

TERRA NOSTRA

ISSUE 1
STORIES FROM SPACE

The Little Rover That Could

The Pale Blue Dot

Life on Mars

China Can Into Space!





THE LITTLE ROVER THAT COULD

The so-called "Adventure Twins" Spirit and Opportunity landed on Mars in January 2004 to complete a 90 day exploration of the surface as part of the MER mission. However, over 2000 days later both rovers were still happily trundling around doing groundbreaking scientific research.

After 5 years, 3 months and 27 days, Spirit fell foul of soft sand and found itself pitched over at an extreme angle unable to recharge its batteries effectively. After months of careful work to free itself Spirit was unable to do so and was downgraded from a rover to a stationary science platform. On March 22nd 2010 Spirit stopped communicating with NASA having been claimed by the cold.

Opportunity, as Opportunity came to be affectionately known, carried on its relentless searching alone. Its mission, like that of its sister, was to find evidence of past water activity. In order to do this, the rover carried a state of the art suite of scientific instruments. Whilst rock abrasion tools, magnets, and Alpha Particle X-Ray Spectrometers are interesting the most important tool that Opportunity carried is probably its panoramic camera. Mounted on a 5 foot mast and fully adjustable, Opportunity was able to take 217,594 images of human eye height providing people with a unique "human" perspective of Mars.

During its lifespan, Opportunity visited over 100 craters and furthered our understanding of how craters form and erode over time. It was in, or around, several of these craters that Opportunity made some of its best discoveries.

Upon landing in its crater on the Meridiani Planum,

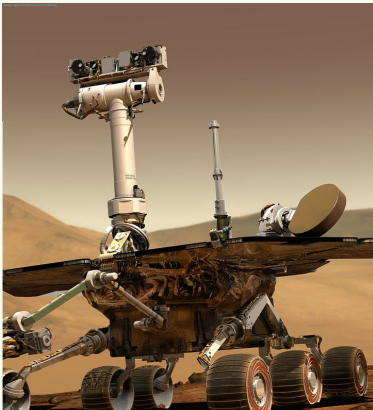
Opportunity discovered the presence of the mineral hematite. Hematite usually forms in areas of standing water on Earth and this provided evidence that Mars was a lot wetter than previously thought in the past. This was the first mineral evidence that Mars had a much more watery past.

Near the rim of the Endeavour Crater, Opportunity made another watery discovery. Rather than hematite, this time Opportunity discovered a vein of brightly coloured gypsum. Gypsum is another mineral that forms when water flows through cracks in rocks leaving behind deposits of calcium. This suggested to the team at NASA that Mars may have been much more suitable to life in the past than it is today!

Opportunity's biggest commitment to science is probably its long lifespan. Over nearly 15 years, Opportunity provided a constant stream of data about how solar powered rovers fare on Mars. By looking at how much energy reaches the surface of Mars after passing through its sometimes dust laden atmosphere scientists are going to be able to ensure that the next generation of rovers are much better equipped to last. Who knows? Perhaps one day soon, a relative of Opportunity might make it past 20 years on the surface!

After nearly 15 years of continuous exploration, NASA's favourite little robot explorer finally lost its battle against the harsh Martian climate. Having completed one of the most gruelling marathons in the Solar System, and claiming the title of the longest distance driven on a different world, Opportunity's achilles heel was finally exposed. Early in June 2018, planet encircling dust storms blocked out the sun whilst simultaneously coating Opportunity's solar panels in a film of dust. Unable to recharge its chemical batteries Opportunity entered hibernation on June 12th 2018. A sleep from which it never awoke.

The crew at NASA didn't give up on their little buddy though. They continued to send Opportunity wake up commands and songs throughout 2018 and into 2019. Over the course of eight months, NASA sent over 1000 wake up commands to Opportunity and listened in every single day just in case the plucky little guy came back online. With heavy hearts the team sent their final commands to Opportunity on February 13th 2019 before declaring the rover dead and the mission complete.





LIFE ON MARS

Why on Earth would you search for life on Mars? Pure aside, it is a valid question. Looking at the red planet today with its dust storms, toxic atmosphere and bitterly cold temperatures it is hard to see why anyone would ever suspect that life might be lurking there.

Perhaps, our interest in Mars has its origins in the early 1800s when early astronomers used their telescopes to gaze upon its face. Imagine their surprise when their eyes were greeted by strange straight channels so reminiscent of the canals winding their way across Britain. It wasn't a great leap of logic for those at the time to assume that some great alien civilisation had constructed these strange features to move water across the barren world.

This assumption inspired some of the great artists of the time to create stories that still resonate with us today. H.G. Wells, the infamous science fiction writer, wrote what is perhaps the best known story to be inspired by the red planet. "The War of the Worlds" is a classic within its genre and describes the invasion of the Earth by a race of tentacular Martians that lay waste to Britain inside metal tripods. Despite their advanced weapons and technology these invaders ultimately fall foul of the simplest of organisms. Bacteria.

The "War of the Worlds" was adapted for radio by Orson Wells and on Sunday 30th October 1938, with the world perched on the edge of catastrophe, his broadcast supposedly created panic across the United States. The very real fear of the "other" engulfing the politics of the

late forties manifested itself during this hour long broadcast with listeners subjected to the drama of the invasion by something truly alien.

Thankfully, any life that scientists do discover on Mars is likely to be very small indeed. As the planet is so inhospitable to large multicellular organisms most scientists think that the best thing they can hope to discover is going to be on the microscopic scale. In fact, many scientists don't expect to find life at all instead, they expect to find the traces that life has left behind within the environment. These traces of life would prove that it was possible for life to exist on Mars in times when the planet was a lot more hospitable than it currently is.

Whilst this sounds quite disappointing when we consider the Martians of pop culture many of the ingredients for life have already been discovered on Mars. Methane and formaldehyde have both been discovered in small amounts in the atmosphere. These two chemicals can be produced inorganically (without living organisms) but they can also be formed by some bacteria here on Earth! It has been suggested that this discovery might hint at the presence of bacteria living deep within the Martian soil.

As well as this, in the 1970s the Viking landers conducted several experiments seeking out life by looking for evidence of metabolism. Metabolism happens when chemicals are transformed into other substances within cells. Of the eight experiments carried out by the two landers only one was positive for metabolism. This result was not accepted by the wider scientific community.

Much more recently, the Curiosity rover has discovered complex organic compounds in the remains of a dried out lake. These mudstone samples contained very simple compounds similar to oil and natural gas. These compounds are used as the basic building blocks of life on Earth so it is assumed that they could fulfill the same role on Mars.

These discoveries are very exciting for scientists because they represent a growing amount of evidence supporting the theory that life once did, or continues to, exist on Mars. However, scientists have to be careful when they look for the traces life leaves behind. In 1984, a team of scientists working in Antarctica picked up a meteorite from the surface of the ice and came to the conclusion that it had originated from Mars. On closer inspection, this meteorite contained magnetite inclusions that looked very much like worms. This claim was put forward by NASA scientists in 1994 with much excitement. However, it was quickly discovered that the worm-like features could be formed by a range of geological processes.

NASA's next mission to hunt for life on Mars is set to land on the 18th February 2021. The Perseverance Rover mission will seek to answer questions about the potential for life to exist. This rover, unlike previous robotic explorers, is equipped with a drill that can take core samples to be sent aside for delivery back to Earth for analysis.

Whilst we will have to wait even longer for a mission to be sent to the red planet to collect these samples the opportunity they offer to scientists is immense. By sending the samples back to Earth, scientists will be able to use a full lab suite to investigate every avenue open to them. One of the biggest drawbacks of sending rovers to Mars is the limited nature of the onboard instruments. Rovers are limited on the weight that can be safely landed on the surface and by the power needed to run the instruments. Every single instrument on a rover has to be carefully considered before being added.

These samples, whilst useful for discovering what there is to learn about life already on the planet, give us the opportunity to learn new techniques that could one day let humans live there too. By identifying deeper stores of water and the chemical processes needed to increase the amount of oxygen in the atmosphere we will come one step closer to the time when humans may come to think of Mars as a second home.





CHINA CAN INTO SPACE!

China might be the new kids on the block when it comes to running a space program but they have more than proven themselves capable of matching those nations with a proven track record. So how did this come about?

If all started, as many space programs in the mid-twentieth century did, with the intention of creating a method of delivering nuclear weapons to distant targets by putting missiles into orbit. Thankfully for the Chinese, the Soviet Union was happy to work in partnership with them. This gave China a huge head start on its neighbours in the new space race as they got access to Soviet R-2 Rocket technology during the 1950s. When this agreement fell apart during the 1960s the Chinese decided to continue to research and experiment with rocketry. In fact, China launched their first independently produced rocket as early as September 1960!

After witnessing Russia putting the first man in space on April 12th 1961, the Chinese also decided to pursue this goal and establish themselves on the global space exploration stage. Events in the late 1960s and the easing of tension between the United States and Russia later in the 20th Century would delay this dream until the 21st Century as their interest in missile technology reduced.

On October 15th 2003, the Chinese National Space Administration (CNSA) successfully sent military pilot, Yang Liwei, into space for 21 hours. During this time he orbited the Earth 14 times! This firmly established China's presence on the intergalactic stage as the third nation ever to put a person into space and safely recover them. Not bad for a man who only found out he was headed into space the day before. Whilst the



mission was a complete success for the CNSA it was not without problems. Extreme vibrations seized the Shenzhou 5 at an altitude of between 30 and 40 kilometres. Yang later claimed that he "thought I was going to die." The cause of this vibration, which lasted 24 long seconds, is thought to have been due to the rockets engines creating slightly different thrust levels. This causes the rocket to experience acceleration differently across its surface and for the flow of propellant to vary. A similar problem occurred on NASA's Apollo 4 mission but as that mission was unmanned they were able to redesign their Saturn V rocket to reduce the effect of any vibration on the later flight's human cargo.



In order to become China's first Talkonaut (the equivalent of an astronaut) Yang had to beat 1,500 other candidates just to be accepted onto the training program. Once he had been selected (along with 11 others), he then had to endure 5 years of intense studying and physical testing.

After finally smashing their goal of putting a person in space, the Chinese then turned their eyes towards the space stations of their competitors and decided to see if they could also build a base in orbit around the Earth.

China's first Space Station, Tiangong-1 (Celestial Palace 1) was successfully put into orbit in September 2011 and stayed in orbit until April 2018. This station provided the CNSA with the ability to test and practice orbital rendezvous and docking, skills necessary for much more ambitious missions in the future. Upon re-entry not all of Tiangong-1 was destroyed by atmospheric friction. What little survived re-entry was spread across an area a few hundred kilometres in size. A few people raised concerns about the chances of being struck by falling space station debris but this was quickly quashed with the odds being described as "one million times smaller than the odds of winning the Powerball jackpot."

The second Space Station, rather imaginatively named Tiangong-2, was a space laboratory launched in September 2016. In October of that year, the Shenzhou 11 docked with the station. It provided two astronauts a 30 day window in which to perform experiments and collect data on a range of topics. These included the effects of weightlessness on the human body, in orbit maintenance and the in orbit release of satellites.

Perhaps most interestingly for the future of space exploration, the Tiangong-2 was used to test the potential for orbital refuelling in late 2017. Three successful docking and refuelling events occurred with one being completed in only 4.5 hours! This fast refuelling technique could be used in the future to allow Chinese rockets to take advantage of narrow launch windows for exploration further out into the Solar System.

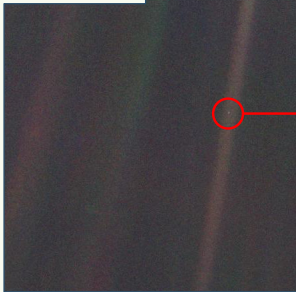
Much more recently, China has set its sights on the Moon. On the 23rd November 2020, they became the first country since the 1970s to try and retrieve samples of Lunar rocks from the moon's surface. This unmanned mission is a significant step towards matching the robotic exploration power of NASA and will give China the chance to explore the engineering challenges that building rovers pose.

The Chang'e-5 mission will deploy two vehicles to the Lunar surface. A drill unit will take the samples, whilst an ascender unit will take the samples to the return vehicle in orbit over the surface. The whole mission is planned to take around 23 days so we can expect to see results in early December!





THE PALE BLUE DOT



THE VOYAGING TWINS

A pair of twins voyage inexorably into the darkness of night proclaiming their presence for all that are there. These spacecraft, Voyager 1 & Voyager 2, have been travelling away from the Earth for over 40 years at unimaginable speeds. The two craft, launched in 1977, were sent to discover information about Jupiter and Saturn before heading out of the Solar System and into interstellar space.

In August 2012, Voyager 1 became the first man-made spacecraft to leave the solar system and head out into the space between. To this day, it continues to send back information about its surroundings like some silent wanderer among the stars. Inscribed on a record made of gold, Voyager 1 carries the images, sounds, music and greetings of the people of Earth in the hope that one day something will be there to listen.

Carl Sagan, an internationally renowned astrophysicist working on the Voyager imaging team, wrote one of the most moving responses to the images taken by Voyager looking back at the Earth from 4 billion kilometres in his book *Pale Blue Dot*. He reminds us that the Earth is an infinitely small but so very important place dwarfed by the scale of the universe around it.

"Look again at that dot. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every "superstar," every "supreme leader," every saint and sinner in the history of our species lived there—on a mote of dust suspended in a sunbeam."

- Carl Sagan

Want to get involved?

Hello future writer!

If you want to get an article published in this magazine please submit a piece of writing on the theme of the next issue by email of no more than 800 words to Mr Green at green@thelandschool.org

Our next issue is exploring stories of ice.

We accept all forms of writing, so warm up your fingers and get typing!

Submission Deadline:

25/12/2020

