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SPACE

Man for Mars

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The European Space Agency and Russia's Institute of Biomedical Problems plan to simulate a 520-day mission to Mars.



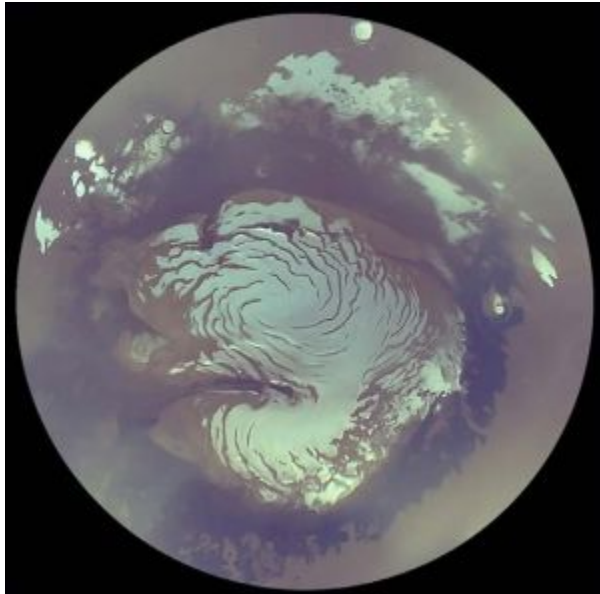
Ice exposed in trenches just a few centimetres deep dug by the Phoenix lander at the high northern latitudes of Mars.

HUMAN exploration of Mars, the red planet, is the ultimate aim of current plans for space exploration. A simulated voyage for a 520-day mission to Mars dreamt up by the European Space Agency (ESA) and Russia's Institute of Biomedical Problems (IBMP) is set to begin at the end of this year. With an international crew of six working and living in a sealed facility near Moscow for almost two years, the programme, referred to as Mars 500, will study the impact confinement for such a long duration will have on human psychology and health.

Long before the space age, Mars was a mysterious landscape in the public mind. The planet appears as a red-coloured celestial object in the night sky and that is why ancient Romans named it after Mars, their bloody god of war. From the end of the 19th century through to the first half

of the 20th, writers of science fiction and the public imagination populated this planet with every imaginable form of life. At the same time, scientists harboured the belief that life of some sort might indeed be found there. The belief that advanced life existed on Mars skyrocketed at the end of the 19th century after Giovanni Schiaparelli, an Italian astronomer, reported seeing 40 lines criss-crossing the Martian surface in 1877 when a favourable opposition of Mars occurred.

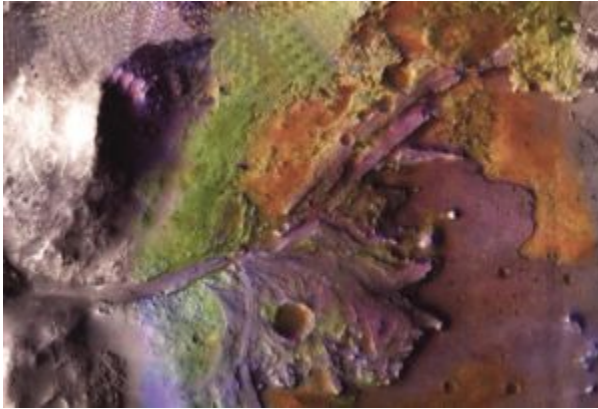
AP/NASA HANDOUT



A VIEW OF the north polar ice cap on Mars taken by NASA's Mars Reconnaissance Orbiter

A configuration is known as an opposition when the earth lies between Mars and the sun and all three bodies are in one line. The orbital eccentricity of Mars is 0.093, much larger than that of most other planets (eccentricity of the earth's orbit is 0.017). Because of this ellipticity of Mars' orbit, its distance from the sun when it is at its perihelion (the closest position of the planet to the sun), namely, 206 million kilometres, is substantially smaller than when it is at its aphelion (the farthest position of the planet from the sun), namely, 249 million km. Mars is at its largest and brightest when it is in opposition.

An opposition of Mars occurs at an interval of 780 days. If such a configuration occurs near the perihelion of Mars, the earth and Mars can come within 56 million km of each other. Such an opposition is said to be favourable. Mars' angular size under such circumstances is about 25 arc seconds. At such times observers on the earth can distinguish surface features on Mars that are as small as 100 km across – about the same resolution the unaided human eye can achieve when it views the moon. The best observations of Mars, then, are generally made near a favourable opposition, which occurs at an interval of 15 or 17 years. The last favourable opposition of Mars occurred in 2003 and the next one will occur on July 27, 2018, when it will be extraordinarily bright.



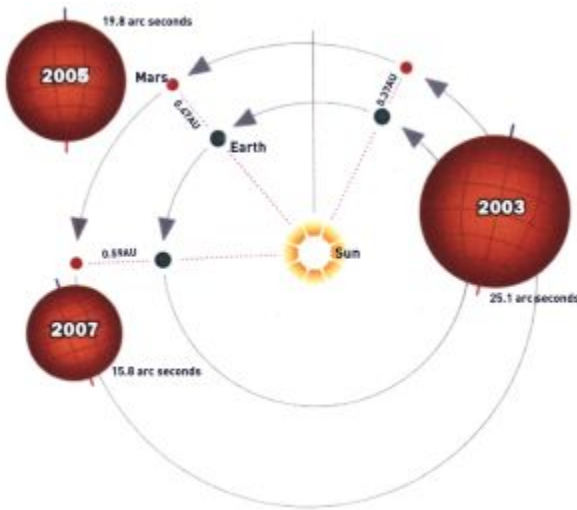
A SYSTEM OF river channels transported clays (green in this enhanced colour image) into a delta within the Jezero Crater lake on Mars (photograph by Mars Pathfinder)

Schiaparelli looked at Mars in 1877 with his telescope, which was only 8.75 inches (22 centimetres) in diameter, when a favourable opposition of Mars occurred and called the dark lines he observed on its surface canali, an Italian term meaning channels. It was soon mistranslated into English as canals, implying the existence on Mars of intelligent creatures capable of engineering feats. This speculation led Percival Lowell, an American astronomer, to observe Mars in 1894 with the aid of a more powerful telescope installed on the mountains of Arizona. He mapped a large number of canals on Mars and publicised his results. Then, in 1898, H.G. Wells' classic science fiction novel the *War of the Worlds* was published. It depicted the existence of advanced life on Mars.

By the beginning of the 20th century, it was fashionable to speculate that the Martian canals formed an enormous, planet-wide irrigation network to transport water from melting polar caps to vegetation near the equator. In view of the planet's reddish, desert-like appearance, Mars was thought to be a dying planet whose inhabitants had to go to great lengths to irrigate their farmlands. No doubt, Martians would readily abandon their ancestral homeland and invade the earth for its abundant resources. Film-makers were not about to let such fertile science fiction material pass by. Hollywood produced a movie titled *War of the Worlds*. The movie was a grand success and attained worldwide popularity.

On October 30, 1938, inspired by the same H.G. Wells book, Orson Welles presented a radio programme in which he announced the invasion of the earth by Martians. His broadcast, live from New York City, was so realistic that it caused panic throughout the New York-New Jersey area.

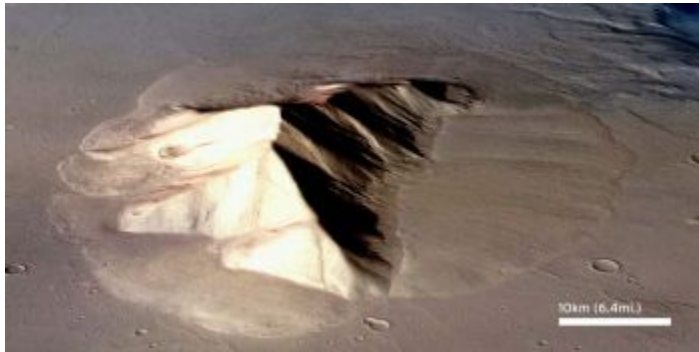
Exploration of Mars



2003: FAVOURABLE OPPOSITION of Mars showing the planet at its largest and brightest

The first spacecraft to reach the red planet was Mariner 4, which flew by Mars in July 1965. The images it sent back showed a large number of impact craters and no earth-like terrain that scientists had been expecting to find. Studies of Mars received an enormous boost with the arrival in November 1971 of the Mariner 9 orbiter. The craft mapped the entire Martian surface at a resolution of about 1 km, and it rapidly became clear that the planet was a far more complex world than imagined earlier. The maps revealed vast plains, volcanoes, and canyons. Planet-wide, high-resolution photographs of Mars over the past 40 years have failed to show one canal of a size consistent with those allegedly seen from the earth. We now know for certain that Schiaparelli's canali were optical illusions and that science fiction writers were completely off the mark.

The next American spacecraft to visit Mars were the two Viking missions, which reached the planet in mid-1976. Viking 1 and Viking 2 each consisted of two parts. An orbiter mapped the surface at a resolution of about 100 metres. A lander descended to the surface and performed a wide array of geological and biological experiments. Each Viking lander carried a compact biological laboratory designed to test for microorganisms in Martian soil. Three biological experiments were conducted, each based on the idea that living things alter their environment: they eat, they breathe, and they give off waste products. In each experiment, a sample of the Martian regolith was placed in a closed container, with or without a nutrient substance. The contents of the container were then examined for any changes. The results were negative; the Viking landers also failed to detect any organic compounds on Mars.



THIS HANDOUT IMAGE, released on November 20, 2008, shows a perspective view of a mountain in the eastern Hellas region of Mars surrounded by a lobate deposit with flow textures on the surface. A radar instrument aboard a NASA spacecraft detected large glaciers hidden under rocky debris that may be the vestiges of ice sheets that blanketed parts of Mars in a past ice age, according to scientists.

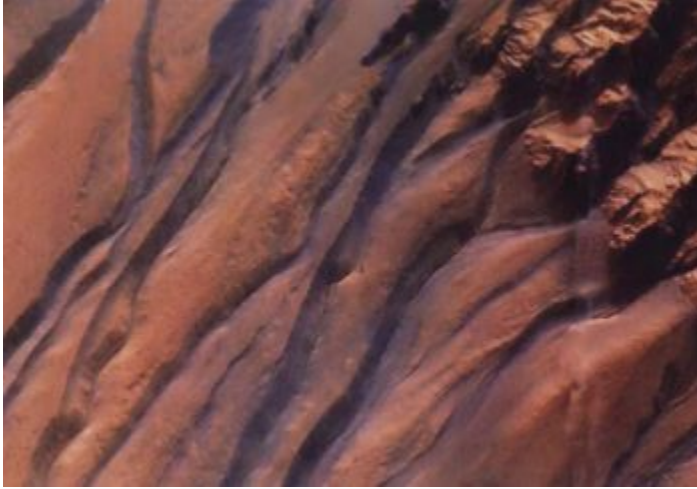
But the reason for the planet's red appearance was explained by the Viking 1 lander. From the analysis carried out by the lander's spectrograph, it became known that the surface of Mars contains a large quantity of iron oxide and that is why sunlight incident on the surface of Mars appears red. Thus, with the advent of the space age, it became crystal clear that the “bloody” imagination of the ancient Romans was all wrong.

The National Aeronautics and Space Administration (NASA) of the United States launched another spacecraft, Mars Pathfinder, which touched down on Mars on July 4, 1997. It found evidence of water very close to Mars' crust, and scientists confirmed that Martian soils are rich in iron and that suspended iron-rich dust particles permeate its atmosphere.

Phoenix mission

On May 25, 2008, NASA's 5.4 m × 1.5 m, three-legged, solar-power Phoenix lander touched down near the north pole of Mars. This spacecraft carried several novel instruments to analyse what it scooped out. Phoenix dug several trenches and in one of them hit something solid, possibly a thick layer of frozen ice. Scientists had detected perfect evidence of water-ice.

ERNST HAUBER/REUTERS

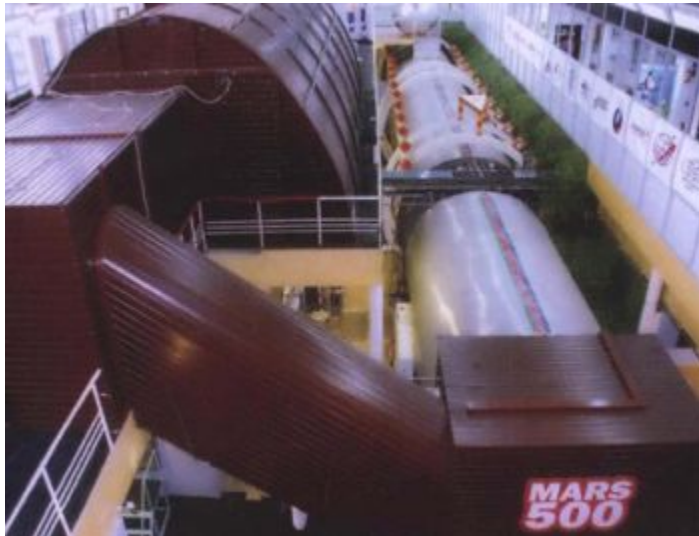


GULLY CHANNELS EMANATING from the rocky cliffs of a crater rim in the southern highlands of Mars show the meandering and braided patterns typical of water-carved channels (a photograph taken by Viking 2).

The presence of water is thought to be necessary for the origin and survival of life. So the apparent discovery that the water on Mars is closer to the surface than expected is of great interest to those searching for extraterrestrial life. Scientists believe that Mars was probably very much like the earth soon after it formed 4.5 billion years ago. For the first 500 million years, there was probably a substantial amount of water on the surface, but it is no longer present. The question is, what happened to Mars after those 500 million years? That is the question on the minds of many planetary scientists. Some of them think that not only is there life on Mars but a fraction of the Martian soil could be biological in origin and that organisms based on a hydrogen peroxide-water mixture could survive the freezing Martian climate. Scientists arrived at the conclusion that the amazing thing about Mars is not that it is an alien world but that in many aspects (such as mineralogy) it is very much like earth.

Planetary scientists strongly believe that human beings may have to go to Mars themselves to solve the mysteries of the red planet. At present, the ESA and the IBMP are exploring the challenges the first manned mission to Mars would face. Until now, humans have only been successful in landing on one celestial object, that is, the moon.

Two astronauts of the Apollo 11 mission prepared for their historic first steps on the moon on the evening of July 20, 1969. It is regarded as the most significant event of that millennium. But one has to keep in mind that Apollo 11 went into orbit around the moon after a three-day journey from the earth, that the two astronauts remained on the surface of the moon for about two hours and 37 minutes, and that Apollo 11 took less than three days to return to the earth.



THE SPECIAL ISOLATION facility at the Institute of Biomedical Problems in Moscow that hosts the Mars 500 simulations

But the technology needed to send humans to Mars is extremely complicated. The average distance of the moon from the earth is 3,84,000 km, whereas the average distance of Mars from the earth is 7,80,00,000 km. The ESA scientists organising the Mars 500 simulation are planning a 250-day journey to Mars, a 240-day voyage back and a 30-day exploration of the Martian surface. The members of the crew are expected to live in a series of tanks and will be confined to an area of only 200 square metres, which will certainly test them mentally. The crew will also have to take time to get acclimatised to the fact that there will be a delay in communications between the earth and Mars and back again of up to 40 minutes and that there will be no way out once the spacecraft is on its way.

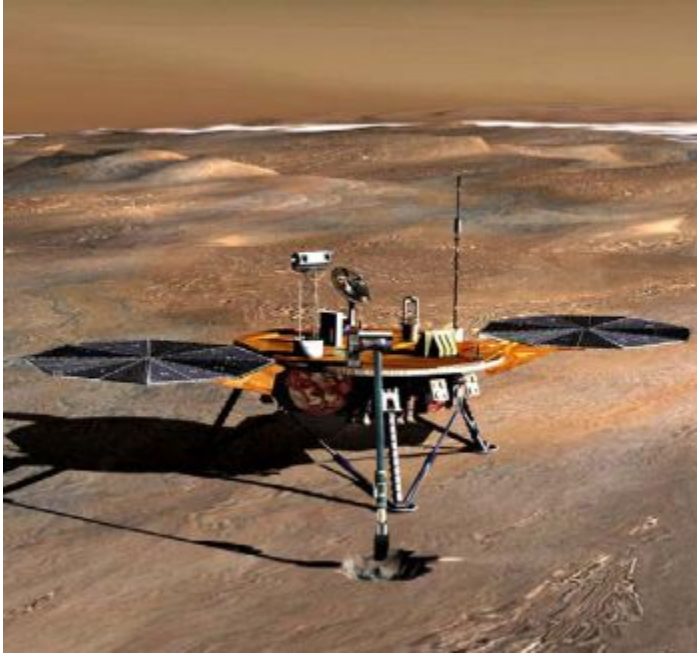


THIS IMAGE provided by NASA shows the scoop of the Phoenix lander's robotic arm. Also shown, at the lower right, with its forks pointing towards the ground, is the thermal and electrical conductivity probe

Scientists are not only interested in the mental well-being of their chosen crew but keen to investigate the ability of each crew member to perform certain tasks that will be vital to ensuring that the mission is able to reach Mars. Will they be capable of performing experiments once they reach their destination? Have the right personalities been chosen to embark on such a long journey? The Mars mission planners are eager to find the answers to these questions. Of course, it has not gone unnoticed that medical issues are of great importance. One of the crew members of the simulated mission must have medical training.

Sending the crew on its way to Mars is the first step. The orbits of both Mars and the earth play an important role in the launch of any spacecraft. To ensure that the crew is able to survive in alien conditions, collect scientific data and return safely to earth, the Mars Society Germany suggested that the ground-based habitat and the Earth Return Vehicle (ERV) be sent ahead of time so that they are already on Mars when the crew arrives. When the mission is complete, the crew will leave the surface in a Mars Ascent Vehicle (MAV) that will rendezvous with the ERV and bring the astronauts home. The possibility of the crew not being able to land at the site where earlier supply modules had touched down is a factor that must not be forgotten.

AP/NASA



AN ARTIST'S RENDERING provided by NASA of the lander called Phoenix Mars

On arrival, the crew's primary activity will involve the organisation of the existing modules at the landing site. Solar panels deployed from the crew and laboratory modules will provide power to critical systems. When all systems are brought online and the astronauts' laboratory is connected to the habitation module, the previously planned experiments that will continue the search for life, either past or present, on Mars can be carried out.

Another source of risk concerns radiation exposure and the effects of zero gravity. Exposure to galactic cosmic rays and solar particles will be at a maximum in transit or on Mars once a spacecraft goes beyond the shelter of the earth's magnetic field. The effects of zero gravity on the human body are detrimental, as astronauts' long-duration stays on various earth-orbiting space stations have shown. Another hazard that astronauts will face on Mars is the 0.38 g Martian gravity.

The challenges associated with a manned mission to Mars are seemingly endless, but once the much-awaited results of the Mars 500 simulation are received, a lot more will be known. To get answers to all of these questions, a few more missions will be required, such as a robotic sample return and then, finally, a human mission.

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