

Pathfinder opens second age of Mars exploration

by Marsha Freeman

The successful July 4 landing of the Pathfinder spacecraft on Mars brought jubilation to the scientists, anxious to start the second era of Mars exploration, following the 1976 Viking missions; to the engineers, who worked for three years to design, build, and navigate the spacecraft through its 7-month, 309-million-mile journey; and to the millions of people around the world, who watched this wondrous feat of science and engineering live on television, or on their computer screens.

The mission was performed under tight constraints of budget and time, with a \$150 million funding cap for the lander (minus the rover), and a three-year deadline. Because with current technology, there is only an opportunity to launch a spacecraft from Earth to Mars every 26 months, the project had to be precisely on time. It was successful, not because of the budget-constrained "faster, better, cheaper," mantra now guiding the U.S. space agency, but thanks to the dedication, ingenuity, and tenacity of the scientists and engineers, who were determined to return to Mars.

Over the next ten years, NASA has a series of unmanned missions planned to explore the south polar region of Mars, penetrate the soil, deploy rovers to gather rocks, and, in the year 2005, bring back samples for detailed examination. All of these missions, and more, are necessary, before people can be sent on a journey to Mars. But also necessary is the development of the next generation propulsion, life support, radiation protection, and other technologies that deploying manned missions will require. Such development is not within the bounds of a "balanced-budget" space program.

Comprehensive plans for the scientific and human exploration and colonization of the Moon and Mars have been put forward for 50 years, by, most notably, Wernher von Braun, Krafft Ehrlicke, Tom Paine, and Lyndon LaRouche. The tens

of millions of people who watched this magnificent mission, and shared the excitement and joy of the scientists and engineers, will have to make their voices heard if the manned exploration of space is to become a reality. Pathfinder has made a magnificent start.

Highlights of the mission

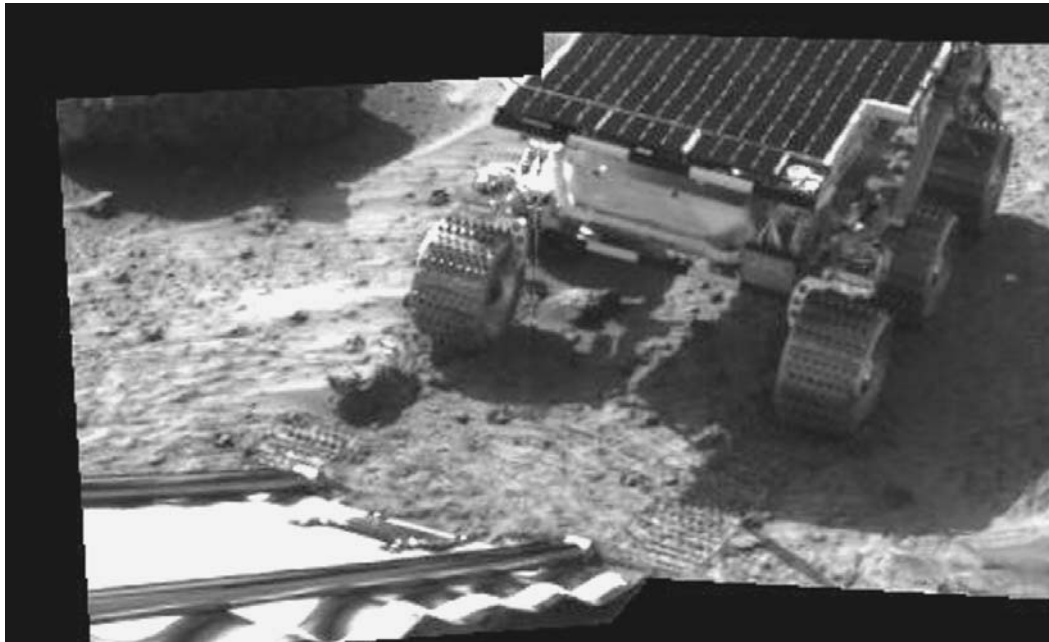
July 4: At 1:05 p.m. EDT*, engineers at the Jet Propulsion Laboratory (JPL) notice a change in Pathfinder's carrier signal, indicating that the parachute used to slow the descending spacecraft, has opened. Three minutes later, it is announced from a jubilant mission control that the spacecraft has successfully landed on Mars.

By 5 p.m., mission control ascertains that Pathfinder has landed on its base petal, and there is no need for it to turn itself over. A signal is received indicating that the air bags deflated and retracted, and that the petals are open. A few minutes later, the first transmission from Pathfinder is received on Earth, saying basically, "I made it, and everything is okay."

At 5:37 p.m., Vice President Al Gore calls in to a press conference being held at JPL, to congratulate the Pathfinder team "on behalf of President Clinton and all of the people of the country."

President Clinton releases a statement which says in part: "On this important day, the American people celebrate another exciting milestone in our nation's long heritage of progress, discovery, and exploration: the first landing on the surface of Mars in over 20 years. . . . I congratulate the Mars Pathfinder team at NASA and the JPL for their pioneering vision and spirit in accomplishing this remarkable feat. Their success in developing the Pathfinder mission is a testament

* All times are Eastern Daylight Time.



The rover Sojourner, on July 5, descends from the Pathfinder to the surface of Mars.

to the ingenuity and ‘can do’ attitude of the American people.”

At about 7:30 p.m., the first pictures from Mars reach the Earth, showing hills and mountains, and a diversity of rocks and soil. At 9:30, scientists report they will have to instruct Pathfinder to lift a petal and further deflate an air bag, which is interfering with the deployment of the ramp for the Sojourner rover. This is performed successfully.

July 5: At 1 p.m., scientists report that data during the downlink from Pathfinder showed that communications between the rover and lander are “degraded,” but they are confident they can solve the problem via commands to the lander. Images from the lander show the rim of a crater, mountains on the horizon, and more dust than expected.

By 8 p.m., scientists report that they have just completed a session of downlinking data from Pathfinder, and the communications problem has been solved.

July 6: At approximately 1:40 a.m., Sojourner drives off the rear ramp of the lander, becoming the first mobile spacecraft on the Martian surface. It rests about 10 cm from the end of the ramp, and will take measurements of the composition of the soil through the Martian night.

At 1 p.m., scientists announce that after studying the first photographs from Pathfinder, they have decided to send Sojourner to a rock they named Barnacle Bill, due to its bumpy appearance. They marvel at the diversity of rocks in Pathfinder’s field of view, and note twin peaks in the distance that appear to be layered or terraced, and rocks likely rounded by the action of rushing water.

The first weather report is presented by meteorologists, who announce that at night, Mars’ temperature plunged to -65°F , and rose to about $+8^{\circ}\text{F}$ mid-day, with moderate winds.

July 7: As reported at 1 p.m., Sojourner successfully

placed its alpha proton X-ray spectrometer up against Barnacle Bill, and was taking measurements. With the lander camera fully deployed, more accurate measurements are being taken of the distance of objects near the horizon, and new targets for rover investigation.

The images show small channels, and scientists believe they see a crusty material, which could be salts left after pools of water evaporated, following a flood. Pathfinder has returned more than 1,000 pictures to Earth.

July 8: Initial analysis of data sent back from Sojourner’s interrogation of Barnacle Bill indicates a composition similar to rocks on Earth, primarily iron and silicon, bound up with oxygen, and combined into minerals such as feldspar and quartz. Scientists have come to no agreement as to the origin of the rocks, although the presence of silicate indicates repeated melting and remelting. High resolution photographs and spectrographic techniques on the lander will be used to further study Barnacle Bill, and other targets of intense scrutiny.

July 9: Scientists report that multi-spectral reflectance measurements will be taken of Barnacle Bill, Yogi, and other Sojourner targets, to provide additional data to help determine the rocks’ origin.

A high-resolution “monster panorama” produced by the lander camera reveals a rock that is cracked, small canyons, and other evidence of the action of water on the terrain. When asked by a reporter how scientists will determine the history of the rocks, Dr. Jeff Johnson replies, “We make hypotheses, make a plan to test them, and then go on” with our work.

The scientists often repeat that it will take days, weeks, even years, to understand what they will receive back from Mars, via Pathfinder.