

World Museum Liverpool Planetarium 'Magnificent Desolation' transcript

(Neil Armstrong clip): 'That's one small step for (a) man; one giant leap for mankind.'

American astronaut Neil Armstrong spoke these famous words when he made history on July 20 1969, as the first human being to set foot on the Moon.

The moon is our nearest neighbour in space; it is our only natural satellite and has been known since prehistoric times.

At three and a half thousand kilometres wide, the moon is the fifth largest moon in the Solar System and it's about one sixth the size of the earth. Its average distance from the earth is 250,000 miles or 400,000 kilometres. The moon is the brightest object in the night sky, but it doesn't make its own light; we see it because it reflects light from the sun. Only half of the moon is lit by the sun at any one time and as the moon orbits the earth we see different amounts of the sunlit half, sometimes we see none, this is called a new moon, then a small amount of the moon becomes visible, this is a crescent moon, the crescent grows to a half moon, then a gibbous moon and finally the full moon, the moon then appears to get smaller, these are called the phases of the moon. When the amount of the moon we can see is growing it is called a waxing moon and when it is getting smaller it's called a waning moon. It takes twenty nine and a half days for the moon to go from one full moon to the next.

The first man made object sent to the moon was launched on January 2nd 1959, it was a Russian probe named Luna 1. It collected new data about the earth's radiation belt and outer space and discovered that the moon has no magnetic field. Luna 2 followed on September 13th 1959, it confirmed the findings of Luna 1 and became the first manmade object to land on the moon, and in October 1959 Luna 3 took these, the first pictures of the far side of the moon.

In total, the Russians sent 29 missions to the moon, some landed, some orbited and some flew by. The Luna programme included Luna 9, the first probe to succeed in a soft landing on another world, Luna 16, which returned samples of moon rock in 1970, and Luna 17 and Luna 21, which carried robot rovers called Lunokhod 1 and 2 on board. Unfortunately these later achievements of the Luna programme were overshadowed by the American Apollo programme.

Apollo 8 was the first manned mission to orbit the moon. The spacecraft was launched on December 21st 1968, and returned to earth on December 27th. By the end of the mission the astronauts had taken one hundred and fifty pictures of the earth and seven hundred of the moon including this famous earthrise image.

The 3rd voyage to the moon, and the first to include a lunar landing was Apollo 11 in July 1969, the mission fulfilled President Kennedy's goal of landing a man on the moon and returning him safely to the earth by the end of the 1960's. It took the three man crew three days to reach the moon travelling at seventeen thousand miles per hour. In a car it would take over two years to drive there! As the eagle neared the lunar surface the astronauts realised that where they had planned to land was actually a boulder field, not the flat terrain they originally thought, and with alarms sounding and fuel running low Armstrong manually piloted the Eagle to a safe landing in the sea of tranquillity. After this nail-biting descent, the astronauts spent six and a half hours to prepare themselves for their walk on the moon (Landing sequence audio)

When lunar module pilot Buzz Aldrin joined Armstrong on the surface of the moon he described the scene as 'magnificent desolation'.

During the two and a half hour moon walk the astronauts explored the surface taking photographs and collecting samples of moon rock and soil. They also left on the surface a Scientific Experiment Package which included a seismograph to measure any moonquakes, and a laser ranging retro-reflector which has since been used to measure the distance to the moon more accurately than ever before. Together Armstrong and Aldrin planted the American flag and then took an extremely long distance phone call from President Nixon.

The Apollo 11 mission returned twenty two kilograms of lunar samples to earth. In order to lighten the load for lift off from the moon the astronauts left behind their life support back packs, their moon boots, a camera and some other equipment. Part of the lunar module remained on the surface of the moon and on the ladder there is a plaque that reads, 'Here men from planet earth first set foot upon the moon, July 1969 A.D. We came in peace for all mankind'.

Apollo 13 is famously known as the successful failure and has even had a film made about it. Although the mission launched, travelled to the moon and returned the crew unharmed, because of an onboard explosion early on in the mission the astronauts were unable to land on the moon. It is down to the quick thinking and ingenuity of both the astronauts and their support crew back on earth that this mission didn't end in disaster.

Astronauts Alan Shepard and Edgar Mitchell of Apollo 14 were the first to use colour TV on the lunar surface and also took part in some sporting activities, Shepard managed to smuggle an improvised golf club on board, he used it to hit a few golf balls he had also brought with him, the golf balls are still on the surface of the moon, this inspired Mitchell to use the handle of a lunar sample collector as a javelin.

Apollo 15 was the first mission to take a lunar rover to the moon, allowing them to travel further from the Lander than had been possible on previous missions, the rover remains on the surface of the moon, it carries a plaque which reads, 'Mans first Wheels on the Moon, delivered by Falcon, July 30th 1971' falcon was the name given to the lunar module.

The last Apollo mission to land men on the moon Apollo 17 also carried on board the first and so far only trained scientist to walk on the Lunar surface, a geologist called Harrison Schmitt, this is him enjoying a stroll on one of the moonwalks.

('Strolling on the moon' clip)

Apollo 17 astronauts, using the Lunar Rover travelled the furthest distance on the moons surface and brought back the largest amount of rock and soil samples. On the way to the moon the astronauts took this beautiful photograph of the earth, it is known as 'The Blue Marble', because the astronauts who took it thought that from space, the earth looked like a giant glass marble. Like the previous Apollo landings Apollo 17 left a plaque on the moon. The inscription reads 'Here Man completed his first explorations of the moon. December 1972 AD. May the spirit of peace in which we came be reflected in the lives of all mankind.'

In total the Apollo astronauts spent more than seventy hours conducting experiments and working on the moons surface, and they brought back three hundred and eighty two kilograms of rock and soil. Among the samples brought back from the later

missions were rocks that date back to the creation of the moon which have helped us understand how the moon was formed. You can see moon samples brought back by the Apollo astronauts on the space galley, outside the planetarium.

The moon and the earth are made from very similar stuff, but the earth has a much larger iron core than the moon, we also know from studying the samples brought back from the moon that it was formed twenty five million years after the earth was. This has helped lead scientists to the Giant Impact Hypothesis which suggests that the moon was formed following a collision between the earth and a mars sized object early in the Solar Systems history.

Often when we look at the moon we can see shapes on the surface, many people talk about the man in the moon, if you look carefully, you may be able to see his face, he's not the only thing people see though, have a closer look, can you see a frog? How about a rabbit or hare? Or maybe you think this is the rabbit? Perhaps you can see a crab?

The pictures are made up from the dark patches on the moon called seas, but they aren't really seas, there *is* no liquid water on the moon, they're huge craters that were flooded by molten rock long ago, but they got their name because early astronomers mistakenly thought that the moon was covered in water.

Water isn't the only thing the moon lacks, it does not have an atmosphere, and this means there is no wind or rain on the moon, When people return to the moon, they will find the footprints made in the dust, by the Apollo astronauts unchanged. Even if we don't go back for hundreds of years, this footprint will look exactly as it did when Neil Armstrong made it.

Called Selene and Artemis by the Greeks, Luna by the Romans and many other names in other mythologies, the moon is an intriguing place that has captured the imagination of people and cultures throughout history.

Ch'ang-O (chang or) is the Chinese moon goddess. According to legend, Ch'ang-O and her husband Hou Yi were immortals living in heaven. One morning ten suns rose in the sky and scorched the earth, Hou Yi shot down nine of the suns with his bow and arrow. The suns were actually the ten children of the Jade Emperor who was so angry; he banished Hou Yi and Ch'ang-O to live as mortals on earth. Ch'ang-O was very upset at the prospect of being mortal so Hou Yi went on a perilous journey to find the elixir of immortality, when he found the pill of immortality; he was warned that half the pill would be enough for each person. Hou Yi stored the pill in a box; he told Ch'ang-O not to open the box and then went out hunting. Ch'ang-O's curiosity finally got the better of her and she opened the box, just as Hou Yi returned home. In her panic, Ch'ang-O swallowed the whole tablet. She started to float into the sky and eventually landed on the moon.

According to Hindu mythology, the hare in the moon was put there by Indra, the god of the storm. The story begins when the hare who was out walking with a fox and a monkey, met a beggar. The beggar told the group he hadn't eaten for days and was about to starve. Now this day was a holy day, when the rich would fast and give food to the poor, so the three friends decided to find some food for the beggar. The fox brought back some eggs and the monkey found some mangoes, but the hare could bring nothing, as humans don't eat grass, so he lit a fire, offered himself as food and jumped into the flames. However he didn't burn. The beggar revealed himself to be Indra and he rewarded the hare by placing him on the moon so people could see him and remember his story of courage and self-sacrifice.

Of course we don't believe in these stories anymore, one myth some people do still believe though is that the moon and its phases has an effect on us and the things we do, that we may be more likely to act oddly and out of character during a full moon, or we should plant seeds during a waxing moon to get the best possible crops. Of course the moon doesn't affect us like this; we can see its effects here on earth though, in the movement of our oceans.

You may know that the earth's gravity pulls on the moon to keep it in orbit, but did you know that the moon pulls back? This is what causes the regular rising and falling of the seas, what we call the tides.

The oceans on the side of the earth facing the moon, are pulled on by the moons gravity, this causes the water to swell up into a bulge. The oceans on the opposite side of the earth are pulled much less strongly and they move away from the moon, this is how we get two high tides and two low tides everyday.

The tides cause friction against the earth, and this is actually slowing the earth down by about two thousandths of a second every hundred years. As the earth slows down, the moon moves further away. Every year the distance between the earth and the moon increases by about 3.8cm. As the distance increases the path the moon takes around the earth gets bigger and it takes the moon longer to complete its journey. This will continue until the length of a day is equal to the time it takes for the moon to orbit the earth. By then, the length of a day and month will both be about 55 current earth days. However, this does assume that the earth and moon will continue to exist for 15 billion more years!

Sometimes the earth, sun and moon line up exactly, when this happens we get an eclipse. If the moon is between the earth and the sun we get a solar eclipse, the moon blocks the suns light and it gets dark during the day, and if the earth is between the moon and the sun we get a lunar eclipse. Total solar eclipses happen about once a year but can only be seen for a short length of time along a narrow path, the last time a total solar eclipse was visible from the UK was 1999, and we won't be able to see another total solar eclipse from the UK until 2090.

Partial solar eclipses happen when only part of the suns disc is obscured by the moon, the sky darkens a little depending on the amount of the suns disc the moon is covering and are seen over larger areas than total solar eclipses.

Lunar eclipses happen more often than solar eclipses, and when they occur they can be seen by the whole night time side of the earth. When a lunar eclipse occurs the moon is still visible, but instead of being lit directly by the sun, it is lit by sunlight that shines through the earth's atmosphere; as the sunlight travels through the earth's atmosphere it gains a red tint, and so during a lunar eclipse the moon appears red.

Solar eclipses can only happen because although the sun is 400 times bigger than the moon, it is also 400 times further away, so both objects appear the same size in the sky.

As the moon moves further away from the earth it will appear smaller and will no longer be able to cover the suns disc, this will mean no more total solar eclipses; however, it will be at least 500 million years before this happens.

When the moon is visible in the night sky it is the brightest object we can see, but when it is between us and the sun and it is in the new moon phase, we can't see any of the sunlit half and we get our best views of the stars.

At first glance the stars seem to be scattered randomly across the sky, but long ago people used to make pictures out of the stars and even tell stories about them, we can still see these star patterns, and we call them constellations.

This starry letter W is Cassiopeia a powerful queen from Greek mythology who was placed in the sky by the gods and this square of stars marks the body of the flying horse Pegasus.

In the south, these three bright stars, Deneb, Vega and Altair make the summer triangle, and in the north, this saucer shaped star pattern is the plough. If we follow the two end stars of the plough we find they point to this star, the North Star. The North Star always points the direction north.

Every twenty four hours the earth makes one complete turn on its axis; during the day we can see the earth's rotation in the way the sun moves across the sky. At night time it is the stars that appear to move across the sky, rising in the east and setting in the west. The North Star is directly above the earth's north pole, look carefully, all the other stars appear to be moving in circles around the North Star, while it stays on the spot.

Some of the brightest stars in the night sky are visible during the winter months. These three bright stars in a line mark the belt of Orion. Orion was a mighty hunter from Greek mythology, this star at Orion's foot is a blue giant called Rigel, and a red giant called Betelgeuse marks his shoulder.

Orion is holding a shield to defend himself from Taurus the bull who is charging down out of the heavens. This bright star called Aldebaran is the eye of Taurus, and this V shaped cluster of stars marks his face.

Sometimes if the sky is very dark and clear we may see a shooting star, shooting stars are not stars at all; they are actually small pieces of rock from outer space. When they enter the earth's atmosphere they are travelling so fast they burn up and leave faint trails of light across the sky, we call them meteors.

The earth continues to turn, the sky begins to brighten and the sun rises in the east signalling the start of a new day.

So what lies in the future for the moon?

Well NASA plan to land humans on the moon again by 2020, they have designed a new rocket to get them there called Orion, it will be able to carry teams of four astronauts to the moon for seven day expeditions to carry out experiments and find out more about our nearest neighbour.

At the moment it may seem like a storyline from a science fiction book but in the future we may even build bases on the moon where astronauts can spend longer periods of time, and far in the future we may even use the moon as a rest stop for manned missions on the way to mars and other more distant planets in our Solar System.