

## First steps in space

### First space explorations

Space exploration belongs to our recent history. In fact, 2007 marked the first fifty-year celebrations of the launch of the Sputnik, the first artificial satellite. On the 4th of October 1957, Radio Moscow announced that the USSR had successfully launched a 59 cm diameter sphere, weighing 83 kg into orbit.

For America it was a severe blow, as it was technologically inferior, and it did not have missiles that could launch objects of that weight so far.

The American reaction was soon seen: on 31 January 1958 a missile, Jupiter, of the army, designed by the German scientist Werner Von Braun, the inventor of the V2 missiles of World War II, launched the first American satellite, called Explorer 1, into orbit.

Starting from the 60s, the USSR concentrated its efforts in the design of satellites orbiting around the Earth, of the Vostok series, which culminated with the announcement, on 12 April 1961, of the first astronaut, Major Yuri Alexievic Gagarin, to orbit the Earth. The Vostok series continued, and in particular, on 16 June 1963, Vostok 6 was the first to carry a woman on board: Valentina Tereskova.

In the meantime, starting from 1 October 1958, the Americans created the National Aeronautic and Space Administration (NASA) and started the Mercury programme, that launched astronaut Alan B. Shepard in the first suborbital flight on 5 May 1961.

On May 25 the same year, President John F. Kennedy delivered a speech, presented as a "Special Message to the Congress on Urgent National Needs", in which he presented the Apollo programme. The part of the speech that drew the attention of the Americans most, concerned space exploration, "I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space...".

The programme certainly involved many dangers: on 27 January 1967 during a test run on ground, a fire broke out inside Apollo 1, and all the members of the crew died. The programme was started again one year later, and continued up to Apollo 11, with Commander Neil Armstrong on board, together with pilots Michael Collins and Edwin Aldrin. At 4:57 (Italian Standard Time) on July 21, Armstrong first set foot on the surface of the moon, and uttered the famous sentence, "That's one small step for [a] man, one giant leap for mankind".

The Apollo series continued up to 1971 with Apollo 17, some missions orbited around the Moon without landing on it, others, such as Apollo 12, 14, 15, 16 and 17, instead, visited its surface.

### Orbiting stations

The first concept of an artificial satellite that could accommodate human life was born from the imagination of writer, Edward Everett Hale. In his short story dated 1870, entitled "The Brick Moon", Hale imagined he would build a space station that would orbit around the Earth, simply using some bricks.

Some time after, the literary fantasy gave room to science. In a series of articles dated 1950, the German scientist Verner Von Braun, proposed the project of a space station shaped like a wheel, that, due to its rotating movement, would allow the creation of artificial gravity within its structure. Braun's idea inspired the American film director Stanley Kubrick in his film "2001: a space odyssey" in 1967.

However, for the theory to be put into practice, we will have to await 19 April 1971. This time it was the Russians' turn. They were still disappointed for having lost the race to the Moon, and they successfully launched the space station Salyut 1, into orbit around the Earth.

This first type of station consisted of a single cylinder shaped module that offered very little comfort to the astronauts inside it, however it was possible to carry out experiments on the resistance, for long periods of time, of men in conditions of microgravity in the environment.

On 14 May 1973, NASA launched Skylab in space. It was 35 metres long and weighed 76 tonnes. Its internal diameter reached 6.7 metres, and therefore the available space was really enormous for its three inhabitants. Three crews

alternated their stay aboard the Skylab in the period from May 1973 to February 1974.

Subsequently, in 1984, the President of the United States, Ronald Reagan, launched the project of the Space Station Freedom, a project in which also Europe with ESA, Canada and Japan were supposed to take part. Unfortunately the disaster of the Challenger (1986) forced NASA to stop, and the project was substantially slowed down. That same year, also, the USSR completed the space station Mir (Peace). It was launched on 20 February 1986 and became the most complex structure ever to be realized.

Mir was the first space station of a modular type, in other words it consisted of various structures that were launched separately and assembled in space. During the 15 year period in which it remained in orbit (in fact, it was supposed to remain in orbit for 5 years), over one hundred cosmonauts and astronauts, from at least twelve different countries, stayed aboard. It was made up of seven modules, designed so that they could be connected to the station in various manners, to adapt to the requirements of the different missions.

At the start of the 90s, the Government of the United States also involved the European Russian, Canadian and Japanese space agencies in the project of a space station. The project was presented in 1993 and the station was called Alpha. In the official documents it was then indicated as ISS (International Space Station). At present sixteen nations are involved: USA, Russia, Japan, Canada, Brazil, Belgium, Denmark, France, Germany, Italy, Holland, Norway, Spain, Sweden, Switzerland and the United Kingdom.

ISS, like Mir, is a modular satellite that rotates around the Earth on a low orbit at an average height of 400 km, just above the denser layers of the atmosphere. It completes an orbit in approximately 90 minutes, and it is inclined more than 50 degrees on the equator, that is defined so that ISS can be reached from the launching bases of almost all the space areas in the world.

The International Space Station is a large scientific laboratory, and it includes one European laboratory, the Columbus, two American laboratories, one Japanese and three Russian laboratories. Here new technologies are experimented, that may be used again for space applications in the future or may turn out to be useful on the Earth to improve everyday life.

## Exploring the Red Planet

In the mid 70s planet Mars, our neighbour, became a fundamental target for two American probes: the Viking twins. Both the orbiter module and the lander module took the first detailed photographs of the surface of Mars, and generated a map of over 90% of the planet. The public image of Mars changed brusquely: the red planet was no longer luxuriant nor did it have a rich vegetation, rather, it was similar to the Earth's tundra region, a desert area with no signs of life.

The estimated duration of the mission was 90 days starting from the time of landing, but both the lander and the orbiter continued to operate well after the estimated term. The mission was declared over on 21 May 1983, more than 6 and a half years after the date that was initially estimated by the module designers.

Subsequently, exploration of Mars was substantially paused for over twenty years, a period of time that was interrupted only by the American Mars Global Surveyor mission, launched in 1996, that started sending the first images of the Red Planet at the end of '97. Its high resolution images made it possible to also appreciate the details of the planet, and for the first time it was hypothesized that water might be present on the planet.

From this time onwards the search for water, be it on the surface or trapped in the form of ice or in the subsoil in the form of permafrost, became the main aim of all the missions to the Red Planet.

In 2001, in fact, the American probe Mars Odyssey, managed to discover large quantities of hydrogen just below the surface, a clear clue of the presence of water.

However 2003 was the year of a peak in the missions to Mars, with the clear aim to "reveal" the water that apparently seems to have disappeared, but which probably is to be found in the layers of the subsoil. The European probe Mars Express was launched, and it transported the rover Beagle 2 and two NASA rovers, Spirit and Opportunity. 2003 was a propitious time for exploration of the Red Planet as Mars and the Earth were in a particularly favourable orbit configuration, called the Great Opposition. In fact, at the end of August, due to the elliptical shape of their orbits, the two planets were at their closest approach point, at a distance of only 56 million km.

The orbiter entered the Mars' orbit on 25 December 2003, and on the same day the rover Beagle 2 was unhooked. After

repeated attempts to communicate with it, on 6 February 2004 the rover was declared lost, probably it was destroyed on impact with the atmosphere.

The first image of the Orbiter showed Valles Marineris, with such a level of detail that had never been reached before. In the two following years, the images sent to the Earth provided the first direct proof of the presence of water on Mars. Finally, on 4 August this year, the American mission Phoenix was launched, which will carry a new lander to the polar regions of the north of Mars, to inspect Martian soil in search of proof of the existence of past or present life. Phoenix shall study the climate and the geology of Mars to prepare for the mission of human exploration on the Red Planet. Peter Smith, researcher at the University of Arizona, in Tucson, has said that Phoenix will enable us to explore the regions of the Northern hemisphere of Mars, where the environmental conditions are similar to those of the Earth. In fact, thanks to a mechanical arm, Phoenix shall be able to probe the frozen layers of Mars and take samples to be analyzed. In a certain sense, Phoenix shall try to give a final answer to the fundamental queries of NASA's long programme of exploration on Mars: was there life on Mars in the past?