Mars : A Planet Of Robots *continued*

The conclusion of this series of articles from our Features Writer **Nik Steggall** which has taken us through the exploration of The Red Planet

Part 5A Mars Helicopter Scout

A 4 lb (1.8 kg) Mars Helicopter Scout was scheduled to travel with the next NASA Mars rover in 2020, with a landing expected in February 2021. This autonomous mini helicopter will make a few brief hops into the Martian air to test out a completely new mode of transport over Mars. It will make a maximum of five such flights as a technology demonstrator: see artist's impression below. If they are successful a new area of Martian exploration could be opened up. It is hoped that more advanced versions of the helicopters could be used as scouts for rovers to explore further regions of the surface. It would also allow exploration in inaccessible area or even over biologically sensitive areas.

The mini helicopter is slightly larger than a baseball. Onboard are a range of avionics and communications equipment, a small solar panel with rechargeable lithium-ion batteries. Survival heaters will keep the electronics warm during the cold Martian night and finally a navigation camera. Being a technology demonstrator it does not carry any science instruments except for a high resolution colour imager.

A couple of months after the rover has landed the helicopter will drop to the surface. Each of the hops then

Future Mars exploration speculation on Australia 2000

taken will be of 90 seconds in duration and at a height of 16.5 ft (5 m). They will be made between 330 to 3,300 ft (100 to 1,000 m) away from the rover. This will be so that the helicopter poses no threat to the rover but also it could still use the rover as a communications link.

The Martial atmosphere is only 1 percent as dense as the Earth`s so that the equivalent altitude on earth would be in the region of 100,000 ft (30,000 m). The helicopter has two stiff rotors 3.9 ft (1.2 m) long which will spin at a rate of 2,400 revolutions per minutes, ten times faster than they would need to be on Earth.

The first flight would be a historic event and like to first powered air flight on Earth in 1903 of the `Wright Flyer`.

Part 6

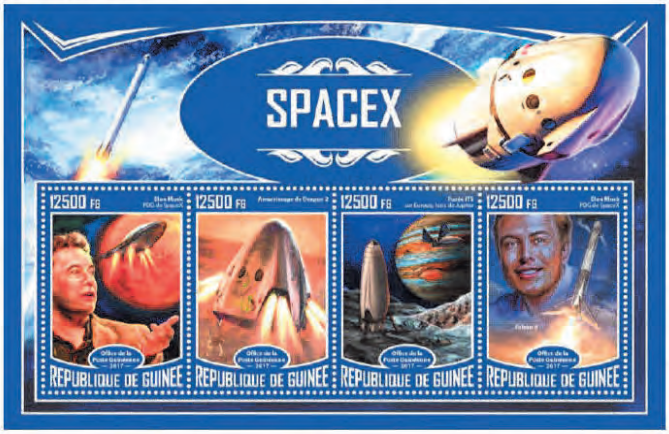
The Humans Are Coming

A Red Dragon on Mars

The SpaceX company promoted the idea of the first private spaceflight to Mars with one of their un-crewed Red Dragon spacecraft launched by the Falcon Heavy rocket. Using a modified Crew Dragon spacecraft on a test flight, it would have evaluated the technologies required to land a large spacecraft on the surface of Mars among other scientific investigations.

The initial Red Dragon demonstration mission would have been a Mars sample return mission with technical assistance from NASA. The concept

would have called for instruments to drill 3.3 ft (1 m) underground to sample reservoirs of water ice in the shallow subsurface.



Stamps showing Red Dragon on Mars and the Starship on Jupiter`s moon Europa

Stamp showing Red Dragon and SpaceX astronaut on Mars. (Note how The astronaut looks very similar to Elon Musk).

Red Dragons linking up to form a Mars base.

It was planned to take supplies and Dragon habitation modules for Martian exploration. SpaceX eventually plans to set up a colony on Mars as this has been the goal of Elon Musk the founder of SpaceX from the outset.

But.....A Change of Plan

With the delay in the crewed Dragon and a rethink, SpaceX's revised plan is now to launch a completely new spacecraft and launch vehicle to Mars, using the Starship and Starship Heavy first stage. Test flights and a demonstration flight around the Moon with the `Dear Moon` crewed flight would take place first. Of course timings and schedules can and most probably will change.

The plans now are for a demonstration mission in 2022 in which it will land and deliver cargo for the next landing. Two years later a crewed flight would go and land on the surface with its astronauts and cargo. SpaceX would then start work on constructing the Mars base. The early Mars missions will have a small crew of 12 with much of the pressurized space taken up with cargo. The primary aim of these first missions will be to build out and troubleshoot the propellant plant and the Mars Base Alpha power systems while preparing the rudimentary base. The first mission will be of 26 months before the astronauts would return to Earth. Before this first mission a number of cargo missions will take place to

SpaceX Starship at Mars Base Alpha.

SpaceX Mars city.

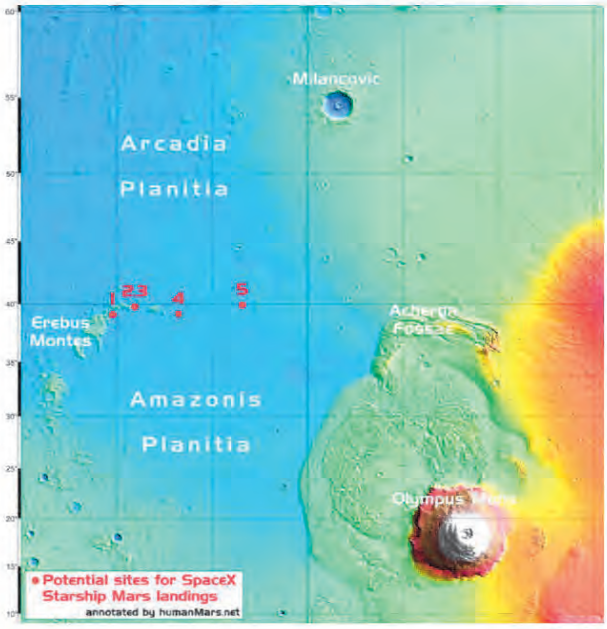
Stamp showing Starship landing at Mars Base Alpha.

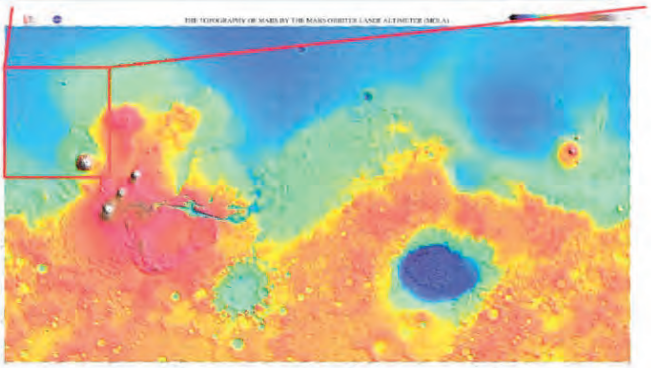
deliver equipment, habitation and supplies to the base area. The early groups to Mars will have equipment to produce fertilizer, methane and oxygen from the subsurface water ice. Construction materials would build transparent domes for crop production. Mining and tunnelling droids would build a large amount of pressurized space for industrial operations. These cities will be able to accommodate the Starships landings with up to 100 people at a time and the cities expanding into a sustainable population on Mars.

The colony ships would have a restaurant, cabins, zero gravity games and movies to pass the time of transit to Mars which would take an average of 115 days. As time goes by the ticket price for travel would come down to create a self sustaining civilization on Mars. Rather than refer to the base as a colony it is now being referred to as a settlement with the long term aim of permanent Mars cities by 2050.

Taken further into the future SpaceX plans would expand the Mars infrastructure to include missions to the Saturnian moon Enceladus, the Jovian moon Europa, the Kuiper belt objects and even further out into the solar system to the Ort cloud.

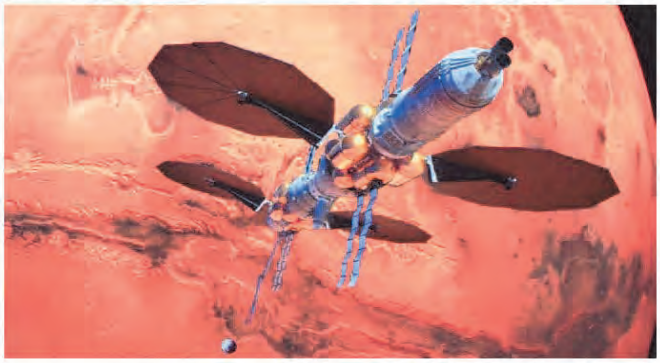
But first the SpaceX company have been looking for places to land its Starship to start the colonization of Mars. Five candidate landing sites are being looked at by the Mars Reconnaissance Orbiter in the Arcadia Region near Olympus Mons. This region has been closely looked at because it has two elements that the Mars Base Alpha will require—water and solar energy—not only to support human life but also to fuel the Starships. These sites have shown that there is abundant shallow ice and also strong evidence of buried ice glaciers is present for life support and also for refuelling the Starships. Previous areas looked at were Deuteronilus Mensae, Phlegra Montes, Utopia Planitia and the southern Arcadia Planitia. All the candidate landing sites are located on the border between Amazonis Planitium and Arcadia Planitia.





A Mars Base Camp

SpaceX is not the only mover in town. NASA has said that it aims to go to Mars too using the Lunar Gateway as a test and proving ground for the infrastructure required to achieve this. In a request by NASA for proposals the Lockheed Martin company has proposed the Mars Base Camp (MBC). This is a crewed Mars laboratory orbiter concept using the Orion MPCV. As a Deep Space Transport it would be a crewed interplanetary spacecraft used to support science exploration missions to Mars of up to 1,000 days.



The MBC would be able to conduct real time telerobotic science both in Mars orbit and on the moons of Phobos and Deimos. This would serve as a proving ground in preparation for human missions to the surface of Mars. This would be achieved by using a reusable shuttle called the Mars Ascent Descent Vehicle, MADV linking the MBC to the Martian surface.

Future Mars exploration speculation on USA 1998

And right colonising the solar system (1993)

Part 7
To Land On a Red Moon

The moons of Mars, Phobos and Deimos, have been studied and photographed from orbiters around Mars but so far nothing has landed on them to study at close hand. This is about to change when a small lander will land and explore one of them. A spacecraft is to be sent to orbit both the moons, land on the surface and also return samples of the surface. Japan is scheduled to launch the Martian Moon eXploration (MMX) mission in September 2024. It is planned to orbit Mars in 2025 and then return the moon's samples back to Earth in 2029.

The plan is for the MMX spacecraft to orbit Mars before transferring to an orbit of Phobos where it will land to gather regolith particles using a simple pneumatic system. This lander mission aims to collect a minimum sample amount of 10g (0.35 oz). The spacecraft will then take off from Phobos before making several flybys of Mars`s smaller moon Deimos before its sends the Sample Return Capsule back to Earth for its arrival in July 2020.

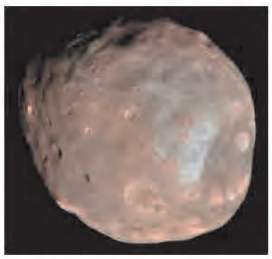


Photo of Phobos and stamp from USSR

Interestingly the masses of both Deimos and Phobos are too small to capture a satellite into a normal orbit. Therefore a special kind of orbit called a quasi-satellite orbit will be managed to keep a satellite in a stable orbit long enough to allow for many months of operations in the vicinity of Phobos.

One question waiting to be answered is where did Mars`s moons come from? Were they created by an impact on Mars or did Mars gravity capture then as asteroids that came close to Mars. Sampling the moon's rocks may be able to answer the question on their origins. The surface of the moons is covered in a fine grainy dust type material so it would be relatively easy to take a sample. As such this may help with learning more of the process of the evolution of the Mars region i.e. Mars and its two moons. learning from the technology involved with this mission will also help to improve future planetary and lunar probes.

Phobos may even act as a way station for crewed missions to the Martian surface. There may also be water that could be made into fuel.

Tony Bela Infographics

A wide range of informative space infographs have been made by the award winning illustrator graphic designer Tony Bela. Tony produces these excellent infographs showing detailed stages of a spaceflight or space mission from launch through to landing. Tony`s infographs evolve until he gets to the finished one. He also produces them for each stage of the space flight as the timeline progresses.

The many subjects covered include the Apollo Moon landing missions, the SpaceX Demo 2 mission returning American astronauts to space from American soil and NASA`s Mars 2020 mission to place a rover on the surface of the planet Mars.

They are free to use for non profit and educational purposes. They are also available for print publications upon request. Tony can be contacted at `www.tonybela.com`. Tony also has a Patreon site for his high definition infographs. Since these are digital files they can be reproduced in any size, e.g. A1, A2 seem best.