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Mission Report

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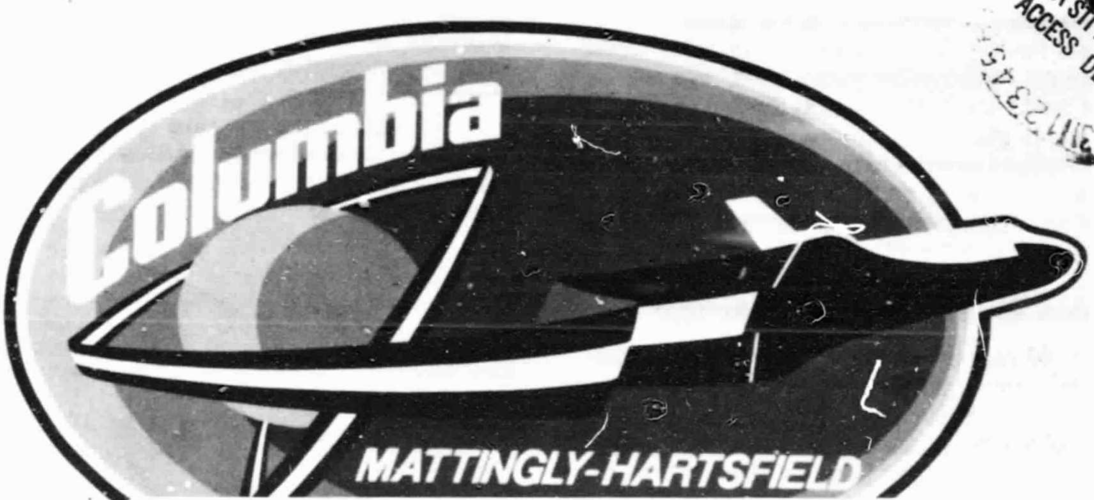
STS-4 Test Mission Simulates Operational Flight—President Terms Success "Golden Spike" in Space



STS-4 insignia.

(NASA-TM-84866) STS-4 TEST MISSION SIMULATES OPERATIONAL FLIGHT: PRESIDENT TERMS SUCCESS GOLDEN SPIKE IN SPACE (National Aeronautics and Space Administration) 4 p HC A02/MF A01 CSCL 22A G3/16 N83-10103 Unclas 35526

Completion of *Columbia's* fourth and final test flight achieved precisely what NASA engineers and technicians had in mind. Its on-time launch, near-flawless completion of all assigned tasks, and perfect landing ushered in a new era in the nation's exploration of space—a fully operational, reusable spacecraft now set to begin its job in earnest. *Columbia's* final test mission finished as planned—as a routine flight.

President Reagan compared the achievement with the "golden spike" that signaled the beginning of transcontinental railroading in an earlier era.

Thomas K. (Ken) Mattingly II (commander) and Henry W. Hartsfield, Jr., (pilot) brought their spacecraft to a perfect landing on concrete runway 22 at Edwards Air Force Base, California at 12:09 p.m. EDT, July 4, 1982—ending a flight of seven days, one hour, and nine minutes that began with a textbook liftoff from Kennedy Space Center, Florida at 11 a.m. EDT, June 27.

Emphasizing that the Shuttle and its crew are now ready for scheduled, on-time duty, they traveled 3 million miles and arrived back on Earth on America's 206th birthday—to celebrate the occasion with the President and an estimated half million of their fellow Americans at Edwards plus a world-wide TV audience. The confidence that this would happen was apparent in their selection of their mission patch design, showing *Columbia* streaking into the future leaving contrails of red, white, and blue.

Reagan Cites Shuttle's Potential

"Now we move forward," President Reagan said, "to capitalize on the tremendous potential offered by the ultimate frontier of space." During the President's speech, the second Shuttle orbiter *Challenger,* perched atop its 747 carrier aircraft, soared past the reviewing stand after taking off from Edwards on its way to Kennedy Space

Center to be groomed for its first launch into orbit. Rolled out from Rockwell International's Palmdale, California, plant June 30, *Challenger* is the second of four operational Space Shuttle orbiters. *Enterprise,* also on display, was used for aerodynamic testing in Earth's atmosphere and will not be flown on orbital flights. *Discovery* and *Atlantis,* scheduled to join in space missions in 1983 and 1984, respectively, complete the presently authorized family of orbiters destined for space duty.

Challenger is the first orbiter designed to be fully operational from the outset. As presently equipped, *Columbia* is capable of limited operational duty. But, after refitting, *Columbia* will closely resemble *Challenger* and share the operational workload. The second orbiting spacecraft has more accommodations for crew and passengers, incorporates engineering changes developed through *Columbia's* test flights, and is at least 2,000 pounds lighter than *Columbia* because of more advanced structures and materials.

Orbiter Certified Operational

Columbia's nearly flawless performance on its final test mission resulted in certification of the Space Transportation System (STS) as a fully operational carrier. James M. Beggs, NASA Administrator, said, "We are ready to put the Space Transportation System to work and it will earn its way."

President Reagan referred to using the "near weightlessness and nearly perfect vacuum of space to produce special alloys, metals, crystals, and biological materials impossible to manufacture on Earth."

Applications Experiments on *Columbia*

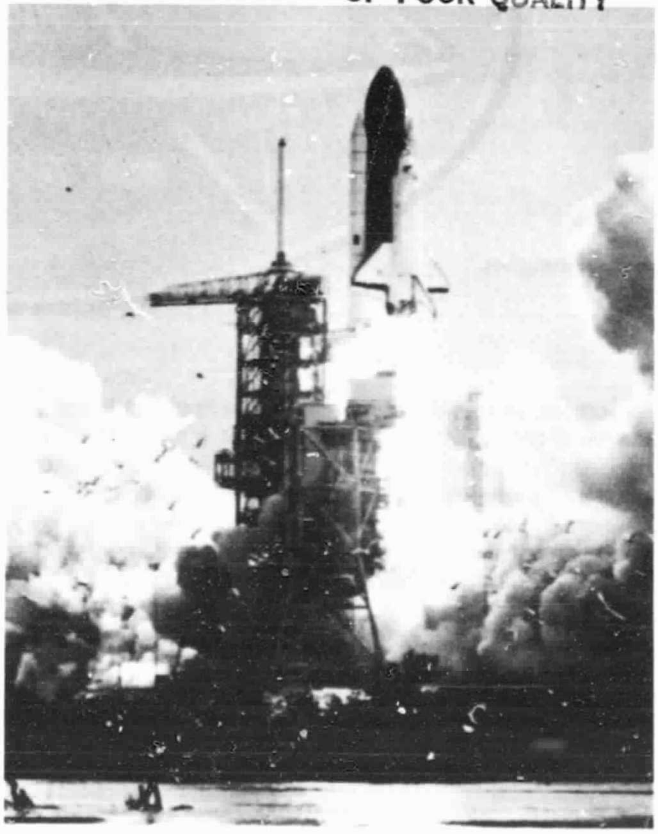
The first experiment by a commercial firm was carried on STS-4. This was an engineering test of the Continuous Flow Electrophoresis System. Unlike other electrophoresis equipment, it processes materials in a continuous stream. It was designed by McDonnell Douglas Astronautics Co., St. Louis, Missouri, which is conducting the experiment in collaboration with scientists of the Ortho Pharmaceutical Division of Johnson and Johnson Co. The experiment was flown as part of a joint endeavor agreement in which NASA and industry become partners in promoting development of advanced commercial products in space. The companies agree in advance to make the products derived from such experiments available to the public at reasonable cost.

Electrophoresis is a technique used to separate biological materials in a fluid according to their electrical charges as they pass through an electrical field. The process is used to produce many pharmaceuticals. On Earth, gravity-induced phenomena in the solution, such as settling and convection, limit the output and purity of materials produced by electrophoresis. In the near zero gravity of space, such limitations are largely removed. On June 30, Mattingly and Hartsfield reported that the materials used had been successfully separated in the Continuous Flow Electrophoresis System, supporting the potential use of this device in space to produce more, better, and lower cost pharmaceuticals.

In another experiment with many medical and scientific applications, STS-4 carried the Monodisperse Latex Reactor which performed successfully on STS-3. Some of the STS-3 experiments were used as "seed" items to test whether larger monodisperse (identically sized) microspheres could be produced in space. The size to which such spheres can be developed on Earth is limited because of Earth's gravity. Production in space may result in microspheres that will be widely used in calibrating instruments such as electron microscopes and in carrying precise amounts of drugs and isotopes directly to diseased or cancerous tissues.

Experiments Involve Crew

Mattingly and Hartsfield participated in two medical experiments, both of which were winning entries of the Shuttle Student Involvement Project of NASA and the National Science Teachers Association. One experiment was by Amy Kusske of Wilson High School, Long Beach, Calif., and the other, by Karla Hauersperger of East Mecklenberg High School, Charlotte, N.C. Mattingly's and Hartsfield's blood and urine were sampled before and after their flight. They recorded their food intake and exercise periods. Miss Kusske wanted to determine whether proper distribution of cholesterol in the body in microgravity requires strenuous exercise. Miss Hauersperger sought to know whether microgravity reduces chromium levels. A chromium deficiency decreases effectiveness of insulin and can produce diabetes-like symptoms. The biomedical laboratories at NASA's Johnson Space Center analyzed the blood and urine samples for both experimenters.



STS-4 lift-off.

First Getaway Special

STS-4 also carried the first Getaway Special, the popular name for the Space Transportation System's Small Self-Contained Payload Program. Customers anywhere in the world can purchase a Getaway Special for as little as $3,000 for scientific and technological experiments. Reservations are accepted on a first-come, first-served, space-available basis. Nearly 350 reservations from individuals, organizations and governments have already been booked from the United States and 14 other countries. Getaway Specials must operate automatically and require little attention in space.

The STS-4 Getaway Special was purchased by Gilbert Moore of North Ogden, Utah, for $10,000 and donated to Utah State University. Its nine experiments by university students covered such fields of microgravity as growth of fruitflies, brine shrimp, duckweed, and algae; testing the thermal conductivity of an oil and water mixture in a near-weightless environment; soldering; alloying; surface tension; and curing of composite materials.

A defective circuit prevented electrical power from reaching the Getaway Special. After several attempts to turn on the experiment failed, Mattingly and Hartsfield followed a technique devised by NASA engineers and described as comparable to "hot wiring" an automobile to start it without an ignition key. Anxious University of Utah students learned on June 29 that their experiment had been turned on and exultingly praised the crew, paraphrasing Apollo 11 astronaut Neil Armstrong as he first set foot on the Moon. They radioed: "One small switch for NASA; a giant turn-on for us."

Lightning Survey

Mattingly and Hartsfield took many still and motion pictures of lightning and thunderstorms viewed from orbit. This Nightime/Daylight Optical Survey of Lightning experiment was first conducted on STS-2, a two-day flight. The photographs will contribute to satellite weather forecasting techniques.

Shuttle's Environment Measured

The crew employed the huge manipulator arm in the cargo bay twice to lift and swing the Induced Environment Contamination Monitor (IECM) around the payload area to get information about particles, moisture, and gases in the bay that could affect experiments. The bay was facing the Sun during these experiments to gain maximum release of orbiter contaminants. When they first tried to use the arm on June 29, the crew saw a glowing trouble light, indicating that the snare-like end effector of the robot arm would not grasp the IECM. This turned out to be a false alarm.

Rain and Hail Precede Launch

STS-4 was the smoothest and most successful of the orbiter test flights. The flawless countdown was achieved despite pre-launch torrential rains and a hail storm which pitted and drenched *Columbia's* skin tiles. Before launch, technicians applied a hardening chemical to smooth and strengthen the tiles.

Getaway Special is installed in *Columbia's* payload bay for STS-4 mission.

Solid Rocket Boosters Lost

The two reusable solid rocket boosters were lost when they plunged into the Atlantic Ocean and sank in about 3100 feet of water. This was the first time the booster rockets were not recovered. "The only conclusion we can draw," George B. Hardy, Solid Rocket Booster Manager said, "is that the main parachutes failed to function."

Thermal Test Program Modified

The test program for the mission exposed parts of *Columbia* for prolonged periods to extremes of heat and cold. Originally planned exposures called for tail to Sun for 66 hours; bottom to Sun for 33 hours; and payload bay to Sun exposure of 5 hours.

These periods were altered because hail had damaged numerous tiles, allowing them to absorb water. Engineers were concerned that the water-soaked tiles might freeze and be further damaged. Consequently they oriented the orbiter allowing its rain-soaked underside to face the Sun—to dry the tiles by vaporizing the water. Temperature readings from instrumented tiles were used to verify that the affected tiles had dried completely.

While keeping the underside facing the Sun, Mattingly and Hartsfield continued their experiments and opened and closed the payload bay doors on the cold side of *Columbia*. One door failed to close properly during this procedure.

When a similar problem occurred during STS-3, it was corrected by rolling the orbiter to heat it evenly. By repeating this maneuver, Mattingly and Hartsfield were able to open and close the payload bay doors easily. This reassured the crew and engineers on Earth that structural warping responsible for the problem was a temporary difficulty and could be solved with relatively simple procedures.

ORIGINAL PAGE IS
OF POOR QUALITY

Message Beamed to World's Fair

Through a special radio hookup on July 1, Mattingly and Hartsfield addressed crowds at the World's Fair in Knoxville, Tennessee. "We are talking to you from *Columbia*," Mattingly said as he described the view over the Mississippi Valley and the coast of the Gulf of Mexico. Hartsfield said, "It's . . . fitting that we land on July 4 and celebrate—ushering in a new era just as our forefathers ushered in an era of democracy over 200 years ago on that same date."

Their comments were heard throughout the fair site over the public address system. The broadcast marked the opening of NASA's exhibit at the fair, which they will visit July 20 in their first post-mission public appearance.

"We're Setting Up Shop"

On June 27, after reaching orbit, checking out *Columbia*, and opening the payload bay doors, Mattingly reported: "Things look pretty nice . . . We're setting up shop."

They accomplished all they set out to do in a flight that had only minor problems. Turnaround time for the STS-4, the shortest to date, was 3 months—as compared to four months between STS-2 and 3 and seven months between STS-1 and STS-2. STS-4 was the first on-time launch—not only to the second but a fraction of a second ahead of schedule—10:59:59.8647 a.m. EDT, June 27.

Major systems operated satisfactorily in orbit. STS-4 carried the first commercial, military, and Getaway Special experiments.

Space Suit Modeled by Mattingly

The crew was kept busy with engineering and navigation tasks as well as hosting television cabin tours. On July 2, Mattingly tried on the new Shuttle space suit for the first time in space. Unlike previous space suits, it is not individually tailored for each astronaut. Mattingly wore the suit in the airlock leading to the open payload bay but did not open the bay door.

The suit may be used on STS-5, the first operational flight, which will launch two commercial communications satellites. For STS-5, *Columbia* will carry a crew of four: Vance D. Brand, commander; Robert F. Overmyer, pilot; and Joseph P. Allen and William P. Lenoir, mission specialists. STS-5 is scheduled for launch in October, 1982.

Columbia Encounters Space Traffic

At 3:02 a.m. EDT, July 3, *Columbia* sped past the spent upper stage of a rocket used to orbit a Soviet satellite in 1975. Although they came within eight miles of each other, they were never in danger of collision. The crew didn't sight the other object. "You'd have to be watching exactly the right place at exactly the right time and not blink," Harold Draughon, a flight director, explained. The North American Defense Command (NORAD) which tracks sizable objects in Earth orbit reported there are more than 4,500 satellites and other man-made objects orbiting our planet.

Return to Earth

Columbia's reentry into the atmosphere and its return to Earth were planned to be more rigorous than previous flights. This was done to generate more heat to test its thermal-resistant structure and protective tiles. The crew also tested Columbia's ability to stabilize itself after rapidly pitching its nose up and down.

Columbia landed for the first time on a concrete runway approximately 300 feet wide and 15,000 feet long. "Which," according to Flight Director Draughon "doesn't go on forever the way lakebed runways do." The previous three orbiter mission landings were on dry lakebeds.

"We now feel confident about landing on the hard-surfaced runway at Kennedy Space Center," Major General James A. Abrahamson, NASA Associate Administrator for Space Transportation Systems, said following the STS-4 landing. Plans call for most operational Shuttle missions to land at Kennedy Space Center's concrete landing strip.

View of mission operations control room, NASA Johnson Space Center, Houston, Texas, during STS-4.