ASTRODIPLOMACY IN ORBIT

Photos: NASA

BY JONATHAN EBERHART

Some are calling it the end of an era. Others, the beginning of one. And it's being called everything in between from "Deke's Dream" to "the Great Wheat Deal in the Sky."

The Apollo-Soyuz Test Project (ASTP) is certainly the end of an era for the United States—an era that began 14 years ago with Alan Shepard's 16-minute sub-orbital ride aboard a cramped Mercury capsule called Freedom 7 and climaxed in 1969 when Neil Armstrong made the first human footprint on the moon. The ASTP Apollo is the last of the throw-away spacecraft. The next U.S. astronauts to venture into space will be aboard the space shuttle, a vehicle designed to fly as many as 100 missions—but not to go to the moon.

The question is, is ASTP also a beginning? A rendezvous in orbit between the United States and the only other nation to send human beings into space has been an official goal only since May 24, 1972, when former President Richard Nixon signed an agreement with Soviet Chairman Aleksei Kosygin, though it had been a topic of discussion since the early days of manned space flight. But will there be a second one? National Aeronautics and Space Administration officials admit to no plans, even tentative ones, for a second such mission.

The official ASTP *raison d'etre* is "to test compatible rendezvous and docking systems being developed for future United States and Soviet manned spacecraft and stations." This has meant developing the physical hardware—primarily a 10-foot tube called a docking module with an Apollo hatch fitting at one end and a Soyuz fitting at the other—along with techniques for controlling the two coupled spacecraft, communicating between them and controlling and monitoring them from the ground.

More often mentioned than joint missions, however, is the possibility of a rescue capability. If ASTP goes as planned, the implication is that if one country has an astronaut or cosmonaut stranded in orbit with no backup spacecraft available to fetch him home, the other country might be able to do the job. (Since the United States plans to fly no more Apollos, a true rescue system would presumably have to be redesigned to accommodate the space shuttle, a more practical rescue vehicle anyway.)

The "wheat deal" argument is that Soviet space officials, while offering little in exchange, are making propaganda points from the flight, by appearing to be on equal footing with the U.S. space program's markedly greater technological sophistication (one NASA official has termed this attitude "precious-bodily-fluids paranoia"). And indeed, the less-maneuverable Soyuz will be the "passive partner" in the docking operation. Furthermore, Soviet officials have permitted only the most necessary holes in the security blanket that cloaks the Soviet space program.

The counter-argument simply states that the cooperation, for all its limitations, is worth it. As a result of ASTP, a few more U.S. officials will be acquainted with a few more Soviet ones; a few more connecting links may have been forged between the two countries . . . and the possibility of future joint missions or the need for rescue may even turn out to be substantial.

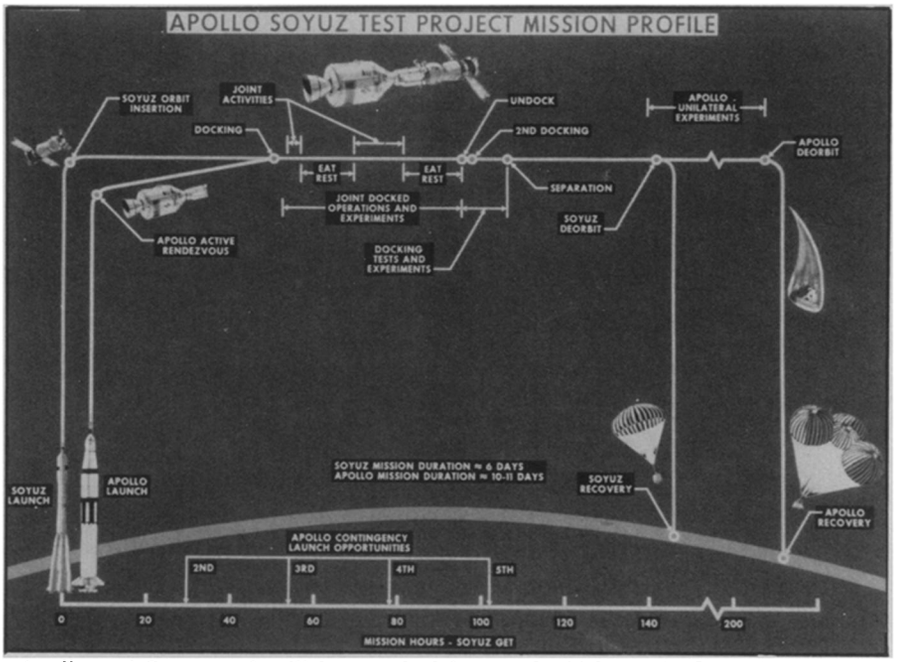
The Apollo-Soyuz Test Project is scheduled to begin at 8:20 a.m. EDT on July 15, when a Soyuz spacecraft takes off from the Baykonur Cosmodrome carrying cosmonauts Aleksey Leonov and Valeriy Kubasov. Seven and a half hours later, the Apollo will be launched from Cape Canaveral, under the command of space veteran Thomas P. Stafford (Gemini 6 and 9 and Apollo 7), with rookies Vance

D. Brand as command module pilot and Donald K. Slayton as "pilot" of the docking module. "Deke" Slayton has waited longer than any other astronaut, and probably any cosmonaut, for his trip into space. Originally scheduled to fly in Project Mercury, he was grounded by the discovery of a slight heart condition in 1959, leaving his mission to be piloted by Scott Carpenter three years later. Finally, just two months before the ASTP agreement was signed in 1972, his condition was reviewed and he was restored to flight status in time to begin training for the bi-national adventure. From grounding to astronaut—in 16 years. He is 51.

Some 73 minutes after launch, Apollo will separate from the final stage of its Saturn 1B rocket (also the last of its kind), turn around 180 degrees in space, and couple with and extract the docking module from its stored position atop the rocket, just as was done with lunar modules in the "old days" of Apollo. The real sign of the difference between the roles of Apollo and Soyuz in the mission is that next, after a brief engine-firing to get out of the way of the spent rocket, Apollo will go through seven separate maneuvers to set up the final docking approach, while Soyuz will perform only a single "burn" to circularize its orbit. Approaching Soyuz from behind, Apollo will come to within "eyeball" distance and pause for about half an hour of final checkouts and preparations, finally nudging the docking adapter in to link with the Soviet craft at what is predicted to be 12:15 p.m. on July 17.

For nearly 44 hours, the two spacecraft will remain attached, during which time the crewmen will visit one another's vehicles (though never leaving either craft without at least one occupant from its home country), exchange meals and gifts, and conduct a few scientific experiments.

A few. Science is not the goal of ASTP; it is an engineering and management exercise. There will be limited time, limited space and the difficulties of language. (The cosmonauts will speak English, the astronauts, Russian. More than a third of the U.S. crew's 2,000 hours of training for the flight were devoted to language lessons.) Also, any new additions to the flight plan during the many months of its development meant seemingly endless negotiations, modifications, translations and other problems. Even so, this has not prevented some criticism of the failure to take fuller scientific advantage of the presence of two manned spacecraft in orbit at the same time.



Apollo and Soyuz craft will be attached for nearly 44 hours in first joint mission.

Only five joint experiments are scheduled for the flight, three of them while the spacecraft are coupled together. In one experiment, the two crews will exchange cotton swabs to determine what quantities and types of microorganisms are to be found in various parts of the two vehicles; skin swabs will also be taken before, during and after the flight, as part of a study of the ways in which weightlessness and other conditions of spaceflight may alter the ability of microbes to infect humans and the ability of humans to resist infection.

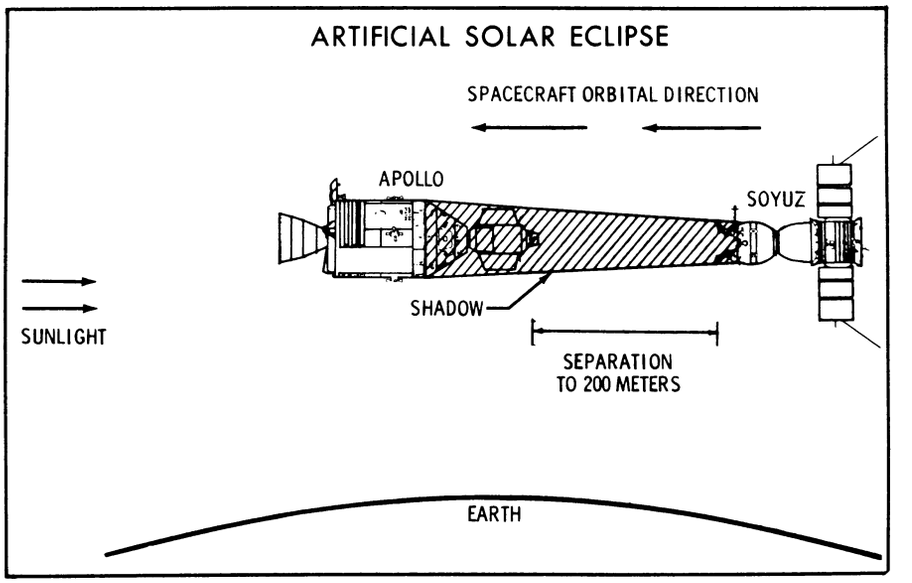
Another test will investigate the effects of "HZE particles"—heavy, energetic cosmic rays with kinetic energies in the GeV range or higher—on zone-forming bacteria. The third is actually a Soviet experiment, by Lev I. Ivanov of the Soviet Academy of Sciences, using a piece of U.S. equipment, a materials-research oven similar to the one aboard the U.S. Skylab orbital workshop. Samples of aluminum with tungsten spheres, germanium rod with 0.5 percent silicon, and powdered aluminum will be melted and resolidified in the oven to study the effects of weightlessness and convection.

Two more experiments are planned after the two spacecraft undock. Before undocking, Apollo will maneuver the pair so that Apollo has its "back," in the shape of its round silhouette, to the sun. Then, uncoupling, Apollo will slowly back up until it is just blocking the solar disk from the Soviet craft's view, providing, points out NASA, "the only spaceflight opportunity to observe the solar corona in 1975."

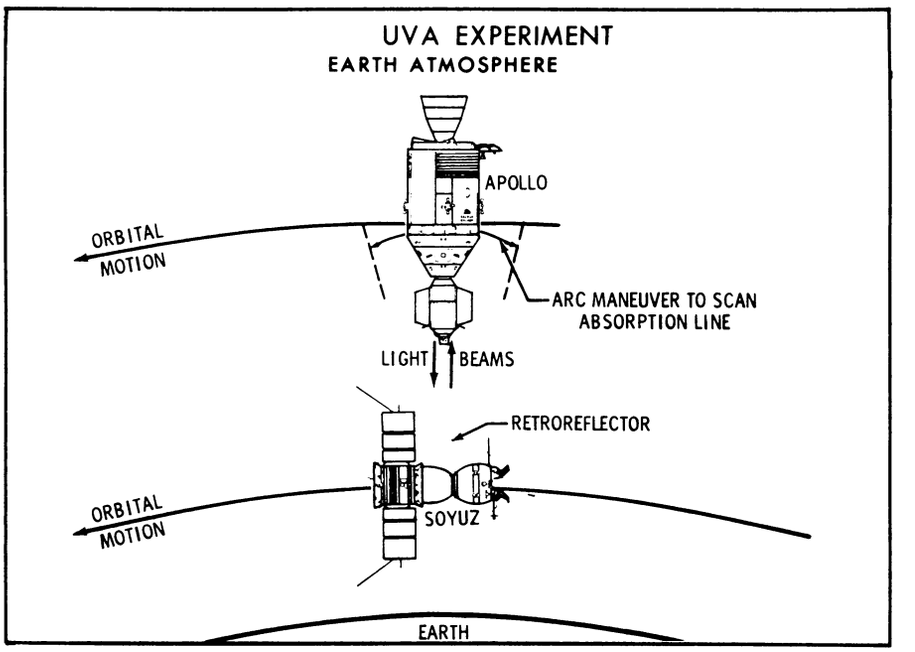
Finally, after conducting a brief repeat docking and undocking to test operating modes of some spacecraft systems, Apollo will back away and circle the Soviet craft at distances ranging from 150 meters to one kilometer. As it does so, ultraviolet light beams will be shone from Apollo at a reflector aboard Soyuz, which will send them back to an optical absorption spectrometer on Apollo. The beams, at wavelengths corresponding to neutral atomic

Slayton, Stafford and Brand with Soyuz cosmonauts Leonov (standing) and Kubasov.

American crew patch for joint mission.



Apollo will screen sun's disk for only 1975 U.S. space chance to observe solar corona.



Reflected ultraviolet beams will measure oxygen and nitrogen in outer atmosphere.

oxygen and atomic nitrogen, are intended to reveal the abundances of these gases at spacecraft altitude, the outermost fringes of earth's atmosphere. The oxygen abundance is uncertain by a factor of five to ten, says NASA, and the nitrogen abundance has never been measured.

The last test out of the way, the two vehicles will go their respective ways, with Soyuz scheduled to land less than 39 hours later. Stafford and company, however, will not touch down for another five days, due to a heavy load of unilateral scientific projects that would not otherwise be possible for U.S. scientists until the shuttle begins its orbital flights in 1979.

Four of the Apollo-only experiments are devoted to as many different kinds of astronomy. A counter aboard the spacecraft will map soft (.1 to 10 KeV) X-ray sources throughout our galaxy, complementing similar measurements from the Uhuru observatory satellite and Skylab. Another instrument will seek extreme ultraviolet sources with wavelengths from 50 to 900 angstroms, in hopes of spotting distant objects through irregularities in the unevenly distributed interstellar medium. A helium-glow detector is assigned the task of measuring the temperature and abundance of the interstellar medium in the vicinity of the solar system, while samples of germanium and sodium iodide are included to see how particle radiation in space may affect their usefulness as detectors in gamma-ray astronomy.

The ever-present earth-resources studies will continue during ASTP. Besides the usual photography, there will be a study of aerosols in the stratosphere, measured by photographing the solar disk by infrared light from Apollo and simultaneously from balloons released from the ground.

On the fourth day after departing from Soyuz, the docking module will be jettisoned from the Apollo command module and given a departing spin. The astronauts will then use Doppler tracking to follow the tumbling tunnel, to see if relative perturbations between spacecraft and docking module can yield information on mass anomalies in the earth through their gravitational effects. In a similar experiment, the crew will try the Doppler approach on the much more distant ATS-6 communications satellite.

Biology experiments will include a study of the light flashes reported by some past astronauts and believed due to high-energy particles passing through the retina of the eye. Particle effects will also be studied with a variety of lifeforms such as plant seeds and brine shrimp eggs.

Perhaps the most elaborate part of the Apollo experiment schedule is in the area of materials research, largely due to promising Skylab results such as the growth of huge, nearly flawless crystals of semiconductor materials. A wide variety of tests is planned with the Skylab-style oven, including crystal growth, alloy formation, surface-tension-induced convection, processing of magnets and others.

Finally, a pair of experiments will be devoted to the effects of the space environment on electrophoresis—the separation or isolation of biological materials by an electric field—including an attempt to isolate urokinase, said to be the only naturally occurring enzyme in the human body known to be capable of dissolving blood clots that have already formed.

And after it all, on July 24, with Leonov and Kubasov long back on earth, comes splashdown, this time aimed at putting Apollo in the Pacific about 555 kilometers west of Honolulu. Although numerous difficulties—budgets, policies, cold-war differences, etc.—are ganged up against the chance of a successor to ASTP, it will be interesting to see whether this big, visible example of hands-across-the-sea can really lead to joining forces in the exploration of a domain that is easily worthy, some day, of a cooperative planet-wide effort. □