

10 HIGH HOPES and WHITHER?

SYNOPSIS

HIGH HOPES – Space Stations

A review of the International Space Station (ISS), currently being assembled, and its forerunners. Most famous was Mir, operated by the Russians for 14 years. ISS has now replaced Mir. But ISS is hugely over budget and way behind schedule due to problems with its two major partners. Russia has been late delivering parts because of money troubles. The Americans, with Space Shuttle grounded after the Columbia disaster, could not service ISS. Russia filled in with 40-year-old space ferries.

WHITHER? – Manned Spaceflight

The story of humans in space. With the German Werner von Braun launching American rocketry and Sergei Korolev masterminding the Soviet space programme, the Russians put the first cosmonaut in space and the Americans the first astronaut on the Moon. Then came America's Space Shuttle and the development of orbiting space stations, largely by the Russians. Today, with the International Space Station proving troublesome, a look at future space travel to the Moon, Mars and beyond.

BACKGROUND

Is the International Space Station (ISS) a nightmare or a dream come true? As the largest structure ever assembled in Earth-orbit, a lot rides on ISS. The station, which is permanently manned, was to be a springboard to the Moon and Mars but since construction began in 1998, progress has been slow.

The main problem has been ferrying crews and materials from Earth. America's Space Shuttle was to do most of the work. Strapped to two enormous boosters – jettisoned after a couple of minutes - Shuttle lifts off like a rocket. Within nine minutes Shuttle is in orbit and flying like a spacecraft. From its payload bay astronauts launch, retrieve and repair satellites – and service ISS.

Mission accomplished, Shuttle's orbiting speed of 27,000 kilometres an hour slows for the heat-friction of re-entering Earth's atmosphere. The craft is now an airplane - and a glider at that - because descent is entirely unpowered. Missions are always hazardous. In 1986, the crew of the Challenger Shuttle was lost as a fuel leak from a booster caused an explosion 76 seconds after lift-off. Shuttle missions were suspended.

Before ISS, the Russians operated a permanently manned space station call Mir - orbiting Earth for 14 years. They serviced it with Soyuz, their trusty old space ferry. Returned to service in 1995, a Shuttle docked with Mir. International co-operation had begun. Three years later, in 1998, the Russians launched Zarya, first module of ISS. Soon after, Shuttle delivered a second module. ISS was bolted together – and born.

ISS was to grow module by module. But high hopes were dogged by delays. First, the Russians fell behind with money problems. Then, with a five or six annual

missions required to keep on schedule, the Americans hit trouble. In 2003, the Columbia Shuttle broke up on re-entry and the crew of seven died. With Shuttle now grounded, the implications for ISS were serious.

Russia came to the rescue. Three months after the tragedy, a Soyuz rocket delivered fresh crew and supplies – 40-year-old technology that still worked. The Russians kept ISS ticking over until the mid-2000s, when Shuttle flights resumed. All being well, ISS will be completed by 2010.

But life on ISS can be awkward and noisy. Crew complain of mechanical reverberation, nightmares, motion sickness and snoring! In weightless conditions, astronauts must exercise to reduce muscle wastage and loss of bone mass. And with no showers, washing is with towels soaked in a cleaning agent. Tooth brushing means either swallowing the paste or wiping it away.

ISS orbits Earth every 90 minutes or 16 times a day. Although gravity still tugs, station and crew are weightless because they are in free-fall – theoretically all plunging to Earth. They never reach it because ISS is moving sideways so fast and our planet is always curving away.

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Space Shuttle and the International Space Station are manifestations of an ambition to escape the pull of gravity that began with the ancient Chinese. They invented fireworks and the rocket. The American Robert Goddard lit the fuse of modern rocketry in 1926 when he launched the first liquid-fuelled rocket.

The Germans pushed development in World War II when they unleashed the V2 as a weapon of mass destruction. It was the brainchild of Werner von Braun. As hostilities ceased, he was captured and shipped with fellow scientists to America. At White Sands, in New Mexico, von Braun spearheaded America's embryonic space programme. But the Soviet Union had the first triumphs.

Masterminded by Sergei Korolev, in 1957 the Soviets launched Sputnik 1, the first artificial satellite, followed by the first man in space in 1961, Yuri Gagarin. By 1963, the Soviets put the first woman in space, Valentina Tereshkova. Next, two cosmonauts (as the Russians call astronauts), then three cosmonauts were in orbit together. In 1965 a Russian was the first to walk in space.

America's first man in space, Alan Shepard, only managed a sub-orbital hop. Stung by the Soviet lead, President Kennedy ordered America to put a man on the Moon before the end of the 1960s. The second crewed mission of Project Apollo sent a craft round the Moon in 1968. Then in 1969, thrust by von Braun's Saturn 5 rocket, the Apollo 11 mission landed two men on the lunar surface - Neil Armstrong and Buzz Aldrin.

The last Moon mission, Apollo 17, was in 1972. Since then, no one has been back. Instead America launched Space Shuttle. As a reusable vehicle, the aim was to cut ferrying costs into low Earth orbit. The Russians stuck with expendable and simple rocketry. They built orbiting space stations, culminating with Mir. Now America and Russia have combined resources as chief participants in the International Space Station.

What of the future? A lightweight aerospace plane is a possibility. Slashing all previous costs, air-breathing engines would suck oxygen from the atmosphere to burn hydrogen fuel – so eliminating the enormous weight of carrying oxygen. Only approaching orbit would conventional rockets kick in. From airport to orbit would take just ten minutes – a budget ride to a spaceport 500 kilometres above the surface of Earth.

The spaceport would be an interchange for onward flights to the Moon, just a couple of days away. The Moon would be colonised and mined for minerals. Spaceport would also launch express trips to Mars. Designs already exist for nuclear-powered rockets that will cut the voyage from nine months to six weeks. On Mars, self-sustaining biospheres would grow food and provide shelter for colonists from Earth.

That could well be the picture in the late 21st century. Farther in the future we may head for the stars. But to leave behind Earth, the Moon, the planets and the Sun, even travelling at one-tenth the speed of light, it would still take 40 years to reach the nearest star and still longer to find a star with a planet like our own.

Weblinks for HIGH HOPES – Space Stations

<http://www.nasa.gov/news/highlights/index.html> - Stay up-to-date with the latest news from the US space agency NASA, including mission and research highlights.

<http://www.nasa.gov/audience/forkids/home/index.html> - NASA's space site for young people, with games, art and stories, activities, a Kid's Club, and answers to a host of questions that young people ask about space.

<http://www.russianspaceweb.com/mir.html> - From the Russian Space Web, a comprehensive overview of the assembly of the space station Mir, with mission highlights and details of all the modules.

<http://www.russianspaceweb.com/soyuz.html>

and

<http://www.russianspaceweb.com/progress.html> - From the Russian Space Web, comprehensive details of the origins, flights and major constructional elements of the Soyuz and Progress spacecraft.

http://www.nasa.gov/audience/foreducators/topnav/subjects/lifesciences/Living_and_Working_in_Space.html - See the many questions and answers received by NASA's Office of Space Flight regarding life and issues related to living and working in space.

http://www.nasa.gov/mission_pages/shuttle/main/index.html - Everything about the US Space Shuttle program – facts and figures, behind the scenes news, vehicle structure, launch and landing, the missions and a host of invaluable resources.

http://www.nasa.gov/mission_pages/station/main/index.html - All about the International Space Station from a US perspective – facts and figures, behind the scenes news, station resupply, station science, station structure and assembly, the expeditions, the crews and a host of invaluable resources.

<http://www.russianspaceweb.com/iss.html> - From the Russian Space Web, a fascinating summary of the design and construction of the International Space Station from a Russian perspective.

http://spaceflight.nasa.gov/spacenews/factsheets/pdfs/living_in_space.pdf - A ready-to-print version of the NASA fact sheet on “Living and Working in Space”.

<http://www.seds.org/~spider/shuttle/iss.html> - The planned Assembly Flight Sequence Schedule for the International Space Station. Note that future launch dates are subject to frequent changes. US Space Shuttle launch dates are still very preliminary.

Weblinks for WHITHER? – Manned Spaceflight

<http://inventors.about.com/library/inventors/blrocket.htm> - An excellent overview of the history of rockets, including the people behind them, the evolution of rockets (with a timeline) and how they work.

<http://www.russianspaceweb.com/rockets.html> - From the Russian Space Web, a useful summary of the history of rocketry.

<http://spaceflight.nasa.gov/home/index.html> - NASA’s main home page for human space flight.

http://www.nasa.gov/centers/kennedy/about/history/spacehistory_toc.html

and

<http://spaceflight.nasa.gov/history/index.html>

and

<http://www.hq.nasa.gov/office/pao/History/40thann/humanspf.htm> - Three sites giving the history of human spaceflight from NASA’s perspective.

http://www.windows.ucar.edu/tour/link=/space_missions/manned.html – From the University Corporation for Atmospheric Research’s “Windows to the Universe” website, a guide to the history of human spaceflight, with information available at beginner, intermediate and advanced levels.

<http://www.russianspaceweb.com/people.html> - From the Russian Space Web, pages dedicated to those who made significant contributions to the development of the Russian space program or influenced its direction – the scientists and engineers, the industrial administrators and the managers.

<http://www.russianspaceweb.com/spacecraft.html> - From the Russian Space Web, an extremely useful resource describing all of the main Soviet and Russian spacecraft. Includes details of the Russian manned lunar program, and the “Moon Race” from a Soviet perspective.

<http://www.hq.nasa.gov/office/pao/History/alsj/picture.html> - The Apollo Lunar Surface Journal’s galleries containing all the images taken on the lunar surface by the astronauts, together with pictures from pre-flight training and pictures of equipment and the flight hardware.

<http://www.badastronomy.com/bad/misc/apollohoax.html> - Astronomer Phil Plait's thorough debunking of the claims that NASA never sent men to the Moon, with links to other sites which also dismiss this notion.

http://www.nasa.gov/mission_pages/shuttle/main/index.html - Everything about the US Space Shuttle program – facts and figures, behind the scenes news, the vehicle structure, launch and landing, the missions and a host of invaluable resources.

<http://www.spacefuture.com/vehicles/designs.shtml> - Brief summaries with pictures of a range of concepts for space vehicles of the future.

http://en.wikipedia.org/wiki/Vision_for_Space_Exploration - From Wikipedia, the free encyclopedia, an overview of NASA's "Vision for Space Exploration".

http://www.nasa.gov/mission_pages/exploration/main/index.html - NASA's home page for "The Vision for Space Exploration", looking ahead to the Moon, Mars and beyond, with descriptions of NASA's new spaceships and robotic spacecraft, a look at why we explore, and some invaluable resources.