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MARS SOCIETY AUSTRALIA SUBMISSION TO THE INTERNATIONAL SPACE ADVISORY GROUP

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1 INTRODUCTION

Human beings have long dreamed of setting foot on the planet Mars. A stated goal of NASA is to send humans to the Red Planet. Using its best plan, the Design Reference Mission, NASA plans to send explorers to Mars by 2020. We firmly believe Australia can play a role in this visionary journey.

People have never been to another planet, a fact that greatly limits our understanding of the Solar System. Robots can tell us many things, but they are yet to even approach human capabilities including on-the-spot observation, intuitive and autonomous exploration and skilful action.

Mars is a world like Earth in many ways. It has an atmosphere, seasons, poles capped with water ice, a surface area equivalent to all the land on Earth, and gravity. Its frigid desert terrain bears the same kinds of minerals we find here, including iron, its rolling sand dunes, cliffs and mountains remind us of deserts in Australia and elsewhere. One Martian day is very nearly equal in length to one Earth day, and Mars orbits the sun every two years. It has all the resources needed to support a substantial human presence. If we are destined to leave the cradle of Earth, the first stop will be the Red Planet.

Some still wonder whether the Moon landings were really a demonstration of technological progress or the product of some cinematic back lot. And while we may joke about it, the fact remains that many have 'tuned out' from our forays into space since that seminal moment in 1969 when Armstrong and Aldrin crossed the Rubicon. We have been focusing our attention on low earth orbiting (LEO) activity, when, for just a fraction of current space expenditures (and without abandoning human LEO space flight), relying on well known technologies, we can go to another planet and return a great scientific harvest. The journey need not be a doorstep visit - we should go there to stay.

Australia has a long history of scientific exploration and peaceful pioneering. Less than 200 years ago, Antarctica may as well have been as remote as the Mars. A systematic series of expeditions opened our eyes to the value of this desolate white continent. To mark the International Geophysical Year in 1958, Antarctica saw the extraordinary establishment of some 60 scientific bases by 12 nations over 12 months. A continual human presence ever since has resulted in a raft of crucial scientific payoffs, including discovery of ozone layer thinning and studies into the greenhouse effect. We led signing of the Antarctic Treaty in 1959, suspending all territorial claims and creating a scientific reserve for current and future generations.

Australia knows about international collaboration on large scale, visionary exploratory efforts through our astronomy programme, reliant on public funding. We understand harsh, remote environments and their value in helping us manage our own backyard. If we do not actively take part in future human Mars missions, we may forego the opportunity to play a role in how Mars is used by humanity. As the custodians of an entire planetary continent and leaders in Antarctica, we believe Australia has an obligation to contribute meaningfully to the human journey to Mars. If we do not, we will be left behind.



Mars is one of the most fascinating and inspiring ideas of our age. But above all it is a place. It beckons just like the Great Southern Land spoke to our European ancestors and no doubt beckoned our Aboriginal ancestors tens of thousands of years earlier. And today its call only grows. The biggest Internet event in history occurred following the landing of Mars Pathfinder when 47 million people across the world accessed the spacecraft's website *in a single day* on 8 July 1997. On 4 July alone, 750,000 hits were recorded on the CSIRO Mars Pathfinder mirror site – hundreds of thousands of Australians wanted to be there, to see for themselves. Yet the tiny Sojourner rover travelled no more than 57 meters during its Mars odyssey – we still have a great deal to learn about the Red Planet.

One thing is clear – millions of people around the world are fascinated by Mars. Exploration of outer space inspires our children like little else and the media feeds this widespread public interest with information about the exploits of other nations. The frontiers that fuelled the great expansion in knowledge and technology during the last 500 years have all but disappeared. Today the world needs a new set of goals. Many point to a future of biotechnology, nanotechnology and other wonders that will no doubt help transform our lives. But nothing can match the wonder of what lies beyond the frontier. Only that which is bigger than us all can truly bring us together and inspire our best. Mars is the emerging challenge for the 21st Century, and one group is mobilising public support while increasing our preparedness for human missions.

2 THE MARS SOCIETY

The Mars Society is an international non-profit incorporated organisation determined to promote a real goal for space programmes around the world, and to undertake private activity taking us a step closer to Mars. Founded in Boulder, Colorado in 1997, it now has thousands of members across dozens of countries. The Society undertakes the world's most ambitious privately funded Mars research programme in co-operation with leading organisations such as NASA. Already it has helped advance Mars mission planning, recruited funding, talent and resources, organised scientific conferences, and established a simulated habitat/lander facility on the largest uninhabited island on Earth, Devon Island, considered analogous in many ways to the Martian surface.

In 1989 the Bush Administration instructed NASA to develop plans for a human mission to Mars. Drawing on outdated concepts inherited from the 1950's, and overly constrained by cross-purposes (e.g. LEO assembly of a Mars spacecraft) the NASA plan was budgeted at US\$550 billion (2001 dollars). For comparison, the current Australian GDP is approximately US\$450 billion. Such an enormous figure scuttled any prospect for humans to Mars in the following two decades. But in 1991 a small team took an innovative approach and developed Mars Direct, a new plan to send humans to the planet. Based upon more practical design philosophies, Mars Direct costs less than US\$55 billion, less than one-tenth the original plan and just half the projected cost of the International Space Station. In a 1994 about-face, NASA effectively adopted the new approach. The Mars Direct team was led by Dr Robert Zubrin, inaugural President of the Mars Society.

3 MARS SOCIETY AUSTRALIA

Mars Society Australia (MSA) is soon to become incorporated in 2001. Although affiliated with The Mars Society, MSA is running its own innovative technical programme and winning respect from its peers and international researchers. This private research is unique in Australian space science and engineering. We know that Australia is unlikely to be able to mount its own human Mars missions in the foreseeable future, but we *can* contribute



significantly to the planning and even execution of international missions. A good part of the putative US\$55 billion could find its way to Australia, where it would stimulate our research and development community and nourish a high technology industry base. Countries will signal their engagement with the 21st century by responding to challenges such as Mars missions - or else turn their backs on tomorrow.

MSA is heavily engaged in outreach work through a grassroots national network. This includes participation in local science fairs and National Science Week activities. In 1999, Melbourne teenager Felix Dance won the prestigious international Hakyluyt Prize, awarded to a young person for the best letter to community leaders advocating Mars exploration. We have received extensive media attention and aim to show all Australians that Mars is not an abstract concept from their school text books but a real goal for a new century, a challenge to which they can contribute. This combination of a growing outreach programme with a credible technical programme provides us with a unique platform for ensuring Australians can play a role in the journey to Mars.

4 MSA TECHNICAL PROGRAMME

The initial phase of our technical work focuses on simulation activities contributing to the design databases for use in Mars mission planning. Later phases will involve participation in small robotic Mars missions, and eventually human missions. MSA runs five projects:

- Mars-Oz, a US\$150,000 facility similar to the Devon Island station, to be located initially in South Australia,
- Marsupial, building a realistic mock-up of a pressurised rover (the Human Operations Prototype or HOP) vehicle for sorties away from the main base,
- Jarntimarra, Aboriginal for "star", building a database of Australian Mars-like sites encouraging local and international researchers to use our natural assets,
- Mars-Skin, developing a simulated surface suit, Marskin-1, for use with Mars-Oz and the HOP,
- SAFMARS, or Store and Forward Mars Analogue Research System developing compact ground stations for remote field messaging and monitoring, testing use of lightweight communications for Mars.

Australia has some of the best field sites in the world for understanding how Mars and Martian life might have evolved. It is also ideally suited as a major location for field simulations and testing in the lead up to the first human Mars missions. In late 2002 MSA plans to undertake a field campaign called Operation Red Centre (ORC) which will bring these projects together, undertaking experiments to improve our understanding of Mars crew-crew, crew-machine and machine-machine interactions in a realistic setting. ORC02 will also be a major public relations exercise with involvement of local and world media, building on the success of Devon Island and making Mars more real for people everywhere.

This programme is innovative and focussed on providing opportunities for Australians to be involved in Mars mission planning. It also seeks to **showcase and develop Australian engineering capabilities**. For instance, the Marsupial HOP, currently in design, includes a number of innovative features with patent potential. Mars Skin will promote the alternate "Mechanical Counter Pressure" (MCP, a garment that uses tight elastic suit layers rather than a bulky and constraining gas pressurised suit) approach to Mars crew EVA systems, and in cooperation with the inventor of the MCP, American Dr Paul Webb, we hope to facilitate outback field tests of a real system produced by Honeywell.



5 LINKAGES

In October 2001, MSA is bringing together renowned local and international scientists including Professor Malcolm Walter from the Australian Centre for Astrobiology and Dr Carol Stoker from NASA Ames Research Centre, to undertake an expedition into South Australia and the Northern Territory. We will survey and catalogue Mars-like areas for use in future Mars simulation and technology testing activities. The Jarntimarra Database has been made publicly available online at the MSA website.

MSA believes strongly in collaborative linkages between fellow Australian space organisations and researchers. We have been instrumental in mobilising and bringing together the local Mars research community through the annual Australian Mars Exploration Conference (AMEC), the first such event being held in May 2001. We have links with academics at Macquarie University, The University of Sydney, The University of Melbourne, The University of Adelaide, Murdoch University and The University of Queensland, amongst others. We have ties with local space groups including the Australian Space Research Institute (ASRI), for example through the SAFMARS project, and the National Space Society of Australia (NSSA).

We believe in a strong, united, local space scene where groups contribute according to their strengths and interests but recognise the importance of critical mass, resource gathering and cooperative problem solving. This can best be facilitated by a central organisation dedicated to fostering relationships, seeding innovative projects and encouraging application of leading-edge Australian research into technologies for local and export consumption.

6 AN AUSTRALIAN SPACE ORGANISATION

MSA believes that Australia needs a national space agency. We acknowledge the triumphs and missed opportunities of past Australian space activity but do not dwell on this. Australia is a nation that *can* afford a significant space programme, properly asserting our place amongst the advanced nations. Such a programme should balance:

- **space engineering** of LEO utility systems *and* of beyond-LEO exploratory systems that build a high value-added export industry raising local wages and living standards and promising spin off technologies, ideas and vision to stimulate the national economy, with
- **space science** that seeks to answer fundamentally pressing questions about Earth such as those concerning climate change, weather dynamics, topsoil degradation, hydrogeography, geology and ecological/biological history and change by using LEO observation, comparative planetary science (including Earth analogue research), studying data collected from other planets such as Mars and the methods and technologies developed in support of Mars voyages.

An Australian space agency should be led by dynamic people with technical knowledge who recognise the importance and value of resourcefulness in the local context. In our view it should be forward thinking and forward acting. Its charter should make **explicit reference to the pursuit of space exploration**. It should regard "space activity" not just as rockets, tracking stations and LEO satellites, but also as:

- Earth-based space science including theoretical research in our universities with potential technological applications for local space engineering;
- comparative planetary studies including analysis of data captured by international missions;



- meaningful involvement in and even initiation of international inter-planetary missions,
- Earth-analogue research including the fields of astrobiology, planetary geology, oceanography, climatology and atmospheric science;
- Earth-analogue simulations and field testing exploiting current leadership and potential in these fields; and
- **Development of planetary surface multi-use technologies with potential in future Mars missions**, exploiting our natural testing environments and know-how of applications in remote and difficult environments.

Particular emphasis is laid on the last item, because it links most closely with terrestrial applications and our current economy. There are many innovators and companies in Australia developing technologies with potential for Mars mission applications, yet they are probably unaware of the possibilities or have not been given opportunities to work with international Mars researchers and scientific field testing facilities. As just one example, we highlight the home-grown PIMA Spectrometer produced by Integrated Spectronics Pty. Ltd. of NSW, a CSIRO spin-off company, as a fertile technology for Mars mission adaptation involving miniaturisation and field testing. It can be used to remotely identify rocks and minerals and could be used in a Mars orbiter and as a hand held version by Mars surface crew.

NASA has identified the desirability of developing so-called “dual-use” (or “multi-use”) technologies for human Mars missions in areas such as communications, in-situ resource utilisation (ISRU), suits, mobility vehicles including tele-operated rovers, structures and materials, science and science equipment.

We can expect to see massive international investment in these areas as the first missions are prepared, and Australia has current niche comparative advantages, with strengths in communications, mining, remote sensing and renewable energy generation to name only a few. But the time to act is now. We believe a national launch vehicle and a satellite manufacturing capacity *can and should* be developed, but only in parallel with an inspiring and sensible space science and engineering programme that taps into current strengths by exploiting emerging opportunities, notably piloted Mars missions. We emphasise that Australia can get to Mars **without ever leaving the launch pad**, by working to develop dual-use technologies for export into planetary surface missions.

At this time we do not advocate any particularly agency model, but suggest that establishment of an Australian space organisation be preceded well in advance by a dialogue with the local space community regarding its objectives, role and structure. Such an organisation must properly interface and encourage private space activity in all its forms, be they space or ground based. We look forward to being involved closely in these future discussions, as an organisation that thinks and acts locally but draws ideas and lessons from our international colleagues, many of whom work in the major space agencies.

7 NEED FOR GOVERNMENT SUPPORT

While MSA looks to the day when private individuals can choose to live in space and on Mars, when space activity is integrated into the international free market, we believe government continues to play a key role in bringing this about. We feel that Australia has left its entry into the modern space arena too long, but not too late. Australia is foregoing major opportunities to exploit our natural, economic and intellectual comparative advantages, and to inspire a major shift in our economy toward knowledge based industries. But challenges faced by other space agencies (including ISS funding) have left



open avenues for us to pursue, including Mars mission planning and technology development.

We acknowledge the **strategic considerations** that come into play with the development of a space programme, including sensitivities of our regional neighbours. We believe, however, that Australia can actively pursue a non-aggressive civilian space programme and co-operate with its neighbours to share the benefits and possibly enhance regional stability by improving standards of living through access to space services at a reasonable cost. While it is important for our own security that Australia continues to develop its own satellite capabilities to reduce reliance upon foreign space assets, our principal aims in space ought to be highly visible, accountable and peaceful pure scientific research and technology development work that supports this, challenges and advances local industry and where possible leads to commercial outcomes.

Such an organisation should be properly equipped to market the benefits, importance and wonder of space exploration to the local and international communities. Australian involvement in human Mars voyages will significantly strengthen efforts to recruit and develop our most important national resource - the hearts and minds of **young Australians**. The current generation could be forgiven for withdrawing from a commitment to public service, with increasing attention paid to monetary gain and consumer goods. In the absence of decent, adventurous and meaningful long term goals, it is natural that creative young people will languish - or leave the country in search of something better. The marketing arm of an Australian space organisation would leverage involvement in human Mars missions to serve the wider community by providing a tonic for this very real social malaise.

Another beneficial consequence would follow from local investment and involvement in Mars projects. To support human crews away from the Earth for extended periods of time (up to 3 years for the first missions), it will be necessary to design, build and maintain small-scale artificial life-supporting systems to provide air, process and recycle water and waste materials and to grow food. The understanding of such micro-ecologies and the mastery of the technologies they require could scarcely fail to enhance the quality of human respect for, and custodianship of, the natural biosphere on which all Earth life depends. Seen this way, a voyage to Mars is a profoundly **ecological project**, spinning off the kinds of attitudes, models, techniques and sophisticated appreciation of Earth's biosphere that will be needed to get us through the next 100 years.

8 CONCLUSIONS

Without urgent action, we may yet miss out on being part of the greatest adventure of the 21st century – human expansion into the Solar System. We may miss out on defining the rules for the peaceful use of Mars, or reaping the benefits of being at the forefront of Mars exploration. The media inspires our young people with tales of robots on Mars, encouraging more of them to tackle mathematics and science and creating our future workforce of technical professionals. What shall we tell our children? That they must leave their country to be a part of this excitement? Is it right that we are leaving it to other nations to inspire our current and future knowledge workers? We are leaving it to someone else to inspire a shift in our economy and culture which is long overdue. We are not pulling our weight as an advanced nation in the space arena.

MSA projects are showcasing Australian space science and engineering to the world. They demonstrate that Australia can play a significant role in space without ever leaving the launch pad. We are seeking to carve out niches in a number of areas in the hope that



someday, when Mars calls, Australians can answer. We are working hard to demonstrate leadership not just in a technical sense, but, in the absence of a national space programme, are actively pursuing private funding.

Facilitation (for example, by helping us engage with local innovators who may have Mars relevant technologies) from State and Federal governments would help us involve more Australians in the emerging opportunities presented by Mars. Provision of seed funding and financial incentives encouraging local firms to develop planetary surface related multi-use technologies will also help attract private support and position Australian firms for space contracting opportunities.

We look forward to growing co-operation amongst space groups throughout Australia, and to the support of the International Space Advisory Group.

The MSA Board of Directors, 2001

For more information see:

<http://www.marssociety.org.au>

9 CONTRIBUTORS

This document was produced in co-operation with the Board and Members of Mars Society Australia. MSA acknowledges input from the following members.

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