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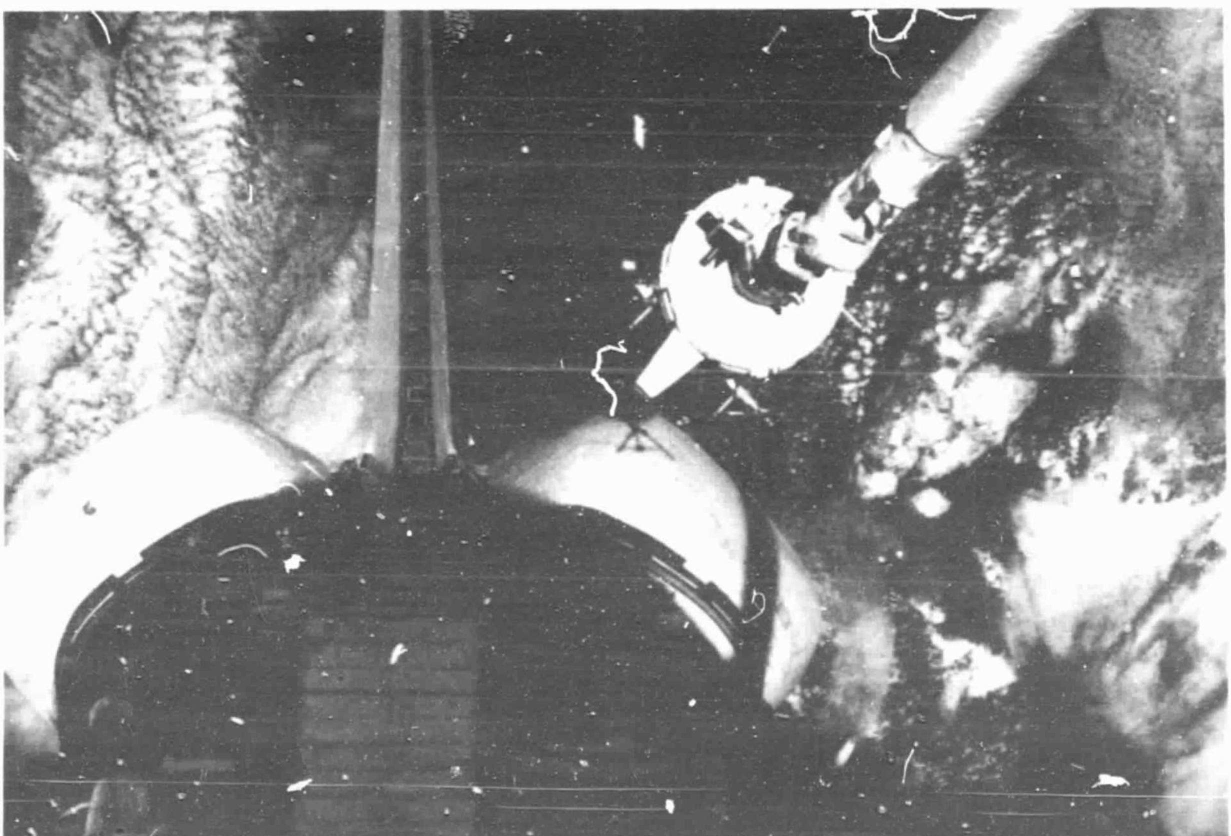
Mission Report

MR-003

STS-3—Busiest and Most Successful Test Mission



Manipulator arm swings Plasma Diagnostics Package over side of *Columbia*.

At 11:05 a.m. EST, March 30, 1982, NASA astronauts Jack R. Lousma (commander) and C. Gordon Fullerton (pilot) landed their Space Shuttle Orbiter *Columbia* on Northrup Air Strip at the White Sands Test Facility, New Mexico. This was *Columbia's* third orbital test flight. STS-3 lasted more than eight days, made 129 Earth orbits, and covered a distance of 6.24 million kilometers (3.9 million miles). It was not only the longest but also the busiest and most demanding of the Space Shuttle test missions. Lousma and Fullerton accomplished nearly everything they set out to do. The third mission of NASA's Space Transportation System (STS) proved a major stride toward an operational spacecraft.

Why Columbia Landed at White Sands

Rogers Dry Lake bed in California's Mojave Desert (Edwards Air Force Base) is the primary landing field for the shuttle orbital flight tests. STS-1 and STS-2 missions landed there. But heavy rains had drenched the dry lake. Nobody could predict how long it would take the Edwards runway surface to be dry enough to support *Columbia's* landing.

The best alternate landing site—Northrup Air Strip at White Sands, New Mexico—was chosen for the STS-3 landing. Like Edwards, Northrup Air Strip is a hard-packed desert floor.

The Northrup strip was sufficiently long and wide to provide the margin of safety needed until the characteristics of *Columbia's* aerodynamics and its new computer-based automatic landing system are fully tested.

Plans called for the STS-3 landing at 2:27 p.m. EST, March 29, 1982. But as Lousma and Fullerton were preparing their spacecraft for entry into the atmosphere on March 29, wind velocities rose sharply at White Sands. John W. Young, commander of STS-1—*Columbia's* maiden flight—piloted a jet aircraft over the landing area. He measured winds much too high for *Columbia* and observed that a severe sand storm had cut visibility at the landing site to near zero. He radioed Mission Control: "I think we ought to knock this off." "We concur," Mission Control replied.

Just 39 minutes minutes before they were scheduled to fire their braking rockets to descend from orbit, Lousma and Fullerton were "waved off." Lousma landed *Columbia* the next morning under clear skies and acceptable wind conditions.

Moving the landing site from Edwards to White Sands meant that facilities for processing *Columbia* after landing had to be set up at White Sands. Equipment and technicians needed for the landing were transported from Edwards to White Sands in 38 railroad cars forming two special trains.

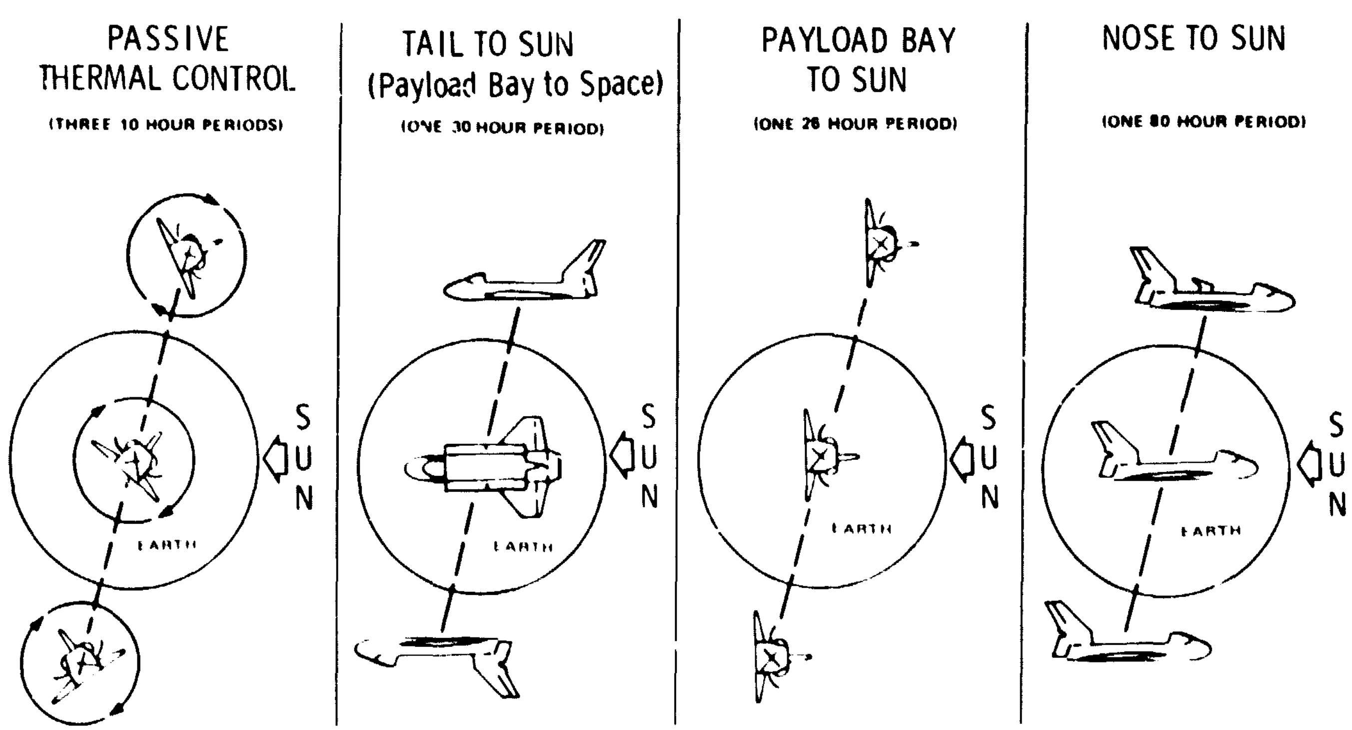
Preparations for Launch Nearly Perfect

Columbia's third mission into space began about four months after completion of its second mission—substantially less than the seven months between STS-1 and STS-2. The STS-3 launch was on the day originally scheduled, March 22, 1982—a first for the Shuttle. It was delayed just one hour from the planned 10 a.m.—to 11 a.m. EST. This slippage was occasioned by the failure of a heater on a nitrogen gas purge line.

Columbia Put Through Exacting Tests

A major STS-3 goal was thermal testing of *Columbia*. First the tail was pointed toward the Sun for 28 hours; later the nose for 80 hours; and finally, the top of the ship with cargo bay doors open, for 28 hours. Between these exposures in various flight attitudes, Lousma and Fullerton rolled the craft for periods of from 3 to 10 hours' duration to equalize external temperatures. While subjecting *Columbia* to thermal stresses, they opened and closed the payload bay doors. Following prolonged exposure of the open bay doors to intense cold away from the Sun, the doors wouldn't latch properly after closing. Latching was completed normally after Sun exposure heated the top of the cargo bay.

The crew started and restarted *Columbia's* orbital maneuvering engines and operated the huge mechanical arm called the Remote Manipulator System. They developed considerable expertise in using the manipulator arm to grasp an experiment called a Plasma Diagnostic Package. They moved this unit around outside and inside the payload bay and returned it to its stowed position.



STS-3 Thermal Test Attitudes

These maneuvers were accomplished despite a short circuit which blacked out the manipulator arm's television wrist camera. They guided the 15-meter (50-foot) arm using only its elbow camera. This marked the first time the arm had taken cargo out of the spacecraft.

Lousma and Fullerton also fired their attitude-control rockets to roll and pitch *Columbia* while they used the manipulator arm. These movements caused no noticeable arm tremors or loss of grip. As they berthed the arm for the last time, Fullerton called it a "fantastic piece of machinery."

Space Science Mission Successful

The mission's space science segment, called OSS-1, provided abundant data for scientists. This project was considered a "pathfinder" effort because many of the experiments were designed to gather information about *Columbia's* interactions with the space environment—to set guidelines for future experiments. The Plasma Diagnostic Package was designed to find out how the movement and the electrical and magnetic fields generated by *Columbia* affected plasma (ionized gases) and magnetic field lines in space.

Other experiments were designed to indicate how outgassing of Orbiter attitude-control propellants and water dumps could affect measurements of celestial and terrestrial objects.

Another experiment was carried to provide information about buildup of condensation on instruments, from volatile materials expended by *Columbia*. Tests of the dynamic, acoustic, and thermal properties of *Columbia's* environment also were made.

On this mission *Columbia* carried experiments to monitor X-rays emitted by solar flares; to gain more information about formation of lignin (the stiffening substance in plant stems) in the nearly gravity-free environment of space; to study the relationship of plant height in space to initial soil moisture content; to gather information about the frequency, mass, and chemistry of micrometeorites; and to find how flying insects behave in a nearly gravity-free environment.

Among the insects that Lousma and Fullerton photgraphed with a motion picture camera were honeybees and velvet bean caterpillar moths. This experiment was submitted by Todd E. Nelson, a student at Southland High School in Adams, Minnesota.

His experiment was one of 10 national winners from 1,500 proposed experiments submitted in the 1980–1981 NASA National Science Teachers Association Shuttle Student Involvement Project competition. The NASA NSTA project was designed to stimulate the study of science and technology in the nation's secondary schools.

To prepare for future low cost science experiments in space, a payload canister for small, self-contained experiments called "getaway specials" was checked out. Getaway specials are experiments developed by industry, schools, individuals, and other organizations and are scheduled for flight on a space-available basis

Medical and Materials-Processing Experiments

One experiment flown on the STS-3 mission employed electrophoresis to separate kidney and blood cells. Electrophoresis uses a small electric charge to separate a solution containing different types of cells. On Earth, the electrophoresis process produces undesirable convection currents in fluids. These currents tend to prevent separation of cells closely resembling one another. The electrophoresis experiment could lead to commercial processing of chemicals and pharmaceuticals in space.

A materials-processing experiment of STS-3 involved the development of uniform-sized latex spheres. Experimenters wanted to determine whether weightlessness can help produce uniform latex spheres of 20-micron diameter, from molten latex suspended in an emulsifier. These spheres are used to measure pores in the intestines and for eye research. They may also be used to convey drugs and isotopes for treatment of cancerous tumors.

Mission's Problems Relatively Minor

STS-3 was the third of four planned orbital test flights, designed to eliminate as many difficulties as possible before the Shuttle goes operational. In STS-3 some problems proved bothersome but most turned out to be of minor concern. About seven minutes after launch, a sensor flashed a message that one of the three Auxiliary Power Units (APUs) on *Columbia* was overheating. The APUs swivel the rocket engines during the launch phase and operate the rudder and elevons during the return through the atmosphere when the Shuttle flies as an aircraft.

The Shuttle Orbiter can operate adequately using only two of its three APUs during the ascent and re-entry modes. They are not used in orbit. During return to Earth on this mission all three units operated properly.

On March 23 Lousma and Fullerton discovered that *Columbia* had lost more than 35 of its 31,000 heat-protection tiles. Loss of the tiles did not endanger the spacecraft during re-entry, when temperatures reached more than 2,000 degrees F. The tiles became detached during launch. Engineers will continue replacement procedures designed to prevent tile separation during the fourth test mission. An inspection of *Columbia* after it landed revealed that it had lost 36 full tiles and parts of 19 others.

Adjustments Ease Crew's Problems

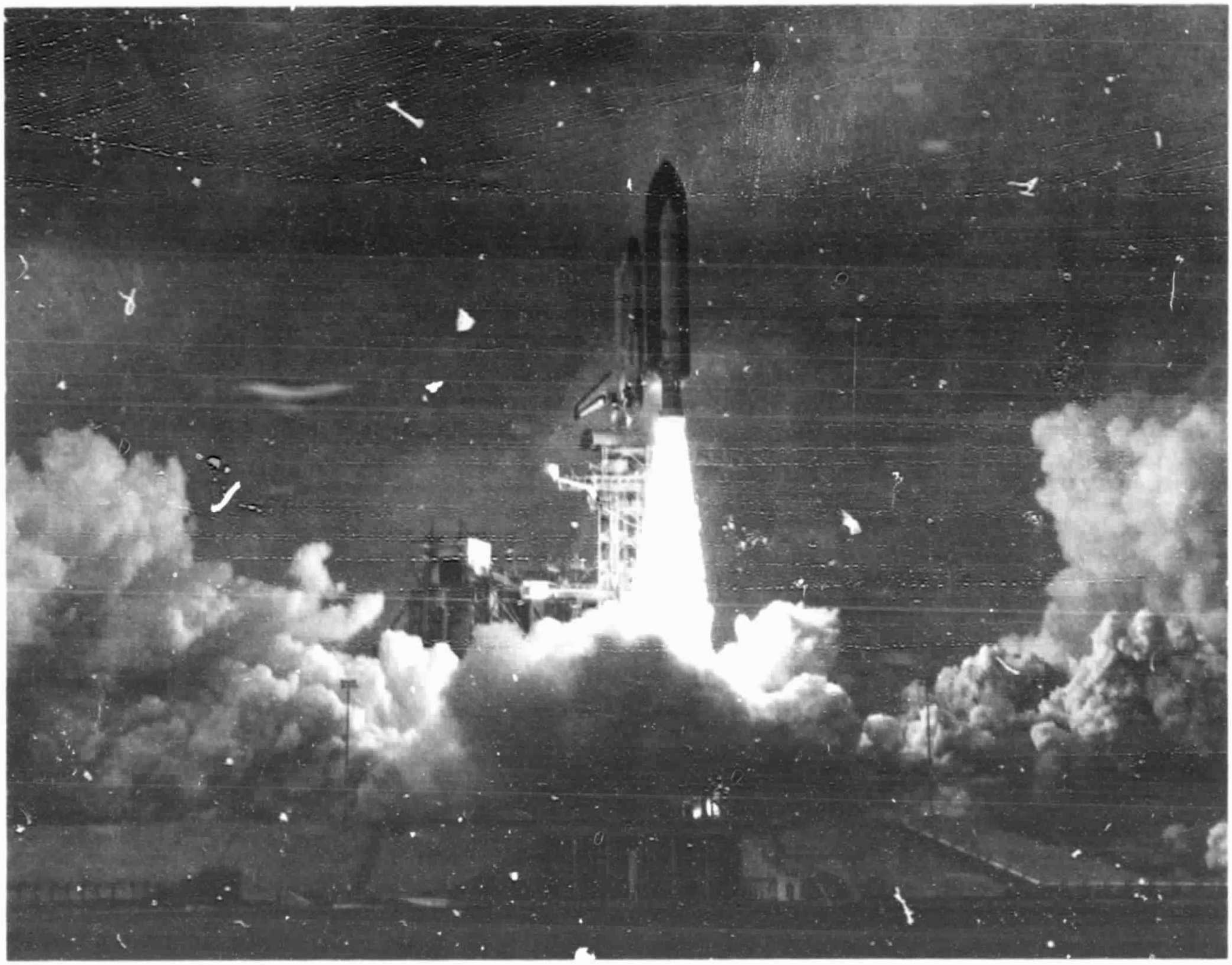
Early in the mission the crew encountered space sickness, a balky toilet, and temperature control and radio static problems that interfered with sleep. A thermostat difficulty kept the cabin either too warm or too chilly. Whenever *Columbia* passed over a certain area of Asia, the crew's radio headsets crackled with static, waking the astronauts if they were attempting to sleep. The static has been attributed to a powerful radar station. Most troubles were corrected by the third day and the astronauts went about their tasks in good health and high spirits for the remainder of the eight-day mission.

On March 26, three of the communications links between *Columbia* and Earth were lost due to transponder malfunctions. Besides the remaining high power communications link, a backup FM radio and UHF voice circuit were still available. Loss of the radio links reduced data transmission from *Columbia* to the ground but did not threaten safety.

All personnel connected with the flight felt the STS-3 mission performed its assigned tasks admirably, achieving an important step toward making Shuttle operational. Lousma and Fullerton agreed in summing up *Columbia's* third flight:

Columbia "performed magnificently."—Lousma

"It's an unbelievably beautiful flying machine."—Fullerton



Launch of STS-3