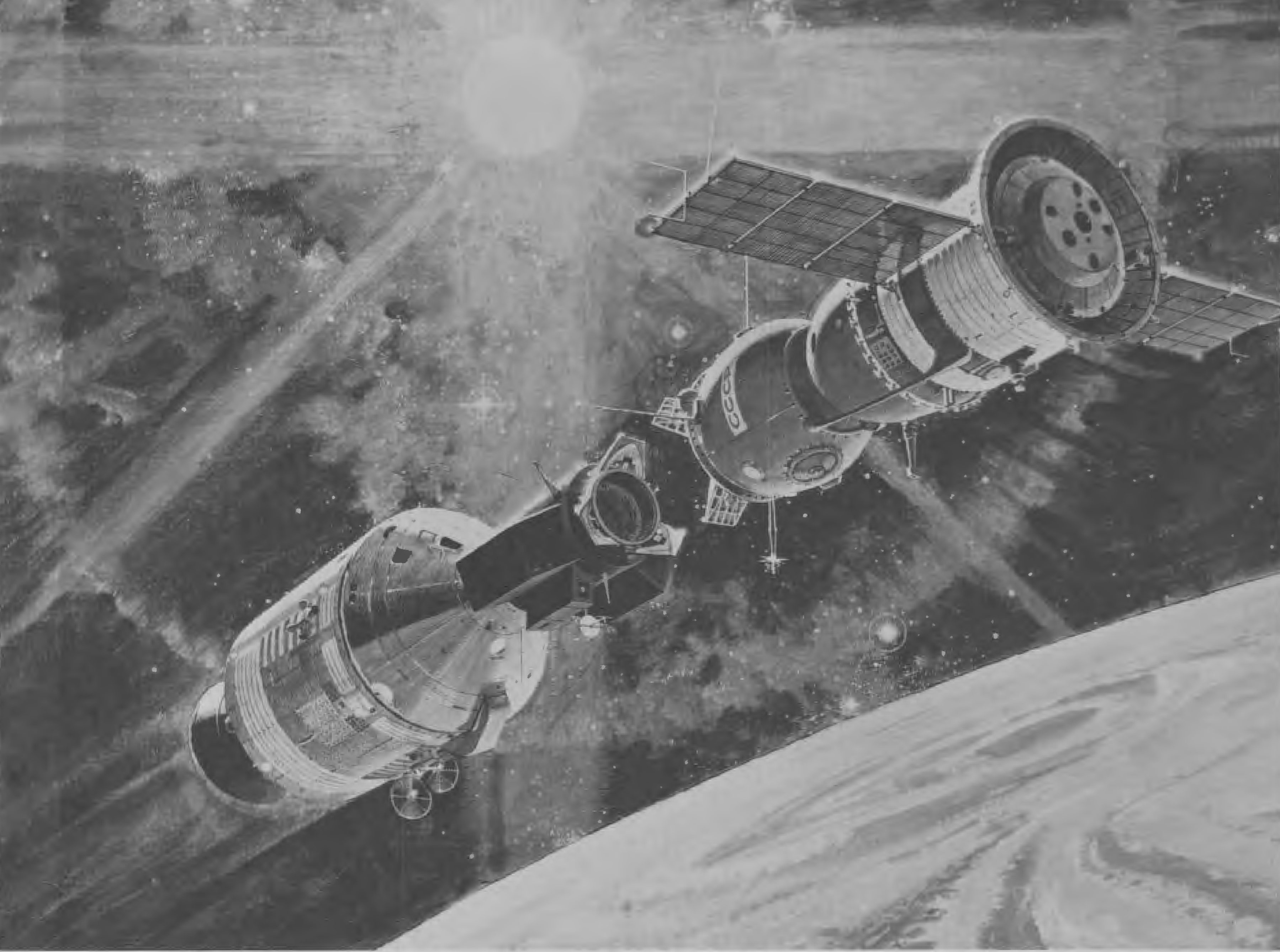


apollo·soyuz test project

Экспериментальный проект «Союз»-«Аполлон»

USSR COSMONAUTS

Aleksey A. Leonov

Valeriy N. Kubasov

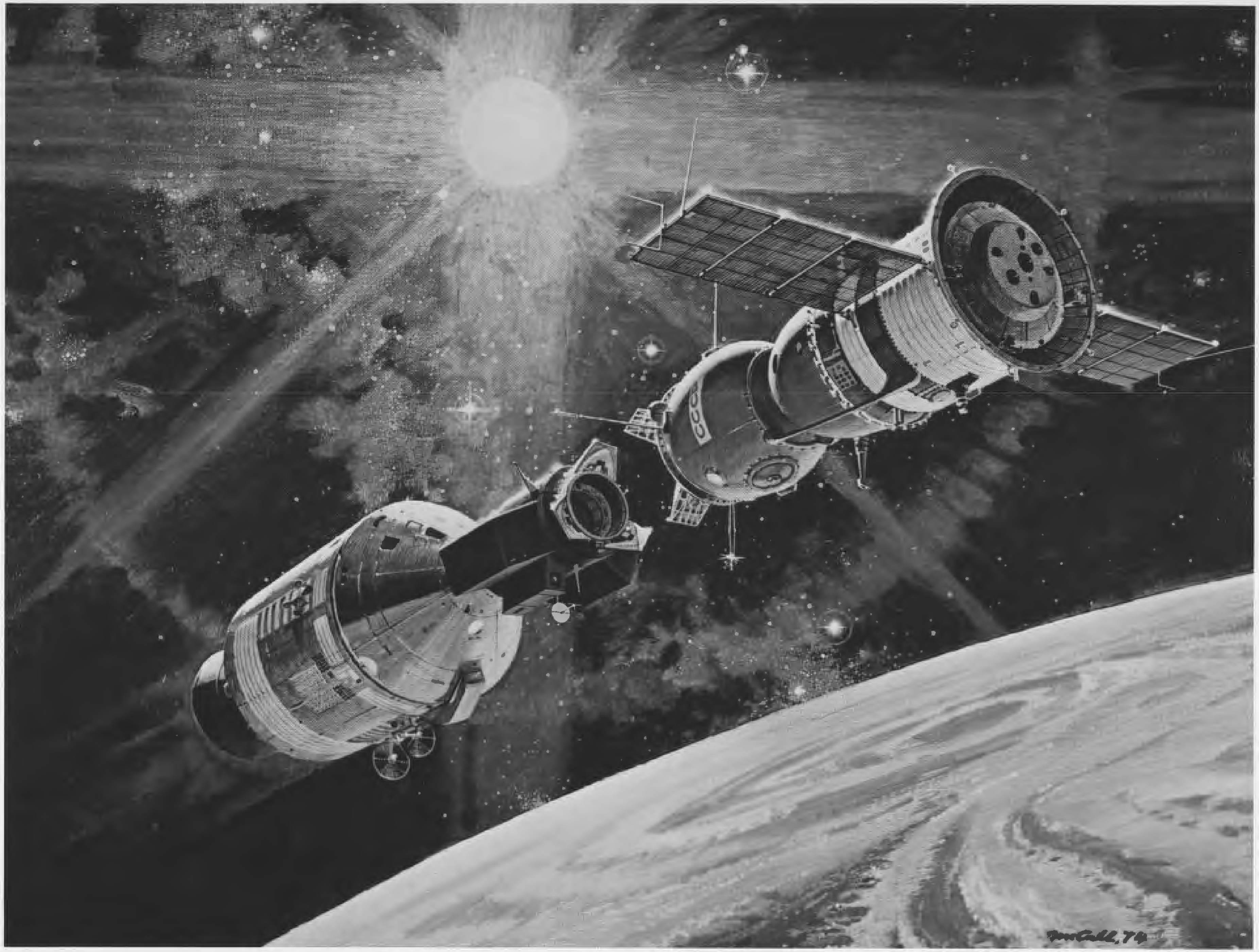
USA ASTRONAUTS

Thomas P. Stafford

Donald K. Slayton

Vance D. Brand

"DECALS INSIDE"



APOLLO SOYUZ TEST PROJECT

ЭКСПЕРИМЕНТАЛЬНЫЙ ПОЛЕТ "АПОЛЛОН"/"СОЮЗ"

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO SOYUZ TEST PROJECT

ЭКСПЕРИМЕНТАЛЬНЫЙ ПОЛЕТ "АПОЛЛОН"/"СОЮЗ"

FIRST INTERNATIONAL MANNED SPACE MISSION

ПЕРВЫЙ МЕЖДУНАРОДНЫЙ ПИЛОТИРУЕМЫЙ ПОЛЕТ В КОСМОСЕ

The Apollo Soyuz Test Project (ASTP) is a joint endeavor of the United States and the Soviet Union as part of the agreement on cooperation in space which President Nixon and Chairman Kosygin signed in Moscow in May of 1972. Both countries have agreed to develop compatible rendezvous and docking systems which will provide a basis for docking and rescue on future spacecraft of both nations.

It was agreed to conduct a joint experimental mission in mid-1975 to rendezvous and dock a manned Apollo spacecraft with a manned Soyuz-type spacecraft to test these docking systems in orbit.

Each nation is separately developing docking systems based on a mutually agreeable single set of interface design specifications.

The major new U.S. program elements are the Docking Module and docking system necessary to achieve compatibility of rendezvous and docking systems with the U.S.S.R. developed hardware to be used on a Soyuz spacecraft. The Docking Module and system together with an Apollo Command and Service Module (CSM) will be launched on a Saturn IB launch vehicle. The ASTP mission will include testing a compatible rendezvous system in orbit testing the compatible docking systems: verifying techniques for transfer of astronauts and cosmonauts: conducting experiments while docked and undocked: developing experience for the conduct of potential joint flights by U.S. and U.S.S.R. spacecraft, including, in case of necessity, rendering aid in emergency situations.

Экспериментальный проект "Аполлон-Союз" /ЭПАС/ - совместное начинание СССР и США на основе соглашения о сотрудничестве в области исследования космического пространства, подписанного в мае 1972 г. в Москве Председателем Совета Министров СССР Косыгиным и Президентом США Никсоном. Стороны заключили соглашение о разработке совместимых систем сближения и стыковки кораблей на орбите, применимых в случае необходимости оказать помощь пилотируемому кораблю в космосе.

Было решено провести в середине 1975 г. совместный экспериментальный полет пилотируемых кораблей и испытать стыковочные системы на орбите.

На основе разработанных единых требований по взаимодействию, каждая страна осуществляет свое самостоятельное конструирование стыковочной системы.

Основной частью американской программы исследований является создание стыковочного модуля и стыковочной системы, совместимых с советской стыковочной системой, используемой на кораблях типа "Союз". Стыковочный модуль со стыковочной системой и командно-служебный модуль /КСМ/ будут выведены на орбиту ракетой-носителем "Сатурн" IB. Программа ЭПАС предусматривает испытание на орбите совместимой системы сближения, испытание совместимой стыковочной системы, проверку методов перехода из корабля в корабль, проведение экспериментов в состыкованных и расстыкованных кораблях, накопление опыта для возможных совместных полетов в будущем и оказания помощи в аварийных ситуациях.

JSCL-128

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APOLLO SOYUZ TEST PROJECT PRIME CREWMEN

ПЕРВЫЕ ЭКИПАЖИ ЭКСПЕРИМЕНТАЛЬНОГО ПРОЕКТА АПОЛЛОН-СОЮЗ

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO SOYUZ TEST PROJECT PRIME CREWMEN

ASTP PRIME CREWS—These five men compose the two prime crews of the joint U.S.-USSR Apollo-Soyuz Test Project docking in Earth orbit mission scheduled for July 1975. They are Astronaut Thomas P. Stafford (standing on left), commander of the American crew; Cosmonaut Aleksey A. Leonov (standing on right), commander of the Soviet crew; Astronaut Donald K. Slayton (seated on left), American docking module pilot; Astronaut Vance D. Brand (seated in center), American command module pilot; and Cosmonaut Valeriy N. Kubasov (seated on right), flight engineer of the Soviet crew.

Космический центр имени Джонсона, Хьюстон, Техас

Первые экипажи ЭПАС.

Эти пять человек составляют два основных экипажа совместного американско-советского экспериментального проекта Аполлон - Союз по стыковке на околоземной орбите, запланированной на июль 1975 года. Они являются: астронавт Томас П. Стаффорд /стоит слева/ - командир американского экипажа; космонавт Алексей А. Леонов /стоит справа/ - командир советского экипажа; астронавт Дональд К. Слэйтон /сидит слева/ - пилот американского стыковочного модуля; астронавт Ванс Д. Бранд /сидит в центре/ - пилот американского командного модуля; и космонавт Валерий Н. Кубасов /сидит справа/ - советский борт-инженер.

JSCL-129

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NASA Facts

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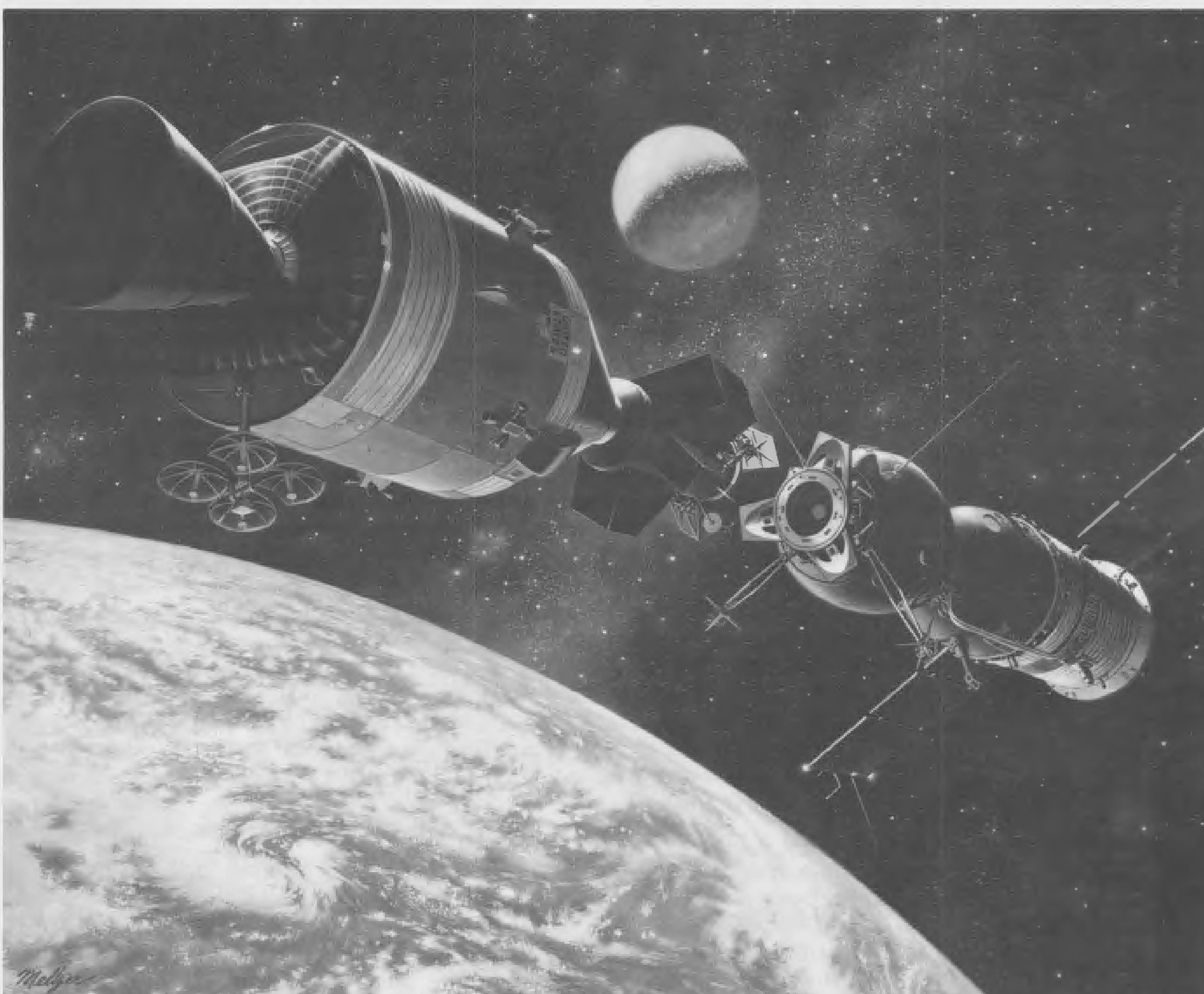
NF-52/5-75

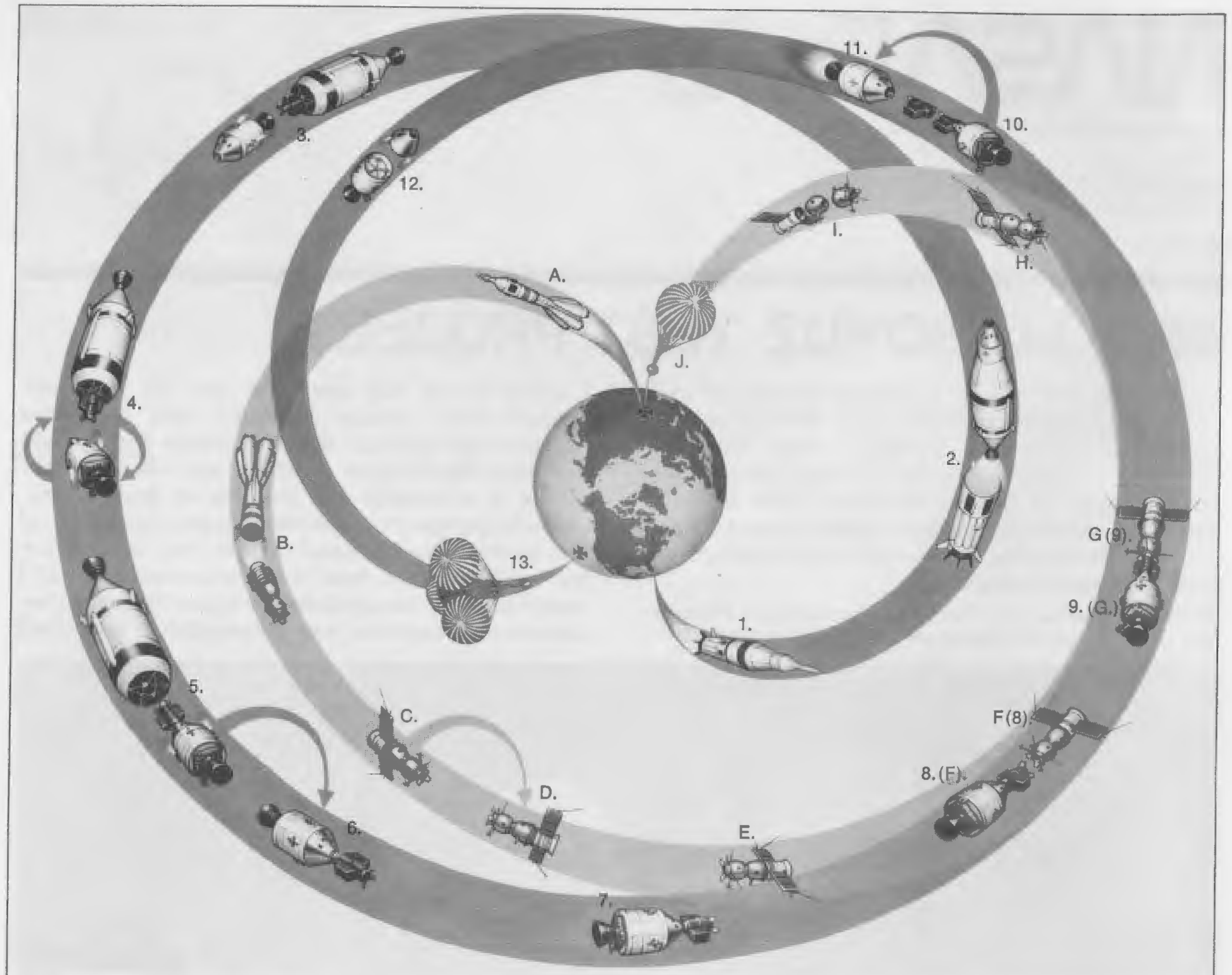
APOLLO SOYUZ TEST PROJECT

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





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.

also for what peoples working together may achieve on Earth.

Existing Spacecraft Used

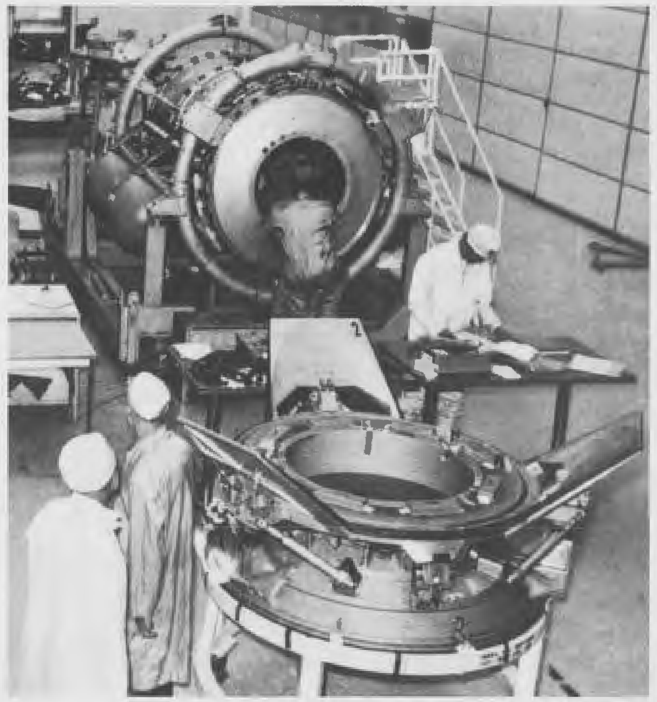
Apollo-Soyuz is named for two tried and tested spacecraft—the American Apollo and Russian Soyuz—that have been adapted for the mission. Apollo is fundamentally the same craft that waited in lunar orbit during the Apollo lunar landings and that later carried astronauts between Earth and the Skylab experimental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



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

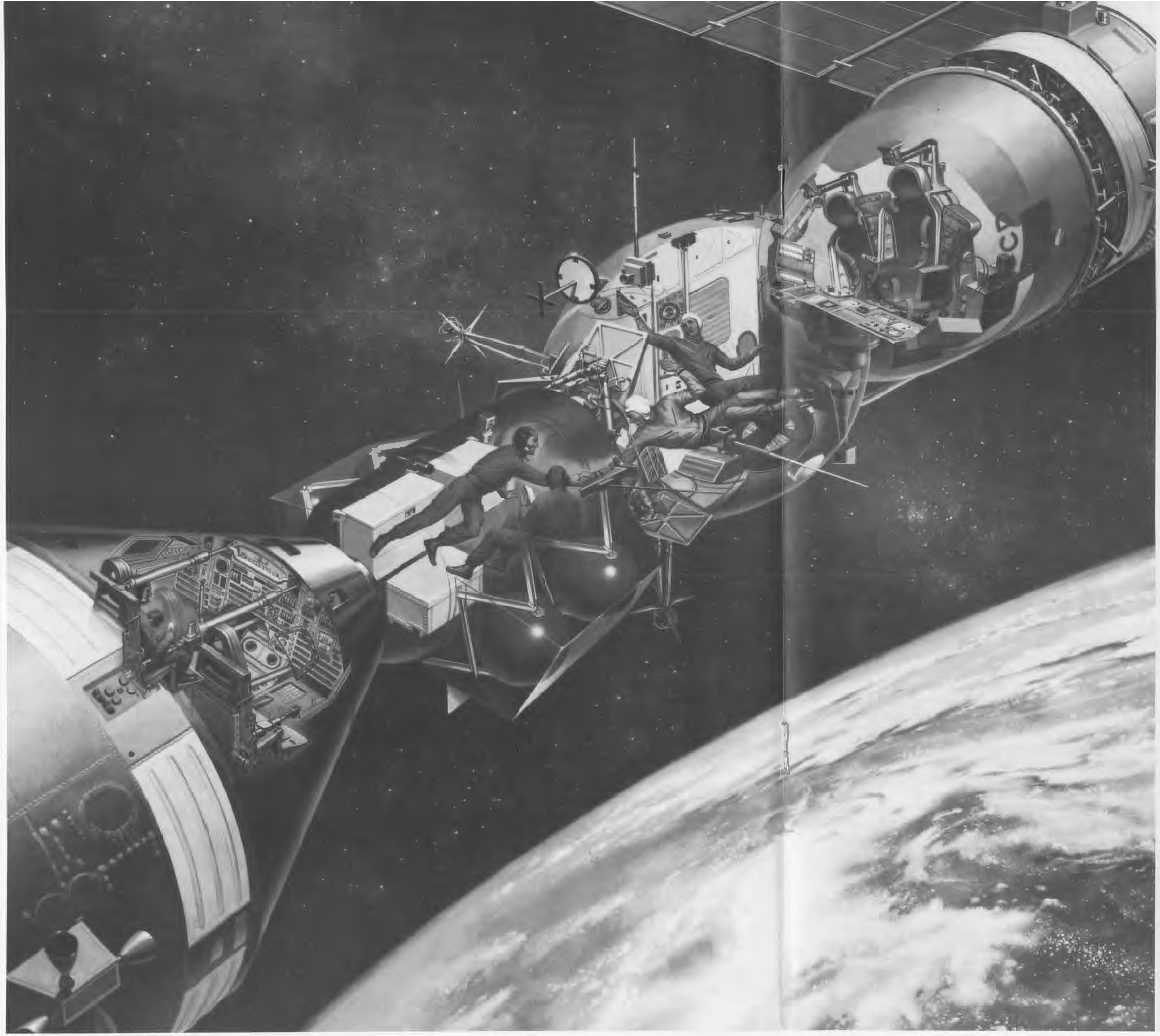
- Instrument, at rear, with subsystems required for power, communications, propulsion, and other functions.

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.

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.

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.

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.

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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RENDEZVOUS IN SPACE: APOLLO-SOYUZ

by F. Dennis Williams

Public Affairs Officer, Office of International Affairs,
National Aeronautics and Space Administration.

Revised and updated from a manuscript written by Gerald R. Kovacs, Department of History, Indiana University.

A reprint from June 1975 "NASA Report to Educators"

As many Americans awaken on July 15, Soviet technicians will be completing an afternoon countdown for a Soyuz rocket booster to be launched from the Baykonur complex near Tyuratam in Central Asia, some 2,000 miles southeast of Moscow.

Meanwhile, NASA technicians at Kennedy Space Center will clear the area around an Apollo launch pad and begin loading liquid hydrogen and liquid oxygen into the 224-foot Saturn IB. Seven and a half hours after Soyuz has begun its journey around the Earth, at 3:50 p.m. EDT, Apollo will roar over the Atlantic Ocean in pursuit.

The dual launch of Apollo and Soyuz, beginning the first manned spaceflight to be conducted jointly by the United States and the Soviet Union, is the result of years of negotiating, careful planning, and extensive testing. The flight itself, though it symbolizes a new era in U.S.-Soviet relations, is only the last in a series of tests for a new docking system—a system designed jointly by engineers of the two nations to give future astronauts of both nations a common mechanism for locking their spacecraft together. For those who have had dreams of Earth-orbiting space stations supplied and manned by spacecraft from many nations, such a standardized docking system is an essential first step. Without a compatible docking system, each nation would be limited to its own independent activity during a period when research and practical applications in Earth orbit are steadily increasing in value. For others, who have watched the independent progress of the two great spacefaring nations, the fact that such a mechanism could be designed and tested jointly will be evidence in itself of a far greater accomplishment—a significant increase in understanding between superpowers that once waged an ideological war that seemed to threaten the safety and security of the entire globe.

Beginnings in space. On October 4, 1957, the Soviet Union launched the first artificial earth satellite. In retrospect, the accomplishment seems a modest one—Sputnik I operated for three weeks and stayed in orbit only three months. During this period, its radio beep and movements revealed information about the density of the upper atmosphere, temperatures experienced in the new environment, and the effectiveness of radio transmission from space.

But the dawn of the space age had a tremendous impact on world public opinion. For more than two years, the United States had been publicizing its plans for launching an artificial satellite as part of the 1957 International Geophysical Year. Now, with virtually no advance publicity, the Soviet Union appeared to have surpassed the United States in a single giant leap.

Soviet representatives had, in fact, made passing mention that their government was pursuing investigations to this end, but such information sounded no alarms in the United States. Now, the resulting political effects in the United States and in other countries were remarkable. Although the Soviet Union had made substantial progress since the 1917 Revolution, the argument that the Soviet system was better able than the American to provide developing nations with economic and technological growth had proved unconvincing to much of the world. Now, in an era of Cold War, the Soviets had scored a propaganda coup of major proportions.

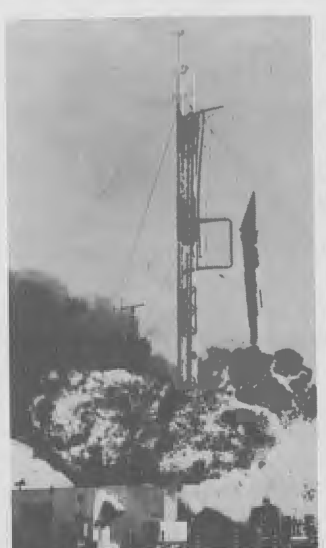
For people all over the world, the space successes of the Soviet Union were viewed as symbolic of the overall technical and scientific level of the Soviet society. During the first few years, the Soviet accomplishments greatly enhanced their prestige and influence in the world. Their new image convinced many that they had at the very least equalled the United States. The military implications of the successful launches of great payloads into Earth orbit were lost on few. The scientific equipment, animals, and finally cosmonauts that orbited the Earth all rode into space on missiles capable of carrying nuclear weapons.

In the United States, the Sputnik launch and the following explosion of our own Vanguard rocket on the launch pad brought a flurry of activity. Within a year, Congress had created a new agency, the National Aeronautics and Space Administration, to lead the civilian space effort.

Following Yuri Gagarin's successful orbital flight on April 12, 1961, President John Kennedy asked his advisors to present him with a space program that would demonstrate American technological leadership and regain our international prestige. Vice-President Lyndon Johnson, chairman of the National Space Council, passed the desired recommendations to the President, who announced on May 25, 1961, an urgent national priority: to land a man on the Moon and to return him safely to Earth before the end of the decade.

International cooperation. During the first years of space activity, international cooperation in space was endorsed by both the United States and the Soviet Union. Because of the military implications of the advanced propulsion and guidance technology, some areas —booster development, for example—were clearly not suited for intimate cooperation between the superpowers.

In the realm of scientific research, however, NASA quickly advertised its willingness to engage in cooperative projects with other nations, and a number of programs to launch sounding rockets and small satellites were agreed to in the early 1960s. The first international satellites, the United Kingdom's Ariel and Canada's Alouette, were launched in 1962 atop U.S. rockets.



Left, Explosion of the U.S. Vanguard on the launch pad in 1957. Below, Britain's Aerial satellite, launched by the U.S. in an early example of cooperation.

Despite a number of formal and informal approaches to Soviet officials in the first years of the space age, no agreement on the nature of specific cooperative projects acceptable to both sides was reached until 1962, after the first orbital flight by John Glenn. Chairman Nikita Khrushchev's congratulatory telegram included a statement concerning the desirability of cooperative effort by our two nations in the exploration of outer space.

In response, NASA and other U.S. agencies provided specific proposals for concrete space projects that might be undertaken by the U.S. and USSR. President Kennedy's letter to Khrushchev outlined these as (1) establishment of an operational world weather satellite system through coordinated satellite launchings and global data exchange; (2) exchange of spacecraft tracking services; (3) mapping of Earth's magnetic field with each nation launching its own satellites equipped to share this task; (4) an invitation to the Soviet Union to provide a ground terminal as part of an international program using U.S. communications satellites.

In view of the extensive cooperation already underway between the United States and many other nations, the agreement signed by Anatoliy Blagonravov of the Soviet Academy of Sciences and Hugh L. Dryden, Deputy Administrator of NASA, in June 1962 represented a very small step toward cooperation between the two nations that were most active in space.

This first agreement on space cooperation between the United States and the Soviet Union provided for mutual exchange of data from weather satellites, mapping of the Earth's magnetic field through an exchange of results from independent satellite launches, and a communications experiment using the U.S. satellite Echo II.

In 1965, stimulated by a Soviet suggestion, negotiators agreed on a plan to prepare a joint review of space biology and medicine, the first U.S.-Soviet cooperative effort in an area directly related to manned spaceflight. After a decade of compilation and review, the U.S.-U.S.S.R. editorial board has approved this impressive joint work for publication in the coming months.

Although U.S. space cooperation with dozens of nations flourished in the 1960s, joint efforts with the Soviet Union were limited to a very modest exchange of results and some small attempts at coordinating the two vigorous independent national programs.

From the launch of Sputnik in 1957 through the 1960s, the Soviet space program recorded a number of firsts: in 1959, the first spacecraft to escape Earth's gravity, Luna I; also in 1959, the first pictures of the far side of the Moon, by Luna 3; in 1960, the first recovery of orbited animals; in 1961, the first manned orbital flight, with Yuri Gagarin in Vostok 1; in 1962, the first spacecraft to fly past Mars, Mars 1; in 1964, the first multi-manned flight with a crew of three in Voskhod 2; in 1965, the first walk in space, by Aleksey Leonov, now commander of the Soviet prime crew for the Apollo-Soyuz mission; in 1966, the first spacecraft to impact Venus, Venera 3; and in 1969, the first circumlunar flight to be returned to Earth.

Meanwhile, the United States national space program also made significant advances. The first global weather photo, the first communications satellites, the first photograph of the Earth from space, the first docking of manned spacecraft in orbit, the first photographs of Mars, the first orbiting solar observatory—all were U.S. accomplishments in the 1960s. The crowning achievements—the first manned flight around the Moon, the first docking in lunar orbit, and finally the first manned landing on the Moon—significantly extended man's reach into space.

Growing U.S.-Soviet communication. In the latter half of the 1960s, as the United States moved toward the successful landing on the Moon, American space officials repeatedly offered to undertake additional cooperative efforts with the Soviet Union, but none of these overtures brought an affirmative response from the USSR.

During this period, however, the United States and the Soviet Union were among the dozens of nations signing the Outer Space Treaty in 1967. These nations, and the others signing in succeeding years, agreed that space is free for exploration and use by all countries, that space exploration shall be carried out for the benefit of all humanity, and that the Moon and other celestial bodies shall be used exclusively for peaceful purposes. This was followed in 1968 by a supplemental treaty concerning assistance by nations to astronauts in distress.

The rapid progress of NASA's lunar program was accompanied by steady growth in U.S. cooperative space activities with other nations. From 1965 through 1969, a dozen separate U.S. launches carried satellites from Canada, the United Kingdom, France, Germany, Italy and the ten-nation European Space Research Organization. Foreign scientists also provided experiments to be included in U.S. spacecraft and shared the responsibility for analyzing data gathered by U.S. instruments.

But even in early 1969, when new NASA Administrator Thomas Paine embarked on another campaign to elicit Soviet cooperation in defining mutually desirable space projects, the results were disappointing. Despite the great potential for space cooperation between the two nations most actively exploring the cosmos, no new joint effort had been undertaken for several years.

Until July 20, 1969, when American astronauts landed their lunar module on the dusty surface of the Moon, the pursuit of a more extensive program of space cooperation between the United States and the Soviet Union produced no hint of success.

If the landing on the Moon awakened mankind to both the needs of Earth and the potential of the human species, the accomplishment also stimulated a new interest in international space activity. Congressional resolutions endorsed an increased effort to bring about cooperation with all nations and to share the benefits of the Apollo success with the entire world. An advisory panel created by President Nixon recommended steps to involve other nations in a wide range of future space activities; a second panel, composed of representatives of several government agencies, began reviewing the possibilities for U.S.-Soviet cooperation in space. The enthusiasm of NASA Administrator Paine for seeking new joint projects was now bolstered by supporting statements from many quarters.

On the other side of the globe, Soviet officials began opening their doors. Congratulatory telegrams and informal expressions of Soviet support for increased space cooperation flowed from Soviet officials to their U.S. counterparts within days of the Apollo 11 landing.

Assured of the President's personal support for a broad initiative, Paine sent Mstislav V. Keldysh, President of the Academy of Sciences of the USSR, a copy of two reports on long-range U.S. goals in space and expressed the hope that they would suggest to Keldysh, as they did to him, possibilities for moving beyond the current, limited cooperation in space between their two countries. In the closing days of 1969 Keldysh replied that he agreed on the need to develop U.S.-USSR cooperation further. He suggested that in three or four months they return to the subject and agree on the time and place for a meeting.

In the succeeding months, the movement toward U.S.-Soviet space cooperation broadened and gathered momentum. In correspondence, at an informal dinner in New York, at private meetings, at an international space meeting in Leningrad, officials from NASA and other interested organizations suggested possible opportunities for cooperative effort.

During these months, several U.S. officials suggested that the two nations work together to develop a common docking mechanism for use on future spacecraft. In July 1970, a year after the first landing on the Moon, the Embassy of the USSR in Washington conveyed a message from Academician Keldysh: Soviet officials were ready to begin discussions leading to the development of common docking mechanisms for space stations.

Agreement is reached. In October, U.S. and Soviet officials met in Moscow for preliminary technical discussions. This first joint session led to basic agreements in several areas. Three joint working groups were formed, each with responsibility for a portion of the effort necessary to create a new docking system. These working teams would adapt procedures and systems developed independently by the two nations so that future vessels would be able to dock in space. This first meeting not only produced a formal agreement to design compatible rendezvous and docking systems for future manned spacecraft, it also led to a plan of action for their development.

The success of the rendezvous and docking meeting in October was followed by an agreement to substantially expand U.S.-Soviet space cooperation by establishing five new joint working groups. NASA Deputy Administrator George Low and Academician Keldysh met in January 1971 and agreed to the formation of new working groups to further cooperation in programs for weather satel-

On May 24, 1972, Richard M. Nixon and Alexei Kosygin signed a cooperative Space Agreement.

lites, atmospheric sounding rockets, space sciences, the environment, and space biology and medicine. Two of the projects to grow from the Low-Keldysh meeting were an exchange of lunar samples and a joint study of the Bering Sea using satellites, research ships and specially equipped aircraft.

At the January meeting, Low suggested to Keldysh that Apollo and Soyuz spacecraft be considered for a test flight of the new docking system the two nations would be developing. Then, in March, Low reported the recent developments in U.S.-Soviet cooperation to the Congressional committees that oversee the U.S. space program. NASA officials held regular discussions with senators, representatives, and staff members from Senate and House committees throughout the negotiations with the Soviet Academy of Sciences.

NASA and Soviet officials met again June 21-25, 1971, in Houston to discuss the technical requirements for compatible docking systems. Among the areas considered were radio and visual systems necessary for rendezvous and docking, differences in the communications and environmental control systems used by the two nations' spacecraft, and the basic functions and design of the proposed docking system. The two groups also agreed to study the costs and technical feasibility of testing the new docking sysem with existing spacecraft.

The technical feasibility of a test flight using existing spacecraft was confirmed in the succeeding meeting, held November 29-December 6 in Moscow; then at the Low-Keldysh meeting the following April, U.S. and Soviet delegations agreed that a test flight using U.S. Apollo and a Soviet Soyuz would be desirable.

During the April session, both sides carefully and completely reviewed the work of the previous eighteen months. Before a formal agreement could be signed by the chief executives of the two nations, every major element in the proposed Apollo-Soyuz Test Project had to be outlined to the satisfaction of both sides. Before advising the President of the United States to formally approve such a test mission, NASA officials sought and obtained firm commitments from their counterparts in the Soviet Union on the methods and schedules to be followed in the coming three years. The two sides carefully detailed the objectives of the joint flight; they agreed on hardware tests, training exercises, and mission simulations to be conducted before the flight; they formulated mutually acceptable policies for handling various situations that might arise in space; and they established general guidelines for the exchange and public release of information concerning the joint flight. Although each of these areas would be more extensively negotiated during future meetings, the basic plan was firmly established when the session concluded on April 6, 1972.

On May 24, 1972, President Richard Nixon and Aleksey Kosygin, Chairman of the USSR Council of Ministers, signed an agreement "concerning cooperation in the exploration and use of outer space for peaceful purposes." The leaders formally endorsed the arrangements previously agreed to at a lower level and established the two nations' determination to test the compatible docking system with an experimental Apollo-Soyuz flight in 1975.

The purpose of the new standardized system being designed for spacecraft and space stations was, in the words of the Nixon-Kosygin agreement, "to enhance the safety of manned flight in space and to provide the opportunity for conducting joint scientific missions in the future." The new docking system would provide the two nations with a steppingstone to cooperation in space.

ASTP development. Subject to continuing budget approval from the Congress, the Apollo-Soyuz Test Project was underway. During the three years to follow, well over a hundred U.S. engineers, astronauts, and project officials have traveled to the Soviet Union to meet with their counterparts, and a similar number of Soviet personnel have visited the United States. At these joint working group meetings, every aspect of the proposed mission that required coordinated effort was discussed. Astronauts and cosmonauts began receiving language instruction in preparation for the flight. Engineers agreed on a design for the docking system, then each nation set about building its own hardware to meet the joint requirements. As a result, the docking systems are internally different, but the parts connect perfectly.

The Apollo and Soyuz spacecraft selected to test the new docking system are different in many important respects. The orbiting Apollo weighs about sixteen tons, more than twice as much as Soyuz. Designed for lengthy missions to the Moon, Apollo has a larger fuel supply for maneuvering; Apollo also has more spacious interior quarters. During the joint flight, the two Soyuz crewmembers will remain in space for just under six days; with a larger supply of fuel, oxygen, water, and food, the three Apollo astronauts will be able to stay in orbit for nine days, permitting additional scientific experiments to be completed.

To be certain that no surprises occur when the two spacecraft dock 140 miles above the Earth, numerous tests were conducted in the U.S. and the Soviet Union. The docking system was subjected to extremes of heat and cold and to other stresses that will be encountered in the vacuum of space. Soviet training teams familiarized

U.S. astronauts with the Soyuz spacecraft in exercises at the cosmonaut facility known as Star City, just outside Moscow. The Soviet crew members practiced in an Apollo training device in Houston. The teams that will be in the U.S. and Soviet mission control centers during the joint flight also exchanged visits and were trained in control center operations.

A total of nine astronauts and eight cosmonauts have received extensive training in all aspects of the joint flight. The Apollo prime crew is commanded by Thomas P. Stafford, 45, a brigadier general in the U.S. Air Force, a veteran of three spaceflights, and an astronaut for more than a dozen years. Stafford flew to within eight miles of the surface of the Moon on Apollo 10, the last test flight to precede the lunar landing in 1969. In 1965, Stafford participated in the first rendezvous in space when he and Walter Schirra brought the Gemini 6 to within a half-dozen feet of Gemini 7. In 1966, Stafford commanded Gemini 9 during a three-day flight in Earth orbit.

Donald K. "Deke" Slayton, Apollo docking module pilot, has called himself the world's oldest space rookie. Slayton, 51, was one of the first seven U.S. astronauts selected in April 1959 and was to have piloted the second U.S. spacecraft to orbit the Earth, until a very slight heart irregularity was discovered. A comprehensive medical review in 1972 found Slayton physically qualified for spaceflight, and he will make his first trip into space on July 15.

The third U.S. prime crewmember is Vance D. Brand, 44. An astronaut for eight years, Brand trained as a backup crewmember for the Apollo 15 lunar landing mission and for the last two missions to use the Skylab space station. Brand has been named Apollo command module pilot for his first spaceflight.

The two-man Soyuz is commanded by Aleksey Leonov, one of the first group of Soviet cosmonauts to be chosen, and now a colonel in the Soviet Air Force. In 1965,

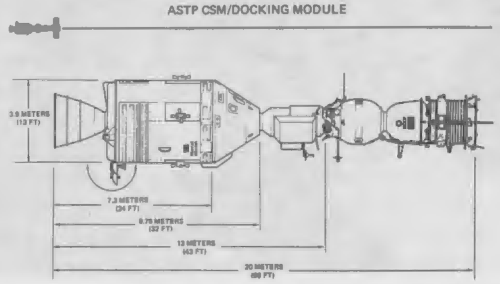
The men who will fly the Apollo-Soyuz Test Project in July, from left to right: astronauts Slayton, Stafford, and Brand; cosmonauts Leonov and Kubazov.

Above, Joint crew training at Johnson Space Center during a "walk-through" of the first day. Below, Soviet flight controllers during a briefing at Houston.

Leonov was the first person to walk in space when he spent 12 minutes outside Voskhod 2. Flight engineer for the Soyuz will be Valeriy Kubasov, who flew aboard Soyuz 6 in a 1969 flight that included a rendezvous with two similar spacecraft, Soyuz 7 and 8.

The spacecraft. The equipment for the Apollo-Soyuz Test Project includes both standard systems and new hardware developed specifically for the upcoming flight. The U.S. will use an Apollo spacecraft left in storage when the number of lunar landing flights was reduced in a cost-cutting effort. Because the Apollo command module was built with a docking system designed to work only with U.S. spacecraft like the Apollo lunar module or the Skylab space station, some method of incorporating the new compatible docking system designed by American and Soviet engineers had to be found.

A second important problem required solution before a joint flight could be made. The Apollo uses a pure oxygen atmosphere at about one-third the atmospheric pressure found on the surface of Earth; Soyuz, on the other hand, uses a nitrogen-oxygen mix like the air we breath on the ground, and at normal atmospheric pressure—14.7 pounds per square inch. To permit crewmembers to pass from Soyuz to Apollo, engineers had to include an airlock to equalize the pressure. A direct transfer from the Soyuz atmosphere to the low-pressure oxygen of Apollo would cause the "bends," a condition experienced by deep-sea divers when they come back to the surface too quickly and nitrogen gas bubbles form in their body fluids.



Fortunately, the problem presented by differences in the two spacecraft atmospheres and the need to adapt the Apollo to use the new docking system were resolved by combined action: the U.S. built a new piece of equipment and the Soviets made a modification to the Soyuz. Since the existing Apollo could not be changed to accommodate the new docking system without considerable work and expense, the U.S. decided to build a small docking module—an airlock ten feet long and five feet in diameter with the new docking system on one end and a system compatible with the Apollo on the other. The Saturn IB rocket used to launch Apollo will also carry the 4,400-pound docking module, and the astronauts will turn the Apollo around and connect it to the docking module after they are in Earth orbit.

To eliminate the need for a lengthy adaptation period for crewmembers passing from Soyuz to Apollo, Soviet engineers will reduce the atmospheric pressure aboard Soyuz by about one-third—to 10 pounds per square inch —while the two spacecraft are linked. The smaller difference in pressures allowed the United States to simplify and reduce the cost of the docking module, since crewmembers will not be required to spend long periods in the airlock. The change also will make enough time available to permit all crewmembers to participate in the exchange of visits.

The docking module includes virtually everything necessary to meet the compatibility requirements for Apollo. Only minor changes were necessary in the Apollo command module itself, for example the installation of controls for the docking module.

The Soviet side built new, modified Soyuz spacecraft specifically for the planned joint mission—each with the new compatible docking system included as an integral part of the Soyuz design. Two unmanned test flights were made with the new configuration, and in December 1974 Soviet back-up crewmembers for the joint flight rehearsed the entire mission independently during the six-day flight of Soyuz 16.

Two of the new Soyuz spacecraft will be prepared for launch from the Baykonur launch complex near Tyuratam, east of the Aral Sea. If one of the Soyuz launches is unsuccessful, or if the Apollo is unable to follow within a few days of the Soyuz launch, the second Soyuz will be available for the joint flight.

By the time the flight itself begins, every procedure will have been worked out in detail, and many of the possible problems will also have been carefully reviewed. As the Soyuz stands ready on the launch pad in the Soviet Union, television pictures of the crew and rocket will be relayed to the U.S. mission control center in Houston from the Soviet mission control center at Kaliningrad, outside Moscow. Throughout the flight, communications between the spacecraft and the global tracking networks of the two nations will be relayed to flight controllers on both sides of the Earth. The control centers will be linked by lines for telephone, teleprinter, and television to permit rapid communication between all of the participants as the flight progresses.

The ASTP mission. The Soyuz will be launched first to take advantage of the fact that Apollo has a greater fuel capacity and is better able to close the gap with Soyuz once the two spacecraft are in orbit. Apollo will follow in 7½ hours, with subsequent launch opportunities on each of the five succeeding days.

About an hour after Apollo is launched, the command module will turn around in orbit, connect with the docking module, and begin moving away from the second stage of the rocket that placed Apollo in orbit.

During the succeeding 42 hours, from Tuesday evening (July 15) to just after noon on Thursday, the Apollo and Soyuz crews will slowly and carefully guide their spacecraft to dock some 137 miles above the Earth. Seven or more Apollo maneuvers will be required to dock with Soyuz—each changing the Apollo's initial velocity—about 17,500 miles an hour—by less than fifty miles an hour to bring it closer and closer to Soyuz.

After docking is completed and a check is made of the new system, Apollo astronauts Stafford and Slayton will open the hatch from the command module to the docking module, leaving Vance Brand behind in Apollo. At 3:26 p.m. EDT Thursday afternoon, the two U.S. crewmembers will open the hatch to Soyuz and greet the Soviet crew. Three more crew transfers will be made on Friday, assuring that all of the U.S. and Soviet crewmembers will crawl through the airlock for at least one visit in the other's spacecraft, an important part of the test of procedures and equipment developed for future cooperative work.

At 8:02 a.m. Saturday morning, the Apollo and Soyuz will undock and Apollo will move about 650 feet away from Soyuz to provide an artificial solar eclipse for Leonov and Kubasov to observe. The cosmonauts will photograph the outer atmosphere of the Sun and will also record the effects of the Apollo steering rockets as they fire their gases into the vacuum around the U.S. spacecraft. Then Apollo will fly around Soyuz, beaming special lights to a mirror or "retroreflector" on Soyuz and back to a spectrometer on the Apollo. The amount of light absorbed as the beam travels between the two

spacecraft will reveal the quantity of atomic nitrogen and atomic oxygen to be found in the region 135 miles above the Earth.

Following the joint experiments, Soyuz will dock with Apollo in a further test of the new docking system. Later on Saturday, following undocking, Apollo will fire its engines briefly and begin moving away from Soyuz. Soyuz will descend from orbit and land in the south central USSR near Karaganda early Monday morning.

The Apollo spacecraft will continue in orbit, with astronauts Stafford, Slayton, and Brand conducting several scientific experiments and making science demonstrations before they splash into the Pacific Ocean southwest of Hawaii at 5:18 p.m. EDT, Thursday, July 24.

U.S. experiments. Because this will be the last U.S. manned spaceflight in Earth orbit until the first Space Shuttle launch in 1979, NASA officials are taking advantage of the joint mission to carry on several scientific research projects during the nine-day flight. In addition to the two experiments mentioned above, which require the participation of both the U.S. and Soviet spacecraft, three other joint experiments and 22 independent U.S. experiments are planned for the flight.

Many of these experiments will explore areas investigated by the crews of the Skylab space station, which completed its work in February 1974. Inside the docking module, an electric furnace will be used to experiment on the processing of materials in space, a field that may someday return great dividends in the form of new materials that cannot be produced on Earth because of the distorting effect of the planet's gravitational forces. A Soviet scientist has prepared one of the samples to be inserted into the furnace. Other joint studies concern the effects of cosmic rays on bacteria, and the movement of microbes between crewmembers and the interior surfaces of the two spacecraft.

The U.S. crew will conduct several independent astronomy projects to record various forms of radiation from within our galaxy—the Milky Way—and from the universe beyond. Two other experiments will measure the relative movement of the Apollo command module in relation to an advanced communications satellite launched last year and in relation to the docking module, which will be sent spinning away by the crew after the docking experiments are concluded. By detecting small changes in the relative motions of the spacecraft, scientists can map areas where the Earth's gravity is slightly greater because of concentrations of mass beneath the surface. Tracking of satellites from the ground has revealed larger concentrations, while smaller differences can be detected by instruments here on the surface. The Apollo experiments will fill the gap between these two.

In two medical experiments, an electric field will be used to separate blood samples into their constituents. In another form of space cooperation, Germany provided the equipment for one of these two electrophoresis experiments. The investigations will help to determine

SCIENCE DEMONSTRATIONS FROM SPACE

During the flight of Apollo-Soyuz, the astronauts will conduct some science demonstrations that will utilize the unique conditions of the spaceflight environment in a way not possible on Earth. These demonstrations, which are in addition to the 27 experiments to be conducted, should be of great interest to science teachers and their students. They will be recorded on motion picture film and made available later for showing in high school science classes. The demonstrations are:

The "book" gyroscope—will show that a book-shaped object can rotate very stably about two of its symmetry axes (those of least and greatest moments of inertia), but no matter how carefully it is started rotating about the third symmetry axis the book soon undergoes an interesting flip-flopping motion which will be visible with the object rotating slowly and unsupported in zero g.

Planetary orbits—two metal spheres tethered together by fine thread will be launched with rotation but no translation about their center of mass, so as to orbit about each other in a plane. A pair with both masses equal will be a double-star model. A pair with one heavy and one light sphere will model a sun-planet or planet-moon or black-hole-star-system. No matter how the spheres are launched, they must always rotate in a plane.

Chemical reactions in foams—will involve the mixing of chemicals in zero g by shaking them to a foam. After a certain delay, a chemical reaction will occur, turning the colorless foam to a deep red. The stability of the foam, as well as the time of reaction, will be noted and compared to ground-based studies.

Capillary wicking—on Earth, the action of wicks is always the result of two forces, adhesion and gravity. Even when the wicking proceeds horizontally, some influence of gravity exists. In orbit, the wicking action should proceed without the disturbing influence of gravity. The rate of capillary action in different wicks placed in a law surface-tension fluid will be observed and compared with rates on Earth.

Liquid spreading—liquids, when brought in contact with solid surfaces, have a tendency to spread over the entire surface, provided that cohesive forces between molecules of the liquid are smaller than adhesive forces between molecules of liquid and molecules of the solid. Under Earth gravity, this wetting action takes place only when the flow of the liquid along the surface proceeds in a horizontal or downward direction. However, under the zero-g conditions, a wetting liquid will spread evenly over a surface irrespective of its orientation.

whether the unique space environment may offer a better means of isolating viruses, enzymes, and other small particles for analysis and whether this space technique may someday play an important role in helping to combat diseases here on Earth.

One of the more interesting Apollo experiments continues a study conducted during the Skylab flights. The U.S. astronauts will focus their eyes and cameras on the Earth, studying such features as snow cover in the Himalayan Mountains, the Great Salt Lake, deserts in both hemispheres, developing weather patterns, and conditions in the oceans.

Although the Soviet crew may also conduct scientific experiments during their flight no similarly extensive program of research has been planned for Soyuz. Soviet cosmonauts completed their most recent scientific mission aboard a Salyut space station early this year.

Despite the many scientific experiments added to the first flight test of the new international docking system, the Apollo-Soyuz Test Project will cost the United States only a little more than the Applications Technology Satellite which will be used to relay communications from the Apollo to a ground station in Spain. With the Soviet Union contributing a significant portion of the total costs, and the U.S. using a left-over Apollo, the overall expense of the project to the average American will be just a little more than one dollar.

The new compatible docking system is now a reality. All that remains to accomplish is the final flight test to prove its effectiveness in space. Two nations with great differences have shown during the intervening years that they can work together to their mutual benefit. The new system developed by the United States and the Soviet Union may be used on future space stations and on the shuttles that will carry crews to and from space.

During the designing of the new docking system, U.S. and Soviet representatives have, on occasion, disagreed as they struggled with the difficult technological problems to be solved. In the end, however, they resolved each of these conflicts to the satisfaction of both sides. When American engineers and managers required information about the Soviet spacecraft to assure the safety of the American crew and the success of the joint flight, Soviet officials provided the necessary assistance. Still, to protect certain technological innovations used in each nation's spacecraft, information about manufacturing techniques and the internal workings of advanced space equipment has not been exchanged.

This first international manned spaceflight is a dramatic climax to years of quiet effort on both sides, a significant step that may lead to a truly international era in space—an era in which all nations share the work and the reward of space exploration. Although the Apollo-Soyuz flight offers no guarantee of future cooperation between the great spacefaring nations, it does illustrate the potential for joint work in space—work that nations may do together despite their ideological differences.

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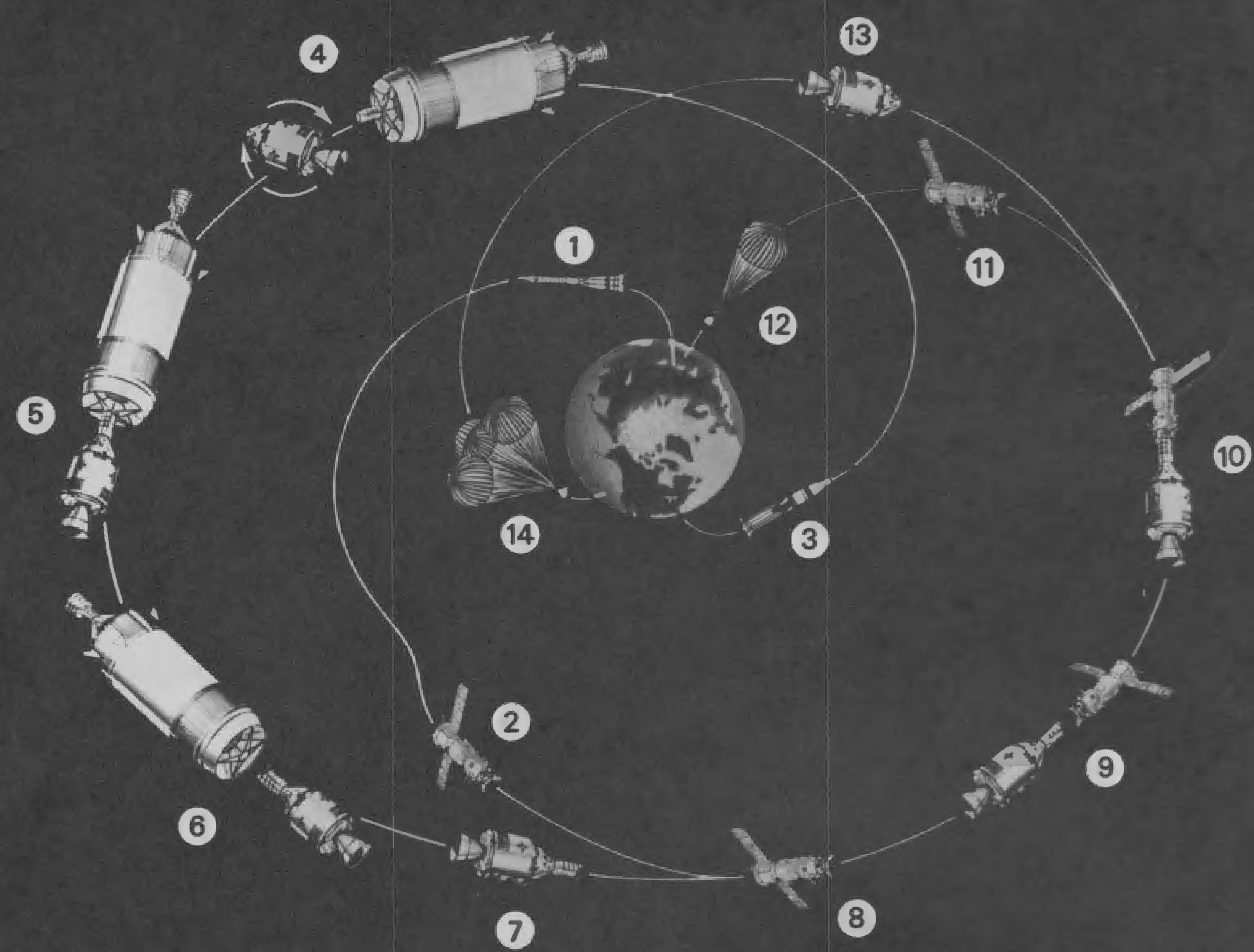

APOLLO SOYUZ TEST PROJECT

MISSION SEQUENCE

1. SOYUZ LIFT-OFF
2. SOYUZ ORBIT ADJUSTMENT MANEUVER
3. APOLLO LIFT-OFF
4. TRANSPOSITION
5. DOCKING
6. DOCKING MODULE EXTRACTION
7. APOLLO RENDEZVOUS MANEUVERS
8. SOYUZ CIRCULARIZATION MANEUVER
9. DOCKING
10. CREW ACTIVITIES
11. SOYUZ DEORBIT MANEUVER
12. SOYUZ LANDING
13. APOLLO DEORBIT MANEUVER
14. APOLLO LANDING