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**by**

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**ART ON MARS: A FOUNDATION FOR  
EXOART**

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# **ABSTRACT**

## **ART ON MARS: A FOUNDATION FOR EXOART**

It could be claimed that human space exploration started when the former Soviet Union (USSR) launched cosmonaut Yuri Gagarin into Earth orbit on 12 April 1961. Since that time there have been numerous human space missions taking American astronauts to the Moon and international crews to orbiting space stations. Several space agencies are now working towards the next major space objective which is to send astronauts to Mars. This will undoubtedly be the most complex and far-reaching human space mission ever undertaken. Because of its large scale and potentially high cost it is inevitable that such a mission will be an international collaborative venture with a profile that will be world-wide.

Although science, technology and engineering have made considerable contributions to human space missions and will be very much involved with a human Mars mission, there has been scant regard for artistic and cultural involvement in these missions.

Space agencies have, however, realised the influence of public perception on space funding outcomes and for some time have strived to engage the public in these space missions. This has provided an opportunity for an art and cultural involvement, but there is a problem for art engaging with space missions as currently there is no artform specific to understanding and tackling the issues of art beyond our planet.

This thesis involves research to recognise these issues and establish a foundation for a form of art that I refer to as Exoart, from which art can build a bridge to connect meaningfully with our new space future.

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# TABLE OF CONTENTS

TABLE OF IMAGES.....	vii
----------------------	-----

## CHAPTER 1, INTRODUCTION

Background to Research .....	1
Research Aim.....	2
Research Parameters .....	2
Overview of Research.....	3

## CHAPTER 2, THE ELEMENTS OF EXOART

Introduction.....	6
A new Artistic Initiative .....	6
Engaging with Space Missions .....	22
Engaging with the Future.....	27
Engaging with Memory .....	37
Audience and Aesthetics.....	45
Summary.....	47

## CHAPTER 3, LAND ART

Introduction.....	49
Background.....	49
Land Art Beginnings.....	53
Land Art Works .....	55
Greg Johns – <i>Horizon Figure</i> .....	55
Trevor Rodwell and Sue Rodwell – <i>Read the Wind</i> .....	56
Chris Drury – <i>Wave Chamber</i> .....	56
Andrew Rogers – <i>Rhythm of Life</i> .....	57
Robert Smithson – <i>Spiral Jetty</i> .....	58
Hansjörg Voth – <i>Sky Stairs</i> .....	59
Michael Heizer – <i>Double Negative</i> .....	59
Antony Gormley – <i>Inside Australia</i> .....	60
Walter De Maria – <i>Lightning Field</i> .....	61
Andy Goldsworthy – <i>Locharbriggs Sandstone Arch</i> .....	62
Trevor Rodwell and Sue Rodwell – <i>Written on the Land</i> .....	63
Nancy Holt – <i>Sun Tunnels</i> .....	63
Charles Ross – <i>Star Axis</i> .....	64
James Turrell – <i>Roden Crater</i> .....	65
Land Art Installation Features.....	66
Issues with Land Art .....	67
Issues of Land .....	70
Sites .....	70
The Palmer Project.....	71
Accessing Land Art Works .....	72
Vandalism and Bureaucratic Issues.....	74
Theoretical Elements .....	76
Nature, environment, landscape and the picturesque .....	76
Land Art Works.....	82
Summary.....	84

## CHAPTER 4, ANCIENT LAND INTERVENTIONS

Introduction.....	86
Overview.....	87
Structures with a predominance of stone .....	89
<i>The Hurlers</i> , Bodmin Moor, UK .....	89
<i>Nonokadō</i> , Oyu, Japan .....	90
<i>Carnac and Locmariaquer</i> , Brittany, France.....	90
<i>Stenness and Ring of Brodgar</i> , Orkney, UK.....	91
<i>Newgrange</i> , County Meath, Ireland.....	91
<i>Stonehenge</i> , Wiltshire, UK .....	93
<i>Avebury Henge and Standing Stones</i> , Wiltshire, UK .....	96
Mounds constructed from environmental materials.....	99
<i>Silbury Hill</i> , Wiltshire, UK.....	99
<i>Serpent Mound</i> , Ohio, USA.....	101
Markings on the Land .....	103
<i>Nazca Lines</i> , Peru .....	103
<i>The White Horse</i> , Uffington, UK.....	106
Carved Sculptures .....	107
<i>Easter Island</i> , South Pacific.....	107
Comment.....	107
Art in the Land of Archaeology.....	109
Recording and Interpretation of Ancient Land Interventions.....	112
Theoretical basis for describing Ancient Land Interventions as Land Art .....	114
Summary.....	123

## CHAPTER 5, SPACE: OBSERVATION AND IMAGINATION

Introduction.....	125
Eye to the Sky.....	125
Popular Culture.....	140
Summary.....	148

## CHAPTER 6, MARS: THE HUMAN JOURNEY

Introduction.....	149
Why go into Space?.....	149
Robotic pathfinders.....	160
Why Mars?.....	162
Towards a human mission to Mars.....	167
Why send humans?.....	175
How would we get there? .....	180
Summary.....	184
Comparison of major features of Earth and Mars.....	186

<b>CHAPTER 7, CONSIDERATIONS FOR AN EXOART PROJECT ON MARS</b>	
Introduction.....	187
Art of the future .....	187
Building a concept .....	191
The Exoart Project Team .....	192
Planetary protection .....	193
Concept design.....	195
Materials .....	196
Time Capsule Component .....	197
Transportation to Mars.....	200
Presentation of the Exoart Project .....	201
Summary.....	204
<b>CHAPTER 8, DISCUSSION AND CONCLUSION</b>	
Introduction.....	206
Fundamentals for a Foundation .....	206
A new Art Initiative .....	208
History .....	212
Culture and Humanity.....	213
Conclusion .....	214
<b>REFERENCES .....</b>	<b>216</b>

# TABLE OF IMAGES

**NOTE: Images are shown *opposite* the page numbers listed.**

## CHAPTER 1, INTRODUCTION

### CHAPTER 2, THE ELEMENTS OF EXOART

Image 1: Plaque attached to the Eagle Moon lander .....	6
Image 2: Silicon disc of goodwill messages left on the Moon.....	6
Image 3: The Australian goodwill message left on the Moon .....	7
Image 4: Moon rock and Australian flag carried on Apollo 17 Mission .....	7
Image 5: Prototype of Beagle 2 Mars lander.....	15
Image 6: Beagle 2 being attached to the Mars Express spacecraft .....	15
Image 7: Pioneer spacecraft plaque.....	18
Image 8: <i>The Sounds of Earth</i> record attached to the Voyager spacecraft.....	18
Image 9: Sydney Opera House .....	20
Image 10: The Planetary Society <i>Visions of Mars</i> DVD on the Phoenix.....	23
Image 11: Certificate of Participation .....	23
Image 12: The San Marino Scale .....	26
Image 13: The Westinghouse Time Capsule.....	29
Image 14: Program page for <i>Vectorial Elevation</i> .....	35
Image 15: <i>Vectorial Elevation</i> , Mexico City .....	35
Image 16: Monument to the establishment of South Australia.....	39
Image 17: Monument to the establishment of South Australia, detail .....	39
Image 18: Captain Cook monument, New Zealand .....	39
Image 19: Australian Federation pavilion, Sydney .....	40
Image 20: Australian Federation pavilion, interior .....	40
Image 21: Artwork/monument <i>On Occupied Territory</i> .....	41
Image 22: Artwork/monument <i>Full Fathom Five</i> .....	41
Image 23: <i>Full Fathom Five</i> , detail.....	41
Image 24: <i>Gateshead Cone</i> , UK .....	42
Image 25: <i>Angel of the North</i> , UK .....	42
Image 26: <i>Angel of the North</i> , UK, winter .....	44

### CHAPTER 3, LAND ART

Image 27: <i>Ice Cone</i> , Canada.....	51
Image 28: <i>Boat Form</i> .....	52
Image 29: <i>Roden Crater</i> , USA .....	52
Image 30: <i>Earth Mound</i> , USA .....	54
Image 31: <i>Horizon Figure</i> , South Australia.....	55
Image 32: <i>Read the Wind</i> , South Australia, summer .....	56
Image 33: <i>Read the Wind</i> , South Australia, winter .....	56
Image 34: <i>Wave Chamber</i> , UK .....	56
Image 35: <i>Rhythm of Life</i> , Nepal.....	57
Image 36: <i>Spiral Jetty</i> , USA .....	58
Image 37: <i>Spiral Jetty</i> , USA, after being submerged.....	58
Image 38: <i>Sky Stairs</i> , South Morocco .....	59
Image 39: <i>Sky Stairs</i> .....	59

### CHAPTER 3, LAND ART (continued)

Image 40: <i>Double Negative</i> , USA.....	59
Image 41: <i>Double Negative</i> , USA.....	60
Image 42: <i>Inside Australia</i> .....	60
Image 43: <i>Inside Australia</i> .....	60
Image 44: <i>Lightning Field</i> , USA.....	61
Image 45: <i>Lightning Field</i> , USA.....	61
Image 46: <i>Locharbriggs Sandstone Arch</i> , UK.....	62
Image 47: <i>Locharbriggs Sandstone Arch</i> , UK.....	62
Image 48: <i>Written on the Land</i> , South Australia.....	63
Image 49: <i>Written on the Land</i> , South Australia.....	63
Image 50: <i>Sun Tunnels</i> , USA .....	63
Image 51: <i>Sun Tunnels</i> , interior of tube .....	64
Image 52: <i>Sun Tunnels</i> , sunset on summer solstice .....	64
Image 53: <i>Star Axis</i> , USA .....	65
Image 54: <i>Star Axis</i> , star tunnel entrance .....	65
Image 55: <i>Roden Crater</i> , USA.....	65
Image 56: <i>Roden Crater</i> , stairs to caldera.....	66
Image 57: <i>Roden Crater</i> , internal tunnel.....	66
Image 58: <i>Roden Crater</i> , entrance to caldera.....	66
Image 59: <i>Running Fence</i> , USA.....	75
Image 60: <i>Earth from Moon orbit</i> .....	84

### CHAPTER 4, ANCIENT LAND INTERVENTIONS

Image 61: <i>The Hurlers</i> , UK.....	89
Image 62: <i>Nonokadō</i> , Japan .....	90
Image 63: <i>Nonokadō</i> , the Sundial .....	90
Image 64: <i>Carnac</i> , France .....	90
Image 65: <i>Stenness</i> , UK .....	91
Image 66: <i>Newgrange</i> , Ireland .....	91
Image 67: <i>Newgrange</i> , carved entrance stone.....	91
Image 68: <i>Stonehenge</i> , UK.....	93
Image 69: <i>Stonehenge</i> , rendering of completed form .....	93
Image 70: <i>Stonehenge</i> impression of site .....	93
Image 71: <i>Avebury</i> , UK, impression of site .....	96
Image 72: <i>Avebury</i> , rendering of ditch and bank .....	96
Image 73: <i>Avebury</i> , section of site .....	96
Image 74: <i>Silbury Hill</i> , UK .....	100
Image 75: <i>Silbury Hill</i> , construction method .....	100
Image 76: <i>Silbury Hill</i> , rendering of completed form.....	100
Image 77: <i>Serpent Mound</i> , USA .....	102
Image 78: <i>Serpent Mound</i> , drawing .....	102
Image 79: <i>Nazca Lines</i> , Peru.....	104
Image 80: <i>Nazca Lines</i> , patterns and designs.....	104
Image 81: <i>Nazca Lines</i> , showing formation.....	104
Image 82: <i>The White Horse of Uffington</i> , UK .....	106
Image 83: <i>Easter Island</i> , South Pacific .....	107
Image 84: <i>Easter Island</i> , figures with topknots .....	107
Image 85: <i>Lesternick</i> , UK .....	111

## **CHAPTER 5, SPACE: OBSERVATION AND IMAGINATION**

Image 86: <i>Night Sky</i> , South Australia .....	128
Image 87: <i>Nebra sky disc</i> , Germany .....	130
Image 88: William Hershel's reflecting telescope .....	137
Image 89: <i>Hubble telescope</i> .....	137
Image 90: Telescopic study of the Moon, Galileo Galilei .....	138
Image 91: <i>Barred Spiral Galaxy</i> .....	138
Image 92: <i>Centaurus A Galaxy</i> , composite image .....	138
Image 93: <i>Nungarrayi – Seven Sisters Dreaming</i> .....	139
Image 94: <i>Starry Night</i> .....	139

## **CHAPTER 6, MARS: THE HUMAN JOURNEY**

Image 95: <i>The Pale Blue Dot</i> , Earth from Voyager I spacecraft .....	150
Image 96: Ice under the Martian surface .....	161
Image 97: <i>Planets in the Solar System</i> , comparison .....	163
Image 98: Mars, showing Valles Marineris canyon system.....	165
Image 99: <i>Mars 500</i> , spacecraft simulator .....	173
Image 100: <i>Mars DRM</i> , proposed by NASA .....	182

## **CHAPTER 7, CONSIDERATIONS FOR AN EXOART PROJECT**

Image 101: <i>MarsDial</i> , calibration target for Spirit and Opportunity .....	195
Image 102: <i>Temple of Zeus at Olympus</i> , comparisons Earth and Mars .....	195
Image 103: Longevity of electronic storage media .....	198
Image 104: <i>Rosetta Disc</i> , front.....	199
Image 105: <i>Rosetta Disc</i> , reverse .....	199
Image 106: Air inflated structure .....	203
Image 107: Air inflated structure, interior.....	203
Image 108: Igloo dome .....	203

## **CHAPTER 8, DISCUSSION AND CONCLUSION**

# CHAPTER 1

## INTRODUCTION

### BACKGROUND TO RESEARCH

It could be claimed that the Space Age officially started on 4 October 1957 when the former Soviet Union (USSR) launched the world's first artificial satellite 'Sputnik' into Earth orbit. Certainly human space exploration began with the launch of the first USSR cosmonaut, Yuri Gagarin, into Earth orbit on 12 April 1961. Since that time there have been numerous human space missions that have taken American astronauts to the Moon and international crews to orbiting space stations. The International Space Station, now complete and fully operational, is permanently crewed and utilised primarily as a science research platform.

The next major human space mission objective is to send astronauts to Mars, an objective that is being diligently worked towards by space agencies of the USA, Russia and Europe, while space agencies from other countries have expressed interest in joining a Mars mission consortium. During the last 50 years there is no denying the major contribution to human space exploration made by science, technology and engineering, and this will continue with a human mission to Mars.

However, during this time there has been scant regard for artistic and cultural involvement in these exploration missions, with any such involvement tending to be more of an afterthought than a considered part of the mission. Yet space agencies have realised for some time the influence of public perception on space mission outcomes. Therefore, they have produced substantial amounts of information regarding their activities; but information is not necessarily communication, the practice of producing and negotiating meaning (Schirato & Yell 2003). Neither is it engagement that can capture public imagination. This highlights a problem that space agencies must contend with which will be especially relevant in a high-cost human mission to Mars. It is unfortunate, therefore, that there is not a vision of how artistic and cultural involvement can assist with this problem.

From an arts perspective, recognising a potential opportunity to present a case to space agencies for a comprehensive expression of art and culture in human exploration missions is tempered by the realisation that such a case is not easy to mount; currently there is no artform that is specific to understanding and tackling the issues of art beyond our planet. This represents a serious impediment within the arts to realising a constructive dialogue with space agencies regarding an art and cultural component on space missions.

Traditionally, artistic expression has permeated all aspects of human life, from prehistory when it was integral to everyday affairs, to the more separated and structured form in Western cultures today. But high technology space missions are now taking us to unfamiliar environments, where the circumstances for art to be able to engage are very different from those which have been experienced before. This poses a potentially difficult challenge to artistic expression to be part of this new space future.

## **RESEARCH AIM**

The preceding section identifies a problem for art in any engagement with space missions in that space agencies controlling these missions do not currently perceive how art can contribute in any significant way to the objectives of such missions. The fact that art has contributed significantly to the richness of human culture to date is only marginally recognised by space agencies intent on focusing on the scientific aspects of missions.

This, then, poses the question: ‘Can there be a foundation from which art can build a bridge to connect meaningfully with our new space future?’ The aim of this thesis is to engage with this question by constructing such a foundation.

## **RESEARCH PARAMETERS**

This thesis covers the areas of art, culture and space exploration that are relevant to the production of knowledge to establish a foundation from which art can engage meaningfully with space agencies. However, some technical areas of space exploration are beyond the scope of this thesis, as the main focus is on art and cultural aspects of space exploration. Having stated that, a base level of technical procedures for spaceflight and some environmental data for Mars has been included to illustrate some of the problem areas the foundation for art will need to consider.

Accounts of historical space missions are included where such missions contribute in some way towards relevant knowledge for the artistic foundation or for considerations of context. These accounts are not intended to be a complete history of spaceflight.

## **OVERVIEW OF THE RESEARCH**

The research for this thesis has been drawn from a wide range of material, as well as personal contact with professionals within relevant areas of the research fields. I have also drawn upon my own experience in the areas of Public Art and Land Art which constitute the main focus of my art practice.

Within the chapters of this thesis, constant references are made to the artistic foundation being constructed. For ease and flow of writing the name 'Exoart' has been ascribed to this foundation.

Chapter 2, The Elements of Exoart, details the derivation of the term 'Exoart'. By analysing the key problems likely to be encountered when promoting an artistic engagement on a space mission, the main characteristics of Exoart are established. The chapter also makes the case for regarding Exoart as a form of art that interacts with human space exploration and cultural engagement. The need for artists to understand the many complexities of space missions which will inevitably affect concept designs and lead to other limitations is discussed and referenced with examples.

Although Exoart is established as a new division in art it is not without a contextual history and its connections to contemporary Land Art are explained.

Chapter 3, Land Art, expands on the connections of Exoart with Land Art and proposes that Land Art is the most appropriate artform from which the foundation for Exoart can develop. There is also discussion on issues of environments to which both Exoart and Land Art are closely connected. This includes our cosmic environment as revealed by past space missions that informed a new perspective on the idea of environment for the creation of Land Art works. It is then argued that Exoart is the next logical step in this new cosmic perspective.

Chapter 4, Ancient Land Interventions, builds a case for applying the contemporary term 'Land Art' to prehistoric monuments and land markings that are referred to in this chapter as Ancient Land Interventions. This establishes a lineage to Land Art that goes back over

5,000 years. Appropriate theories to substantiate the case are discussed. In building this case the claim that humans have been engaging with their environments for thousands of years is established and reinforces the claim in the previous chapter that Land Art, with its long cultural history is the most appropriate artform from which to develop a foundation to engage with new and alien environments in the future.

Chapter 5, *Space: Observation and Imagination*, runs a parallel course with the previous chapter but concentrates on the cultural history of cosmic space and sky observations to establish how, for thousands of years, the cosmic environment has featured in the lives of humankind. The chapter also makes observations on human space exploration in popular culture and explains the effect this has had on the perception of cosmic space as part of our greater environment. This chapter presents a view that the cultural engagement with our cosmic environment in the past warrants a cultural engagement with human space exploration missions of the future.

Chapter 6, *Mars: the Human Journey*, presents a range of technical aspects concerning human space exploration and introduces the arguments on human versus robotic space missions. It also provides an overview of current space agency policies and directions regarding a future human mission to Mars and explains why Mars is acknowledged as the destination for the next major step in human space exploration. This chapter also establishes how societal perceptions of human space exploration are now seen as important by space administrators and governments and how this provides an opportunity for Exoart projects.

Chapter 7, *Considerations for an Exoart Project on Mars*, is an analysis of how the fundamental characteristics of Exoart would come into play in an Exoart project. For this a hypothetical project related to the first human mission to Mars is utilised. The first part of this chapter contains observations on Danto's claims that art of the future is unknowable (Danto 1997). In response, reference is made to the continuing and historical narrative of Land Art regarding engagement with environments and how, by this on-going engagement, Exoart provides not only one future direction for art but a practical means by which art can engage with our space future.

The chapter then continues with the potential issues that may be encountered in an Exoart project and how the foundation for Exoart provides a reference for understanding these issues. From project concept through to project installation on the Martian surface, an

Exoart team will need to be aware of mission procedures and environments never before experienced in an art project. Documentation and presentation are also considered in relation to contextual considerations.

Chapter 8, Discussion and Conclusion, draws all the relevant points together in a final analysis relating to the research aim of this thesis and provides a positive answer to the central question: 'Can there be a foundation from which art can build a bridge to connect meaningfully with our new space future'.

## **CHAPTER 2**

### **THE ELEMENTS OF EXOART**

#### **INTRODUCTION**

This chapter introduces the foundation for Exoart as well as describing the derivation of the term. In discussing some of the areas where Exoart is expected to function, the basic characteristics of the artform are revealed and their relevance within the foundation explained.

The need at this particular time for such a foundation is also discussed as well as the way it could be used to engage with space agencies and human space missions. Many aspects of the foundation for Exoart are also covered in other chapters. The aim of this chapter is to establish the primary elements that go to make up the foundation of Exoart.

#### **A NEW ARTISTIC INITIATIVE**

The raison d'être of art never stays entirely the same ... the function of art changes in a changing world (Fisher 1981).

When Neil Armstrong descended the ladder of the Eagle lander and became the first human to make a footprint in the dusty surface of the Moon, he proclaimed that it was 'One small step for a man, one giant leap for mankind'. The giant leap referred to was the technological achievement of being able to leave the gravitational pull of Earth and fly to, and land on, another body in the solar system.

This momentous occasion was marked by the planting of a United States flag and the unveiling of a small plaque attached to one leg of the Eagle landing platform which was left behind on the lunar surface. The plaque read:

Here men from the planet earth first set foot upon the Moon. July 1969 AD. We came in peace for all mankind.

Beneath the text were the signatures of the three astronauts who made the journey – Neil Armstrong and Edwin (Buzz) Aldrin Jr, who landed on the Moon, and Michael Collins orbiting in the Apollo 11 spacecraft, along with the signature of the then United States President, Richard Nixon. *Image 1*

Just before leaving the Moon, one of the two astronauts tossed on to the dusty surface, somewhat unceremoniously, a small etched silicon disc with goodwill messages from 74 heads of state (Rahman 2008). *Image 2*. To fit the messages on the 38mm diameter disc the text was reduced to a size which meant that the lower case letters were only a quarter the width of a human hair. Nevertheless the messages are still legible through a low-powered microscope.

The message from Australia reads:

Australians are pleased and proud to have played a part in helping to make it possible for the first man from earth to land on the moon. This is a dramatic fulfillment of man's urge to go 'always a little further'; to explore and know the formerly unknown; to strive, to seek, and to find, and not to yield. May the high courage and the technical genius which made this achievement possible be so used in the future that mankind will live in a universe in which peace, self expression, and the chance of dangerous adventure are available to all. John Gorton, Prime Minister (Rahman 2008). *Image 3*.

This simple marking of the first human expedition to another terrestrial body can be contextualised by the fact that there were severe weight limitations imposed on the first landing mission and the astronauts spent only 2.5 hours exploring the surface, therefore time was extremely valuable with every minute pre-planned. Scientific projects took priority over time-consuming symbolic activities.

In return for Australia's goodwill message and help with the Apollo Missions, the USA presented Australia with a commemorative plaque on which was mounted a fragment of Moon rock and an Australian flag which was carried on the Apollo 17 Mission. *Image 4*.

The commemorative issues of the Apollo 11 Moon landing were in flux until the establishment of a committee in February 1969, only five months before the launch. The resulting plan stated:

1. No activity should jeopardize crew safety.
2. The activities should be in good taste from a world perspective.
3. An historic "forward step for all mankind" theme.
4. Make it clear that this was an American accomplishment, symbolized by placing the U.S. flag on the surface, without implying U.S. sovereignty on the Moon.

5. A commemorative plaque, affixed to the lunar module descent stage, would include the two hemispheres of Earth, without boundaries. It would also contain the names of the astronauts and the president of the United States. There would be a short and simple statement regarding the peaceful nature of the mission, and that the achievement was for all mankind.
6. Miniature flags of all U.S. states, the District of Columbia, U.S. territories, flags of all nations (to be presented to heads of state), and miniature U.S. flags, as well as two full size U.S. flags (for the House and the Senate), were to be carried in the command module only.
7. Create a stamp die from which the U.S. post office would print commemorative stamps (Rahman 2008).

Compared to the staged events of today, for example the Olympic Games where even the opening and closing ceremonies are planned years in advance, the cultural side of the Apollo missions seem a low key afterthought. Of course, cultural considerations were not high on the agenda of space activities in the 1960s; national pride and cold war considerations ranked as the primary issues.

In the near future, the next ‘giant leap for mankind’ will be a human mission to Mars. But, because of its technological complexity, its long duration and its international partnership potential, it could be proclaimed as a *massive bound for the human race*. When it happens, humans will be on the path to becoming a multi-planet species, and the expectation of the world for cultural representation will be great. Ron Miller (2007), writing on the topic of popular culture in space exploration sees a need for space programs that are ‘as exciting conceptually to the general public’ as they are ‘scientifically important to the scientists’. The authors of *The Global Exploration Strategy: The Framework for Coordination* also acknowledge the importance of the need to engage the public through a ‘vibrant space exploration programme’ (GES 2007).

The need for public engagement has been stated in a report issued by Dittmar Associates of Houston summarising their field research, surveys and polls over several years on behalf of the National Aeronautics and Space Administration (NASA). They found, among other things, many people, especially those in their mid to late twenties, were fairly disengaged from the space program and that to become interested they would need more interaction (David 2008).

A paper jointly published by the European Science Foundation, Standing Committee for the Humanities and the European Space Sciences Committee stated that, in recent forums on space exploration, the human element is gaining in prominence. As a consequence, the areas of humanities and social sciences are now being included. Although the main focus of this paper was on the humans who may go into space, a significant portion was devoted to the cultural aspects of space exploration, including ‘Artistic expression as a means to share the human exploration experience’ (SCH-ESSC 2008).

Such an artistic expression is the basis for developing a foundation for Exoart. As the world and technology changes, so do public expectations. In 1969, astronauts went to the Moon with a computer in the lander module that would hardly rate against a games console today. Those lucky enough to have a television in the home watched grainy black and white images of the first Moon walk.

Today we live in a world saturated with information technology; communication is the consummation of activity. Space agencies are acutely aware of this as was demonstrated with the Mars landing of the NASA Phoenix spacecraft in May 2008. NASA has its own television station which is accessible via the World Wide Web and, on such occasions, it transmits live images from the mission control centre and from cameras on board the spacecraft.

During the Phoenix mission, transmission started three hours prior to touchdown and continued until the spacecraft successfully landed. Cameras caught the tension in the control centre as the spacecraft was given its final instructions from which point, because of a ten minute communication delay to and from the spacecraft, Phoenix had to rely on its onboard computers to, literally, fly itself down. Everything had to work perfectly, in the right order and at the right time within parameters of a few seconds.

In a cooperative gesture, the European Space Agency redirected its Mars orbiting satellite to allow its camera to cover the landing zone and caught the opening of the main parachute with the tiny spacecraft suspended beneath, as it drifted down prior to the firing of its retro-rockets for a soft landing.

This was broadcast live to millions of people around the world with email questions regarding the mission answered by experts in the studio. In this respect at least the

mission became a shared experience. But, for a human mission to Mars, more can be achieved for a global interaction and commemoration of the event.

The reality of a permanently crewed orbiting space station, coupled with current space agency plans for a human mission to Mars in the comparatively near future, provides the reason for developing a foundation for Exoart. The fact that space agencies are aware of the impact of public perception and rely on public support for their major space projects is an incentive to engage with the public. This provides the opportunity for Exoart.

The name Exoart is developed from the word 'art' with the prefix 'Exo'; 'Exo' from the Greek root meaning external, outside (The Macquarie Dictionary 1988). In the space sciences it is used in the term Exobiology, linking it with the sciences of Astronomy and Biology and having the objective of searching for life on other worlds besides Earth (Nahle 2006). The European Space Agency denotes Exobiology in its broadest terms as the study of 'the origin, evolution and distribution of life in the Universe' (Vago, Gordini et al 2006) and the Nobel Prize Winning scientist, Joshua Lederberg, who is regarded as having first developed the term, summarises its meaning as the study of life beyond the Earth (Henahan 2009).

NASA also uses the term in its research into the origin, evolution and adaption of life in our stellar neighbourhood (NASA 2008a). The use of 'Exo' as a prefix has also been used recently in space science in the form of Exoplanets, defined as planets orbiting other stars (Fischer 2009). So far nearly 500 Exoplanets have been detected in our cosmic environment (European Southern Observatory 2011).

Exoart can therefore be defined as art or an artistic and cultural expression outside of planet Earth.

Several missions to the Moon have resulted in twelve people reaching the lunar surface – therefore, it could be claimed, because of what was left behind, that Exoart may exist on the Moon. Certainly, there are culturally specific items on the Moon - for example, the first landing plaque and the silicon disc of messages from world leaders. There have also been mission patches and family photographs left behind by astronauts. But these do not fit with the definition of Exoart because there is no intended art in these objects. They are, in effect, mnemonic items for future visitors to the Moon.

Although the conceptual basis of Exoart is embedded in the name, the art component should not be taken as referring to current art practice. Exoart is not Exo Art. In other words, it does not imply that any object currently deemed a work of art taken to the Moon, Mars or any other solar system body would automatically qualify as Exoart as defined in this thesis. The conceptual underpinnings, and the foundation of Exoart, are based on a symbiotic relationship with human space exploration objectives that seek to add significant cultural dimensions to human space ventures.

Exoart is a product of its time and can be taken as a new artistic expression with a domain that encompasses environments beyond the realm of Earth. It utilises and builds on the vision of collaboration between the arts and sciences.

The development of Exoart follows in much the same way as arts utilising technology. For example, prior to photography there was no photographic art; prior to computers there was no computer art; prior to cinematography there were no art films. It then follows that, prior to the development of rockets capable of taking people beyond the gravitational pull of Earth, there could be no Exoart. Artists can and do speculate on how far they could push their concepts if only there were the materials or technology to achieve it. The reality is that ideas can lie dormant for long periods of time until science and technology catches up.

Martin Kemp (2000) follows a similar line when he explores how knowledge and, by implication, the development of ideas are relative to a given society. As an example, he cites how Kepler developed astrological laws that proved the elliptical orbits of the planets, something he claims could never have been formulated by prehistoric people using their stone circles.

Apart from not having the resources to develop an elliptical orbit theory, prehistoric people would have had no need for such information. Kepler, on the other hand, along with many others, was trying to reconcile cosmic observations with a heliocentric model of the universe.

The term 'art' in the title Exoart references both a historical lineage of artistic expression and a cultural engagement for the future that can be best explored through artistic innovation. Exoart introduces a new division in art with a new conceptual foundation but, as Paul Connerton (2008) points out, 'the absolutely new is inconceivable'. New ideas

without a reference point or a contextual history have nothing to anchor them. New ideas grow from a base and into a realm of examination and debate but, as Connerton argues, interpretive activity is based on memory and experience and ‘our mind is already predisposed with a framework of outlines’ (Connerton 2008).

John Carey (2005) comments on this when examining differences between the sciences and arts. In science he sees a reductive truth mechanism in that, when a new discovery establishes a scientific truth, it displaces innumerable false ones which then cease to have any scientific value. Art, on the other hand, builds on the past; it has no provable truths therefore the past stays relevant because new ideas do not replace it.

The contextual history that Exoart draws on is derived from referencing the characteristics of extraterrestrial sites that could host an artistic and cultural artefact. These sites will be distant and unexplored except for any robotic surveys. They will be environments that will have dramatically different climatic conditions depending on location and variable terrains. In the near future at least, they will only be visited by astronauts, therefore art projects will only be known indirectly through photographs, television or virtual reality devices. Any artwork will have to be constructed specifically for the environment in which it will be placed. The nearest comparison to this on Earth is Land Art.

The key aspect of this artform is place. The artwork encompasses the environment and the environment acts with or becomes part of the artwork. Many artists who work in Land Art seek out obscure and isolated places to undertake their work, often utilising materials found at the site. If artworks are pre-made or parts fabricated away from the site, their installation is undertaken with an emphasis on the synergetic attributes of the environment.

Land Art does not belong in a gallery or urban spaces and it is not sculpture simply placed in an open area. It is art to enact engagement with and a response to place, which is an ideal concept for an alien planetary environment. As Ben Tufnell (2006) points out, Land Art ‘is about and is in the real world’. It reflects on real environments and demands real experiences and, although not all those engaged in this area would agree with the comments of artist Walter De Maria, he captures a salient point in his comment that ‘Isolation is the essence of Land Art’ (Tufnell 2006).

Because Land Art is often created in isolated areas that are sometimes difficult to access, the documentation of the work is often how most people know it. This will most definitely be true for Exoart projects. The documentation of such artwork needs imagination and creativity to capture the relationship of environment and artwork, something that will be essential yet demanding for Exoart as those undertaking the documentation will not only be in a new environment but will also be in a spacesuit.

Although not generally acknowledged, Land Art has a lineage from prehistory in the building of monuments such as stone circles, earthen mounds and land markings. I refer to these as 'Ancient Land Interventions' in Chapter 4 where a case is presented to establish a connection with contemporary Land Art that goes back several thousand years. This makes Land Art, in its various forms, one of the oldest types of artistic practice providing a solid and enduring base from which Exoart can develop into a space-based artform.

It is relevant here to consider the parameters which will have an impact on any Exoart Project and thereby will affect the development of a foundation for Exoart. Anything taken into space on a mission to the Moon, Mars or any other solar system body in the foreseeable future will have to undergo inspection and approval from the space agencies involved in the mission. Private enterprise companies, like Virgin Galactic, are offering sub-orbital commercial trips that will give passengers a short experience of weightlessness, but are not planning extended stays in Low Earth Orbit or interplanetary missions.

NASA will shortly be calling for tenders from private contractors to build rockets for transporting astronauts to the International Space Station on their behalf. But major human space missions to the Moon or Mars are currently far beyond the capabilities of private companies.

Although, as previously mentioned, these space agencies have become aware in recent times of the advantages in public communication and engagement, any art and cultural initiative will still have to compete with many science projects for inclusion in the spacecraft itinerary. They will also have to compete for time allocation for astronauts to undertake whatever is necessary when the mission reaches the surface of the planetary body.

Currently with robotic missions to Mars and other solar system bodies, the instruments and scientific experiments on board the spacecraft or surface rovers are included through a very competitive tender process. Scientific teams from around the world propose scientific experiments relevant to the particular mission and include in their applications the proposed instruments, their size and weight, power requirements and the amount of funding required for construction. It is then a juggling act for the space agency to determine which experiments and equipment will be included based on stated mission objectives, the available space within the craft and the total payload weight the rocket can lift and deliver to the intended destination.

An account of the UK Mars Lander Beagle 2 provides a good example of how a proposal needs to be flexible and also illustrates public influence on a project. In April 1997, Colin Pillinger, head of the Planetary and Space Sciences Research Institute at the Open University in UK, made an initial proposal to the European Space Agency (ESA) for a lander on their Mars Express planetary orbiter which was scheduled to be launched mid-2003. This date coincided with a particularly favourable alignment of Earth and Mars.

Pillinger's idea for a lander to search for evidence of past life on Mars was rejected because another lander, proposed by a French and Finnish team of scientists, was deemed more appropriate due to the scientific work proposed. However, this project became unviable early in the sequence of planning as the team could not reduce the weight of their lander below 200 kilograms, which was calculated as being too heavy by the ESA.

At this stage, the ESA decided that the Mars Express would be a planetary orbiter only, carrying no lander, but Pillinger made another approach with a lander design at just over 100 kilograms. This was named Beagle 2 after the sailing ship that took Charles Darwin around the world on the expedition that led to his theory of evolution.

The ESA was still reluctant to accept the proposal because they did not intend to fund it and were unsure that Pillinger and his team could raise the money to build it. However, after protracted negotiations, in the autumn of 1998 the ESA accepted Beagle 2 as part of the Mars Express Mission. Although at first jubilant at the decision, major anxiety set in when the ESA reduced the final payload for the lander to 68 kilograms. To comply with this Beagle 2 was made smaller and the surface rover, that was to be part of the project hardware, was abandoned. Because of this, other mechanical parts of the lander had to be

redesigned, with the emphasis then on a robotic arm to obtain surface samples for analysis. *Image 5.*

Running concurrently with this was the effort to raise funds for the Beagle 2 Project. An approach to the then UK Science Minister, Lord Sainsbury, met with a negative response and the project was in jeopardy almost before it had begun. Team members were working for no pay to keep the project alive. According to Pillinger, the turning point came when the rock band, Blur and artist Damien Hirst volunteered to help promote the project. This raised the profile of Beagle 2 with the general public who perceived that national pride was being undermined through a lack of government support. As Pillinger (2003) stated – ‘Public opinion was to be Beagle 2’s strongest card’. The UK government relented and allocated £8 million towards the lander plus a major contribution to university groups who were to build the instruments. The ESA also found some money and 13 other countries contributed to the project. Beagle 2, attached to the exterior of the Mars Express spacecraft, was launched on 2 June 2003 (Pillinger 2003). *Image 6.*

Beagle 2 was released prior to the Mars Express going into orbit. It was to have air-braked through the Martian atmosphere and parachuted to the surface on 26 December 2003 but, after its entry into the Martian environment, it was never heard from again.

An interesting footnote to this, however, is that the venture gave the public and media a chance to evaluate the position of the UK in space exploration. Andrew Weston (2008) wrote of a feeling of ‘unfinished business’ when reviewing the space achievements of the UK up until the 1970s and the re-awakening of enthusiasm for space initiated by Pillinger and the Beagle 2 project culminating in a call for the British National Space Centre (BNSC) to be upgraded to a full space agency. The BNSC responded in 2008 that its major objective in the next four years was to ‘improve public and political recognition of the value of space systems as part of the critical national infrastructure’ (Weston 2008). Public opinion and the new stance taken by the BNSC resulted in the UK Government replacing the BNSC with the UK Space Agency on 23 March 2010. Part of the charter of the new Space Agency is ‘to increase awareness among the general public of the UK’s space programme and of the role that space plays in everyday life’ (UKSA 2010).

Acknowledging the influence of grass roots public opinion, the UK Space Agency is enlisting community groups ‘to present the UK’s space programme and stimulate the use

of space in inspiration and learning' by offering *Space for All* sponsorship awards of up to £5,000 (UKSA 2010).

It is interesting to speculate on whether the Beagle 2 project acted as a catalyst for change. Certainly it was a very ambitious project working on a shoe-string budget compared to similar projects initiated by agencies such as the ESA and NASA. Although Beagle 2 failed to meet the mission objectives, it stimulated debate in the UK which prompted public thinking about involvement in space missions. There was also a sense of pride that a small group of British entrepreneurs might achieve something large space agencies had not to this point been able to do - prove the existence of past life on Mars.

The story of Beagle 2 is not an isolated case for consortiums intent on procuring a place for their experiments and instruments on space missions. Rockets and spacecraft cost large amounts of money and missions involve major commitments of time for design and testing. Space agencies are funded by governments who expect positive outcomes, defined often by the political situation at the time. Under these circumstances Exoart projects will have to be resourceful and competitive.

Considering all that has been previously mentioned, a foundation for Exoart can be started with the fundamental characteristics needed for a space-based artform:

Exoart will be:

- Adaptive
- Encompassing
- Collaborative
- Flexible
- Innovative
- Capable of identifying and articulating objectives

Each of these characteristics can be expanded as:

Adaptive: Exoart will have to adapt to the parameters of each mission as set by the space agency or mission consortium. This could dictate size, weight, materials and on-site positioning. It could also include raising some or all of the money needed for the Exoart Project once accepted by the space agency.

Encompassing: Mission aims would not necessarily coincide with the artistic concepts proposed by the artist or artist team. Specific mission aims or space agency directives may have to be accommodated within an Exoart project.

Collaborative: The artist or artist team would need to collaborate with many sections of the space mission team. Artists cannot transport material to another planet; neither in the foreseeable future will they be included in the flight crew to enable them to construct their artwork at the mission destination. If ideas on a physical structure are discussed with mission designers at an early stage there may be opportunities for a collaborative use of equipment or other infrastructure.

Flexible: As highlighted in the Beagle 2 account regarding weight issues, artists will have to build flexibility into their designs and be prepared to adapt to changes in schedules, budgets, landing sites and any other restrictions imposed by the space agency.

Innovative: Artists will have to be aware of and willing to utilise new technologies and materials to accomplish a design within mission parameters of space and weight. Keeping in mind the mission destination, materials that are unsuitable for an exposed environment on Earth may be adequate for the environment of another planet. For example, Mars has no surface water and does not experience rain, therefore materials such as paper and fabric may be considered for certain parts of an installation. Also there will be spacecraft related items that will be redundant once the spacecraft has landed, such as heat shields, parachutes and, maybe, some electronic devices used only for guiding the spacecraft to the surface. With an innovative approach to design these materials may be utilised and would not need to be considered in the weight allocation for the art installation.

Identify objectives: As previously stated governments that fund major space ventures expect clearly defined outcomes. Chapter 6, Mars: The Human Journey, provides an indication of the huge fuel requirements to land a kilogram of infrastructure on Mars. This translates to high mission costs and economies on weight and size. Space may be infinite, but inside a spacecraft it is at a premium and everything has to be justified. All items carried on a mission, including art and cultural artefacts, will require to be supported by an acceptable objective and an outcome that enhances the mission.

It would be clear from the above that artists engaging with space missions should not be daunted by perceived limitations. Artist Robert Smithson was very aware of this, even

when working on his Land Art pieces in remote areas. At a Land Art Symposium in 1970 he stated:

I think that artists are now very conscious of strict limitations and they see them very clearly and can expand them in terms of other limitations. There's no way you can really break down limitations; it's a kind of fantasy that you might have, that things are unlimited, but I think there's greater freedom if you realize that you have these limits to work against and actually it's more challenging that way (Smithson 1979).

Patricia Stokes (2009) comments on this issue from a psychological perspective and concludes that limitations or constraints are almost a prerequisite for an innovative solution. If an artist has no limitations the artistic result can often be predictable because the artist simply references other artworks that are similar to what they wish to create. With limitations, an original outcome must be searched for.

There is, however, one limitation that, with good scheduling and communication, can be avoided, and that is a lack of time. Space missions take years in planning and production yet somehow there has been a history of cultural considerations being left until, metaphorically, the last minute.

Examples can start with the plaques attached to the Pioneer 10 and 11 spacecraft launched in 1972 and 1973. Both these spacecraft would journey to the outer planets and then swing out of the solar system to travel indefinitely through the galaxy. Because of this it was decided, very late in the schedule, to attach a plaque to each spacecraft that would carry information about Earth, its inhabitants and a pulsar map that would indicate its location in the Milky Way galaxy in case any extraterrestrial life found it. *Image 7*. Frank Drake, who worked closely with Carl Sagan and his wife Linda designing the plaque, describes how Sagan asked if he could undertake the drawing of his pulsar map 'quickly because time was very short' (Drake 1979).

Sagan also gathered together a team to create the records illustrating humanity on planet Earth that were attached to two Voyager spacecraft launched in 1977 that, like the Pioneers, would eventually leave the solar system to cruise among the stars. *Image 8*.

Sagan's team had to decide on music, images, greetings and anything else that would represent Earth and its peoples to an alien intelligence that might encounter it. They also

had to investigate how to record this information (it was decided a phonograph record was the best at the time), obtain all the necessary approvals and copyright clearances for the material chosen and organise the manufacture of the recordings. They had about seven months to complete this huge and politically sensitive task. Sagan wrote that the process was very demanding, sometimes frustrating and always occurred with a sense of overlooking something vital (Sagan 1979).

At their launch, the records comprised 118 pictures, greetings from the President of the United States and the Secretary-General of the United Nations, other greetings in 54 languages, various sounds of Earth, 87.5 minutes of music from around the world and a whale song. In the run-out groove of the record, a recording technician added his own personal message: 'To the makers of music – all worlds, all times' (Ferris 1979).

As mentioned at the beginning of this chapter the symbolic activities associated with the first human Moon landing were only determined a few months prior to the launch. As part of this, 116 nations were invited to forward messages of goodwill for the Apollo 11 astronauts to deposit on the Moon. These would then be engraved on a small silicon disc. However, the late approval for this idea meant that there was less than three weeks' notice for heads of state to respond so only 73 messages were received. Typical of the confusion this caused was a telegram sent from the King of Thailand and received by NASA on launch day:

In view of our total ignorance of this project ... and Kings apparent keen interest, would appreciate any information you can provide concerning NASA invitation to send message ... number of countries responding ... methods of recording and method of deposit on the Moon (Rahman 2008).

At the time of sending the invitations NASA was unsure how the messages would be recorded. With an artist team engaged at an early stage of a human Mars mission, these sorts of pressure situations should be avoidable.

There is however a potential downside with the early engagement of artists in the mission team because such missions are many years in the planning. For the first human Mars expedition, which could be launched in the next couple of decades, some mission design work has already started. This long lead-time could have the consequence that some artists in the team may not, for various reasons, be available for that length of time and the

project would have to be handed on to other artists. This is virtually unheard of in the art world; generally an artist would not presume to finish the work of another in case the original concept and design was misinterpreted.

One case that is known came about because of the death in a light plane crash of Robert Smithson. At the time of his death he was working on a land art installation in Texas, USA, which he named *Amarillo Ramp*. After his death his wife Nancy Holt, also an artist, helped by Richard Serra and Tony Shafrazi, completed the earthworks (Tufnell 2006).

Instances of the originators of ideas and designs having to hand the project to others, is evidenced in the works of major prehistoric monuments that archaeologists have claimed, in some cases, to have taken many hundreds of years to complete.

More contemporary instances of designers being unable to complete a project are seen in major architectural buildings – an Australian example is the iconic Sydney Opera House. In 1957, the Danish architect Jørn Utzon won an international competition for the Opera House with his innovative design and, in 1959, the foundations for Stage 1 were begun. But, in 1965, a new state government was elected and with it came a new Minister for Public Works. By 1966, irreconcilable differences with the new minister forced Utzon to withdraw from the project and he was replaced by design architect, Peter Hall. The building, slightly modified from Utzon's original designs, was completed in 1973 (Watson 2006).

The finished building has been commented on both as sculpture and architecture, with Philip Drew (2006) quoting a new classification of 'sculptitecture' when describing the Opera House as 'sculpted terrain' and 'a work of exceptional expressive power'. It could certainly be described as a sculptural form with a function which highlights the difference between sculptitecture and industrial design that often quotes the mantra of 'form follows function'; form being a practical solution to contain the functional device. With sculptitecture, as used for the Sydney Opera House, the organic sculptural form creates its own function, as a landmark and an emblem for Sydney. *Image 9.*

In some respects producing an extraterrestrial artwork may be seen as sculpture, having something in common with architecture. Certainly the concept and design area will be familiar ground for many artists, especially those involved in Land Art, but the necessary interaction with other design, science and administrative professionals that may result in

design changes and construction disputes will necessarily have to be resolved in a professional business-like manner. Engaging with other professionals to complete a commission, as architects do, will be integral to any Exoart project which, like the Sydney Opera House, may be considered a sculptural form with a function.

This model of producing artworks could prompt some unfavourable criticism from the institutional art world but, as Carey (2005) points out, in his writing on the value and perception of art in a changing world, that in the culture of art today where ‘everything and anything goes’, to allow the institutional art world to decide ‘what is or is not a work of art is comically unrealistic’.

One manifestation of Exoart as a collaboration with a space mission could be that it becomes a documented journey with the physical artwork on another planet forming part of the finished work. Tufnell (2006) comments on the contemporary rethinking of art by some artists who designate research, process and result as the whole artwork. In this instance, the journey is crucial and integral to the work of art and is revealed in documentation. This idea would fit well with Exoart; the journey of an artwork reflecting on the journey of a space mission that will bring it to realisation.

This raises the issue of current theories of art that may be referenced for Exoart. It is obvious that, because there are no Exoart installations at present in existence, there is no theoretical writing on Exoart apart from this thesis. Also a review of the few theories that have emerged on Land Art, from where Exoart draws much of its conceptual inspiration, shows an unrealistic fit with Exoart.

In Chapter 3, Land Art, an artist-based theory proposed by Nick Zangwill (1999) is discussed as appropriately reflecting the ideas of artists engaged in Land Art. This theory focuses on the artist’s intent to realise certain properties in an artwork that could include an interaction with the environment in which it is situated.

Other writers mentioned in the chapter have emphasised the relationship between artwork and environment as a crucial component of Land Art. Such an interaction or engagement with the environment forms a cornerstone of the foundation for Exoart. Regarding audience engagement, Zangwill’s proposition is that it would be with those people who make the effort to travel to potentially obscure environments of the artworks and so would automatically appreciate and value the same artistic properties as the artist. However, this

proposition is invalid for Exoart. As already stated no one, other than astronauts, will be able to visit Exoart installations. Therefore, the foundation for Exoart incorporates the essence of Land Art in its interaction with the environment, integrates the documented journey idea explained by Tufnell (2006) and embraces an interactive involvement with the audience who may or may not be interested in art per se, but are part of the global cultural community. But, like much of Land Art, it will only be accessible through documentation.

## **ENGAGING WITH SPACE MISSIONS**

The function of Exoart previously referred to could encompass an engagement with the general public who wish to be part of any space exploration mission. Public engagement and, where possible, participation, is now seen as an important part of space activities by space agencies. Through ventures already undertaken an assessment of public willingness to engage can be judged. Apart from space agency broadcasts and websites that can have millions of hits daily when a major space venture is in progress, (such as the Phoenix spacecraft Mars landing previously mentioned in this chapter), engagement is also invited through names or message schemes and competitions. Names and messages on spacecraft have recently become a popular form of participation and, because modern recording technology can produce large volumes of data on small devices, it is not usually inconvenient to install them on spacecraft.

Usually these schemes are initiated by organisations wishing to support membership interest in becoming part of the projects that they follow so keenly. In most instances, however, these initiatives have only resulted in names or a very short message being sent on the spacecraft. The Planetary Society has been very active in this area and its participation projects have flown on 13 different spacecraft to Earth orbit, the Moon, Mars, Saturn, Pluto and several asteroids and comets (The Planetary Society 2010).

These projects started flying on spacecraft in 1996 with the first being on the failed Russian Mars orbiter Mars 96; but the first successful mission was also in 1996 when 100,000 names flew on the NASA Mars Pathfinder spacecraft. In 1997 a mini-DVD containing 616,400 hand-written signatures was included on the Cassini-Huygens Saturn orbiter and Titan moon probe mission. The comet sample return spacecraft Stardust, launched in 1999, took with it a microscopically etched metal plate containing over 1,136,000 names.

In 2003 the Japanese space agency (JAXA) launched its Hayabusa asteroid sample return spacecraft. When it reached the asteroid Itokawa it fired two shiny target markers onto its surface to facilitate its optical navigation instruments in manoeuvring the spacecraft to the asteroid surface. Inside one of the markers was a thin aluminium foil etched with 877,490 names which are still travelling through space on the back of Itokawa.

The landers that brought the twin rovers Spirit and Opportunity safely to the Martian surface in 2004 both had on board identical silica glass DVDs containing more than four million names. In 2007, when JAXA launched its lunar orbiter Selene it also marked the culmination of its *Wish upon the Moon* campaign which invited people to submit their name and a very short message, of 20 Japanese characters or 40 English letters, to be carried by the spacecraft (JAXA 2007). The number of people who responded was 412,627 and their messages were micro-written on metal foil and attached to the outside of the spacecraft.

Also in 2007, NASA launched its Phoenix Mars lander which excavated a small portion of the northern polar Martian surface and discovered ice. For this mission, the Planetary Society provided a silica glass DVD containing what they titled the *Visions of Mars*. The DVD contained messages from Carl Sagan, Arthur C Clarke and others, books and stories of Mars by such authors as Isaac Asimov and Ray Bradbury, the Orson Welles' radio broadcast of the H G Wells' story *War of the Worlds* and a musical production of Bob Derkach's *Winds of Mars*. Also included on the disc were over 250,000 names from people around the world (The Planetary Society 2007). *Image 10.*

The latest mission to carry nearly 70,000 names on a DVD is the Japanese experimental solar sail spacecraft IKAROS, the acronym for Interplanetary Kite-craft Accelerated by Radiation Of the Sun, launched in May 2010 and headed in the direction of Venus (Friedman 2010).

Currently NASA is collecting names to be included on a microchip to be carried to Mars on the Science Laboratory Rover that has been named *Curiosity*. This rover is scheduled for launch in the latter part of 2011 and land on Mars in August 2012 and, to date, (early April 2011), over one million names have been forwarded to the website from 246 nations (NASA 2009). *Image 11.*

These few examples of public engagement with space missions also indicate a level of popular interest in such missions, especially in the light of limited mainstream media publicity about these missions and the opportunities for participation that are offered.

Another form of public engagement is that of competitions built around a particular project. These mostly take the form of ‘name the spacecraft’ type events, for example the two Mars exploration rovers launched in 2003 were named after a student contest during which 10,000 entries were received. The winner of this particular competition was nine-year-old Sofi Collis with her names of ‘Spirit’ and ‘Opportunity’ (Betts 2009).

The Japanese Space Agency (JAXA) also has a history of competitions to name their spacecraft and their ground-breaking mission to collect a sample from an asteroid was named ‘Hayabusa’, which translates to Peregrine Falcon, following a competition. When the spacecraft experienced major difficulties and its ability to return to Earth was in doubt, the spacecraft with its name linked to a bird with legendary flying powers became a national hero for its ‘never say die’ adventure. After seven years in space the falcon finally returned with its sample return section achieving a safe landing at Woomera, South Australia in June 2010 (Lakdawalla 2010).

Although not directly attached to any space mission, the Search for Extraterrestrial Intelligence (SETI) organisation that listens for radio signals from the cosmos in its search for extraterrestrial intelligent life has been very successful in utilising public participation. The radio signals sourced initially from the Arecibo Radio Telescope in Puerto Rico and now obtained from SETI’s own Allan Telescope Array contain huge amounts of data (DiGregorio 2008).

To analyse these signals over a large frequency range with high sensitivity requires large amounts of computing power – power that SETI did not have available when they started. In 1995, David Gedye proposed the idea of using internet-connected home computers to build, in effect, a virtual super-computer. This idea was pursued and in May 1999 SETI@home was launched. By downloading a program from the internet a home computer could analyse data, fed to it from SETI, in its under-employed periods. Participants not only had the satisfaction of being part of a major space science program but could also feel part of a global community bonded by a shared goal. Three years after it started, SETI had more than 3.5 million participants in 226 countries (Benjamin 2004).

One other way that the public has engaged with space is through the sending of messages beamed into the galaxy by radio transmitters which is sometimes referred to as METI, Messaging to Extra Terrestrial Intelligence, or 'active SETI' (Almár 2008). The genesis of this idea came from a dedication transmission in 1974 at the Arecibo Radio Telescope. A new 300 metre reflector surface had just been installed along with a new 500,000 Watt transmitter which was capable of sending a detectable radio signal across an interstellar distance of thousands of light years. It was decided to take advantage of this with an initial transmission aimed at the Great Globular Cluster star system in the Hercules Constellation. This was a message from the people of Earth to anyone who may intercept the signal. The transmission can be transcribed into simple pixel-type graphic giving information on our form, make-up, mathematics and where we are in the Milky Way Galaxy (Drake 1979). This type of signal, encoded in a very obvious and transparent way that its decoding presents few problems and leaves the least amount of room for error, has been termed anticryptography (Watziawick 1983).

After some criticism of the radio transmission from the Arecibo Radio Telescope that Earth's whereabouts could have been revealed to a hostile alien race, members of the international community of radio astronomers agreed never to unilaterally expose Earth to such a risk again (Weisman 2007). This appears to have been a non-binding agreement as, in 1999 and again in 2003, the Evpatoria Radio Astronomical Telescope in Ukraine beamed a set of messages known as the 'Cosmic Call' to a nearby star system. In 2001, the same transmitter sent another message composed by Russian teenagers called 'Teenage Message to the Stars' (Than 2005).

In March 2005 a commercial company called Deep Space Communications Network (DSCN) started transmitting public messages into space. For just US\$99 they would send up to five digital images or up to two minutes of audio or video plus a text message of up to 50 words into space. Because of the comparatively low power of this transmitter the radio signal will only be detectable to a distance of around three light years, which is the approximate distance only to our nearest star neighbour (DSCN 2008).

In 2008, another cosmic call was transmitted from the Evpatoria Radio Astronomical Telescope owned by the National Space Agency of Ukraine. Called 'A Message from Earth' it was organised as a competition on the social networking site Bebo. What were deemed the best 500 messages were transmitted towards the exoplanet Gliese 581C, 20.5

light years away. Around 500,000 people submitted messages for the competition (AMFE 2008; Marshall 2010).

The Deep Space Communication Complex in Canberra also transmitted messages from the public in 2009. The messages were collected by Cosmos journal in a project called 'Hello from Earth' (Marshall 2010).

The success of radio signals acting as deep space message carriers depends on the strength of the signal. Electromagnetic radio waves travel at the speed of light but as they move through space they spread out and their intensity drops by a factor of one over the distance squared. This means that at 100 million kilometres from Earth the signal strength is only 25% of that at 50 million kilometres (Weisman 2007). This effect is known as the inverse-square law of electromagnetic propagation. To be able to effectively reach deep into the galaxy requires an enormous amount of power and only a few of Earth's transmitters are capable of this.

Although the transmission of radio messages into space is becoming a popular activity, there has been ongoing concern expressed regarding the wisdom of this. It has been argued that revealing our technological capabilities and our whereabouts in the galaxy might not be such a good idea if we assume there may be aggressive life-forms in our vicinity. Because of this, a mathematical tool was developed to quantify the potential impact of such transmissions. The concept for such a tool was introduced at the 6<sup>th</sup> World Symposium on the Exploration of Space and Life in the Universe, held in the Republic of San Marino in 2005. Given the name the San Marino Scale, it was officially adopted in 2007 by the International Academy of Astronautics – SETI Permanent Study Group (Almár 2008).

The San Marino Scale consists of two parts each having a rating between 1 and 5 that relates to an assessment of characteristics of the signal. The combined ranking of these two parts gives a position on the San Marino Scale. *Image 12*. This Scale can be defined mathematically as:

$$SMI = I + C$$

where SMI is the San Marino Scale expressed between an order of 1 to 10. 'I' is the logarithmic measure of signal strength relative to the Sun's background radiation intensity at the same frequency and over the same bandwidth. 'C' represents a characteristic of the

transmission related to its information content (Almár 2008). Using this formula, several active SETI transmissions have been analysed including those from the Arecibo and Eypatoria transmitters.

The 1974 radio transmission from the Arecibo telescope was assessed as having a signal strength that outshone the sun by a factor of  $10^5$  giving it a top 'I' rating of 5. Information content was assessed on the basis that the signal was directed towards the star cluster M13 which is 25,000 light years away from Earth. This constitutes a 'special signal targeting a specific star or stars, at a preselected time, in order to draw the attention of Extra Terrestrial Intelligent astronomers' which corresponds to a 'C' rating of 3. Therefore, the overall San Marino score is 8, which rates its significance as 'far-reaching' (Shuch and Almár 2007).

The Eypatoria transmissions rated an 'I' factor of 4 and a 'C' factor of 3 constituting a total of 7, which rates their significance as 'high' (Shuch and Almár 2007). To put these signals in context, Shuch and Almár (2007) also analysed a wide variety of satellite telecommunications uplink signals and found that even the most powerful were many orders of magnitude weaker than the solar flux. Therefore, this type of transmission corresponds to a San Marino 'I' factor of zero.

The potential of using radio transmissions as a means of public engagement with space, even taking into account any possible terrestrial impact, can be seen to be limited to the use of large and sophisticated facilities. Even when opportunities arise, the ability of individuals to send more than a token short message has proved to be very restricted.

## **ENGAGING WITH THE FUTURE**

The appeal of sending a name or message into space via a spacecraft or radio signal could partly be explained as tapping into the psychological aspects of time capsuling. Carl Sagan (1979) saw the Voyager records as such and commented that: 'communication to the future is an almost irresistible temptation, and it has been attempted in virtually every human culture'

Under the characteristics 'Identify Objectives' in the foundation of Exoart it is stated that an Exoart project will have to be supported by 'an acceptable objective and an outcome that enhances the mission'. An Exoart project design that incorporates a substantial time capsule element and so initiates a public participation event would most probably be

classified as a desirable outcome by space mission planners, especially in the light of previous participation activity for similar events. For space agencies reliant on government funding, public participation that raises the profile of the mission would contribute to a positive outcome.

There is a long history of time capsules that William Jarvis (2003) divides into four main types:

1. The deliberate deposit for an indefinite time span
2. The deliberate deposit with a definite target date for opening
3. Accidentally deposited – no target date
4. Space time capsule, extraterrestrial, indefinite time span

Writings and artefacts from the distant past have travelled through time via types 1 and 3. Although graves and tombs have been a rich source of artefacts they are generally not regarded as time capsules except within the metaphor of the transfer of information from the past to the present. Items deliberately included with the dead were generally to help the spirit in the afterlife and were never intended, or deemed desirable, to be redeemed by others. Type 3, accidentally deposited, could include items lost by their original owners or discarded as being of no further value or be buried by a natural catastrophe such as Pompeii. What is interesting is the type 1 deposit in relation to ancient times. Although there are cave paintings, stone engravings and clay sculptures dating back to antiquity it would be hard to recognise these as deliberate attempts to transfer information to the future.

However, some clear intention of future communication could be claimed by the discovery in the 1980s of many clay cylinders deposited within the walls of the ancient Mesopotamian city of Mashkan-shapir. These cylinders identified the city's royal founder, the construction date of the wall at 1843 BCE and even the wages paid to the labourers (Jarvis 2003).

Esarhaddon, the king of the region of Assyria, Babylonia and Egypt in the 7<sup>th</sup> century BCE buried a number of inscribed tablets in the foundation stones of monuments and other buildings containing information about his kingdom and its civilisation (Sagan 1979). There are many other such finds that indicate the recognition by the depositors of a future time in which they wished to be remembered. To be considered for a type 1 time

capsule the artefacts need to be deliberately deposited in an inaccessible place for their own time period. Cornerstone deposits in buildings and cavities in walls, as the previous examples, fit this requirement.

Most of the more contemporary time capsules fall into type 2 where there is a definite expected retrieval date. These divide into two broad groups. The commemorative type that are sparse in content and have a short scheduled duration (usually less than 100 years) and time capsules that are, in effect, miniature museums and long term archives such as the ‘Tropico Time Tunnel’, a mine shaft in Rosamond, California that was sealed in 1966 for an expected re-opening in 2966 (Jarvis 2003). The Japanese Osaka Time Capsule No 1 is filled with over 2,000 cultural artefacts; the high-tech capsule, weighing over two tonnes was buried in the Osaka Castle Park in 1970 with a 5,000 year retrieval date (Lefcowitz 2002; NFO 2000).

The Crypt of Civilization, a large underground chamber beneath the buildings of the Oglethorpe University, USA, filled and welded shut in 1940 is impressive in its contents. Not only containing a broad range of artefacts it also has more than 640,000 pages of microfilm from over eight hundred works on the arts and sciences. It is scheduled for re-opening in 8,113 AD (Hudson 2008; Jarvis 2003). At the New York World’s Fair in 1939 a torpedo-shaped container sponsored by the Westinghouse Electric and Manufacturing Company was lowered into the ground for 5,000 years. *Image 13*. The original proposed name of ‘time bomb’ was changed before its burial to ‘time capsule’ which is the first recorded use of this term (Jarvis 2003).

Space time capsules, by their very nature of being extraterrestrial, are very contemporary and, although in the context of the group of four definitions of time capsule put forward by William Jarvis they are associated with an indefinite time span, many do have duplicates on Earth. These are an interesting type of time capsule as their contents are not only known, but because of contemporary methods of communication, are accessible to everyone. The uniqueness of these time capsules is where they are. The first of this type was left on the Moon by the two astronauts who made the first human landing on 20 July 1969 which consisted of an inscribed plaque and a small silicon disc etched with 74 goodwill messages, mentioned earlier in this chapter.

The plaques attached to the Pioneer 10 and 11 spacecraft, also mentioned earlier in this chapter, could also be considered as space time capsules as they were designed to convey

information not only into the future but potentially to a different intelligent species. Because of this it was considered that anyone recovering these plaques would know absolutely nothing about humans or our planet. For this reason the engravings on the plaques showed a graphic of our solar system, a pulsar map to locate our position in the Milky Way Galaxy and a line drawing of a naked man and woman standing in front of the spacecraft for scale (Sagan 1979; Watzlawick 1983). (See Image 7.)

In 1976, two NASA robotic probes named Viking 1 and 2 made a safe landing on the Martian surface and began to analyse the soil and atmosphere. On board each was a microfilm recording the names of the people who had worked on the mission (Lomberg 2008). This type of future communication is similar to the names collected from the public and included in various space missions previously mentioned. These types of space time capsules are limited in their information value as there is little or no context associated with the names.

A rather different response in space time capsules was initiated with the Voyager records. The intention here was to include the most amount of information possible within the confinements of the recording media, which was selected mainly for its anticipated longevity. The final decision for the information carrier was for a double-sided copper phonograph record encased in an aluminium cocoon that had graphic instructions on how to play the record and how to transcribe the information. Included with it was the record stylus and cartridge. It was decided early in the project to slow the speed of the record from a normal  $33\frac{1}{3}$  revolutions per minute to  $16\frac{3}{8}$  revolutions per minute, thereby doubling the recording time available. In addition, it was found that pictures could be encoded in the audio spectrum which provided a great opportunity for showcasing the Earth and its diverse peoples. In a way, this was a watershed moment. For the first time in human history we had the means to encapsulate who and what we are and send that showcase deep into our galaxy. (See Image 8.)

Carl Sagan (1979) wrote that it was unfortunate that, due to time constraints, a committee could not be assembled to choose any great works of art to be included on the record. However, there is one picture of an artist sitting at his easel painting. This raises the question of whether an alien species would have the same idea of art that we have; that is if they have any concept of art at all. This is an interesting question to which we will probably never have a definitive answer. What we do know is that the records, in the

vacuum of space, will last for at least one billion years (Sagan 1997). Talking of this at a presentation in Adelaide, Jon Lomberg (2009), a collaborator on the Voyager record, stated that a billion years is the estimated length of time for cosmic dust to wear through the outer aluminium case of the record. It would take another billion years to wear through the front face of the record. As all the images are on the back it is theoretically possible that these might still be retrievable up to two billion years in the future.

If, considering the prospect of a cataclysmic event extinguishing all life on the planet or a global pandemic or even self-annihilation from our own weapons of mass destruction, a pessimistic view of the potential life span of the human race is less than a billion years then the Voyager records may prove to be our swansong.

If any aliens recover the record and understand how to play it, apart from no representation of art they will also see no images of naked humans. The one picture that NASA insisted on deleting from the record was of a naked man and woman with the woman many months pregnant. Although a line drawing of a naked man and woman was on the Pioneer plaques an actual photographic image was too much for the space agency. As Sagan (1979) said 'There was no way that NASA was going to launch full-frontal nudity to the stars'.

Although attitudes have changed since the 1970s, this issue of space agency censorship is mentioned to reinforce the constraints that may be encountered by artists involved in an Exoart project. As previously stated, if space agencies do not approve items they will simply not be included and artists will need to be flexible enough to work around similar problems.

At the present time, only the plaques aboard the Pioneer 10 and 11 spacecraft and the two records attached to the Voyager spacecraft can be considered as unique space time capsules insofar as they are not intended for future humans but for an alien intelligence. Because of this, Timothy Ferris (1979), a member of the Voyager record team, wrote a short statement on the cultural meaning of the records, both to us and any intelligent life form that comes across it. We dispatch it, he says, 'with no hope of its return'; a gesture that speaks positively about the perception of ourselves as cosmic beings. To those who receive the record, Ferris hopes its meaning will be interpreted as the team intended. For them, the record says:

However primitive we seem, however crude this spacecraft, we knew enough to envision ourselves citizens of the cosmos. It says: However, small we are, something in us was large enough to want to reach out to discoverers unknown, in times when we shall have perished or have changed beyond recognition. It says: Whoever and whatever you are, we too once lived in this house of stars, and we thought of you (Ferris 1979).

If in the future, another spaceflight mission leaves our solar system it may include an even more substantial data base than the Voyager records. In that event, it could be an Exoart Project. As stated, Exoart characteristics are that it is an Adaptive and Innovative Artform where, in the above instance, the physical artefact not only encompasses but becomes the recorded device. Artists engaged in Exoart projects would need to recognise where potential opportunities can be found. Where space missions have a history of public and cultural engagement opportunities exist and can be argued for from a sound Exoart foundation that emphasises the multi-faceted and functionality aspects of such an art initiative.

With an Exoart project for Mars, the inclusion of a space time capsule could be argued for on the grounds of gaining public support for a human Mars mission through a major public participation initiative and also as a safe deposit of expressions of human culture.

Rand Simberg (2008) in his article that examines reasons to explore other worlds suggests that because of the many threats to humanity, both natural and human made, it would be beneficial to transfer some of our knowledge off-planet.

Jarvis (2003) is also in favour of a practical approach to 'time encapsulate' our era's writings stating that the multi-millennial survival of the bulk of any age's records and imaged media is improbable. As with Simberg, Jarvis agrees that an inaccessible storage site off-planet would be ideal.

The idea of inaccessibility of contents is derived from a realisation that, unless secure, the contents could be contaminated, tampered with or stolen. The case of the National Museum of Afghanistan is an example of this. In 1988 as the country slipped into civil war, staff at the Museum secretly hid many of their most valuable artefacts. Items that remained were either looted or destroyed by the Taliban. In 2003 the secret vault was opened to find everything intact. Some of the treasures had been through a similar

situation before, being secretly hidden in the ancient city of Pegram around AD 200 and found by archaeologists in the late 1930s (Atwood 2008).

In early 2008 the Global Seed Vault commenced in Longyearbyan on the Norwegian island of Spitsbergen. This vault, 150 metres below the permafrost, aims to preserve the world's crop biodiversity. It is deemed so valuable that no one person knows the access combination in its entirety (Krauss 2008).

With the capacity to store information increasing significantly over short periods of time, the space available by the time a human Mars mission gets underway may be enough for every individual who wishes to participate to include photographs, writings, music, family histories etc as their contribution to this cultural initiative.

Artists engaged in such an Exoart project could collaborate with cultural historians to produce a segment that reflected and expanded on ideas developed for the Voyager record but intended for humans of the future. In the document *The Global Exploration Strategy: The framework for Coordination* co-authored by 14 space agencies, it is acknowledged that having a sustained human presence in space will 'allow humanity to maintain off-world repositories of knowledge and history' (GES 2007).

This forward-thinking idea is prompted by the considerations of what has become known as 'global catastrophic risks' (Bostrom & Ćirković 2008). This is described as an event or series of events that have the potential to inflict serious damage on humankind on a global scale. Bostrom and Ćirković also describe a subset of this that they term 'existential risks' which are those that have the power to cause the extinction of humans and many, if not all, other species of life on Earth. The difference between these two states of risk is that, with a catastrophic event, there is the potential for some form of recovery, even though this may take many generations. However, an existential event is terminal with no possibility of recovery. With an existential event there is no opportunity to learn from experience.

One such existential event that is absolutely certain and unavoidable concerns the fate of our sun. Currently around halfway through its life it will, over the next five billion years, be transformed through its nuclear fusion reactions into a red giant star. It will shine nearly 2,000 times brighter than it does now and expand to around 100 times its present

size. In this stage it will engulf Mercury and probably Venus and the surface of Earth will be more than 1,000°C (Prinja & Ignace 2002).

Unfortunately for the human race, and every other living creature on Earth, this massive expansion of the Sun is not thought to happen instantaneously but rather by slow progression, meaning Earth will be subject to increasing heat and will be habitable for only about another one billion years (Rees 2008; Adams 2008). The irony of this is that, if the human race does not venture out into the galaxy, the prediction that the Voyager record may be all that remains of our culture and history could become true. Of course, a billion years is a very long time, especially in the context of human existence, nevertheless it does prove the point that our impressions of stability are relative.

Existential events can happen in various ways and Ćirković (2008) advises against complacency on the issue on the grounds that such an event has not happened in the last million years. Our luck in this regard, he points out, provides no guarantee of similar luck in the future and accepting the principle that ‘the past is the key to the future’ can result in an ‘anthropic overconfidence bias’ that leads to a dangerous underestimating of potential risks.

The probability of our own self-destruction through a global nuclear war is now very low because of treaties and nuclear arms reductions started in the 1980s. However, even a regional use of nuclear weapons could alter the Earth’s atmosphere and block the sun’s thermal energy causing massive global crop failure and a nuclear-induced winter that could last for many years (Cirincione 2008).

Four other potential existential risks are listed by Ćirković (2008), namely:

1. asteroid or comet impact
2. super-volcanism episodes
3. supernovae/gamma-ray bursts
4. super strong solar flares

The first two would be almost instantly felt, with the amount of destruction and long-term consequences known soon after. The second two may have direct repercussions but their main effects would be felt in a long-term biotic crisis.

One other event of constant concern for centres of disease control is some form of infectious agent arising that would have a major impact on the entire human species. However, scientists have mostly classified the risk as potentially catastrophic rather than existential because to date there are always survivors in even the most virulent outbreaks (Weisman 2007).

Whether a space time capsule is utilised for the storage of specific knowledge in the case of a catastrophic event or not, it would certainly be of value to future cultural historians if the contents were submitted from people around the world and were of sufficient depth to provide an analytical base.

The method of engagement for global public participation could be via the Internet which has already been successfully used for global art projects.

One prominent artist in this field, Rafael Lozano-Hemmer, installed his interactive artwork *Vectorial Elevation* in Mexico City as part of the millennium celebrations. Since then, he has installed it in three other countries. The artwork consists of 18 searchlights placed on top of buildings. These robotically controlled lights can be made to form patterns in the night sky via a controlling program that is easily downloaded from the Internet. People from around the world could then create a virtual light sculpture on a computer, and then upload the data to move the lights to actually recreate that sculpture with the searchlights. Webcams then recorded the actual light sculpture and relayed it in real time on a website. *Images 14 and 15*. When it was installed in Mexico more than 800,000 people from 89 countries visited the website during the two weeks the installation was active. When it was last shown in Dublin, Ireland, in 2004 over 522,000 people from 100 countries downloaded over 19 million pages of documents and created over 14,000 light sculptures in twelve days (Lovink 2000; Lozano-Hemmer 2000; IESANZ 2004).

Lozano-Hemmer uses the term 'relationship specific' for such works as *Vectorial Elevation* and states that 'Without the public the piece cannot unfold, it cannot exist; it would be like a play without actors' (Lozada 2003).

There are conflicting arguments regarding public engagement using Internet access. These arguments encompass social, cultural, economic and political spheres but, in the context of the Internet for participation in a global space time capsule, two views can be examined.

The first concerns access to computers and the Internet which, it is argued is highly inequitable which reduces the possibility of genuine global participation. But, if Internet access is available, a second view is that it enables groups and individuals to communicate and participate freely and in most cases avoid traditional cultural gate-keepers. It also facilitates the establishment of global communities that have shared interests (Barraket 2005). This latter view can be seen in effect with the SETI program. The Internet not only provides the facility for people genuinely interested in the venture to participate and form an online community but allows these people to actively engage, via the Internet, with the science of the program.

When establishing his artwork *Vectorial Elevation*, Lozano-Hemmer considered the aspects of citizen engagement in relation to the Internet. He saw online engagement as ‘de-hierarchicalising and decentralising and a challenge to the biased intermediation of mass media’ (Lozano-Hemmer 2000). The criteria for his interactive website for the project included that it should be independent and devoid of political or technological censorship, this translated as the site not requiring the download of plug-ins or any special hardware or software. The site would promote a message of unity that was not a call for centralisation but the interdependence of different regions of the world. Also free Internet access points were established to allow people without a net connection to participate (Lozano-Hemmer 2000).

Tackling the inequitable access to computers and the Internet is an issue that is not easily solved; however, at least one non-profit organisation is making inroads into the problem. The ‘One Laptop per Child’ organisation has a mission statement to deliver to ‘500 million children in all remote corners of the planet’ a computer with wireless Internet capabilities. Its initial laptop was specially designed and manufactured for the organisation and branded the XO, which was distributed to more than 1.4 million children in 35 countries and in 25 languages (OLPC 2009).

In December 2009 the organisation announced three new models with updated specifications that it intended to produce - the XO1.5 available from January 2010 and the XO1.75 available early 2011. Both have more processing capacity with less battery power requirements and both can run the Linux and Windows operating systems. The new XO3.0 is less like a conventional laptop and more like a single sheet of flexible, unbreakable plastic (OLPC 2009).

In 2010 a preliminary evaluation of the 'One Laptop per Child' scheme undertaken in Peru was released. Although there was a high level of enthusiasm from teachers, parents and school children the report highlighted a few problems. Although the computers have a wireless facility, to access the Internet the school has to be linked to a server and have a networking facility which, in this case, was only available in 2% of schools. The report also showed that 5% of the schools did not have electricity, an issue the Peruvian government is addressing with the installation of solar panels. The report also highlighted the need for more technical and educational support for the teachers (Derndorfer 2010).

These are issues that can be tackled over time but the 'One Laptop per Child' scheme does demonstrate the effort that is being made to broaden the access to computers and the Internet worldwide. By the time a human mission to Mars is being finalised and an Exoart project is being developed it could reasonably be expected that many more people around the world will have, in some way or another, access to the Internet.

For a space time capsule Internet access is crucial to its success as a truly global participation event. Historically, time capsules have contained physical items deemed important by those assembling the contents. However, physical items will be very difficult to justify on the initial long-distance human spaceflights, where space and weight are limiting factors. Digitally encoded or micro-engraved devices carrying personal information will arguably be the only practical way potentially millions of people will be able to engage with a time capsule event.

## **ENGAGING WITH MEMORY**

Any physical Exoart sculpture installed on Mars, or any other space body, will by its association with the particular spaceflight mission become a mnemonic object. This could be defined as a monument, as the word derives from the Latin 'monere' to remind, which has the derivative 'monimentum' – anything that recalls the mind, especially the memory to people (Partridge 1978). Because the term 'monument' is often used for a physical object that calls to mind a memory, especially of a historical event, it seems inevitable that some Exoart project sculptures will be referred to as monuments.

Beryl Henderson (1988) in her introduction to the book which recounts the identification and cataloguing of 5,000 monuments throughout New South Wales, Australia, raises the issue of what can be classified as a monument. In the analysis it became evident that one

important criterion was for people in the future to be able to recognise who or what was being commemorated and why. Relics of a historical past or information markers did not qualify as monuments, however, it was established that time causes changes in public perception and that sometimes to be thought of as a monument is enough to make it a monument; at least in the present. Conversely, time can erode memory and a monument can lose its meaning if no information is available. As the theoretical foundation for Exoart states that it is a flexible artform, an Exoart project sculpture referred to as a monument would not impinge on any conceptual base and may even enhance its status.

Laura Brooks (1997) states that:

In its physical form a monument acts as a historical document and its visual appearance can elicit responses of nostalgia, pride, empathy, sorrow, compassion and respect and cause people to feel connected to a collective past or a shared experience.

Brooks also claims that from the beginning of recorded history to the present day people have erected monuments and, although these monuments are as varied as the people who created them, it is nothing less than quintessentially human.

Marilyn Lake (2006) while commenting on the many monuments erected in the late nineteenth century says that they acted as insurance for a potential failure of public memory. However, to act in this way they would need to be highly visible, therefore placement would be crucial. A monument that was not on Earth would not easily accommodate this role.

Monuments can also be created to incorporate political aspects of a nation, focusing on an ideal self-representation of supposedly shared values (Khazanov 2007). In this regard, Peter Conrad (2006) sees some monuments as establishing a certain prescribed truth of history that acts as an adjudication of memory.

Kress and van Leeuwen (1995) articulate what they call the narrative structure of sculpture and, although not specific to monuments, they do talk about sculpture in public places. Their analysis of the use of colour, material, texture and form as well as the symbolic attributive process can all relate to monuments, as can their observations on the interactive dimensions of sculpture. What towers over us, they claim, is socially distant,

the vertical is the dimension of power and reverential distance, height, indicates 'highly placed' and a frontal eye level view invites involvement.

An example that utilises these elements is a monument at Glenelg in South Australia that marks the site of the landing of the pioneer settlers and the announcement by Governor Hindmarsh of the establishment of the government on 28 December 1836. *Images 16 and 17*. The structure is a tall, monolithic, square sided marble column. At the top is a bronze model of the sailing vessel *Buffalo* which brought the settlers from England and on the two broadest sides are carvings depicting the establishment of the colony and its development a hundred years later, when the monument was erected. Text, in English, is incorporated into the fabric of the structure. This monument presents a classical narrative reading. The carved figures of the first settlers are represented realistically in authentic dress and are depicted in a ceremonial scene. The other image is of a hundred years later, where a number of stereotypical people reference past events that have shaped the character of South Australia. The bronze model of the *Buffalo* is also realistic and sits in a position atop the monument where its sails are still silhouetted against the sky.

The position of the viewer, once near enough to see the detail in the images, is one where the monument exerts its greatest authority. In towering over us with its great mass it is designed to humble the viewer into recognising the great achievements of the pioneer settlers. This is reinforced by the carved images being above head height so that the viewer has to literally 'look up' to the people depicted.

Another traditional type of monument to Captain James Cook stands at Poverty Bay, Gisborne, New Zealand at the spot where Cook landed in October 1769. *Image 18*. The monument consists of a ubiquitous bronze statue on a stone plinth. Cook, legs apart and hand on hip gazes not out to sea but at the land, and historically at the Maori who were gathered nearby. Was this really the stance that Cook took when encountering the Maori chief – a posture of dominance and superiority? The rendering of the human form in life-like detail will always encounter a problem with interpretation. When Conrad (2006) states that monuments can incorporate a prescribed truth he could easily be referring to statues such as this, an interpretive view of the landing from the perspective of the Europeans who eventually dominated the islands, not the Maori whose ancestors were killed during the encounter. The text on the stone plinth that elevates Cook above the eye line of the viewer, who can never quite see his vision, states:

A fine seaman, an outstanding captain and an honest man, Captain Cook was one of the last of the great explorer-navigators and the first of the scientific expedition leaders.

A more architectural structure that is classified as a monument is the Federation Pavilion standing in Centennial Park, Sydney. *Image 19*. Completed in 1988, it replaced the original Victorian Federation Pavilion which marked the location where Australia officially became a nation (Mossop 2006). The Pavilion is a solid, heavy-looking structure designed to last for a millennium. It has the feel of authority and inside its thick sandstone walls has the sort of cool reverence of a church.

The interior houses the historic ‘Commonwealth Stone’ which has now been elevated, like Captain Cook, with its own plinth. *Image 20*. An inscribed metal strip on the floor proclaims:

On January 1<sup>st</sup> 1901 the Right Hon. The Earl of Hopetoun was sworn in as the first Governor General of the Australian Commonwealth on this hexagonal stone in the presence of the representatives of the six states.

The stone now sits under a coloured glass canopy by artist Imants Tillers, the historic and the contemporary which, according to Mossop (2006), imbues the structure ‘with reflections on history, culture and the spirit of place, creating an environment which is both coherent and symbolically rich’.

Although these three examples of classical monuments have different forms, they were chosen because of one common feature that is important to the considerations of an Exoart project sculpture being referenced as a monument, and that is they all have a major emphasis on the marking of place. The monument at Glenelg marks the site of the landing of the pioneer settlers to South Australia, the Captain Cook monument in New Zealand marks the spot where he landed in 1769 and the bay where his ship HM Bark *Endeavour* anchored was named Poverty Bay because the expedition had to leave without provisions from the site after the skirmish with the Maori. The Federation Pavilion commemorates the spot where the first Governor General of Australia was sworn in.

Monuments that mark the site of an historic event form a major part of the heritage of cultural remembering. This propensity to acknowledge the site as well as the event can be utilised in an Exoart project, especially for something as significant as a first human

landing on Mars. The site, like the first Moon landing site at the Sea of Tranquillity, immortalised in Neil Armstrong's words after touchdown 'Houston, Tranquillity Base here. The Eagle has landed' (Rahman 2008), will inevitably become a major landmark. The Exoart Project team will have to decide on a form for a site marking artwork and, in this respect, there is a growing trend towards more abstract designs.

An example is a work produced by artist Margaret Worth at Victor Harbor in South Australia entitled *On Occupied Territory*. *Image 21*. The artwork/monument acknowledges the meeting in 1802 of English Captain Matthew Flinders and French Captain Nicolas Baudin in the Aboriginal waters of the Ramindjeri Ngarrindjeri people. Visually the three slender poles forming the major components of the sculpture deviate from the concepts of solidity and realistic representation to one of metaphor. The three poles represent the masts of the English and French ships and the indigenous Knobby Club Rush and present the meeting of three cultures at this geographical point. The sculpture is not intended to be dominant over the viewer and this is achieved by presenting the best view from a distance. From this position it can be seen that the height of the three elements is the same, giving no supremacy to any culture. And although the rigging of the French and English masts overlap, they do not touch, keeping the three elements separate.

The introduction of colour into this marker is also one key to understanding the artwork. The colours red, white and blue are the only ones on both the English and French flags, and the proportions and spacing of these colours on the masts tells us which is which. But with this type of sign there is an assumption of knowledge of the two flags. Without this familiarity a certain amount of meaning is lost, as it is with the Knobby Club Rush if the viewer has no knowledge of this grass and its uses by the local indigenous population.

It also helps to know the English and French were at war at the time, which makes this peaceful meeting even more extraordinary. The abstracted form of this artwork can produce numerous interpretations, making it not only visually strong but conceptually very interesting.

Not all monuments that incorporate place marking are specific to site. The work *Full Fathom Five* by artist Michael Dan Archer at Portishead in the UK is a monument to seafarers from that broad geographical area. *Images 22 and 23*. Comprising 108 granite pillars that form serpentine avenues across a grassy mound, it looks out over the waters of

the Bristol Channel. Thirty-eight of the pillars incorporate etched text that the artist collected from local people who had connections with seafaring at Portishead. The texts include such things as historical ship names, destinations, wartime radio codes and fragments of stories and a poem. Archer readily concedes that the artwork/monument became 'a sort of sculptural architecture' (Archer 2008). No doubt Archer would concede the usefulness of Philip Drew's (2006) term 'sculptitecture' for *Full Fathom Five*.

In Newcastle/Gateshead, UK, the borough council commissioned two artists to create artworks that would recognise the heavy iron and steel based industries like shipbuilding that were once the district's economic base, but are now almost gone. Andy Goldsworthy made a four metre high cone of rusted off-cut steel plates. *Image 24*. The cone is a form Goldsworthy has used often in his work but is usually constructed from natural or organic material. However, in this work, the rusting plates of the cone act as a metaphor for a 'monument to a decayed industrial environment' (Causey 1991).

For the second commission the council decided that it should also incorporate a 'millennial image that would be a marker and a guardian for our town' (Collins 2007). The commission went to Antony Gormley for his piece *Angel of the North*. *Image 25*. Created from 200 tonnes of weathering steel the Angel stands 20 metres tall with a wingspan of 54 metres. Its enormous size is not designed to intimidate or overpower, although standing at the feet of the Angel it is hard not to feel overwhelmed by its sheer presence, rather it is designed to fit in its environment, its scale appropriate for its most intended viewing, from the A1 highway where an estimated 33 million people pass it every year (Gateshead Council 1998).

Gormley acknowledges the iron and steel industry of the district yet the Angel, he says, also has a function to 'grasp hold of the future expressing our transition from the industrial to the information age' (Gormley 1998). The figure with aeroplane wings is, in effect, a monument to the district's past and its aspirations for the future.

Currently there are no exo-monuments; however, NASA has reclassified some of the spacecraft from its robotic missions as memorials. Having a slightly different interpretation from monuments, the word memorial is derived from the Latin 'memoria', a sign of remembrance (Partridge 1978).

Although memorials are generally regarded as acknowledging the lives of individuals or groups after their deaths, they are still mnemonic devices and important cultural identifiers. Therefore, a few examples are worth mentioning to highlight the importance placed by governments and government agencies on this form of remembering.

In 1976 a small robotic lander named Viking 1 successfully touched down on the Martian surface. In 1982 the lander was re-named the Thomas Mutch Memorial Station in honour of the man who was the leader of the imaging team for the mission. In 1997 the Pathfinder spacecraft reached the Martian surface with a rover named Sojourner. After the rover set off on its first perambulations the Pathfinder base was renamed the Sagan Memorial Station to honour the scientist, author and co-founder of the Planetary Society, Carl Sagan.

A second Viking probe landed on Mars a short time after Viking 1 in 1976 and, in 2001, NASA renamed it the Gerald Soffen Memorial Station in honour of the deceased Viking mission lead scientist. The two landing platforms for the highly successful Mars rovers Spirit and Opportunity were both renamed in 2004 to honour the crews of the two Space Shuttle disasters. The Spirit landing platform was renamed the Columbia Memorial Station and the Opportunity platform the Challenger Memorial Station (Rayl, Melton et al 2008).

An Exoart project sculpture intended as a device for public participation and representing the people of the world is unlikely to be reclassified as a memorial, even in the tragic event of loss of life during the space mission. It would be more appropriate to rename the actual spacecraft as a memorial station as has been done in the past.

Various interpretations may be entertained for an Exoart project sculpture, but what needs to be considered is the linkage between creative objects and creative memory as an aspect of human culture. John Mack (2003) writes on aspects of 'monuments and aides-memoires' that indicate not only where we have been but where we wish to go. The linkage between objects and memory, he states, can be direct as in the creation of specific mnemonic devices or it can be in the creation of mechanisms in which individuals, groups or whole communities can engage in a commemorative process.

Mark Johnson (1991) interprets such mechanisms as 'shared structures of imagination' by which global communities can share the world and communicate an experience of it.

Johnson sees imagination as a key element in an active cognitive process that links imagery and memory.

Imagination itself is linked to perception which is culturally mediated. Because of this, images and objects can become symbols as well as monuments, as in the *Angel of the North* sculpture which is seen by the local community as being formed from the past (the industrial steel plate) but representing aspirations for the future. This example of a linkage between a creative object and creative memory is evident in the way that the declining heavy steel industrial base of the district is no longer seen as a liability, but as the historic base from which the district will transform itself.

In the Newcastle/Gateshead area, images of the *Angel* appear everywhere. From tourist information, hotel letterheads, restaurant menus, advertising displays and websites and, in December 2010 the weekly UK newspaper, *The Telegraph*, reporting on the heavy snowfalls blanketing the north and eastern areas of the UK featured an image on the front page of the *Angel* with the caption 'The Angel of the North stands tall among the snowy landscape surrounding Gateshead' (Milward & Wardrop 2010). *Image 26*.

Writing on the work of Antony Gormley, Anthony Bond (2005) comments that because sculptures occupy real space in the world they also can assume a metaphorical dimension; a dimension that he sees as the most enduring instrument of art.

Metaphorical and symbolic associations combined with a mnemonic dimension are a combination that would fit within the theoretical foundation of Exoart. Mnemonic dimensions would reflect on the human global aspects of a space mission and its relevance for those living in the present. Exoart would provide an alternative focus from the science and high technology accompanying the mission and in the future it would present a point of departure from the official historical account of the expedition.

As a metaphor, Exoart would interact with popular culture, providing a route for individuals to engage with new worlds. As a symbol of creative human thought it could become, as Johnson (1991) suggests, a shared structure of imagination for global communities.

## **AUDIENCE AND AESTHETICS**

Although Exoart is at present an unrealised artistic expression and will remain so until the first Exoart project is completed, some further aspects can be described with the intention of adding another dimension to the foundation of Exoart.

It is acknowledged and accepted that any theory related to Exoart will be subject to debate and will potentially be modified as Exoart projects proceed, for Exoart is intended to be dynamic and not rigid and structured. Its defining aim is to engage with human space missions to promote and accomplish Exoart projects in other cosmic environments.

In this regard the anticipated audience would be a global community that can find value in a cultural engagement with human space exploration. But, because of the reliance on space agencies to accept an Exoart project within a mission, a preliminary audience would be those responsible for making a decision on the inclusion of the project.

Nick Zangwill (1999) reviews a series of audience-based art theories but insists that any plausible theory must reference the artists' intention in producing the work. This would be paramount when relating to space agency audiences and sets up an interesting dichotomy in that, if the artists fail to make this particular audience appreciate some value in the nature of an Exoart project, any potential global audience will never experience it.

Zangwill prefers, and makes a case for, an artist-based art theory that builds a relationship between the artist and the work, but says this theory would not need to deny that an audience exists. It would focus more on the artist determining an artwork by intending to realise certain desired or aesthetic properties in the work that an appreciative audience would also want to experience. This shifts the emphasis from an artist creating an artwork with the specific intention of affecting an audience in certain ways, to where the artist's desired properties are encapsulated in the essence of the artwork and these properties are also found valuable by an appreciative audience.

This stance is logical and could be adopted within a theoretical definition of Exoart if it were not for the fact that space agencies will make the decision on whether an Exoart project makes it to the launch pad. Therefore, this space agency group will need to be considered as a select audience within a specific space exploration mission that the Exoart project team will have to relate to. Whether this proves to be a help or hindrance to the project team will depend on the structure of this particular audience.

There has been considerable debate regarding aesthetics in ascribing the term ‘artwork’. (See sections in Chapter 3, Land Art and Chapter 4, Ancient Land Interventions.) Richard Lind (1992) points out the difficulty in distinguishing the difference between artistic and non-artistic forms without reference to aesthetics. The importance of aesthetics is observed in his comment that conceptual aspects ‘must subserve the aesthetic function’ in a theory of art where the intention of an artwork is to make a statement and produce an aesthetic object.

With Exoart there is an intention to make a statement which can be taken to include the human relationship with our solar system and the cosmos. Also, because of the anticipated global audience, any physical artwork should aim to communicate visually in the broadest terms, notwithstanding previous references to the preferred ideas of Zangwill and his artist-based theory. Therefore, aesthetic considerations, tempered with the practical aspects of delivering an artwork to an interplanetary site, would rate as significant in any Exoart project.

Other aspects of Exoart are:

- A design consideration for an Exoart project artwork is for an engagement with the planetary environment in which it will be placed – hence its conceptual link with Land Art.
- An Exoart project artwork will be intended to be left permanently in its planetary environment. Just as works of Land Art are connected to their environment, Exoart artworks will be similarly connected and therefore cease to be Exoart artworks if returned to Earth.
- In considering whether prehistoric objects can be deemed works of art Lopes (2007) proposes a theory that they can, if it is established that such objects were made to be ‘special’ or ‘significantly different’. (Lopes’ theory is discussed in more detail in Chapter 4, Ancient Land Interventions.) Anticipating a similar conundrum in the far future with space mission equipment left on planetary surfaces, Exoart project artworks should aim to have an appearance that is significantly different from the mission equipment that may occupy the same environment. Aesthetic considerations could possibly achieve this differentiation.
- In his theory on art and audience, Zangwill (1999) acknowledges that, even if an audience plays no essential role in the artist’s mind, the artist may still want the

audience's experience to be worthwhile. It could be expected that the Exoart artist team would similarly want the experience of the artwork, which may be interpreted beyond the physical form, to be worthwhile especially as the anticipated audience would be global. Therefore, aspects that function as a means for public participation would not be out of place within the artwork.

These areas are expanded on throughout this thesis.

## **SUMMARY**

This chapter defines the term 'Exoart', its characteristics and the basis for the development of a theoretical foundation. The name Exoart is derived from 'Exo' meaning external, outside; and 'art', which together can be read as an artistic and cultural expression outside of planet Earth.

Exoart is a new form of artistic expression based on a close interaction with space science and cultural engagement. There are no current art theories that encompass all aspects of Exoart; however, Exoart is not without a historical base. It can be viewed as having close conceptual links with contemporary Land Art which itself is, in part, derived from ancient land markings and interventions.

The proposal that there is now a need to formulate a solid foundation for Exoart comes from the fact that space agencies are currently making plans, and undertaking research, for a human mission to Mars in the foreseeable future. If the population of the world outside of the areas of space science is to be represented on this and future historic missions, a cultural engagement needs to be considered. Exoart, as defined in this chapter, can provide a foundation for such an engagement.

Space agencies themselves have seen a benefit in the involvement of the general public in their space missions as well as participating in cultural initiatives. These, however, have been relatively small scale. It is proposed that, as human space missions grow in size and scope, these cultural initiatives will also expand to a point where an artist team will be engaged within the space mission project. To achieve this position, a strong foundation from which to argue a case is needed. This foundation will have to show an understanding of the complexities of space ventures as well as the political and social aspects that influence space agency decisions.

The key characteristics of Exoart are therefore defined as: Adaptive, Encompassing, Collaborative, Flexible, Innovative and capable of identifying and articulating objectives.

An Exoart project sculpture may, in certain contexts, be regarded as a mnemonic device, as a symbol or take the role of a shared structure of imagination. None of these viewpoints would be detrimental to the underlying concept of Exoart. An Exoart project may also take the form of a documented journey where the research, process and result, together constitute the whole artwork.

An important aspect of Exoart is the embracing of public engagement within a project. Although this is not usual in contemporary art practice it is not unheard of and a relevant example is given in the work of artist Rafael Lozano-Hemmer. One opportunity for global public engagement within an Exoart project is through an Internet structured time capsule.

Time capsule initiatives are known to space agencies who have instigated several within past space missions. The public has also participated in time capsule-like events through submitting their names and, in a few instances, a short message to be carried on board a spacecraft. This form of global public participation could be expanded within an Exoart project.

The development of an Exoart project would require a special type of artist team who can work closely with space agencies and accept the limitations that will be imposed. A constructive and innovative approach to dealing with limitations will be required to obtain the best outcome for both the space mission and the Exoart project.

The foundation for Exoart provides a solid reference for future artists engaged in such projects.

## **CHAPTER 3**

### **LAND ART**

#### **INTRODUCTION**

The aim of this chapter is to introduce Land Art within the context of this thesis, the focus of which is art moving beyond terrestrial boundaries.

My premise is that Land Art is the most appropriate area of art from which to develop a foundation for Exoart. Land Art encompasses a wide spectrum of works and ideas that incorporate or reference the open environment. The artists themselves articulate a broad vision of environment that advocates a deeper observation not only of the space around us but also the space above us.

In this thesis I am proposing that Exoart is the art of new extraterrestrial environments such as Mars, where the establishment of any artwork will have to engage with an open and challenging environment. Therefore, an understanding of terrestrial art that similarly engages with open and challenging environments, as well as the concepts and issues associated with that art, will help in establishing the foundation for Exoart.

This chapter is not intended as a comprehensive reference for Land Art, it is written to accompany and provide detail for the thesis for Exoart. Because of this the structure and content of this chapter is focussed towards aspects and artworks of Land Art that contribute to this end.

#### **BACKGROUND**

The term 'Land Art' has evolved to become a generic name for the many, varied and subtly different forms of art in the natural or non-urban environment.

The terms used by authors researched for this chapter to reference these different forms include:

- Environmental Art
- Art in the Landscape
- Earth Art
- Earthworks

- Sited Sculpture
- Ecological Art or Eco-Art
- Ecoventions
- Landscape Art
- New Landscape Art
- Nature Art
- Site-Specific Installations
- Environmental Sculpture
- Environmental Interventions

These terms highlight the difficulty of labelling the very wide range of work undertaken by artists in the non-urban environment for reference purposes.

Tiberghien (1995) sums up this problem by pointing out that there is nothing resembling a movement in the classical art sense that can be labelled 'Land Art'. To make things even more confusing, many artists who work in this area do not use Land Art or any of the terms mentioned to describe their work. If artists mention anything regarding the context of their work they tend to speak about working with, or in, nature and the environment.

Fisher (2007) also points out that the term 'Land Art' can encompass works that utilise the environment in which they are sited, making it an integral part of the work, but can also include an artwork made *about* an environment but not necessarily in that environment.

Expanding the boundaries even further, Malpas (2007) proposes that Land Art could include poetry and writing about the land. Also Performance Art, in some situations, can be linked to Land Art. Land Art has also been utilised in a gallery situation, for example by the artist Robert Smithson (1979) with his exhibition pieces that he called 'non-sites', that referenced and were often made from material of some of his other works in remote environments. Artists have also engaged in land remediation projects that aim to restore or stabilise degraded areas of the natural environment.

Generally, though, the term Land Art has come to mean works of art that have, or are intended to have, an engagement with the non-urban environment in which they are situated and this meaning will be used in this thesis.

This engagement between the artwork and the environment is explored by Allen Carlson, who states:

Environmental works of art share a common feature that both distinguishes them from traditional art and makes them examples of the most intimate of relationships between nature and art. This is that all such works of art are in or on the land in such a way that a part of nature constitutes a part of the relevant aesthetic object. In other words, not only is the site of an environmental work an environmental site, but the site itself is an aspect of the work (Carlson quoted in Lintott 2007).

Spivey (2005) points out that artists often incorporate materials from the site in their work, either organic or inorganic, as an aspect of the construction. Smithson describes it in this way: ‘instead of putting a work of art on some land, some land is put into a work of art’ (Smithson quoted in Malpas 2007).

Beardsley (1998) in his writing on the subject highlights the issue of scale in a particular environment and the relevance of topography, natural history and character when an artist chooses a site in which to work. The relationship of the scale of the work to the environment in which it is created is a complex issue in Land Art because the environments can sometimes go from horizon to horizon. Robert Smithson (1979) stated in his writing on *Spiral Jetty* that: ‘Size determines an object, but scale determines art’. Beardsley also raises the important aspect of the ever-changing environmental conditions that an artist must contend with. These changing conditions affect the character of the work, especially changing light conditions which can include the brightness of the summer sun or a leaden overcast winter day, a bright moonlit night or lightning storm with heavy rain.

Environmental conditions also bring to the fore issues of entropy. Andy Goldsworthy (2003) writes about the challenge of entropy in his work and that, by changing his view on its effects, he can now make it:

an integral part of a work’s purpose so that, if anything, it becomes stronger and more complete as it falls apart and disappears.

This is particularly relevant to his work with ice and snow where, as he points out, the sun that brings the work to life would soon destroy it. *Image 27*. Also his sand works in tidal zones have a limited life before rising water washes them away.

Utilising the term 'Land Art' allows the exploration of a wide range of works and debates that will contribute to the foundation of Exoart. Tufnell (2006) states that the term 'Land Art' is 'appropriately open and non-specific'. It also does not relate to particular concepts, themes or styles of artwork and is not prescriptive about the way artists encounter the environment. There are, however, issues associated with artists working in some environments that could have an impact on Exoart and these are discussed in other parts of this chapter.

A broad range of Land Art works have been surveyed for those that demonstrate specific attributes to present the case that this artform is the most suited to reference for the development of a foundation for Exoart.

Under the broad heading of Land Art works can include small and ephemeral pieces, such as the boat form constructed from twigs, grass and bindweed flowers by artist Nils-Udo, *Image 28*, to the grand gesture of environment engagement such as the *Roden Crater* by artist James Turrell. *Image 29*.

For this thesis, however, the artworks to be discussed will be included because of their conceptual engagement with a chosen environment. In using the term 'environment' in the context of this thesis it is meant both as terrestrial and cosmic.

Michael Lailach (2007) points out that works in the environment are not only uncompromisingly conceived for specific locations but they aim for the creation of an art experience that takes in both the physical and sociological environment. Humans in one way or another have had an influence on the physical appearance of most of the environments on this planet but our cosmic environment, that is beyond the immediate influence of Earth, is still being discovered by scientists and astronomers.

Within the aim of many Land Art works is a reference to human aspects of the environment. These can take the form of direct interaction to emphasise the way an environment has been altered, to utilising an altered environment to highlight a concept of the artwork. There is also a commitment by some artists to engage with and focus on our cosmic environment. Their concepts incorporate expansive ideas about the cosmos and our place within it, and this thesis argues that Land Art is an artform best positioned to engage with these cosmic ideas.

Waldemar Januszczak (2008) enthusiastically summed up this view in this way:

One of the things I really like about Land Art is that it is always about big subjects, the cosmos, the summer solstice, the sun, the stars – big ideas ... If you're making Land Art you have to make art about the big ideas.

## **LAND ART BEGINNINGS**

As Tiberghien (1995) rightly points out, many of the early artists involved in producing Land Art were also contributors to a vast array of ideas and theories that, when combined with other critical writings, make Land Art difficult to categorise in theoretical terms.

In part this is because the range of work, as exemplified in the section Land Art Works, is large and expansive - the only theme that would link them all is that they are created outside, usually well away from the urban environment. In effect, it is these characteristics that separated Land Art from gallery art and introduced a rethink of the age-old question *What is art?* Tiberghien (1995) re-formats this in relation to the development of Land Art and asked *When is there art?* But the question could be asked as *When is there new art?* That question could be answered with the somewhat cynical response – When curators start to show it and museums start to collect it. This is, of course, the dividing line.

Lailach (2007) states that the unsaleability of Land Art, because of its inability to be moved from the remote locations where it is usually constructed, was 'an affront to the art world'. The curators of galleries and museums wondered what could be shown or collected.

Certainly, galleries and museums can collect images and some constructed representations of the work, pieces that Smithson (1979) referred to as 'non-sites' in that they related to a specific work at a specific site but what the viewer was looking at in the gallery was neither the artwork nor the site.

Therefore, when accounts of Land Art are being written it is usually in terms of when these artists started moving away from the gallery system of displaying art. A wide consensus amongst writers is that this commenced in the mid to late 1960s. However, the concept of what was to become known as Land Art was being conceived long before this.

Writings of the German architect Bruno Taut in 1919 showed he was creating designs for transforming a whole Alpine mountain range. After the First World War there was a lack

of architectural commissions, so Taut began working on his other artistic ideas. Among these he proposed:

Alpine peaks to be recut and studded with coloured glass to emphasize their crystallinity. Glaciers were to be decorated with lanceolate glass blades to capture and magnify the first rays of the rising sun. Mountain lakes were to be improved with floating glass ornaments that, viewed from an aerial perspective, were intended to be seen like some man-made water lilies (Bletter 1982).

None of these ideas was actually built by Taut, but another architect/designer and artist, Herbert Bayer, produced some landscape architecture works that could be considered as fore-runners to Land Art. One of his earliest pieces was *Earth Mound* constructed in 1955 in Aspen, Colorado, USA. *Image 30*. This work has strong references to ancient land interventions with its circular rampart enclosing a mound and hollow and a small standing stone. Works like this, of which many followed, can be viewed as a beginning of contemporary land interventions influenced by ancient forms.

Andrew Causey (1991) notes in his essay 'Environmental Sculptures' that English landscape architecture in the eighteenth century contained an essence of art in constructed environments. Aesthetic theories of this time promoted visual experience and physical sensation as part of the concept for beautifying nature. Although visual experience and physical sensation are often associated with Land Art works, Land Art is not an artform intended for beautifying nature. Artists work with nature and as such may contribute aesthetically to a natural environment but they cannot easily be linked with English or European landscape architecture. However, it is possible to go back to prehistoric times and find evidence of major interventions on the land that can be interpreted as the foundations of Land Art. This is covered in detail in Chapter 4, Ancient Land Interventions.

For artists such as Alan Wood, Richard Long, Andy Goldsworthy, Robert Morris, Carl Andre, Nancy Holt, Dan Archer, Martin Vosswinkel, Michelle Stuart, James Turrell and many others, including myself, ancient land interventions have informed and sometimes inspired works of contemporary Land Art. Tiberghien (1995) underscores this in his statement that:

The origins of Land Art can be traced back to distant eras of human history, to the spectacular remains left by ancient civilizations that have influenced contemporary artists.

Spivey (2005) comments on Land Art that: ‘Perhaps no other mode of art has had such a keen sense of its own potential archaeology’. Lucy Lippard (1983) terms the influence of ancient land interventions on contemporary artists as ‘communicative bridges’ and writes of the work that emanates from this as the ‘overlay’ effect.

## **LAND ART WORKS**

The following examples of Land Art were chosen as a cross-section of works that engage with specific environments including our cosmic environment. By intention, many of the works discussed here were chosen because of some relevance to the concept of Exoart and it is acknowledged that many fine and maybe iconic works have been omitted due to the focussed nature of this chapter in relation to the overall thesis.

### **Greg Johns – *Horizon Figure*, Palmer, South Australia, 2004 *Image 31***

Johns is an Australian artist and the owner of the Palmer property that hosts the Palmer Sculpture Biennial. Many of his works are large scale and the use of Corten steel is his preferred medium, a material that is designed to surface rust into a patina that he comments is reminiscent of the colour of Australian outback rocks and earth. This linking with the Australian environment is important to Johns, as is the scale of his work.

Many of Johns’ forms reference visual elements in Aboriginal and European culture, especially universal ancient mythical forms. As Johns (2010a) says:

To produce sculpture which is Australian in feel, but also connected to universal themes, is a challenge I have been attempting to meet over the last twenty years.

Johns sometimes incorporates into his sculpture pieces of the environment in which the work will stand, and the careful positioning of his works in the environment is intended to give a clue as to their conceptual component.

The work *Horizon Figure* stands on a rocky escarpment looking out over the plains around Palmer and illustrates how a sculptural form can interact with an environment by adding something enigmatic to the vista. The viewer engages with the artwork by also observing the view.

**Trevor Rodwell and Sue Rodwell – *Read the Wind*, Palmer, South Australia, 2010**

5 metres by 1.8 metres (ground plan), rods variable to 3.4 metres *Images 32 and 33*

In the work for the Palmer Sculpture Biennial 2010, with my partner Sue Rodwell, we created a kinetic work that interacted with the wind. Forty-nine rods, constructed from a base of polished aluminium and a top section of acrylic with fused optical glass tips were designed to dip and sway in response to the slightest air movement.

The movement of the rods causes refracted sunlight to add sparkle within the fused glass tips and, combined with the soft sounds of acrylic rods touching and sliding against each other, the work produces a meditative connection with the natural environment.

Wind and intense sun are two very noticeable climatic features at Palmer. To also reference the sun the rods were arranged in the pattern of an analemma, which is a form represented by the angular offset of the sun as viewed from earth; this creates a flattened figure of eight with the smaller part lower in the sky in the southern hemisphere.

This work, like the ice sculptures of Andy Goldsworthy previously mentioned, needs the elements to bring it to life. Sun and wind interact with the work and their presence is then observed through the never repeating patterns of the swaying rods and the constant flashing in the glass tips reminiscent of a message in Morse code. This is work that allows the natural elements of this particular environment to speak.

**Chris Drury – *Wave Chamber*, Northumberland, UK, 1996 *Image 34***

The wave chamber is a variation of several cloud chambers that Drury has built. These are in effect large-scale camera obscura, enclosed, often cone-shaped, structures with a small hole in the apex of the roof allowing a reversed image of the sky to appear on the interior floor.

In keeping with Drury's philosophy of minimal land disturbance for his works, all the stone for the *Wave Chamber* was taken from old and broken dry stone walls no longer used. The difference with this chamber compared with his cloud chambers is the use of a steel periscope with mirror and lens at the apex of the structure designed to pick up the movement of the adjacent water. Drury (1998) describes his first viewing of its effect after the chamber was completed:

Inside it was as if a thousand silver coins were dancing across the floor. As the sun moved away, this changed to ghostly ripples, giving you the feeling of standing on liquid.

This was also my own impression standing in the darkness after the small door had been closed. Drury has also incorporated into the work some clever design within the stonework that amplifies the sound of the lapping water outside. The illusion of standing on water and hearing its sound in the darkened confines of the stone chamber, that gradually reveals itself as your eyes become accustomed to the low light, provides a strange but aesthetic sensory experience.

**Andrew Rogers – *Rhythm of Life*, Nepal, 2008. 100 metres by 100 metres Image 35**

*Rhythm of Life*, in a deep gorge in Jomson, Nepal, is constructed from local stones to form a low embossed geoglyph. The form of this geoglyph is taken from a bronze sculpture made by the artist in 1996 and is part of the *Rhythm of Life* land art project instigated by Rogers. This project currently comprises forty of his large-scale stone geoglyphs that have been installed in twelve countries over the last eleven years. The installation of these works always involves the co-operation and physical help of the local people. Rogers (2010) states that 5,500 people have been involved so far.

Many of Rogers' large-scale geoglyphs are constructed in remote areas such as the Arava Desert in Israel, Atacama Desert in Chile, Cerro Rico Mountains in Bolivia, a site near Kurunegala in Sri Lanka, the Akureyri region of Iceland and the Gobi Desert in China.

For Rogers, the earth that his geoglyphs stand on, and where that is, forms part of the structure and a dimension of the form. This land, however, is not always flat and easy to work on but Rogers is undeterred by massive undulations, mountain-folds or water run-off trenches. The works follow these land contours and accommodate whatever is in the environment.

Rogers (2010) says his geoglyphs provide a spatial experience and that they are:

metaphors for the eternal cycle of life, growth, and all the attendant emotions that colour human existence. They are optimistic symbols of life and regeneration-expressive and suggestive of human striving and introspection.

Sigurdsson (2006) adds that Rogers' works are grounded 'in the cycle and rhythms of life that permeate nature'. However, Rogers acknowledges that any meaning is contingent upon an individual's personal history and perception.

Rogers (2010) also acknowledges the co-operation he receives from communities in the regions in which he is working. Some of the forms Rogers uses for his land drawings are inspired by ancient symbols or artefacts from these regions and his interpretations of these are produced with input from the local people who also help in the construction. For Rogers, this community effort forms part of the concept for his works and he feels that the finished geoglyphs belong equally to the community who helped create it.

**Robert Smithson – *Spiral Jetty*, Utah, USA, 1970 Images 36 and 37**

Robert Smithson's *Spiral Jetty* has become one of the most recognisable pieces of Land Art produced in the USA during the late 1960s and 1970s. As its name suggests, this work consists of a large spiral of black basalt rock and earth, 460 metres long and 4.5 metres wide, jutting out from a rocky promontory into the pink waters of the Great Salt Lake in Utah, USA. The colour of the lake comes from the micro-bacteria that live in the concentrated salt water, a concentration so high that large crystals grow everywhere around the site.

When Smithson first saw the site he admits he was not sure what form the artwork would take. Finally he decided to let the site determine what he should build. Regarding this, Smithson (1979) wrote:

This site was a rotary that enclosed itself in an immense roundness. From that gyrating space emerged the possibility of the Spiral Jetty.

Later he would write about the micro and macro elements of nature to reference the spiral:

(E)ach cubic salt crystal echoes the Spiral Jetty in terms of the crystal's molecular lattice. Growth in a crystal advances around a dislocation point, in the manner of a screw. The Spiral Jetty could be considered one layer within the spiralling crystal lattice, magnified trillions of times (Smithson 1979).

Two years after its completion the water level in the lake rose to completely submerge the *Spiral Jetty*. For some years, when it was under water, its ghostly form could still be seen from the air. Nature had not removed it, merely sequestered it to do some work of its

own. In 1999 the water level in the lake dropped and returned the artwork to the surface, by then it was completely covered in a thick coating of white salt crystals. Its reappearance, sparkling in the sun in a pool of pink water, was its completion. The synergy between artist and nature had completely transformed not only its appearance but, as world-wide media coverage would attest, its status as an artwork.

This is an extraordinary example of an artwork that engages with an environment that then, over time, becomes an environment that engages with an artwork. The glistening salt-encrusted rock spiral becomes the result of a collaboration between artist and nature.

**Hansjörg Voth – *Sky Stairs*, Morocco, 1987** *Images 38 and 39*

For artist Hansjörg Voth the desert plain of Marla, in the South of Morocco, is the environment for his artwork that references both inner and outer space. Fifty steps created from adobe blocks form a huge stairway in a triangular monolith entitled *Himmelstreppe*, translated as *Sky Stairs*. The structure is 16 metres high and 23 metres along its base with three internal spaces that can only be accessed through an opening in the platform at the top of the stairs.

It is unnecessary to pass [through] any doors to enter, but one must go up to the platform and descend from there. The act of going up in order to go down into the construction is ritual in nature (McGrath 2002).

*Sky Stairs* stands alone in the surrounding flat environment, its scale from a distance emphasising the vastness of the desert and a closer view of the stairs lead the viewer's eyes to the environment above. The adobe blocks are made from the same material on which the *Sky Stairs* is situated, therefore it is not only in this environment but of it.

In this desert setting, *Sky Stairs* appears to be an invitation to climb up into the sky and, with imagination, perhaps one day at the top level there will appear the superfine nanotechnology cable of a space elevator.

**Michael Heizer – *Double Negative*, Nevada, USA, 1966** *Images 40 and 41*

*Double Negative* is a rare kind of artwork that, in effect, has no mass and so could be described as an artwork of space. It consists of two deep vertical cuts facing each other across a landslide in the Mormon Mesa in Nevada. The cuts are nearly 10 metres wide and together are 460 metres in length. About 245,000 tonnes of rock and earth were

excavated for the two cuts. The artwork is not *in* the space of an environment, it is the environment that contains the space that *is* the artwork. The double spaces reflect each other across a landslide at the edge of a canyon.

The 'negative' in the title relates to absence, something taken away, tonnes of rock and earth, but what is left is not empty, it is not a vacuum, it is filled with air and dust particles. The view from the base of the cuts is of the crust of the earth looming above and vision is restricted to the sky or the corresponding cut across the chasm of the rock subsidence. It is an interior that is part of the vast desert exterior, a challenge to the perception of what constitutes an object. Heizer states that:

In *Double Negative* there is the implication of an object or form that is actually not there ... There is nothing there, yet there is still a sculpture (Heizer quoted in Tufnell 2006).

**Antony Gormley – *Inside Australia, Western Australia, 2002* Images 42 and 43**

This artwork consists of 51 cast metal figures installed over an area of 3.5 kilometres by 2.5 kilometres in the salt bed of Lake Ballard, between Kalgoorlie and Leonora in Western Australia.

Gormley is well-known for his installations of figurative forms, some cast from moulds of his own body and others more abstracted but formed with traditional sculptural techniques. For this work though he chose to use a computer scanner capable of full-body scans with the resulting data processed through a program that reduced the bodies to 30% of their original mass. The vertical dimensions and the width of the hips and shoulders remained the same. The scanning process required the participants to be scanned naked – not an easy request in a small country town like Menzies where the process took place. After initial scepticism, enough people supported the project to accomplish Gormley's concept.

The resulting three-dimensional forms were cast in a stainless steel alloy and installed across the salt lake in a precise way. Each figure was spaced between 300 and 600 paces apart, with no figure facing another. Gormley chose the site because he wanted an environment that was open, large and inspiring to work with the abstracted figures. However, Lake Ballard is a significant Aboriginal site; an area of women's dreaming that

references the story of the seven sisters and known in Western terms as the seven stars of the constellation Pleiades.

At a meeting of the traditional owners to obtain permission to use the site, Gormley was asked why he had to come to Lake Ballard. The account of that questioning by Hugh Brody (2005) makes clear the different attitudes towards an environment from the artist's and an Aboriginal viewpoint. Gormley was thinking about the visual interaction of the land with his sculptural forms; the Aboriginal people who viewed it as a spiritual place intimated that the land may have called for the artwork to be placed there. To be part of an engagement with the Dreamtime is why many of them had agreed to strip naked to be scanned.

This incident raises interesting aspects about environmental awareness and whether artists can claim a special relationship to the environments in which they work. In fairness to Gormley, the type of relationship that Aboriginal people have with their land, anchored in a long history of tradition, mythology and way of life, would not easily be comprehended even by someone as well-travelled as Gormley, whose tradition and customs are Eurocentric.

**Walter De Maria – *Lightning Field*, New Mexico, USA, 1977 *Images 44 and 45***

This large area work is situated near Quemado in the semi-arid region of New Mexico known for its relatively high incidence of storms and lightning. *Lightning Field* consists of 400 polished stainless steel rods, 50mm in diameter, chamfered to a point at their tips. These rods cover an area defined by a length of one mile by a width of one kilometre; De Maria deliberately using the two most widely used measurements for dividing up land.

The rods are arranged precisely in a grid of 16 rows of 25 east to west, by 25 rows of 16 north to south. The height of these rods varies up to 8 metres, to take into account the undulations of the land, so that the tips form a level plain.

De Maria undertook major planning to give his work the best chance of lightning strikes, for it is this element that brings the work to life and gives it meaning. Because of this the work is intended to be viewed under storm clouds with bolts of lightning connecting the earth, the artwork and sky in moments of dramatic visual effects.

But, even though the site was selected for its atmospheric conditions, lightning storms only occur on an average of three days per month during the best five month season. Therefore, there is only a low chance of seeing the artwork as it was intended. Tufnell (2006) writes that this is not so important. It is more about imagination - the 'idea of the coming lightning storm, the potential unleashing of terrifyingly powerful natural forces'.

This does, however, raise the question of how much a viewer needs to know about an artwork to really appreciate it. Without knowing its title the work could easily be mistaken for a scientific or industrial project. Malpas (2007) suggests something like a radio telescope site or a military communication facility. Bond (2005) comments on this by stating that it is generally thought that exemplary artworks will reveal themselves through the natural senses with no external references. But he adds 'this is not quite how experience ever happens'.

At the right time in the right situation *Lightning Field* will explode into violent life; on other occasions it may be enough to contemplate its aesthetics and large scale in an even larger environment.

*Lightning Field* is another example where an aspect of the environment, in this case lightning, is required to fulfill the concept of the artwork. The idea of utilising the ever-changing environment as a major component of an artwork could be considered for an Exoart project to highlight the different conditions on another planet.

### **Andy Goldsworthy – *Locharbriggs Sandstone Arch*, Wiltshire, UK, 1999-2000**

*Images 46 and 47*

Andy Goldsworthy is an artist who often works with time; the constructed time of minutes/hours/days/years or the seasonal time of nature. An example of the former is the Locharbriggs Arch that contains within its construction the conceptual element of time as we construct it.

In this case the arch was half built in September 1999 and then deliberately left for completion in May 2000. This particular span of time incorporated into the fabric of the structure is subtle yet meaningful to those who know the story, for it is an artwork that 'bridges two centuries – stepping through time' (Goldsworthy 2003). Goldsworthy acknowledges that this aspect of the arch, and other works that have embedded stories, will be lost in time. The structures will remain - interesting, aesthetic but slightly

enigmatic, like the stone circles and other structures of ancient times whose stories have also been lost in time past.

The idea of time and the meaning that people have attributed to it, especially meaning embedded in a constructed form, links directly to ancient land interventions discussed in Chapter 4.

**Trevor Rodwell and Sue Rodwell - *Written on the Land*, Palmer, South Australia, 2008**

*Images 48 and 49*

This work consists of a golden sphere, one metre in diameter, within a sand spiral. The sphere is patterned with marks referencing the marks nature leaves on the planet over long periods of time. Nature's marks tell us about our environment; strata in rock give us a geological story, erosion patterns tell about climatic conditions, marks in vegetation show the stresses of nature. These stories spiral through historical time, connected and interconnected, requiring re-evaluation as more understanding is gained. The work is also part of the story of Palmer, an environment affected by past abuse of the land. The specific location of this work, on a bare patch of earth, shows how over time nature will revegetate the area, slowly covering the sand spiral, leaving the golden sphere to reflect a new story in a future time.

This work is an example of Land Art that is partly constructed away from the site and partly at the site. The golden sphere was fabricated in a studio and the yellow sand spiral was formed from local material. This method of construction that enlarges a pre-formed component by utilising locally sourced material could be an option for an Exoart project where interplanetary transportation would restrict the size and mass of any art component.

**Nancy Holt - *Sun Tunnels*, Great Basin Desert, Utah, USA, 1976**

*Images 50, 51 and 52*

This work engages with the rising and setting sun on the summer and winter solstices and references the four constellations of Draco, Perseus, Columba and Capricorn.

*Sun Tunnels* consists of four large concrete tubes 5.5 metres in length and 2.75 metres in diameter placed in an 'X' configuration with 15 metres spacing between them. Holes of various sizes and spacing are drilled into the upper surface corresponding with the pattern and light intensity of the stars that make up the referenced constellation. During the day,

in the interior shade of the tubes, the constellations, light years distant from Earth, are revealed by the sunlight. Nancy Holt commented on the work:

Day is turned into night, and an inversion of the sky takes place: stars are cast down to earth, spots of warmth in cool tunnels (Holt quoted in Beardsley 1998).

The openings of the tubes are aligned with the summer and winter solstices, emphasising its cosmological referencing and the time scales it embraces, elements that Holt describes as giving ‘a sense of being on this planet, rotating in space, in universal time’ (Holt quoted in Malpas 2007).

The main concept of this work is to engage with our cosmic environment. For an Exoart project this concept will be important to consider as any installation on another planet, by the very fact of it being there, will not only reference but be in our cosmic environment.

**Charles Ross – *Star Axis*, New Mexico, USA, 2010 *Images 53 and 54***

Ross describes *Star Axis* as an ‘architectonic earth/star sculpture’ (Ross nd) that was conceived in 1971. Its physical size, at eleven storeys high and 160 metres wide, could certainly be taken as an engagement with architecture. It is constructed from stone and concrete and built into the escarpment of the Chupinas Mesa in New Mexico.

The *Star Axis* name refers to the precise alignment of the sculpture with the Earth’s axis and the Northern Pole Star, Polaris. The concept of the design is to make visible the 25,920 years cycle of the precession of the equinoxes, which happens as a consequence of the slow retrograde motion of the equinoctial points along the ecliptic. Ross explains that this cycle can be experienced by climbing the internal stairs of the element he calls the Star Tunnel.

From the first stair you see the smallest circle of Polaris’s circumpolar orbit. It’s about the size of a dime [approximately 18 millimetres in diameter] held at arm’s length. From the top stair the largest circle of Polaris’s orbit encompasses your entire field of vision. Wherever you stand in the Star Tunnel, the circle of sky framed by the opening at the top of the stairs precisely represents Polaris’s orbit for a particular period of history. Dates engraved in each stair will identify the years you’re viewing. Thus, the visitor can view the orbit of Polaris as it existed

for Nefertiti, or Plato or Leonardo da Vinci, as it was in the Stone Age and will be again in AD 13,000 (Ross nd).

Cosmic time and cosmic space are the dominant themes of *Star Axis* and come from Ross's conviction that art can assimilate scientific knowledge, especially space science, to produce a work that renders complex facts visible and understandable as well as interactive at a human scale.

**James Turrell – *Roden Crater, Arizona, USA* Images 55, 56, 57 and 58**

The *Roden Crater* project represents a commitment of over 30 years on the part of Turrell. This artwork has not been created from the ground up, but rather took as its starting point an extinct volcano in the Painted Desert of Arizona.

After purchasing the volcano and the ranch property on which it stood in 1977 Turrell started work on reshaping the caldera and some internal works in 1979. The scale of the work can be appreciated in the size of the volcano – three kilometres wide at its base and rising to around 182 metres above the surrounding land.

The reconstruction of the volcano is modelled on naked eye observatories from ancient times, and Turrell's aim is to engage the visual and perceptual senses in an innovative way while observing cosmic events and cosmic time. Commenting on the 20 internal spaces and over 300 metres of tunnels within the volcano, Turrell says: 'When there's an event on the horizon or in the skies, there's an event in light in the Roden spaces that I am creating' (Turrell quoted in Hogrefe 2000).

Turrell is very aware of the immensity of the cosmos and the relationship of cosmic time in his work. He has a practical understanding of what we are actually seeing when we look at a starry sky is light that, in some cases, has taken millions of years to reach us. As Carl Sagan says: 'We cannot look out into space without looking back in time' (Sagan 1980). To give some context to this statement, Sagan (1980) explains that when we look at the spiral galaxy M31 in the Andromeda constellation, we are looking at light that left there two million years ago.

When the light we see today from M31 left for Earth, there were no humans on our planet ... The distance from Earth to the most remote quasars is eight or ten billion light years. We see them today as they were before the Earth accumulated, before the Milky Way was formed.

Even the light we are experiencing from our sun has an age; it takes 8.5 minutes to reach us.

Within some of the chambers of Roden Crater this ‘young’ light and ancient star light will mix and, as Turrell explains: ‘you can actually be in close contact with both of them’ (Turrell quoted in Hogrefe 2000).

The caldera, sculpted into an even ellipsoid, forms a large amphitheatre-like space where sky observations are designed to affect the viewer’s spatial perception. Within this space, the only horizon is the crater rim, with the sky seemingly resting upon it. This creates an effect that is referred to as celestial vaulting, when the sky overhead appears closer than the horizon (Tufnell 2006).

The *Roden Crater* project utilises a geological formation that was created by nature in a distant time past to give an experience in the present of a cosmos that, by the time it is viewed on Earth, is already far in the future.

Using a natural feature such as a volcano could be considered in an Exoart project as Mars has many inactive volcanoes. A conversion such as the *Roden Crater* would not be feasible on Mars in the foreseeable future, however, the exterior of a volcanic cone could provide a sloping or elevated surface that may be utilised within an Exoart project.

### **Land Art Installation features**

These examples of Land Art installations feature many of the conceptual themes associated with environmental engagement. These can be listed as:

- the incorporation of elements of the site in the work
- the considered positioning of the artwork on the site
- references to the patterns in nature
- the deliberate attempt to promote the interaction of nature with the artwork
- the promotion of environmental and cultural awareness
- seeking local community co-operation and contribution
- the utilisation of natural features in the environment
- the incorporation of ritual references in the artwork
- elements of illusion within the artwork

- challenges to visual and cognitive perception
- seeking an interaction of climatic conditions with the artwork
- direct reference to constructed and cosmic time
- inclusion of the cosmic environment

This broad spread of concepts for environmental engagement provides a resource from which an extraterrestrial environmental engagement can be considered. This will contribute to the foundation for Exoart.

## **ISSUES WITH LAND ART**

What arises in the way of issues with Land Art stems mostly from the fact it is out in the open, in the landscape, in perceived wilderness areas and for some ‘in their face’. The idea of unspoilt nature, whether fact or fantasy, is at the heart of much debate over the use of land for Land Art. Prior knowledge of and an understanding of the artform can be of immense benefit when engaging with Land Art and help to avoid misconceptions about ‘strange’ structures on the land.

When it comes to criticism, Land Art is no different from other artforms. Artists have been accused of trying to romanticise nature while avoiding issues of blatant exploitation of natural environments and also of avoiding controversial issues such as AIDS, world poverty, war, global corruption and pollution; they are escapists and self-indulgent.

It has also been said that Land Art is accepted by the bourgeoisie to appease their guilt about over-consumption that has resulted in the destruction of large areas of the natural world (Malpas 2007). This idea would only be credible if it was accepted that Land Art was an artform of environmental consciousness. As Tufnell (2006) points out, it would be simplistic to assume this. No amount of Land Art can compensate for the effect of human greed on the environment.

The claim of artworks disfiguring the land in their construction and placement can be accounted for in works such as Heizer’s *Double Negative* that entailed the excavation of 245,000 tonnes of material from the Mormon Mesa. The curator, Michael Auping, who wrote about this as well as the morality of Land Art, concluded that: ‘earth art, with very few exceptions, not only doesn’t improve upon its natural environment, it destroys it’ (Auping quoted in Tufnell 2006). Brady (2007) writing on this subject stated that

Heizer's work is akin to a power relationship with nature and agreed with a charge of it being an aesthetic affront to nature.

The idea of an affront to nature comes from a philosophical theory called 'positive aesthetics'. Parsons (2002) says that: 'if nature is viewed properly (that is, in light of scientific knowledge about it) then nature appears aesthetically positive, or good. Parsons acknowledges the early work of Allen Carlson on this theory but queries the premise that an understanding of appropriate categories of scientific knowledge, defined by Carlson as scientific cognitivism, will result in all cases in an appropriate positive appreciation of nature. Parsons argues that scientific categories of knowledge need to be expanded to avoid inappropriate appraisals of nature. He proposes that the theory be amended so that an object in nature is viewed 'under scientific categories in which it truly belongs and which maximize the aesthetic appeal of the object' (Parsons 2002).

This theory appears to start from an idealised view of nature. Proponents work backwards from this point and modify it to make sure that a positive aesthetics of nature is always the outcome. Parsons states in his writing that:

A realization of the deep beauty of nature is not where we need to end up in our theorizing, but the place where we should begin (Parsons 2002).

Mostly this theory has an arguable basis, although it is not universally accepted. Eaton (1998) reveals this by stating:

Many people, even those who greatly admire the contribution Carlson has made to environmental aesthetics, believe that the cognitive model is over-intellectualized.

The problem, insofar as it has an impact on art, comes from the way it is sometimes used to interpret the worth of Land Art. Lintott (2007) points to charges utilising this theory, that Land Art changes an environment from being a part of nature to being a part of an artwork, and not for the better.

Lintott (2007) states that the positive aesthetic theory does not claim that all nature is aesthetically superior to things in the environment that are not natural and this then can accommodate a claim that artwork is worth some environmental exploitation, but this must be assessed on a case by case basis. Brady (2007) also supports this view. Her

position is that there are good examples of art mediating positive relationships with nature and in these cases the artists have shown an aesthetic regard for nature.

Simus (2007) is another who has a more flexible view of this theory, saying that any aesthetic affronts to nature by artworks will never be permanent because of new standards of interpretation. He adds that many artworks raise questions that challenge assumptions about nature and the aesthetic appreciation of it.

Another charge against Land Art is that it is unethical because it uses the environment for its own ends without concern for the future of that environment. This argument seems to focus on virgin environments, completely untouched by human interventions. There is not much of this left on the Earth and, as Lintott (2007) points out, there is very little, if any, of this used in Land Art. In view of the arguments outlined, the question could be asked as to whether there is a difference in the way aesthetic appreciation of nature and art are perceived.

Brink (2007) throws light on this from the theoretical field of situated cognition and the related dynamic systems theory. Her claim is that, although an aesthetic experience is specific to an individual viewing either nature or an artwork, there are universal aspects to this experience that would be shared by all, because aesthetic experience is biologically grounded. She adds to this that viewers from the same socio-culture will relate to issues of values and artwork content in similar ways. The cognitive process for this is heavily dependent on the surrounding context and environments and relies not only on vision, often emphasised in aesthetics, but other senses such as touch, hearing and smell.

Matthews (2001) makes a similar point from a philosophical perspective stating that she sees little difference between the way art and nature are appreciated and that arguments that promote a wide difference fail when thoroughly examined. Views about appropriate knowledge required for the aesthetic appreciation of nature are equally true for appreciating art.

Matthews (2001) also claims that with an artwork there is usually an intention by the artist to create an artwork that will initiate a certain response from a viewer, but in nature there is no such intent. However, Matthews does not view this as a divergent issue concluding that, regardless of the neutrality of nature, it still requires requisite knowledge and sensitivity to fully appreciate it, in exactly the same way an artwork does. These two

areas of knowledge may come from different theoretical sources but they have close parallels for the appreciation of both nature and art.

## **ISSUES OF LAND**

### **Sites**

The 'land' component of Land Art is an important part of this artform. For the artist, a particular piece of land, a location or environment, may be crucial for the artwork. As Malpas (2007) points out: 'Land art gains much of its power (its meaning, its value, its presence) from particular places'.

*Star Axis* and *Roden Crater* both required an environment with no light pollution (artificial light spill from cities and large towns) and predominantly clear skies. Ross (*Star Axis*) also needed a large escarpment to build against to reduce construction and engineering requirements. James Turrell (*Roden Crater*) required a specific land formation to fulfill his concept for a large naked eye observatory and, in 1974, funded by a Guggenheim Fellowship, spent 500 hours in a light plane searching across the United States before finding the Roden Crater.

Other artists work with specific environments such as deserts, mountains or forests which enhance or become part of the concept of their artwork. However, these sites are not always easy to find, with various forms of land utilisation and ownership often restricting access and usage.

For the small ephemeral works of artists such as Goldsworthy and Nils-Udo using natural materials this does not present too much of a problem as, after photographing the finished work, it can be left to return to the land with few people the wiser.

Some sites may be allocated for semi-permanent works that will be removed or dismantled after a period of time. But for larger and more permanent works in remote locations the issue of obtaining access to the site and permission to build can be a problem.

Artists who can afford it usually decide to buy or lease a parcel of land for their work. Nancy Holt purchased 40 acres of the Great Basin Desert for her work *Sun Tunnels* (McGrath 2002); Robert Smithson took out a 20 year lease from the Utah Land Board for the site of his *Spiral Jetty* (Hobbs 1981); Michael Heizer purchased 60 acres of the

Mormon Mesa to create his work *Double Negative* (Tufnell 2006) and Charles Ross, who started looking for a suitable site for his work *Star Axis* in 1971, was eventually able to buy land at the Chupinas Mesa in 1975 (Ross nd).

With the permission and support of the Kingdom of Morocco, Hansjörg Voth produced three large scale works in the desert, including his *Sky Stairs*, which he financed himself (Voth 2009). In Australia, artist Greg Johns bought a 160 hectare property at Palmer, South Australia, in 2001 to display some of his large steel sculptures on a permanent basis.

### **The Palmer Project**

Palmer is situated in the eastern section of South Australia's Mt Lofty Ranges, about 70 kilometres from Adelaide. With the weather usually coming from the west, it is in rain shadow country; hence it is mostly dry and sparsely vegetated.

At Greg Johns' property the rocky escarpments rise steeply to an undulating plateau area. From the eastern side of this plateau the land drops away sharply towards the plains of the River Murray.

Because the property had been subjected to years of abuse by early European settlers, 'the hills of Palmer stand denuded of major vegetation – here rock, wind and the arc of the sky that reaches uninterrupted from horizon to horizon, are the present features of the area' (Rodwell & Rodwell 2006). But as Johns points out there are also Aboriginal connections with the site that should not be forgotten.

From the start of Johns' ownership all non-native livestock was removed and a revegetation and weed removal program was implemented in conjunction with Trees for Life, a voluntary organisation dedicated to growing and distributing native trees and understorey plants in South Australia.

In 2004 Johns, with fellow artist Gavin Malone, organised a landscape sculpture exhibition on the Palmer property to coincide with the Adelaide International Festival of Arts. This proved to be a watershed event, not only for Johns but for the many artists who desired to engage with and produce work for such an environment. The success of that first exhibition has led to the continuation of the event on a biennial basis which has

grown in scope and recognition throughout the art community, both in Australia and now overseas.

In the 2010 exhibition catalogue, Johns wrote:

I hope that the Palmer Sculpture Biennial's function as a bubbling, potent cauldron, an internet of ideas and discussion where there is an overflow effect, will encourage the development of sculpture. Sculpture that is challenging, thought-provoking and revealing of a sense of wonder (Johns 2010b).

The biennials are artist organised and run and the only stipulation that Johns puts on exhibiting artists is that, where possible, they should visit the site and respond in their own way to the environment. The Palmer Biennials provide a unique opportunity for artists interested in the genre of Land Art who cannot, for various reasons, acquire land to make permanent work, to engage with a challenging Australian environment. But, as Ken Scarlett (2010) in his catalogue essay points out, Palmer should not be thought of as a sculpture park.

For Palmer has none of the controlled order and easy accessibility of well-known Sculpture Parks around the world: ... at Palmer only the fit walk the rocky hills; many visitors welcome the four-wheel drive from site to site.

In 2010 there were 25 artworks spread over the entire 160 hectares.

### **Accessing Land Art works**

It can be noted from previous sections that some artists choose to make their work in remote areas. Getting to these works is sometimes considered an aspect of the work itself; it encompasses an engagement and awareness of the environment prior to viewing the artwork. Anthony Bond (2005), writing about visiting the *Inside Australia* work of Antony Gormley says:

(A)n important part of this work is the difficult journey we must make to find it, the impact on us of that journey, the sense of discovery when we arrive, the people we meet and of course the extraordinary feeling of the space itself.

Curator Diane Waldman writes in a similar vein about Michael Heizer's work *Double Negative*:

The vast expanse of the desert was matched by its stillness, the arid heat and the wind. There were no signs of life except for the occasional cloud of dust raised by an automobile off in the distance. It took two days to reach Michael Heizer's *Double Negative*. Our first attempt failed when the only road became impassable, the cars bogged down, tyres spinning, and the spectre of getting stuck or miscalculating a turn and going off the road over the edge of the precipice was all too real.

...

In contrast to the monotony of the parched cracked earth of the mesa – a flat landscape of rocks, tumbleweed and scrub brush – the drop off the escarpment unfolded a vista of harsh beauty, with the work itself cut below the shelf of the mesa, overlooking the snaking ribbon of the Virgin River far below. Waldman concludes: It is the land, of course, that unifies *Double Negative*' (Waldman quoted in Tufnell 2006).

The artist Hansjörg Voth built his large work *Sky Stairs* in the desert plain of South Morocco. The photographs of this work were supplied by Tim Cullis who tried three times to reach it. Only on the third occasion riding an all-terrain motorbike did he succeed.

At Palmer, a 90 minute drive from Adelaide and the site of the Palmer Sculpture Biennial, the terrain is so steep and rocky that many visitors require a lift in a four-wheel drive vehicle to transport them to areas from which they can comfortably walk.

Beardsley (2010) makes the observation that 'Land Art draws people out into landscapes that they might not otherwise see'. This, he says, could lead to a new environmental experience and appreciation of areas that should be preserved. This situation has been noted at Palmer where visitors often comment on the experience of climbing and walking the rugged terrain and have then been moved to make generous donations towards the Land Care efforts that are being undertaken at the property.

Generally though, artists working in the area of Land Art consider the accessibility of the site as being less important than the contribution of the site to the artwork.

## **Vandalism and Bureaucratic Issues**

The Land Artist may choose to locate their work in isolated areas but, nevertheless, they still have to contend with vandalism. In Tasmania, Bridgit Heller was commissioned to undertake a series of sculptures for the Great Western Tiers Sculpture Trail. Her work ... *and kingdom come* ... consisted of four large cast concrete pieces that were positioned along a trail leading to a mountain peak known as Devils Gullet. The trail is several kilometres long, steep and rocky in sections and within one of Tasmania's National Parks (Sculptures of the Great Western Tiers, 2002).

Shortly after the installation of Heller's work, all four pieces were smashed. Having personally visited the site not long after this event, it was obvious that this was a planned and intensely violent attack. The cast concrete pieces were such that they could not have been significantly damaged by stone throwing. It would have required something like a sledge-hammer to have destroyed the works in the way they had been broken into so many pieces. Also, as the last artwork was near the mountain summit, someone presumably carried the heavy implement several kilometres up a rough track to deliver the final blows.

A Park Ranger noted that the perpetrator may have been someone unhappy with having artworks placed in a National Park. There had been a number of written protests at the plan and, as the Ranger pointed out, some people are very possessive about the Parks and what happens within them. They may have felt that contemporary art had no place in such a 'pristine' environment.

A work by Nils-Udo was subjected to a strange vandal attack in 1979 after he had leased some land and meadows in the Chiemgau region of southern Germany for a series of living tree sculptures. One such work *Paradise Garden, The Morning* consisted of a large circle of Birch trees planted at an oblique angle with their foliage pointing in towards the centre of the circle. As the trees grew the leaves and boughs would form a shrubbery suspended above the ground by their long silver trunks. However, this artwork was ultimately unrealised after someone poisoned all the trees (Besacier 2002).

Andy Goldsworthy experienced a series of thefts of material when he was constructing the Gateshead Cairn, in a public park in UK. (See Image 24.) He had been commissioned to build the artwork as a monument to the heavy iron and steel industries that had once

flourished in the area. Goldsworthy (2003) decided to construct the large cairn from scrap rusted steel plate but was amazed when much of the work began to disappear. He commented that:

after each day's work, the top part had to be welded on to prevent materials being stolen. Even so, as the cairn neared completion, the top foot or so (representing several days' work) was prised off. Had the culprits not been apprehended by a passing plain-clothes policemen, still more of the sculpture would probably have vanished. When charged, the vandals claimed they couldn't tell the difference between scrap steel and a work of art.

Although it can be assumed that the vandals in Goldsworthy's case were not artists, this was not the case in an event relating to Smithson's *Spiral Jetty*. (See Image 36.) After being submerged in the Great Salt Lake for a number of years it partially re-emerged in the early 1990s. Taking the opportunity to do a piece of what Pagel (nd) describes as an 'assisted-entropy performance', Salt Lake City artist David Baddley went to the artwork and began prising away its stones to throw them into the lake. Baddley commented he was 'actualizing' Smithson's idea of entropy, which had always been a strong concept in many of Smithson's ideas and writings. But there is no indication that Smithson (who died in a plane crash in 1973) ever expected entropy in *Spiral Jetty* to be assisted by anything other than natural forces.

Creating work in open spaces can also cause artists to clash with bureaucratic regulations. A classic case was the work *Running Fence* (1976) by artists Christo and Jeanne-Claude. *Image 59*. A 39.5 kilometre white nylon fabric fence, 5.5 metres high, was constructed across Sonoma and Marin Counties in California, USA. In order to do this, the artists had to negotiate with the owners of 59 properties that the fence would cross. On top of this there were 18 public hearings, three sessions in the California Superior Courts which resulted in the artists being required to produce an environmental impact report that, when complete, ran to 355 pages (Baal-Teshuva 1995). The artwork was in place for two weeks.

James Turrell encountered issues regarding the remodelling of his Roden Crater when the local county's building department told him he required a building permit for the work; Turrell argued it was an artwork but the department thought it looked more like a building and at 182 metres high, *Roden Crater* would become one of the tallest buildings in the

state of Arizona. According to Turrell, it took protracted negotiations before the county's building department designated a new category of building: Land Art (Hogrefe 2000).

It can be reasonably assumed that vandalism will not be a problem on Mars or other solar system bodies in the foreseeable future. But the bureaucracy that entangled Christo and Jeanne-Claude and the building department issues encountered by James Turrell with his *Roden Crater* project, are similar to some of the problems encountered by teams in getting their projects accepted for space missions. Such issues that have been encountered by artists undertaking Land Art projects can be considered indicative of dealing with government departments that are unfamiliar with the fundamentals of art projects. Other issues, no less frustrating for the artists, can be expected with Exoart projects, at least in the first few missions.

## **THEORETICAL ELEMENTS**

### **Nature, environment, landscape and the picturesque**

These terms have been used in this chapter and need some clarification in relation to Land Art. They are all perceived through a cultural filter, so much so that writers on Land Art often swap the word 'environment' with 'landscape' as though the two represent a similar meaning in the mind of the artist. Beardsley (1998) states that: 'a people's relationship to landscape is one of the most significant expressions of culture'. But this view of landscape hinges predominantly on the human reconfiguration of the earth and the picturesque as rendered by representational painters.

Catriona Moore (2007) makes the point that, in post-modern visual culture, artists who wanted their audiences to engage with their environments distanced themselves from the picturesque landscape. In Australia she observes that 'the landscape tradition has been thoroughly modified by the forces of Indigenous knowledge, scientific research and environmental activism'. Artists such as Robert Smithson (1979) rejected the picturesque and landscaped vistas and sought out sites 'that have been disrupted by industry, reckless urbanisation, or nature's own devastation'.

The term 'environment' references much more than the look of the land. An environment for artists such as Nancy Holt, Charles Ross and James Turrell includes cosmic space. They see the sky and distant star systems as an element of the environment with which they can interact. As the poet Diane Ackerman (1996) points out, we all live in the sky:

Look at your feet. You are standing in the sky. When we think of the sky, we tend to look up, but the sky actually begins at the earth. We walk through it, yell into it, rake leaves, wash the dog, and drive cars in it. We breathe it deep within us.

Charles Ross thinks along similar lines when he talks about his artwork *Star Axis* that: ‘offers an intimate experience of how the earth’s environment extends into the space of the stars’ (Ross nd).

In an environment a rock can be more than just a feature in the landscape – to the artist, as with the geologist, it can be an indication of geological time. Nancy Holt, commenting on the aspect of time in her work, referenced the way rocks had been formed by deposited layers of material over vast periods of time. Looking at them, she observed that: ‘Time takes on a physical presence’ (Holt quoted in Malpas 2007).

To an artist an environment can, and does, encompass mountain tops, deserts, caves, the depths of a lake, the interior of a volcano, the night sky, an abandoned mine works or a single tree or bush; also, as this thesis will expand upon, the very different environment of the planet Mars.

The term ‘nature’ can have a number of interpretations. Various writers have stated that artists engage with nature, some make their work from nature, some see their art as part of nature, nature can be a cultural mirror, it can be a destroyer or a passive observer, and it can be cosmic or imbued with aesthetic qualities. Or, as Oscar Wilde’s character Vivian concluded provocatively ‘external Nature also imitates Art’ (Wilde 1889).

The artist Robert Smithson (1979) was also provocative when he wrote that ‘Any discussion concerning nature and art is bound to be shot through with moral implications’. Responding to a comment that nature was anything that was not made by humans, Smithson challenged the view that humans were somehow outside of nature. He had a view that the idea of *humans versus nature* found traction with the Romantics (Pagel nd). This art movement dominated Europe from around 1825 to 1850 (Preble & Preble 1989).

The fact that humans are part of the complex fabric of nature is now well established by science. Barrow (1995) explains how atoms and molecules need stable natural conditions over long periods of time to develop complexity and self-replication. It is these

conditions, provided by what is called nature, that allow all living things to form, develop and flourish on this planet; life that includes humans.

What is argued over is our perception of nature and how we should best interact with our environments. Because Land Art is about engagement and interaction with environments it has also been drawn into the debate.

The area of this debate that has an impact on Land Art is that concerning the aesthetic appreciation of nature. It is reasoned that nature, within this context, is not a blank canvas for artists to work with in any way they choose. Artists need to be aware and consider environmental and aesthetic issues when planning their works.

This theory has been taken to extremes, in some cases resulting in a number of installations being destroyed. If opponents of Land Art take the view that certain parts of nature are pristine or have a positive aesthetic value that warrants their being left untouched, then in their minds there is justification for rejecting or even destroying an installation. (An example of this was given in the case of a work by Bridgit Heller in Tasmania.) The irony is that the environment in question may have been altered or even completely constructed by human hands. Lintott (2007) makes a point in her article regarding ethically evaluating Land Art, raising the question of value for all nature as opposed to what she terms 'virgin nature' – untouched and unaltered by humans. She argues that there is very little, if any, virgin land used by artists and so, by implication, artists are only using parts of nature that have already been altered, the aesthetic value of which is now open to debate.

Carlson (1995) proposes that an aesthetic evaluation of nature can only be achieved with appropriate knowledge provided by the natural sciences. This is in contrast to other theories that he mentions such as the 'arousal model' and the 'mystery model' of aesthetic evaluation.

The arousal model proposes an assessment based on *being moved by nature*, an internal physical response to the visual experience of a particular environment. The mystery model proposes acknowledging, through the senses, the mystery of nature, a state described as *appreciative incomprehension* and recognising a human state outside of nature. This state of not belonging to nature has the consequence that humans can never

really understand nature. Both of these models are subjective in their assessment of nature and do not fit with Carlson's more scientific theory.

Carlson (1995) does observe, however, that traditional aesthetics as a tool for evaluating nature has been subject to extensive philosophical critiques that may have lessened its value as a point of argument. To counter this he suggests the term 'aesthetics' is replaced by 'appreciation'. This, he claims, moves the discussion on from the issue of finding an appropriate theory of aesthetics of nature to finding a satisfactory theory regarding the appreciation of nature.

Carlson acknowledges a limitation in this model for there has to be a reason behind any appreciation of nature, and this reason leads back to its aesthetic qualities. He carefully side-steps this issue by returning to his original theory that only with the knowledge of natural science can we make a rational and cognitive evaluation of nature.

Brady (1998) offers an alternative to the science and non-science approach by proposing a model based on perception and imagination. This does not rule out the relevance of specific scientific knowledge appropriate to a particular environment, but stresses that this knowledge is not essential in all cases. This model emphasises the role of imagination as a catalyst in perceptual perspectives that can expand and enrich the appreciation of nature. The author references three types of imagination in her model: exploratory imagination, projective imagination and ampliative imagination.

Exploratory imagination she describes as a *free contemplation* of something that takes place during observation and initiates a first impression of aesthetic qualities. It is the imagination of association linking, for example, the micro and macro, manufactured and natural and can also be responsible for filling in missing detail in a scene, such as what lies beyond the horizon. Projective imagination relates to perception at another level, imagining how it might feel under a blistering desert sun or living above the snow line of a mountain. This could allow a more in-depth exploration of aesthetics. Ampliative imagination is described as being more penetrative in the evaluation of an object. For example, when viewing a valley the imagination might reflect on the enormous power of a glacier or river to cut through the land to form it.

In later writings Brady (2003) expands on these ideas in her 'integrated aesthetic theory'. In this it is stated that the perception of environments is achieved through all the human

sensory experiences including sight, sound, smell and touch, combined with thoughts, beliefs and the imagination.

Another important aspect of the theory is viewing the environment with disinterestedness. This, as Brady explains, is often taken in the wrong way and does not imply an indifference to the environment or inactive perceptual contemplation but rather that the environment is approached with an absence of purpose that eliminates thoughts of its use as a means to some end.

Artists often are unable to approach an environment with disinterestedness because their concept requires very specific environmental features. Also, the selection of a landing site for a human Mars mission will be chosen after an examination of several sites for their appropriateness for a safe landing, its ability to help sustain life and scientific discovery. An Exoart project team will also have to examine images of the chosen site for its potential incorporation in the artwork. This is expanded on in Chapter 7, The Exoart Project.

These requirements of artists that engage in Land Art do at first appear to challenge the disinterestedness component of Brady's integrated aesthetic theory. But if, as part of the conceptual component of the artwork, the artist approaches the environment as a partner in a creative enterprise then it could be argued that the artist is engaging imagination in a particular perceptual way that equates to an aesthetic appreciation of nature.

Brady (2003) indirectly comments on this by pointing out that artworks have a social aim that nature does not. The social aspects of an artwork are expressed through a creative process but nature is subject to geological and environmental processes. Engaging artistically with environments requires a moral attitude towards nature and particular environments and it is this that has prompted some critical debate on Land Art.

Saito (1998) raises another issue of assessing nature relating to the picturesque which the author states is a legacy of late eighteenth-century aesthetic appreciation of the natural landscape. In this case what was deemed scenically interesting or beautiful was regarded as having aesthetic merit while environments not worthy of being reproduced in a picture were deemed to be lacking in aesthetic value.

In effect, this gave the judgement of aesthetic value of nature to painters and, later, photographers who had the means of reproducing certain scenes. This turned nature into a

visual resource with the emphasis on the enjoyment of viewing an interpretation of nature rather than the real thing.

These interpretations can and often did exclude parts of an environment that were deemed to render a scene aesthetically compromised, for example dead animals, landslides or dry salt lakes. This served to reinforce a position that a positive aesthetic assessment of an environment does not necessarily imply a positive aesthetic of everything in that environment.

Nature, of course, can and does change environments through what we term *natural disasters* such as cyclones and volcanic eruptions. But, as Saito (1998) points out, they may seem a disaster to us but in fact all that is happening is a redistribution of mass. There is no less mass after an event and nature is indifferent to the way we would like the environment to be. Saito (1998) advocates a change of view on so-called unscenic nature on the moral grounds that nature should not be viewed as a visual resource.

However, artists working in Land Art would no doubt disagree with this. The natural or non-urban environment in which Land Art is constructed is, for the most part, incorporated into the visual aspects of the work. In Land Art, nature *is* viewed as a visual resource.

According to Simus (2008), the acknowledgement that environmental disasters are part of the natural workings of nature forms part of a new paradigm of nature. This recognises dynamic changes, disturbances and unstable conditions associated with nature resulting in aesthetic appraisal being more inclusive of systems that are dynamic and chaotic rather than stable and orderly. Nature is accepted as being in flux rather than in balance. This new paradigm also rejects the view of humans outside of nature - not only including humans as part of nature, but also taking into account the effects humans have on natural systems.

This change of view has an impact on the idea of nature being the sole instrument in the creation or destruction of environments. As Simus (2008) makes clear, all natural systems have been affected by human actions to some degree. Regarding the aesthetic appreciation of nature, Simus endorses the basic premise of Carlson's model of cognitive evaluation of nature through the knowledge of natural sciences. The proviso being that the 'appropriate knowledge provided by the natural sciences' be updated to incorporate

the science of the new paradigm. Carlson seems to recognise this new thinking by admitting that his theory might be 'paradigm relative' (Simus 2008).

An artist may consider a certain environment suitable for a work because of perceived attributes that will relate to the artwork. But if this artwork is viewed in its location (as opposed to viewing a photograph of it) the artist cannot dictate what else the viewer will focus attention on. As previously mentioned, in a picturesque rendering a dead animal would be removed on aesthetic grounds, but with permanently sited works, especially in remote places, it is not practical to monitor and remove unwanted visual objects. The artist also has no control over atmospheric conditions that may significantly affect the perception of the work. Another factor the artist has little control over is the direction from which the viewer approaches the work. This may be dictated more by features within the environment or by natural events (even natural disasters) that happen after the installation of the work.

Artists working in the area of Land Art have always had to work with nature and perhaps have a slightly more practical view of nature than some of the theorists. After all, nature is claimed by many artists to be an integral aspect of their work.

### **Land Art Works**

Writers such as Tiberghien (1995), Malpas (2007) and Tufnell (2006) have written about the rise of Minimal Art in the late 1950s and early 1960s in relation to its effect on Land Art works. The aim of minimalism was form that spoke of itself, that provided an immediate total impression and was of clean, pared down lines. In sculpture this resulted in works that were non-sensual, impersonal and often geometric (Preble & Preble 1989). Although there was a definite influence of minimalism in some gallery works by artists who later turned to Land Art, any claim that this influence carried over into their environmental work is based solely on observations of the constructions and ignores their environmental context. Even works in the desert, such as De Maria's *Two Parallel Lines* (1968) which consisted of two half-mile long straight lines scored into the Californian Mojave Desert, led the eye towards the rugged distant mountains and were situated on dried and heavily cracked earth that seemed to transform the space between the lines into a crazy paving pathway. This environment was part of the work which moved it out of the sphere of minimalism.

Bond (2005) makes a similar point that Minimalism may have provided a conceptual framework for some early Land Art but this soon changed as the site became an important part of the meaning of an artwork. Based on the observation of Robert Morris that the new aesthetic of Land Art ‘put the viewer in the same space as the object’, (Malpas 2007). Malpas contends that, while observing the artwork, a relationship is being established with its environment. In effect, the viewer is inside the artwork.

This relationship between artwork and viewer is, however, restricted to permanent works of Land Art, leaving the ephemeral pieces to be viewed mostly in photographic form distanced from the site in which they were made. This dichotomy of viewer engagement poses problems for contemporary theories on Land Art.

In his article ‘Art and Audience’, Nick Zangwill (1999) puts forward a proposal that if the audience/viewer is seen as having no essential role in the development of an artwork, then an artist-based theory can be developed. This theory focuses on the artist’s intent to realise certain desired properties that are valuable to the artist and would constitute the essence of the artwork.

In the case of Land Art, these valued properties might include the interaction of the work with its environment. The theory then proposes that artists can pursue their own artistic values based on a realisation that any audience who would make the effort to travel to the site of the artwork would probably value the same properties. However, Zangwill (1999) concludes that these properties in the artwork can be valued either intrinsically or instrumentally. Therefore, visiting the actual site of an artwork is not the only way these properties can be appreciated. A photographic representation showing the environmental context of the work could, according to Zangwill, serve an aesthetic purpose to the ‘right’ appreciative audience. It could be presumed that this ‘right’ appreciative audience would be one that already has a wide aesthetic appreciation of non-urban environments.

The representation of an artwork, either in photographic or some other form, is an important issue to be considered with Exoart as the audience/viewer will never be able to actually visit the project site and, in this regard, Zangwill offers a starting point for discussion.

Although the relevance of various theories of art may be debated, there is one event that could be regarded as pivotal in the development of Land Art. That event took place in

December 1968, when the first humans orbited the moon in the Apollo 8 spacecraft. The photographs of Earth that they took, showing a luminous blue globe suspended in the vast blackness of space, brought a new perspective to our sense of environment. *Image 60*. Artists responded enthusiastically.

## **SUMMARY**

Land Art is an artform distinct from gallery or public art and removed from the urban environment. Concepts explored by artists in this area can encompass the ephemeral works of Andy Goldsworthy and Nils-Udo through to cosmic encounters with space and time in such works as James Turrell's *Roden Crater* and Charles Ross's *Star Axis*.

The environment in which the artists work informs and becomes part of the work that they make. This is an important aspect of Land Art that is relevant to Exoart, because art on another planet will have to engage with a new environment and new environmental conditions. This chapter sets out a case that many artists working in Land Art have engaged with challenging environments and concepts on Earth. Therefore, I propose that Land Art is the most appropriate artform to reference in the development of a foundation for Exoart.

This chapter has also discussed issues of nature, environments and entropy because similar issues emerge in the development of Exoart; as, of course, do bureaucratic regulations, in which respect Mars is not much different from Earth.

Also mentioned in this chapter is the relationship of Land Art with what I term Ancient Land Interventions, also commented on by Tiberghien (1995), Spivey (2005) and Lippard (1983). In the following chapter I explore the idea that these interventions can be regarded as the beginnings of Land Art. In that sense Land Art can be seen to stretch back over 5,000 years and so reinforce the claim that an artistic/cultural human engagement with a new extraterrestrial environment would be appropriate through Exoart derived from the essence of Land Art.

The theory of Positive Aesthetics has been discussed in relation to the appropriateness of Land Art in natural environments. Similar issues have already been debated with regard to space hardware on the Martian surface as a result of many years of robotic missions. This debate is covered in Chapter 6, Mars: The Human Journey. The theories that Nick Zangwill (1999) puts forward regarding the intent of the artist in creating an artwork and

the representation of that artwork in an alternative form, such as photographs, have been briefly covered. These points have a bearing on artists who may be engaged in producing Exoart and its representation on Earth. Zangwill's theories provide a good starting point for discussion of these issues in Chapter 7, Considerations for an Exoart Project on Mars.

Finally, I have mentioned in this chapter a new environmental perspective that emanated from pictures of Earth taken from space in the late 1960s. It is a perspective that not only gave added meaning to the only environment we currently have but, for many artists, reinforced the idea of engagement with other environments in space. This thesis proposes that Exoart is the next logical step in this new perspective.

## CHAPTER 4

### ANCIENT LAND INTERVENTIONS

#### INTRODUCTION

This chapter covers ancient land interventions and sculptural forms and presents a case that the origins of what we currently call Land Art are present in human environmental structures from prehistoric times.

The aim of presenting this case is to provide a historical context for both Land Art and Exoart and, in so doing, establish that there is a uniquely human aspect to land interventions. It proposes and presents a case for the concept that some ancient land interventions can be classified as works of art, as we understand the term today, and so establish a lineage for Land Art back at least 5,000 years.

From early human existence when little of permanence, other than burial mounds, was created in the environment, through land interventions that were constructed so well they have survived thousands of years, to the present time when similar interventions are constructed as artworks. In this present age of space exploration with the prospect of a near future human mission to Mars a new environment will be encountered. This chapter presents an argument that historically there is evidence that we have engaged with our environment in an artistic or culturally significant way and that these environmental interventions have contributed to present-day Land Art. This in turn will contribute to Exoart for an engagement with a new and very different environment.

This chapter is not intended to be a complete account of all ancient land interventions, the subject is too large, and it is unnecessary for the objective of this case to present more than a few well-documented examples. Also, no claim is being made that *all* ancient land interventions are works of art and, for this reason, burial and settlement sites are not referenced. The one exception is Newgrange in Ireland which will be discussed in the context of its astronomical and rock patterning features as well as its ring of standing stones.

The term ‘ancient land interventions’ has already been used and will continue to be used throughout this chapter and should be taken to mean constructions in the natural environment by people in ancient times for reasons that are not wholly established. It is

acknowledged that some authors use the term ‘monument’ for these structures, a term that was defined in Chapter 2 as something to remind or something that recalls the mind, especially the memory to people. As there is no definitive consensus on the actual use of these structures and no written documents from the time it would be an assumption that they were intended as mnemonic devices, therefore the term ‘ancient land interventions’ is used. What remains of these ancient land interventions as well as archaeological determinations allows for debate on whether there was an artistic intent in their creation. At the conclusion of this chapter arguments will be presented to substantiate a claim that these interventions can be considered artworks along with any other cultural meanings they may have had.

In relation to dating – all dates in the literature reviewed, if not already expressed as years from present, will be converted to this format so that a direct comparison can be made between sites mentioned. Where it is a direct quote from a source the original dating will be maintained. Also, the techniques used by archaeologists for dating sites and the difficulties experienced will be discussed in the section entitled ‘Art in the land of Archaeology’.

It should be noted that images of the sites discussed are of the constructions today. Because of erosion, land disturbance, human action (including large-scale dismantling) and many other events, most of the sites only hint at what they may have been like when first constructed. Because of this computer-generated images and illustrations of Avebury, Silbury Hill and Stonehenge in the UK showing their probable original appearance have also been included.

## **OVERVIEW**

There are times when one arrives at a place just after something fantastic has happened. Things left behind are in strange disorder, or are slightly disconnected. One begins to collect the visible evidence of some invisible event, hoping with these clues, to reconstruct the mysterious event in the past (MacNamara 1993).

No specific time-frame has been allocated for this study; however, several of the sites in the United Kingdom (UK) under discussion have construction dates in the later Neolithic and early Bronze Age. However, these names do not imply a clearly defined change in the structure of ancient cultures. The Neolithic era is generally regarded as the period

when people began to switch from hunter gathering to farming, but this change was neither instantaneous nor uniform throughout the UK and Europe (Trubshaw 2005).

As this study is not concerned with anthropological issues, these terms will not be used again except where they are contained in quotes. Also this thesis is concerned with making a connection between these structures and contemporary Land Art, therefore the emphasis regarding these land interventions is on their visual and aesthetic qualities.

To add some perspective to this study there is a brief account of the continuing debates and controversies involving various viewpoints in archaeology and the consequences on historical accounts.

As Dixon (1982) notes in his article when writing about the visual and actual form of ancient land interventions:

We must pay the most precise, the most exact, attention to what we can see in these works, to what we can know on the basis of what we see, lest we violate both their integrity and ours.

Unfortunately, the ancient land interventions we can see today are, for the most part, in ruins. However, there are enough elements remaining to be able to understand the skills needed to conceive of and design such structures and to appreciate the determined effort needed to construct them. The land interventions that will be discussed in this chapter broadly fall into four categories:

1. Structures with a predominance of stone to define the form, for example Stonehenge (UK) and the stone rows of Carnac (France)
2. Mounds constructed from environmental materials, for example Silbury Hill (UK) and the Serpent Mound (USA)
3. Markings on the land, for example the Uffington White Horse (UK) and the Nazca Lines (Peru)
4. Carved sculptures, for example the Easter Island figures

When defining categories it is inevitable that some sites will not sit comfortably within one particular boundary. An example of this is Avebury, Wiltshire, UK, with its monumental earthworks that include a ditch with an accompanying earthwork bank. The interior, enclosing 11.5 hectares, is generally believed to have contained a circle of 100

large standing stones (Burl 1981). As can be seen, this structure could fit into categories 1 or 2 above and, for this reason; these categories should be viewed only as indicative of the type of ancient land interventions that will be referenced. The point of introducing the four categories is to show early on the extent and type of constructions undertaken by ancient people so that they can be compared with the constructions of contemporary Land Artists mentioned in the preceding chapter.

### **Structures with a predominance of stone**

The category has been formulated in this way because, although there is evidence of large wooden monuments, not much survives of them, unlike their stone counterparts. Probably the most well-preserved of these wooden structures is a site referred to as Seahenge, discovered in 1998 partly-submerged in the sea in Norfolk, UK. It was this continual immersion that preserved what is left of the structure which consists of the root ball of a large oak tree, upturned towards the sky and surrounded by a seven metre circle of 55 oak posts, of which only the bases in the soil remain. When the structure was first built it is thought it was some distance inland from the shore, but over time the sea encroached over the low-lying area and immersed it. With a combination of dendochronology, which matches the age of wood with tree growth rings, historical climate data and radiocarbon measurements, an age for Seahenge has been established at just over 4,000 years (Arosio & Meozzi 1999).

Ancient land interventions constructed with a predominance of stone generally last far better than wood, hence there are more surviving today. The most frequent form of these structures is the standing stone circle of which there are over 900 known in the UK alone (Burl 1981).

Aubrey Burl (1981) defines them as:

an approximately circular setting of spaced standing stones which do not act as a kerb ... Integrated with the structure may be banks, ditches, single stones, avenues, or other auxiliary settings which vary from locality to locality.

### ***The Hurlers, Bodmin Moor, UK Image 61***

Small versions of standing stones proliferate throughout the UK, some still quite well preserved such as The Hurlers on Bodmin Moor, which are actually three stone circles in

close proximity to one another. The granite stones average around a metre high and the circles vary from 33 metres to 42 metres (Burl 1981).

***Nonakadō, Oyu, Japan Images 62 and 63***

At Oyu in Japan is a circular stone land intervention referred to as the Nonakadō. The form is slightly oval, measuring 38.5 metres north/south and 41.5 metres east/west (Watson 1994). The monument consists of two concentric circular bands of many small stones in a bullseye configuration. Separating these two bands is a clear circular area featuring a large standing stone surrounded by long stones placed radially on their sides, called the Sundial. A precise date for this monument is not known but recovered artefacts at the site suggest it is at least 2,000 years old (Watson 1994).

To construct the Nonakadō circle, stones were brought from the Akuya River which is more than five kilometres away. This stone land intervention is just one of hundreds of similar stone forms found throughout Japan, many of which are thought to have incorporated astronomical features. Other low stone land interventions were found throughout south-east Asia but unfortunately many have been removed to create farmland (Heritage of Japan 2008).

***Carnac and Locmariaquer, Brittany, France Image 64***

In the districts of Carnac and Locmariaquer in southern Brittany, France, are a number of sites where the stones are aligned in rows. Three substantial structures are Le Ménéac alignment that consists of 11 parallel rows around 90 metres wide and almost 1,100 metres long containing 1,100 standing stones; the Mermario alignment has 10 rows and is around the same length, containing over 1,000 stones; and the Kerlescan alignment consisting of 13 rows over 900 metres in length. The stones vary in height with some up to 4 metres and occasional separate stones over 6 metres. At these three sites there are around 3,000 stones in total in the constructions built over 5,000 years ago (Sieveking A 1994; Burenhult 1993).

Although the purpose of the stone rows remains unknown, it has been debated as to whether the existence of a magnetic field in the vicinity had any bearing on the selection of these particular sites (Molyneux & Vitebsky 2001). We can only speculate as to whether the people who created these land forms knew of, or felt, this field, but it is not

unheard of for Land Artists today to choose a site for their work on the feeling of the place.

A prominent Land Artist, the late Robert Smithson (1979), stated that:

Perception is prior to conception, when it comes to site selection or definition. One does not improve, but rather exposes the site ... The unknown areas of sites can best be explored by artists.

***Stenness and Ring of Brodgar standing stones, Orkney, UK Image 65***

On the island of Orkney Mainland, in the far north of the UK, are two large stone henges standing only 1.6 kilometres apart. The standing stones of Stenness and the Ring of Brodgar have large stones that are almost sculptural in their appearance. These stones may have been quarried or selected for this form, much as a Land Artist today would carefully choose the stones they wish to work with.

Andy Goldsworthy (1994), an English environmental artist who often works with stone, writes:

I am drawn to the stone itself. I want to explore the space within and around the stone through a touch that is a brief moment in its life. A long resting stone is not an object in the landscape but a deeply ingrained witness to time and a focus of energy for its surroundings.

Both circles are impressive in size, with the larger Ring of Brodgar having a 103 metre diameter standing stone circle inside a rock cut ditch that is 142 metres in diameter. The standing stone circle of Stenness has a bank of 61 metres diameter that surrounds a 31 metre circle of what was originally 12 large stones, but only four now remain standing. These stones that stand around five metres high are unusually thin with sloping tops and it is possible that they were chosen or even worked into this form for aesthetic reasons. The two rings have been radiocarbon dated at around 4,200 to 4,350 years old and, although there is opinion that the two were in some way connected, there is only circumstantial evidence for this (Burl 1981).

***Newgrange, County Meath, Ireland Images 66 and 67***

A site that makes a distinctive feature of the stones within its construction is Newgrange in County Meath, Ireland. It is generally described as a burial mound although few

human remains have been found inside its chamber (Molyneux & Vitebsky 2001). Göran Burenhult (1993) suggests it may primarily have been used as a cult centre, not a burial place. His theory that the few human remains found do not warrant it being described as primarily a burial mound has some merit if the site is compared to other large burial mounds; for example the West Kennet long barrow in the south west of England contained the remains of 40 to 50 people (Cleal 2000a).

The mound itself is a slightly flattened circle in plan, measuring 79 metres by 85 metres and 11 metres in height at the centre. Its single entrance opens into an 18 metre long passage leading to a main chamber incorporating three smaller chambers. The passage and chambers are constructed from stone covered with soil and turf. Delimiting the outside base of the mound are 97 large kerbstones varying in height from 1.7 metres to 4.6 metres (Eogan 1994). Surrounding the mound is a circle of standing stones 103 metres in diameter. Originally there were about 35 stones but now only 12 remain. An analysis of these stones found they were syenite, with the nearest source being 96 kilometres away (Burl 1981). It is uncertain whether the stone circle was constructed at the same time as the mound, which has been radiocarbon dated as 5,300 years old; however, archaeological evidence suggests it is not later than the mound which makes it the earliest stone circle yet recognised (Burl 1981).

Inside the mound chamber and on kerbstones outside are complex spiral patterns carved into the stones. An interesting feature of these patterns is that one path of a spiral leads into the centre and, without a break, becomes another path that leads out of the spiral. Göran Burenhult (1993) remarks on the quality of these and other stone carvings, especially those of the large passage grave of Gavrinis, on an island in the Bay of Morbihan near Carnac, France.

Burenhult (1993) points to close similarities in the designs of the stone carvings at both sites to propose there may have been contact between the people of the two regions. Whether there was regional contact is unknown but the similarities in the stone carving designs are superficial. The carvings at Newgrange, where the same path of a spiral leads both into the centre and out from the centre, demonstrates a remarkable design development and conceptual expansion that is not readily apparent in the carvings of Gavrinis.

Another interesting feature of this site is that, during an excavation and restoration of the mound between 1962 and 1979, archaeologist Michael O’Kelly discovered a ‘roof box’, a horizontal slit above the entrance to the passage. It was later revealed that this opening allowed the rising sun at the winter solstice to penetrate to the back of the interior chamber, lighting up the carved stones (Mitchell 2001). Artist Martin Brennan, spent several years up to 1981 investigating astronomical features in other chambered mounds in Ireland, finding many other examples involving both sun and moonlight (Mitchell 2001).

***Stonehenge, Wiltshire, UK Images 68, 69 and 70***

Although Stonehenge is one of the most well-known of the British prehistoric monuments there are varying opinions on its construction dates and its previous forms prior to the lintelled stone circle and trilithons that we see today. The variations in dating in texts on the structure stem from archaeological work undertaken in the 1920s, 1950s and 1960s which, according to Mike Pitts, editor of the journal *British Archaeology* were not well-recorded (Jones 2009).

Archaeologist Barbara Bender adds weight to this statement in her assessment of a 500 page report on these excavations. She comments that anyone reading it:

will catch glimpses of barely-suppressed outrage at the amount of evidence lost, fudged or (almost wilfully) misinterpreted. Given a prehistoric landscape central to our sense of national identity, we have astonishingly little evidence (Bender quoted in Trubshaw 2005).

English Heritage, the current custodian of the site, is reluctant to allow further digging, apart from small targeted excavations, but these are inadequate to establish the exact chronology and nature of the various structures (Jones 2009).

There appears to be no consensus on the starting date for Stonehenge with Gale Sieveking (1994) stating a time of 4,200 years ago and Mike Parker Pearson claiming it was around 5,000 years ago (Geddes 2008). Both state carbon dating as their evidence, which emphasises the care that must be taken when analysing results from these sources. Other authors give starting dates between these two and there is also no consensus on the time period over which the various incarnations of the site took place; estimates vary from between 650 years (Sieveking G 1994) to 1,000 years (Burl 1981).

These variations are not crucial for this thesis as it is primarily concerned with the visual aspects of this and other sites being examined. This examination is affected by the current state of Stonehenge. As Aubrey Burl (1981) so interestingly puts it:

(T)his ravaged colossus rests like a cage of sand-scoured ribs on the shores of eternity, its flesh forever lost.

The following is an edited account of Stonehenge and is included to give an indication of the phases of construction that culminated in its final form. The first phase was the digging of a ditch and the construction of a 1.8 metre high bank around 97 metres in diameter (Burl 1981). Around the internal edge of this bank are 56 holes some of which contained human cremated remains (Sieveking G 1994). At a later stage four large station stones were erected and the construction of two concentric circles of bluestones was started inside the henge surrounding the central area. An avenue was also constructed by digging two parallel ditches to create banks 12 metres apart and extending four kilometres to the Avon River (Sieveking G 1994).

The origin of the bluestones and the method of transportation to the Salisbury Plain site has been the subject of much debate. Geologists eventually established that the source of these stones is the Presceli Mountains in Wales, some 386 kilometres from the Stonehenge site (Hayes 1993). Estimates of as many as 82 stones weighing as much as four tonnes each were accumulated at the site for the construction of the circles, but these were never completed and, instead, work began on erecting the large lintelled sarsen circle that is the predominant image of Stonehenge today (Burl 1981).

This change in design, according to Hayes (1993) 'transformed a rather ordinary henge monument to something spectacular and unique in C.2000 B.C'. Statistically, this new design consisted of 30 sarsen stones over four metres high and weighing at least 26 tonnes, which were shaped and smoothed on one side before being erected into a circle 30 metres in diameter. Sarsen lintel stones were shaped into a curve to match the circle and peg and hole joints were fashioned into the lintel and upright stone to lock them once in position, with the lintel stones secured to each other with tongue and groove joints.

Inside this circle, five massive trilithons (two uprights with one lintel stone) the tallest being 7.5 metres in height were erected in a horseshoe configuration with the open end facing north-east. Finally, some of the smaller bluestones were placed in a circle between

the ring of sarsens and the horseshoe of the trilithons, with the remainder forming a smaller horseshoe pattern inside the trilithons (Burl 1981; Pick 1979; Hayes 1993).

Astronomical alignments appear to have been built into this new design because the midsummer sunrise and midwinter moonrise could be observed within the horseshoe configuration of stones (Sieveking G 1994). Referencing this, the American astronomer Gerald Hawkins proclaimed that part of its purpose was an instrument for predicting solar and lunar eclipses (Molyneux & Vitebsky 2001). However, Anthony Johnson (2008), in his book *Solving Stonehenge* writes:

Such theories demand that we see the people who built and used the monument as ‘observers’ of external events which the stones were in some way arranged to register. No matter how astonishing or sophisticated the concept may be, it removes a vital human dimension, taking away the soul and artistry, and reducing it to no more than a very clever 1,200-ton mechanism.

It is probable that the structure had several uses over the lengthy period of its construction phases and speculation about its function, significance and knowledge of its builders is in abundance. Caroline Alexander (2008) observes:

The heart of its mystique is, surely, that it excites an equal measure both zealous certitude and utter bafflement.

Whatever its uses and the intentions of its builders were, which we will probably never know for certain, we can respond to its visual form. Johnson (2008) writes:

The design is a celebration of intellect and discovery, and the final stone construction heralded a new and enlightened age where technology and creativity flourished.

As if to connect this enigmatic structure with the technological space age, USA astronaut Story Musgrave flew a small piece of Stonehenge into space (Winchester 2006). This could be seen as an interesting example of how an engagement with a new environment, in this case outer space, can create cultural meaning even for a small piece of stone. It is this cultural meaning, created through an interlinking of object and event, that will play a fundamental role in an Exoart project.

*Avebury Henge and Standing Stones, Wiltshire, UK Images 71, 72 and 73*

When writing about the stone circles of the British Isles, Aubrey Burl (1981) describes the giant henge and standing stones of Avebury as ‘the mightiest in size and grandeur of all of them’. There is no doubt that the physical dimensions of Avebury are impressive. At its outer extreme a huge bank encircles what was originally a deep and wide ditch. The bank, which is not truly circular, is about 420 metres in diameter. Today it stands at an average five metres high but, before thousands of years of erosion, it is estimated to have been 6.7 metres high with a base varying between 23 metres and 30 metres wide with four entrances with causeways across the ditch to the inner plateau. This bank contains an area of 11.5 hectares (Burl 1981). The ditch, which is partly silted up from erosion of its sides and the collapse of parts of the bank, was excavated between 1908 and 1922 by Harold St George Gray. These excavations established that the ditch would have been on average nine metres deep, up to five metres wide at its base and nine to ten metres wide at the top (Gillings & Pollard 2004).

The location of Avebury is in an area of chalk upland on the westernmost extension of the Berkshire Downs (Gillings & Pollard 2004). At lower depths the chalk becomes compacted and excavation requires the chalk to be levered out in solid blocks. It has been estimated that 112,000 tonnes was dug to form the ditch (Burl 1981).

This excavation would have been done with antler picks to break up the solid chalk before raking the loose material into baskets to be hauled up and added to the bank. It is estimated this would have taken about 1.5 million work hours (Cleal 2008).

The effect of looking down from the top of the chalk bank to the gleaming white bottom of the ditch 16 metres below can only be imagined, but it must have served as a major design element for the structure.

On the outer perimeter of the plateau, six metres from the inside edge of the ditch, is the great standing stone circle. Originally 98 sarsen stones formed this circle, these were natural blocks and not dressed or shaped as the sarsen blocks at Stonehenge. The stones in the Avebury outer circle range from 2.7 to 5.8 metres in height and weigh up to 60 tonnes (Vatcher & Vatcher 1980). Unfortunately, only 30 stones are visible today after the rest were broken up and removed for building material or simply pulled over and

buried. There are various theories on the reasons for this and over what time period, but Gillings & Pollard (2004) conclude from fragmented evidence that:

rather than a concerted plan of eradication, the stone burials looked to have comprised a series of acts carried out as and when needed over a 300 year period, each being driven by a contingent and specific set of concerns ... What happened to the Avebury megaliths during the 14<sup>th</sup> to 17<sup>th</sup> centuries appears unique ... the eradication of megalithic monuments through the burial of stones is hardly attested anywhere else in medieval Britain.

Whatever the reasons for this attempted eradication of the stones it could be concluded that, in the minds of the people of that era, they were a very powerful visual representation of something that they were not prepared to live with, despite the dangers in the practice of pulling such large stones over. This is evidenced by the discovery of a crushed body under one of the excavated stones (Gillings & Pollard 2004).

Within the outer circle of stones are two further stone circles that, at around 100 metres in diameter, rank in the top two percent of all stone circle sites in UK for size (Burl 1981). Given that these circles fit comfortably inside the outer circle serves to reinforce the enormous size of the Avebury structure

In addition, within each of these circles were further stone features. The southern circle once contained a large standing stone 2.5 metres in diameter and 6.4 metres in height described as an 'Obelisk' along with a curious straight line of smaller stones. The other circle in the north-west appeared to enclose a set of stones in an egg shaped pattern. It also includes a feature known as the 'Cove' which originally consisted of three large broad stones enclosing a triangular space of 40 square metres. Their large height and width puts their weight at around 100 tonnes (Gillings & Pollard 2004). A few other stone features have been recognised within the monument but damage and the poor record-keeping of the early excavators makes identifying any form difficult.

As with many ancient land interventions, its age and sequence of construction is still open to debate. The National Trust, that manages the site on behalf of English Heritage, publishes a booklet stating the bank and ditch were started around 4,600 years ago (Cleal 2008). However, Gillings and Pollard raise the differences in opinion among writers on the subject as to whether in fact the bank and ditch were started before the erection of the

stones. The argument is that it would have been an easier task to drag the stones into position without having to negotiate a narrow causeway through a bank and over a deep ditch. There are also some claims of radiocarbon dating to support this theory with a suggested starting date for the Cove structure at 5,400 years ago (Gillings & Pollard 2004). If these dates are correct the large stones of the Cove structure were erected 800 years before the construction of the ditch and bank.

Only around six percent of the monument has been excavated by professional archaeologists and it is now listed as a World Heritage Site therefore opportunities for major new discoveries are limited because of the control process (Chadburn & Pomeroy-Kellinger 2000).

It is evident that a certain amount of ambiguity will remain around interpretations of dating, but it seems clear this will not deter future debates. On other aspects of the structure Aaron Watson (2001) speculates on the visual, aesthetic and sound experiences open to the people who visited the site thousands of years ago.

The natural profile of the land within the henge is a shallow dome and people walking around the perimeter following the stone circle would gradually descend to a point where only half the henge is visible, with the centre becoming a new horizon and the inner stone circles:

skylined and crested upon the break of the slope. The visual appearance of the monument has been transformed (Watson 2001).

He goes on to explain that one of the most fundamental aesthetic qualities of the henge is its sense of enclosure while also, at various points, permitting restricted views of the surrounding environment. However, from within the two central circles the whole interior of the henge can be viewed and an optimal view of the distant hills above the earthworks monumentalises the space (Watson 2001).

Watson also proposed there may have been special sound qualities within the henge, specifically an acoustic focus within the two inner stone circles. This idea is partly substantiated by work done by Steve Marshall (2007a) within the Avebury complex. The potential for sound reflection comes from the way the stones of both the outer and inner circles have their smoothest sides facing in towards the centre. This feature was noted in 1720 by antiquarian William Stukeley.

Experiments by Marshall (2007a) showed that ‘echoes of the human voice are not very loud but sharp percussive sounds and short whistles echo well’. He also noticed that, at the centre of one of the smaller circles, ‘by the Obelisk, a sharp click would produce an echo that appeared to come equally from all around the circle’.

The caveat on his work comes from the difficulty of taking audio readings within the greatly-changed structure of the complex. As Marshall (2007a) makes clear, there is a:

busy and very noisy road that passes through the middle of the Henge. Most of the stones are missing; houses have been built inside the henge that reflect sound; there is a busy pub and a good deal of military aviation noise. It’s often very windy. Trees reflect sound extremely well, especially if growing in clumps, and the two groups of mature Beeches at the eastern and southern entrances to Avebury reflect sound as efficiently as a cliff face.

To counteract this, work is underway on constructing a computer model that will allow the removal of these encumbrances and, it is hoped, give some indication of whether this aspect could possibly have been a deliberate design feature.

Three-dimensional computer modelling is also being undertaken jointly by the Universities of Newcastle, Leicester, Southampton and Wales (Newport) in the UK to help create an appreciation of this and other sites as structures and spaces that were created and used by real people with real aesthetic design ideas (Cleal 2000b).

Watson (2001) concludes in his text on Avebury that it was, in its original form:

a landscape within a landscape ... the stones may have been derived from the landscape, but now they were composed according to their shape, size, colour and texture. The architecture itself contrived a circular view of the world and a sense of centrality which could not be recreated elsewhere.

### **Mounds constructed from environmental materials**

*Silbury Hill, Wiltshire, UK Images 74, 75 and 76*

This entirely human-made hill is in close proximity to the Avebury henge and standing stone structure in Wiltshire, UK. Its form is conical with a flat top and its dimensions are impressive considering, like Avebury, it was built using simple tools and a massive amount of human labour. Its height is around 37 metres, the flat top section has a 30

metre diameter and it is about 500 metres around its base which is contained within a large moat (Cleal 2008).

During a one year archaeological program in 2007 and 2008, which accessed the interior of the hill through old archaeological tunnels prior to permanent backfilling, new samples were taken for radiocarbon dating. These new samples put the first stages of construction at 4,400 years ago but material taken for establishing the completion of the hill has given varying results. Some interpretations say it was completed comparatively quickly, within 100 years, but another conflicting model puts its completion much later which shows a 400 year building schedule (Leary 2008).

Other interesting discoveries were that the mound contained nearly 240,000 cubic metres of deposited material which almost perfectly matched the material excavated from the moat at 235,000 cubic metres (Field 2008). An analysis of drilled core samples taken prior to this archaeological program confirmed the hill is almost entirely constructed from chalk (Canti, Campbell, Robinson D & Robinson M 2004).

Some excavation work on top of the hill also confirmed a construction technique proposed in earlier archaeological excavations. The hill was constructed by building a series of circular platforms, each platform being slightly smaller in diameter than the one below. Each platform was built up with chalk block walls, an outer circular wall and matrix of internal walls in a spiders-web pattern. The voids were then infilled with chalk rubble. At its completion the steps of the hill were filled and compacted with chalk rubble. To this innovative building technique is attributed its stability and lack of major erosion over the years (Vatcher & Vatcher 1980; Leary 2008).

It was also found that, at a later stage possibly in the medieval period, some form of structure had been erected on the summit and that to accommodate this the top section of the hill may have been removed (Leary 2008).

United Nations Educational, Scientific and Cultural Organisation (UNESCO) has now given recognition to Silbury Hill as a 'masterpiece of human creative genius' (Chadburn 2008) and even in its 'decapitated' state it is still acknowledged as the largest human-made prehistoric mound in Europe (Cleal 2008). At this point in time there is no credible explanation for why the hill was built and not one of the episodes of tunnelling into the

centre of the hill has produced artefacts or remains to provide a clue (Vatcher & Vatcher 1980; Cleal 2008).

A relevant factor for this thesis is the appearance of the hill in the landscape when it was finally completed. It has been described as a 'snow-capped mountain' (Roberts 2009) and, in the rich green of a summer environment, its brightness would have had an impact on any viewer especially at times when the moat was filled with water.

As with the Avebury structure, Silbury Hill has been subjected to acoustic experiments. The culmination of these experiments was an Archaeoacoustic Event organised by English Heritage in July 2007. As part of this event, at various times during a weekend, musicians played replica instruments of Neolithic and Bronze Age eras from the top of the hill. The instruments included stone flutes, frame drums, animal horns, bone flutes, along with male vocal.

Steve Marshall (2007b), who was making binaural recordings at the event, stated that all the instruments, including some speech, could be heard clearly. Also:

(F)rom a position close to the hill, on its north side, I recorded some very spectacular repeat echoes, of about half a second in length, coming from the surrounding hills ... The effect is so dramatic that I am now convinced that it was an important factor in the design of the hill.

He concludes that there would be a 'sweet spot' somewhere around the hill where an audience could be positioned for maximum theatrical effect although it is difficult to comprehend ancient people spending at least a hundred years building such a structure solely as a sound stage. Its design and location, in close proximity to the rolling hills of the downs and the Avebury structure, would suggest at least some aesthetic engagement with the environment.

### ***Serpent Mound, Ohio, USA Images 77 and 78***

This mound, in the form of a wriggling snake, appears from above as though it is embossed on the high bluff on which it is located. The snake has a coiled tail, undulating body and a head that is described as having open jaws 'with what appears to be an egg in its mouth' (Molyneux & Vitebsky 2001).

The mound varies in height and width. At the centre of the body the earthwork is 6 metres wide at the base and around 1.8 metres in height. At the coiling tail the work tapers to approximately 1.5 metres wide at the base and 1.2 metres in height, with the total length of the work being 430 metres. (Randall 1907). Theories of who built the mound have influenced its dating and until recently it was thought to be around 2,000 years old and a product of the Adana people. However, carbon dating has put its age at around 1,300 years old (MacNamara 1993).

The mound was built by covering a layer of clay and stones with a layer of yellow clay, which would have been transported to the site from elsewhere, as the natural ground at the site is composed of a grey clay (Randall 1907).

In his essay on the mound, Marshall (1993) poses the question of what led the makers:

to expend thousands of hours of work carrying earth and shaping a monument that can (because of its size) only be seen in its entirety from high above ground?

This is certainly the case today because of the heavily-timbered environment on that section of the bluff, but it may not always have been so. Randall (1907) stated that the surface of the bluff where the Serpent Mound had been constructed slopes down towards an almost vertical 30 metre cliff wall and, making no mention of the forest that is there now, he commented how the bluff made a good platform for the Serpent Mound to be observed from the plains below.

The tipped [sloped] surface enabled his creators and promoters to so place the wonderful serpent upon a shelving bed that he would easily be seen in all his majestic length and snake splendor from far and near on the plains below. For exhibition purposes no finer opportunity from a natural combination of features, could have been found in the Ohio valley and perhaps not in the Mississippi basin (Randall 1907).

In contemporary Land Art, location within the environment is important and the bluff chosen by ancient people for their installation would not be out of place from the viewpoint of a contemporary Land Artist.

Through time the Serpent Mound had suffered from erosion, aggravated by human abuse, until a restoration around 1900 by P. W. Putnam of the Peabody Museum, Harvard University (Molyneux & Vitebsky 2001).

However, Josua Lindahl, Secretary and Curator of the Cincinnati Society of Natural History, thought there was more to the serpent head than had been revealed by the restoration. The oval within the so-called jaws of the serpent was created by a low earth wall, less than a metre high, which enclosed a depression rather than the convex shell of an egg which could have been easily achieved by forming a mound on the same outline. Lindahl thought that, rather than jaws about to swallow an egg, it was a complete head that contained a hollow basin. He claimed that a curving pattern on the ground had once joined up with the so-called jaws to form what he called a skull.

That *skull* I saw plainly. It is not raised like the parts restored by Putnam; but the grass has a different shade of green (indicating a different soil) on a spot with a sharply defined outline and perfectly symmetrical form, extending from near the edge of the precipice, where the soil has been washed away, and continued backward by two symmetrical curves, corresponding to the curves of the so-called “jaw” of the snake, to which they, no doubt, were joined originally (Lindahl quoted in Randall 1907).

W. H. Holmes of the Smithsonian Institution was equally intrigued by the serpent’s head and his drawing seems to substantiate the design idea proposed by Lindahl (Randall 1907). The true design of this earthwork may now be lost, however, there is enough left to appreciate the skill and effort needed for its construction.

### **Markings on the Land**

#### ***Nazca Lines, Peru*** Images 79, 80 and 81

[Note: in current literature there are two spellings – Nazca and Nasca. For consistency, Nazca will be used in this thesis.]

Situated in the desert coastal region of Peru, around 400 kilometres south of Lima, the giant land markings have been created on flat plateaus called ‘pampas’ on the extension of the western slopes of the Andes. This is a region with no significant rainfall; the only water comes from small rivers originating in the high mountains. Therefore there is little natural vegetation on the plateaus which consist mostly of sand, gravel and small rocks (Grün, Bär & Beutner 2000).

Over 1,000 geoglyphs have been noted by researchers, extending over an area of many hundreds of square kilometres, although it is also known that many have been ruined through natural occurrences and human interference. In 1994 the World Heritage Centre of UNESCO placed the geoglyphs contained within a 450 square kilometre area on the World Heritage List to help protect them (UNESCO 2009).

The variety of patterns and figures that have been surveyed include:

long straight lines, star-shaped arrangements, geometrical elements like triangles, trapezoids, rectangles, spirals, double spirals, zigzag lines, meandering lines, biomorphic figures (human-like, animals, plants) and patterns that are hard to interpret as anything realistic; dog, anteater, condor, hummingbird, parrot, chaucato, flamingo, frigate bird, pelican, snake, spider, lizard, dragonfly and plant-like species such as tree, flower, spices etc (Grün et al 2000).

Other strange creatures have a cat's head and the tail of a fish, while some seem to be half animal and half plant. Some appear to have conceptual elements, such as a bird with a very large zigzag neck.. A detailed study of South American birds showed that it could possibly be an Anhinga, a coastal fish-eating bird noted for diving in a zigzag pattern (Aveni 2000).

These images, created by removing the small stones from the ground to reveal a lighter surface beneath, can be up to 300 metres in length and 'are made of one continuous line that never crosses itself and is never broken' (MacNamara 1993). The large scale of these drawings means that they can only be seen from nearby high peaks or, in many cases, being airborne is necessary for viewing. So to the mystery of why they were made can be added *how were they drawn so large?*

Dating these lines has proved difficult, although common attribution has been given to the Nazca people who lived in the area about 2,200 years ago. The Nazca culture lasted about 800 years when it is thought that extreme aridity brought it to an end and the region around Palpa was all but abandoned for the next 400 years (Reindel & Grün 2006).

An extensive project to record the geoglyphs within the contours of their environment in three dimensions by photogrammetric means was started with photo flights in 1997 (Grün et al 2000). Results from this project have shown that:

Geoglyphs are located where topography admits. There is a strong correlation between geoglyphs and topography. Geoglyphs are crowded in vast, flat areas and on smooth slopes. Geoglyphs are overlaying each other. Therefore the builders were not very respectful of previous works (Grün et al 2000).

On this last point, Aveni (2000) proposed that the lines may be representing two separate and unrelated time scales of construction.

The Nazca markings may have had many functions for their creators that we will never know about but there is a clear indication that the land itself was of great significance in their lives. The artist Robert Morris (1975) who became prominent in the Land Art movement of the 1970s wrote an extensive diary of his visit to the Nazca Plateau and described the partnership of the Nazca people with the land as a 'unique cooperation' with the environment. He put forward the view that the lines could be seen as large scale public art and noted that their horizontal form on the flatness of the earth set them apart from other forms of land intervention that had vertical form and tended to confront and dominate the people.

Morris (1975) also put forward the opinion that the Nazca people must have felt the physical space as an indeterminate exterior with the markings reflective of the palpable emptiness that is often common to contemporary artwork. His idea of emptiness, however, is far from universal with Land Artists. The perception of emptiness is part of the cognitive process of the mind, which has the capacity for more imaginative interpretation. Vision, observation and perception bring a personalised order to the world and, according to Gestalt theory; we naturally try and see familiar patterns within unfamiliar environments (Solso 2003). This imaginative interpretation is very much utilised by artists engaged with Land Art.

Martin Kemp (2000) talks of this as the 'aesthetic impulse' that is:

part of the feedback mechanism that reinforces our hugely demanding attempts to make coherent sense of those natural orders with which we can and must work if we are to survive.

For the Nazca people their perception of the world based on their own knowledge resulted in monumental lines and images that are a mystery to us today. Nevertheless, the observation of these lines can leave no doubt about their aesthetic content.

*The White Horse at Uffington, UK Image 82*

The land drawing of a white horse near the village of Uffington, Oxfordshire, UK, is noted for its size and abstracted form. It is 114 metres in length and of an entirely different design to other, later, horse renderings in the UK which tend to be more solid and naturalistic (Wiltshire White Horses 2009).

The Uffington White Horse has an almost skeletal appearance with a slim elongated body and front legs disproportionately thin. Its head is in outline and appears to be almost separated from its neck, while one front and one back leg are detached from its body. Despite these abstractions it reads as a horse, although there has been some debate that it may originally have represented another creature (Wiltshire White Horses 2009).

The image was formed by cutting trenches into the hill and filling them with chalk. Interestingly, the image was not formed on the steepest part of the hill slope, which would have provided the best view from nearby, but on a shallower slope near the top. As a result it can only be viewed well from a distance, where it appears a lot smaller and somewhat distorted or, like the Nazca Lines, from some considerable height above it

The White Horse is not a feature in isolation. The area around it incorporates a Neolithic long mound, a number of early Bronze Age round barrows and a hilltop enclosure of a probably late Bronze Age date (Gosden & Lock 1998).

The age of the White Horse itself was, until recently, thought to be much later than these other ancient sites but a dating technique known as Optically Stimulated Luminescence has placed its age at somewhere between 2,600 and 3,400 years old (Schwyzer 1999).

The fact that the White Horse is still visible today is proof that, since the time of its creation, it has seldom been neglected. Its survival has relied on periodic weeding and maintenance, an act traditionally known as scouring (Schwyzer 1999).

Records from 1755 show that this scouring took place at intervals of between 4 and 21 years, (Schwyzer 1999) however, it is not certain this timeframe extends back to the period it was made or that this regular maintenance has not distorted the original form, something that seems likely.

Gosden and Lock (1998) propose that the regular cycle of scouring maintained social relationships where people were connected to their environment as well as strengthening their ties to a known past.

### **Carved Sculptures**

#### ***Easter Island, South Pacific Images 83, 84***

Easter Island, Rapa Nui being its local name, measures just 170 square kilometres. At over 1,000 kilometres from the coast of Chile and 2,200 kilometres from New Zealand it is one of the most remote islands in the Pacific. It was named Easter Island after the date it was discovered in 1722 by Admiral Jacob Roggeveen of the Dutch West India Company. The island is home to large carved stone figures, referred to by the local population as Moai, of which around 600 still survive (Hicks 1993). Carved from the volcanic rock of the island, they range in height from around four metres to 12 metres and were erected in groups at various positions on the island.

There is evidence that their abstracted faces once had eyes made from white coral with red tufa irises (MacNamara 1993). Their form is unusual for figurative sculpture, for none seem to have any legs, their torso usually sited on a low stone plinth, their arms, if they have any, are straight by their sides. On their heads were placed a pukao or redstone topknot (Pick 1979). Some dating of these figures has been undertaken which suggests they were carved and set up between 1,000 and 500 years ago (Hamilton 2008) but their exact meaning is not known, although there are many myths associated with them.

Jacob Bronowski (1976) writes that people ask the wrong questions about these figures. They want to know why they were carved in this form and how were they transported? He states that the critical question about the figures is ‘Why were they all made alike?’ There is no definitive answer to this but what can be said is that the effort required to quarry the stone with only primitive tools, carve the figures then move and establish them into their positions must indicate a significant meaning to the people who created them.

### **COMMENT**

Ancient land interventions have been shown to have existed for over 5,000 years. These forms of human expression are differentiated from others of everyday life, for example dwellings or burial places, by the fact that there is no obvious reason for their existence other than the representation of cultural ideas or aesthetic constructions. John Beardsley

(1998) comments on people's engagement with their environment in such a way as to be 'in many respects equal in importance to the relationship to the sacred'.

The human effort required to construct many of these ancient forms clearly underlines their importance to the people associated with them. Also the care and skill in their design and fabrication, the selection of sites and maintenance over extended periods provides an indication of an aesthetic intent.

Myth and ritual may well have played a part in the concept for these forms but there is no obvious reason why, in an age of limited engineering facilities, they needed to be made so large, as the Nazca Lines, or require enormous stones to be moved hundreds of kilometres, such as the bluestones of Stonehenge or such major excavations as the ditch at the Avebury complex or the major construction of Silbury Hill.

Land Artists today build monumental forms in isolated areas but, of course, they have the help of cranes and bulldozers. Tiberghien (1995) undertakes some analysis of size in his book on Land Art and concludes that:

The larger the object and the more space it requires, the more our relationship to it becomes public. The [large] size of the works forbids any private relationship with them.

Could it be that the large size of some of these ancient forms was to intentionally utilise this idea to reinforce a sense of meaning for the whole community? Unfortunately, we can only speculate on an answer to this, but we can look at the scale of the works in relation to the effort needed to build them and the environment in which they were created. Scale provides a definite indication of aesthetic intent and, as Robert Smithson (1979) stated in his writing on *Spiral Jetty*: 'Size determines an object, but scale determines art'.

Andrew Rogers, an Australian artist who constructs giant geoglyphs in remote areas around the world, also comments on the relevance of scale in his own artworks, especially in very open environments. He states that the artwork has to be large to obtain scale 'against the dome of the sky and the vastness of the landscape' (Rogers quoted in Taylor 2004).

## **ART IN THE LAND OF ACHAEOLOGY**

It would be evident from the images accompanying the previous section of this chapter that many of these land interventions are in partial or total ruin. Attempts at restoration, although undertaken with the best of intentions, are often informed more by the restorer's perception of the structure rather than by archaeology. This was the case in the past when enthusiastic and wealthy antiquarians, having purchased sites such as Stonehenge and Avebury, set about transforming the ruins. This has changed in the last few decades as archaeologists take a different stance.

Newgrange in Ireland (see Images 66 and 67) is probably one of the finest-looking restorations of an ancient site and was undertaken between 1962 and 1979 by Michael O'Kelly (Mitchell 2001). However, in order to transform it to its present immaculate state, a large proportion of the mound was demolished and reconstructed using modern building techniques and materials. Many of the passage stones were repositioned and the roof box, which allows the mid-winter sun-rise to penetrate to the back of the chamber, was rebuilt but this destroyed the original alignment. In some quarters, the restoration is now regretted (Mitchell 2001).

There is now widespread debate in archaeological circles on future methods of practice and philosophical stance. This debate is summarised in the publication by English Heritage in the research agenda for Avebury:

For some interests, past destruction may already have precluded the pursuit of some lines of research; for some, nothing less than total preservation of what remains will suffice; for others, a more modest level of preservation will be required (Chadburn & Pomeroy-Kellinger 2000).

The way archaeology is conducted and the interpretation of results has an impact, to some degree, on the primary aim of this section of the thesis. That is to make a case for some ancient land interventions to be classified as Land Art. To achieve this, an appropriate theory of art needs to mesh with archaeological objectivity regarding ancient monuments.

That such objectivity is evident in archaeology has been questioned by a new breed of archaeologists. Shanks and Tilley (1996), in their book *Re-constructing Archaeology*, which they acknowledge is controversial, comment on the interpretation or explanation of the archaeological record.

Argument has raged for at least the past twenty years to what archaeology should be – an historical discipline producing a description of what happened in the past, a science of human behaviour, a science of ‘culture process’ or a science of the traces of the past themselves in the archaeological record. Concern has also been focussed on ideological distortion of the past for present purposes.

Watson (2004) observes that archaeological recording by photographs and plans with substantial features abstracted into cartographic symbols, fails to capture any sense of scale or materiality and imply a fixed and rigid phenomenon that is static and silent.

There is, however, a new line of thinking from a younger generation of archaeologists who take a more comprehensive view of the past (Shanks & Tilley 1996; Trubshaw 2005). Gillings and Pollard (2004) also comment on this change of approach by observing that, among many archaeologists, is ‘a growing openness to other views and perspectives’.

In relation to the experiences created within the spaces of the Avebury complex, Watson (2001) engages with these new perspectives by writing about the aesthetic characteristics of such sites, concluding that they are the ‘ultimate expression of the aesthetic relations between people and the world in which they lived’.

An archaeological project conducted under the auspices of University College, London, at Lesternick on Bodmin Moor, Cornwall, UK, expands on this aesthetic idea. The research area of the project is described as a late-Neolithic stone structure and an early Bronze Age settlement (Bender, Hamilton & Tilley 1997).

The area is naturally stony and the surrounding topographic feature of the landscape is one of dramatic rocky tors. The excavation site contains the remains of two settlements consisting of clusters of circular houses nested into the western and southern slopes of the hill. The pre-historic inhabitants of these settlements created the lower structure of their houses from stone and these were surrounded by compounds and stone walls. Within the walls of houses and boundary walls were incorporated significantly different stones – they were termed ‘cultural’ stones by the archaeologists. They commented that:

We can easily recognise aesthetic effects and ‘artistic’ qualities in the arrangements of stones within the houses and boundary walls; different shapes, sizes, masses, textures, juxtapositions and superimposition (Bender, Hamilton & Tilley 1999).

The archaeological team became aware of the intense relationship of the people with their environment when they discovered there was an alignment with a cultural stone at the rear of each dwelling, and the single doorway of every house towards the view of a distant tor or cairn. *Image 85*.

These people produced a large number of small stone cairns and emphasised free-standing stones by clearing the area around them. A stone structure was also discovered near the site consisting of a large stone row over 300 metres long with two stone circles and a large cairn (Tilley, Hamilton, Harrison & Anderson 2000). After several years of working on the project the archaeologists concluded that they moved ‘from the concept of a nested landscape to that of nested art in the landscape’ (Bender et al 1999).

Inspired by the works of contemporary artists working in the environment, especially the fabric wrapping works of Christo and Jeanne-Claude and the stone installations of Andy Goldsworthy, the team devised interventions at the site in response to the creativity of the original builders.

This was manifested by:

- Physically transforming and adding to the surface structures of the hill by wrapping stones and creating installations. The stone wrapping entailed covering what were thought to be prominent stones with cling film and painting them white. This revealed a deliberate patterning of the landscape by the Lesternick people.
- Materialising surface activities by placing markers and flags on poles in the landscape to make connections between places.
- Constructing visual representations of their perceptions/understandings of the site and their own activities (Bender et al 1999).

This, they claimed, was to address their concern with the poetics and the aesthetics of a study of the past to enrich the understanding and meanings of a particular place and particular landscape.

It is alongside these more contemporary ideas of archaeology and the defining of how ancient people may have thought and interacted with their environment and the structures they built, that a case will be made for ancient land interventions to be interpreted as Land Art.

## **RECORDING AND INTERPRETATION OF ANCIENT LAND INTERVENTIONS**

The previous section of this chapter covered the changing attitude of some archaeologists towards the interpretation of the fieldwork they undertake. One aspect of these changing attitudes is to highlight previous unease with defining how ancient people may have experienced or thought about the structures they built (Watson 2001).

The way that ancient structures, and the people of these times, are interpreted and subsequently written about can render the past static and lifeless resulting in what Watson (2004) terms ‘disembodied perspectives’ where the documentation is not related to the physical experience of the sites.

Dixon (1982) comments along these lines by declaring that subjecting ancient structures to the taxonomies of history can tend to render them ‘humanly irrelevant’ instead of their being viewed as aesthetic objects created by people contending with their world and their environment as they saw it.

This last point is important when making an appraisal of ancient land interventions, for the people would have had a different perception of their world than we do of ours (Watson 2004). Also, it cannot be assumed that they would understand art as it is perceived today:

(T)he very concept of art is arguably as much a philosophical – or at any rate intellectual – invention as that of the aesthetic (Scruton 2007).

However, this should not be taken as a statement that the people of 5,000 years ago had no understanding of design, art and aesthetics; merely that they probably had no words or theories for these concepts. Trubshaw (2005) points out that archaeologists have recently begun to acknowledge that the thinking of these people was far more sophisticated than had previously been recognised.

The building of the larger structures would have taken a knowledge of mathematics, design, basic engineering, communication and, it could be claimed, some political skills to be able to maintain the enthusiasm of a large workforce over decades or sometimes centuries. Provisions for this workforce would have required an organising body for administrative purposes. There is evidence that some of these structures incorporated astronomical alignments, so there must also have been people conversant with fundamental astronomy.

The sophisticated enterprise of these people has to be borne in mind when considering the structures they built; land interventions over time have been subjected to the vagaries of weather, subsidence and human interference which altered their appearance and character. There is, though, enough left for examination and with computer modelling a virtual reconstruction can sometimes be achieved.

This still does not solve the mystery of what these structures were used for (Burl 1981; Chadburn et al 2000; Trubshaw 2005).

Before considering contemporary theories of art that may provide a basis for defining these ancient land interventions as Land Art, a summary of the previous points is in order:

- Ancient land interventions have often been recorded in purely descriptive terms that isolate them from their environment.
- The creators of these structures would have had a different perception of the world from us today.
- Our present day concepts of art would probably not be recognised by the builders of ancient land interventions.
- Some people within these ancient communities would have had the skills to conceive and design these structures and, within the group, would have been the necessary technological skills to obtain the materials and construct the form.
- In the absence of written records there is no consensus among archaeologists as to why these structures were built or what they were used for.

Regarding this last point, a lack of consensus does not mean there is a lack of theories. Writing about structures in the Avebury area, Cleal (2000a) notes that, even though their original motive for construction is obscure, there is a continuing change of meaning designated to them.

These will have varied from, perhaps, their origins being ascribed to natural forces, or to supernatural ones, or the ascription to them of associations with the spiritual which may be quite different to their primary associations.

Molyneux and Vitebsky (2001) add, in relation to standing stone monuments generally, that:

Almost inevitably, folk legends have crowded around them – as they always do around a monument once its purpose has been forgotten.

### **THEORETICAL BASIS FOR DESCRIBING ANCIENT LAND INTERVENTIONS AS LAND ART**

Before undertaking an analysis of art theories it must be recognised that, as far as is known, people of this era would not have had a concept of art as it is known today, so it is unlikely they themselves would have designated such a term to their structures. But it is important to the following debate to note that what has been written about in terms of Land Art is recognised as such only within the context of Western art theories. There would, no doubt, be many cultures today that would find difficulty comprehending many Land Art creations. This, however, should not imply that these cultures have no art; they may have a different concept of art and have no word for this that accurately translates as ‘art’ in Western terms.

This poses the basic question: Can ancient land interventions be considered works of art when the people who made them probably did not have a concept for art as defined in current Western terms?

Lopes (2007) covers two theories that are relevant to this specific question. One he calls ‘incidental art’:

A work of incidental art is art but it did not come to be art accidentally and it was not intended as art.

The basis for this line of reasoning is that something could be made for a very specific and special purpose, such as for a ritual. In making this special ritual object, elements by which we would define an artwork are incorporated in the object, not with the intention of making an artwork, but with the intention of making something special. If, in a later time, we designate this ritual object an artwork it becomes so ‘incidentally’ to the maker’s

intention for the object. It does not become an artwork by accident because there was always intent to make something special. This scenario tends to support a case that, if the maker had a concept for something 'special', it may coincide with a concept of art for that type of object today.

Lind (1992) commenting on the claim by the American philosopher Arthur Danto that 'not everything can be an artwork at every time' states that, something in one time that is not recognised as art but in a later time is regarded as such, could be said to have always been art, just 'unappreciated art'.

The second theory that Lopes (2007) discusses questions the universality of the term 'art'.

If art is not just what Westerners have a concept of, then theorists must look beyond Western art to ascertain the nature of art. They cannot assume that the nature of art is determined by the Western concept of art.

This, he claims, implies a cultural relativism about art. If the people of prehistory had a concept for something 'special' or 'significantly different' then this could be assumed to work as a concept for art in their time and in their culture. This theory implies that long passages of time cannot only separate cultural differences, but can also question the relevance of contemporary Western theories of art in relation to ancient land interventions.

Kamber (1993) also reflects on the Western concept of art when he poses the question of 'whether there could be works of art if there were no art world?' His emphatic response is 'yes'. This, he claims, underscores the divergence between his definition of the term 'art' and strictly institutional theories. To accept institutional theories is to accept that nothing was art until an art world arose to proclaim it art. This, he says, 'is to confuse the event of labelling with the product being labelled. Art was being made and used before there was an art world.'

A view from the art side of the debate comes from internationally recognised English artist Antony Gormley (2004), whose work encompasses various environments. Speaking at a Symposium on Archaeology and Art and commenting on his view of ancient artefacts to an audience formed mostly of archaeologists, he said:

I know a lot of the time you spend attempting to define what the specific purpose of this artefact was, and how it was used and how it carries the sense of the culture which gave rise to it. I admire this in the discipline of archaeology. But I also admire the way that objects can communicate directly over vast areas of time

Continuing on potential interaction between the art world and archaeology, he commented that:

the art world is a very self-serving and somewhat isolated part of the world at large. I suppose I look at the cultures that many of you are studying and looking at and wonder whether this word 'art' isn't itself a bit of a problem (Gormley 2004).

Referencing all of the above, two propositions can be made. Prehistoric monuments may well have been perceived by at least some of the people of the time as artworks according to their own concepts of something 'special' or 'significantly different'. Secondly, apart from institutional theories of art, there may be contemporary theories that can cross the gulf of time and make an assessment of ancient land interventions, even though there is no written evidence from the time to indicate exactly what these land interventions represented or were used for.

The institutional theories of art are rejected as inappropriate for determining if ancient land interventions can be classified as Land Art as we understand that term today. However, before moving on, an elaboration of institutional theories is in order to clarify exactly what is being rejected and why.

Mattick (1993) gives an account of the history of Western art from whence the institutional theories developed. He relates that in the 15<sup>th</sup> and 16<sup>th</sup> centuries artists began to distance themselves from the manual crafts with which they had been associated, to pursue a re-definition of their 'creative genius', which was achieved to some degree in the latter part of the 18<sup>th</sup> century.

Artists at this time became part of what was known as the 'Modern System of the Arts which canonized certain art forms'. These included painting, sculpture, architecture, poetry and music and were referred to as the 'Fine Arts' (Zangwill 2002; Scruton 2007). Contemporary artists have not felt the need to necessarily conform to the concepts that underpinned these designations so, to avoid challenges from artists pushing the

boundaries, the art world produced theories which could accommodate progressive practices within the now well-established institution.

Kamber (1993) summarises this art world in its broadest sense as consisting of:

institutions, organizations, professions and professionals whose principle work is to produce, present, study or critique any of the fine or performing arts

To focus this description towards professionalism he continues that this is taken to include:

only those institutions, organizations, professions and professionals who command some influence and respect in their chosen art form (Kamber 1993).

But Kamber (1993) also states that, in his opinion, art does not need to be defined in terms of this art world and that association with this art world is not a condition for something being art.

In the Western world the art institutions and their theories have become the dominant arbiter of what is art and what is not. They attempt to maintain this position by what may be termed hierarchical theories of art. Lopes (2007) summarises George Dickie's institutional version of art as:

an item counts as art only if it is an artefact made by an artist who intends it for presentation as art to an art world public whose members recognize that it is so presented.

This implies that nothing is an artwork until it is presented as such by the artist and accepted as such by the art world. It should be noted that not everyone in the art world as previously described, or all artists who see themselves as part of this art world, would agree with this definition without reservations. As Lopes (2007) states 'Institutional theories of art are controversial'.

But on the basis that it fundamentally reflects the main stance of the institutional art world, it needs to be bypassed in relation to accessing ancient land interventions on several counts. First, it is not known who formed the concept, developed the concept design, or built any particular land intervention. Therefore, it cannot be assumed that they would have considered themselves artists even if they were familiar with our concept of

such. Second, their creations could not have been intended for an art world public because, as far as is known, no art world existed at that time. Third, it is not known what these land interventions were intended for, so it cannot be assumed they were made to be art, even though in their own time they may have been considered ‘special’ as discussed previously.

Agreeing with Kamber’s assertion (1993) that association with this institutional art world is not a prerequisite for something being art; other theories can be examined that reflect more on the artefact than on the motive of the maker.

There are a multitude of theories on art coming from various theoretical areas such as psychology, philosophy, semiotics, aesthetics, and constructive ideas from archaeology and science.

Robert Solso (2003) goes back to basics with his observations on human cognition and the visual arts. In noting that there is ‘a remarkable co-evolution of the brain, consciousness, cultural developments, and art’ he states that:

Art is a perception consciously experienced and defined by human beings as aesthetic. A further attribute of art is that it is interpreted in some way as being representational or symbolic.

Solso’s research (2003) on cognition encompasses the development of consciousness, which he says arose in humans in its current state about 60,000 to 30,000 years ago and was essential for the evolution of art.

Bearing this in mind along with his previous statement regarding aesthetics, it can be argued that, in aesthetic theories, it may be possible to analyse ancient land interventions from an arts perspective. Aesthetic theories also seem appropriate when considering what there is to analyse. As previously stated, most ancient land interventions are not in their original state; they are, for the most part, ruins. Some have undergone a measure of restoration but not all restorations have been appropriately undertaken. With no written text available it is not known who the artist/concept originator was or the intent in building the structures. These last two points pose a serious problem with many art theories, while the condition of the structures potentially handicaps an analysis using aesthetic theories. However, with a more innovative approach to these sites by

contemporary archaeologists and the help of computer reconstructions, aesthetic theories focusing on visual interpretation are the best option in these particular cases.

The term aesthetics is derived from the Greek word 'aesthesis' that 'denoted the study of sense experience generally' (Speake 1984). Curt Ducasse (1966), in his book *The Philosophy of Art* interprets the word as 'perceptive, or fitted to be perceived'; while Catriona Moore (2007) bridges the previous two definitions by describing the original meaning as 'perception through the senses'. Roger Scruton (2007) emphasises that the meaning is dependent on context and can relate to sensation, perception or feeling.

In the mid 18<sup>th</sup> century the German philosopher Alexander Baumgarten wrote his (unfinished) *Aesthetica* that references the idea of beauty in nature and art. In 1790 another German philosopher, Immanuel Kant, wrote his *Critique of Judgement* in which he explored the concept of aesthetic judgement, a device, he claimed, provided 'the essential focus for connecting the theoretical and practical aspects of our nature' (Speake 1984).

At a more scientific level Ingar Brinck (2007) uses the theory of situated cognition to discuss the aesthetic experience:

Although any aesthetic experience will be specific to a particular viewer and a particular artwork, it nonetheless will involve a universal element that is shared among viewers, because it is biologically grounded.

The theory claims that perception is embodied and happens *in* the body and not by way of the body.

This is to say that the body, on a subpersonal level that is independent of conscious awareness, actively modulates perception in determining which information will be picked up, when and how (Brinck 2007).

It is a theory that presents cognitive processes, including the aesthetic experience, as part of environment and surrounding context. Brinck (2007) also points out that, although vision is prominent, as in other aesthetic theories, perceptual processing in this regard also incorporates hearing, touch, smell and taste. This incorporation of other senses apart from vision is included in theories by some aesthetic philosophers quoted in Chapter 3, Land Art.

Sometime before Brinck's publication, Richard Kamber (1993), who reasons that aesthetics is psychologically based, arrived at a definition of aesthetics that incorporates many of the above points. His definition is:

One's response to an object, event or design is aesthetic if and only if one is responding at least in part to the way it looks, sounds, feels, smells or 'reads', and not just to some other things, purpose, or some part of one's own body to which that object, event or design calls attention.

Kamber (1993) makes it clear in his writing that use of the term 'aesthetic' does not 'require that there be such a thing as a work of art'. The essence of an artwork, according to his definition, is that the intent behind its creation is to cause, at least in part, an aesthetic interest of some intensity.

Solso's writings (2003) about the human experience of art from the perspective of the sensory-cognitive system include what he refers to as directed perception. This incorporates an individual's personal history and knowledge from past experiences into their own perception of the world. This concept promotes the theory that, as individuals, we live in a world that our personal mind has constructed as rational, but that our individual histories and genetic predispositions create differences in our perceptions of what might be interpreted as art.

It cannot be known for sure how ancient people interpreted the structures that they built but we do know, through the new findings in cognitive research, that their personal perception of the world around them was constructed in their minds neurologically the same way ours is today. In other words, if we find ancient land interventions provide an aesthetic experience, it is very likely that at least some of the people of that period had a similar experience. Even today, in their ruined state, many of these land interventions induce an aesthetic response from an interested viewer (Crawford 1983).

However, aesthetic theories overall require more than just an aesthetic response to an object to justify the term 'artwork'.

Amie Thomasson (2005) writing on the ontology of art makes the observation that the various positions on aesthetics 'seem to be an embarrassment of riches, for it is not clear how to decide among these apparently mutually incompatible and often surprising views'

This is readily apparent when reviewing the literature on aesthetics, but this chapter is solely concerned with presenting a case for some ancient land interventions to be viewed as works of artistic endeavour, as contemporary Land Art would be viewed today. It could be argued that had they been constructed at any time after the mid-1960s when Land Art became prominent, they would be readily accepted as such on the basis at least that they resembled what was being constructed by the artists who engaged in this type of work.

However, Thomasson (2005) queries this avenue of reasoning:

Resemblance is also not a plausible demarcating feature, since everything resembles everything in so many ways that this is useless as a unifying criterion without specifying the *sorts* of resemblance that are relevant to belonging to the same art-kind.

Accepting that this is the case, an aesthetic theory would recognise the intent of the creator of the work. But, as mentioned earlier in this chapter, this is impossible in relation to prehistoric land interventions. However, Lind (1992) proposes that intent can be replaced with function which ‘refers to what the object actually does, rather than simply what the artist intended’.

Lind expands this idea by stating that in his theory the function of an artwork is to communicate a significant aesthetic object. He uses the verb *communicate* in the sense ‘to make common to many’. Therefore, if something communicates, at a level that can be interpreted as functioning as a significant aesthetic object, it is, by this definition, an artwork.

Lind (1992) gives as an example the Lascaux cave paintings in France, to pose the question – ‘are these artworks?’ His response is:

Their fulfilment of that role, in the absence of controverting evidence, would qualify them as art. Since pre-historical artefacts that happen to be significantly aesthetic objects are generally treated as artworks, our shift from intention to function seems to reflect the way we actually understand the concept of artwork.

Apart from providing a means to access pre-historic objects, Lind states that his theory works just as well with such 20<sup>th</sup> century ‘challenges’ to tradition as Land Art.

If this theory acts as Lind proposes, it could accompany the opening argument by archaeologists Bender, Hamilton and Tilley (1999) in their article ‘Art and the representation of the past’.

We argue that the production of artworks in the present provides much more than a contemporary cultural work. It permits us to actively engage with the past in a new manner and acts as a powerful and empowering means of interpreting the past in the present ... Art and archaeology can act together dialectically to produce a novel conceptualisation of the past that can appeal to different audiences in different ways and produce a means of relating to the past that is considerably more than the sum of its component parts.

John Billingsley (2003) also comments on ancient structures as ‘being in their own way massive site-specific installations’ that:

occupy their place and work on the imagination, secretive agents of change and meaning ... Archaeology in transition to art, and the resulting collaborative landscape creates the potential for change in the viewer-participant.

To make a decisive judgement on whether ancient land interventions can be classified as works of art, or more specifically, pieces of Land Art, the term ‘art’ has to be considered carefully as well as what can be interpreted from the remains of the ancient structures.

Lopes (2007) provides the rationale for considering objects made as ‘special’ or ‘significantly different’ in prehistoric times as containing a concept for art in their own time and culture. Looking at any of the ancient land interventions included in this chapter a claim could be substantiated that they were constructed as something special or to be significantly different from normal everyday buildings. Lind (1992) introduces an aesthetic theory that can be used to interpret ancient land interventions by replacing the originators’ intent, which cannot be known, with the recognition of a function of the structure that aims to communicate a significant aesthetic aspect.

These two theories, in the context of other theories mentioned in this Chapter, can substantiate the claim that ancient land interventions can, indeed, be called artworks and regarded as the genesis of Land Art.

## **SUMMARY**

The aim of this chapter is to give an overview of ancient land interventions and to present a case to justify applying the contemporary term Land Art to them. The object of this is to create a lineage for Land Art that can be referenced for the foundation of Exoart.

The examples cited are a personal choice which, in my opinion, are a representative selection of each of the broad types of ancient land interventions listed at the beginning of the chapter. The sites I have personally visited are: Stonehenge; Avebury monument; Silbury Hill; The Hurlers; Lesternick, all in the UK. Other people, known well to me, have provided me with images and personal accounts of: Newgrange, Ireland; Stenness and Ring of Brodgar standing stones in Scotland; the statues of Easter Island in the Pacific.

These personal accounts and my own experience support the claim by Crawford (1983) that even in their ruined state many of these ancient land interventions induce an aesthetic response within an interested viewer.

An account has been presented on the current shift within archaeology in methods of practice and interpretation of results, which has prompted new writings on the meaning of ancient land interventions. This new approach has also provided an opportunity for other views to be considered and, in this respect, the argument to designate these ancient land interventions a form of Land Art is presented.

It has been stated that people from ancient times would probably not have had a concept of art as is understood today, but to produce many of the ancient land interventions known around the world they would have had to have a concept of something 'special' or 'significantly different'.

An aesthetic theory of art has been proposed in relation to a visual assessment of ancient land interventions with a view to interpreting them as Land Art. This assessment does not preclude other views or interpretations claiming other terms or meanings for these interventions for, as Solso and Brinck point out, perception and therefore views are dependent on personal context.

In the final section several theories appropriate to the discussion on ancient land interventions are reviewed with a focus on the theories of Lopes and Lind. In the final analysis the claim that ancient land interventions can be interpreted as Land Art can be substantiated.

## **CHAPTER 5**

### **SPACE: OBSERVATION AND IMAGINATION**

#### **INTRODUCTION**

This chapter covers the areas of observation of the skies from ancient times to the present day, as well as the portrayal of space and, in particular, the planet Mars in popular culture.

For thousands of years humans have studied the stars and produced cultural artefacts relating to the observable sky. We have pondered the workings of the universe and used imagination to write or tell stories about our cosmic environment. This provides a cultural context for Exoart.

To early humans, the night sky was a place of wonderment that contained the myths and legends of their culture. Later it was recognised as carrying information that was useful in their lives, and then became a puzzle to be solved scientifically. In popular culture it was an area for speculation, portrayed in paintings, books and films.

The human relationship with the stars and solar system is a relationship that can confidently be predicted to extend into the future. Exoart is a new expression of art and culture in this future, yet references the cosmic cultures of the past and present.

The aim of this chapter is to build a picture of human engagement, both cultural and scientific, with our cosmic environment to add to the background and texture of the foundation for Exoart.

#### **EYE TO THE SKY**

In every age and in every place where humans have left records, we see evidence of a marvellous instinct. As soon as societies obtain by their labours even a little product beyond the needs of bare survival, they begin to create arts, to invent gods, to wonder and theorize about the universe (Burke 2008).

We know from structures, artefacts and writing left behind from bygone eras that humans have studied the sky for millennia. In many cultures there are examples of myths and legends concerning the cosmos. For ancient people there appears to be several reasons for studying the sky:

- To identify markers that would indicate seasonal changes. This knowledge would help with agricultural practices and aid awareness of forthcoming changes in their environment.
- To have prior warning of cosmic events associated with superstitions. Examples of these were found on Babylonian clay tablets called Enuma Anu Enlil which are thought to be several thousand years old. These tablets detail omens associated with Moon phases, eclipses and the rising and setting of planets (Marchant 2009).
- For what could be termed scientific enquiry, a search to understand our solar system and the cosmos.

Comets were also believed to be predictors of forthcoming events, mostly undesirable. Over two thousand years ago Chinese astronomers studied comets intensely and observed that the tail always pointed away from the Sun irrespective of the direction in which the comet was travelling. They concluded that this phenomenon must be due to a form of solar energy (Haines & Riley 2004). We now know from evidence gathered by spacecraft, such as from Mariner 2, that this is correct. The energy they observed is the solar wind, the stream of charged particles emitted from the Sun (Sagan 1997).

It is often reported that ancient structures incorporate astronomical alignments or were used as observatories. The oldest known of such monuments is at Goseck in Germany which is claimed to be nearly 7,000 years old. From archaeological excavations it appears to consist of two concentric circles of wooden palisades surrounded by an outer narrow ditch that was around 70 metres in diameter. Within the palisade circles were three openings, or gates, facing south east, south west and north. Adjacent to these gates were earthen walkways across the ditch.

An observer standing in the centre of the inner circle would see the sun through the two southern gates indicating the start of the summer and winter solstices (Boser 2006). This phenomenon has prompted the henge to be described as ‘possibly the world’s oldest solar observatory’ (Boser 2006), however, no astrological reason for the north gate has been found. Although the main function of the henge at Goseck is still open to debate, it is now accepted that, in part at least, solar and possibly lunar observations were integral to its use.

Cosmic observations have been attributed to many ancient structures or, as I have referred to them in Chapter 4, Ancient Land Interventions. Two ancient land interventions that

feature prominently are Stonehenge and Avebury in the UK. An explanation of how Stonehenge aligns to the mid-summer sunrise and the mid-winter sunset is contained in the English Heritage guide book to Stonehenge. In the summer, the sun rises behind the Heel Stone and its rays penetrate into the centre of the henge. In winter the solstice sunset would drop down in the narrow gap between the Great Trilithon stones. It is suggested, and there is some logic in the reasoning, that the winter solstice might have been the main event for these alignments. It not only marked the shortest day, but heralded the gradual return of the light and warmth of summer; a time when crops would be growing and animals would thrive (Richards 2007).

Gillings & Pollard (2004) and Burl (1981) acknowledge research carried out on Avebury regarding solar alignments within the structure of the complex. The problem is that Avebury is so large and originally contained so many stones within its huge bank and ditch that astronomical alignments could, and probably did, occur by chance. Also, many stones are missing so it is difficult to substantiate claims of it being an observatory. Burl, though, does state that arguments for Sun and Moon alignments, as well as Venus which shows as a very bright star, are soundly based.

However, Gillings & Pollard (2004) and Burl (1981) all advocate caution when considering ancient monuments as observatories; Burl points out that a stone circle is not necessarily the best design for an astronomical observatory. Rows of stones would have been more effective for solar alignments or a horse-shoe configuration for calendrical observations. Burl also elaborates on the difficulty of using large bulky stones for alignments, as either side or the top could be used for a sight line. Although he does acknowledge that many entrances to long barrows used for burials and megalithic tombs faced an alignment to the rising sun. This could be taken as indicating that solar movements did have some significance in the thinking of ancient people and that alignments in their structures were not accidental.

Two other examples show that the peoples of America were also tuned to their cosmic environment. The feature known as the Anasazi Sun Dagger is thought to have been constructed by the prehistoric Anasazi people of New Mexico. The feature is situated on a high ledge of Fajada Butte in Chaco Canyon and consists of two carved spirals, one large and one small, on a rock wall. Leaning against this wall at a steep angle are three slender stone slabs that rest above the spirals. At around noon on the summer and winter

solstices as well as the spring and autumn equinoxes, sunlight shines between the slabs producing long daggers of light on the carvings which then indicate the seasons. At the winter solstice, two daggers of light are formed on each side of the large spiral, just touching the outer lines. At the summer solstice one dagger of light is formed which passes through the centre of the large spiral. At the spring and autumn equinoxes two daggers appear, one passing through the centre of the small spiral while the other crosses the large spiral (Hicks 1993).

The other example is the Navaho Indian star charts in Arizona, USA. Local star patterns have been stamped on the ceilings of rock shelters and, according to Lippard (1983) who refers to the shelters as large planetariums, there are at least 32 of these known in the area.

It should not be surprising that prehistoric people would feel more connection to the Sun, Moon and night sky; the Sun and Moon cycles were useful indicators of seasons and, at a time when terrestrial light pollution was unheard of, the night sky would have been awe-inspiring, especially for people who often slept under the stars. *Image 86.*

Such is the case with Australian Aboriginals who have been described as ‘probably the world’s first astronomers’ (Slarke 1996). This statement is based on assessments that Aboriginal people probably inhabited the Australian continent for at least 40,000 years and, during this time, they built up a system of social cultural astronomy (Bhathal 2009).

There is clear evidence from recorded accounts as well as Aboriginals living today that the sky was regarded as part of their environment as much as the land that they walked upon. The environment above them was referred to as Skyworld and played a significant role in their cultural organisation (Clarke 1997).

The night sky, full of stars, would serve as a giant storyboard for the many and varied stories associated with individual groups. This can be illustrated by a recorded discussion with an Aboriginal man from the Lake Albert area of the Lower Murray in 1887. In pointing to a group of stars he stated that to him it was a bush turkey sitting on her eggs. The stars that constituted the eggs are known to us as the Pleiades constellation (Clarke 1997).

In the Greek story the seven stars of the Pleiades were the daughters of Atlas and were pursued by Orion when he fell in love with them. Coincidentally, in many of the Australian Aboriginal stories the stars represent sisters and, in some of these, they are

being chased across the sky. There is an account of several of these stories by Adele Pring (2002). Also a similar story was related to artist Antony Gormley by the traditional owners of the area incorporating Lake Ballard when he was undertaking his artwork *Inside Australia* in Western Australia (Brody 2005).

Alma Nungarrayi Granites is an Australian Aboriginal artist who has painted many night skies. Her Napaljarri-warnu Jukurrpa (Seven Sisters Dreaming) depicts the story of the seven ancestral Napaljarri sisters who are represented by the stars of the Pleiades. In the story, the seven sisters are chased by a Jakamarra man who is in love with them. In order to escape from him the sisters turn themselves into fire and ascend into the sky. At times, the Jakamarra man – the morning star Jukurra-Jukurra - can be seen still chasing the sisters across the night sky (Nungarrayi Granites 2010).

The Pitjantjatjara and Yankunytjatjara people of central Australia relied on the Pleiades making its first dawn appearance (helical rising) to inform them that it was the time of year when Dingos would be giving birth to pups, which they hunted (Curnow 2006). To other groups further north the appearance of the stars Upsilon and Lambda Scorpii in the evening sky was an indication that the wet season was ending and forecast the dry south easterly wind (Bhathal 2009).

Knowing the night sky intimately was essential to Australian Aboriginals when travelling at night. The stars acted as a map so that they always knew the direction in which they were travelling. Understanding the night sky was of such importance it was considered a major part of their education system (Clarke 1997).

Patterns of intaglio dots that resemble star systems were found on the Hornsby Plateau north of Sydney and archaeological surveys of the area have recognised seven occurrences of these dots on what are termed tessellated sandstone pavements. These pavements are within a region that was known to be once occupied by an Aboriginal group. Some of the dot patterns have been interpreted as star patterns of the Southern Cross, Taurus, Corvus, The Pleiades, Orion, Canis Major, Argo and Sagittarius, while other patterns remain unidentified (Branagan & Cairns 1993).

The Australian Aboriginals have been noted for their ability to remember large amounts of data concerning their environment, but in other cultures mnemonic devices are known to have been used, especially regarding sky observations.

A visually impressive ancient astronomical mnemonic device was found in 1999 at the summit of Mittelberg Hill, near the town of Nebra in Germany. Now known as the Sky Disc of Nebra, (*Image 87*), it is a 32 centimetre diameter bronze disc with astronomical features highlighted in gold (Mozel 2003). According to forensic investigation the patina of the bronze disc would have originally been a deep violet colour, making the gold representations of the Sun, Moon and stars stand out almost like the real objects in the sky.

The disc has been dated at around 3,600 years old (Mozel 2003) although some sections, namely the two lateral arcs and the lower pinnate arc, were added at a later date (Schlosser 2005). Possibly as more knowledge was gained these pieces were added to assist with more accurate interpretation. The seven closely arranged stars have been acknowledged as representing the Pleiades group, although they are not in an accurate configuration. The rest of the stars have not been linked to other constellations and are taken to represent a generic starry night sky (Schlosser 2005).

It is conceivable that the original owner of the disc did not require detailed accuracy of the observed sky. The disc may have been a type of mnemonic device that references some form of codification that is highly personalised or culturally specific. A detailed investigation of how the disc was used was undertaken utilising assigned references to the markings as relevant to its found position on Mittelberg Hill. Observing the cycle of the Pleiades using these references produced dates of 10 March and 17 October, which coincide with the beginning and end of the agricultural season in that area (Schlosser 2005). The Sky Disc of Nebra is just one of many prehistoric devices that give a tantalising glimpse of the relevance of astrological observation to these people.

The methods of recording astrological events so that future predictions could be made reached remarkable levels of sophistication, as revealed in the Antikythera mechanism. The device was found in 1900 by sponge divers who had been blown off course by a gale in the Aegean Sea. Finding themselves near an islet called Antikythera they resumed their diving but, instead of sponges, they found an ancient shipwreck. The ship was identified as Roman carrying looted Greek treasures back to Rome when it sank sometime between 70 and 60 BC (Marchant 2008). Among the many treasures recovered from the wreck was a corroded bronze mechanism that contained many gearwheels.

Although large scale gears were developed at least two centuries earlier, with probably the most well-known devices credited to Archimedes, such small fine clockwork gears were not known to have existed around this time. Although there were many attempts to understand the purpose of the mechanism, none was conclusive until recent times when a more scientific diagnosis could be implemented. The device was originally housed in a wooden box estimated to have been 32 centimetres high by 17 centimetres wide. On the side of this box was a small rotating handle that activated the complex gear mechanism which operated revolving pointers on the front and back of the box. It has been established that these pointers revolved around inscribed dials that had accompanying text describing how to interpret the readings.

It is now recognised that the Antikythera mechanism is a device that could chart the changing positions of the Sun, Moon and planets. It showed the phases of the Moon and could determine eclipses to a high degree of accuracy. Other dials showed a repeating 19 year calendar which reflected the 235 lunar months that fit almost exactly into 19 solar years. Inscriptions also detailed the movement of stars for any given time that was dialled into the device. Turning the handle allowed the viewer to see cosmic events in the past and well into the future with a precision unheard of before the discovery of this device (Marchant 2008 and 2009).

Careful observations of the sky probably prompted people in ancient times to build structures and devices that utilised what they saw. With varying degrees of accuracy, cultures around the world devised means of predicting or using cosmic events for reasons including the foretelling of omens and the sowing and harvesting of crops. Many eyes, across many continents, over thousands of years, surveyed and recorded the environment above them. The Sun, Moon, the planets and stars were a reality that could be constantly seen; they reacted in certain ways and had observable consequences which, if predicted, could be advantageous. However, for some astronomers this was not enough and so began a quest to discover not only what cosmic events would happen in the future but why they would happen. They wanted to know how the observable universe worked.

One of the first recorded documents that details a theory based on years of continual observation and calculation came from the Greek mathematician Aristarchus. Living around 310 to 250 BC his work *On the sizes and distances of the Sun and Moon* involved

18 propositions, from which his most well-known results concerned the distance of the Earth to the Sun as well as an estimate of the size of the Sun.

Using geometry, he calculated the distance to the Sun in measurements of Earth to Moon distance. The result he arrived at was that the Sun was 19 times further away from the Earth than the distance from the Earth to the Moon (this figure is actually around 390). He also calculated that the Sun was seven times larger than the Earth. This figure is also wrong as the diameter of the Sun is around 109 times that of Earth.

Even though Aristarchus was inaccurate with his calculations, his conclusion that it was more likely that the Earth, as the smaller body, went around the Sun was correct. This is the first known recording of what was to be later termed the heliocentric model of the universe (Bartusiak 2004).

However, the accepted view at the time was for a model where the Earth was stationary at the centre of the universe, with the five observable planets (Mercury, Venus, Mars, Jupiter and Saturn), or wandering stars as they were known, plus the Sun and Moon revolving around it. The background of stars, it was thought, were attached to a hemisphere whose boundary was just beyond Saturn (Tillett 2002). This geocentric model of the universe could account for most of the observable cosmic events to the satisfaction of other sky observers, and was eminently acceptable to the rulers who liked the idea that their gods created the earthly world at the centre of everything. The Aristarchus heliocentric idea would not be seriously revisited until early 1500 by Nicolaus Copernicus.

A century after Aristarchus another Greek astronomer, Hipparchus, produced the first major star chart by listing and identifying the position of about 850 stars. In conjunction with this work he also classified the apparent brightness of the stars he observed (Tillett 2002). Through this undertaking Hipparchus noted that, over time, the entire celestial sphere shifted in relation to the Earth. He observed the positions of constellations in the sky on a particular day were not in exactly the same position on the same day one year later. He estimated this movement to be one degree every one hundred years (Bartusiak 2004). Considering the elementary measuring equipment they had available at the time this is a remarkable observation and one that is not too inaccurate - the actual figure is one degree every 72 years. The reason for this movement is because the Earth has a slight wobble in its rotation, with its axis tracing a circle instead of being a fixed point. It takes the Earth 26,000 years to complete one revolution of this circle (Bartusiak 2004).

However, Hipparchus could not have resolved this phenomenon because the geocentric model dictated that the Earth was not in motion.

Hipparchus has been credited with many more celestial discoveries, but much of his original work has been lost. What is known of him comes mostly from the writings of Claudius Ptolemy, an astronomer in Alexandria in the second century AD.

Ptolemy, like Hipparchus, accepted the geocentric model of the universe and spent much of his time endeavouring to make the model work. As more observations were made and recorded and the general body of astronomical and mathematical knowledge grew, so the model presented more and more problems.

One of the main difficulties was the movement of the planets in the sky, which appeared to have a looped path. In the case of Mars, this phenomenon is particularly noticeable on its passage through the sky, with the effect showing as if the planet comes to a halt, then for several weeks reverses its direction, before resuming its original eastward motion. It is known today as retrograde motion, which happens when Earth passes Mars as they orbit the sun at different speeds. Ptolemy developed an innovative cosmic model to account for this and other conflicting observations but his model had to be continually modified as more accurate observations revealed more inconsistencies (Aveni 2008).

It could be concluded from this brief account of ancient astronomy that the few prominent astronomers mentioned were working in comparative isolation, but this is not the case. There were many people either assisting with observations or devising new theories to be tested. In Egyptian Alexandria, an academy of Greek learning including astronomy had been established around 300 BC (Tillett 2002). Statistics on cosmic events and the writings of scholars travelled widely throughout Europe and the Middle East and were translated into other languages including Arabic and Latin.

In 813 AD Caliph Al-Ma'mun founded the academy of the 'House of Wisdom' in Baghdad, a place containing an observatory, research centre and library where scholars from different cultures could meet and study and where many of the Greek documents on astronomy were translated. Several middle-eastern astronomers made significant contributions to the growing bank of knowledge including Al-Khwarizmi (780 to 850 AD) who, apart from his astrological writings, is also credited with developing basic algebra and trigonometry. His writings also introduced the Hindu-Arabic numeral system to the

Middle East and Europe making calculations considerably easier (Lachièze-Rey & Luminet 2001).

Between 853 and 929 AD Al-Battani wrote the 'al-Zij al-Sabi' which were the most accurate observational tables of the Sun and Moon at the time. Copernicus was to refer to these tables on numerous occasions in his own writing (Lachièze-Rey & Luminet 2001). Although many new observations were made and theories promoted the geocentric model in one form or another persisted throughout this period.

The first concerted challenge to this theory came from the writings of Nicolaus Copernicus who finished his major work *On the Revolutions of Heavenly Spheres* in 1530. His thesis put the Sun at the centre of the universe and the Earth as another planetary sphere revolving around it. He correctly positioned Mercury and Venus as the inner two planets, Earth as the third from the Sun and also predicted the correct order for Mars, Jupiter and Saturn (still the only known planets at the time). In his writing *On Revolutions* he also calculated that the Earth had a slow gyration around its axis and that it turned on this axis once every day and revolved around the Sun once every year (Hawking 2002).

At this time Europe was very much under the influence of the church who subscribed to the geocentric model of the universe for the same reason as the Greek and Roman rulers. It was dangerous to promote other theories so Copernicus waited for 13 years after writing his major work and was, in fact, dying before he finally published it. He was probably wise in this regard as an Italian scientist, Giordano Bruno, who agreed with the heliocentric model proposed by Copernicus and answered some of the problem areas of the model, ran foul of the Inquisition. Bruno's writings and lectures on this model, plus his views that there may be an infinite number of worlds in the universe, some of which may have intelligent life of a level that could be superior to humans, resulted in his being put on trial. He was subsequently found guilty of heretical beliefs and, in 1600, he was burned at the stake (Hawking 2002).

Although the heliocentric model of the universe was correct and, theoretically, a more robust basis on which to build, it was not overwhelmingly accepted by astronomers and mathematicians, even in circles distant from religious observers.

The most important endorsement of the model after the publication of *On the Revolution of Heavenly Spheres* came from the work and subsequent publications of Johannes Kepler. Kepler, following the astronomer and mathematician Tycho Brahe as the Imperial Mathematician in Prague in 1601, used his skill in mathematics to enhance his astrological observations to underpin the heliocentric model.

Up until this point, the orbits of the planets, either around the Earth or as later proposed, around the Sun, were assumed to be perfectly circular. This assumption was the root problem for many of the mismatches between observations and calculations. Kepler broke away from this and correctly proved that the planets move in elliptical orbits around the Sun. He also calculated the comparative distances of each planet from the Sun with a high degree of accuracy, as well as creating tables that were used to calculate the positions of the planets in their cycles. This work dramatically improved the heliocentric model to match precisely what was being observed in the sky (Tillett 2002).

Kepler also made significant contributions in the field of optics, especially in theoretical models of telescopes. The invention of a working telescope is usually credited to the Dutch spectacle-maker, Hans Lippershey, in 1608. However, spectacle lenses had been in use since the 13<sup>th</sup> century and mathematicians such as Kepler realised that a combination of concave and convex lenses could act as a magnifying instrument (Hanlon 2001).

David Whitehouse (2001) disputes the claim of Lippershey being the creator of the telescope and cites developments in the late 1500s in optics. Whatever the facts are it is known that telescopes started to be produced widely in Europe in the early 1600s.

Lippershey's telescope is claimed to have had a magnifying power of only three. Realising the potential of such an instrument, the Italian mathematician and inventor, Galileo Galilei, who had a good understanding of optics, decided to build his own telescope. He produced a version that had a magnifying power of nine and, within a year, had produced a device with a magnifying power of 30 (Hawking 2002).

Although only comparable to a reasonable pair of binoculars today, these instruments were at the cutting edge of technology at the time. Galileo's telescopes were at first thought of as instruments that would be of use to the navy for sighting enemy ships at a distance; which is how the word originated – from the Greek tele = distant and skopos = watcher (Tillett 2002).

Apart from his many other talents and interests Galileo became involved in astronomy after observing a rare supernova in the night sky in 1604 (Hawking 2002). With his new telescopes, Galileo began observing the night sky. He could clearly see the features of the Moon and many more stars in the constellations than were known before. In January 1610 he trained his telescope on Jupiter and made observations that would eventually end the geocentric model of the universe.

Observing Jupiter, he noticed at first three tiny stars alongside the planet. Over a period of time these stars moved, disappeared and seemingly reappeared on the other side of the planet to be joined by a fourth star. Galileo soon realised that these four points of light were moons revolving around the planet. Today, through images obtained from spacecraft we know of 63 moons orbiting the planet (John 2006) but Galileo's telescope was not strong enough to resolve more than the four largest.

The well theorised geocentric model of the universe stated that all heavenly bodies orbited the Earth exclusively. Four moons, orbiting a planet that was observed to be a world in its own right shattered this basic premise of the model.

Galileo quickly published his findings but omitted to name the four moons he had observed, referring to them as the Medicean stars in honour of Cosimo de' Medici who was part of the powerful Medici family of the time. However, the German astronomer Simon Marius who, it is claimed, discovered the moons of Jupiter independently at around the same time as Galileo, gave them their current names of Io, Europa, Ganymede and Callisto (Hanlon 2001).

The invention and refinement of the telescope completely revolutionised the field of astronomy. Astronomers, keen to make new discoveries, sought more light-gathering and magnifying power from the instruments.

In response to this challenge, some of the glass optics were replaced with mirrors made of a polished alloy called speculum which allowed larger telescopes to be built. But, although more powerful than Galileo's, they brought with them other problems and progress developing them was slow. Even so, in 1781, the English amateur astronomer William Herschel using a seven inch speculum reflector telescope became the first person to discover a new planet in the solar system, the next beyond Saturn named as Uranus

(DeVorkin & Smith 2004). Because of this discovery he was appointed King's Astronomer and went on to build some of the largest telescopes of the time. *Image 88*.

Apart from increases in telescope sizes the next major advance in astronomy came with the development of photography. The major advantages photography provided were to eliminate the subjectivity of the observer and to produce images with more detail than the observer could see. Photographic emulsion can accumulate light over time, something the human eye cannot do. Therefore, photographic plates on a long exposure revealed substantially more of the night sky than the observer could see. Over time, ground-based observatories became more sophisticated, computers replaced the need to physically look through an eyepiece and digital photography has superseded photographic film.

Telescopes today are not confined to the ground, for example, the Hubble Space Telescope was launched into Low Earth Orbit on 24 April 1990. *Image 89*. The 12 tonne telescope is, in fact, five dedicated scientific observational instruments comprising a faint-object camera, a wide-field planetary camera, a faint-object spectrograph, a high-resolution spectrograph and a high speed photometer (DeVorkin & Smith 2004).

When Galileo made his first telescope he had to grind and polish the lenses himself and the only way to communicate what he saw was through hand-drawn sketches available only to a privileged few. *Image 90*. With the Hubble Space Telescope, thousands of people were involved in its conception, design, construction and launch and, because of digital recording, mass media and the World Wide Web, millions of people have seen the images it has captured. *Image 91*.

Today there are numerous space-based observatories looking into the furthest reaches of the universe. The eye to the sky now ranges across the entire electromagnetic spectrum allowing composite imagery that reveals far more of our space environment than the ancient astronomers could have imagined.

The range of observation covers spectral wavelengths in the visible light, Infrared, X-ray and Gamma ray. Those wavelengths outside the visible light spectrum emit large amounts of information about the energetic states of star systems and allow complex investigation into exotic cosmic objects such as quasars, pulsars and black holes. Some of these wavelengths can only be usefully observed outside Earth's atmosphere hence the need to put these specialist eyes into space. *Image 92*.

There are also two other types of observation that are currently taking place from space; microwave detection from the Planck Space Observatory launched in May 2009 and photometer star brightness from the Kepler Space Observatory launched in March 2009.

Both of these observatories have very specialised functions. Planck is monitoring microwave radiation in the cosmic background using sensitive radio receivers. Its objectives are to help determine the nature of dark matter in the universe, to give more precise values to fundamental cosmological parameters, such as the Hubble constant (which concerns the velocity that galaxies are receding from Earth), and to test inflationary models of the universe (ESA 2009c). Kepler is designed to search for planets in the habitable zone of star systems in the Milky Way Galaxy. To do this the telescope will constantly monitor more than 100,000 stars with its 95 megapixel CCD (NASA 2010a).

The James Webb Space Telescope is scheduled for launch in 2014 and is often referred to as the Hubble replacement. Webb is a joint endeavour between the National Aeronautical and Space Administration (NASA), the European Space Agency (ESA) and the Canadian Space Agency (CSA) and will have, at 6.5 metres, the largest primary mirror put into a space telescope. The James Webb will operate in the Infrared and visible range of the electromagnetic spectrum and will be capable of observing the furthest reaches of the universe, as well as studying stars with solar systems capable of supporting life (NASA 2010b).

It is interesting to note that many space observatories and space probes are given the names of people who have made a major contribution in a number of related fields to the particular mission design. For example, the Hubble Space Telescope was named after Edwin Hubble who made many advances in astronomy in the early 1900s (DeVorkin & Smith 2004); the Kepler Space Telescope was named after Johannes Kepler mentioned earlier in this chapter (NASA 2010a). In 2009 the ESA launched the Herschel Infrared Space Observatory named after Sir William Herschel and his sister Caroline Herschel who were both pioneering and successful astronomers in the late 1700s (ESA 2010a). The Planck Microwave Observatory was named after the scientist Max Planck (1858-1947) who won the Nobel Prize for Physics in 1918 (ESA 2009).

Space agencies today are very aware of the history that they are building on, they are also aware that relating their missions to human endeavours is more appealing to the general

public. They need to, and are becoming, more responsive and engaging with the public in an endeavour to show space as something exciting and worthy of observation. It is this current thinking of space agencies that an Exoart project will be able to tap into when engaging with these agencies.

Many artists have engaged with cosmic space as part of their art; some to build on their concepts, others to tell their stories. The Australian Aboriginal artist, Gulumbu Yunupingu, tells of her introduction to the stories of the stars, recognising that they are for everyone. In this respect, her sharing of how she sees the sky is not far removed from the sharing of a technological view of the universe by space agencies. Gulumbu Yunupingu (2010) says:

I found the story of constellations from the sacred songs my father used to sing about them. When we were children, we grew up listening to him sing about them. Every day at dawn he would sing until the sun came up. When he saw the first glow before dawn he would start to sing the Djulpan constellation. He would sing those stars. That is the story that came from him. Well, only a few clans have the right to sing the story of those constellations but it is very sacred to them, to us.

I found it better painting the stars of the universe because it doesn't belong to anybody and is not sacred. Anyone can paint it. The meaning of this, I discovered. It came to my mind. I saw the universe, this place, the earth, the people and the stars. And I thought we are just like the stars, all gathered close together. We are really as one like the stars. We are so many living together on the earth and the land. The sea and the sky are a continuum.

Alma Nungarrayi Granites (2010) is another Aboriginal artist who paints rich images of her star stories. The Napaljarri-warnu Jukurrpa painting (Seven Sisters Dreaming) (*Image 93*) tells the story of the seven Napaljarri sisters, represented by the stars of the Pleiades and the Jampijinpa man, who is in love with the sisters, and represented in the Orion's belt cluster of stars. Also in the painting's story is a Jakamarra man represented by the Morning Star, who is also in love with the sisters and chases them across the sky. Observing the stars helps the people to learn the stories but also the stories help in locating the stars that may be culturally significant or, because of their particular movements in the sky, function in more practical ways. In a similar way being familiar with the discoveries

made in space exploration can help in the awareness of ourselves as space beings in a cosmic environment.

Other artists, like Vincent van Gogh, also made the stars the subject of paintings such as *Starry night over the Rhône* and *The Starry Night. Image 94*. In Chapter 4, Land Art, several artists are mentioned who have produced major installations focusing on the stars. Nancy Holt's *Sun Tunnels* references the four constellations of Draco, Perseus, Columba and Capricorn; Charles Ross uses the northern pole star Polaris as the focus of his work *Star Axis*; Hansjörg Voth references the whole cosmic environment in his work *Sky Stairs* as does James Turrell with his *Roden Crater Project*.

The history of astronomy was Earth-based until the advent of rocket systems capable of lifting telescopes into space; art has also been Earth-based while referencing the solar system and universe, but with approaching human space missions to other planets there is an opportunity for Exoart.

As space agencies seek to engage with the public, Exoart is an artform that also seeks a similar engagement on behalf of art and culture. For, as the next section will show, popular culture has already embraced that engagement.

## **POPULAR CULTURE**

The effects of science, and in particular for this thesis space science on culture and societal perceptions of environments beyond Earth, can in part be gauged by a review of popular science fiction.

Howard McCurdy (2007) writing of the portrayal of spaceflight in the USA suggests that the way people think about their life and times determines the type of world in which they live. He says that 'By imagining space or, more specifically, anticipating the events that will occur there, people may shape their future'.

Technologies related in science fiction may not have a direct relationship with science fact, at least of that particular time, but they can and do stir the imagination of both creators and audience. Ron Miller (2007), writing on the correlation between spaceflight and popular culture proposes that astronautics owes its origins in part to art and literature that explored space travel long before the possibility of spaceflight was taken seriously by scientists.

The first stories of space travel in science fiction literature were primarily focussed on ventures to the Moon. The Moon was a place that was observable as a destination with the naked eye and even early telescopes confirmed it had physical features, mountains and valleys similar to the Earth.

One of the first serious attempts to explore the idea of humans travelling to the Moon was written by Johannes Kepler, mentioned in the previous section of this chapter. Very early in his career Kepler had realised that the heliocentric model of the universe more accurately reflected what was observable in the sky than the geocentric models that were being taught. As an astronomer and mathematician he made many important contributions to the heliocentric model, but it was while he was a student at Tübingen University in Germany that the idea for his story emerged. At this time he was wondering what the cosmic environment, and particularly Earth, would look like from the Moon. He reasoned that by observing Earth from the Moon he would see the planet rotating and changing its position, thus contradicting the theory that the Earth was stationary. His story, entitled *Somnium* translated from the Latin as *The Dream* was worked on over the duration of his career and was published in 1634, four years after his death.

Like other storytellers who followed, Kepler had no scientific theory on how to get to the Moon. In his story he introduced a mythical race who lived on the Moon and had the power, during a lunar eclipse, to travel between the Moon and Earth. It was these strange creatures who were to transport the characters in the story to the Moon.

Despite the almost *Alice in Wonderland* theme, Kepler wrote the story as a way of working through some of his unresolved scientific questions. For instance, he understood that to leave the Earth would take a significant velocity, which was described by the main character as though being shot from a canon. He also speculated that during the journey in space it would be difficult to breathe. Subscribing to the heliocentric model he also understood that, because both the Earth and Moon are in motion, the shortest route to the Moon is not to aim directly at it but to a point ahead, where the Moon will be when the voyagers arrive after a period of time (Christianson 1976).

Although Kepler could not conceive of the technology needed to get to the Moon, he nevertheless believed it was theoretically possible. Today, we know that it is not only theoretically possible but humans have actually done it. Kepler's story and his belief in future space travel set him apart from many other astronomers of his time. There could be

justification in claiming that Kepler's inclusion of scientific thought in his story, which he explained in his copious footnotes, set the benchmark for other science fiction writers to explore what may be feasible rather than revel in sheer fantasy. However, stories that followed, like Francis Godwin's *The Man in the Moon*, 1638, that had the hero carried to the Moon by a flock of geese (Miller 2007) showed that there was inevitably a divide between serious and what would today be called 'pulp' science fiction.

The advent of the balloon as a means of human flight in the late 1700s gave writers a proven technology for launching their characters into the sky – and beyond. Edgar Allan Poe utilised this method to transport his hero to the Moon in his book *The Unparalleled Adventure of one Hans Pfaall* (Pringle et al 1997).

In the many books written by Jules Verne, one entitled *Round the Moon* published in 1870 foretold with reasonable accuracy the Apollo 8 mission to the Moon in 1968. The Apollo 8 mission was a precursor to the later Apollo missions that made a Moon landing. In Verne's story, astronauts are launched from Florida in the USA, successfully flew around the Moon and returned to Earth to finally splash down in the Pacific Ocean (Pringle et al 1997).

Jules Verne's stories were read by a wide general public and notes that he made while writing on subjects, such as the distance of Earth to astronomical points, indicate his intention to integrate facts in his stories. Because of the wide popularity of his writing, the European Space Agency named their first Automated Transfer Vehicle (ATV) the *Jules Verne*. This ATV was designed to supply cargo to the International Space Station (ISS). The *Jules Verne* spacecraft docked with the ISS on 3 April 2008 and, apart from vital supplies for the astronauts, it delivered two of Jules Verne's handwritten notes, a handwritten quote and two of his books – *Round the Moon* and *From the Earth to the Moon* that were published in his lifetime. Jean-François Clervoy, an ESA spokesperson for the mission, said:

We chose two of his [Jules Verne's] notes directly related to space travel, and selected also one of his own quotes that reflects well the vision of the European Space Agency; 'en avant ... ce doit être la devise de l'humanité!' (Pearlman 2008).

['go forward ... it should be the motto of humankind!']

The naming of the ATV the *Jules Verne* and the decision of the European Space Agency to carry original notes and first edition books by the writer is an interesting example of science and humanities – space science and literature – coming together. Historically, this partnering is not new but, as Barrow (1995) points out, as science became more academic and focused on revealing the precise laws of nature, so art became increasingly subjective and involved with metaphysical aspects of the mind, causing science and art to diverge.

Barrow (1995) states that science and art now present different views of the world, summed up in his statement:

Science and art are two things most uniquely human. They witness to a desire to see beyond the seen. They display the crowning successes of the objective and subjective view of the world. But while they spring from a shared source – the careful observation of things – they evoke different theories about the world; what it means, what its inner connections truly are, and what we should judge as important.

Yet Barrow argues that the two are not mutually exclusive; discoveries in science can promote artistic creation and the arts can render the universalities of human thinking and give science a human aspect.

The linking of science and art is one of the key components of Exoart; the creative areas of space science and art, both informed by the same reality, linking to present a cosmic picture that can engage with human culture.

With more telescopic observations of the solar system planets, Mars began to feature in science fiction writing. As Mars is the subject of this thesis regarding the potential first Exoart Project, further accounts of science fiction in popular media will be restricted to this planet.

From the 18<sup>th</sup> century when William Herschel described his observation of the Martian polar caps seemingly melting, suggesting that they were formed of ice or snow and that Mars may have an Earth-like environment, there was speculation that Mars may support alien life-forms.

At the beginning of the 19<sup>th</sup> century many, often ludicrous, ideas were put forward on how we might gain the attention of the Martians, for it was assumed that Martian technology

would be at least comparable to our own or, some suggested, even superior. The fact that they would be observing Earth also appeared to be taken for granted. Ideas ranged from creating huge geometric forms from different coloured vegetation to prove we knew about mathematics, lighting a 24-mile-wide circular fire in the Sahara Desert, or constructing huge mirrors to focus the sun's rays and burn numbers onto the surface of Mars (hoping, we could presume, that no Martian was in the vicinity while this was in progress) (Rayl et al 2008).

The debate about whether Mars was inhabited became more intense with the American, Percival Lowell, who built his own observatory in Flagstaff, Arizona, being the most prominent supporter of the theory, claiming he had seen canals on the Mars surface that could only have been built by intelligent beings. In 1895 he published his theories in a book entitled *Mars* (Hogan 2007). However, many other astronomers disputed these claims and in 1909 observations from the Meudon Observatory, near Paris, and also Mount Wilson in California, USA, confirmed the canals did not exist (Lachièze-Rey & Luminet 2001).

Science fiction writers had many ideas on Martian life-forms. A book entitled *A Parallel Unveiled: A Romance* (1893) by Alice Jones and Ella Merchant depicted Mars as a site of a feminist utopia whereas the *War of the Worlds* (1898) by H. G. Wells portrayed the Martians as aggressive invaders. H. G. Wells book *War of the Worlds* was adapted and broadcast as a radio play in 1938. Read by Orson Welles as though it were a live newscast, it caused mild panic in New Jersey, USA, to those who missed the announcement that it was a work of radio theatre (Rayl et al 2008). Two film versions of the story were also produced.

Other authors such as Edgar Rice Burroughs were prolific in their output of Martian stories and Ray Bradbury's *The Martian Chronicles* became the most widely read science fiction book during the 1950s (Rayl et al 2008) and, in 1980, was adapted for a three-part television series (Pringle et al 1997).

The science fiction author, Jack McDevitt (2006), in his book *Odyssey* wrote of an Exoart-type cosmic engagement by an alien species who, before becoming extinct, left 17 monuments at various locations in the galaxy. The story reveals that two were believed to be self-portrait statues, five others were statues of creatures unknown to humans and so were thought to be mythical, and ten were geometric structures, the largest of which was

31.5 metres wide by 126 metres long with all other measurements in its three-dimensional form in the proportion of 1:4. The story reveals that this particular structure was carved from an asteroid and was in orbit around a distant planet.

Although fictional, the story raises the possibility for an Exoart project to consider leaving something in orbit around Mars instead of, or as well as, a structure on the surface. This is an interesting example of how science fiction writers can prompt the expansion of ideas in other areas of space exploration. Many other film and television stories were produced such as the fifteen episode film version of *Flash Gordon's Trip to Mars*, produced in 1938 for children's Saturday morning cinema; in 1964 the film *Robinson Crusoe on Mars* came to the cinema (Pringle et al 1997) and, in 2009, the very popular *Doctor Who* television series aired the episode *Doctor Who: The Waters of Mars* (ABC1 Television 2009).

The visual arts has also been involved in popular representations of Mars, for example, artist Chesley Bonestell produced the book *The Conquest of Space* in 1949 that contained some of the finest illustrative depictions of Mars and the moons of Jupiter and Saturn of the time. Miller (2007) states that the images were so realistic that they looked 'like postcards from the future'.

Later, Bonestell teamed up with rocket scientist Wernher von Braun, who became the first director of the Marshall Space Flight Centre of NASA, USA to produce magazine articles on rockets and spaceflight and the book *The Exploration of Mars* in 1954. Like Jules Verne, von Braun was keen to show that spaceflight was not just imagination but actually achievable. Bonestell's paintings, with their photographic quality, depicted the images that von Braun was writing about and contributed to raising public awareness of the possibility of human space exploration. By the time the USA government was deciding on allocating billions of dollars to a space program they found that they had the enthusiastic support of the taxpayers (Miller 2007).

In a more tongue-in-cheek reference to Mars and art, in 2008 contemporary artists transformed the art gallery at London's Barbican Centre into *The Martian Museum of Terrestrial Art*. The exhibition was supposedly curated by Martians whose culture happily manages without either art or aesthetics. In the exhibition catalogue, an alien philosopher writes:

In most human tongues there is a word whose meaning escapes you and whose usage varies among humans but which in all their societies seems to refer to an activity that is either integrative or compensatory, lying midway between their myths and their sciences. This word is 'art' (Grayson 2008).

In relation to societal perceptions and popular culture it is easy to imagine that something as technical and complex as astronomy and spaceflight has an impact on ideas and society that is unidirectional. Certainly, new theories on space open up potential in the sphere of science fiction. When Percival Lowell claimed there were canals and probably intelligent life on Mars, Ray Bradbury built his Martian civilisation around this theory in his book *The Martian Chronicles* (Hogan 2007).

Asner (2007), though, warns against jumping to conclusions on the societal impact of space activities. He observes that viewing society 'as a monolithic, homogenous blob that reacts as a singular entity to new capabilities and ideas' especially those generated from space ventures, is misleading. Asner also sees an assertion implied in some areas of social history that 'Society does not act but is acted upon'. However, the evidence for this is inconclusive. The cancelling of the Apollo Moon Program, in part, because of a waning in public interest would indicate that the mood of society can influence the actions of politicians in matters of space exploration.

The terms 'society' and 'general public' encompass topical diversity and cultural variation. As a result of this, different events will evoke varying interest in sections of a society. The amount of interest depends significantly on the way these events are communicated to the public.

As an example, during National Science Week the Mars Society Australia (MSA), Adelaide Chapter, has a booth in the large temporary marquee erected to house a variety of science organisations on the forecourt of the South Australian Museum. The MSA booth is primarily there to promote membership of the Mars Society Australia and to also show career options in space-related areas to young people still at school.

I was involved in this MSA project in 2007, 2008 and 2009 during which I spoke to hundreds of people about space issues. Everyone knew something of the Apollo Moon landings and the International Space Station. A surprisingly large number of both adults and children had some knowledge of the plaques placed aboard the two Pioneer spacecraft

or the record on the two Voyager spacecraft. These spacecraft have now left our solar system to cruise for the duration of their life, possibly billions of years, into deep space where maybe one day they may encounter intelligent alien life. A high proportion, especially of the children, had read space science fiction books and seen similar films.

However, few had knowledge of space agency attempts at public participation in space missions, such as people's names and short messages on the JAXA Selene spacecraft orbiting the Moon, or the DVD placed on the Phoenix Mars lander,

High profile space ventures such as the Apollo Moon program or the International Space Station receive regular mention in the mainstream media. The Pioneer and Voyager spacecraft appear occasionally in selected documentaries or journals such as *New Scientist* and *Scientific American*, but virtually the only place to find information on public participation is on the websites of the Space Agencies or through dedicated journals such as those produced by the Mars Society or the Planetary Society.

It is obvious, of course, that those attending Science Week are interested in or see some value in science, and those who engaged with the MSA display would feel the same about space matters. Parents bringing their children for interest or career advice were the main group who attended the event and there was, on the whole, a broad but different range of knowledge between parents and children. Parents overall knew more about the Moon Missions and the space race between the former USSR and the USA, while the children knew or were interested in knowing more about how rockets fly in space, planet Mars and the two rovers Spirit and Opportunity.

An analysis of this cannot be extrapolated over the whole of society because the focused nature of the event attracted those already interested in science; and those who engaged with the MSA display already had an interest in space. However, it is of some value to note that, generally, parents knew more about the Moon landings and the Voyager missions which were in the past, and younger people knew more about the space station and Mars rovers which are happening at the present time. Also, neither group knew much about public participation activities of space missions, yet at the 2009 National Science Week event when the MSA team promoted a 'Send your name to Mars' initiative organised by NASA to be included on their Mars Science Laboratory rover due for launch in 2011, there was an enthusiastic response from both adults and children. (See Image 11.)

## SUMMARY

Ancient observations of the sky took place for reasons such as identifying forthcoming seasonal changes, predicting cosmic events associated with superstitions and for scientific enquiry. Ancient Land Interventions probably incorporated features for celestial observations while other prehistoric artefacts may have been mnemonic cosmic devices. The starry night sky provided a canvas for many ancient people on which they could superimpose their myths and stories while, for others, it became a map for guiding travel at night.

The ancient recording of astrological events were, in some instances, highly sophisticated with devices such as the Antikythera mechanism as an example. Scientific observations of the sky also date back over 2,000 years with astronomers such as Aristarchus and Hipparchus. Astronomy became a prominent science throughout Europe and the Middle East, with the incorrect geocentric model of the universe being promoted until the theories of Copernicus and the telescopic observations of Galileo proved the heliocentric model was correct. As telescopes became larger, more was discovered about the stars and the solar system and today space telescopes peer deep into the universe with eyes that range across the entire electromagnetic spectrum.

Many of the telescopes are named by space agencies after pioneers who went before as a means of promoting the history of astronomy to the public. Artists in various fields have also referenced the stars and the cosmos in their work.

In popular culture, the stars and planets are central to many works of science fiction going back to stories by Kepler, Edgar Allen Poe, Jules Verne, H. G. Wells and many others. Joining the variety of ideas for science fiction stories were 19<sup>th</sup> century proposals for contacting Martians who were believed to be creating a world where canals were the main means for transportation.

Film companies also produced a variety of science fiction stories with many focused on Mars. Because of the books and films of science fiction accompanying major achievements of space agencies, space and space science is now part of human culture.

Exoart references this historical base to present a new art and cultural concept for the future.

## **CHAPTER 6**

### **MARS: THE HUMAN JOURNEY**

#### **INTRODUCTION**

This chapter provides a background and some technical detail on humans in space, robotic space missions to Mars, a profile of the planet Mars, why human missions to the planet are being considered and, finally, how a human mission might be achievable.

The relevance of this to the Exoart project is embedded in the basic concept of Exoart; that it is a form of art that resides outside of planet Earth. This thesis proposes that Exoart could become established when humans visit another planet because such an achievement will require the recognition of Earth and its peoples in a physical form that will remain where the first human footprints touch new ground.

This chapter details why the only contender for that new ground at the present time is the planet Mars; it also outlines the serious plans to achieve a human mission to Mars in the near future.

Exoart encompasses the characteristics of adaptation, collaboration and flexibility. The final section of this chapter ‘How would we get there?’ explains why these would be such fundamental qualities for the transportation of an Exoart project.

Finally, it should be noted that this chapter is intended only to give a very broad overview of past robotic ventures, and the scientific and technical aspects of a human Mars mission. A Mars mission is extremely complex and it is beyond the scope of this chapter to elaborate on all the details. The content of this chapter covers, in condensed form, what is considered relevant to an Exoart project.

#### **WHY GO TO INTO SPACE?**

This is an often-asked question and the one Stephen Hawking (2010) posed and thoughtfully answered in his speech following the presentation to him of the Cosmos Award for Outstanding Public Presentation of Science. But, like most answers to this question, the starting point was a premise that we are not already in space.

This perception is related to the geocentric model of the solar system, formulated in ancient Greek times. The geocentric model places the Earth as the centre of the solar

system with everything, including the sun, revolving around it. To the classical Greeks, who were never able to see the Earth in its entirety, the idea that Earth was stationary while everything else was moving, carried with it an implication that Earth was somehow fixed; that it was a stable, non-movable platform from which humans could contemplate the heavens. Although this view was to dominate well into the 16<sup>th</sup> century, other theories were proposed in ancient times that came to be known as the heliocentric model that put the Earth and other observable objects orbiting the sun.

It was not until the Apollo Missions to the Moon that humans were able to get far enough away from Earth to be able to photograph it as a whole planet. Later photographs of Earth in some form of context were taken by the Voyager 1 spacecraft in February 1990 as it sped through the solar system on a mission to record the planets. After it had passed the orbit of Saturn it was commanded to turn its camera back to its home and take some final pictures. It took sixty before heading out into deep space. They show Earth as a small point of light in the blackness of space. *Image 95*. In writing about the pictures Carl Sagan (1997) described Earth as the ‘pale blue dot’ and used this description as the title of one of his books.

Had that little spacecraft been able to park itself for a while and take some movie pictures of our planet, it would have recorded Earth orbiting the Sun at a speed of over 100,000 kilometres per hour (Croswell 1999). If it had been possible for Voyager to instantly leave the Milky Way Galaxy it would have observed that ‘pale blue dot’ near the end of a spiral arm of the galaxy that itself was spinning in space - the stars and planets at the end of the spiral arms travelling at around a million kilometres an hour (Tillett 2002).

The evidence is now there – not only are we ‘in’ space, but our spaceship, with us gravitationally attached to its outer surface, is speeding through space at an unimaginable speed. We are, and always have been, space farers.

The question ‘Why go into space?’ appears to reinforce the observation of Arthur C Clarke that we are ‘space conscious’ but not yet sufficiently ‘space-minded’ (Benjamin 2004). Yet we have already taken the first tentative steps to leave our spaceship and explore our cosmic environment. Our robots have already travelled to the furthest reaches of our solar system and beyond. The two Voyager spacecraft are now heading towards Sirius and the star system known as the Big Dipper. Others have orbited and landed on planets and moons, taken a sample of an asteroid, sailed through the tail of a comet and

plunged into the sun. Humans have orbited the Earth, built space stations in Low Earth Orbit and walked on our Moon.

But to be ‘space-minded’ a different question needs to be asked. That question is ‘Should we commit to *human* exploration of our solar system?’ Hawking (2010) likens this to the situation in Europe before 1492.

People might have argued that it was a waste of money to send Columbus on a wild-goose chase, yet the discovery of the New World made a profound difference to the old.

Commenting on the argument that we have many problems on Earth that need our attention before we should consider exploring other worlds he says that we have the capacity to do both. Although human space exploration may appear expensive, on a global scale it would take only a quarter of one percent of world GDP. For this we would get a new perspective on our problems by looking outwards rather than inwards (Hawking 2010).

The arguments surrounding expenditure on space are diverse although there would be few who would deny the benefits the world has derived from space activity. The many satellites that now orbit the Earth and perform such tasks as data gathering for weather forecasting, GPS positioning, telecommunications, monitoring of global situations that range from defence to the gradual movements of the continents, have provided the tools to raise the standard of living around the world.

However, satellites are only one aspect of space activity. Humans have walked on the Moon and we now have a functioning International Space Station (ISS) in Low Earth Orbit which is permanently crewed. There are also space probes and robotic devices investigating the solar system including planetary surface landings.

The next proposed step is for humans to venture beyond the Moon to eventually make a landing on Mars. But currently it is the human exploration of space that is the most controversial. One of the main arguments promoted by those who are intent on getting humans beyond the Moon is that exploration is inherent to humans, it is part of our basic fabric and history shows it is something we have always done.

Those who question the cost and effort in human space exploration dispute this claim and instead say that robotic missions will provide us with all the information we need to know and that to send humans on dangerous missions to other planets need to be justified in other ways, for example with a commercial benefit. To provide an insight into these arguments some analysis follows.

The document *The Global Exploration Strategy: The Framework for Coordination* produced by fourteen space-capable nations states that:

Space exploration is today's expression of a fundamental human characteristic: our deep curiosity and a resulting imperative to explore the unknown.

This is how we gain new knowledge and skills that become part of our collective ability to solve human problems and support commercial activities in useful and unpredictable ways. The very difficulty of space exploration is what triggers human inspiration and innovation (GES 2007).

The fourteen nations who are signatories to this document are: ASI (Italy), BNSC (United Kingdom), CNES (France), CNSA (China), CSA (Canada), CSIRO (Australia), DLR (Germany), ESA (European Space Agency), ISRO (India), JAXA (Japan), KARI (Republic of Korea), NASA (United States of America), NSAU (Ukraine), Roskosmos (Russia).

The document envisioned a coordination mechanism to facilitate international planning on robotic and human space missions throughout the solar system. To this end representatives formed the International Space Exploration Coordination Group (ISECG) at a meeting in Montréal, Canada in July 2008. The secretariat for this group will initially be hosted by the European Space Agency (ESA 2008a).

The reference to commercial activities in *The Global Exploration Strategy: The Framework for Coordination* document is to put the case that there have been some remarkable spin-offs from the science and technology developed for space missions. The implication is that, in the future, as missions become more complex and science and technology are pushed even further the rewards in technology transfer will be even greater.

For the past thirty years NASA's commercial technology program has worked to introduce over 1,400 space technologies into the commercial sector. The European Space Agency also has a similar office that links with technology and medical industries.

Space technology has been developed into such things as hand-held blood viscometers, GPS systems, artificial blood pumps and computer programs that now guide lasers for eye surgery and check for tumours in mammograms (Cartwright 2010). Space technology has also contributed to CAT scan machines, kidney dialysis, cordless power tools, freeze-dried foods (McCurdy 2007) and large-scale integrated circuits which are the basis of modern computers (Hawking 2010). Technology developed for the British Beagle 2 Mars Lander which, unfortunately, crashed into the Martian surface, is now being used in a rapid test for tuberculosis (Weston 2008).

A statement in the *Global Exploration Strategy: The Framework for Coordination* document that a 'fundamental human characteristic is our deep curiosity that results in an imperative to explore the unknown' is supported by a document by the European Space Agency in relation to their Aurora Space Exploration Programme. It states:

From the dawn of humankind the need to explore has driven expansion across our planet. Today this expansion continues towards other planets in the solar system (ESA 2008b).

It is interesting to note that this document links the need to explore with human expansion into new territories. This references the predominantly American view of the frontier, the movement into and taming of the 'Wild West'. Carl Sagan (1997) reiterates this in his statement that 'we're the kind of species that need a frontier – for fundamental biological reasons'.

Alan Marshall (1995) views notions of human expansion into new space frontiers as a socio-psychological model of imperialism. This model, with reference to space activities, proposes that as humans have a fundamental desire to explore the unknown we might as well expand into new frontiers for the benefits it offers for scientific exploitation.

Marshall suggests that there is no single rationale that is sufficiently strong to justify a human solar system expansion except that leading to the economic growth of space hardware manufacturing companies on Earth. Marshall concludes that, if eventually the development of space bodies does occur, it will be undertaken with an imperialistic intent

by the technologically elite space-capable nations with little regard for the others. Marshall's concerns could be seen as an extreme view of the motives for human space exploration but, nevertheless, are a valid contribution to the debate.

Another document that claims exploration as a characteristic of humans is written by the European Space Sciences Committee of the European Science Foundation and states – 'Exploration is inherent to humans' (SCH-ESSC 2008). The document focuses on aspects of human exploration of space, remarking that the debate on robotic machines assuming a lead role over humans in exploration is an obsolete argument. It claims that exploration is a human activity and is important in a societal as well as a scientific way.

The paper does expand on the definition of exploration to give context to its claims. It argues that it was people throughout the ages exploring their environments for food and resources that led them into new territories. The three drivers for this exploration are: curiosity; the quest to experience or obtain something new; and prestige. This essentially prompts humans to 'go beyond the existing limits' (SCH-ESSC 2008).

Nolan (2008) also claims that 'exploration is instinctive to us', being innately a human activity because of our curiosity and a desire to challenge ourselves. Through this process, Nolan thinks that we extend ourselves and redefine who we are. The interesting aspect of Nolan's argument is that he sees examples of our exploration efforts in things such as our individual goals and ambitions, or our desire to contribute towards a better society.

Pressing for a personal achievement like winning a race or competition, climbing a mountain, exploring a new cave is not far removed from committing oneself to learning a new language or musical instrument or gaining qualifications in a new area. Nolan's argument concludes that the concept of exploration manifests itself in many different ways in each individual. Even with feats that many of us would never consider undertaking, like sailing solo round the world, trekking across the polar ice-caps, or sitting on top of a rocket to be blasted into space, we can still engage with the people who do and share, in a personal way, their adventures. The ethos of exploration in the history of humanity has metamorphosed, but not been lost.

NASA also emphasises in its communications on space exploration the inquisitive nature of humans. At a NASA Administrators Symposium, Sean O'Keefe (2004) talked about

the human character wanting to know and understand what was over the horizon and the willingness to take risks to find out. O’Keefe also stated that every major advancement in human history has been due to the temerity of humans exploring the unknown and pushing to understand what they find. Although O’Keefe did not expand on his definition of advancement, the document did imply a meaning of the broadening of human knowledge and experience.

When United States President Barack Obama (2010) gave a speech at the John F Kennedy Space Center regarding his administration’s plans for future space exploration, he used phrases about humans pushing the boundaries and pursuing discoveries, claiming these were an essential element of the American character. Taking what has been described as universal human attributes and claiming they are essentially American could be viewed as political grandstanding. However, the essence and context of his remarks meant that, more than the expected economic benefits, human exploration of space is something we were driven to do once the technology became available to undertake such ventures.

An alternative view is put by Rand Simberg (2008) writing on the subject ‘Are we driven to explore?’ He argues that at an early stage in human history we may have had this trait as a survival mechanism, but this is no longer the case today. Simberg is convinced that, for most people today, exploration is not a prominent motivator and that they are not particularly interested in participating vicariously in exploration by others, especially if such exploration is perceived to be expensive and funded from public money.

The authors of a document from the Space, Policy, and Society Research Group at the Massachusetts Institute of Technology, USA (MITSPS 2008) also reject the idea that the need to explore is in our genes. They state that there is no social science or genetic evidence to substantiate a claim that humans have an innate compulsion to explore. Further to this, they see space exploration as radically different to any terrestrial exploration that humans have undertaken in the past.

Their definition of exploration, as an expansion of human experience in new places, situations and environments, is broad enough to cover major government-funded ventures as well as personal endeavours such as those explored by Nolan (2008). Although the authors from MIT would probably not disagree with the three driving factors of exploration that Nolan puts forward: curiosity, quest and prestige, they would certainly take issue with his claim it is instinctive to us and an innately human activity. The MIT

authors see exploration as a cultural phenomena adding meaning to human life, with human space exploration a defining aspect of modernity. Because of this, the authors conclude that human space exploration can be deemed a worthy exercise (MITSPS 2008).

Apart from issues of the human characteristic to explore, other areas of debate regarding human spaceflight focus on the perceived and real benefits of human exploration. The *Global Exploration Strategy: The Framework for Coordination* (GES 2007) lists five areas that space exploration will potentially benefit society:

- New knowledge in science and technology. The document states that ‘problem solving drives innovation and the bigger the problem, the greater the innovation’. The implication here is that space exploration throws up so many big problems that the innovation needed to solve them increases our knowledge in science and technology by significant factors. There is evidence of this in the space spin-offs that have already been mentioned but, apart from these, the document claims that what is learnt from exploring other solar system bodies helps to focus, define and indicate areas of study for potential problems on Earth. An example is the study of the planet Venus that space probes found had runaway global warming with a sulphuric acid atmosphere and surface temperatures hot enough to melt lead. This has helped us understand the effects of climate change that we are currently facing on Earth.
- Extending human frontiers and technology. Under this heading the main benefits are said to be a redefining of our relationship with Earth and the ability to have an off-world repository of some of our knowledge and history. It could be assumed that this would be in case of a global disaster. The Exoart project could be one means of providing this off-world repository and is discussed in Chapter 7, Considerations for an Exoart Project on Mars.
- Economic expansion. This is seen as providing opportunities for industries on Earth as well as potential for new industries and the development of new technologies in, or linked with, space exploration especially the habitation of other bodies such as Mars.
- Global Partnerships. There is a fundamental imperative for nations to work together on space exploration so that costs and technology transfer can make large missions viable. This is already happening in many space projects, with the best

current example being the International Space Station (ISS) with the United States, Canada, Europe, Japan, Russia, Italy and Brazil contributing to build an operating space structure that no single nation would be willing to afford. The document states that projects like this encourage nations to work together in a spirit of friendship and cooperation. It goes on to say:

This spirit of partnership will indirectly enhance global security by providing a challenging and peaceful activity that unites nations in the pursuit of common objectives. It is inclusive; the goal is to expand the opportunity for participation in space exploration to all nations and their citizens.

- Inspiration and Education. The claim here is that space exploration inspires us to think about our planet as a whole as well as the universe in which we live. This could be beneficial in prompting young people to take up a career in science and technology, especially if they perceive it as an exciting and creative career. This, though, depends heavily on a sustained regime of communication between space agencies, schools and the general public. There are many outreach programs initiated by space agencies and space advocacy groups like The Planetary Society and the Mars Society. In Australia there is the Victorian Space Science Education Centre where students can not only learn about space science but also participate in a simulated Mars mission. With part of the centre set up as a space mission control centre and reproduction Martian terrain where students dressed in space suits perform various experiments – a mock Mars landing can be authentically undertaken by the students (VSSEC 2007).

This is an aspect that David Livingston (2008) has researched among people involved in space science, engineering and other space-related fields, including start-up space businesses. In response to the question ‘What motivated you to pursue an education or business opportunity in a space field?’ 80% said they were inspired by the Apollo Moon missions. Australian NASA astronaut Andy Thomas also says that seeing men walk on the Moon ‘galvanised my passion for space’ (Thomas and Peddie 2009).

The Planetary Society document *Beyond the Moon: a roadmap for human space exploration in the 21<sup>st</sup> century* (Bell, Friedman et al 2008) also referenced the potential of grand space projects to ‘motivate the younger, technically-sophisticated generation’. The document was designed to add to the debate on the ‘Vision for Space Exploration’

initiative proposed by US President Bush in 2004 and the Constellation program that was intended to deliver it. The Planetary Society felt that ‘the present plan may fail to realize the promise and potential articulated in the Vision’ and proposed in their *Beyond the Moon* document a new space exploration paradigm for the United States. It is interesting to note that this document, along with many other presentations made to the *Review of US Human Spaceflight Plans Committee* in 2009 (Augustine et al 2009) resulted in major changes to the US space program, announced by President Obama (Obama 2010).

The Augustine Report, as the *Review of US Human Spaceflight Plans Committee* became known, stated clearly that the ultimate goal of human spaceflight was to advance civilisation and expand a human presence in the solar system. The report also published the results of a public survey asking ‘How important is it to you, if at all, that NASA continues with space exploration?’ 50% answered ‘very’, with another 27% answering ‘somewhat’. Although making a strong case that human spaceflight would advance science, the review committee also acknowledged the importance of societal benefits from US space initiatives.

Other surveys showed that, up until 1995, the majority of Americans polled thought that NASA should concentrate more on robotic space missions rather than human ones. In 1995 this changed, with 60% indicating that NASA should concentrate on human missions (Launius 2003).

Launius admits that there is no clear evidence of why this change in opinion should occur but points to the fact that in 1995 the US Space Shuttle docked with the Russian Mir Space Station and began a series of collaborative missions that may have emphasised the importance of humans in space. Also, in that same year, the film *Apollo 13* came onto cinema screens (this depicted the near-tragic moon mission and the remarkable efforts of NASA to successfully return the three astronauts safely to Earth). Other space films followed and Launius suggests that popular fictional space depictions linked with actual space achievements could act as a powerful cultural influence. This idea was touched on in Chapter 5, *Space: Observation and Imagination*, in the section on Popular Culture.

Noting public opinion, Governments can and do change their stance on issues such as human spaceflight. In 2001 the then British Science Minister, Lord Sainsbury, announced that Britain did not intend to participate in human space exploration because they were not convinced of the benefits for the financial investment (Crawford 2003). However, in

2008, after large public support for the UK Beagle 2 space mission (discussed in Chapter 2, The Elements of Exoart) the newly appointed British Science Minister, Paul Drayson, advocated that Britain should join in iconic human space missions like those proposing to send humans to the Moon or Mars because they inspire public interest in space and promote science and engineering to young people (Henderson 2008). In 2010 the UK government established the UK Space Agency which will consider partnerships in such missions. The newly-formed space agency is also offering public learning awards in their *Space for All* sponsorship scheme (UKSA 2010).

Crawford (2005) reiterates this in what he calls the Social Case for space exploration. In this he covers the economic, the industrial, the educational and the geopolitical but also covers a cultural aspect. Society, he claims, needs a vibrant culture that continually provides intellectual stimuli and an ambitious program of human space exploration is one option that can satisfy this requirement; if people can engage with this, our horizons will be broader and our culture richer.

Steven J Dick (2007), the Chief Historian at NASA, has looked back over its space programs since its founding document. *The National Aeronautics and Space Act of 1958* sets out eight objectives for NASA, including long range studies on the societal impact of space activities. He notes that history has shown that large-scale, long-term space programs require that the public has a vested interest and this would be true of a Mars mission. He adds that images of Earth from space, the development of spacecraft that made possible studies of cosmic evolution, technology that has enabled the search for extra-terrestrial life and representations of these themes in literature and the arts, has had a major impact on cultural world views.

The theme of space and Mars in popular culture was covered in Chapter 5, Space: Observation and Imagination, along with the influence of the night sky in ancient times. The establishment of a connection between humans and their cosmic environment going back thousands of years reinforces the theory that current space exploration endeavours do have an impact on cultural world views.

Following the debates since the end of the Apollo era it would appear that the major space agencies, supported by their governments, now have renewed interest in pushing the boundaries of human spaceflight beyond Low Earth Orbit. Possibly with the forthcoming programs of human planetary exploration, we may be on the cusp of being what Arthur C

Clarke described as 'space-minded', and it is this that may prove vital for an Exoart project.

## **ROBOTIC PATHFINDERS**

Despite a number of failures, NASA has been mostly successful in its investigation of Mars with robotic probes since the mid-1960s. In 1965 the NASA spacecraft Mariner 4 was the first to fly close by Mars and photograph its surface, followed by Mariner 7 in 1969, and Mariner 9 in 1971 which was the first to go into orbit around Mars. In 1976 NASA sent two Viking spacecraft to Mars, each with a separate landing platform. The two Viking landers made a safe touchdown and became the first spacecraft to transmit pictures of the Martian landscape from the surface.

In 1997 NASA's Pathfinder spacecraft landed on the Martian surface and released the first interplanetary rover, a small six-wheeled machine that stood only 25 centimetres high. Although small, the little rover did some valuable scientific work while it travelled over 100 metres on the surface (Shirley 1998).

In terms of scientific and visual data delivered from surface robots, the USA twin rovers Spirit and Opportunity and the polar lander Phoenix could be considered the most outstanding successes to date. The rovers landed on the opposite sides of Mars in January 2004 and immediately began transmitting high resolution panoramic views of their locations. Apart from cameras the two rovers also carried scientific instruments that consisted of a Thermal Emission Spectrometer for determining the process that formed Martian rocks; a Mössbauer Spectrometer for investigating the mineralogy of iron-bearing rocks and soils; an Alpha Particle X-Ray Spectrometer for close-up analysis of rock and soil elements; Magnets for collecting magnetic dust particles for examination by the other instruments; a Rock Abrasion Tool for boring into rock surfaces to collect samples, also for examination by the other instruments; and a Microscopic Imager for obtaining close-up, high resolution images (JPL 2009). These particular instruments were chosen to fulfill the primary mission goal of establishing if Mars ever had water activity on its surface, something that they have been able to establish almost conclusively.

Although only designed to last for 90 days and travel 600 metres (Squyres 2005) both rovers have functioned far longer. Spirit became bogged in sand and could not reach a sheltered position for the Martian winter and no communication has been received from it

since March 2010. However, Opportunity is still operational and mobile (as of April 2011) after more than seven years and 28 kilometres of roving on the Martian surface (JPL 2010b).

The other major robotic success has little to do with longevity of the craft (it was designed for and lasted five months), but rather the implications of what it found. The Phoenix Mars Lander was launched by NASA on 4 August 2007 and made a rocket-assisted soft landing at the north pole of Mars on 25 May 2008. The mission objective was to test for the presence of water ice below the surface, a feature that had been indicated by the Mars Odyssey orbiting spacecraft in 2002 (JPL 2008). Phoenix was equipped with a robot arm that could dig into the ground and place samples of excavated soil in various testing chambers within the main body of the craft. These experiments proved the existence of two distinct types of ice deposits not far below the surface (NASA 2008). The fact that the ice delineated by the Odyssey orbiter has now been proved means that there are extensive water resources within the structure of the Martian surface. *Image 96.*

The former Soviet Union also designed many probes for Mars but these were plagued with problems and few were successful. Their first attempt was Marsnik 1 launched in October 1960 and designed as a Mars fly-by mission. Marsnik 2 was launched four days later but neither reached Earth orbit. Further attempts at robotic Mars missions followed in 1962, but the craft failed to get out of Earth orbit.

In 1964 Zond 2 was launched and reached Mars but contact was lost before it was due to launch a surface probe. In 1969 two more spacecraft were launched for Mars but both failed before reaching Earth orbit. Kosmos 419 was launched in 1971 and, after reaching Earth orbit, engine failure prevented it heading for Mars. However, in the same year spacecraft Mars 2 and Mars 3 reached Mars and went into orbit around the planet but, although both of their landers reached the surface, neither was successful in their mission objectives.

In 1973 the former Soviet Union launched four spacecraft to the Red Planet – Mars 4, 5, 6 and 7. They all arrived at the planet in 1974 but all experienced problems and transmitted only a limited amount of data (Rayl et al 2008).

Before the final collapse of the Soviet Union in 1991, the last Mars mission was the ambitious twin spacecraft Phobos 1 and 2. The mission objectives for these craft were to survey Mars from orbit and drop landers onto the surface of the Mars moon Phobos.

Phobos 1 was lost in 1988, just two months into its flight, due to a faulty command from the mission controllers. Phobos 2 reached a Mars orbit but contact was lost with the craft while it was in the process of engaging with the Martian moon in 1989 (Winchester 2006). Winchester suggested that from the late 1970s the Soviet Union was designing complex missions to match the achievements of the USA and this may have resulted in some of the failures. Pressure to perform to tight time-lines and with limited budgets is not a recipe for success in space exploration. Until the collapse of the Soviet Union it would appear that both governments were still trying to compete with each other, although the Phobos missions might indicate that there was less competition between the space agencies themselves, as the spacecraft carried experimental equipment from twelve European nations and the USA.

After the demise of the Soviet Union, Russia launched a Mars mission in 1996 but this was unsuccessful in entering Earth orbit. However, more recently, Russia has revived its interplanetary ambitions through its new Program for Deep Space Exploration with an adventurous sample return mission to Phobos, due for launch in 2011.

In 1998 the Japanese joined the efforts to explore Mars by launching the orbiter Nozomi. However, the spacecraft failed to gain enough speed for the anticipated rendezvous with Mars in 1999 and was sent on a slower route that involved two gravitational slingshots from Earth, and it eventually encountered Mars in December 2003. But a failed trajectory correction manoeuvre that would have placed Nozomi in Mars orbit caused the spacecraft to fly past Mars (Rayl 2008).

## **WHY MARS?**

What is it about the planet Mars that prompted the Augustine committee on the *Review of US Human Spaceflight* to state:

A human landing and extended human presence on Mars stands prominently above all other opportunities for exploration. Mars is unquestionably the most scientifically interesting destination in the inner solar system (Augustine et al 2009).

The short answer is revealed in another document *The Global Exploration Strategy* that says, for humans 'it is a place we can contemplate visiting' (GES 2007). This is because, of all the planets in our solar system, it is the only one we could land on and survive.

Our solar system is divided into two major groups of planets. *Image 97*. The four nearest the sun, Mercury, Venus, Earth and Mars, are known as terrestrial planets because they all have a solid rocky surface. The four outer planets, Jupiter, Saturn, Uranus and Neptune, are known as gas giants. They are massively bigger than Earth but are comprised of dense atmospheric gases surrounding relatively small cores. Uranus and Neptune also have a thick coating of ice around their centres (John 2006). The atmospheric pressure in the gas giants becomes so intense nearer the cores that any spacecraft we could build would be totally crushed long before it reached any firm surface.

The outermost planet, Pluto, is formed of rock and ice but its small size and eccentric orbit makes it more like a comet. Because of this, in 2006 its status was downgraded to a planetoid or dwarf planet by the International Astronomical Union. Because of its distance from the Sun its surface temperature is estimated to be around  $-225^{\circ}\text{C}$  (Spinrad nd).

In contrast the inner two planets both have surface temperatures that are far too high to make a human landing a viable option. As the innermost planet, Mercury can experience temperatures up to  $350^{\circ}\text{C}$ . Logically, Venus orbiting between Earth and Mercury should be cooler, but in fact it has an average temperature  $100^{\circ}\text{C}$  higher than the maximum for Mercury. The reason for this is that the planet has a runaway greenhouse atmosphere. The thick cloud cover which extends up to 65 kilometres above the surface is rich in sulphuric compounds, therefore when Venus experiences rain it consists of sulphuric acid (John 2006). The conclusion of *The Global Exploration Strategy* on Venus is that it 'could hardly be more hostile to life as we know it' and 'it is unlikely to be a destination for human exploration' (GES 2007).

Being further from the Sun than Earth, Mars is a cold planet but survivable for humans with our technology. It is a planet that has been extensively mapped with satellites and is known to have interesting geological features. It has a thin atmosphere that partially shields the surface from radiation, a day that is only 37 minutes longer than an Earth day and large expanses suitable for a spacecraft landing. It is a planet we can get to, it has a surface we can explore in spacesuits and, as the Augustine report says:

If humans are ever to live for long periods with the intention of extended settlement on another planetary surface, it is likely to be on Mars (Augustine et al 2009).

Many of the processes and mechanisms that formed Earth also took place on Mars. These include bombardment by cosmic debris, the formation of a dipolar magnetic field, extensive volcanism, the presence of liquid water on its surface at some stage in its formation, geochemical cycles and the formation of polar caps (MEPAG 2008a). There is now a growing body of evidence that, at some stage, maybe several billion years ago, Mars may have had a climate and land surface with flowing water similar to the environment when life began to form on Earth (Bell 2006).

It is this that primarily drives the interest in Mars. It poses the question; did life ever form on Mars? And, if it did, is there still some remnant of it today existing deep in the Martian crust where conditions may be suitable for it to survive?

This life may be very small, even microbial, but this type of life has been found on Earth in extreme environments, such as the dry and hot Death Valley in the USA, the wind stripped Gobi Desert of Mongolia, the nitrate-laden expanses of the Atacama Desert in Chile and extremely cold interior valleys of Antarctica (Koerner & Le Vay 2000). Mars today has no discernable life or vegetation on its surface, it has a thin, cold atmosphere but what is known of its wet and warmer past raises another question. What made it change so dramatically? This is of interest to many scientists, as a better understanding of the history of Mars may provide important data for considering the future of Earth.

Because there is now no liquid water on the surface of Mars, its land area is equal to the land area of Earth despite being a little over half the size (Crawford 1998). Geological features include several colossal volcanoes, with Olympus Mons being the largest. At over 27 kilometres above the surrounding plain it is three times the height of Mount Everest. Its base is 600 kilometres across (John 2006) making its footprint easily large enough to cover the whole of Tasmania.

Just south of the equator is the canyon system named Valles Marineris, after the Mariner 9 spacecraft that first observed it in 1971. It is, in fact, a conglomerate of canyons that merge in the central part of the system to a width of up to 600 kilometres. The length of

Valles Marineris is over 4,000 kilometres, greater than the distance between Brisbane and Perth, Australia. The depth in some canyons can be eight to ten kilometres. *Image 98.*

It is not known for certain how this canyon system was formed, but one theory is that it was due to rifting, the crust splitting due to being stretched. At the eastern end of the system are a series of large channels and layered sediments that indicate that, at some time in the past, at least part of the canyon system contained substantial amounts of water (Squyres 2004).

Mars also has large impact craters that are scientifically very interesting. The largest is the Hellas impact basin that has a diameter of 2,300 kilometres with a floor depth below the surrounding plain of nine kilometres (Squyres 2004).

The recent discovery of vast amounts of water locked up in the ice and permafrost reservoirs has now made Mars a heightened target for exploration. In 2002 the Mars Odyssey Orbiter plotted large amounts of subsurface water ice in the northern arctic plain using a gamma ray instrument that detected hydrogen (JPL 2008). (See Image 96.) This water ice was confirmed in 2008 by the Phoenix spacecraft that landed on the North Polar Region and dug into an ice layer a few centimetres below the surface (NASA 2008).

In 2004 the Mars Express orbiting spacecraft detected vast fields of perennial water ice at the South Polar Region using its Visible and Infrared Mineralogical Mapping Spectrometer to measure sunlight and heat reflection. The analysed data revealed hundreds of square kilometres of permafrost (ESA 2004a).

Further analysis of all available data has shown sequences of ice-rich layers extending further out from the poles than originally thought. It has been estimated that known amounts of this ice-rich material is equal to a layer up to 35 metres thick over the entire planet (Christensen 2006). This amount of available water is positive for a human mission to the planet because it has the potential to be used as a resource by the astronauts. It also adds weight to the theory that organisms could exist in subterranean pockets of water made liquid by geothermal processes.

This hypothesis was put forward by scientists at the ESA after correlating data from the Mars Express spacecraft Planetary Fourier Spectrometer (PFS) and data from the Odyssey spacecraft. The PFS instrument detected a concentration of methane in areas where Odyssey had observed layers of water ice relatively near the surface. These areas

emit detectable water vapour and methane two to three times higher than in other regions. Methane can be a biomarker for life and, in the presence of water vapour, which could have been released from melted ice due to geothermal heat, prompted speculation that this could indicate some form of life (ESA 2004b).

Ongoing observations by scientists at NASA have reinforced this theory by discovering that the methane plumes also correlated with areas that are thought to have had ancient ground ice or flowing water. On Earth methane mostly comes from organisms digesting nutrients, some living deep underground, like those that exist two to three kilometres below the surface in the Witwatersrand basin in South Africa. Methane-producing microbes are one of the earliest known forms of life on Earth, but it will take isotope measurements of the Martian gas to decisively conclude whether it is microbes or geological processes that are releasing it (Steigerwald 2009).

The combined data from the Phoenix lander and the rovers Spirit and Opportunity that large amounts of liquid water were probably present on Mars at some time in the past provide a tantalising image of a Mars that could have supported life. These positive results substantiate NASA's strategy to 'Follow the Water' in their Mars Exploration Program, which has four science goals:

- Determine whether life ever arose on Mars
- Characterize the climate of Mars
- Characterize the geology of Mars
- Prepare for Human Exploration (JPL 2008)

The Mars Exploration Program Analysis Group (MEPAG 2008b) lists scientific goals for Mars exploration that also include the search for life. MEPAG is chartered by NASA to assist in planning the scientific exploration of Mars. To do this the group liaises with the scientific community to establish priorities for Mars missions. Its 2008 document *Mars Science Goals, Objectives, Investigations and Priorities* referred to as the Goals document, details its main goals:

- Determine if life ever arose on Mars. Key objectives are to assess the past and present habitability of Mars, taking into account different micro-environments will have different potential for habitability. Sampling across as wide an area as possible is preferable. Also investigate carbon cycling with a view to

understanding its distribution on Mars to help pinpoint locations for the search for life.

- Understand the processes and history of climate on Mars. Key objectives are to understand how the climate of Mars evolved and what processes were involved to produce the climate of today from what is thought to have been a warmer and wetter climate in the past.
- Determine the evolution of the surface and interior of Mars. Key objectives are to gain an understanding of the composition, structure and history of Mars. The geology of Mars will provide a key for understanding the solar system as a whole and provide an insight for understanding the history of Earth.
- Prepare for human exploration. Key objectives are to characterise the Martian atmosphere and its variations including an analysis of surface and airborne dust that could be detrimental to humans and their activities while on Mars. Also undertake flight procedures to test aero capture and landing technology for large spacecraft that would be required for a human expedition. (The relevance of this will be covered in the section – How would we get there?)

Mars has proved to be a place that keeps throwing up intriguing questions the more we learn about it. Questions that will take enormous effort to answer but will nevertheless provide a richer understanding of the universe and our place within it.

A comparison chart of major features of Earth and Mars is included at the end of this chapter.

## **TOWARDS A HUMAN MISSION TO MARS**

On 12 April 1961 at the Baikonur Cosmodrome in Soviet Kazakhstan, Yuri Gagarin was blasted into Low Earth Orbit aboard a Vostok spacecraft to become the first person in space. Gagarin made one orbit of Earth and the mission took 108 minutes (Winchester 2006).

Since that time, over 500 people have gone into space but only 24 have left Low Earth Orbit on Apollo Moon missions with twelve people descending to the lunar surface. The last of the US Apollo missions, Apollo 17, returned to Earth on 19 December 1972 and, although much has been learnt about space travel since those times, humans have never returned to the Moon or left Low Earth Orbit (LEO), regarded as being up to 2,000

kilometres above the Earth's surface. For reference the International Space Station orbits at around 340 kilometres above the Earth.

The main reason astronauts have not gone beyond LEO since 1972 is often quoted as the expense of human spaceflight. In the days of the early human space missions, when there was a race to the Moon between the then Soviet Union and the USA, space budgets rose and many risks were taken, some resulting in loss of life. Today, these risks would be unacceptable to governments, space agencies and the public; space budgets are also subject to cuts along with other government departments.

The repercussions of a fatal space event can be seen in the disaster of the US space shuttle Columbia which broke up at an altitude of 63,000 metres in February 2003 as it returned from a two-week scientific mission in space. The death of the seven astronauts triggered a major safety investigation. This prohibited further space shuttle launches until July 2005 when recommended changes from the accident investigation board had been carried out which improved safety on future missions (Winchester 2006).

For humans to venture beyond the Moon within acceptable safety parameters would involve spacecraft and technology far superior to the Apollo craft. It was deemed that orbiting space laboratories, such as the Russian Mir and now the International Space Station (ISS) were better cost/return options and were in any case essential for space agencies to be able to gain the necessary information regarding the effects on humans of being in space for long periods.

Although humans have not ventured deep into our solar system, many robotic spacecraft have done so, sending back valuable data and images of all of our neighbouring planets. This has prompted space agencies to reconsider a human mission to another planet and to share the costs through a collaborative process. The target planet, as previously explained, would be Mars.

The *Review of US Human Spaceflight Plans Report* stated that:

A human landing that leads to an extended human presence on the Martian surface stands prominently above all other opportunities for human space exploration (Augustine et al 2009).

Recounting some of the past difficulties in managing international programs the committee concluded that:

The management structure that has evolved for the ISS [International Space Station] has proven particularly effective and could serve as the basis for the next major international cooperative human venture into space (Augustine et al 2009).

In 2001 the European Space Agency (ESA), while identifying potential space initiatives, decided upon robotic and human exploration of the solar system as its major aim in the 21<sup>st</sup> century. To focus this aim ESA partners and other scientific and industrial organisations were surveyed on preferred destinations and objectives for a long-term exploration program – Mars came top of the list (Messina et al 2006).

To provide a framework for ESA plans in space exploration the *Aurora Programme* was developed and ratified at the Ministerial Council in December 2005. The program document states that Europe will ‘play a significant role in exploring and understanding the Solar System, in particular Mars and the Moon’ (Messina et al 2006).

From its inception the ESA *Aurora Programme* stated that cooperation and joint ventures with other space agencies were key elements in achieving its long-term goals. Being part of the International Space Station (ISS) consortium has provided many European astronauts with opportunities to work in space and allowed ESA to develop space station modules. ESA has also had some robotic successes including its Mars Express spacecraft that began orbiting Mars at the end of 2003. The suite of scientific instruments on board included cameras to take high resolution images of the entire Martian surface.

ESA is currently building a Mars surface rover that will search for signs of Martian life, past or present as well as investigate the environment. The ExoMars rover is scheduled to be launched in 2013.

ESA is also developing a Mars Sample Return Mission that will deliver an excavated portion of the Martian surface to Earth. This mission is planned for launch in the timeframe 2020 to 2022. The Mars Sample Return Mission will be a complex engineering project combining five spacecraft: an Earth/Mars transfer stage; a Mars orbiter; a descent module; an ascent module; and an Earth re-entry vehicle (ESA 2008c). ESA is viewing this mission as a major exploration milestone because the configuration of

dedicated spacecraft is suitable for a subsequent human mission to Mars (Massina et al 2006).

This focus on Mars is also in line with NASA objectives, and because of this the two space agencies created a *Mars Exploration Joint Initiative* (MEJI) in June 2009 (ESA 2009a). The MEJI is designed to allow ESA and NASA to increase cooperation and expand collective capabilities within a framework specifically targeting future Mars missions. The first mission in this joint venture is already approved and will be the ExoMars Trace Gas Orbiter which is scheduled for launch in 2016. A further joint mission consisting of two rovers is scheduled for 2018 (JPL 2010a).

Both ESA and NASA also have representation on the International Mars Exploration Working Group (IMEWG), along with other space agencies and major institutions participating in mars exploration. The present charter of IMEWG, approved in 1996, states that it will:

- Produce and maintain an international strategy for the exploration of Mars
- Provide a forum for the coordination of Mars exploration missions
- Examine the possibilities for the next steps beyond the currently defined missions (IMEWG nd)

Its document *Towards Mars* points out its members discussions recently have focused on sample return missions, such as the one being developed by ESA, and the preparatory activities for a human mission to Mars.

China has had a space program since 1956 but it was not until 1970 that it launched its first satellite. Even so, it took until 1986 before the Chinese government described their space efforts as a cornerstone in their science and technology program (Smith 2003). The China National Space Administration (CNSA) issued a white paper in 2006 outlining their achievements and aims. The paper recognised that:

The role of space activities in a country's overall development strategy is becoming increasingly salient, and their influence on human civilization and social progress is increasing.

CNSA will, it said, 'explore outer space and enhance understanding of the Earth and the cosmos' and 'do its best to make the country's space industry develop faster and better' (CNSA 2006).

However, Brown (2009) claims it is hard to make a comprehensive assessment of China's space plans because it is not a transparent program. They tend to report extensively on successfully completed activities but offer little detail on stated forthcoming missions.

The fact that China is surging ahead with its space program, especially in the area of human spaceflight, can be gauged by its current achievements. In October 2003 it launched its first astronaut into space to complete 14 orbits of Earth, making China the third country, with USA and Russia, to have the capability of launching humans into orbit (Smith 2003). In October 2005 the Shenzhou 6 spacecraft completed a five-day space mission with two astronauts on board. This was followed in September 2008 with China's first astronaut space walk during the Shenzhou 7 mission carrying a three-person crew.

China has also announced a lunar exploration program that started in 2007 with the launch of the Chang'e 1 robotic spacecraft. It has plans for further robotic missions including a lunar rover and a sample return mission. It is reported that China is also building the robotic space probe Yinghuo 1 to send on a mission to Mars (Brown 2009). Nolan (2008) suggests that the USA and probably Europe are restructuring their long-term programs for space exploration in the light of China's progress 'lest they be overtaken'.

US President Barack Obama's address on Space Exploration in the 21<sup>st</sup> Century could be seen to substantiate this claim. In the address Obama (2010) confirmed the cancellation of parts of the US Constellation Program that was planned to return humans to the Moon and then onto Mars at some unspecified date. He stated that, with regard to the Moon – 'We've been there before ... There's a lot more of space to explore, and a lot more to learn when we do.' He continued that it was more important to aim for increasingly demanding targets. To this end NASA would be developing a program and infrastructure to send humans beyond the Moon, possibly to rendezvous with an asteroid, by 2025 as a precursor to a Mars mission around 2030.

It is probable that the ESA will become involved in any human mission to Mars as its Aurora Program sets out collaborative intentions for such a mission and states that it could

become a reality by 2025 (ESA 2008b). This date would appear optimistic in the light of dates for a Mars mission proposed by the US, but nonetheless it does give a clear indication that both parties are serious about a human Mars mission.

The new US position was forecast in the Augustine Report when it stated that, over the next ten years, NASA is scheduled to spend US\$99 billion on the nation's human spaceflight program. But it concluded 'it is perilous to pursue goals that do not match allocated resources' (Augustine et al 2009). The Constellation Program over-extended the funds available and was focused on a return to the Moon as an initial goal.

However, going to the Moon and going to Mars require fundamentally different vehicle architecture and it was improbable the program could deliver both. The new proposals, outlined by Obama in the 2010 NASA Authorization Act which was finally funded in the Appropriations Bill passed in April 2011, utilise the funds in a more focused way by potentially by-passing the Moon and going straight to Mars, upstaging the Chinese in the process.

It should be clarified that there is no serious writing indicating another space race, although Nolan (2008) points out that political rivalry between the USA and China might become significant. Prestige is still important. The ESA document *Human Spaceflight in Europe* reiterates this by stating: 'Space activities help to define nations and their place in the world. Countries that explore space are envied as frontier nations with cultural vigour and leading technologies' (ESA 2009b).

The USA Augustine report acknowledges their image as a space nation, stating that: 'America continues to enjoy a clear global leadership role in space capabilities' and 'NASA is the most accomplished space organisation in the world' (Augustine et al 2009). This is a view that could be easily substantiated by the sheer number of space missions and its impressive achievements. With this comes a certain status, acknowledged by other space organisations as well as the general public, and it is a position the US would not want to relinquish.

A human mission to Mars will undoubtedly be the most challenging and technically difficult enterprise yet considered in space. Knowing this, Russia has invited international cooperation in their ambitious plans for a human Mars mission, unveiled in August 2009. The Russian Federal Space Agency, Roskosmos, admitted that the plan was unachievable

by them alone, but the hope was that it would become the basis for a broad cooperative effort similar to the International Space Station. Many lessons were learnt during that project, both good and bad, Roskosmos admitted, but now a better understanding had developed between the partners that could be built upon and expanded for such a mission as Russia is now proposing (Zak 2009).

The Russian plan aims to go directly to Mars, without using the Moon as an intermediate staging post. This is now the new plan of NASA as described by President Obama in 2010. Preliminary studies for the Russian mission started in 2006 and, in 2009, Roskosmos approved the development of a new heavy-lift rocket and crew vehicle.

In partnership with the ESA, Russia is also conducting a project called Mars 500 which is designed to test the physiological and psychological aspects of human spaceflight. The project is being conducted by the Russian Institute for Biomedical Problems in Moscow. The aim of the project is to simulate an actual mission to Mars, with a crew of six people sealed into a mock-up spacecraft for 520 days and monitored continuously to assess their operational and mental condition. The crew consists of three Russians, two Europeans and one from China.

A shorter 105 day study under similar circumstances was undertaken between March and July 2009. The results of that study were used to fine-tune the 520 day experiment which began on 3 June 2010 and is due for completion on 6 November 2011. The simulated spacecraft consists of four hermetically-sealed interconnected modules plus one external module which acts as the Martian surface for simulated extra-vehicular activity (EVA) which represents operations by astronauts in space suits outside of habitats. *Image 99*.

During the 520 days the crew will undertake procedures for:

- Departure from Earth orbit
- Transfer flight to Mars
- Mars orbital insertion
- Landing on Mars
- Surface operations
- Departure from Mars surface and docking with Earth return vehicle
- Return trip to Earth
- Insertion into Earth orbit and Earth landing

The enactment of these procedures will be as near as possible to a real mission, including a time delay of up to 20 minutes on transmissions from the control centre, living conditions and meals similar to those on the ISS and the use of air-locks and spacesuits for EVAs. Although there will be no effect of weightlessness, the study is more about identifying potential unwanted side-effects of such a mission, which will help in the development of counter-measures and astronaut selection (ESA 2010b). As of late April 2011 the simulated mission had reached Mars and the surface operations had been completed. The crew are now in a return to Earth phase.

Although there are many individual experiments, robotic missions and plans in preparation for a human mission to Mars, there is not, as yet, a definite structured mission. Because of the complexity and need for expensive infrastructure for such a project, combined with the politics from space-capable nations that will not want to be left behind, it is inevitable that such a mission would be a collaborative exercise.

Crawford (2005) makes the case that such collaboration has the potential for a wide range of benefits including scientific, technological, economic, political and cultural. Culhane (2000) observes that, in the sciences, the tradition of international collaboration has always been strong and this tradition has been strengthened by the high cost and access to operations in space.

There are, of course, some hurdles to overcome in collaborative ventures and, in the high-tech environment of space hardware, this often involves government regulations. A case in point is the US International Traffic in Arms Regulation which restricts the transfer of technology to foreign persons or institutions and has been deemed to include spacecraft and components (ESSC 2000). These restrictions have been worked through by NASA with the best example being the building of the International Space Station.

The three largest space agencies, NASA, ESA and Roskosmos, all have policies acknowledging cooperative ventures as the only way forward in future large-scale missions such as a human expedition to Mars. As well, there is political interest in a Mars mission from the governments of those agencies, mainly for the prestige but also because of the growing debate on the existence of life on other planets; a notion that has caught the public interest.

Scientifically there is now a comprehensive understanding of the major issues of a human Mars mission and a large technological base to draw on to resolve the problems. There is no doubt that such an undertaking will be the most challenging project in space exploration history, but there is also no doubt it will capture the minds and imagination of people around the world. However, there are difficulties in major science-based space exploration missions accommodating public involvement. Public enthusiasm for information will drive general and dedicated media sites, as is now the case for most space projects, with space agencies having dedicated websites and some people involved in the project operating a personal blog. But an Exoart project based on an art and cultural engagement with the mission will potentially be able to offer the public a way of actually becoming involved.

### **WHY SEND HUMANS?**

‘A well-trained human could do in days what it’s taken our two intrepid rovers four years to do.’ Such was the comment by Scott Hubbard when talking about the exploration program of the two Mars rovers Spirit and Opportunity (Hubbard quoted in Lovett 2007).

The claim that it is inherently human to explore was covered previously in this chapter and comes primarily from mission planners and space support groups as one point of justification for human space missions. The claim that humans are far superior to robots in terms of planetary exploration comes mainly from scientists intent on getting the most amount of science out of any potential surface mission to another planet.

Human attributes that are superior to robots in exploration terms included greater intelligence (humans made and programmed the robots so we must be more intelligent), adaptability, agility, dexterity and the ability to problem solve and analyse in real time in a given environment (MEPAG 2008a).

These claims can be partly substantiated when comparing the scientific achievements of the Apollo 17 astronauts in the Taurus-Littrow Valley on the Moon and the achievements of the Spirit rover on Mars. In almost a year, Spirit traversed only 3.9 kilometres whereas the Apollo 17 astronauts covered 35 kilometres in three days during only 22 hours of excursions on the surface.

In its first year the Spirit science instruments analysed around a dozen rocks, while the astronauts collected 471 samples, including a three metre deep core sample of the regolith.

They also conducted experiments on lunar heat flow, performed an active seismic profile experiment that involved the deployment of eight explosive devices, measured the local gravity field and also the mechanical and electrical properties of surface material (Crawford 2005).

The Moon analysis can be explored further by comparing the sample return missions of three Soviet robotic spacecraft (Lunas 16, 20 and 24) and the six Apollo surface missions. While not detracting from the very successful Soviet robotic missions, the samples returned to earth consisted of 321 grams of lunar material. The Apollo astronauts collected over 2,000 individual samples from many and varied locations, totalling 382 kilograms (Crawford 1998).

It could be argued that the cost of the Apollo program was far more than any robotic mission so a comparison is not valid. However, this argument can be countered by focussing on the amount and quality of the returned science of the Apollo missions (which were more political than science missions) and the time it would take robots to produce similar results. This could be decades and involve numerous robotic missions. When the cost of these is calculated, human exploration may be more economical than using robots.

As an example, the Spirit and Opportunity rovers cost around US\$1 billion, plus expenses to extend the mission by several years because they were able to continue well beyond their expected failure date. If a human Mars expedition cost US\$100 billion but proved to be more than one hundred times more effective, the cost per discovery in scientific terms would be cheaper than using robots (Crawford 2005).

The exploration of Mars is not necessarily a robot versus human argument. In the Mars Exploration Program Analysis Group document *Planning for the Scientific Exploration of Mars by Humans* (MEPAG 2008a) the idea of a synergistic partnership between humans and robotic devices is reported as a logical way to leverage more from a mission. Under real-time human control the robots could be sent into environments that may be too risky for a human in a spacesuit to go, for example to be lowered down a cliff face to photograph and collect samples of varying geological strata. Robots would definitely add a safety margin to a human mission.

The time difference between a signal being sent from Earth and it reaching Mars is also a problem for controlling robots. This time delay is at least ten minutes and increases as the

two planets move further apart as they orbit the sun. This means that, if the robot experiences something that its own internal computer logic cannot solve, the message for help takes at least ten minutes to reach Earth. Controllers then have to analyse the problem and the signal in response takes another ten minutes to reach the robot. Even then, that may not fix the problem and more information may be required by mission control, taking more time.

The experience with the Mars rovers Spirit and Opportunity has shown that some problems can take days to resolve. In some robotic missions the problems are never resolved which leads to a mission failure. A recent example of a major robotic problem was with the Mars rover Spirit which became bogged in soft sand. Using a duplicate rover on Earth and a sand pit containing material similar to the Martian surface, scientists and engineers spent months trying to build a command regime for the rover that would dislodge it before the Martian winter set in. At this time, the rover would automatically go into hibernation mode because the reduced sunlight on its solar panels does not produce enough electricity over and above what is required to keep its internal batteries charged. Despite enormous effort by the ground staff Spirit could not be moved and has not survived the winter trapped in an exposed position. Of course, had astronauts been around they would simply have lifted the rover out of the sand, a comparatively easy task despite its size because its weight on Mars is only 38% of that on Earth.

This type of scenario was obviously envisaged by the authors of *The Global Exploration Strategy* when they wrote:

Humans have unique decision-making capabilities that allow them to respond to new situations based on previous experience and knowledge. Sending humans to live and work in space takes full advantage of the intellectual capital and real-time reasoning that only they can provide (GES 2007).

The Mars Society, founded by Robert Zubrin in 1998, built two Mars analogue research stations which are operated on Devon Island in the arctic region and the other in a desert in Utah, USA. The stations act as working Mars habitats, with airlocks to enter and exit for surface explorations in spacesuits and a time delay on the radio to mission control. Geologists and other scientists participate in several missions per year to test out theories and equipment in preparation for an actual human Mars encounter.

Frequent experiments centre on the search for life, which would be a primary objective in a Mars mission. Such experiments include comparisons between the observational capabilities of humans and robots by undertaking actual simulations at the stations. During one simulation at Devon Island in 2001 a three member surface excursion went searching for fossils. They ranged over a significantly large area, making decisions to move from location to location based on geological observations of the age of the rocks. The team visually processed the equivalent of millions of still images to lead them to a ridge that they thought may have potential. This proved correct, with the team discovering several stromatolites. As Zubrin (2003) explains:

Stromatolites are macroscopic fossils left by colonies of bacteria, exactly what we will be looking for on Mars. They are not as easy to find as conventional fossils of animals and plants, as they are much less distinctive. Yet we found them on Devon Island under sub-optimal EVA [extra-vehicular activity] conditions in less than two hours. Could a robot landed on the ridge also have found the stromatolites? I believe the answer is no ... We could have wasted centuries trying to explore the ridge with robots and never made a discovery.

Scientists agree that evidence of past or present life on Mars may be quite subtle and would need good observational faculties to recognise and collect relevant rock samples from appropriate environments. Also the accurate deployment of sophisticated geophysics instruments and the careful recovery and checking of these would require unique capabilities that are not presently available in robots, but are in humans (MEPAG 2008a).

The MEPAG (2008a) document sums up by saying that:

Only a human presence in Mars mission surface operations activities could facilitate and achieve the ambitious scientific goals and objectives of MEPAG.

Crawford (1998) states that scientific goals are not the only reason for human space ventures - there are compelling social and political motivations for governments to allocate the resources needed for such missions. The public can engage more readily with humans risking their lives than robots facing power failures. That is not to say the public are not capable of interest in a robot. As Donna Shirley points out with the 1997 Pathfinder mission, when the small Sojourner rover reached the Martian surface the

Internet site took 150 million hits. By the end of the rover's first month of excursions the hits were up to 500 million (Shirley 1998).

The geopolitical reasons for human space missions are the greater cooperation between participating countries, especially between former Cold War adversaries (Crawford 1998). When there are human lives at stake nobody wants the mission to fail.

The main thrust of opposition to human space missions is cost but, as with all large long-term projects, to be realistic this has to be put into perspective. According to Euroconsult, (2009) the worldwide expenditure on space activities in 2008 was US\$62 billion and, although human spaceflight represented the largest single budget item, it accounted for only US\$11 billion. Nearly US\$30 billion was allocated to defence space programs.

NASA has by far the largest budget of all the world wide space agencies and spends the most on human spaceflight. In 2010 NASA's budget was US\$19 billion (Foust 2010). But NASA's budget in 1974 was 1% of the US Federal Budget with the figure in 2010 dropping to 0.5% (Augustine et al 2009).

To expand this context, the US defence budget for 2010 was US\$691.2 billion (USA Department of Defense 2011), meaning the NASA budget was only 2.75% of the military budget. NASA will devote nearly US\$10 billion a year for the next ten years to human spaceflight (Augustine et al 2009) which equates to less than 1.5% of the defence budget. In the case of the USA it is certainly a lot cheaper to undertake human spaceflight than it is to maintain a defence force.

The International Space Station has cost US\$100 billion (Euroconsult 2009) which gives an indication of the capacity of an international cooperative venture to undertake large and expensive projects.

There are no current costings for a human Mars mission, these would depend on final mission architecture and what percentage of currently developed space technology could be used compared to the cost of what would need to be developed. However, the money for any development does not travel to Mars with the astronauts; it stays on Earth creating jobs and opportunities.

The infrastructure required for human Mars exploration such as rockets, habitats and life support systems will cost many billions of dollars but, as an investment in expanding human capabilities and knowledge, it is a price that humanity can easily afford.

## **HOW WOULD WE GET THERE?**

In 1952 rocket scientist Wernher von Braun wrote of his plans for a human mission to Mars. This would involve ten interplanetary spacecraft, 70 crew members and three Mars landers (Sagan 1997). Impractical as this plan is, it indicates the length of time that serious thought has been applied to the problem of physically sending humans to Mars.

The central problem in this exercise revolves around two opposing forces that must be overcome. In simple terms it is the breaking of inertia, the ability to leave the gravitational pull of Earth, and the ability to apply the brakes at the other end of the journey. The various ways in which this can be done has an impact on the type and performance of space vehicles to be used, the way they will be used and their expendability during the mission. The design for each variation is referred to as the 'mission architecture'.

In designing mission architecture a number of issues need to be considered. How much needs to be lifted into Low Earth Orbit (LEO)? Will assembly of infrastructure be needed in space? How much fuel will be needed for a LEO departure and Mars return? Will the spacecraft go straight to the Mars surface or will it go into orbit around the planet first? How much infrastructure and supplies will be taken to the surface? How will the surface vehicle land? Will the return vehicle rendezvous with an orbiting vehicle or head straight back to Earth? How will the return vehicle land on Earth?

Many computations of the above have been incorporated into proposals for Mars missions; in 2005 the Massachusetts Institute of Technology analysed over one thousand of these for practicability, risk and cost (Rapp 2008). The best models depended on the anticipated achievements for the mission (such as a short or long stay on the Martian surface), and what new technology could be developed and incorporated into the spacecraft. This is especially relevant when it came to propulsion systems and whether conventional chemical rockets would be used or a new generation of nuclear thermal propulsion systems would be available.

Whichever mission architecture is decided upon, one inescapable fact cannot be altered, Mars is a very long distance from Earth and this distance increases as the different speeds of their orbits around the sun move them out of alignment. It is for this reason that launch windows, opportunities to take the most direct route, only occur every 26 months.

There are essentially two available scenarios for launch plans and these have been called the 'conjunction class route' and the 'opposition class route'. The main difference between these is the length of stay required on the Martian surface before the return journey must commence. In the conjunction class route, using conventional rockets, the journey to and from Mars would take around six months with a compulsory surface stay of around 18 months. This is needed for Earth to traverse around the Sun to a return launch position, making this a two and a half year mission.

With the opposition class route the return trip from Mars to Earth has to leave at a time when it is still possible for the spacecraft to catch up with Earth before orbital separation makes the distance too great. This allows only around thirty days on the Martian surface and results in a mission of between 400 and 650 days (Nolan 2008). This option has two drawbacks, first the comparatively short stay on Mars as a percentage of the total mission duration, and second it has the potential to extend the flight time for the astronauts which means there would be extra time spent in zero gravity conditions with increased exposure to cosmic radiation. Because of these factors this option has not gained much support.

The Augustine committee *Review of US Human Spaceflight* is in favour of a longer surface stay (Augustine et al 2009) and both NASA and the European Space Agency are committed to the conjunction class route (Nolan 2008).

A mission design that has been much debated was originally proposed by Robert Zubrin (2003) and named Mars Direct. His idea was to split the mission in half and have two separate launch dates. The first launch would consist only of the Earth return vehicle, including supplies and equipment but no fuel for the return journey. According to Zubrin, this would lighten the payload on the launch pad by two-thirds. Because of this, a launch rocket would be able to send the vehicle on a direct route to Mars. On arrival at Mars, the vehicle would be aero captured (a technique using a heat shield to generate friction against the Martian atmosphere to slow it down) and move into orbit around the planet. After a systems check, it would descend through the Martian atmosphere using a heat shield, parachutes and finally a rocket-assisted touchdown.

On board the craft would be a small nuclear reactor power plant that would be deployed away from the vehicle and a supply of hydrogen as a reactant. A chemical plant and other equipment would then start making rocket fuel (methane and oxygen) from the carbon dioxide atmosphere. Oxygen ( $O_2$ ) is stripped from the carbon dioxide ( $CO_2$ ) and then the carbon (C) is reacted with the hydrogen (H) to form methane ( $CH_4$ ). Zubrin (2003) estimates that it would take the plant ten months to fill the tanks of the return vehicle. When this has been achieved and confirmed by mission control, the crew would leave Earth at the next available launch window knowing that a fully fuelled return vehicle is waiting on the Martian surface.

Although this has been acknowledged as a theoretically innovative plan, its viability has been questioned. The main concern is with the robotic refuelling of the Earth return vehicle on the Martian surface, which would be untried technology in that environment. Also in the Zubrin plan there is no Mars orbiting vehicle to provide a safety platform to escape to in the event of an emergency on the Martian surface.

A NASA Exploration Systems Architecture Study (NASA 2005) includes a Design Reference Mission for Mars that is also implemented through a split mission concept. *Image 100*. This comprises three vehicle sets; two cargo vehicles and one round-trip crew vehicle. One of the cargo vehicles would land on the Martian surface with a crew habitat and other infrastructure, while the second carrier would remain in Mars orbit with a Mars lander vehicle. When these two vehicles are successfully deployed, the crew will be launched to Mars, which would be about 26 months after the cargo vehicles. The main difference with this plan is that the Earth return vehicle will not need to make fuel on the Martian surface, therefore the cargo vehicle that lands will not be required to carry a fuel-processing plant so will have more space available for items and equipment needed by the astronauts. This aspect of the mission could be vital for the prospects of an Exoart project that would require an allocation of space within one of the spacecraft. (This is discussed in more detail in Chapter 7, Considerations for an Exoart Project on Mars.)

The analysis of some variations with Mars mission designs is given as an indication of the alternative mission architecture designers must decide on in preparing for a human Mars mission. Many of these decisions will have an impact on the potential viability of the Exoart project and would have to be considered carefully by the Exoart team with a

willingness to adapt concept designs to fit in with the mission architecture that is finally chosen.

Two main areas that will affect the Exoart project are weight and available space within the spacecraft, especially the Mars descent vehicle if it is decided that the Earth-Mars transfer vehicle is left in Mars orbit. Vehicle volume on a long duration mission such as proposed for Mars will always be a compromise. The larger the combined vehicle mass the more difficult it is to get it into Low Earth Orbit, yet vehicles that are too small could have a detrimental physiological effect on the crew and make for difficulties with the storage of supplies and life support systems. It is for this reason that split mission architecture, with cargo vessels launching first, is the preferred option for NASA. A separate cargo vessel is also a feature in the Russian plans.

Low Earth Orbit assembly or vehicle docking will be needed before leaving for Mars so, until the architecture configuration is confirmed, it is uncertain what the internal volumes of the spacecraft may be. However, it has been estimated that, for a six person crew for a round trip to Mars with an 18 month surface stay, total equipment and consumables would exceed 100 tonnes and could be as much as 200 tonnes (Rapp 2008).

The impact of weight would probably be the most critical area for the Exoart project. Fuel is heavy and accounts for a substantial amount of volume in the rocket, so much so that the payload weight that can be launched into space is comparatively small. Therefore, on a Mars mission where a large amount of supplies, equipment and life support infrastructure is required, the weight of every component will be critical.

Rapp (2008) quotes some basic figures to explain this stating that the launch vehicle, being the rocket that will lift the payload into Low Earth Orbit, comprises mostly propellants. Typically, for every 20 tonnes of rocket only one tonne of payload will be lifted to LEO. A heavy-lift rocket may be able to lift around 125 tonnes to LEO and would weigh about 2,500 tonnes on the launch pad.

Nolan (2008) writing about the actual payload that will arrive at Mars estimates that around 80% of the payload in LEO will comprise fuel needed for the rest of the mission. Using the heavy-lift rocket mentioned above as an example, 2,500 tonnes of rocket sits on the launch pad, 125 tonnes is put into LEO and only around 25 tonnes actually arrives on

the surface of Mars. From this it is quite clear that anything that can reduce the fuel load in LEO will have an impact in a positive way on payload delivery.

In the Exoart project weight and volume will need to be very seriously considered. Innovation is the key, along with a flexible and collaborative relationship with mission designers for the project to become a reality. These qualities are incorporated in the foundation for Exoart.

## **SUMMARY**

It has been shown that, within a cosmic context, we are space farers travelling on a large rocky spacecraft. Although astronauts have left the surface, with a few travelling to the Moon, the human missions of solar system exploration came to an end nearly 40 years ago. Today astronauts do not venture beyond Low Earth Orbit. Robotic spacecraft have been dispatched to the farthest reaches of our solar system, and beyond. As a result we know more than ever about our cosmic environment; we also know that Mars is the only planet where humans can operate and that we have the technological capability to reach.

With the knowledge that a human Mars mission is possible there is renewed interest from space agencies and governments to pursue such a mission. Debates around the issue have focused on the inherent nature of humans to explore and the science that can only be achieved with humans on the surface. Others claim that the costs of human missions are too high and that robots are cheaper, and safer. But there are other reasons that appeal to governments such as national pride, perceived technological leadership and societal inspiration and benefits.

In some respects, all sides of the debate on human space exploration are correct. Humans are better at science than robots, human space missions are expensive and there is evidence that the public are responsive to major space endeavours. It is therefore highly probable that a human Mars mission will be a collaborative effort of many, if not all, space-capable nations that can share costs. The Russian space agency, Roskosmos, have publicised their plans for a human Mars mission with an invitation for others to join them. An administrative structure similar to that of the International Space Station has been described as a model that could work for a human Mars mission.

Many documents have been written on a human mission to Mars, collaborative partnerships between space agencies have been established for such projects as the Mars

500 project and new innovative robotic missions to the planet. New rockets, crew vehicles and surface infrastructure are being developed, with the human Mars mission concept accepted amongst all major space policy administrations.

The European Space Agency has stated that a human Mars mission could become a reality by 2025. United States President Obama has indicated a date of around 2030. Mars is now in the spotlight because it is achievable; it has frozen water and an atmosphere that can be used as a resource, and it may have or had life.

Two aspects of a human Mars mission are relevant to the Exoart project. Firstly, there has to be a human mission to establish Exoart outside of Earth, and Mars is an ideal environment for the first project. Secondly, there is now an acknowledgement by space administrators, space committees and governments that societal perceptions are important to the viability of major space projects. Society engagement at an early stage is important and this provides an opportunity for the Exoart project.

## COMPARISON OF MAJOR FEATURES OF EARTH AND MARS

	<b>EARTH</b>	<b>MARS</b>
<b>Diameter in kilometres</b>	<b>12,750</b>	<b>6,800</b>
<b>Average distance from the Sun in kilometres</b>	<b>150,000,000</b>	<b>228,000,000</b>
<b>Length of day</b>	<b>24 hours</b>	<b>24 hours, 37 minutes</b>
<b>Length of Year (in Earth days)</b>	<b>365</b>	<b>687 (669 Martian days)</b>
<b>Surface gravity as a % of Earth</b>	<b>100%</b>	<b>38%</b>
<b>Atmospheric pressure as a % of Earth</b>	<b>100%</b>	<b>1%</b>
<b>Atmospheric composition</b>	<b>78% Nitrogen 21% Oxygen 1% Argon</b>	<b>95% Carbon dioxide 3% Nitrogen 1.5% Argon + traces of oxygen and other gases</b>
<b>Rotational tilt *</b>	<b>23.5°</b>	<b>25°</b>
<b>Temperature range **</b>	<b>-90° to 60°C</b>	<b>-140° to 20°C</b>

**NOTE:** These figures have been rounded to make comparisons easier.

\* **Rotational tilt gives a planet its seasons. Mars has a comparable tilt to Earth and therefore has similar seasons but they last twice as long.**

\*\* **The maximum temperatures on Mars are at the equator in summer. Although daytime temperatures have been recorded at 20°C these are very rare. An average summer day would be below 0°C and could drop to -70°C overnight.**

**This chart has been constructed from the following sources: John 2006; Augustine et al 2009; Tillman & Johnson nd; Hanlon 2004.**

# **CHAPTER 7**

## **CONSIDERATIONS FOR AN EXOART PROJECT ON MARS**

### **INTRODUCTION**

This chapter is a distillation of considerations and procedures that could be expected to be encountered in an actual Exoart project. Because of the very different environments of celestial bodies in our solar system, every Exoart project to these bodies will require different considerations in the design development and construction. Therefore, this chapter focuses on the first human landing on Mars as the hypothetical project. As a human Mars mission is still some years away, the mission architecture can only be estimated by preliminary reports issued to date from space and science agencies. However, the experiences of previous robotic missions to Mars can provide an insight into the structure of projects within such missions.

This chapter also covers conceptual considerations and the aspect of public participation within the project. At the end of the chapter are considerations for the presentation of the Exoart project to the public on Earth along with some of the current equipment and technology that could be utilised. This is included only as a representation of how the project may be recorded and presented as, by the time a human Mars mission eventuates, new and more advanced equipment will no doubt be available.

### **ART OF THE FUTURE**

Arthur Danto (1997) states that the art of the future is unimaginable ‘in any interesting detail’ because we cannot know the historical future. This claim evolved as part of a thesis he had been promoting for a number of years, culminating in the 1997 Mellon Lectures in Fine Art at the National Gallery of Art in Washington, USA, in which he presented a case that we are experiencing the ‘end of art’.

His thesis caused some controversy with art theorists such as Jakob Steinbrenner (1998) and Martin Seel (1998) disputing some of the fundamentals on which the thesis is based. Danto’s case is built on what he sees as the end of the great narrative of art that came about with the advent of post modern art, or as it is now mostly referred to, contemporary

art. This historical narrative referenced styles of previous art movements, something that Danto claims cannot be done with contemporary art because the post modern period is defined by a lack of stylistic unity which, as a consequence, provides no possibility for a narrative direction. This leads to the end of art as it has previously been written about and heralds the period of what he terms 'post historical' art.

Because contemporary art now embraces a completely open meaning to the term 'work of art', with no requirement to reference or even acknowledge art history, there is an 'overall corollary of the unknowability of the historical future' (Danto 1997). It must be pointed out that Danto's main focus in art history lies within the visual arts and in particular painting, which he mostly references to substantiate his arguments.

The strength or otherwise of Danto's thesis will not be debated here; but two interesting points that he makes - the unknowability of future art and the end of the narrative of art are relevant to this chapter.

Danto's arguments on the narrative of art do not appear to apply to Land Art. It is as well to reiterate at this point that a case has been presented in this thesis that shows a narrative from ancient land interventions dating back thousands of years, through to contemporary artworks of today. The strong narrative structure of engaging with the natural environment has been a key element throughout the whole period and is still the focus of writing about the artworks. Style has changed along the way in keeping with the accessibility of machinery, although some artists reject mechanical aids and still prefer to work with whatever the environment provides. In Land Art boundaries have been pushed but mostly within a framework of engagement with the natural environment, including our cosmic environment. This narrative can now be extended off-planet with Exoart projects.

Danto's other point is the unknowability of future art based, as he states, on an 'anything goes' philosophy where artists were 'free to make art in whatever way they wished, for any purposes they wished, or for no purposes at all' (Danto 1997). This will not be the case with Exoart projects and, in this respect, a future for art can be considered.

The basis for this claim on Exoart projects comes from the reality that artists will be part of a space mission team with all that that entails regarding the creation of an artwork that will be dependent on space agencies to bring it to fruition. There will be no 'anything goes' and the artists will not have the freedom to do whatever they wish. They will have

to work carefully within prescribed boundaries and have a clearly defined project concept and a structure for achieving this.

By way of explanation of the processes involved in bringing a project to completion within a space mission, it is of some value to précis the Mars mission involving the two surface rovers Spirit and Opportunity as written by the science team leader, Steve Squyres (2005).

For several years before finally being awarded the project, Squyres had been lobbying for a science mission on the surface of Mars to study in detail the Martian geology over a wide area. NASA, the space agency involved, invites project initiatives through a system called an 'Announcement of Opportunity' (AO) and one was called in 1997 for the scientific payload for a Mars rover that NASA intended to build. Squyres put together a team of specialists who spent many months preparing their tender documents and in November of that year the team was awarded the project, which they named the 'Mars 2001 Project' to reflect the intended launch date. However, only six months into the project, the Jet Propulsion Laboratory (JPL) which was undertaking the design and build of the rover, ran into funding and scheduling difficulties resulting in the whole project being re-designed. The rover was to be replaced with a static lander platform with many of the scientific instruments deleted to save weight.

The disappointed Squyres team put forward an initiative to reinstate the rover component by utilising a small rover that had already been built as a spare for the successful Pathfinder mission launched in December 1996. The small autonomous rover was the twin of Sojourner that was active on Mars for nearly three months. Money was found to accommodate this proposal but the small rover, even when adapted, could not carry all the science instruments originally proposed by Squyres' team. It was a compromise they had to accept to keep their project concept alive.

In the second half of 1999 two major calamities hit NASA space missions. In September the Mars Climate Orbiter reached Mars but failed to go into orbit around the planet and the spacecraft was lost. Then in December the Mars Polar Lander was lost as it was descending to the Martian surface.

NASA came under pressure from government and public sources for the implementation of their 'faster, better, cheaper' regime for building spacecraft, which was seen as

hampering innovation and accepting too many risks. NASA's reaction was to cancel several projects including Squyres' 'Mars 2001 Project'.

Not willing to accept rejection the Squyres team continued to work on ideas for a science rover that could accommodate their original instrument platform. After numerous redesigns, meetings and presentations, in mid-2000, NASA decided to proceed with the Squyres' team proposal for a larger rover with a full suite of science instruments, but to reduce the risk of another major failure two identical rovers would be built and launched to different landing areas of Mars. NASA also decided to increase the budget and launch in 2003 instead of 2001.

The science team, with engineers from JPL, started another new rover design that would fit into the space provided at the centre of an airbag delivery system which was deemed to be the safest way to land on the Martian surface. The airbag centre space was not only a fixed size but also a fixed shape, that of a three-sided pyramid, which was not conducive to an easy rover design.

The rover became more complex, having to incorporate many hinged components and fold-out solar panels. Because of this it soon became too heavy and a 15 kilogram reduction in weight was necessary. Having come so far, the science team were reluctant to eliminate any instruments that they had fought so hard and for so long to include.

As part of the design and construction procedure, NASA insists on a periodic 'Critical Design Review' plus a review by an 'Independent Review Team'. Also, for each NASA project, there is what is termed a 'Level One Requirement' which is the agency's fundamental statement of what the mission is expected to achieve. The two reviews found that the rovers' complex design and their overweight problems would mean that the Level One Requirement would not be achieved. A complete redesign was recommended.

Time was then a critical factor in the mission so more designers and engineers were assigned to the project which inflated the budget by US\$58 million. NASA reluctantly granted the increased budget with a warning that any more over-runs would result in one of the rovers being cancelled.

A final design was approved and construction begun, with every component tested before assembly and the completed rovers fully tested again in a giant thermal vacuum chamber that simulated a Mars environment. Only when everything worked to its design

specifications under these conditions were the rovers loaded into the nose cones of the Delta II rockets and taken to the launch site. With a tight launch window to Mars every 26 months the two rovers were finished with only days to spare.

The happy footnote to this is that the twin rovers Spirit and Opportunity, after landing successfully on Mars, have exceeded all expectations on their performance and returned exceptional scientific results (Squyres 2005).

The above example of necessary interaction with other professionals, the pressure of timelines, the control of budgets and the constant reviewing of the project is something of which an Exoart project team will need to be very conscious.

The fundamental characteristics of Exoart, as laid out in Chapter 2, The Elements of Exoart recognise many of the issues in the Mars rover mission just mentioned. It is precisely these issues, and others covered in this chapter, that make an Exoart project unlike any previous art commission and why the foundation for Exoart is necessary.

### **BUILDING A CONCEPT**

On the face of it, building a concept for an Exoart Project should not be so different from building a concept for, say, a piece of Land Art or Public Art. The concept in any artwork should be the core to which everything relates.

Conceptual themes in Land Art have included the degradation of wilderness areas, the pollution of human environments, urban sprawl, the extinction of animal species, the plight of indigenous cultures, the arbitrariness of land borders and the historical aspects of migration and land settlement. In other instances artists have endeavoured to emphasise the wonders of nature and natural environments or our connection with the world on which we live.

These conceptual themes can be readily understood as they are relevant to planet Earth and its biosphere; however, they would have little meaning on the surface of Mars. To relate meaning within a cosmic environment, concepts would have to relate more to how we perceive ourselves as space beings, our ambitions as a human race towards expansion into the solar system or our quest for knowledge from other planets and star systems.

The need for a strong concept on which to base the Exoart project is likely to become evident during the design and construction stage when the consortium of space agencies

running the mission will inevitably require some flexibility from the art team. Continual project reviews are the standard situation currently in NASA-led missions. Steve Squyres (2005), commenting on the Mars Exploration Rover Mission said that: ‘It was impossible to do anything without somebody reviewing it first’. A strong conceptual base will therefore allow flexibility in design.

It could be expected that the first review of any Exoart project will be an assessment of the contribution such a project would add to the mission. In this regard the project should be able to claim a contribution to public engagement and to achieve this the Exoart project team will have to consider enlisting the support of the public at the outset.

In the Squyres rover project, adverse public reaction to the loss of two spacecraft caused a knee-jerk reaction from NASA resulting in the cancellation of Squyres’ project. However, positive public support can save a project, as was experienced by the British Beagle Mars lander team. Therefore, there is strong justification for space agencies to include a component within the mission framework that offers an engagement with the general public.

It is this engagement with the general public that an Exoart project can utilise to reinforce a proposal to be included in a human space mission. For this hypothetical Exoart project for the first human landing on Mars, a time capsule along the lines of those already discussed in Chapter 2, The Elements of Exoart, will be nominated as a suitable device for public participation.

Although this could become the primary device for public participation the Exoart project team will have to present a strong case for an art initiative to house the time capsule element, otherwise it could be merely attached to some mission equipment that is to be left on the Martian surface after departure. An Exoart project for the first human landing on Mars should be primarily focussed on an art component that will engage with the Martian environment, conceptually reflect the human endeavour of space exploration and be meaningful and associative for an interested public.

## **THE EXOART PROJECT TEAM**

Space mission projects are highly complex and involve the coordination of many diverse elements. For this reason individual projects, even though they may form only a part of the entire mission enterprise, are usually team efforts. In the example of the Mars rovers,

Squyres was the scientific team leader, designated the Principal Investigator (PI) and the rover design team also had a team leader who the PI had to liaise with and come to mutually agreeable design resolutions.

This could represent the type of structure that the Exoart project will encounter, as there will be many aspects of project construction which will necessarily be undertaken by space engineers.

For efficiency in managing what potentially could be a large workload, a project team would need to be assembled. This team would include at least one artist or possibly several if they could work cohesively together. This situation is not uncommon in Public Art projects where artists who have various specialist skills combine to produce a stronger expression of interest for a commission.

It would be beneficial to have an engineer on the team who could liaise with the space engineers at the Assembly, Test and Launch Operations. Also for this particular hypothetical project where a time capsule element is to be included, a specialist in data preservation would be essential.

For the fabrication element of the project, a specialist in high-tech materials would be an advantage, especially in determining how materials may react to the Martian environment. In this respect it would be advantageous to have input from a scientist who specialises in the Martian environment, including its atmosphere.

Finally, a team communications person who can keep in constant touch with the space mission managers, feeding updates to them and, importantly, keeping the Exoart project team up to date on mission developments. The twin Mars rover project is a good example of how broader events can easily have an impact on current projects.

## **PLANETARY PROTECTION**

Everything that we send to another planetary body is subject to international treaties concerning planetary protection. Under the United Nations Office for Outer Space Affairs the *Treaty on Principles governing the activities of states in the exploration and use of outer space including the Moon and other celestial bodies* known as *The Outer Space Treaty* came into force in October 1967 (OOSA nd). There are 195 signatories to the treaty including all the space-capable nations. The treaty acts as a framework on

international space law and contains a number of principles, one of which is: ‘States shall avoid harmful contamination of space and celestial bodies’ (OOSA nd). Administration of the principles is undertaken by the Committee on Space Research (COSPAR) which was established by the International Council for Science.

The COSPAR principles on planetary protection are divided into five categories with varying degrees of stringency depending on space mission objectives. Contamination counter-measures are less if the mission does not take the spacecraft near a celestial body, increasing to a high state of sterilisation if part of the mission includes landing on the surface of a celestial body (Nolan 2008).

Category 4 is designed for missions that intend to land in planetary areas where there may be evidence of biological life, and this category is subdivided into three sections:

- a. for missions not searching for extant life
- b. missions looking for extant life
- c. missions to special planetary regions that are deemed highly favourable for the probable existence of alien life

The Martian surface has a category 4 rating and in every section the requirement is for a high degree of sterilisation of the craft and other landed equipment.

Because the search for life on Mars is a major objective for space agencies there is a high level of concern regarding forward contamination in missions to the planet. Therefore, NASA requested that the US Space Science Board undertake a review of the planetary protection principles and their recommendations were published in 2005. These form part of NASA’s argument for updating planetary protection policy and having this in place by 2016, long before a human mission to Mars will be undertaken (Nolan 2008).

Two of the US recommendations are of particular relevance for an Exoart project for Mars. The first is that the entire Martian surface be recognised as a special region, designating its status as category 4c, giving it the highest protection in this category. The second is the development of superior sterilisation techniques which should include gamma radiation and hydrogen peroxide plasma technologies.

For any Exoart project the team must be aware of these stringent requirements and ascertain how any of these sterilisation procedures will affect the materials that are to be used in the project.

## **CONCEPT DESIGN**

Concept design for an artwork on Mars is likely to be challenging. There will be many variables impacting on materials, transportation and installation that could put limitations on visual aspects of the artwork. The artist team will need to be aware of these variables and what may be utilised at the mission site to supplement or finish the artwork.

The form of the artwork will be crucial as it will not only need to convey the proposed concept but also to engage with potentially billions of viewers on Earth. Ian Heywood (1997) points out how form can be easily foregrounded in such circumstances. Using a design approach that focuses excessively or exclusively on material processes and cliché imagery can obscure the concept or implied meaning. What results he concludes is a failure in the concept design, even though the viewer may not be directly aware of this.

The design of the artwork will also have to take account of testing to withstand spaceflight forces. This will be particularly relevant if any artwork component is to travel in a cargo vehicle, as the flight plan may involve more severe forces than the crew vehicle. Donna Shirley (1998) recounts the flight testing for the Sojourner rover, part of the Pathfinder Mars mission, that was subjected to a force 66 times that of Earth gravity in a centrifuge. Although this was twice the pressure the rover was expected to endure during its flight to the Martian surface, testing always allows for a margin of error.

Aspects of the Martian environment will also have an impact on design decisions. Extreme cold has already been discussed in Chapter 6, Mars: the Human Journey, but the super fine dust that is blown around on the surface may also need a design resolution.

*Image 101.*

On the plus side, the reduced gravity on Mars will assist astronauts with installation and with facilitating other artwork requirements, such as utilising surface rocks to complete the artwork. The reduced gravity will also facilitate the use of thinner or more lightweight construction materials. *Image 102.*

Stephen Hawking (2008), delivering a NASA Anniversary Lecture, suggested that astronaut bases could be dug into the surface for thermal insulation and protection from meteors and cosmic rays. Any equipment taken to facilitate such an option could also be utilised for the Exoart project, providing opportunities for the artwork design.

## **MATERIALS**

Artists who create Land Art come to know how materials will withstand climatic conditions. Within their work they may favour robust materials such as steel, concrete, stone and bronze and use other materials only if they are ultra-violet stable or waterproof. This knowledge comes with experience over time but, in the case of initial Exoart projects, this experience would need to be gained.

Heavy materials will be unacceptable because of total mission weight restrictions and other materials may be untested for long-term durability in a Mars environment.

The Mars Exploration Program Analysis Group (MEPAG) is very aware of this and recommends that materials under consideration for the Mars surface, especially those required for long-term exposure, be tested in a long duration exposure facility. MEPAG lists material degrading phenomena as: radiation; temperature extremes and cycles; wind; atmosphere chemical and electromagnetic properties; regolith and dust chemical properties (MEPAG 2008b). A current example of material degradation is that being experienced by history and art museums within their plastic collections. Innovative ways of preserving these items are now under investigation (Crow 2010). Plastic, once thought to be virtually indestructible, is now viewed like many other materials, to be treated with care and stored in appropriate conditions. Oxygen molecules, ultra-violet photons and heat will attack and break the long chain polymer molecules of many plastics. If the intention for an artwork on Mars is for it to last several hundred years these issues must be rigorously investigated.

There are, however, many innovative new materials being developed and although these will have to be similarly tested for a Mars environment, some are already being formulated to be stable in harsh environmental and industrial conditions. Catalogues of such products have been compiled as a resource for designers, such as the Transmaterial project, where regular updates on innovative materials are posted on the web ([www.transstudio.com](http://www.transstudio.com)) and also available in book form (Brownell 2006).

The Transmaterial project provides seven broad categories of innovative materials:

- **Ultrapperforming:** Materials that incorporate features such as being stronger, more flexible, lighter or more durable than their counterparts.
- **Multidimensional:** Materials with augmented dimensionality that allow them to become more structurally stable. In some cases this is achieved with enhanced surface texture that also makes the material more visually interesting.
- **Repurposed:** Materials that have certain inherent properties that allow them to be used in areas not originally designed for. They can replace other materials that may be more expensive or more difficult to manufacture.
- **Recombinant:** These are multi-material products that utilise two or more different materials that, when combined, form a product that performs better than the sum of its parts.
- **Intelligent:** These are products that are inherently smart by design and often take inspiration from biological systems. Materials in this category are sometimes formed by microscopic manipulation.
- **Transformational:** These materials undergo an intended change in their physical condition as a result of certain environmental stimuli.
- **Interfacial:** These materials act as a bridge between physical and virtual worlds. They can be utilised in areas such as rapid prototyping complex shapes, integrating digital design into physical objects and making the invisible visible.

## **TIME CAPSULE COMPONENT**

As previously referenced in Chapter 2, The Elements of Exoart, a time capsule component within an Exoart project provides the opportunity for the public to engage with the space mission in a meaningful way. Previous time capsule-like events in space missions have restricted participants' engagement to their names or a very short text-like message. For a major human mission to Mars the public's involvement could be increased substantially with an Exoart project time capsule.

Consideration could be given to a set allocation of space that the participant could utilise in whatever way they chose and submit via the Internet. This could produce a snapshot of everyday life and culture in the early 21<sup>st</sup> century that would remain as an archive on Mars

accessed in the future by cultural historians. The main problem for this is the long term viability of data storage and future readability of files in electronic digital format.

Electronic storage media is subject to physical decay and obsolescence. A chart produced by the Canadian Conservation Institute/Verbatim indicates that only one type of storage medium would last beyond 25 years. *Image 103*. The CD-R (phthalocyanine dye, gold metal layer) is assessed as having a 100 year lifetime (Simonite and Le Page 2010). The custom-produced silica glass DVD *Visions of Mars* accompanying the Phoenix Mars Lander is expected to last for several hundred years (The Planetary Society 2007). However, this becomes meaningless if the files are unreadable because of the obsolescence of devices and software to decode the embedded digital information.

This is a major problem currently faced by libraries and museums that collect or store digital media. Many ideas have been debated to achieve a solution but most present further problems. One proposal gaining much attention is that of emulation (Depocas 2001). This relies on being able to run the original software, or some related software that can take its place. But simply saving the original software does not solve the problem because to run it requires specific computer hardware which becomes obsolete almost as quickly as the software. To allow a file to be readable on a computer of the future the file should contain the:

specification of an emulator for the document's original computing platform ...  
Among other things, it must specify all attributes of the original hardware platform that are deemed relevant to recreating the behaviour of the original document when its original software is run under emulation (Rothenberg 1998).

An alternative to electronic storage devices could be to microscopically engrave participants' contributions on small plates, similar to that undertaken for the goodwill messages engraved on a silicon disc and left on the Moon by the Apollo 11 astronauts. (See *Image 2*.) Advances in ion beam engraving technology now mean that thousands of pages of text can be engraved on only a few square centimetres of substrates such as nickel, silicon, plastic or gold. Images can also be engraved but these will only be in monotone. The engravings can be viewed through an optical microscope which, if attached to a monitor, can also be viewed on a screen (Norsam Technologies 2011).

The Long Now Foundation (2011) is using this technique in their Rosetta Project which aims to record and preserve languages that have a high probability of becoming extinct in the next one hundred years. They have started on this project by producing a 74 millimetre etched disc that is contained in an optical glass and stainless steel sphere. *Images 104 and 105.* The top section of the disc can be viewed through the glass hemisphere which gives a slight magnification to the tapering text spiral and central image of the world. Micro-etched on the reverse side of the disc are 13,000 pages of language documentation. Each page is only 0.5 millimetres across and, because the text is physical rather than digitally encoded, it can be read through a 650x microscope.

Although this recording technique overcomes the problems associated with retrieval of electronic digitally recorded information it does restrict the submitted material to text or images and precludes audio and video works.

Other considerations for a Mars time capsule are issues of:

Editing: should all documents and images be subject to certain guidelines regarding decency and cultural tolerance or would this be influencing the true picture of our times?

Copyright: should each participant include a statement that everything submitted was their own work and how might this be checked?

Creative Commons licences could be considered if, as part of the Exoart project, some submitted material was to be used to promote the project or the space mission as a whole. Creative Commons allows material to be copied and distributed with an author credit and under conditions specified by the author with the author retaining copyright (Creative Commons nd). However, this must be considered only as an option for submitting material because some people may want to include statements or images that could be deemed treasonable or at least dangerous for the author in their country of residence. There may have to be some assurance that submitted material will be kept confidential and copies on Earth would be destroyed after the successful installation of the recorded device on Mars. This would then guarantee that the recovery and reading of the device would involve another space mission to that particular site, probably long after the life of the author.

Infringement of privacy rights: could include images and speeches of people recorded without knowledge or consent to have this material included in a time capsule. An interesting subset of this is the digital reconstruction of someone who is dead. This can now be achieved by creating a look-alike digital image of the deceased person that speaks the person's actual words that were captured on an audio recording while they were alive. Such a recording could be edited to distort the person's intention, but would appear as one seamless speech when spoken by the digital creation. Digital technology today is so sophisticated that it provides numerous ways to achieve such look-alikes (Beard 2001). This type of material would be dependent on the use of electronic recording technology within the time capsule and the allocation of enough digital space for video recordings. This would not be relevant if the recording technique chosen for the time capsule was micro-etched plates similar to those produced by Norsam Technologies or the Long Now Rosetta Project.

## **TRANSPORTATION TO MARS**

The important feature of human exploration missions as far as Exoart projects are concerned, is that the longer the mission the more life-support equipment is required, which means cargo transportation becomes a major consideration in the mission. Life-support cargo for a Mars mission will be considerable because of the intended long-term stay on the Martian surface – around 18 months.

Because of storage space requirements for the crew to be able to live and perform adequately on the six month flight to Mars, it could reasonably be assumed that any items not specifically needed by the crew in their transit vehicle would be transported as cargo. The NASA Design Reference Mission for Mars (NASA 2005) features a split mission concept with the cargo being sent 26 months before the crew leave. (See Image 100.) An Exoart project would probably be classified as cargo which means that the project would need to be completed to coordinate with the launch of the cargo.

The logistics of packing and loading the cargo vehicle to land on the Martian surface will be an important consideration in the overall mission. This will not be comparable to packing a shipping container for a short voyage to another port. Infrastructure will include such items as a human surface habitat, power systems, thermal control system, communication system, navigation infrastructure and robotic surface vehicles (Rapp

2008). Some of this infrastructure may be unloaded and made operational by robotic means before the crew arrives. Therefore, packing the cargo vehicle will be crucial to the success of the robotic unpacking, and items cannot impinge on the ease of manipulating other items from the vehicle. For the Exoart project team this will mean careful consideration in the design and foldability of any items to be transported in the cargo vehicle.

The objective that the astronauts assemble and install the project artwork removes the need for robots to be involved. Because the astronauts will have direct input into the artwork assembly and installation, the Exoart project team will need to consider if any parts require an ungloved hand to be assembled. If so, this will have to be done in a pressurised environment and account taken of the completed size to ascertain if it can easily pass through an airlock to be taken out to the Martian surface.

Fixing will also need to be considered carefully because working in a spacesuit will make procedures that are comparatively easy on Earth quite difficult. Anchoring for environmental factors can be less robust than required on Earth. For example, winds on Mars can routinely reach speeds of over 100 kilometres per hour but, in its low pressure atmosphere, this would only have the effect of a breeze (Lovett 2007).

When both the cargo and astronauts are on the Martian surface and images of the landing site are sent to Earth, the Exoart project team may decide that a specific environmental feature would be an appropriate place to install the artwork, however, this may prove to be difficult for astronauts to achieve. This is one reason why the artwork should be designed with the maximum amount of inherent flexibility and preferably in small easy-to-assemble modules that can be put together at the chosen surface location.

## **PRESENTATION OF THE EXOART PROJECT**

An innovative presentation of the Exoart project will rely on two major components: first the quality of the documentation of the project on Mars and, second, the technology and environment used for its presentation on Earth.

On Mars this documenting of the Exoart project will be handled by astronauts in space suits, so the technology for recording will need to be chosen carefully. Cameras and recording devices should be easy to set up and operate, or have capacity to be operated remotely from the astronauts' habitat.

The recording of the artwork in the Martian environment is more than creating a program for people to view on Earth. It is also about visually preserving and archiving a new cultural environment, an environment that few people will experience directly but nevertheless will hold the potential for future engagement and research on Earth. It is for this reason that it is imperative to record the site in the most flexible and detailed way possible. This will also be important if the artists decide that documentation of the Exoart project, from its beginning to its final installation, is to be recognised as part of the artwork. This was mentioned in Chapter 2, The Elements of Exoart, where Tufnell (2006) comments on the contemporary idea of designating research, process and the result as the whole artwork.

Current visualising technology, such as the Giga Pan system (Barras 2010) can capture highly detailed panoramas. The camera on the system takes high resolution images on a rotating tripod head. Stitching the individual pictures together creates one seamless image. These images, over a gigapixel in size, allow virtual exploration of the smallest detail.

Technology can also be combined in innovative ways for particular projects, such as that undertaken at the University of Plymouth, UK (Kwiatek & Woolner 2010). To create an interactive panoramic environment the team combined both still and spherical digital video to produce a branching visualisation of an urban area. This project used an off-the-shelf high resolution spherical digital video camera with six imaging devices within the unit to capture more than 80% of the full sphere (Point Grey 2010). In the University of Plymouth project, the camera was attached to an electric invalid scooter which toured the designated site capturing a continuous 360° image which was then linked with corresponding still images captured with a conventional digital camera.

Combining this type of innovative visual technology for an Exoart project could be practical as the astronauts will very likely have a motorised transportation system to which the camera could be attached.

The method and technology used on Mars to record the artwork and environment will have a considerable impact on the choices available for presenting the Exoart project on Earth. The Exoart project team will need to be deeply involved with this aspect of the project if the original concept is to be fully communicated to the viewing public.

A major consideration here will concern the context of the presentation in relation to place, and the merging of the real and the virtual. The real cultural place is the environment on Mars that contains the artwork, but unlike Land Art the public cannot visit it even if they wanted to. Therefore, the place in which the project is presented should contribute to visitors' understanding of the cultural environment to which it relates. Because of this, traditional galleries may not be appropriate for such a presentation as they are loaded with cultural coding and have the capacity to influence cultural thought along historical lines (Tompkins & Delbridge 2009).

The case has already been made that Exoart is not simply terrestrial art taken to an extraterrestrial location. It has a different cultural context and meaning and references complex relationships between cosmic perceptions and awareness of the place of humans within our galactic environment. It may, therefore, be appropriate to consider utilising non-permanent presentation spaces that can be moved to various locations such as parks or other open areas which clearly separate the Martian cultural space that is being represented from the terrestrial urban environment.

Structures for such presentations may include air-inflated translucent fabric spaces such as those created by artist Monika Gora as part of her large-scale lighting installations (Cerver 2001). The fabrics have good light transmission qualities for image projection from outside that can create an immersive space on the inside. *Images 106 and 107.*

Another structure that has already been used for seamless projection to create an interior immersive space is the hemispherical demountable dome, such as the proprietary Igloo domes (Igloo Vision 2010). *Image 108.* These can enclose a very large internal space that would be suitable for spherical digital projection such as images produced by the cameras from Point Grey, previously mentioned. In September 2010, Igloo Vision installed a 21 metre Igloo dome in London for the Sky Ride cycling event that featured a 360° projection in 3D.

Such a structure could be utilised for the Exoart project using such projections, a simulated Martian terrain on the ground and a duplicate of the Exoart project artwork. The whole immersive experience could be enhanced by pumping refrigerated air into the space, adding to the simulated Martian environment, and offering mock spacesuits for visitors to wear.

The aim of an innovative presentation is to enhance the viewers' experience by emphasising the relevance of the Martian environment and the cultural significance of the artwork. In this regard the outer space that is being referenced in the Exoart project needs a considered inner space for its presentation.

## **SUMMARY**

Danto's ideas on the unknowability of future art and the end of the narrative of art are responded to regarding Land Art and Exoart. In previous chapters a lineage of Land Art has been shown to stretch from prehistoric times to the present that does incorporate a continuing narrative. This narrative, which is both incorporated in conceptual aspects of works and in writing, including contemporary writing, relates to an engagement with the environment. Exoart embraces this narrative, which this chapter claims provides an opportunity for one future direction of art. But an Exoart project, unlike Danto's observation of contemporary art with its 'anything goes' philosophy, will be subject to prescribed limitations and continual reviews.

However, these restrictions were accounted for within the fundamental characteristics of Exoart, detailed in Chapter 2, The Elements of Exoart, that makes a case for the continuing engagement with the environment into the future and into the solar system.

This chapter claims that concepts for Exoart projects will need to relate to human visions of our cosmic environment to make them relevant. Also the Exoart team should ideally consist of specialist people who can contribute to the delivery of a conceptual artwork for Mars.

The concept design stage will need to take account of the Martian environmental conditions and utilise materials that can endure these conditions. As well, attention must be given to planetary protection treaties in force at the time and also to flight testing requirements, both of which could impact on aspects of design and construction. Cargo allocation restrictions and the limitations of astronauts working in spacesuits while assembling and installing could also affect the artwork design.

The time capsule component will need to be considered carefully, especially the longevity of the recording media to be used, the amount of space that could be allocated, the recording method and issues of editing, copyright and infringement of privacy rights.

Documentation of the artwork on Mars should be as detailed as possible for visually preserving and archiving the new cultural environment as well as for providing opportunities for the creative presentation of the project on Earth.

# **CHAPTER 8**

## **DISCUSSION AND CONCLUSION**

### **INTRODUCTION**

Research has highlighted several key areas that relate to the objectives of this thesis. These have been examined in the main chapters. In this final chapter an analysis of these areas will be discussed before conclusions are drawn.

In Chapter 6, Mars, The Human Journey, the plans of several space agencies to initiate a human mission to Mars are outlined. These plans form the backdrop to the research undertaken and have been referenced in several chapters. Because space missions and, in particular, human space missions are currently focused on returns in scientific knowledge, artistic and cultural involvement has been minimal.

The reasons for this are many and have been examined in this thesis, however, one overriding factor has been highlighted - there is no artform specific to understanding and tackling the issues of art beyond our planetary boundaries. This represents a serious impediment to engaging in constructive dialogue with space agencies regarding artistic expression in this new space future.

In response, this thesis proposes building a foundation that could act as a bridge to connect meaningfully with space agencies undertaking human space exploration missions. This foundation has been developed through a diverse range of subject areas that interlink and are consolidated in the structure of this thesis. The art initiative derived from this foundation has been given the name 'Exoart'. Four areas which are recognised as key to building a foundation will now be analysed.

### **FUNDAMENTALS FOR A FOUNDATION**

If art is to engage with new environments revealed by future human space missions, a foundation from which to argue this position is essential. This is so because of one paramount fact; any such engagement will rely on a space mission to bring it to fruition. In effect, there will need to be a symbiotic relationship between an Exoart project and a space mission. For this symbiosis to occur artists will need to know and understand some basic aspects of human space ventures – for example how they can contribute to mission

objectives, as well as understanding appropriate cultural history that will enhance arguments for the inclusion of an Exoart project. Because of this the foundation for Exoart is a foundation of required knowledge, in some respects similar to the foundation subjects in University courses.

What is built on this foundation will determine how Exoart develops in the future, for Exoart projects are likely to be as varied as the associated space missions. This close association with exploration missions, in fact the dependence on these missions for any Exoart project to succeed, makes Exoart unlike any other art initiative.

The use of the term 'art initiative' is used for Exoart in preference to 'artform' which, in traditional terms, implies a certain style or grouping of artworks. In the foundation for Exoart there is no actual or implied style, it is acknowledged that every Exoart project artwork would be unique and more dependent on the circumstances of engagement with space agencies and the integration with each space mission in deciding its completed form than complying with any notion of a particular style. Also the word 'initiative' can be taken literally in the context of engaging with space missions, as it is probable that artists will have to take the initiative in presenting Exoart to space agencies for consideration on their missions. It cannot be expected that there will be a call for expressions of interest, or Announcement of Opportunity as NASA calls it, for an art project on Mars.

By examining the way space missions have been undertaken and then analysing what would be required for an Exoart project the following list was compiled of characteristics for the foundation of Exoart:

- Adaptive
- Encompassing
- Collaborative
- Flexible
- Innovative
- Capable of identifying and articulating objectives

Each of these characteristics was elaborated on and referenced at various points in the chapters where it was shown that there are significant hurdles to be overcome to get any project onto a space mission, therefore these characteristics would be essential for the development of an Exoart space project.

The required knowledge for the foundation is built from diverse subjects covered in the chapters however these subjects, when combined, give the foundation a depth of theoretical writing that would be expected of any new art initiative.

Research for this thesis resulted in a bibliography of over 650 references, however, no theories have been found specific to an artistic engagement with solar system bodies outside Earth. This is not unexpected as there is no artform specific to engaging with environments beyond our planetary boundaries. An adjunct aim of this thesis is to initiate theoretical debate on this issue.

As Paul Connerton (2008) rightly points out – ‘the absolutely new is inconceivable’ and there are many theories covering a wide spectrum of ideas that contribute to the Foundation of Exoart. The art, cultural, historical and scientific underpinnings of the foundation are intended to reflect a broadening view of artistic expression that is promoted by Exoart. By being open to ideas from other spheres and embracing a co-operative involvement with other professionals Exoart is more likely to be accepted as a contributing element in a human exploration mission.

In the far future private exploration companies may emerge that will carry artists and their artworks to outer space environments and, in that eventuality, the foundation of Exoart may change, which would be appropriate and expected from an historical arts perspective. But at the present time government-funded space agencies are the only organisations that will achieve human landings on other planets and their primary focus is on Mars. Therefore, the foundation for Exoart developed in this thesis is structured around this event which could eventuate in the comparatively near future.

## **A NEW ART INITIATIVE**

A salient point was made in Chapter 2, The Elements of Exoart, that prior to the invention of photography, there was no photographic art, prior to the invention of computers there was no computer art. Then, in Chapter 5, Space: Observation and Imagination, the point was made that astronomy was Earth-based until the development of rockets that could put multi-tonne telescopes into orbit.

It follows then that, prior to human space exploration there could not be any Exoart projects. Human space exploration was established just over 50 years ago, with the launch of cosmonaut Yuri Gagarin. But the first human expedition to land on another

solar system body was the Apollo 11 mission to the Moon in July 1969 and further missions ended with Apollo 17 in December 1972 and humans have not ventured beyond Low Earth Orbit since, therefore there has only been the potential for an Exoart project to another body in the solar system for three and a half years. The Apollo missions were all short-term surface duration affairs, and an artistic initiative in these early stages of human space exploration was not a priority.

The proposed first human landing on Mars will provide an outstanding opportunity for an Exoart project if artists are prepared and can demonstrate a sound case for the inclusion of a new art initiative.

The emphasis on human space missions to incorporate Exoart projects and exclude robotic missions has been examined in the arguments presented regarding human versus robotic space missions in general. To summarise, the weight of opinion from scientific quarters is that present-day robots are not capable of undertaking complex tasks in acceptable timeframes to fulfill the mission objectives; therefore they would also be unacceptable for assembling and installing a major artwork. Also, if the artwork is to go beyond an engagement with a new planetary environment and reference the human achievement of interplanetary spaceflight, it is only appropriate that humans install it.

In the document *The Global Exploration Strategy: The Framework for Coordination* (GES 2007) by the space agencies of 14 nations, it is stated that ‘The very difficulty of space exploration is what triggers human inspiration and innovation’. This statement is not specific to space scientists and engineers and could also be applied to the arts for an initiative such as Exoart which recognises and engages with these difficulties.

In Nolan’s argument (2008) that the term ‘exploration’ can be interpreted in many different ways and can include the efforts of individuals to achieve their goals and ambitions, it is not unreasonable to declare Exoart as an initiative of artistic exploration.

The research contained in this thesis is the culmination of an exploration of many areas that contributed to the foundation of Exoart and the first, and probably subsequent, Exoart projects will also be an exploration into the new territories of space agencies and their workings as well as a literal exploration of other planetary environments.

Exoart artist teams will also need to learn new techniques of concept design and construction because other planetary environments will present conditions that are

unfamiliar to artists on Earth. This, together with any artwork having to fit into the confines of a rocket, will make the whole exercise challenging. The finished artwork will also have to undergo harsh pre-flight testing, adding to the uniqueness of this art initiative.

Although spaceflight procedures will be unfamiliar to artists and the sheer scale and complexity of a human space mission may appear daunting, these ventures have opened a door for an informed and well-constructed art initiative to engage with new environments and new human experiences. In this respect an Exoart project can act not only as a new art experience but as a cultural conduit for people of the world also to engage with these space missions.

Of course an Exoart project team will have to go even further, incorporating space science and technology into their repertoire of skills needed to undertake the project. The artist team will need to be as professional as those they are working with, but they will bring a new perspective, a new sensibility, a new vision of art and cultural engagement to the space mission. Research has shown that this contribution should not be under-estimated.

Exoart is an engagement with non-Earth environments and as such it is not Exo Art – in much the same way as sculpture put outside is not necessarily Land Art. Exo Art could be considered as artwork made on Earth, with typically Earth-related concepts, and taken to a non-Earth place. This could possibly happen by way of astronauts taking small artwork items with them on a mission to keep in their quarters and maybe leaving them behind when they return home. Although on Earth these items may be considered artworks and may continue to be considered so while on another planetary body, they would not fit with the foundation of Exoart because they were not made specifically for that planetary body and were not intended for engagement with that specific environment.

This distinction needs to be made because an Exoart project will be commissioned by space agencies, preferably at an early stage of the space mission, and the artist team allowed to work and create within the mission structure, which is one objective of building the foundation for Exoart. The consequences of a space mission art project not proceeding in this way will reduce any artwork taken to little more than a token gesture, or worse, the artwork being deemed inappropriate when it is installed in a non-Earth environment. Time to interact with the space mission and communicate with the global community, along with a commitment to engage with mission objectives and a new planetary environment should produce a result distinctive from art as an afterthought.

Engagement with and installation on a non-Earth environment presents an Exoart project with a problem relating to presentation. Many Land Art installations are in remote and inaccessible locations, yet a determined viewer could undertake the travel to encounter the work. In the foreseeable future this will not be the case for Exoart projects on other planets.

A similar situation exists for ephemeral works of art, especially those that may exist for only minutes or a few hours. In these cases, documentation is crucial to allow the artwork another life beyond its physical presence. This will be the case for an Exoart project for, although the artwork will still exist, people will be unable to view it or its location in reality.

In this thesis two methods to tackle this problem are suggested. Firstly, the project can be recorded from its very beginning and presented as a documented journey. In effect the artwork will not only be the physical form on another planet, but will encompass the documented journey from its inception through to its installation. This would be an appropriate route for presentation especially if the project involved a component of public participation.

Secondly the artwork could be presented in a simulated interplanetary environment or a computer-generated virtual reality, or a combination of the two. Such an immersive environment would allow the viewer to experience a sense of the significant achievement of the project.

The problem here is that, for the audience, there is no first-hand experience of the artwork; there is no reality of it or its location other than through information and presentation. The manner of the presentation, if not fully understood, can become an exhibition that is then viewed as the actual artwork. This is a conundrum faced by many artists creating Land Art who utilise photography as a tool for communicating their work, often with the intention of enticing the audience to visit the site which, of course, for an Exoart project is impossible.

This is an area where Exoart will need to cross boundaries, becoming adaptive, flexible and innovative in its approach to presentation; utilising art, science, technology, theatre and even illusion to embed the feeling of the project reality into the imagination.

## HISTORY

An art engagement with our environment is not wholly about placing a sculptural form in a non-urban setting, it is a human action that says something about the human relationship with the planetary sphere that is our home. For Exoart it is different in that it is about a forthcoming relationship with a planet that is not our home. This relationship dichotomy can be addressed by defining one as historical and the other as futuristic.

The historical base that Exoart is founded upon is Land Art as it has been argued to be the most appropriate artform from which to extend into a foundation for Exoart due to its central theme of environmental engagement. The writing in this thesis about Land Art has covered the term 'environment' from the way it has been perceived by artists and also builders of ancient land interventions. Examples have shown that environment has been taken to include the cosmos, the night sky as well as the land we walk on.

General writing on Land Art tends to focus on form, scale and construction and is light on conceptual issues. Theoretical writing predominantly explores issues of land occupation, aesthetics, audience engagement and the context of Land Art within the wider areas of art theory and history. The conceptual issues of Land Art and the artists' intentions in devoting considerable time and effort into the making are frequently not well covered. In part this may be because, with a few notable exceptions, these artists are not prolific writers yet, when they do write or are interviewed, many of them articulate a deep relationship with nature, place and the mystery of our cosmic environment.

Land Art is not afraid to tackle the big issues of human engagement, to explore ideas of connection with our vast cosmic environment. Waldemar Januszczak (2008) in his film presentation concludes: 'What Land Art does is bring everything else into play ... the artwork is like the final piece of the jigsaw, put that in and all of it is complete'.

The idea of bringing everything into play may well have been influential in the construction and placement of ancient land interventions. There seems no doubt that there are parallel motivating influences between many ancient land interventions and Land Art and these contribute to the argument in this thesis that these are the genesis of contemporary Land Art. Therefore, by extending the ideas and conceptual thinking of Land Art into the foundation of Exoart a lineage of human environmental engagement can be traced back over 5,000 years.

## **CULTURE AND HUMANITY**

The foundation for Exoart is intended as a bridge for the engagement of art with space agencies and their human space missions. This bridge can also accommodate a cultural strand which contributes to and strengthens the case for an Exoart project.

Although an argument has been presented that art and in particular Land Art can and does reference the interaction of people and their cosmic environment, some cultural areas have also been shown to have a similar engagement that sometimes comes from an alternative direction.

In its earliest forms it was a study of the sky for agricultural and navigation purposes as well as the predictions provided by omens. This fascination with and study of the sky appears to have been universal, with evidence from major centres of occupation to remote areas of the world. The development of astronomy to determine the structure of the solar system followed and ideas were incorporated into popular science fiction writing. It was therefore no surprise that keen public interest was shown in the development of human spaceflight.

In a way this can be viewed as a triad of exploration ideas that the foundation for Exoart encompasses. Human space missions are at the cutting edge of humanity's desire to explore unknown environments; art has explored the human relationship between us and our engagement with terrestrial and cosmic environments; and the exploration and adoption of ideas about humanity's place in the cosmos contributes towards cultural development.

Humanity also has a need to remember what it considers to be the important aspects of cultural development and, in this respect, art can act as a mnemonic device. The first photographic images of Earth as a complete sphere suspended in space taken during the Moon missions had a profound effect on the way we view our global environment. The planned human mission to Mars will, like the Moon missions, be a historical event for humanity and will need to be remembered as part of human history.

It has already been stated that Exoart cannot exist without the direct involvement of human space missions, but those same missions will also be inhibited without public support. This thesis has shown how public support can be engaged with the development of an Exoart project.

## CONCLUSION

The Introduction chapter stated a potential problem if artists wish to push the boundaries of art towards engagement with other planetary environments inasmuch as this requires an interaction with space agencies that, at present, have little perception of how art can contribute in any significant way to the objectives of human space missions. When analysing this problem, it is clear that creating an artwork for another planetary environment is completely different from creating similar artworks for a terrestrial environment. The concept design, construction and final installation would involve issues not previously encountered by artists for the reason that artworks specifically intended for another planet have never before been commissioned. Because of this, there has been no need for artists to survey the issues involved.

Until now this has been a purely hypothetical problem but, with recent announcements by space agencies that a human mission to Mars is proposed for the comparatively near future, an opportunity is opening up for a creative and important art engagement with that planet. If artists are equipped with a soundly-based foundation from which they can argue an understanding of the issues involved, plus a historical context for art engaging with environments and cultural themes of exploration, a positive and mutually beneficial outcome is more likely to eventuate. Therefore, the research aim of this thesis asks ‘Can there be a foundation from which art can build a bridge to connect meaningfully with our new space future?’

In researching for the construction of a foundation, this thesis has covered areas of Land Art, argued to be the most appropriate artform to extend into a substantial contributor to Exoart; space history and human space exploration, along with encounters of Mars; ancient land interventions; cultural engagements with environments including our cosmic environment; and the issues involved with an Exoart project on Mars.

This thesis then presented an art initiative for this that has been named ‘Exoart’; a conceptual and theoretical underpinning to this described as the ‘foundation for Exoart’ and references to potential physical Exoart developments as ‘Exoart projects’.

In the Discussion sections at the beginning of this chapter four key areas for a foundation were recognised and, in this thesis, all relevant aspects of these areas have been covered in detail. Therefore a claim can be substantiated that this thesis represents a foundation for

Exoart and the question ‘Can there be a foundation from which art can build a bridge to connect meaningfully with our new space future?’ can now be answered in the affirmative.

It has been acknowledged that this foundation may grow or change over time and it is inevitable that Exoart projects in the future will find only parts of this foundation relevant. Nevertheless the intention is to start the process of thinking about an art engagement with other planetary environments and to equip artists with a substantial body of knowledge that constitutes a foundation from which such engagements can grow.

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