AUSTRALIAN ALMANAC Vol.3 No21

Curiosity Will Drive Us To Understanding a New Mars

August 10. 2012

by Marsha Freeman

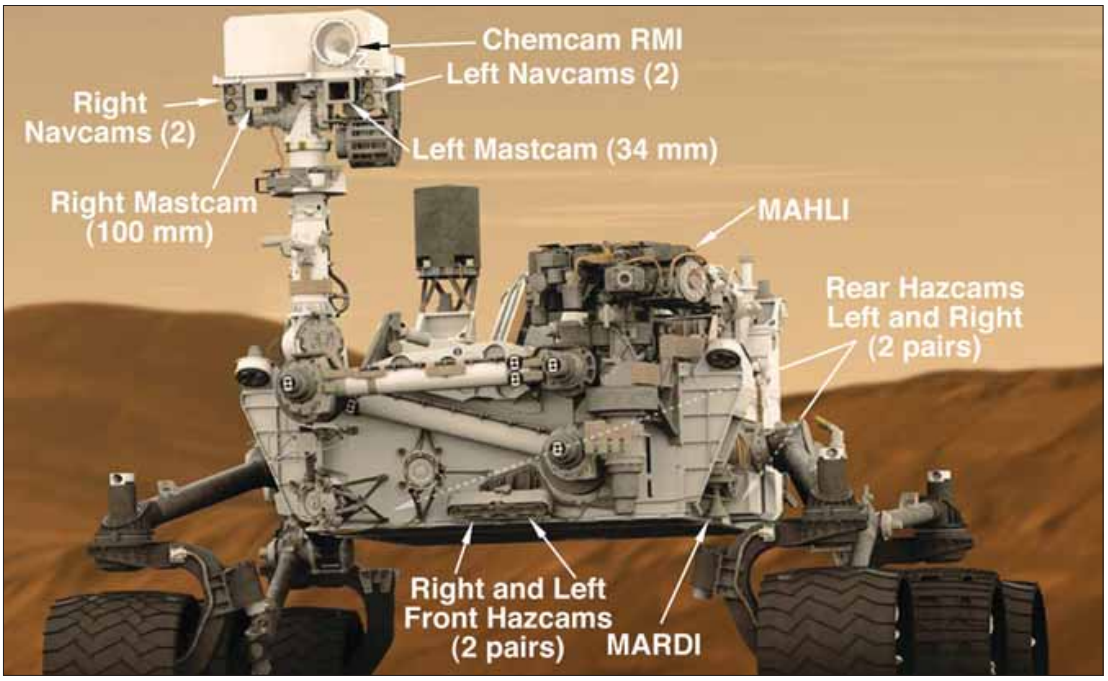
The successful landing of the Mars Curiosity rover early on August 6th opens a new chapter in what has been a continually re-written history of Mars. Curiosity's current mission builds upon a 50-year legacy of breakthroughs in planetary exploration. The planet Mars has undergone dramatic changes over billions of years, in its geology, chemistry, topography, hydrology, and atmosphere. But in the past few decades, Mars has undergone *revolutionary* changes, in the mind of man. Through a carefully crafted series of unmanned missions to the red planet, man has sent increasingly complex representatives of his extended sensorium, to observe and probe a planet that might have supported life. It is we who have "changed" the planet Mars.

From Earth-based telescope observations, Mars was thought by Italian astronomer Giovanni Schiaparelli in 1877 to have "channels," then mistranslated to "canals," and proposed to have been built by intelligent beings. But man's first preliminary look at Mars from quick fly-bys of the planet in the mid-1960s, revealed what disappointingly looked like the lifeless Moon—barren, dry, cold, bombarded for milllenia by asteroids and comets, devoid of any possibility that there could have been life.

Then, in 1971, Mariner 9 orbited the planet for the first time, and for almost a year, took a closer look. It showed us a new Mars. Here was a planet that has the largest volcano in the Solar System; channels and dry lake beds, most likely formed by liquid water; indications of a warmer past for Mars, and an environment that could possibly have been hospitable to life. From the Mariner 9 results, an ambitious Viking mission was planned, to, for the first time, land spacecraft on the surface of Mars, to carry out an *in situ* investigation of this increasingly mysterious place.

Looking for Life

Viking's mission, launched in 1975, was an extremely ambitious one: to look for evidence of life on Mars. Based on a very preliminary understanding of the complex chemistry and other features of the planet, Viking's scientific instruments, investigating Mars' surface, could only provide



The *Curiosity* rover is the size of a small 4WD—far larger than previous Mars rovers. It is a mobile laboratory, equipped with leading-edge camera and analysis technology, and a laser beam. MAHLI is the Mars Hand Lens Imager, which can take very high-resolution colour photos of rocks and surface materials.

contradictory results as to whether or not organic material, which could indicate the presence of past or present life, were found. The "consensus" in the scientific community, that no indication of life was found by Viking, put on the back burner plans for any future missions to pursue the direct detection of life. But interest in understanding the red planet—the one most similar to Earth—suffered only a temporary hiatus. If life never did exist on Mars, "why not" would be as important a question to answer as, "how did it?" Scientists stepped back from the "life" question, to begin a campaign to gain a more comprehensive understanding of Mars.

"Follow the water," based on the proposition that liquid water is prerequisite for life, became the theme for the next two decades. Mars Global Surveyor, launched in November 1996, arrived at the red planet in September the following year. Just four days after being inserted into orbit around Mars, the spacecraft discovered a remnant magnetic field there, possibly a requirement for life. Over its nine year mission, the orbiter discovered extensive layers in the planet's crust, ancient deltas, channels which appear to exhibit relatively recent activity, minerals that form under wet conditions, and it served as a communications relay for the Mars Exploration rovers, Spirit and Opportunity.

Just a few months earlier, on August 7, 1996, scientists announced a stunning observation. They had been given a gift—a piece of Mars that had been ejected from the planet billions of years ago, eventually to land in Antarctica. Meteorite ALH84001, (a piece of which can be seen in the National Museum of Natural History, in Washington, D.C.) was found to contain carbonates, and tiny structures, evocative of miniscule worm-like creatures on Earth. Although, still today, the debate continues over whether ALH84001 contains fossil evidence of life on Mars, the Mars meteorite helped to spur on the next series of Mars missions that were being planned.

On July 4th, 1997 the first lander on Mars in two decades, and the first-ever rover, made it to the surface of the planet. The Pathfinder mission, and its diminutive, 25-pound rover, Sojourner, were designed mainly as a technology testbed for more complex future missions, but contributed our first up-close look at the surface since Viking. Pathfinder sent back extensive data on wind and weather on Mars, more than 17,000 images, and more than 15 chemical analyses of rocks and soil.

After two mission failures in 1998 and 1999, the next U.S. craft to arrive at Mars, in 2001, is the one that, today, is the prime communications relay satellite for Curiosity data to be sent to Earth—Mars Odyssey. Early on, its gamma-ray spectrometer provided strong evidence for large quantities of frozen water, mixed in to the top layer of soil, near the north and south poles. Later, a site in this region was chosen as the target for the near-polar Phoenix Mars Lander.

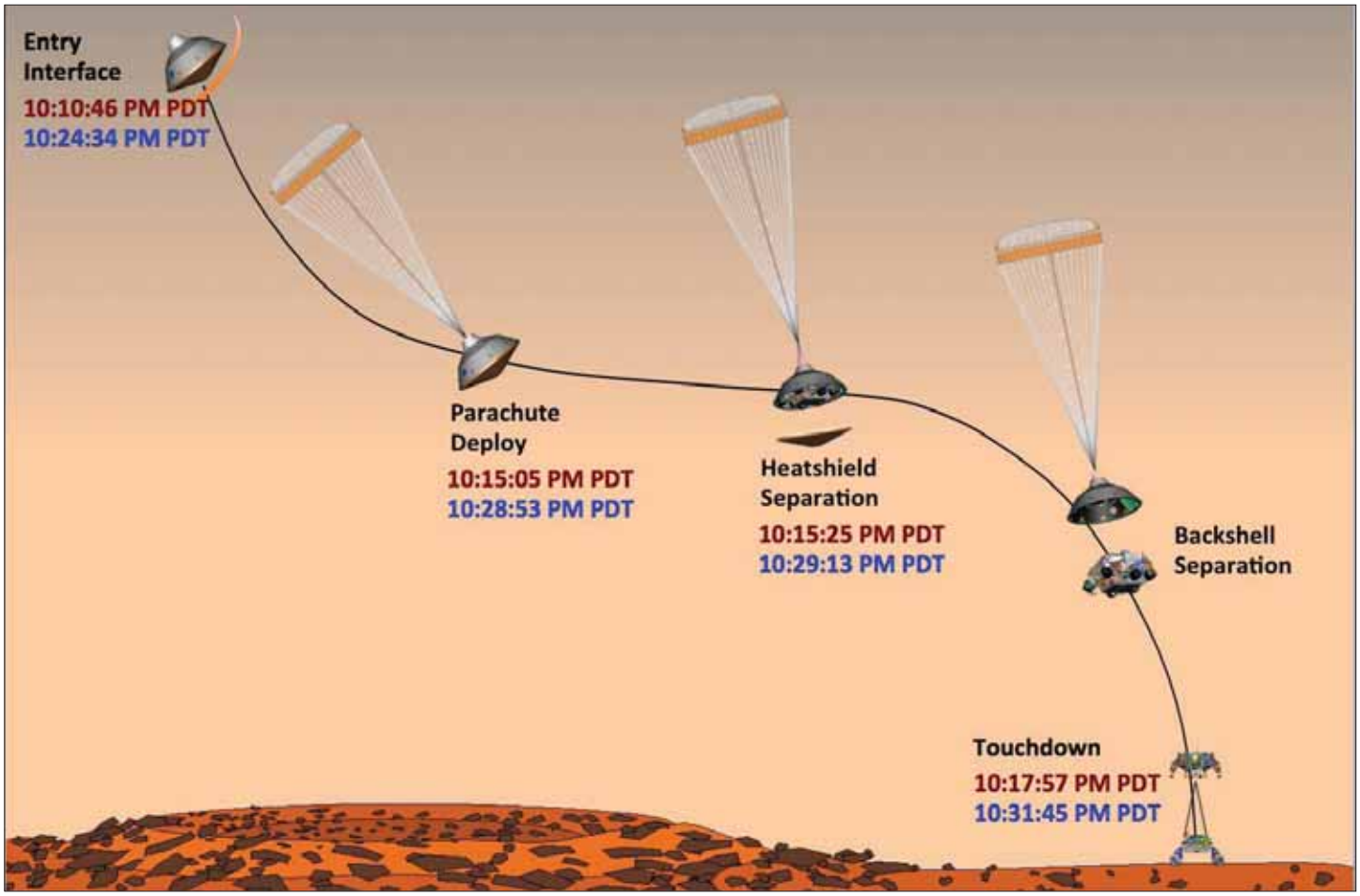
Odyssey's cameras have identified minerals in Martian rocks and soils, and compiled the highest-resolution global map of Mars. Its observations helped identify potential landing sites for the Spirit and Opportunity rovers, the Phoenix lander, and Curiosity. For over a decade, Odyssey has monitored the atmosphere of Mars, which data was critical for predicting the possible range of weather conditions, during Curiosity's highly-complex landing.

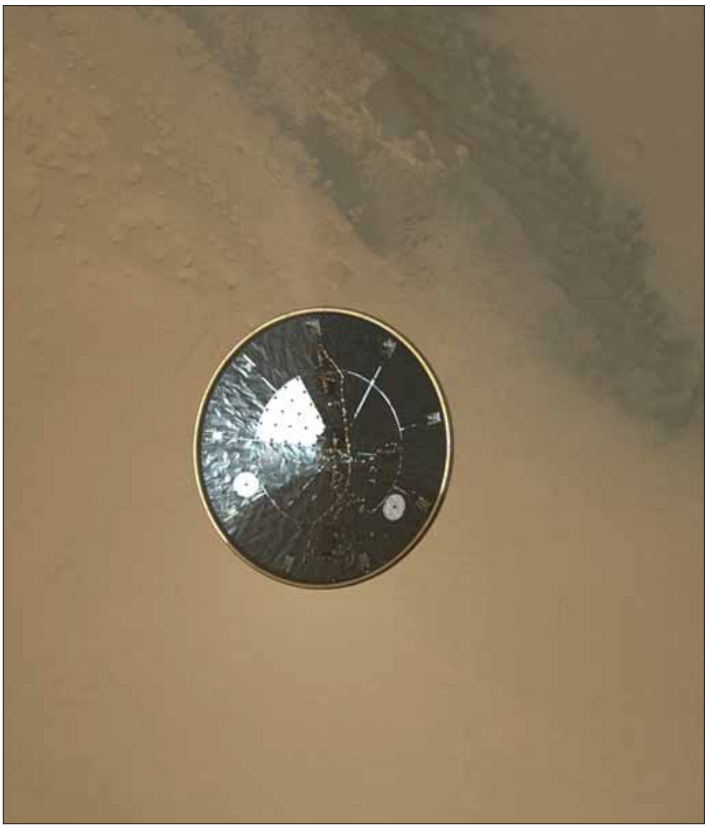
Spirit and Opportunity, Mars' first mobile field geologists, landed in early 2004, and confirmed the past presence of liquid water on Mars. During its investigation of the Columbia Hills, Spirit discovered rocks and soils bearing minerals providing evidence of extensive exposure to water. Opportunity's findings were a clincher: inside a small crater, the roving geologist examined an outcrop of bedrock. Not only had the rocks been saturated with water, but they had been laid down under the surface of gently flowing water. The presence of the mineral hematite, which had been identified from orbit by Mars Global Surveyor, was verified by Opportunity. Some hematite presented itself in the form of nearly-perfect spherical shapes, termed "blueberries" by the scientists, likely formed in flowing water.

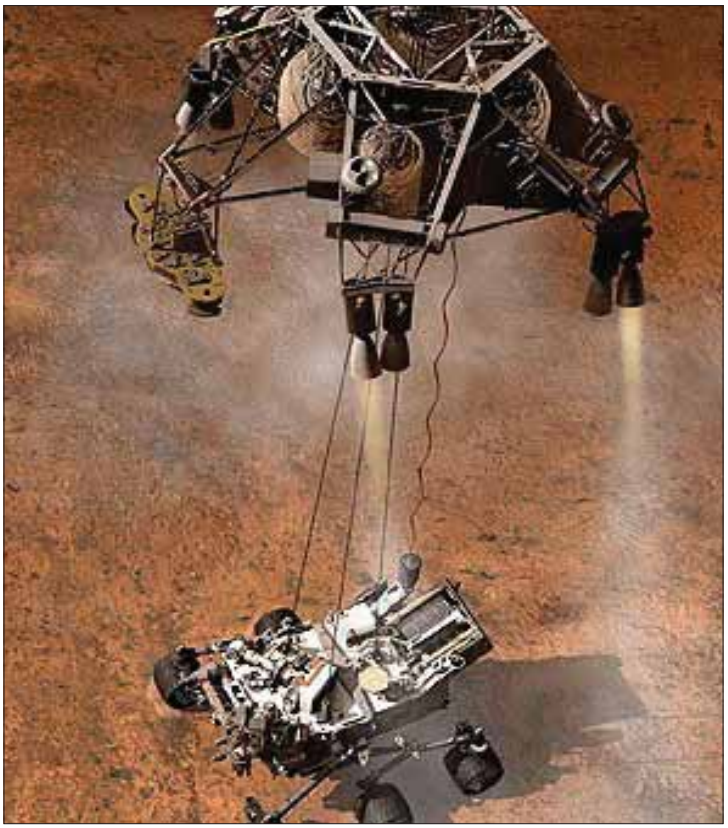
Following the excitement of the "new" Mars that was taking shape, the European Space Agency (ESA) decided to embark on its own Mars exploration program, and in June 2003, ESA's Mars Express went in to orbit around Mars. The spacecraft has been able to identify deposits of clay minerals, similar to what Curiosity will encounter at Gale Crater, indicating a past wet environment. One intriguing observation by Mars Express was the detection of methane in the atmosphere. Since methane from the past would break down too rapidly to be detectable in the atmosphere today, it is apparently still being produced there. Although there are various ways that methane can be produced on Mars, one is by life.

Since 2006, the Mars Reconnaissance Orbiter (MRO) has been on station. It is now beaming back data from Curiosity. MRO has shown us three distinctly different time periods of Mars, and that Mars is still a dynamic world. It has observed dust storms, new craters, and avalanches. MRO has tracked the cycling of water from Mars' poles through its atmosphere, shown the effect of cyclical variations in the tilt of its axis of rotation, and deep deposits of carbon-dioxide ice buried in the solar cap. In 2008, the Mars Polar lander verified deposits of underground water ice, first detected by Mars Odyssey from orbit. But its ground-breaking surprise observation was the detection of perchlorate, which is food for some microbes, and a chemical that can lower the freezing point of liquid water, perhaps enough to allow liquid water to exist in otherwise below-freezing environments.

The team of more than 700 scientists around the world who have conceived Curiosity have waited nearly a decade for the mission's realization. In April 2004, NASA announced an opportunity for researchers to propose science investigations for the mission. Eight months later, NASA announced the selection of eight experiments, and also scientific investigations, through international agreements, by Spain and Russia. Over the next few weeks, their wait will be over. It is the past discoveries about Mars, and the infrastructure that has been built in orbit around the planet over decades,







Top: The timeline of the very technical landing of Curiosity. Above left: A photo of the inside surface of Curiosity's heat shield, three seconds after it separated from the orbiter—the shield protected Curiosity from the intense heat generated by its entry. Above right: An artists image of the careful lowering of Curiosity, designed this way so that the rockets wouldn't touch down and stir up dust that could damage Curiosity's instruments.

that will enable the breakthroughs that Curiosity will make.

A 20 minute interview with Marsha Freeman on the historical significance of the Mars rover 'curiosity' landing, and where we go from here, can be viewed at http://larouchepac.com/node/23647.

Photos taken by Curiosity. Top: the wall of Gale Crater, to the north of the landing site. This is the first look at a fluvial system, shaped by water. Inset: Curiosity's picture of part of itself. Bottom: Blue rocks on a red planet? This image doesn't look this way on Mars, but has been "white-balanced" to appear the way it would on earth, which generates colours that enable scientists to determine the chemical composition of the rocks.