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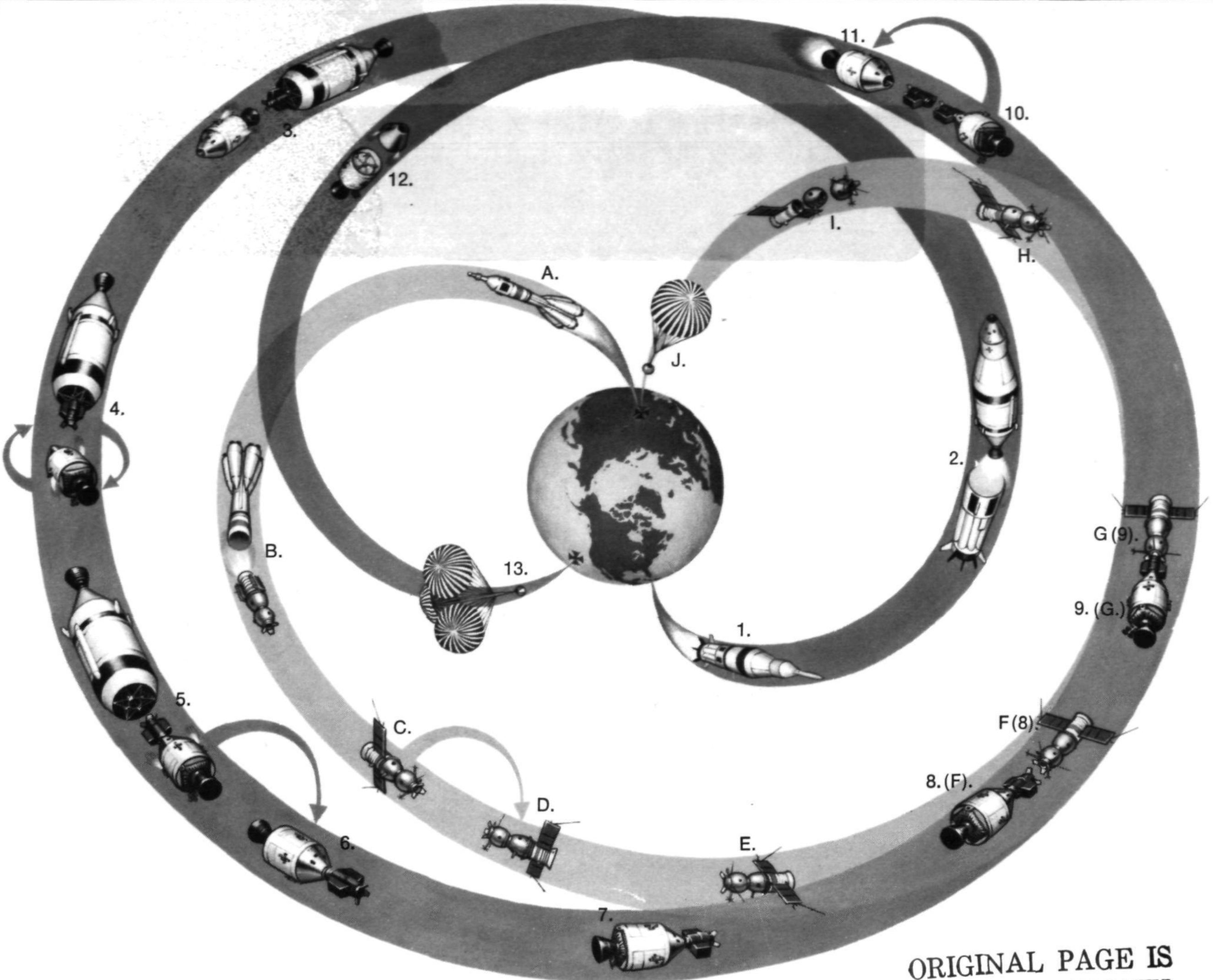
APOLLO SOYUZ TEST PROJECT

In mid-July 1975, three American astronauts and two Russian cosmonauts will bring their spacecraft together in Earth orbit, exchange visits, and conduct joint scientific and technical experiments. The principal goal of this Apollo-Soyuz Test Project, the world's first international manned space flight, is to test compatible rendezvous and docking systems for manned spacecraft.

Apollo-Soyuz rendezvous. Rendezvous occurs about 50 hours after Soyuz launch. The spacecraft dock about an hour later.

Apollo-Soyuz will open the way to an international space rescue capability and to future international manned space missions that would eliminate duplications of effort and thereby contribute to economies and progress in space operations. In perspective, the most important result of this international manned mission may be the mutual confidence and trust it creates—confidence and trust that may be significant not just for what peoples working together may accomplish in space but



Apollo-Soyuz Mission Profile.

Soyuz

A. Launch.

B. Soyuz—launch vehicle separation.

C. Solar panels, that generate electricity from sunlight, unfold.

D. Soyuz turnaround.

E. Soyuz continues to final orbit.

F. (8) Rendezvous.

G. (9) Joint activities.

H. Deorbit.

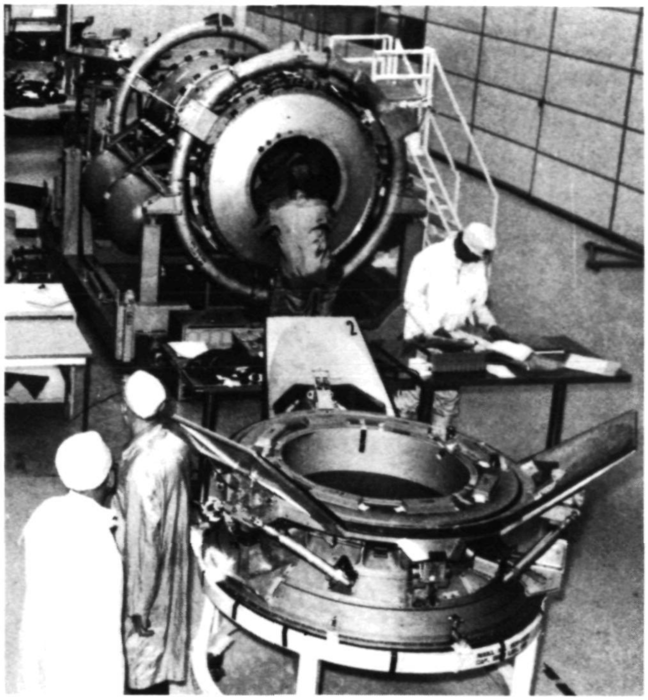
I. Separations of Orbital, Descent, and Instrument Modules.

J. Descent and landing of Descent Module in Kazakhstan. U.S.S.R.

Apollo

1. Launch.
2. Separation of Saturn IB first stage.
3. Second-stage separation.
4. Apollo turnaround.
5. Apollo extracts Docking Module from second stage.
6. Apollo turnaround.
7. Apollo orbit circularization.
8. (F) Rendezvous.
9. (G) Joint activities.
10. Apollo jettisons Docking Module.
11. Turnaround and rocket firing for deorbit.
12. Service Module jettison.
13. Descent and landing near Hawaii.

Command Module is readied for flight.



American part of docking system (foreground) and cylindrically shaped Docking Module (background) during check-out.

also for what peoples working together may achieve on Earth.

Existing Spacecraft Used

Apollo-Soyuz is named for two tried and tested spacecraft—the American Apollo and Russian Soyuz—that have been adapted for the mission. Apollo is fundamentally the same craft that waited in lunar orbit during the Apollo lunar landings and that later carried astronauts between Earth and the Skylab experimental manned space station.

Apollo consists of the cone-shaped Command Module in which the men live, eat, and work; and the cylindrical Service Module with its rocket engines, propellant, oxygen, and electrical power supplies. As in the Apollo and Skylab programs, the Service Module will be jettisoned when Apollo begins the atmosphere-entry portion of its descent to Earth. The astronauts will return in the Command Module.

Among major modifications to the Command/Service Module for Apollo-Soyuz are an increased number of propellant tanks for the reaction control (orientation and stabilization) system, added equipment required to operate the new Docking Module and the American-Russian rendezvous and docking systems, and provisions for scientific and technical experiments.

The Soyuz has been the primary Soviet manned spacecraft since its introduction in 1967. It consists of three basic modules:

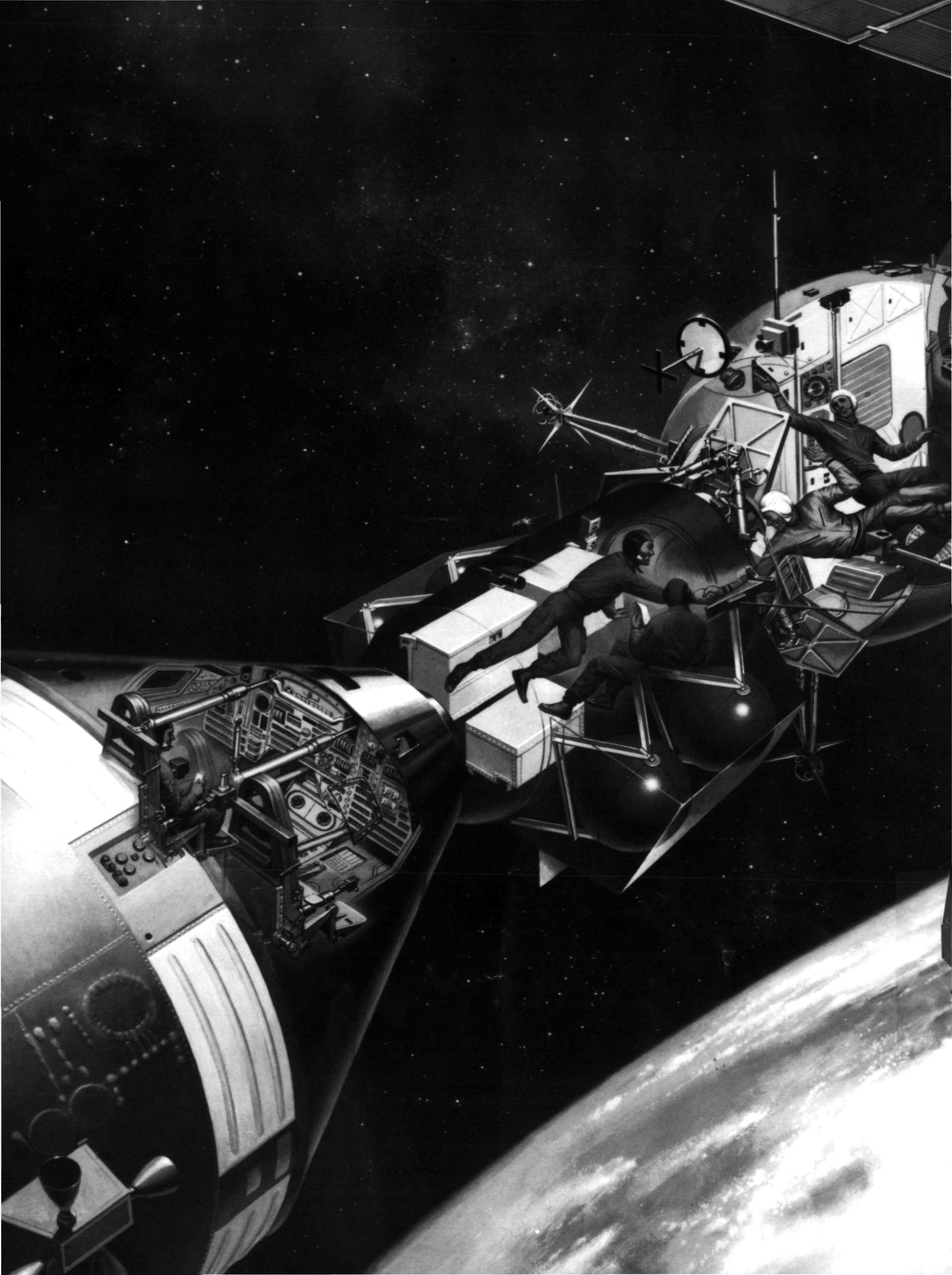
- Orbital, located at the forward end, used by the crew for work and rest in orbit.
- Descent, with main controls and crew couches, used by crew during launch and return to Earth.
- Instrument, at rear, with subsystems required for power, communications, propulsion, and other functions.

Among the major modifications of Soyuz for the joint program are a new type of docking mechanism, additional communications equipment to accommodate the United States ultra-high frequency of 296 MHz, a transponder (a combined receiver-transmitter that beams a signal when triggered by another radio signal) for Apollo use in ranging (distance calculation) during rendezvous, and alignment aids to aid Apollo in docking.

Soyuz's internal atmosphere consists of nitrogen and oxygen at an Earth sea level pressure of 760 mHg (millimeters of mercury), or 14.7 pounds per square inch. Apollo's atmosphere is pure oxygen at about 260 mHg (5 pounds per square inch). To facilitate crew transfer, Soyuz pressure will be reduced to about 520 mHg (10 pounds per square inch) during docking and re-pressurized to sea level before atmosphere entry. Equipment to reduce and increase pressure has been added to Soyuz. The lowered air pressure in Soyuz enables the men to transfer from Soyuz to Apollo without a lengthy period in the airlock to breathe pure oxygen and wash nitrogen from their bodies. Otherwise, the men would be subject to the bends, a painful condition caused by nitrogen gas bubbles in the body tissues.

Docking Module Is New

NASA developed and constructed a Docking Module that will also serve astronauts and cosmonauts as an airlock and transfer corridor between Apollo and Soyuz. It holds two suited crewmen and is attached to the forward end of Apollo.



The Docking Module and Soyuz use a compatible docking system designed by NASA and Soviet engineers. Such a system will later be employed on the United States Space Shuttle, on Soviet manned spacecraft, and possibly future spacecraft of other nations, providing international space rescue capabilities as well as facilitating future international manned space flights requiring docking of two or more vehicles.

Proven Launch Vehicles Used

Saturn IB launches Apollo into Earth orbit. Saturn IB was employed for the Earth-orbital Apollo test flights prior to the Moon launches and for Skylab, the first American Earth-orbital space station program. Saturn IB has a first-stage thrust of 720,000 kilograms (1.6 million pounds).

Soyuz is launched by the Raketa Nosityel Soyuz, or Soyuz Rocket Booster. The Soviet Union has used this rocket vehicle in all Soyuz missions, including Soyuz 4 and 5 which achieved the first manned transfer between spacecraft on July 16, 1969.

Mission Highlights

The mission plan calls for the Soviet Union to rocket Soyuz from the Baikonur launch complex near the Aral Sea in Kazakhstan. Initially, Soyuz's orbit will be elliptical. However, the Soyuz will execute one or two maneuvers to circularize its orbit at an altitude of 225 kilometers (140 miles).

About 7½ hours after the Soyuz launch, Apollo will be rocketed into orbit from the John F. Kennedy Space Center in Florida. After separating from Saturn, Apollo will turn about, maneuver to the forward end of Saturn, and dock with and extract the Docking Module housed there.

Apollo will then execute a series of maneuvers that will result in rendezvous and docking with Soyuz. The docking will occur about 52 hours after the Soyuz launch. The spacecraft will remain docked for approximately two days as exchange visits and joint experiments are conducted. Then, they will be separated.

The Soyuz is expected to remain in orbit for an additional 43 hours before returning to Earth. It will land in Kazakhstan. Apollo will operate in space for approximately six days after separation. It will land in the Pacific Ocean near Hawaii.

Experimental Activities

Twenty-seven experiments planned for Apollo-Soyuz involve space science, space processing and manufacturing, Earth surveys, and life sciences. A few examples:

- The stable and relatively prolonged mission will be employed to gain more data on a compara-

Historic meeting in space. Astronaut and cosmonaut greet each other with handshake. Two astronauts are in Docking Module air lock. The other is in Apollo Command Module. Both cosmonauts are in the Orbital Module of Soyuz. Descent Module is behind Orbital Module.

Astronauts Slayton (foreground) and Stafford in back-up Docking Module.

tively low-energy, X-ray background in the sky detected by sounding rocket studies. Little is known about this phenomenon. The aim is to ascertain both the source of the radiation and the process by which it is derived. Just as studies of solar emission processes contributed to development of atomic power plants, understanding of these X-ray sources may lead to development of improved techniques for generating energy.

- Mixtures of living cells will be separated by electrophoresis into groups, each having a different function. Electrophoresis refers to the movement of particles suspended in a fluid under the influence of an electric field. The weightless spacecraft environment may permit better separation than can be obtained on Earth. If so, electrophoretic separation on future space missions such as those of the Space Shuttle could be a valuable tool for biological research and lead to useful applications in preparation of cell transplants and products that can be obtained from cell cultures, such as enzymes and antibodies.
- Observations will be made of Earth features, processes, and phenomena in many scientific disciplines. Among these are surveying the Himalayan snow fields and drainage patterns as an aid to irrigation and flood control on the Indan Subcontinent and mapping extensions of the San Andreas Fault and related fracture systems in the United States for oil and mineral exploration and earthquake studies.
- Among the life sciences experiments are studies of how weightlessness may affect the body's response or resistance to infection. Studies will be made of lymphocytes and polymorphonuclear leukocytes in blood samples taken from the astronauts before and after their mission. Leukocytes are the white cells that attack infectious bacteria. Lymphocytes either manufacture antibodies that battle viruses and other infectious agents or transmit information to other cells on how to repel disease. The studies will add to knowledge about the body's defense mechanisms.

Astronauts Stafford (light coat, black cap) and Cernan (on his left) on Moscow tour with other members of Soviet and American Apollo-Soyuz technical teams. Cernan is Special Assistant to Dr. Glynn S. Lunney, the U. S. Technical Director of Apollo-Soyuz. The American team was in Star City near Moscow for Soyuz familiarization training. In background is Cathedral of the Intercession (St. Basil's) Museum. Kremlin is at right.

Satellite To Play Important Role

Communications from the docked Apollo and Soyuz spacecraft will be relayed to Earth through NASA's Applications Technology Satellite-6, a versatile spacecraft being used for experiments on the frontiers of communications, meteorology, and space science.

If Apollo-Soyuz were transmitting directly to ground stations, as has been the practice in past manned flights, its comparatively low orbit and the limited number of stations would restrict communications between the astronauts and Mission Control to an average of only about 15 minutes out of each approximately 90-minute orbit.

Applications Technology Satellite-6, however, is in constant communications view of nearly half the globe from its vantage point about 35,680 kilometers (22,300 miles) above Earth and, with supporting ground stations, Apollo and the ground-based flight controllers will be able to communicate for about 50 minutes out of each orbit.

Training Grounds Include Both Nations

Astronauts, cosmonauts, and Russian and American technical support staffs for Apollo-Soyuz have made numerous visits to each other's facilities for training and for working group meetings. Joint tests have been made of such components as the docking system.

Representatives of each country will be in the other's mission control center during the mission. Americans also will check out Apollo communications equipment that will be carried aboard Soyuz prior to the Soyuz launch.

Each country's team is being intensively trained in the other's language. Flight documents and primary ground and space controls will be labeled in both Russian and English.

Biographies Of The Prime Crews

Astronauts

Thomas P. Stafford, Commander, was born in Weatherford, Oklahoma, September 17, 1930. He graduated from the U. S. Naval Academy in 1952.

Stafford is a recipient of the following honorary degrees: Doctorate of Science, Oklahoma City University, 1967; Doctorate of Laws, Western State University College of Law, 1969; Doctorate of Communications, Emerson College, 1969; Doctorate of Aeronautical Engineering, Embry-Riddle Aeronautical University, 1970.

Special honors have included the NASA Distinguished Service Medal, two NASA Exceptional Service Medals, the Johnson Space Center Certificate of Commendation, the Air Force Command Pilot Astronaut Wings and Distinguished Flying Cross, the National Academy of Television Arts and Science Special Trustees Award, and the 1966 Harmon International Trophy, administered by the Clifford B. Harmon Trust.

His space flights include Gemini 6 as pilot, Gemini 9 as command pilot, and Apollo 10 as commander. He has logged more than 290 hours in space.

Commander Stafford and his wife, Faye, have two children.

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Vance D. Brand, Command Module Pilot, was born May 9, 1931 in Longmont, Colorado. He earned a Bachelor of Science degree in Business from the University of Colorado in 1953, a Bachelor of Science degree in Aeronautical Engineering from the University of Colorado in 1969, and a Master's degree in Business Administration from the University of California, Los Angeles, in 1964.

Mr. Brand earned the Johnson Space Center Certificate of Commendation in 1970 and the NASA Exceptional Service Medal in 1974.

Mr. Brand and his wife, Joan, have four children.

Donald K. Slayton, Docking Module Pilot, was born March 1, 1924, in Sparta, Wisconsin. He earned a Bachelor of Science degree in Aeronautical Engineering from the University of Minnesota in 1949. His honorary degrees include Doctorate of Science from Carthage University, Carthage, Illinois, in 1961 and Doctorate in Engineering from Michigan Technological University, Houghton, Michigan, in 1965.

He has been awarded two NASA Distinguished Service Medals, the NASA Exceptional Service

Medal, the Collier Trophy of the National Aeronautic Association, and the Society of Experimental Test Pilots' Iven C. Kinchloe Award and J. H. Doolittle Award.

Mr. Slayton was chosen as one of the original seven Mercury astronauts in April 1959 but a heart condition, discovered in August 1959, precluded his making any space flights. He subsequently served as Coordinator of Astronaut Activities and later as Director of Flight Crew Operations. In March 1972, following a comprehensive medical review by NASA's Director of Life Sciences and by the Federal Aviation Administration, Mr. Slayton was restored to full flight status.

Mr. Slayton and his wife, Marjory, have one child.

Cosmonauts

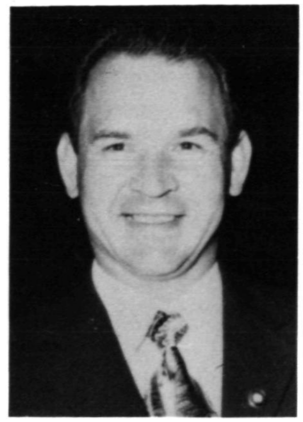
Aleksey Arkhipovich Leonov, Commander, was born May 30, 1934, in Listvayanka, in the Kemerovo Region of Siberia. He is a graduate of the Chuguyev Air Force School and the Zhukovsky Air Force Academy. He is also qualified as an Air Force Paradrop Instructor.

Commander Leonov is a Hero of the Soviet Union and a Pilot Cosmonaut of the U.S.S.R. He is also a deputy to the Moscow Regional Soviet. In addition, he is a vice-president of the USSR-Egypt Friendship Society and a board member of the USSR-Italy Society.

Commander Leonov was enlisted, together with Yuri Gargarin, in 1960 in the first unit of Soviet cosmonauts. He was second pilot in the Earth orbital flight of Voskhod 2 on May 18, 1965. During that mission, he achieved the world's first extravehicular activity in space.

Commander Leonov and wife, Svetlana, have two children.

Valeriy Nikolayevich Kubasov, Flight Engineer, was born January 7, 1935, in Vyazniki, Vladimir Region. He graduated from the Moscow Aviation Institute in 1958. He is the author of a number of studies dealing with the calculation of spacecraft trajectories and holds a Master of Science (Engineering) degree.



Flight Engineer Kubasov is a Hero of the Soviet Union and a Pilot-Cosmonaut of the U.S.S.R.

Kubasov was enlisted in the Soviet cosmonaut unit in 1966. As flight engineer of Soyuz 6, he took part in the group flight with Soyuz 7 and Soyuz 8 in October 1969. During this mission, he conducted the first experimental welding in space.

Valeriy Kubasov and his wife, Lyudmila, have two children.

Part Of 1972 Agreement

Apollo-Soyuz was included in an agreement on cooperation in space between the United States and the Union of Soviet Socialist Republics. The agreement was signed May 24, 1972, by President Nixon and Premier Kosygin, Chairman of the U.S.S.R. Council of Ministers.

Spacecraft Statistics

APOLLO		
Command Module		
Rear End Diameter	3.90 meters	(12.8 feet)
Length	3.66 meters	(12 feet)
Service Module		
Diameter	3.90 meters	(12.8 feet)
Length	6.71 meters	(22 feet)
Docking Module		
Diameter	1.52 meters	(5 feet)
Length	3.05 meters	(10 feet)
SOYUZ		
Orbital Module		
Diameter	2.29 meters	(7.5 feet)
Length	2.65 meters	(8.7 feet)
Descent Module		
Diameter	2.29 meters	(7.5 feet)
Length	2.20 meters	(7.2 feet)
Instrument Module		
Diameter	2.77 meters	(9.75 feet)
Length	2.29 meters	(7.5 feet)

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