraph, and more civics. This course included cultural subjects in the form of interviews with Italian artists, musicians, and writers."

There are numerous other examples of the successful use of television for

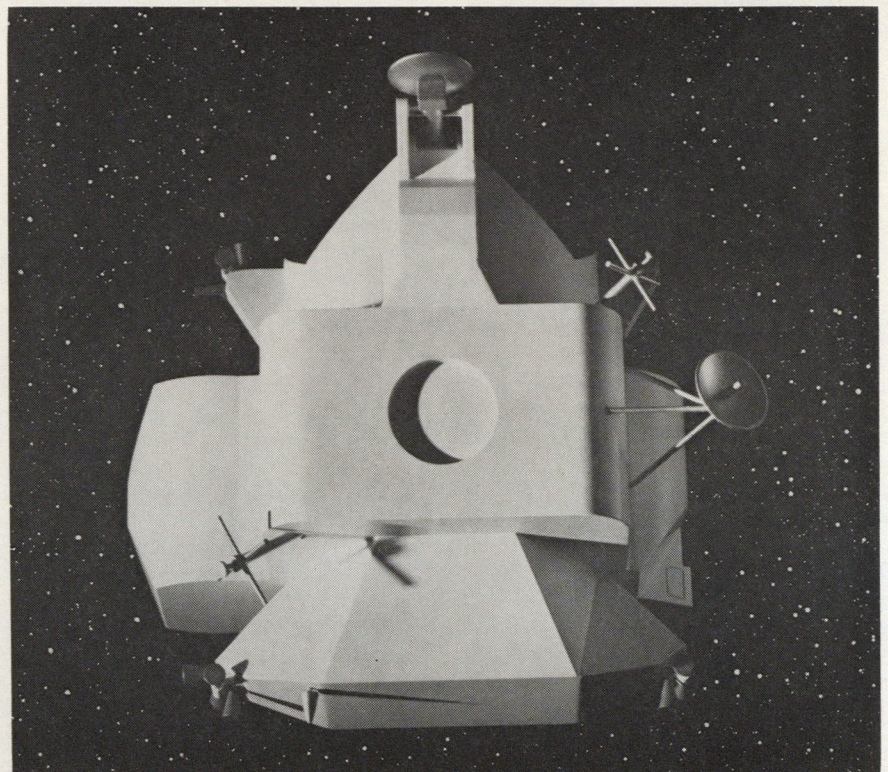
instruction in such basic subjects around the world, in the U.S., Japan, Canada, the United Arab Republic, Yugoslavia, Nigeria, American Samoa, just to mention a few. And they represent just a portion of the potential of television as a tool for helping bring deprived populations into the modern world.

With the coming availability of di-

rect-broadcast satellites, the size of audiences could be greatly enlarged and the cost of instruction and equipment would undoubtedly be brought down, as the Hughes study suggests.

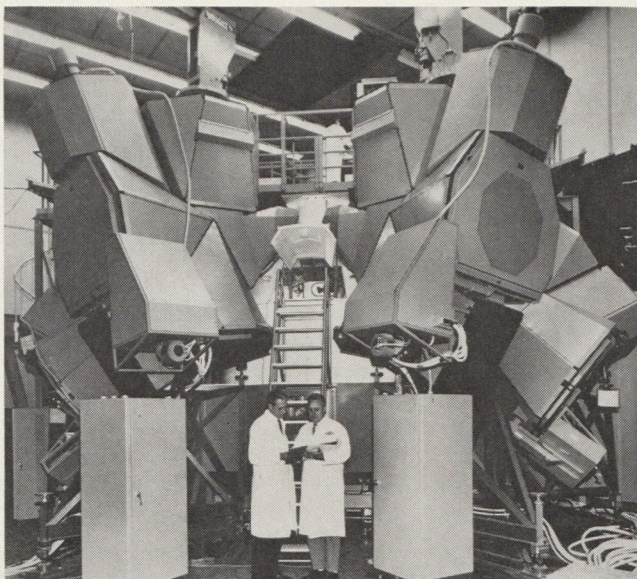
To return to the original point of American interest in the possibility of sponsoring direct-broadcast educational television systems in the emerging world: One might ask how such a policy could evolve and what might be the basic techniques used. As Vincent Rock and several of his associates see it, the political difficulties that might attend an agreement with India could be overcome by guaranteeing to the Indian Government that it, not the American Government, would be responsible for the development of the programming. And from the start the programming would be designed to meet Indian needs. The U.S. would help fund the satellite launching system and provide assistance on the technical side as well as with programming techniques. But essential content of the programs would be prepared by Indians for Indians.

What about the problem of propaganda? Aside from the suspicions of foreign governments and populations of U.S. motives and fears that spaceborne educational television might be used for dissemination of American propaganda, there is the question of



Above, part of new docking-simulation system developed for NASA by F. B. McLaren and Company, New York, for use in the Apollo program. The picture shows model of Lunar Excursion Module as it would appear to astronauts against a star field.

This is Apollo Mission Simulator produced by General Precision-Link, under contract to North American Aviation, in which Apollo astronauts will prepare for the moon mission. It is 30 feet (91.5 m) high, weighs 40 tons (36.3 mt).



whether the foreign governments themselves might not tend to use the medium for domestic political, and possibly even inflammatory, propaganda, in regions of smoldering conflict.

The danger is recognized. But it is pointed out that the broadening effect of television provides considerable built-in protection against this medium. At first the uninitiated viewer who has never left his native village might well uncritically absorb everything he saw on the screen, whether it were pure instruction, entertainment or just plain propaganda. But eventually he would develop the sort of discernment that is routine among viewers in the United States.

American television watchers see mostly commercial television and run in age from 2 years to near-senility. From youth upward, as viewers, they seem to have developed a "sev-

enth sense" which tells them when a commercial interruption is about to intrude on the program they are watching. As soon as the commercial comes on, the family audience in a darkened living room usually bursts into conversation, people step into the kitchen for snacks and cold drinks—and indeed even to the bathroom. A commercial message is not quite the same as a political harangue, but often it gets close.

Thus, it is argued, the viewer's critical faculties are enhanced by television, and he learns to "tune out" what annoys him. Such sophistication might lead eventually to popular demand for more than just the government channel, even programming from abroad. This would help broaden points of view and contribute to peace.

The proponents of a U.S.-sponsored satellite educational television effort in the emerging world have some

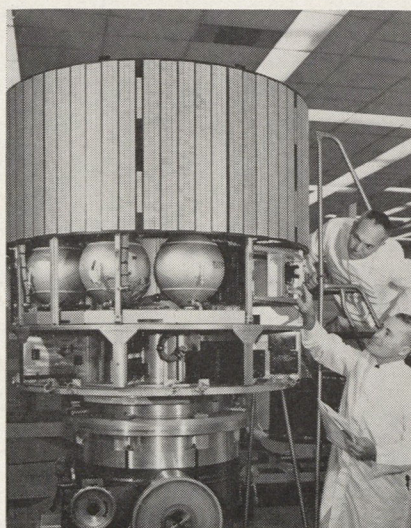
strong Cold-War arguments. They point out that television, in one form or another, is inexorably growing across the world, and that in this sense, it is similar as a technological development to nuclear weaponry. Everyone either wants it or is weighing the advantages of having it. But they point out, the proliferation of television has obviously positive potential, used properly. And, like nuclear weaponry, its marriage with space technology has universal significance.

India is considered by Rock and others as a prime candidate and testing ground for a direct-broadcast educational television system. Successful deployment of such a U.S.-sponsored system could provide the needed demonstration to the rest of the emerging world of the potential of such systems. It is at least conceivable that successful use of the system over the sub-continent would result in a desire and willingness by Pakistan to cooperate with the Indians, share costs, and derive benefits.

If that kind of benevolent chain reaction could start, it might extend eventually throughout Southeast Asia, and over to Africa. Similar systems could be sponsored by the U.S. in Latin America. But always, in order to credibly avoid the charge of U.S. propagandizing, such systems would have to be operated in the cultural terms of the nation or region using it.

How could the U.S. most sensibly run the assistance aspect of such programs? There are many suggestions being made. Many proponents suggest that rather than using an old-line American agency such as the U.S. Information Agency, a kind of "cultural Comsat" corporation be established which would gather a programming and technical talent pool from the existing (Continued on following page)

Westinghouse scientists propose restoration of radiation-damaged solar cells by concentrating solar heat, in orbit, that would anneal and bring damaged cells back to nearly 100 percent efficiency. Special lens is used in the Westinghouse process.



This is a full-scale structural model of the NASA Applications Technology Satellite, one of 5 models being built by Hughes Aircraft for NASA's Goddard Space Flight Center, Maryland. The ATS spacecraft would perform series of scientific space experiments.

American commercial radio-television networks; from the existing American noncommercial educational television system, which is really a series of community stations around the country; from the U.S. university community; and from government agencies.

The best available people from all these institutions would be able to provide early programming and technical guidance to emerging countries participating in bilateral or regional, direct-broadcast educational television system arrangements. They would work with planners in the participating countries. In a parallel manner, a "financial Comsat," specifically de-

ing fantasy purely for entertainment's sake. They see their own real world around them. But this is not always true overseas.

At the moment, U.S.-sponsored spaceborne educational television in the emerging world is in the embryonic stage of discussion with the U.S. Administration. For a number of reasons, ranging from cost to fears that such a proposal might open a Pandora's box of troubles, the idea may never get off the ground. If it seems reasonably feasible, it would be a shame if it were not attempted. A decent measure of success with such an effort might greatly benefit a suffering world

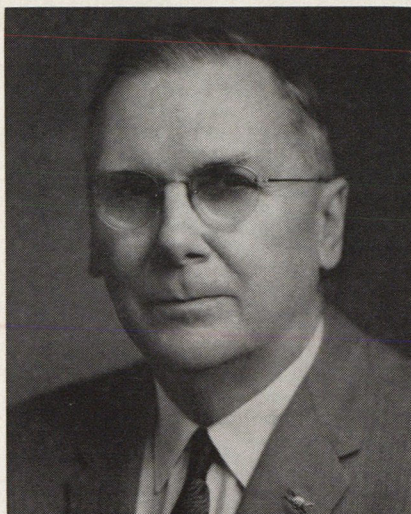
cancer. Dr. Lovelace, a longtime leader in aerospace medicine and a former President of the U.S. Air Force Association, was killed in a tragic plane crash in Colorado, and General White died of leukemia. Each of them will be sorely missed.

Longer Time to Planets

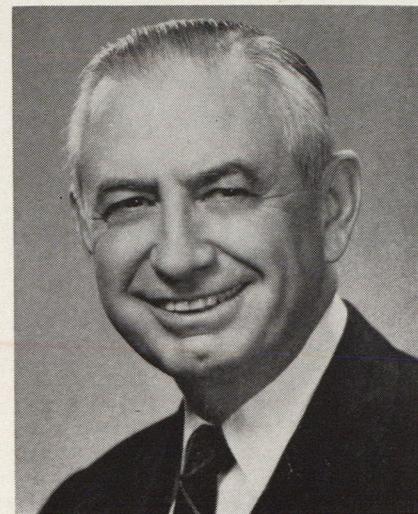
The tightening squeeze on the U.S. space budget occasioned by the Vietnamese War is reflected by the announcement that NASA will defer its first unmanned Voyager planetary mission to Mars until 1973. It had been planned for 1971. At the same time, 3



General Thomas D. White, former Chief of Staff, United States Air Force, a noted military statesman, died at age of 64 in Washington, D.C., on December 22.



Dr. Hugh L. Dryden, Deputy Administrator, NASA, leading aerodynamic scientist, and noted leader in international space cooperation, died on December 2.



Dr. William R. Lovelace, II, aeromedical pioneer, former President of U.S. Air Force Association, NASA Director of Space Medicine, died on December 12.

signed to fund in a nonprofit fashion such programs, could be established with participation by the U.S. and those countries "buying" into the spaceborne educational television idea.

A crucial point made by the Rock group is that successful operation of such systems would not only help bring deprived masses into the modern world via sight and sound but would do so in their own cultural terms. This, they suggest, would be far more useful than what is happening now in many places—the viewing overseas of "canned" American television programming, which often represents mere escapist fantasy such as cowboy and Indian shows, gangster movies, and situation comedies that are utterly irrelevant to the lives of the villagers who view them and who receive a distorted view of the modern Western world.

In America, for the most part, audiences recognize that they are watch-

ing and demonstrate the high potential of space technology—married to television and modern instructional techniques—for peaceful human advance.

Irreparable Losses

Year's end saw the deaths of 3 of America's major contributors to aerospace in science and the military.

Dr. Hugh L. Dryden, 67, Deputy Administrator of the National Aeronautics and Space Administration; Dr. William R. Lovelace, II, 57, NASA's Director of Space Medicine; and General Thomas D. White, 64, former Chief of Staff of the United States Air Force and a leading military intellectual and columnist in later years. All died in December.

Dr. Dryden, noted not only for his contributions to aerospace science, but also for his major efforts in the field of international space cooperation, died after a valiant battle with

Mariner missions to Venus have been announced.

This is the new NASA planetary exploration schedule:

1967—The Mariner-4 spacecraft used for the Mars mission in 1965 will be modified for launch to Venus in mid-year. An Atlas-Agena will be the launcher. Experiments will be improved versions of those on earlier Mariners.

1969—A somewhat heavier Mariner spacecraft will be developed, and 2 of the new version will be launched early in the year to Mars. Atlas-Centaur will serve as the launch vehicle.

1973—Two Voyager missions, using identical hardware, may be launched to Mars early in the year to orbit the planet and release life-detection capsules onto the surface and make other scientific studies. The Saturn V moon booster would be used for launch. Hardware decisions are still not firm.



Economy is taking its toll of the USAF bomber force, but in prospect is a "dual-purpose" bomber replacement for the outgoing B-58s and older B-52s—the FB-111 . . . Satellite communications, with transmitting power 3 times that of Early Bird, will soon be established in the Pacific . . . The XB-70 research craft sets another speed record . . . Radio repeaters at high altitude will improve communications among ground forces in Vietnam . . . Fiberglass-reinforced plastic may eventually replace heavier metals in airframe designs, and rocket-powered mail delivery is being examined . . .

Pylons, Parasails, and Plastic Planes

BY JUDITH DAWSON, Editorial Assistant

At year's end, there was concern throughout the U.S. about the future of the country's Strategic Air Command and over-all defense capability after the Defense Department announcement in December that 345 Boeing B-52s and all 80 Convair B-58s would be removed from the inventory by 1970. Furthermore, Defense Secretary Robert S. McNamara had stated that the Air Defense Command, the Nike anti-aircraft system, and the early-warning system will be reduced, and that the Air Force Reserve and Air National Guard airlift capability will be cut back. The U.S. Congress was thus confronted with OSD's plans to severely limit U.S. airpower.

These announcements followed

shortly after decisions to close, consolidate, or reduce military bases and activities that were, according to Mr. McNamara, surplus to U.S. needs. Primarily as a result of the phase-out of the B-52s and B-58s, Mr. McNamara announced that 49 Air Force bases could either be eliminated or their activities transferred to other locations, thereby reducing USAF personnel by 53,010, saving \$410 million annually, and releasing more than 93,000 acres for other uses.

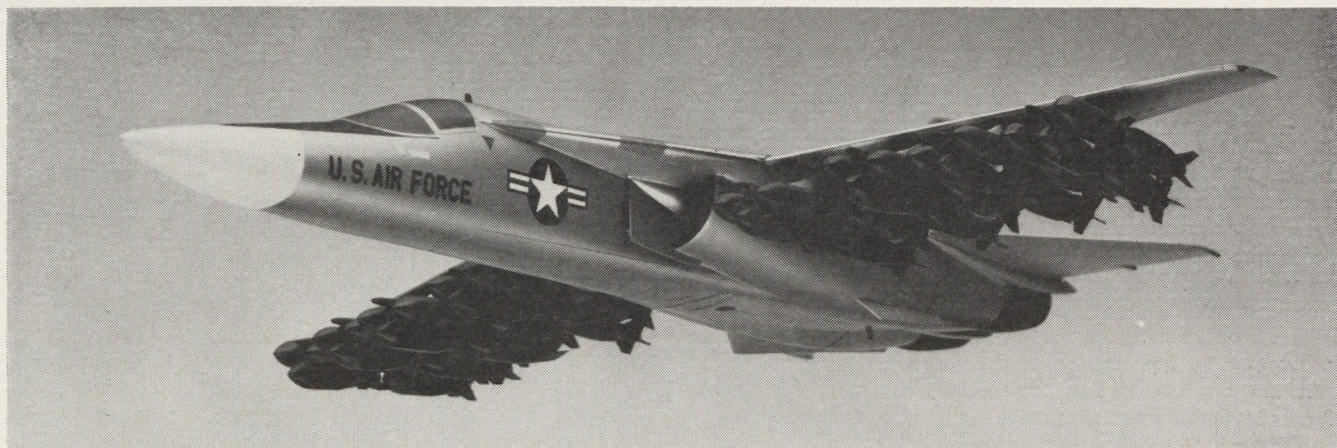
U.S. Congressional reaction to the Defense Secretary's steps in the name of economy has been stormy. To ease the evident dismay, Mr. McNamara went on to announce that a "dual-purpose" bomber version of the Gen-

eral Dynamics F-111 would be built and deployed to replace the B-52s and B-58s and that USAF would receive 210 of the new FB-111s.

Delivery of the FB-111 is scheduled to begin in 1968. Pylons under variable-sweep wings will carry conventional or nuclear weapons, auxiliary fuel tanks to boost range, or both. The pylons swivel to point externally carried stores in the direction of flight, regardless of the wing angle.

The present F-111 has a speed capability of 1,850 miles per hour (2,980 km/hr). It is powered by 2 Pratt & Whitney TF30 turbofans, each with more than 20,000 pounds (9,000 kg) of thrust. The F-111's wingspan is 32

(Continued on following page)



The Air Force's proposed new interim bomber, the FB-111, has raised questions among U.S. Congressmen and military leaders. Here the bomber version of the present F-111 is shown loaded with bombs on pylons under the wings. Secretary McNamara says it can carry 50 750-pound (340 kg) bombs, with performance comparable to the present B-52. He proposes to build 210, to be operational by 1971.

feet (9.7 m) swept, 63 feet (19.2 m) fully extended; length is 72 feet 2 inches (21.99 m), height 17 feet 1 inch (5.2 m).

The new FB-111 has not been endorsed by all high-ranking officers of SAC and the Air Staff, although General Thomas S. Power, recently retired SAC Commander, has commented, "The FB-111 possesses all of the characteristics of an advanced medium strategic bomber; it will be able to do everything the B-58 can do, and will do it better." He made no effort to equate the FB-111 with the B-52.

Indeed, most military experts look upon the FB-111 as a stopgap airplane, one that could serve usefully in the Strategic Air Command as an interim aircraft but not as a true replacement for the B-52.

What the Air Force is hoping for is ultimate approval for the development and the production of the Advanced Manned Strategic Aircraft, designated AMSA. This would be a completely new bomber that would require new engines, new avionics, new performance requirements, and new ground-support facilities. Until that time—if it comes at all—the Defense Secretary has appointed the FB-111 to perform the manned strategic role.

* * *

The second and newest of the Air Force's 2 giant XB-70 research planes came close in December to matching the 2,000 mph (3,200 km/hr) October flight of its older twin.

The younger 6-engine jet reached a new planned top speed of 1,920 mph (3,090 km/hr), nearly 3 times as fast as sound, and altitude of 70,000 feet (21,300 m), more than 13 miles (21 km) high, on its fifteenth test hop.

Pilots for the 2-hour, 3-minute flight at the Air Force Flight Test Center, Edwards Air Force Base, California, were Alvin S. White and Van H. Shepard, both of North American Aviation, which built the 2 research planes. They also tested the XB-70's stability and control at near triple-sonic speed, as well as the effect of intense air friction heat on the plane's surfaces. Laden with fuel, the 250-ton (227 mt) aircraft took off weighing about 530,000 pounds (240,000 kg), making it the heaviest ever airborne.

At the same time, the older XB-70 went through a series of performance tests, including engine shutdowns and restarts. It was the aircraft's twenty-fifth test hop since its maiden flight in September 1964.

At the controls during the 2-hour, 18-minute flight were Lieutenant Colonel Fitzhugh L. Fulton, Jr., and Mr. Shepard.

Main purpose of the flight was calibration of the XB-70's complex engine

air-inlet control system at supersonic speeds and altitudes of from 35,000 to 50,000 feet (10,670 to 15,240 m). Three of the 250-ton airplane's 6 engines were stopped and restarted separately at speed nearly twice that of sound. Two were later stopped and restarted simultaneously.

Top speed and altitude were 1,200 mph (1,900 km/hr), nearly twice as fast as sound, and 50,700 feet (15,450 m).

* * *

Progress in rocketry over the next decade could lead to commercial cargo rockets, according to R. L. Johnson, Vice President-Director of the Manned Orbiting Laboratory subdivision, Douglas Aircraft Company's Missile and Space Systems Division.

There is no doubt about the technical feasibility of globe-girdling cargo flights by giant rockets, Johnson says. The real question is whether rockets can be made economically practical in the face of competition from giant subsonic and supersonic jet transports.

Transport of cargo by rocket was successfully attempted as long ago as 1931, he points out, in experiments by Austrian engineer Friedrich Schmiedl. He conducted approximately one dozen flights in the province of Styria, delivering mail in a service which achieved semiformal status before the effort was terminated in 1933.

In spite of this and other pioneering efforts at rocket mail delivery, he says, commercial development of the rocket has remained stagnant through the recent years of swift technological progress.

Reexamination of this potential, in light of modern technology, proves that rockets can be built to deliver any amount of cargo, mail, or passen-

gers to any point on earth from any other point, although present-day rockets, and even those now contemplated for future space roles, would be overly expensive for commercial cargo use.

It appears, Mr. Johnson says, that commercial rocket transport may emerge from an evolutionary development, starting with highly subsidized, low-payload carriers for high-priority cargo.

* * *

The citizens of the thousand-year-old city of Bremen, West Germany, paid tribute to one of the city's most distinguished sons when General B. A. Schriever, Commander of the U.S. Air Force Systems Command, visited there recently.

A civic reception and dinner for the Systems Command chief at the historic city hall was held, attended by Bremen state senate and municipal officials. General Schriever had not been to his birthplace since leaving for the U.S. in 1917 at the age of 7.

The event highlighted a 4-day tour of German aeronautical companies by General Schriever; Command Chief Scientist Dr. B. H. Goethert; Major General Joseph J. Cody, Jr., Deputy Chief of Staff for Systems; and other staff officers. Included in the tour was a visit to Bremen's Aeronautical Works, Ltd. (Vereinigte Flugtechnische Werke), Germany's leading aircraft firm, and the German Northern Area Air Command at Rheine Air Base.

* * *

G. Ward Hobbs, former Deputy Director of the U.S. Federal Aviation Agency's Bureau of National Capital Airports, has been appointed Special Assistant to the Assistant Administrator for International Aviation Affairs.

An experimental helicopter is demonstrated at Bremen, Germany, for General B. A. Schriever, Commander of the USAF Systems Command, right. German engineer, C. Fischer, developer of the test model, explains its operation. General Schriever and his staff recently toured German aeronautical companies and air bases.





Bringing his 25 years of airline operation experience into the international aviation field is G. Ward Hobbs. He will program and coordinate U. S. visits of foreign aviation officials for Federal Aviation Agency.

Mr. Hobbs will be responsible for programming and coordinating the visits of high-level foreign officials coming to the United States to inspect American aviation facilities. He will also manage various international aviation activities and provide airport consultation services to aviation officials from abroad.

Before coming to FAA in 1960, Hobbs was an airlines vice president with 25 years of experience in airline operations.

* * *

KLM Royal Dutch Airlines has ordered from Douglas Aircraft Company 2 Super 63 DC-8 jetliners to be delivered in April and May of 1967.

KLM is the first to order the Super 63, most advanced of Douglas' Super 60 series DC-8 transports. The airline said it plans to operate the new transports over the North Atlantic. Cost of the Super 63 DC-8, with spares, is approximately \$10 million each.

The Super 63, almost 37 feet (11.3 m) longer than DC-8s currently in operation, will accommodate a maximum of 234 passengers in KLM's economy arrangement as compared to 150 in the airline's series 50 DC-8s. Wing-span of the Super 63 has been increased 6 feet (1.8 m) over the DC-8.

The new transports feature significant range increase; a newly developed pylon and redesigned pods, or nacelles, for the 4 Pratt & Whitney JT3D-3B turbofan engines to give them the added performance of a ducted fan; improved climb capabilities; and increased fuel capacity.

* * *

A program to expand the U.S. Air Force-developed Automatic Digital Network (AUTODIN) into the total common user message communication

network of the Department of Defense began its cutover phase in December.

AUTODIN is an advanced digital data system which began in 1958 as COMLOGNET (Combat Logistics Network), originally designed to meet the purely logistical requirements of the Air Force. This was expanded to AFDATACOM (Air Force Data Communications Network) to include operational and administrative needs. It became AUTODIN in 1963 when it was completed.

The cutover phase calls for deactivation of 18 existing continental U.S. common-use electromechanical and manual teletype relay networks. Current users of these networks will be serviced by terminals operating through new computerized switching centers.

The Air Force Communications Service, which operates the largest segment of AUTODIN in the continental U.S., indicated the cutover will continue for at least 9 months. The U.S. Army Strategic Communications Command will operate AUTODIN overseas. The worldwide AUTODIN program is under the management of the Defense Communications Agency.

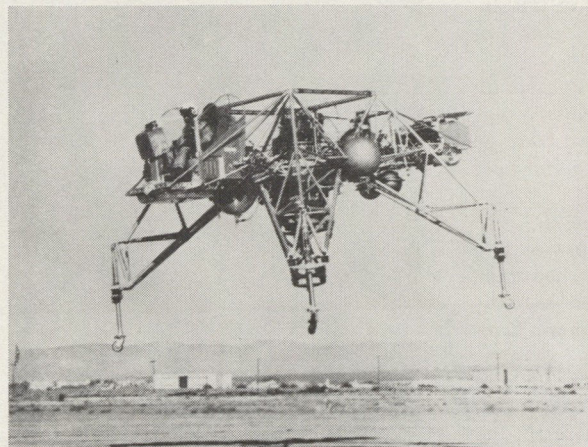
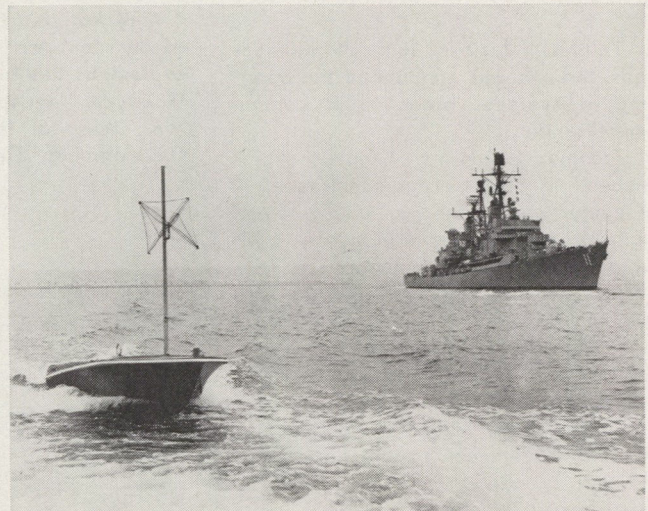
The expansion program allows for 4 new automatic switching centers to supplement 5 existing Stateside centers and 10 overseas centers. The 5 existing continental U.S. stations already service more than 300 tributary stations, located at Army, Navy, and Air Force commands, supply depots, bases, defense contractors, and other Defense Department agencies. Within one year, the system will serve an estimated 2,700 military and other DoD subscribers.

AUTODIN overseas, although a manual operation now, will become fully automatic in 1967-68. The supply network of the Air Force alone lists more than 1.5 million different items in varying quantities in warehouses in 39 countries. With AUTODIN, an order for any item can be placed at once through the memory of an associated computer and sent on its way.

Western Union Telegraph Company is the prime contractor for the expansion program in the U.S., and Radio Corporation of America is the major subcontractor. AUTODIN facilities for overseas locations are being procured from the Philco Corporation.

(Continued on following page)

Introduced in 1965 was this U. S. Navy surface target vehicle, the Ryan "Fire-fish." Simulating hostile PT boats, it is commanded by remote control and can perform evasive course and speed changes. It is used throughout the Atlantic and Pacific fleets in surface gunnery and air-to-surface exercises.



Another new development in 1965 was this spider-shaped lunar-landing research vehicle (LLRV). It simulates pilot-controlled landing with doppler radar provided by Ryan Aeronautical Company. The system is being tested in connection with the Apollo program at Edwards Air Force Base, California.

The longest structure in space is Canada's second satellite, Alouette B, which was launched recently from Vandenberg Air Force Base, California. Built by de Havilland Aircraft of Canada Ltd., the new satellite features a long unfurlable crossed dipole sounder antenna, which extends to 240 feet (73 m) by 75 feet (23 m). Alouette I, in orbit since 1962, also has a long sounding antenna. Both satellites are used in the study of the earth's ionosphere.



AUTODIN is compatible with other Department of Defense communications systems and adaptable to a satellite system. Computers are used to control the switching of messages and circuits. The system is basically error free with less than 1 error in each 10 million characters transmitted.

* * *

Telonic Industries, Inc., of Indianapolis, Indiana, has announced the opening of overseas branches in London and Frankfurt.

Telonic Industries GmbH, established at 16 Holzhausenstrasse, 6 Frankfurt am Main, a wholly-owned subsidiary, and Telonic Industries U.K., a division of Telonic Industries, Inc., "The Summit," 2 Castle Hill Terrace in Maidenhead, England, will both maintain stocks of instruments, accessories, and parts.

The company produces sweep generators for the audio, RF, and microwave frequencies, oscilloscopes, attenuators, detectors, and coaxial switches. A second plant in Laguna Beach, California, manufactures low-pass and bandpass filters, VSWR instrumentation, wave meters, and frequency multipliers.

The company now has representatives in France, Switzerland, Italy, Belgium, Holland, Norway, and Sweden marketing Telonic sweep generators and accessory equipment.

* * *

Miniaturization of rocket power into a lightweight and simple handgun, called Gyrojet, was disclosed recently by MB Associates, San Ramon, California.

A small, solid-fuel bullet-shaped rocket which can travel a mile (1.6 km) in less than 5 seconds is fired from a

vented handgun much like a .45-caliber pistol. Canted ports on the "rocket" give it a stabilizing spin for true flight.

The gun, which is mechanically much less complex than a conventional weapon, will carry 6 rounds.

* * *

A rocket sled for high-speed testing of missile nose cones during nuclear explosions has been completed by the Goodyear Aerospace Corporation, Akron, Ohio, for the Air Force Missile Development Center, Holloman Air

Force Base, New Mexico. The sled, riding on a track nearly 7 miles (11.3 km) long, will measure the effects on a missile hit by an atomic antimissile missile. It will travel at about 2,300 mph (3,700 km/hr) and weighs 4,500 pounds (2,000 kg).

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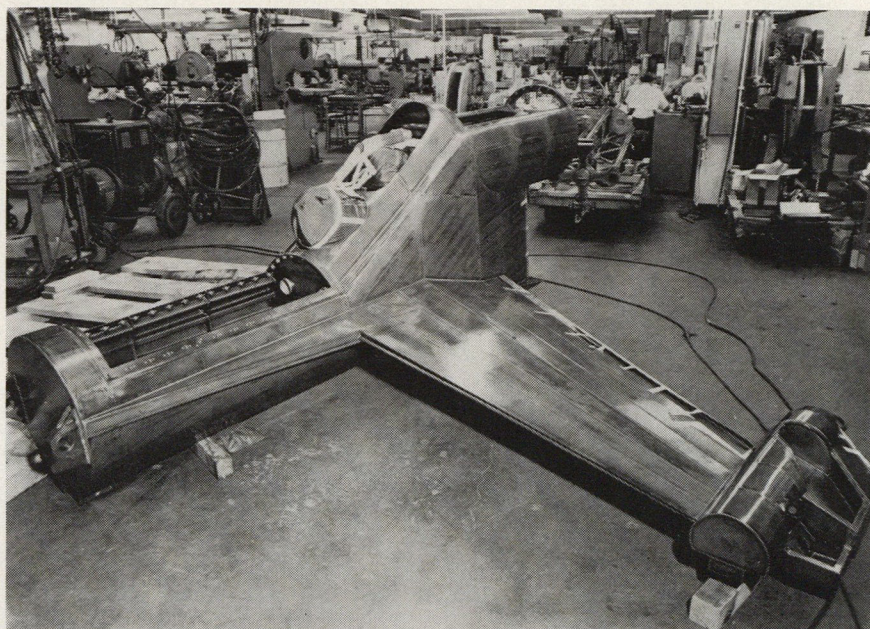
The Republic of China (Formosa) became the third U.S. ally in Southeast Asia to modernize its Air Force late last year when it received a squadron of Northrop F-5 supersonic tactical fighters. South Korea and the Philippines had received F-5s earlier.

The F-5 Freedom Fighter, being supplied to several allied air forces throughout the world, is the same lightweight aircraft that is undergoing an intensive combat analysis by the U.S. Air Force in South Vietnam. The U.S. Department of Defense has placed orders with Northrop Corporation for more than 700 of the new fighters under the Military Assistance Program.

The Republic of China is the fifth of 9 allied countries to receive the F-5. In addition, 3 countries—Canada, Norway, and Spain—have made direct purchases of the plane.

Turkey was scheduled to receive Freedom Fighters before the end of 1965. Iran and Greece are already flying their first squadrons of the aircraft.

The squadron being flown in South Vietnam by the U.S. Air Force has logged more than 1,000 combat sorties and dropped over 2 million pounds (900,000 kg) of bombs and rockets since 12 of the twin-engine planes



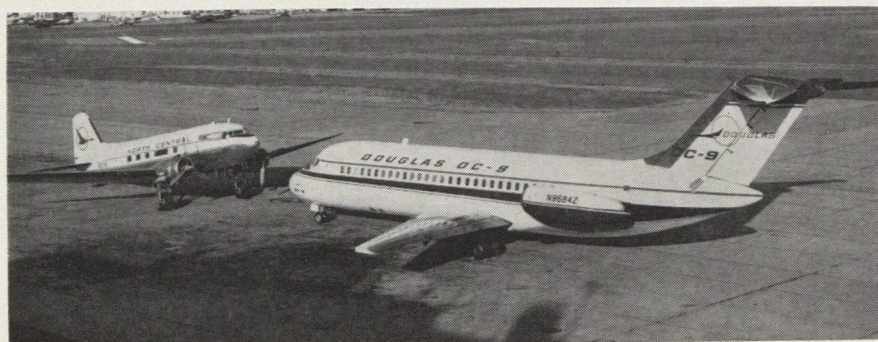
This supersonic rocket sled is designed to take a missile nose cone, traveling at more than 2,000 mph (3,200 km/hr), through a simulated atomic blast area. The nose cone is mounted on forward end of sled, which travels down a 35,000-foot (10,700 m) long rail course. A "ballute"—balloon parachute—decelerates sled after it passes through blast area.

arrived there in October. A combat analysis of the new fighter is being conducted by the 4503d Tactical Fighter Squadron.

In the Southeast Asia environment, the aircraft has shown to be especially easy to maintain. Maintenance hours per hour of flight were originally forecast at 21 hours, but have amounted to only 11.5 hours, including normal maintenance and battle damage repairs. A daily average of more than 43,000 pounds (19,500 kg) of ordnance has been fired against ground targets on close support and interdiction missions, representing about 15 percent of all USAF combat sorties since its arrival. One F-5 was lost to ground fire in mid-December.

* * *

Alitalia will purchase 28 Douglas DC-9 twinjets for its short- to medium-



Celebrating its thirtieth anniversary in December was Douglas Aircraft Company's DC-3, left, which has flown more hours than any other airplane in the history of aviation. Posing here with its older sister is latest addition to the fleet—the DC-9. Twenty-four airlines have placed orders and leases for the short-to-medium-range twinjet DC-9.

range requirements. The aircraft was awarded its Federal Aviation Agency type certificate in November, 2 months ahead of schedule.

Purchase of the DC-9s adds another type of Douglas-built transport to the Alitalia fleet, which already includes 15 Series 40 DC-8 4-engine jetliners and 2 ultra-long-range Super 62 versions of the DC-8.

Alitalia is the twenty-fifth airline to announce orders for the DC-9; orders and leases now total 259.

* * *

A camera that will hang thousands of miles in space to photograph the weather patterns of half the earth will be developed by a division of International Telephone & Telegraph Corporation.

Unlike other satellite weather cameras, the new daytime camera will be put in a higher, fixed orbit 22,300 miles (35,880 km) above the earth aboard the U.S. National Aeronautics and Space Administration's Applications

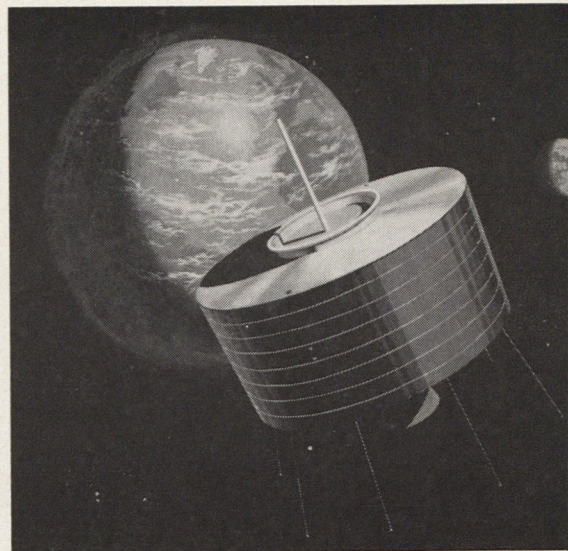
Technology Satellite. This camera satellite will be synchronized with the earth's rotation to photograph weather over a chosen part of the earth at 12-minute intervals.

To "see" cloud cover and weather conditions, the camera will utilize the ITT Vidisector camera tube, which can photograph even when the satellite spins at 100 revolutions per minute.

Electronic pictures will be transmitted to ground stations, where the images will be reconstructed by display and film-recording equipment.

* * *

Satellite communications in the Pacific area may not be too far off. The Communications Satellite Corporation (Comsat) has awarded Hughes Aircraft Company a contract to build 4 new satellites to provide instant voice contact between the Apollo moon as-



A new voice in space is shown in this artist's sketch of the satellite being built by Hughes Aircraft Company for Comsat. It will provide the first commercial transpacific relay by satellite and will be used in the Apollo lunar program. Two will be launched late next summer.

rope and the U.S., the new satellites will have broader antenna coverage over a wider global area and will be able to carry multiple conversations among several ground stations simultaneously.

They are expected to permit instant voice contact with the Apollo astronauts, made directly from ground terminals in contact with the orbiting spacemen. These reports will be flashed directly to the NASA control center in Texas.

Nine ground terminals are planned; 3 will be operated by Comsat. These will be transportable terminals with 42-foot (12.8 m) antennas located at Andover, Maine; Brewster Flat, Washington; and Paumotu, Oahu, Hawaii. The antennas in Washington and Hawaii will be built by Sylvania Electronic Systems, division of General Telephone and Electronics Corporation. They will be capable of operating in winds gusting to 60 mph (96.5 km/hr) and withstanding winds up to 120 mph (193 km/hr) when locked in a fixed position.

Three shipboard terminals, provided by the U.S. Government, will be located in the Indian, South Pacific, and Atlantic Oceans during the Apollo orbits. Three others will be fixed terminals provided by the United Kingdom on Ascension Island in the Atlantic, by Australia at Carnarvon, and by Spain on Grand Canary Island.

* * *

Six companies around the world will cooperate in developing a satellite for
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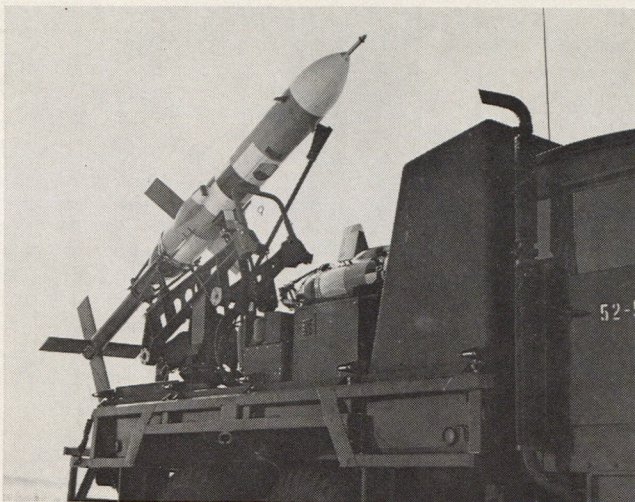
tronauts, the Space Flight Center at Houston, Texas, and the various ground stations linked to the center during Apollo's earth-orbiting phase.

Launch of the new satellites is scheduled for late next summer, when the spacecraft will be sent, separately, into synchronous equatorial orbits 22,300 miles (35,880 km) above the Atlantic and Pacific Oceans.

The Atlantic satellite will be placed in space above the Ivory Coast of western Africa, and the Pacific satellite will be positioned near the International Dateline in the Pacific.

The new satellites will have 3 times the transmitter power of Early Bird, the world's first commercial communications satellite. They will be 56 inches (142 cm) in diameter and 26 inches (66 cm) high.

Early Bird, which also was built for Comsat by Hughes, has been in commercial operation since June. Unlike Early Bird, whose antenna concentrates its beam between western Eu-



West Germany has joined Canada and Britain in the development of a low-cost CL-89 short-range reconnaissance drone, built by Canadair Ltd. The U.S. Army is providing firing-range facilities and technical supervision in the flight-test program.



The CL-89, now designated the AN/USD-501, is launched by booster rocket and has a turbojet sustainer engine. Carrying sensor equipment, it provides tactical information for Army formations in battle areas. It is recovered by parachute and reused.

the European Space Research Organization.

The European group, known as ESRO, selected Junkers, a Munich firm, from 8 participants in an international competition to design and build the highly eccentric orbit satellite (HEOS).

Junkers heads a group including Messerschmitt in Augsburg, Germany; ECTA (Etudes Techniques et Constructions Aérospatiales) in Belgium; SNECMA (Société Nationale d'Etude et de Construction de Moteurs d'Aviation) in France; BAC (British Aircraft Corporation) in England; and the Lockheed Missiles & Space Com-

pany, Sunnyvale, California, as general consultant.

The satellite will be the first to be designed and developed in Germany. Purpose of the satellite will be scientific investigation of charged particles in space and the effects on them of magnetic fields.

HEOS will be launched by the U.S. National Aeronautics and Space Administration on a Thor-Delta from Cape Kennedy, Florida, in the second half of 1968 when there will be a period of intense sun activity.

* * *

Canada and Britain have a new partner in the development program of an airborne surveillance drone system. The Federal Republic of Germany will cooperate with Canada and Britain on the system, being developed by Canadair Limited, Montreal, a subsidiary of General Dynamics. It has been a joint Canadian and British project for the past 2 years.

As a partner, Germany will pay one-third of the total cost of the program.

Initially known as the CL-89, the wingless drone is now designated AN/USD-501. It is designed to provide tactical information in forward battle areas. Propelled by a jet engine, which provides speeds close to supersonic, it is missile-shaped and approximately 8 feet (2.4 m) long.

It is launched from a mobile launcher and utilizes a booster to gain altitude and operational speed rapidly. The drone follows a preselected course and can accurately photograph hostile terrain and military equipment. Before returning to base, the engine cuts off and a parachute floats the drone to ground for reuse later.

The U.S. Army has provided firing-

range facilities and technical support for the flight-test program.

* * *

A shock-absorbent padding so effective an egg can be dropped on it from an 11-story building without breaking is now being used in the training of America's astronauts.

The padding was developed by United States Rubber Company and is being used to cushion the fall of astronauts as they pass from a stage of weightlessness back into gravity. During weightlessness, astronauts can float as high as 7 feet (2.1 m) before crashing down on the padding.

The padding, called Ensolite, is a shock-absorbing cellular material made from a blend of vinyl plastic and nitrile rubber and is used in the Aeronautical Systems Division test airplanes at Wright-Patterson Air Force Base, Ohio. Both the floor and overhead area of the fuselage in a Boeing KC-135 and Convair C-131 aircraft are lined with Ensolite to protect the astronaut trainees.

Weightlessness is achieved by flying the KC-135 aircraft in a parabolic arc, similar to a roller coaster. The aircraft starts the parabola at 24,000 feet (7,300 m) and makes a 2½-G (2½ times gravity) pull-up. As the airplane rises, the pilot pushes the controls forward until the airplane coasts over the arc, its movement balancing the pull of gravity. During this period the airplane and everything inside it is weightless.

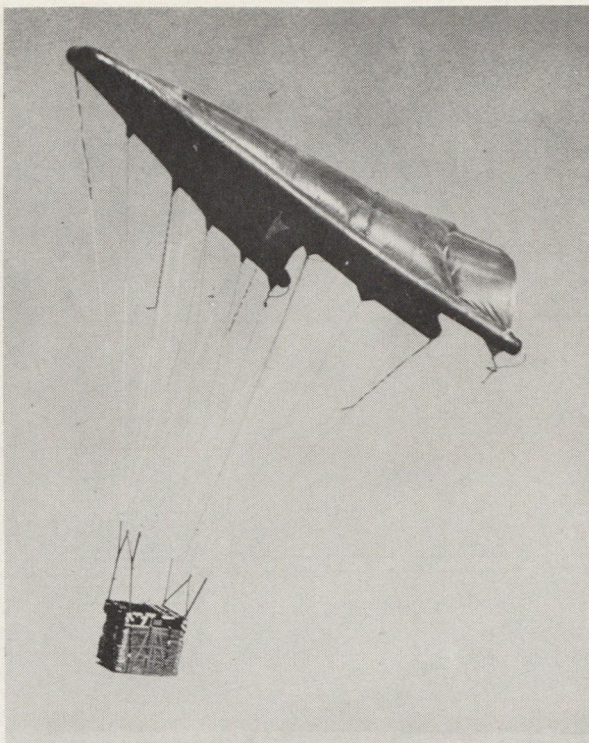
As the airplane dives at the completion of the arc, the pilot pulls the controls back in a 2½-G pullout.

During the maneuver, a 150-pound (68 kg) man weighs 375 pounds (170 kg) during the 2½-G pull-ups and then



This is the latest in a family of Avroc weapons being developed by Avco Corporation. The 20-pound (9 kg) Avroc 5-20 fires 5-mm. projectiles by means of a rocket motor, which eliminates need for cartridge. Exhaust gas recycles the gun.

The U.S. Army will receive this Precision Drop Glider, being manufactured by Ryan Aeronautical Company. The flex-wing delivery system is designed for high-priority cargo delivery to forward combat areas. It can be deployed from either helicopter or fixed-wing aircraft, gliding to a predetermined landing through remote control. It can carry 500 pounds (227 kg) of cargo.



becomes weightless. At the end of the weightless period, he could hit the floor with the force of a 375-pound (170 kg) weight.

* * *

The U.S. Navy is employing a vital new weapon to bolster the nation's defenses against fast-moving enemy submarines. It is the Mark 46-0 submarine hunting torpedo, manufactured by Aerojet-General Corporation at its Von Kármán Center, Azusa, California.

The Navy regards the Mark 46-0 as one of its most potent antisubmarine punches. Packed with electronic searching equipment, the Mark 46-0 can range deeper and further than any previous antisubmarine weapon and can track down the most modern nuclear-powered submarines now known.

The Mark 46-0 can be launched by destroyers, frigates, and other antisubmarine surface craft, as well as long-range aircraft squadrons and spe-

cially designed drone helicopters. It is not designed to be fired from submarines.

Though labeled a torpedo, the Mark 46-0 is really an underwater guided missile. It is powered by a solid-fuel rocket motor, the first time in history a torpedo has been so powered.

Heart and brains of the new torpedo is the intricate guidance/control system which directs the torpedo to its submarine target. The Mark 46-0 sends out a pulsed signal, and when it receives an echo answer which it identifies as a submarine, it begins its attack.

The Naval Ordnance Test Station was technical director for the new weapon during its 6-year development phase. It is now a project of the U.S. Navy.

Major contributors to the Navy-industry team with Aerojet include Bendix Corporation's Pacific Division at Sylmar, California; Clevite Corporation of Cleveland, Ohio; National Waterlift Company of Kalamazoo, Michigan; and Honeywell Corporation's Seattle, Washington, Development Laboratory.

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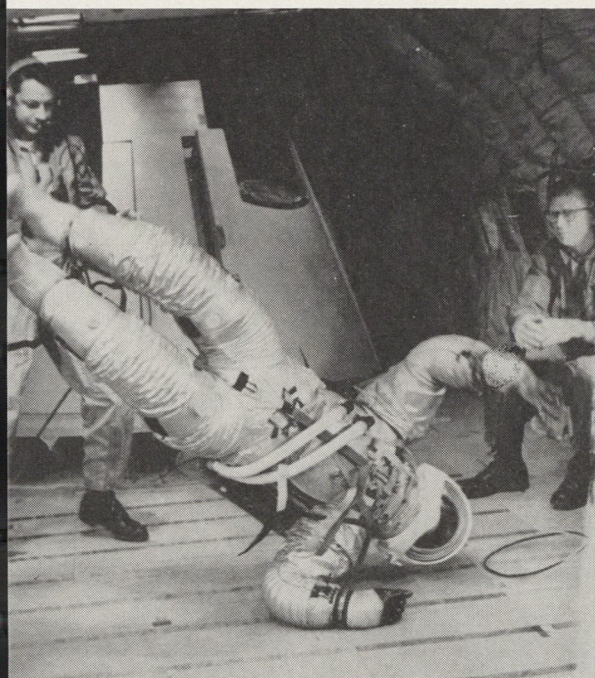
The remote, sandy wasteland of the northwest Australian coast will soon have fresh water from 2 desalting units, the first commercial-size plants employing the electrodialysis process to be installed in that country. Manufactured by Ionics, Inc., Watertown, Massachusetts, the units will serve a new communications station being built on the Northwest Cape by the U.S. Bureau of Yards and Docks and manned by U.S. Navy personnel. The area is known for temperatures reaching as high as 130 degrees F (54 degrees C), prolonged droughts, cyclones, and intermittent tropical downpours.

The \$70-million very-low and very-high-frequency radio station will be used to communicate with the growing fleet of submerged submarines patrolling the Pacific and Indian Oceans.

Both of the Australian units are designed to handle up to 2,000 parts per million of dissolved salts to produce water containing a maximum of 500 ppm (U.S. Public Health Standard) for domestic and general-purpose use. More than 130 similar Ionics desalters are now in use throughout the world.

The larger of the 2 units, with a capacity of 60,000 U.S. gallons (226,000 l) per day, will serve Area B, a high-frequency transmission station going up on a 3,000-acre (1,214 hectares) site on Exmouth Gulf. Area C is a high-frequency receiving station on a 9,500-acre (3,845 hectares) site, 30 miles (48 km) from Area B and 8 miles

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Passing from a state of weightlessness back into gravity, this 150-pound (68 kg) astronaut trainee hits the floor with a force equal to 375 pounds (170 kg). Cushioning his fall in the KC-135 test fuselage is a new shock-absorbent cellular material, Ensolite. Developed by U.S. Rubber Company, it is a blend of vinyl plastic and nitrile rubber. The padding is so effective an egg can be dropped on it from an 11-story building without breaking.

(12.8 km) south of Learmouth Airport. Fresh water will be produced at the rate of 10,000 U.S. gallons (37,854 l) per day at this location by a standard Ionics package plant. B.T.M. Agencies Proprietary Limited, Adelaide, represents Ionics in Australia.

* * *

Douglas Aircraft Company, Santa Monica, California, is considering the feasibility of constructing an airplane entirely of fiberglass reinforced plastic.

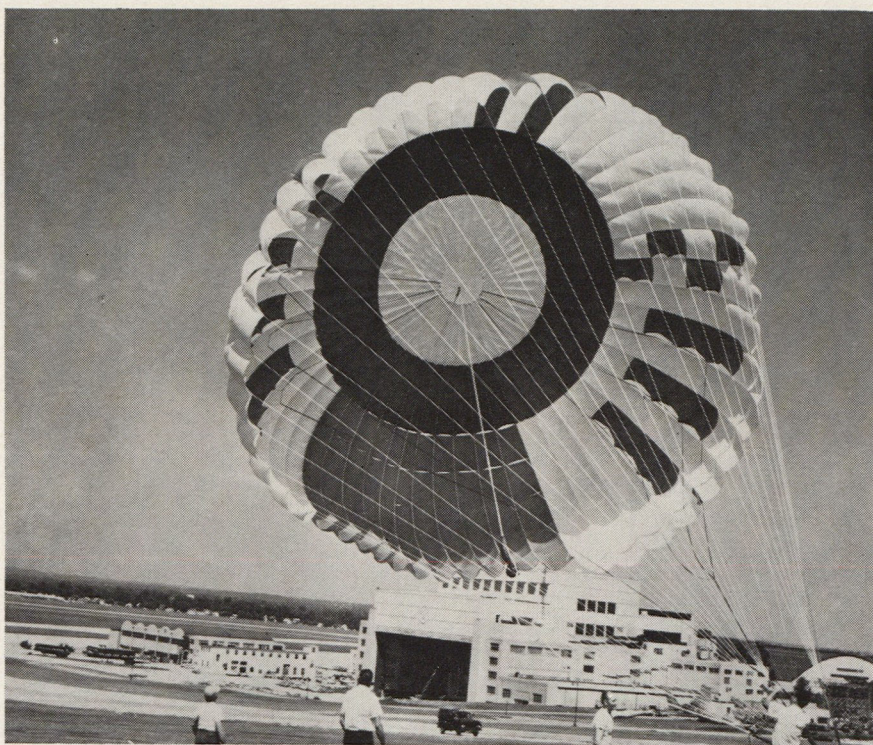
The all-plastic aircraft would be superior in strength and performance to an identical design of conventional riveted metal construction. Plastic airframes, according to the Douglas study, are free from corrosion, have greater resistance to damage, greater ease of shaping aerodynamic contours and making minor field repairs, and have fewer small assemblies.

The hypothetical design used for the study was a light, aerodynamically conventional, low-wing monoplane. This simple type permitted a complete structural analysis without undue complexity.

High flight-load factors such as those encountered in severe aerobatic maneuvers were considered in order to determine high-stress structural performance of various kinds of fiberglass materials.

The structure of the airplane was configured to provide a minimum of mechanical joints and a maximum of adhesive joint bonding areas. This planning allowed a greater number of large structural components for increased efficiency in tooling and fabrication.

Properties of sandwich panels of both honeycomb and fluted cores, as well as laminated panels, were investigated. Epoxy laminate studies included those reinforced with woven



High-altitude cargo drops can be accomplished with greater accuracy with this radio-guided parachute, developed for the Air Force. Engineering personnel of the Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio, static test the 51-foot (15.5 m) parasail chute. It is guided by a unit on the chute which "homes" on signal from ground.

fiberglass fabric and nonwoven unidirectional fibers oriented for best response to a particular load.

Known information from previous Douglas studies in plastic laminates was fed into a digital computer for ready calculation of elasticity and other properties, enabling a selection of the pattern type and fiber angle best suited to a particular component or applied loading condition.

Other advantages of the all-plastic

approach to airframe construction pointed up by Douglas are the inherent "fail-safe" characteristics of bonded joints and multiple fiber load paths, low sensitivity to crack propagation from notches, retention of optimum aerodynamic contours at high load levels, high damping properties which reduce vibration transmission, and reduced skin drag because of the smooth finish possible.

* * *

Radio-guided parachutes were tested recently in the Bavarian Alps to determine how well they "home" on unseen drop areas through fog and darkness.

A project of the Air Force Systems Command's Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio, the 51-foot (15.5 m) diameter parasail parachute was demonstrated for the Air Force's 7th Air Force Group near Sembach Air Base, West Germany.

About 10 drops with the steerable parachute were made from C-123 aircraft to impact zones located approximately 2,000 feet (609 m) below the mountain ridge line at the bottom of a narrow valley. The parasail payload pack had red, green, and white lights for night manual control drops.

The parasail parachute, developed for the Air Force by the Pioneer Parachute Company of Manchester, Con-



A new airborne system, UNACE (Universal Aircraft Communication/Navigation Evaluation), installed on Beech Aircraft Corporation's King Air, was purchased for calibration purposes in December by the Canadian Department of Transport. UNACE, designed to simplify inspection from the air, can check all airway electronic and radar installations.

necticut, has an on-board guidance and control unit weighing 115 pounds (52 kg). A 30-pound (13.6 kg) ground transmitter station automatically or manually directs the parasail to the impact point.

A 15-foot (4.5 m) ringslot parachute, which pulls the 2,000-pound (907 kg) payload from the aircraft, also deploys the main parachute canopy. The canopy is designed so that it can turn right or left through manipulation of the parachute guide lines by the guidance and control unit.

More than 60 tests of the parasail homing cargo delivery system were made at Wright-Patterson in Ohio; El Centro, California; and Eglin Air Force Base, Florida. The closest landing was 69 feet (21 m) from the ground transmitter, with release for the system at 5,000 feet (1,524 m) and at 130 knots (240 km/hr) speed. The parasail has a glide angle of 10 feet (3 m) of guided horizontal glide for each 10 feet of vertical drop.

* * *

Turbine-powered and pressurized piston-powered airplanes operated by foreign air carriers into the continental United States are now required to have DME (distance-measuring equipment), under a new rule issued by the Federal Aviation Agency.

Nonpressurized piston aircraft operated by foreign air carriers into the United States will have to be DME-equipped after December 31, 1967.

Foreign civil aircraft engaged in air cargo carrier operations into the United States will be required to have DME after December 31, 1966, only when flying at or above 24,000 feet (7,315 m).

The new regulations, which do not presently affect foreign operations in Alaska or Hawaii, apply to foreign air-

craft which are required by FAA to have VOR (very high frequency omnirange) navigation equipment for flights into the U.S.

Current FAA rules require DME on all large turbine-powered and pressurized piston-powered aircraft operated by U.S. air carriers and commercial operators. Nonpressurized planes will need DME by February 28, 1966. U.S. general-aviation aircraft must have DME for flights at or above 24,000 feet (7,315 m).

The distance information obtained from DME is considered just as important for safety and efficiency in the air traffic control system as the bearing information from the VOR. Both kinds of information are needed to operate the VORTAC system of air navigation, the U.S. standard for short-range navigation and also adopted by all member nations of the International Civil Aviation Organization as the international standard until 1975.

* * *

A programmed bombing pattern that allows the pilot to automatically release his bombs in predetermined quantity, mode, and interval, thus freeing him to concentrate on flying, is possible through a solid-state electronic system being built for the U.S. Navy by the Bendix Corporation's Eclipse-Pioneer Division, Teterboro, New Jersey.

A cockpit-mounted controller and a remotely located programmer make up the basic system. Through the controller, the pilot selects the quantity of stores to be released, the mode of release, and the drop interval between release of individual bombs.

The pilot has 11 combinations of "stores release" in quantities of 2 to 6 bombs in steps of 1 at a time, 8 to 20 steps of 4, and 20 to 40 bombs

in steps of 10. A control allows him to select any drop interval in the ripple mode from 20 to 2,000 milliseconds. A rotary switch allows the pilot any of the 6 modes of operations: singles, pairs, or salvos in the "step" mode, and the same choice in ripple.

"The system's solid-state electronics assures high reliability and low power consumption at minimum weight and volume," says James E. Bevins, general manager of the Eclipse-Pioneer Division. "And modular circuitry permits maximum adaptability to specific aircraft and integration with existing weapon systems."

* * *

Jet aircraft may soon be taking off and landing on unique, filament-wound tires made like doughnuts.

T. J. Reinhart, a project engineer in the Air Force Systems Command's Materials Laboratory, Wright-Patterson Air Force Base, Ohio, devised the revolutionary design which will enable aircraft tires to last longer under higher temperatures and pressures.

Ten prototype, filament-wound, toroidal, continuous, cross-section tires are being manufactured by Aerojet-General Corporation, Azusa, California, and tested under a 12-month program.

Tires will be constructed by winding an elastomer-impregnated tape over a mandrel. The wheel will require a split rim since it does not have the conventional bead usually formed in tires. Tire carcasses of nylon fiber-reinforced compounds will first be produced and then be completed with standard rubber compounds.

Identical to standard aircraft tires size 30 x 7.7, 12-ply rated, the toroidal tires will have a load rating of 10,000 pounds (4,500 kg). They will be tested with 50 high-speed (200 mph, 320 km/hr) landings and 100 low-speed (90-100 mph, 144-160 km/hr) landings by the Air Force at Wright-Patterson.

A major drawback in current tire design is use of the bead which builds up and retains excessive heat and adversely affects strength of the tire. Present aircraft tires consist of 2 or more beads around which a noncontinuous tire reinforcement is clinched or bound.

In filament-wound tires, the bead is eliminated, the reinforcements are continuous, giving the tire greater strength and enabling aircraft tires to last longer under increased loads and temperatures that may reach 400 to 600 degrees F (204 to 316 degrees C). The tires have thin, nearly uniform cross-sections with no fatigue "hinge points" where excessive heat could build up.

When feasibility of the tire design (Continued on following page)



Participating in a year-long survey for the United Nations is this Piper Aztec, part of the Avis Rent-A-Plane fleet. The survey will cover 6 islands in the Solomons. Geologists and U. N. technical staff members from Australia, Sweden, and the U. S. will search for minerals, oil, and coal which could help develop the islands. The Aztec is fitted with surveillance and geological equipment and externally mounted recording instruments.

and production processes are demonstrated, glass or metal filaments and high-temperature-resistant polymers may be used to replace the nylon reinforcements. The filament-wound tires will be cheaper because they can be produced at a higher rate of speed than can current aircraft tires.

* * *

Philippine Air Lines (PAL) is planning to install an advanced data-processing system that eventually will integrate all aspects of the line's operations and supply prompt information.

A 315 computer, manufactured by National Cash Register Company, Dayton, Ohio, is scheduled for delivery in the fall of this year.

Initially, the system will be used for inventory control, aircraft maintenance scheduling, and passenger-load analysis. It may later be used to handle seat reservations.

PAL's international routes serve Honolulu, San Francisco, Hong Kong, Singapore, Taipei, and Sydney, Australia. Its domestic flights serve 71 locations in the Philippines. The line's nonstop jet flight between Manila and Honolulu is one of the longest scheduled airline hops in the world.

Other equipment ordered by PAL includes, in addition to the 315 processor, a high-speed printer, a high-



A minigun which can fire 6,000 shots per minute is fitted here to the Army's XM-21 helicopter armament subsystem. Produced by General Electric, the 34-pound (15.4 kg) weapon has a rotating barrel. The armament system, mounted on a UH-1B Huey, also features a multiple rocket launcher.

speed punched card reader, a paper tape reader and punch, and 4 CRAM (Card Random Access Memory) units.

* * *

Ground forces operating in heavy jungle and hilly terrain in Vietnam will soon be able to communicate over hundreds of miles and will no longer be handicapped by horizon limitations of line-of-sight communications.

A transistorized low-power radio repeater, launched by both balloon and BQM-34A drone, was tested recently by the Rome Air Development Center at Holloman Air Force Base, New Mexico.

During the first test, the equipment operated successfully for 4 hours at 30,000 feet (9,144 m), establishing solid communications by both voices and teletype between stations located 250 miles (400 km) apart. At higher altitudes, contact was also established with a station more than 300 miles (480 km) away from the repeater. Later, duplicate equipment was launched for 1 hour, establishing contact between the 2 stations at 48,000 feet (14,630 m).

The small solid-state ultrahigh-frequency repeater is produced by Sylvania Electric Products, Inc.

* * *

Brazil successfully launched a sounding rocket from its Natal Range in December under a joint program with the U.S. National Aeronautics and Space Administration. The Brazilian Space Activities Commission (CNAE) conducted the launching.

Instrumentation for the rocket payload and the telemetry ground-support equipment was constructed by Brazilian technicians at NASA's Goddard Space Flight Center, Greenbelt, Maryland.

The Brazilian commission and NASA

are cooperating in investigating the lower regions of the ionosphere and the effects of cosmic rays, and are comparing sounding-rocket measurements taken from NASA's station at Wallops Island, Virginia, and from Natal. The Wallops launching was conducted last August.

* * *

For the first time, aircraft from Western Europe will be displayed at the Farnborough Air Show this year.

Plans for the exhibition were announced in London in December by the Society of British Aerospace Companies, organizers of the show. Under the new schedule, Farnborough will be held every 2 years, alternating with the Paris Salon.

As a first step in broadening the scope of the SBAC flying display, aircraft which have been designed and built in the member countries of AICMA (Association Internationale des Constructeurs de Matériel Aérospatial) may be shown.

The new entry rules allow exhibition of AICMA aircraft fitted with British engines and a percentage of British-designed equipment. Aircraft being developed as joint projects, such as Concorde and Jaguar, will be automatically eligible in future years.

However, consideration will also be given to requests from SBAC members for the presentation of European-designed aircraft fitted with foreign engines which embody a high percentage of British equipment. Foreign-designed equipment scheduled for manufacture in Britain will be eligible where a license to manufacture the equipment has been signed by an SBAC member wishing to display the equipment. Farnborough '66 will be held from September 5 to 11. ☆☆☆



The largest submerged rocket nozzle was successfully tested by Lockheed Propulsion Company in December. This 156-inch (396 cm) solid-propellant motor generated 3,000,000 pounds (1,361,000 kg) of thrust.



The CH53A moves more men and equipment faster than any other Free-World helicopter.

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