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Mars Up Close: Scott Murchie's team of scientists helps uncover the secrets of the red planet

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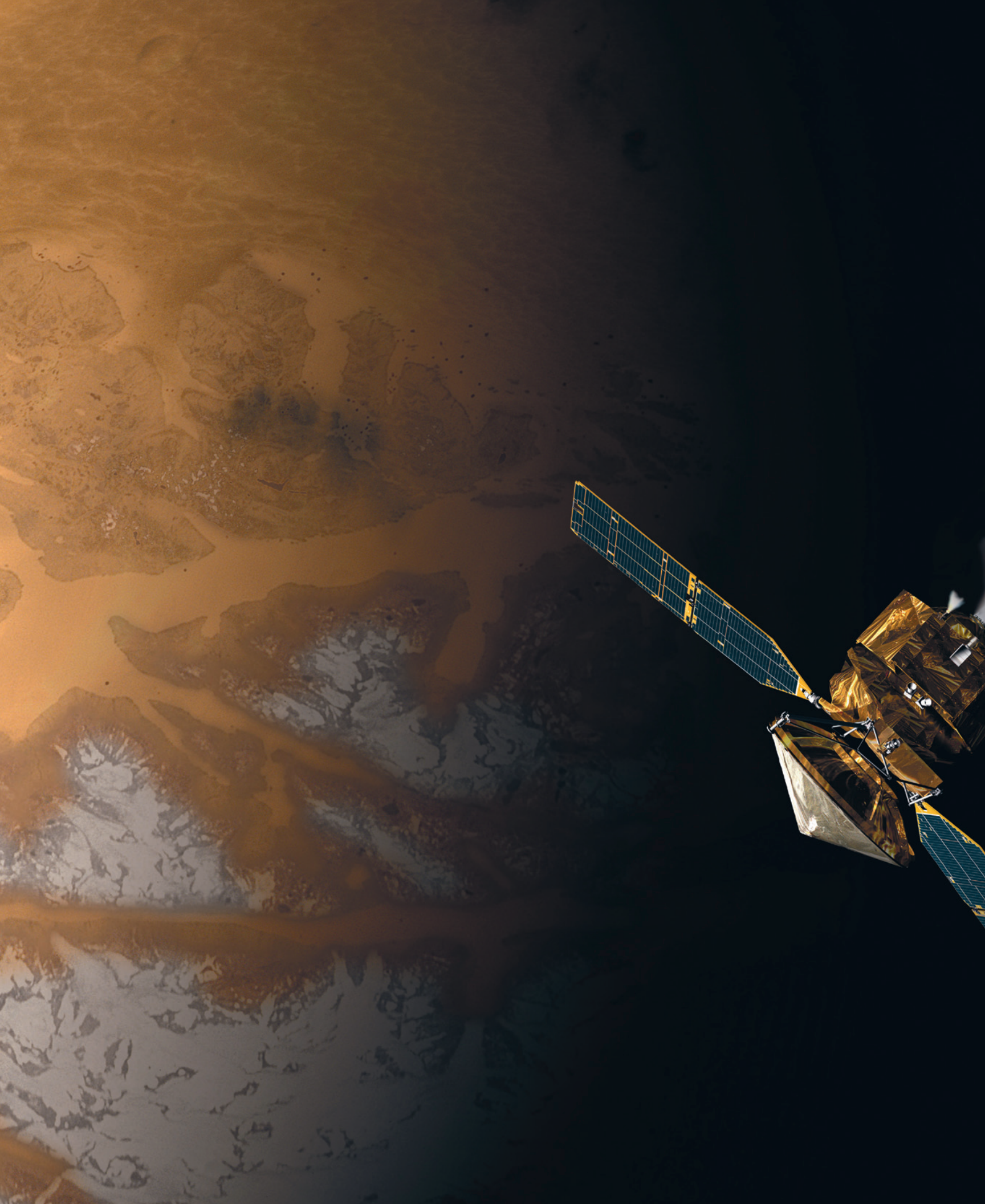
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MARS UP CLOSE

Scott Murchie's team of scientists helps uncover the secrets of the red planet

By Tom Nugent

After a 12,000-mile-an-hour descent through the Martian atmosphere, the unmanned Phoenix spacecraft settled gently onto the planet's surface. Watching a live webcast in Maryland that Sunday evening in May, planetary geologist Scott Murchie '81 breathed an enormous sigh of relief.

Like the elated NASA executives on the computer before him, Murchie was feeling "a whole lot of excitement and euphoria" as the tiny spacecraft deployed its solar panels and geared up for the historic excavation project that lay ahead.

As the principal investigator for NASA's Compact Reconnaissance Imaging Spectrometer for Mars (CRISM), one of the optical instruments that has been peering at the red planet from space, the former Colby geology major played a role in choosing the site (on the frigid flatlands of the planet's arctic circle) in the months leading up to the rocket-assisted descent. Murchie, 48, spent the past year and a half studying high-tech snapshots of the Martian surface taken with a powerful camera that is aboard the U.S. space agency's Mars Reconnaissance Orbiter (MRO).

His team of NASA optical specialists used the imaging spectrometer to look for mineral fingerprints that might have been left behind by water during the planet's remote past. The images, and others, also were used by the team to pinpoint an ideal landing spot for Phoenix above the planet's buried ice.

Based on powerful evidence from earlier Mars flybys, Murchie and most other space scientists are convinced that vast quantities of liquid H₂O once covered portions of Mars, helping to create the environmental conditions required for life. During the next few months, Phoenix will root through the Martian soil in an effort to retrieve some of the ancient ice so that it can be analyzed for signs of microbial life from eons ago.

Armed with the high-powered CRISM and directing a team of more than 30 scientists affiliated with major U.S. universities, Murchie now is engaged in what he describes as a "truly thrilling task"—taking specialized photos that could play a key role in determining whether mineral deposits on Mars were formed in

water, which could have provided habitat for life.

It was the CRISM images that helped put Phoenix on Mars. Images from the same orbiting camera (200 gigabytes worth and counting) are playing an even more central role in determining the landing site for the Mars Science Laboratory, a nuclear-powered, Hummer-sized rover that is scheduled to land on Mars in 2010. The mission: to look for preserved organic carbon and other evidence of biological processes that may have taken place on Mars in the past.

"It's really the first time since the Viking lander [in 1976] that a lander has gone down on Mars looking for evidence of biology," Murchie said.

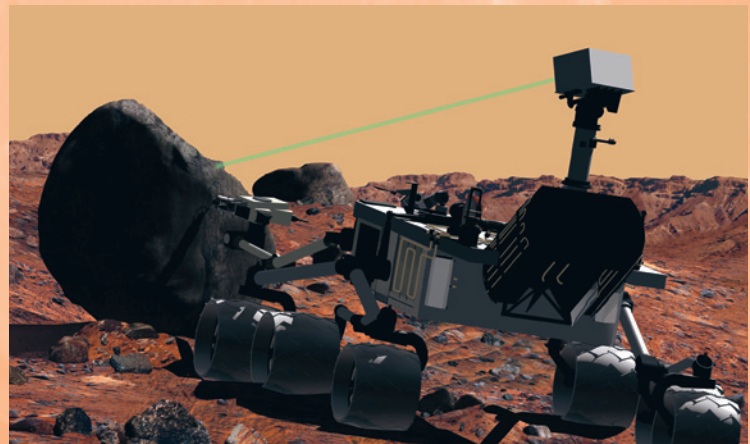
Murchie helped design CRISM at The Johns Hopkins University's Applied Physics Laboratory (APL) in Maryland, where he's been doing planetary science since 1994. The camera can take pictures in more than 500 colors to help locate minerals that might show evidence of water in the past, says the veteran investigator. "These mineral traces are important," he said, "because they tell us about habitability—about whether liquid water existed at some point during the past few billion years on Mars.

"We've taken thousands of photos of such minerals by now, and we've found lots of evidence—everything from clay deposits to sulfates and other mineral traces—that Mars once had the kind of environment you would need for life. That doesn't confirm that life actually ever *existed* there, of course, but it does suggest that organic creatures, including bacteria and other microbes, were certainly possible."

Murchie points out that scientists won't know for sure until they bring some Mars rock and soil samples back to earth "and throw entire buildings full of chemistry instruments" at them. "I do think we're getting closer all the time to answering the question of whether we're alone in the cosmos," he said. "As a scientist—as a human being—I think this is a very exciting time to be alive, and I can hardly wait to see where all of this space exploration is going to take us next."

Murchie's own scientific exploration began in his boyhood in rural Massachusetts.





Scott Murchie '81, seated at right above, celebrates with his team at the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) operations center at The Johns Hopkins University Applied Physics Laboratory in 2006. The team had just learned that the cover on CRISM had opened, allowing it to begin collecting images of Mars that are being used in investigations to determine whether elements necessary for life existed on the planet. At right is the Mars Science Laboratory, the car-sized rover scheduled for launch in 2009.

Raised in Leominster, west of Boston, Murchie is the son of a woodworker and an office secretary. Their own parents hadn't been able to afford to send them to college, but Murchie's mother and father were determined their son would get there. "They were adamant about that, and my mom was already bugging me about getting ready for college when I was in the first grade," Murchie said with a chuckle. "But their interest in books and in learning really got me started down the educational path, and I'm still very grateful for that."

In fact, Murchie says his interest in geology got its start during long walks with his father. "Our New England neighborhood was full of stone walls, and when I was four or five years old my dad pointed out to me that the walls contained many different kinds of rocks, and I think my natural curiosity just took over from there."

Murchie's growing interest in geology took a giant leap forward in the late 1970s at Colby. After arriving on campus for his freshman year in the fall of 1977, he found a "terrific mentor" in the legendary Dana Professor of Geology (Emeritus) Donaldson Koons, who chaired the department from 1947 to 1982. "Dr. Koons was a passionate teacher who really pushed you to the limit," Murchie recalled. "He taught the most eye-opening course I took at Colby, which was called Glacial Geology, as I remember. And our major assignment that semester was to study the giant ice cap that had once covered all of northern North America."

"Our instructions were to drive way out in the really serious backwoods and look for the kinds of rock and sand deposits that had been left behind when the glaciers melted. We got turned loose on a three-hundred-square-mile area of northern Maine, and hiking through that rugged wilderness was a great introduction to the rigors of science."

After collecting his geology B.A. in 1981, Murchie went on to earn a Ph.D. at Brown in 1988, focusing on the relatively narrow field of planetary geology, in which scientists study geological processes occurring on other planets in the solar system.

Through a mentor at Brown, Murchie then landed a post-

doctoral fellowship with the Soviet Union-sponsored Mars landing mission, Phobos II. That vehicle successfully reached the planet but vanished in the late 1980s.

Murchie's career, meanwhile, was on an upward trajectory.

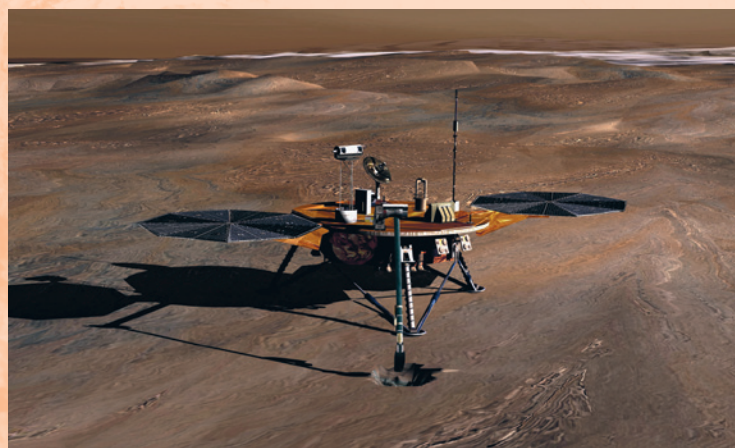
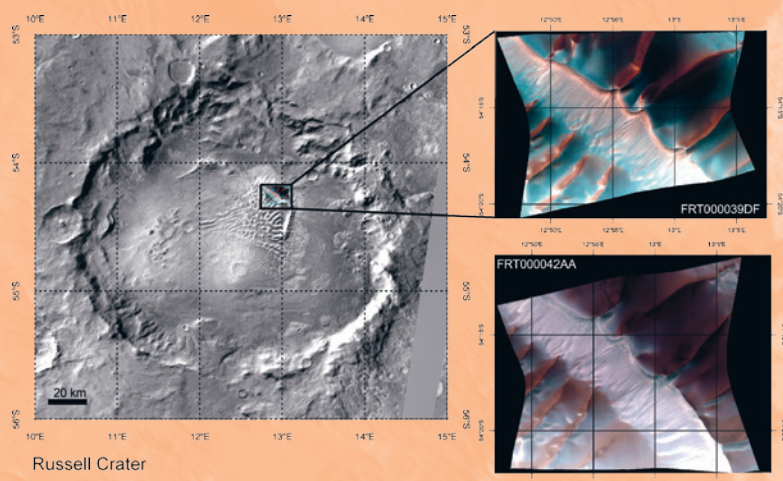
Based on his growing knowledge of Martian geology, the Johns Hopkins University Applied Physics Lab hired him in 1994 to work on a series of planetary missions. He studied the structure of planetary crusts, asteroids, and worked on exploratory missions like Mars Pathfinder and New Horizons. "My interests are broad," Murchie said, "but have always focused on Mars."

These culminated in his appointment as principal investigator on CRISM in 2001.

Drop by Murchie's sprawling, computer-jammed laboratory at the APL on a typical weekday afternoon, and the odds are high that you'll find him leafing through giant cyber-maps of such intriguing Mars locales as the West Candor Chasma and the Nili Fossae Trough. At this point CRISM has already mapped more than half of the planet and made more than 6,500 high-resolution observations of the Martian surface, Murchie said, leading a brief tour of the buzzing facility.

"The orbiting camera we use for all of this has a pretty fancy name—imaging spectrometer—but it's really just like any other camera, with one major difference: CRISM takes its images in five-hundred forty-four colors that are reflected in sunlight. Its highest resolution is about twenty times sharper than any previous observations ever made in the near-infrared wavelengths, which is why CRISM has been discovering more about Mars than any other instrument yet flown to the planet."

In spite of the project's undeniable success at gathering knockout images of the Martian landscape, however, Murchie is philosophical about the attention—or lack there of—that CRISM got from the mainstream news media. "The problem is that we don't have the glitz of a Mars rover," Murchie said, describing the widely publicized Mars Exploration Rover (MER) landings, in



Images above were taken by the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) now orbiting the planet. The spectrometer takes the sharpest pictures of Mars ever, including, in these images, showing carbon dioxide frost in Russell Crater. At right is the Phoenix unmanned spacecraft, now collecting and analyzing samples of Martian ice.

“Its highest resolution is about twenty times sharper than any previous observations ever made in the near-infrared wavelengths, which is why CRISM has been discovering more about Mars than any other instrument yet flown to the planet.”

—Scott Murchie '81, CRISM Principal Investigator

which two frisky, wheeled robots zipped across the Martian surface to delight millions watching MSNBC and CNN.

“Don’t get me wrong. The rovers do great science, but because they’re dune buggies, they often seem to get all the attention. Driving a dune buggy across the surface, as opposed to just taking pictures ... well, I guess that’s *sexier*.”

Prosaic as a camera may appear to some rover fans, however, the story of how CRISM has been snapping all those high-resolution photos of the Martian surface in recent months is thrilling, in Murchie’s view. Launched in August 2005 from Cape Canaveral in Florida, the big camera hitched a ride aboard the Mars Reconnaissance Orbiter for the more-than-300-million-mile journey. It now orbits Mars, looking down on the planet’s red deserts, jagged meteor scars, and underground ice.

What CRISM has been doing most of the time is looking for areas of Mars that were once wet enough to leave behind a “mineral signature on the surface,” Murchie said. The camera is searching for the spectral traces of aqueous and hydrothermal deposits—while at the same time mapping the geology, composition, and stratigraphy of the surface features.

“One of the most exciting features of this powerful camera,” he said, “is that it can clearly observe areas—from a distance of about one-hundred ninety miles—that are no more than sixty feet across, which means that it can see and then photograph objects that are no larger than a typical house. And that’s a fabulous resource if you’re interested in learning about things like topography and rock formations and soil structure.”

After nearly two years of studying the planet in detail, Murchie says the evidence shows clearly that Mars must have contained “a great deal of liquid water” at some point, and that it “could easily have provided a habitable environment for life as we know it to have evolved on the Martian landscape.”

Ask him to reflect on the philosophical implications of life on Mars, and this avid gardener (he raises viburnums and other American trees and shrubs at his rural spread in Mt. Airy, Maryland) will tell you that he isn’t troubled at all by the thought that we may not be alone in the cosmos.

“I’m a scientist, but I also like to think that I’m a religious person,” said Murchie, who often teaches Sunday school at his local Methodist church. “I think both ways of seeing reality are valid, and I don’t have any problem at all with the idea that there might be life elsewhere in the universe.”

Then, pausing over his cup of cooling Dunkin’ Donuts coffee, he breaks into a smile. “Did you see *Contact*, that film with Jodie Foster about life in another galaxy, and she discovers it with a radio telescope?

“She has this great line in the movie that I’ve never forgotten, where she asks somebody: ‘Wouldn’t it be a *waste*—if the earth turned out to be the only place in the cosmos where there was life?’

“I think that’s a great way to think about the possibility that we may soon discover evidence of past microbial life on Mars, and I’m delighted to be doing my little bit to help solve the puzzle by taking pictures of rocks.” 