

The comeback kids

NASA's Jet Propulsion Laboratory practically invented planetary exploration. Then, in 1999, it lost two craft in quick succession. Tony Reichhardt meets the staff behind two new Mars rovers, which could restore the lab's reputation.

Those working on this year's Mars missions probably want to forget the precedent set by previous attempts. More than half of the 31 craft sent to Mars since 1960 have failed, including six of the last ten. "This is a very unforgiving business," says Richard Cook, an engineer at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California. "We're still in the phase where landing on Mars is a miracle every time."

Cook knows just how unpredictable planetary exploration can be. In 1997, at the age of 32, he was flight operations manager for Mars Pathfinder — the first craft to land on the red planet in two decades. Two years later, he was project manager for the Mars Climate Orbiter and the Mars Polar Lander. The first of these veered off course because of a mix-up over imperial and metric units; a software error sent the second crashing into the planet. After contact with the lander was lost, Cook's glum face appeared on television every night, waiting for a signal that never came.

After the losses, the staff of a lab that had built pioneering spacecraft that journeyed to the edge of the Solar System were cast as a bunch of incompetents. "It caused a lot of soul-searching," says Steve Squyres, a planetary scientist at Cornell University in Ithaca, New York. But NASA kept faith, choosing JPL and its staff, including Cook, to develop its two Mars Exploration Rovers. As launch dates for the rovers approach — 5 June and 25 June provisionally — morale at the lab is high, even if the pressure is on. "This is the best team that I have ever seen at any JPL project," says Squyres, who is principal investigator for the rovers' science package. "We all feel like we must succeed."

Staff at the lab say that the challenge of the new mission has prevented them from dwelling on the past. Joy Crisp, project scientist for the rovers, has indirect knowledge of the pain caused by the lost missions — her husband, David Crisp, was a project scientist for the Mars Polar Lander. "The complexity of these new missions is amazing," she says.

This time there will be two rovers instead of one, each travelling many times the 100 metres that Pathfinder ventured from its landing site. Improved scientific instruments will also allow more detailed studies of rock chemistry and mineralogy. Crisp coordinates the roughly 100 scientific staff who will use these instruments. They will meet twice daily to weigh up their research objectives and sta-



tus reports before deciding what to do next.

JPL staff have also been kept busy planning how to deal with working in martian time. Rover operations start at the crack of the martian dawn, but a day on Mars is 24 hours and 37 minutes long. Shifts and meeting times at JPL have to move forwards by 37 minutes each day to stay in sync, and staff have to try to adjust their lives accordingly. Project managers worry about 'martian jet lag', and have brought in experts on fatigue to advise them on how to arrange work shifts to avoid burn-out. Crisp lived on martian time for the 30 days of the Pathfinder mission. "That's about as much as you'd want to do," she says.

Matters might be better if the team were heading into the landing well-rested. But Squyres says that the project's timescale has been "absolutely brutal". As well as worrying about every last bolt and wire on the spacecraft, the team has rehearsed whatever operations it can ahead of time. Four times,

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Ready for action: the team behind NASA's rover mission to Mars includes Joy Crisp and Richard Cook (insets), and Steve Squyres, seen here testing a model rover in the desert.

scientists have conducted practice sessions with mock rovers in the deserts of the American southwest. By orchestrating its procedures before the rovers reach Mars, the JPL team hopes that it won't waste precious time debating which rock to examine next, how best to drill into it, or what images to take.

The practice runs may have been tiring, but Crisp says that they feel much more prepared this time. Even though Pathfinder was a success, she says, "we felt like we were winging it" after it landed on the martian surface. That might have been acceptable for Pathfinder, which was primarily intended as a technology demonstrator. But it won't be acceptable for the rovers, which need to do more than just touch down in one piece. "If all we do is land," says Squyres, "we don't score any points at all."

And so the researchers head towards the launch pad acknowledging the pressure, but not allowing themselves to be overwhelmed by it. Cook is philosophical. "The line between success and failure is very thin," he says. "You are literally dependent on 10,000 things going exactly right, and if you're wrong on one of them, that can be it." ■

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