

SCOTLAND on SUNDAY

Sun 18 Jun 2006

The all-new space race

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ON EACH of his four visits, Robert Zubrin found life on Mars a cumbersome and challenging experience. There were personality clashes and arguments inside the 27ft-wide fibreglass and steel living chamber, which he shared with four other crew members. There was the bulky spacesuit he was forced to don every time he wanted to venture outside into the freezing landscape to collect soil and rock samples.

There were also difficulties with the inflatable greenhouses in which he and his colleagues attempted to grow their own fresh vegetables to supplement the dried food they had brought with them. And the terrain, buried in permafrost on the edge of an impact crater, was tough going.

"One of the first challenges is selecting the right crew," explains Zubrin. "A Mars mission is a team sport."

So far this "Mars" has only been a simulation, 132 million miles from the actual surface of the Red Planet. The Mars Society, of which Zubrin is president, has created the Mars Arctic Research Station, on Canada's Devon Island, 900 miles from the North Pole, in order to give scientists some idea of what life would be like there. Everything the crews undertake is carried out as if they are living on Mars for real.

"I have been on four missions to our Arctic station myself and each time the group behaved differently," said Zubrin. "From the work we have done, it is going to be extremely hard work for those first people sent to Mars, and no one can afford to slack off."

The tantalising and once unthinkable prospect of humans leaving Earth to live on other planets and exploit the rich, and perhaps unique, resources to be found there was raised last week by the world's most famous scientist, the eminent British astrophysicist Professor Stephen Hawking. The 64-year-old told a conference in Hong Kong that he believed there could be a permanent base on the Moon in 20 years and a colony on Mars within 40 years.

The author of *A Brief History of Time* warned: "It is important for the human race to spread out into space for the survival of the species. Life on Earth is at the ever-increasing risk of being wiped out by a disaster, such as sudden global warming, nuclear war, a genetically engineered virus or other dangers we have not yet thought of."

Hawking is not alone. Space agencies around the world are already developing plans to build bases on other planets, with missions scouting out potential sites for extra-terrestrial real estate. Three years ago US President George W Bush announced a grand plan to return to the Moon and then continue to Mars.

And while currently only government-funded agencies such as Nasa and the European Space Agency have the potential to send humans to either, private firms are beginning to eye this new, fertile ground with greedy eyes.

But the arrival of Starbucks and McDonald's on the Moon is not quite imminent. Even for the heavily funded American space agency, the Herculean task of just getting humans to set foot on it again is still 13 years away. Nasa has only just begun work on a new crew exploration vehicle that will carry astronauts the 239,000 miles back to the Moon. Costing more than \$104bn, the programme has already been hit by doubts over funding when Bush's presidency ends in 2008.

The European Space Agency last week also launched a new project aimed at blazing the trail for the first human flight to Mars. Its ExoMars project will send robotic explorers to the Red Planet to search for resources and even life. And this, claims Bruno Gardini, head of the Agency's Aurora space exploration programme, could be the first stumbling block.

"If we do find life on Mars we will face some difficult ethical questions about whether we should be sending humans there," he explained. "If we put humans on Mars, we will contaminate the environment and this would undoubtedly damage any life living there. Martian bacteria could also be dangerous to humans, so could we really justify bringing that back to Earth?"

But even without this added complication, the road to establishing a colony on either Mars or the Moon is likely to be a long one. Gardini believes we still lack the crucial technologies to make life possible in these inhospitable environments. The limits of our ingenuity are already stretched by the searing -70°C cold of the Antarctic. On the Moon the temperature fluctuates from more than 100°C to less than -100°C . Without the protective cocoon of the Earth's atmosphere and magnetic field, the Moon is also bombarded by dangerously high levels of radiation and solar flares. Despite the presence of a thin atmosphere, Mars is little better.

Gardini believes that, despite these challenges, it is inevitable that humans will one day be living on Mars and the Moon. "Getting there is not going to be a solo enterprise. It is going to require real global co-operation due to the difficulties and the costs involved."

Science fiction author Arthur C Clarke believes space agencies must now begin investing in developing cheaper alternatives to rockets to make colonies on other planets a viable option.

He said: "There is at least one idea that may ultimately make space transport cheap and affordable to ordinary people - the space elevator. Imagine a cable linking a satellite to the ground. Payloads could be hoisted up it by purely mechanical means, reaching orbit without any use of rocket power. The cost of launching payloads into orbit could be reduced to a tiny fraction of today's costs.

"If this ever happens, the most expensive component of travel around the solar system would be for life support - and in-flight movies."

Yet while science fiction geeks dream of sprawling urban landscapes straight out of hit movies such as Blade Runner, the reality for the first extra-terrestrial settlements will be closer to the Styrofoam and fibreglass structures being used in the Arctic by the Mars Society.

To build a settlement on the Moon or Mars, pioneers will have to find air, water and power on their new home. Frozen water was recently discovered at the poles of the Moon while experts claim minerals and metal ores can be extracted from the lunar rocks. As it costs millions of pounds for every kilogramme sent into space, the more self-sufficient a base can be, the better.

Despite the relative proximity of the Moon - just five days' spaceflight away - Zubrin believes Mars provides a far more realistic option for permanent human habitation.

"If we develop the technology to make it possible, there are the resources available on Mars to support life," he explained. "It has permafrost that can be melted, carbon dioxide that can be broken down to make oxygen and fuel. It has a 24-hour day for growing plants.

"Humans will probably colonise other planets in the same way as they colonised the Earth - by developing technologies such as clothing, housing and discovering fire to help them adapt to new habitats."

The analogy is clear. When human beings finally venture into space they will develop the craft to learn how to live out there and find new ways of extracting resources from a different environment.

Zubrin claims these first tentative steps towards colonising other planets will begin with simple scientific bases being established on Mars and the Moon.

He said: "Any colony on Mars will need government support initially as it cannot be economically viable.

"The initial bases will be scientific communities. With these highly intelligent and motivated people, the colonies would become invention hot-houses. I envisage the Martian economy being built around exporting concepts rather than products. It will cost too much to transport goods back and forth to Earth, but intellectual products are far better for interplanetary commerce."

Other commentators predict the surge to colonise other planets will mimic that which followed the discovery of the New World in the 16th century, with a mixture of social experiments as different nationalities and religious groups attempt to carve out their own civilisation in space. But, like those experiments in government and economic design during the early colonisation of America, many fear there will be similar mistakes made in setting up the first colonies in space.

Already more than a dozen countries are expanding their space programmes in a bid to stake their claim on the rich and untapped resources of other planets when humans finally begin settling there. At the moment space exploration is governed by a United Nations treaty that states the Moon and other planets are the heritage of all mankind for the purposes of exploration.

But Bob Zimmerman, author of *Leaving Earth*, a book about exploring outer space, believes these rules will be rewritten once the possibility of living on other planets draws near. He claims another more powerful force - capitalism - will overtake the government-funded drives to inhabit other planets.

"At the moment we have countries all competing for a piece of this pie, but once the aggressive commercial movement gets into space they will quickly overtake the government projects," he said.

"The Outer Space Treaty will be quickly rewritten and, unless governments try to block private

companies from expanding on to other planets, they will make the most of the rich resources they can find there. It is going to become a turf war."

Zimmerman also believes tourism may become the biggest driver behind expanding into the solar system. Already three companies, including Richard Branson's Virgin Galactic, are on the verge of sending tourists on affordable sub-orbital space trips.

Other private firms are developing technology to house the first human settlers on Mars. The US-based 4Frontiers Corporation hopes to open a small human settlement on Mars in 20 years' time. With wealthy millionaires prepared to spend £20m for a trip into space on a Russian rocket, the financial rewards for taking the first civilian pioneers to Mars could be huge.

For those who have already experienced a version of life on the Red Planet, just getting humans to take those first steps on its surface would be a big step forward.

Zubrin said: "We have the capability to go to Mars in just 10 years from when a programme to send a manned mission starts. The only issue is that the programme might not start soon."

There may be delays and hiccups along the way, but all the experts agree on one thing: life on Mars is a question of when, not if.

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Last updated: 18-Jun-06 01:25 BST

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