

PAST, PRESENT AND FUTURE MARS EXPLORATION

Marion Anderson

School of Geoscience, Monash University, VIC, AUSTRALIA

Sine the first hominids looked up at the sky there has been one blood-red beacon that has fascinated mankind, the planet that we now call Mars. The ancient Egyptians called the planet *Har decher* – the red one, and associated with Horus. In Babylonian times it was known as *Nergal* – the death star. To the ancient Greeks, it was *Ares*, god of war, renamed *Mars* by the Romans – a name that has survived to this day.

Mars was recognized as a planet (wandering star) by the Greek astronomers, but it wasn't until the invention of the telescope that it was seen to be a solid body in space. Further refinements of telescope lenses allowed the first surface features to be sketched by Christian Huygens in 1659 – his sketch was of a dark region that is now known as Syrtis Major. More detailed drawings were made by Giovanni Cassini, and working together with Huygens he calculated that Mars had a day length of 24 hours 40 minutes, remarkably close to its actual day length of 24 hours, 39 minutes and 35 seconds! Huygens suspected that Mars may be inhabited, a suspicion that was supported by seasonal changes in the planet's surface colouration and polar cap size by Giacomo Maraldi and William Herschel. Herschel also observed that Mars' axial tilt was similar to Earth's – leading more astronomers to draw obvious parallels between the two planets.

The first highly detailed drawings of Mars were made by the English astronomer William Dawes, using an 8" telescope, but the pictures were biased by atmospheric disturbances and the limits of the observer's own eyesight.

Mars' two moons, Phobos (fright) and Deimos (fear), were discovered with the aid of the 26" telescope at the US Naval Observatory by Asaph Hall in 1877. They were no more than tiny points of light through this telescope, and have since been discovered to be captured asteroids.

More observations and drawings were made by Giovanni Schiaparelli in the 1870s, and in 1877 he produced his first map of Mars – a detailed drawing showing bright areas (continents) and dark areas (seas) connected by linear features he called "*Canali*", Italian for *Channels*. He was convinced that these *canali* were natural geological features, but when his works were translated into English, *canali* was frequently mistranslated as *canal* – a feature that implied manufacture by intelligent beings. This mistranslation fired the imagination of other observers, especially Percival Lowell, who in 1895 published "Mars", a book containing detailed drawings of a vast artificial Martian canal network, in which he states in regard to the canals that... "*Their very aspect is such as to defy natural explanation, and to hint that in them we are regarding something other than the outcome of purely natural causes.*" He went on to publish "Mars as the abode of life" in 1908 in which he expanded on the artificiality of the canals, and proposed that they were constructed by intelligent beings.

This led to a plethora of works of fiction, in which Martian life was investigated and imagined in adventurous ways. H. G. Wells published "*The War of the Worlds*" in 1898, inspired by the work of Lowell and a close approach of Mars to Earth in 1894. This novel described how Martian life sought to make the Earth Mars-like in order to escape its own dying planet.

Edgar Rice Burroughs continued on this theme with “*A Princess of Mars*” in 1911, in which a Civil War soldier travels across space at the point of death, and then combats green-skinned six-limbed Martians to rescue a surprisingly human four-limbed almost-naked princess! This book sold so well that he wrote another 9 novels in the Mars series, with the final one published in 1948. Most were serialized in “pulp” fiction magazines – an increasingly popular way of exploring Mars in the 1920s-1960s, many of which featured covers that showed Earth women being threatened in some way by fiendish Martians.

The famous Orson Welles radio broadcast of War of the Worlds on October 30th 1938 panicked Americans into thinking that Martians were indeed invading, leading to scenes of hysteria as listeners who tuned in after the show began attempted to flee the (fictional) Martian invasion, such was the strength of the public perception that malevolent life did exist on Mars. This investigation of the fantastic continued into the 1950s and 1960s, with Martian intelligence investigated in stories published by authors such as Leigh Brackett, Ray Bradbury, John Brunner, Arthur C. Clarke, and Michael Moorcock.

With the advent of the space age, however, the trend for Martian life stories was replaced by fiction featuring humans investigating a dead land, and more stories of conflict between human travelers – the works of Robert Heinlein, Phillip K. Dick, and Kim Stanley Robinson are some of the best examples.

The first close-up images of the Martian surface were provided by the flypast of Mariner 4 in 1964. This was the first success after at least 6 failed USSR and USA Mars missions. These showed the surface to be barren and cratered, similar to the surface of the moon, with no signs of dying civilizations or ancient canals. Higher resolution images were returned by Mariner 6 and 7 in 1969, again showing a heavily cratered desolate surface, but when Mariner 9 returned more than 7,300 images in 1971 some intriguing flow structures were seen in the northern plains of Mars. These flows inspired scientists again to speculate about the water history of Mars, and plans were made for two orbiters and two landers – the Vikings.

During this period, the USSR was also regularly launching paired orbiters and landers to Mars, but with severely limited success. Mars 2 (1971) lander failed, but the orbiter returned data until 1972. The Mars 3 (1971) lander operated on the surface, returning 20 seconds of video data to the orbiter before failing, while the orbiter returned atmospheric data until August 1972, but Mars 4 (1973-74) failed to achieve Mars orbit, although it did send some images and data as it flew past. The Mars 5 (1973-74) orbiter survived a few days and sent back images to prepare for the next missions. The Mars 6 & 7 (1973) landers both failed, although the Mars 6 lander did return some atmospheric observations on its way to the surface.

The flood of Mars data really began with the Viking 1 & 2 paired orbiter-lander missions launched by the USA in 1975. Both landers examined the surface for signs of life, returning data that initially were judged to show that Mars was lifeless, but which is now being re-examined. The orbiters provided extremely detailed maps of the planet’s surface, and returned data until 1982 when Viking 2 was accidentally shut down! (Viking 1 was deactivated in 1980.) The Viking orbiter images confirmed fluid flow patterns in equatorial regions of Mars, and also triggered the

“Face on Mars” rumors, resulting from hyperactive imaginations and accidental placement of location dots in some images of the Cydonia Plains.

More failures followed after a hiatus of almost 10 years - USSR’s Phobos 1 & 2 probes failed (1988-1989) and USA’s Mars Observer orbiter was lost just before it should have entered Mars Orbit in 1993. These failures were eclipsed by the phenomenal success of the Mars Global Surveyor (MGS), launched in 1996 and still operating today.

MGS has mapped the surface of Mars, photographically, topographically, and mineralogically, at a resolution down to 1metre per pixel in some cases. These images re-confirmed the presence of fluid flow features, hinted at current liquid seeps out of crater walls, and debunked the “Face on Mars” for once and all.

USA’s Mars Pathfinder (1996-97) lander and sojourner rover successfully landed in one of the “flow” areas in Ares Vallis, and returned 84 days of data from a mission originally designed to last 30 days. The results hinted at water action on Mars, but were still debatable.

USSR’s Mars 96 orbiter and landers ended up in the Pacific Ocean when the fourth stage of the rocket ignited prematurely. Japan’s Nozomi orbiter (launched 1998) also failed to enter Mars orbit in 2003, when communications were lost.

The USA’s Mars Climate Orbiter and Mars Polar Lander also failed, but the 2003 Mars Odyssey entered Mars Orbit in 2001, and is enhancing the MGS maps and data, with higher resolution images and thermal data.

ESA’s first attempts at a Mars mission were a mixed success. The Beagle 2 lander entered Mar’s atmosphere but then disappeared, but the Mars Express Orbiter that carried Beagle 2 to Mars has been outstandingly successful, having just sent back the first images of water ice on the surface of Mars, further paving the way for the possibility of manned missions to Mars.

Arguably the most successful surface missions, NASA’s Spirit and Opportunity rovers, landed on Mars in January 2004, each with a 90 sol (martian day) mission. As at 16th August 2005, both rovers are still operating, with Spirit at sol 485 nearing the summit of Husband Hill, and Opportunity at sol 465 approaching Erebus Crater. Both rovers have found evidence of ancient water on Mars, both mineralogically and geologically, and their investigations now paint a picture of an early wet Mars, with lakes or oceans of salty water and water flowing through rock layers.

USA’s Mars Reconnaissance Orbiter was launched successfully on the 12th August 2005 and will provide even more detailed surface mapping of the planet when it arrives in early 2006. The Phoenix lander (reborn out of the spare parts of the Mars Polar Lander) is scheduled to be launched in 2007, with a large rover, the Mars Science Laboratory (MSL) planned for a 2009-2111 launch. Joint Russian and ESA missions are currently in the planning stage, and there is a proposal for a British Beagle 3 lander to be piggybacked on the MSL.

Manned missions are currently speculated for 2025-2030, but much of that will depend on the success of redesigned launch vehicles and a continued world-wide governmental commitment to

exploration and investigation. It is up to us to make sure that the red planet is never far from the thoughts of the people who control the purse-strings, and that the dreams of Schiaparelli, Lowell, Burroughs, and millions of others are realized.

One day I hope to see you on Mars!

Further investigations – all websites current as at 16th August 2005:

- Lowell, P, “Mars”, 1895, available on the web at:
<http://www.wanderer.org/references/lowell/Mars/>
- Bibliography of Mars-themed fiction:
<http://www.steampunk.com/sfch/bibliographies/mars.html>
- Chronology of Mars Exploration:
<http://www.hq.nasa.gov/office/pao/History/marschro.htm>
- Mars Global Surveyor:
<http://mpfwww.jpl.nasa.gov/mgs/index.html>
- Mars Pathfinder (as at end of mission):
<http://mpfwww.jpl.nasa.gov/MPF/index1.html>
- ESA’s Mars Express
http://www.esa.int/SPECIALS/Mars_Express/
- Spirit and Opportunity
<http://marsrovers.jpl.nasa.gov/home/index.html>
- Mars Reconnaissance Orbiter
http://www.nasa.gov/mission_pages/MRO/main/index.html
- Future NASA Mars missions
http://nssdc.gsfc.nasa.gov/planetary/mars_future.html

NOTES