

Mars : A Planet Of Robots

In a series of articles which will appear throughout this year our Features Writer **Nik Steggall** takes us through the exploration of The Red Planet

Part 1 : The Early Expeditions

All the talk now is for mankind to go and colonise that planet Mars. Plans have been laid out to build colonies on the Martian surface with the infrastructure of a small town. SpaceX's Elon Musk set out from the onset for his company to have the end aim of sending humans to Mars and staying there permanently.

For the past 60 years "visitors" have attempted and made the 140 million mile (225 million km) journey from the Earth to Mars to see what it is like. After some failures even to reach Earth orbit, they flew past initially, then orbited before landing and finally moving about its surface. So far the only moving things on Mars have been the robots and it looks like it will be for some time yet even though there are big plans to colonise Mars.

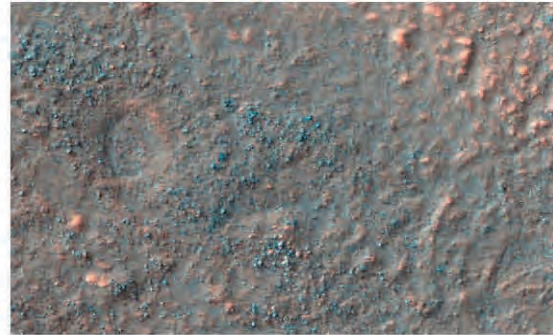
The first spacecraft attempt to get to Mars was made by the Soviet Union on October 10, 1960 but the spacecraft (1M No1) which was aimed at a flyby of the planet was lost in a launch failure not even reaching Earth orbit. Subsequent spacecraft were launched to the vicinity of Mars and a lot of the early attempts failed but some flew past and even orbited Mars. The first successful flyby was made by the United States spacecraft Mariner 4 (as seen on Hungary 1974) which flew by in July 1965.



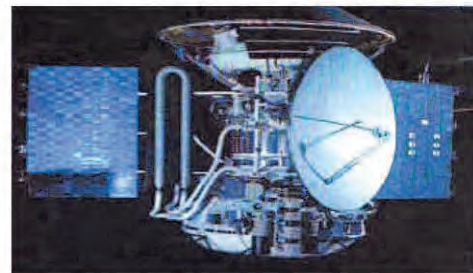
The first lander mission was attempted by the Soviet Union with its 2MV-3 No 1 spacecraft. The date was November 4, 1962 but again it suffered a launch failure. Since then up to 1971 all the missions to Mars were flybys or orbital missions. Plans were underway in the Soviet Union for a successful landing on the surface. Two identical spacecraft (Mars 2 and Mars 3) were launched in May 1971 (USSR 1972) with the former successfully entering Mars orbit on November 27, 1971. Later that day the lander was deployed from the main spacecraft but failed to land successfully. The descent module entered the Martian atmosphere too steeply with the landing sequence not operating as planned so the parachute system did not deploy and it crashed into the surface becoming the first man made object to impact the surface of Mars. The area of impact has been imaged but so far the Mars 2 lander has not been located.



USSR 1972 depicting Mars 2 approaching the planet and below a photo showing the debris field



Mars 3 entered Mars orbit on December 2, 1971 and, shortly after, the lander separated from the main spacecraft. As it



descended through the thin atmosphere it used its landing system of aerodynamic braking, parachutes and finally retrorockets to achieve a soft landing in the Ptolemaeus Crater. It immediately began operations transmitting to the orbiting spacecraft the first images 90 seconds after landing. Unfortunately after only 14.5 seconds its transmissions ceased partially returning an image of the surface. It was joked at the time that the lander had been thumped by an irate Martian but this has not been proved (!) Onboard the lander was the small Prop-M rover, a first but of course with the failure of the lander this rover was not deployed onto the surface. Had it done so the rover was planned to move across the surface on skis while it was still connected to the lander by a (15 metre) umbilical cable. A manipulator arm would have placed Prop-M onto the surface and in view of the television cameras. Mars 3 has been located in a Mars Reconnaissance Orbiter (MRO) image showing the parachute, retrorockets, heat shield and lander. Both Mars 2 and 3 arrived at Mars during a large dust storm which may have contributed to their loss.



ORBIT

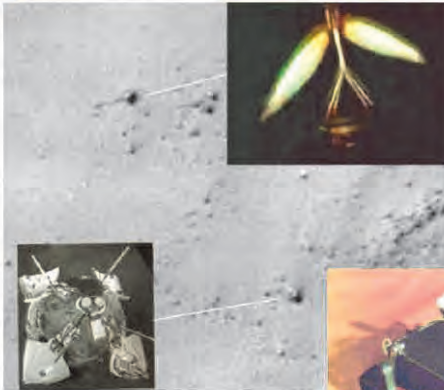


Image of Mars 3 lander and hardware

Below Prop-M rover vehicle.



The next landing attempt was again by the Soviet Union in their Mars series of mission. Both Mars 6 and 7 were launched in August 1973 on a flyby trajectory which carried a lander that was released before reaching Mars and the carrier spacecraft continuing past Mars both arriving at Mars in March 1974. During the descent phase of Mars 6 it sent back data to the flyby spacecraft for relay back to Earth. Unfortunately the 224 seconds of atmospheric data sent back was unreadable. The lander mission ended in failure when contact was lost just seconds prior to impact with the surface and before the retro-rockets were expected to fire to make a soft landing at the Samara Valles. (USSR 1974)



The Samara Valles is a valley some miles (615 km) long and it was named after the ancient name for the modern Somme river in France. the crash site is known (see photo left) but Mars 6 has yet to be accurately pinpointed.



Mars 7 was the companion lander arriving 3 days before Mars 6 but it was lost when it separated prematurely from its carrier and failed to enter the Martian atmosphere. It would not separate at first but it was eventually released late which meant

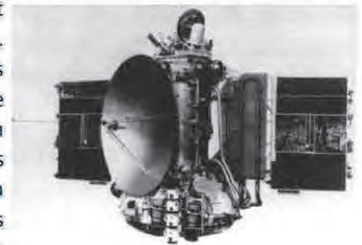
that it missed the atmosphere and continued into an orbit around the Sun.

Had both the Mars 6 and 7 landers survived and functioned correctly they would have sent back their data and images to the Mars 4 and 5 orbiting spacecraft. Both these pairs of spacecraft failed to complete their intended missions.

Mars 4 was launched in July 1973 but on its way to Mars two onboard computers failed and it could not enter Mars orbit continuing on its way missing Mars by 1,146 miles (1,844 km). All was not lost as it did take 12 photographs as it flew past.

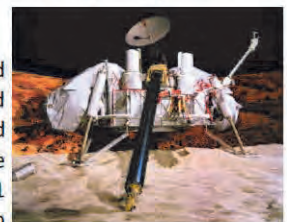


Mars 5 was successfully launched in July 1973 and entered orbit in February 1974. As soon as it did so the spacecraft's pressurized instrument compartment began to leak. The cause of that was believed to be that the spacecraft was hit by a micrometeoroid during its orbital insertion. While in orbit it returned 180 images of the surface before ceasing operation 16 days later.



Emphasis now turned to the United States to continue surface exploration. In 1975 NASA would use the mighty Titan IIIE rockets to launch the two Viking spacecraft to Mars each consisting of an orbiter and a lander. The Vikings were linked celebrate the 200th anniversary of the foundation of the United States of America as NASA had originally planned to land Viking 1 on July 4th.

The Vikings reached Mars in June and August of 1976. After the probes had orbited Mars for over a month and selected suitable landing sites the landings took place. The Viking 1 lander touched down on June 19 in the Western Chryse Planitia or Golden Plain and the Viking 2 lander on September 3 at a site 124 mile (200 km) west of the crater Mie in Utopia Planitia or in Greek 'Nowhere Land Plain', the Plain of Paradise.





Viking 1 MS showing launch, the orbiter and lander

Viking Space Missions FDC



They were the first successful soft landings on the red planet and to operate. Initially after landing they took images of the surrounding area in colour. Each undertook a range of scientific surveys of the immediate area including taking soil samples for its composition and possible signs of life. The primary objectives of the landers were to search for bio signatures and to observe meteorological, seismic and magnetic properties of Mars from the surface. The results of these biological experiments aboard the landers were inconclusive although years later the Viking data suggested signs of microbial life on Mars if read correctly but still inconclusive.

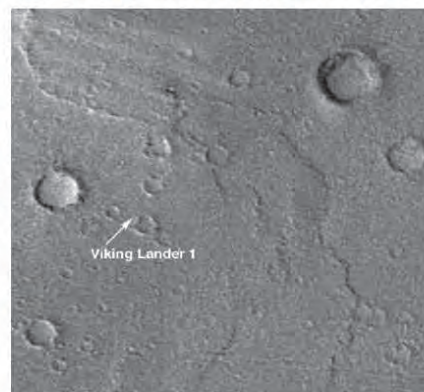


Viking 1 landing site

Viking 2 landing site



In January 1982 the Viking 1 lander was renamed the 'Thomas Mutch Memorial Station' in honour of the leader of the Viking imaging team, Thomas A Mutch. The Viking 1 lander continued working for 2245 Sols which is 2306 Earth days or around six years. The Viking 1 lander ceased operations on November 11 1982. At this time a faulty command was sent to uplink new battery charging software to extend its battery lifetime but this resulted in loss of signal. In 2006 the Mars Global Surveyor spacecraft imaged the Viking 1 lander on the surface, as below.



The Viking 2 lander shut down after a battery failure on April 11, 1980 after 3 years and 7 months or 1281 Sols.



Sol - A "Day" On Mars

"Sol" the Latin for "Sun" is the term for a Mars solar day or a Mars day. A Sol is the interval between two successive returns of the sun to the same meridian or sundial time as seen from an observer standing on Mars. The Sol system of time keeping was first adopted with the Viking lander missions and has since been used by NASA for its Mars missions and in particular its rovers.

The average duration of the day - night cycle on Mars, a Martian day is 24 hours, 39 minutes and 35.244 seconds. However, the sidereal rotational period of Mars, the planets rotation compared to the fixed stars is only 24 hours, 37 minutes and 22.66 seconds.



The InSight lander photographs the Sun.
India Mars stamp from 2018

With each lander and rover using a starting Sol date for its own mission timeline it makes it easier for planners to follow mission events and to prepare a mission timeline, so when a lander touches down it's Sol 0 as was used by the Vikings, Mars Phoenix, Mars science Laboratory Curiosity and InSight. However, the Mars Pathfinder and the two Mars Exploration Rovers started their missions on Sol 1. The choice was made if the lander touched down later in the Martian day—Sol 0 or if it was an early day landing it would begin at Sol 1.



Human colonization of Mars will require a time keeping method or calendar. How this works out on Mars will be interesting. On the International Space Station the standard time used is GMT (GB 1984) which could be used on the journey to Mars but would be meaningless on Mars following its day - night cycles.

Using the Sol system would work for a single Mars base or city but when two or more bases are constructed in different areas of Mars a universal Mars time and even date line system would be required as on the Earth. A new industry of Mars clock and watch making could be set up. (Tonga 1984)

