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Towards an LSMR and MSMR (Lunar and Martian Sites & Monuments Records): recording planetary spacecraft landing sites as archaeological monuments of the future

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Imagine the following scenario unfold in the year 2097:

> "The children could hardly wait to jump down onto the Martian surface. They had been cooped up for months aboard the *Sigourney Weaver* on its journey from Earth Orbital Station 5 and now, at last, they could be free of the confines of the ship. After making contact with Martian soil, Ricky and Donna bounded (somewhat shakily, but with much enthusiasm) towards the *Carl Sagan Memorial Station*. They didn't know who Carl Sagan was (and didn't really care), but they had learnt in school that one of the earliest spacecraft sent to Mars had landed at the memorial where it was still to be seen. The children hoped they'd be able to take a piece of the *Mars Pathfinder* spacecraft with them on their way home to earth so that they could prove to their friends that they had been to see the memorial. Their father, however, had warned them that they'd get into serious trouble if he found them tinkering with the old space probe. He was particularly mindful of the recent news coverage of the craft's one hundredth birthday and how scientists visiting the memorial on the occasion had found it to have been damaged by souvenir hunters. He groaned when he saw the kids scramble up *Pathfinder's* ramps and snap its aerial mast in an abortive attempt to climb it..."

One hundred years earlier, as we enter a new millennium, it is a time when we have numerous spacecraft circling our planet, probing various locations of the solar system or lying on the surfaces of other planets. Many of these spacecraft have provided

important scientific breakthroughs in the technology of space travel and in astronomical research yet there is no international legislative framework that protects these craft or their landing sites from future human interference should astro-tourism ever take off (so to speak). In this chapter, I will outline the extent of human exploration of other planets to date, provide an overview of the international regulations relating to space travel and offer some suggestions on conserving the integrity of spacecraft and their landing or crash sites as places of international historic and scientific interest.

The Sites in question

Although the other planets of our solar system are still beyond the reach of tourists, visitors have offered a constant source of disturbance to remote sites on earth, such as the encampments of nineteenth-century Arctic expeditions including that of the ill-fated Sir John Franklin who sought the Northwest Passage in northern Canada in 1845–48 (Beattie and Geiger 1987, 69–70, 98). The discovery, during excavations carried out in the mid-1980s, of the frozen, and consequently well-preserved, corpses of three members of Franklin's crew made headline news around the world.

The corpses' preservation was due to their burial six feet under the ground in permafrost where they had quite literally been placed into a deep freeze. Even though a century or more has passed since the original deposition of such nineteenth-century explorers' artefacts, the near absence of vegetation and the low density of wild animals and people north of the Arctic Circle has allowed many finds to remain *in situ* on the surface of the soil where they are clearly visible to the visitors of today. Consequently, the Canadian authorities have raised signs at these historic sites with the inscription: 'PLEASE do not remove artefacts' (Beattie and Geiger 1987, plate between p 116 and 117) in a sometimes vain attempt to limit damage.

Interestingly, in the context of this chapter, Franklin expedition archaeologist, Owen Beattie, and his journalist colleague John Geiger found that "Apart from the Antarctic, and perhaps a handful of other places, there is nowhere in the world that a person can face solitude as in the Canadian Arctic. It is perhaps the closest experience on earth to that of the astronauts in space." (Beattie and Geiger 1987, 92–3).

Turning our gaze to outer space, there are a number of spacecraft landing and wreckage sites on Mars and, more particularly, the Moon. The bulk of these date from the late 1950s to the early 1970s during the Space Race between the United States and the Soviet Union. Of unmanned spacecraft on the Moon, the United States had sent *Lunar Orbiters 1–5*, all of which were deliberately crashed onto the Moon's surface once they had successfully carried out their orbital missions (Turnill 1974, 58–9). *Rangers 6–9* were also impacted onto the Moon at the ends of their missions (which were to provide data on the nature of the lunar surface prior to the launching of the *Apollo* series of manually-controlled spacecraft: Turnill 1974, 105–6).

Some remotely-controlled spacecraft were successfully soft-landed by the Americans onto the Moon and these include *Surveyors 1, 3, 5, 6* and *7*, *Surveyors 2* and *4* having crashed accidentally (Turnill 1974, 107–8). Meanwhile the Soviet Union successfully soft-landed six spacecraft (*Luna 9, 13, 16, 17, 20* and *21*), crashing seven

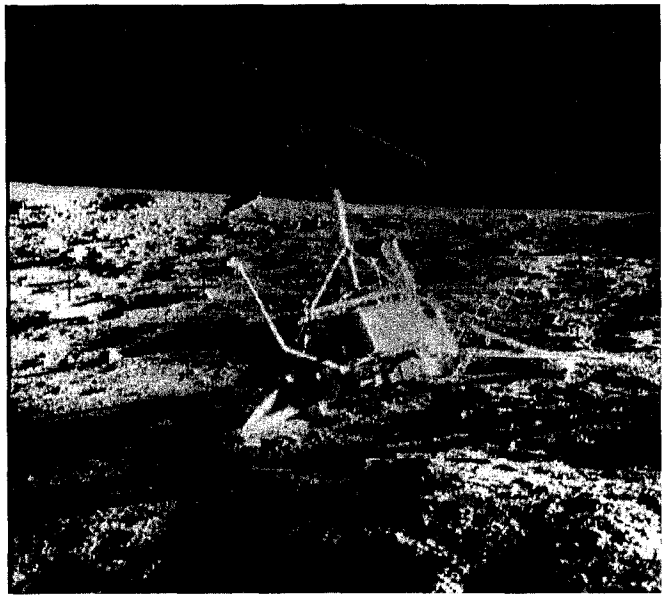

Figure 12.1 Surveyor 3 photographed on the lunar surface during the Apollo 12 mission in 1969. © NASA and the NSSDC.

others in the *Luna* series. As part of their research programme, two robotic exploratory vehicles (*Lunokhod 1* and 2) were deployed onto the Moon by *Luna* spacecraft (Turnill 1974, 134–51). In all, the Moon's surface bears the remains of no less than 29 remotely-controlled spacecraft and two robotic rovers, to which may be added the lunar modules and associated equipment of the manually-controlled *Apollo* missions that I will shortly discuss.

Remote-controlled spacecraft sent to Mars include the Russian *Mars 2* and *3* rovers (the former having crashed onto the surface), the more well-known American landers *Viking 1* and *2*, and of course the recent success-story of *Mars Pathfinder* and its robotic rover called *Sojourner* (Turnill 1974, 157–9; Anon 1976; Anon 1998; Begley 1997). The landing sites of both *Viking 1* and *Pathfinder* have additional historical significance since both were named after space scientists. That for *Viking 1* is now known as the *Thomas A. Mutch Memorial Station* and was named after the NASA Associate Administrator in charge of the imaging team of that spacecraft. When *Pathfinder* successfully touched down on Martian soil on 4 July 1997, NASA Administrator Dan Goldin named it the *Carl Sagan Memorial Station* in honour of the well-known scientist and science publicist who died in 1996 (Friedman 1997).

It might be added here that Mars and the Moon are not the only planetary bodies on which space probes have landed or crashed. Venus was studied over many years by the Russians who sent a series of remotely-controlled spacecraft to explore the

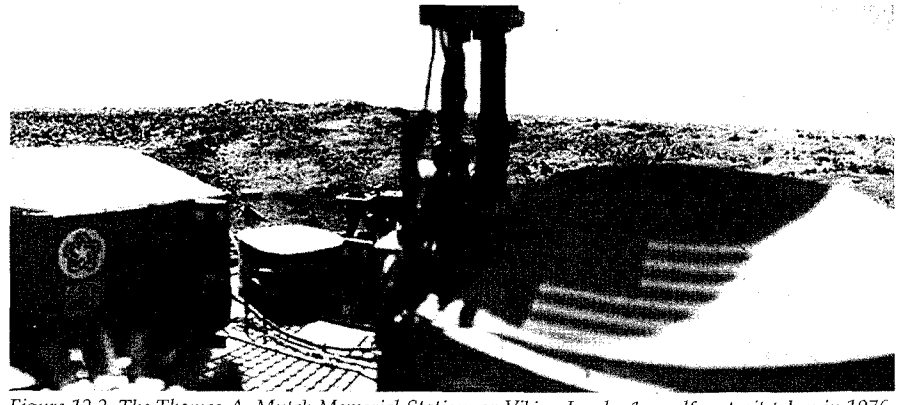

Figure 12.2 The Thomas A. Mutch Memorial Station, or Viking Lander 1: a self portrait taken in 1976. © NASA and the NSSDC.

Figure 12.3 Apollo 15. The lunar landing site photographed in 1971. © NASA and the NSSDC.

planet in the sixties and seventies. Six of these (*Venus 3–8*) penetrated the planet's dense atmosphere either to land or impact onto its surface (Turnill 1974, 172–81). Also, once its orbital mapping mission was completed, NASA's *Magellan* spacecraft was gradually dragged into the Venusian atmosphere in the summer of 1993 to test the theory of aerobraking as a method of slowing down spacecraft in orbit. The experiment proved successful, allowing *Magellan* to add some useful data to that which it had already collected, but it also caused the spacecraft's orbit to decay (as

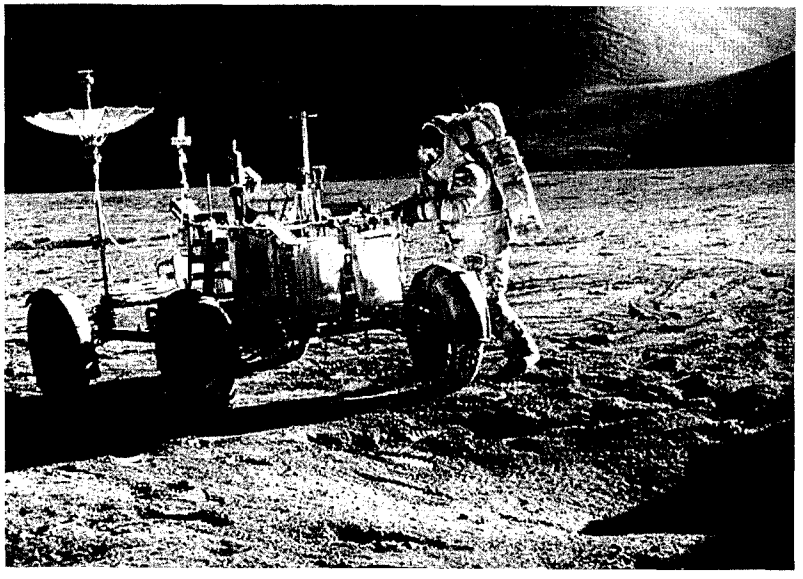

Figure 12.4 Apollo 15. The Lunar Rover seen in action during the Apollo 15 mission in August 1971. © NASA and the NSSDC.

expected) until it entered the Venusian atmosphere to impact onto the planet's surface on 12 October 1994 (Doody 1994; Magee 1995).

Since the intense pressure, heat and corrosive atmosphere on Venus would make it extremely unlikely for the remains of any of these craft to be found (much less visited), there should be no reason for them to be listed in any inventory of landing and crash sites. The same could be said for the *Galileo* probe that plumbed the upper layers of Jupiter's atmosphere for just over an hour before its signal ended on 7 December 1995 (Young 1996).

Turning to human interplanetary expeditions, the only other planetary body to be visited by people so far is, of course, the Moon. There have been a total of six missions, all of them American, and these took place between 1969 and 1972. *Apollo 11* is probably the best known mission, its lunar module, *Eagle*, having brought human beings to set foot for the first time on the lunar surface on 20 July 1969.

Interestingly, from the point of view of conserving the integrity of spacecraft on other planetary bodies, members of the *Apollo 12* crew removed selected parts of the *Surveyor 3* spacecraft which had landed on the Moon two years previously, its landing site being only 600m from that of the *Intrepid*. These parts were taken back to earth for analysis to learn how conditions on the Moon had affected them over time (Ordway and von Braun 1979, 568b–568c). Thus, the precedent for souvenir-taking has already been set, though at least it was for scientific purposes on this occasion.

The Legislation

Okay, so there are lots of spacecraft, and spaceship debris, scattered across the Moon and Mars (with those on Venus and Jupiter probably being no longer identifiable), but how might they be protected from human interference in the future (should this ever arise)? The most important piece of international legislation in place that may serve as the basis for their protection is what is popularly known as the Outer Space Treaty which was opened for signature at Moscow, London and Washington, on 27 January 1967 (United Nations, 1967). This treaty has been ratified by ninety-one countries (United Nations Office for Outer Space Affairs 1967) and re-affirms an earlier agreement of 1963, by which the General Assembly of the United Nations had declared, "That outer space should be used for the benefit of all people and that no nation could claim any part of it" (Bloomfield 1979, 40e).

The Outer Space Treaty is currently the primary international treaty regarding exploration and use of space and underpins others that have followed it. It states that "the exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, [...] and shall be the province of all mankind". It specifies that "there shall be free access to all areas of celestial bodies" and that there will be freedom of scientific research throughout outer space. In addition, no country may claim sovereignty over any part of outer space, such as the moon, on any basis (United Nations 1967b, Articles I and II).

With regard to spacecraft, each of the treaty's signatories retains jurisdiction and control over these and any associated personnel that it launches into space and is internationally liable for damage caused by such craft or its crew to another signatory state or to its citizens (United Nations 1967b, Articles VII, VIII). The liability for damage caused by spacecraft and personnel was spelled out in greater detail in a subsequent international agreement known as the 'Liability Convention' which was opened for signature on 29 March 1972 (United Nations 1972b). Also, according to Article XII of the Outer Space Treaty, all stations, installations, equipment and space vehicles on the moon and other celestial bodies are to be reciprocally open to representatives of the other signatories (United Nations 1967b, XII).

Other treaties that affect the legal status of spacecraft and their component parts include, notably, the 'Registration Convention' of 1975 and the 'Moon Treaty' of 1979. The former, known in full as the 'Convention on Registration of Objects Launched into Outer Space', requires that all space objects "launched into earth orbit or beyond" shall be registered by the launching state (or states in cases of international co-operation) and that the Secretary-General of the United Nations shall keep a register listing standard details of the space objects launched by each country (United Nations 1975).

In fact, two registers are maintained by the Secretary-General. One was begun in 1962, in accordance with a resolution of the General Assembly of the United Nations. This register remains in operation today and records information supplied by states that are not party to the Registration Convention, whilst the other register takes account of launchings made by those UN member states and by intergovernmental organisations that have ratified the convention since 1975 (United Nations Office for Outer Space Affairs, 1975b). These registers would be useful as underlying documents

for any future Sites and Monuments Records of Mars and the Moon since every registered item has an identification number which could be used in the classification of each Martian or Lunar site.

The 'Moon Treaty' (United Nations 1979) offers some interesting legislative features. Firstly, Article 11, paragraph 1, of the treaty states that "The moon and its natural resources are the common heritage of mankind", which (I suppose) makes the entire moon a *world* heritage site, not only in the sense that it belongs to everybody on earth, but that this designation happens to encompass an entire *world* in its own right. Paragraphs 2 and 3 of Article 11 also declare that the moon is not subject to national appropriation on any basis and disallows both organisations (whether governmental, inter-governmental or non-governmental) and 'natural persons' from claiming any part of the moon as property. Furthermore, the placing of spacecraft or personnel on the moon cannot be used to create a right of ownership over the surface or even subsurface of the moon.

But what of the spacecraft themselves? Well, Article 12, paragraph 1, declares that all countries that are party to the Moon Treaty "shall retain jurisdiction and control over their personnel, space vehicles, equipment, facilities, stations and installations on the moon". However, Article 15, paragraph 1, states that "all space vehicles, equipment, facilities, stations and installations on the moon shall be open to other States" that are party to the agreement, although advance notice of any projected visits must be given.

There are a number of problems, however, regarding these treaties. Firstly, in no case has *every* country in the world ratified each of the treaties. This means that non-signatory states that gain the capability of space travel might decide to ignore these treaties and do as they please on other planetary bodies. Furthermore, while there is wide international support for the Outer Space Treaty, only eight or nine countries have ratified the Moon Treaty (United Nations 1997). Finally, there is the difficulty of enforcing these treaties. How, in practice, can a country protect its spacecraft, equipment and even its personnel while these are in space or on other planetary bodies? Furthermore, once the crews of any spacecraft have returned home and once remotely-controlled space objects cease to function, the governments of few countries are likely to take much interest in conserving such scientifically redundant equipment.

Another problem of the various UN treaties concerns the extent to which they cover the activities of civilians in outer space. While the *governments* of signatory states of the Outer Space Treaty and – more particularly – the Liability Convention may be held liable for damages caused by the spacecraft they launch, to what extent can the provisions of these treaties be expected to extend to objects independently owned and launched by civilians or non-governmental organisations? How would the activities of civilians on the Moon or Mars be monitored and what kind of legal basis could be used to ensure the prosecution of private individuals or corporate entities for stealing or vandalising parts of planetary spacecraft and their landing sites?

Once the landers, rovers and other equipment on the surfaces of planets have completed their missions, they could become fair game to companies or private individuals interested in salvaging them, especially whenever the government of a

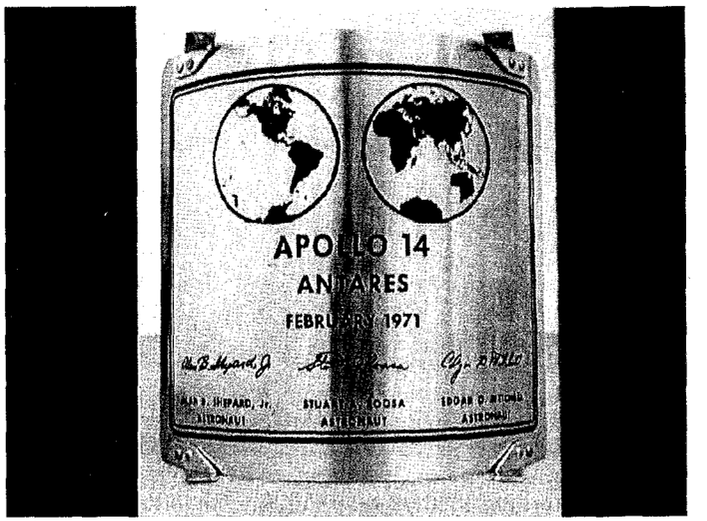

Figure 12.5 View of the commemorative plaque left by the crew of Apollo 14 close to the site of the lunar landing. © NASA and the NSSDC.

country that had launched one of these objects is unconcerned about the object's conservation once it has fallen into disuse. It would, therefore, seem to me that there may be grounds for designating all planetary landing and crash sites to date as historic sites and monuments with international protection in the form of United Nations World Heritage Sites.

The United Nations Educational, Scientific and Cultural Organisation (UNESCO) adopted the World Heritage Convention in 1972 and manages the World Heritage Fund which is used to provide financial assistance in conserving World Heritage Sites (Hickie 1997, 89, 91). If a convention similar to this could be adopted that dealt specifically with the protection of disused planetary spacecraft, their associated equipment and a specified zone around those places where they had landed or roved, perhaps the scenario envisaged at the beginning of this chapter could, for the most part, be avoided. To give it teeth, the governments of each signatory state could be required to enact supporting legislation within their own jurisdictions specifying penalties that would be awarded to those of its citizens who fail to observe the articles of the convention.

To support this convention, I would propose that internationally-funded and publicly-accessible Sites and Monuments Records for both Mars and the Moon could be compiled to raise awareness of this conservation issue and to facilitate any future planning authorities charged with overseeing the commercial exploitation (for example, by mining) of either planetary body. The protected zones would include not only the spacecraft, vehicles and other equipment present on the surfaces of the Moon

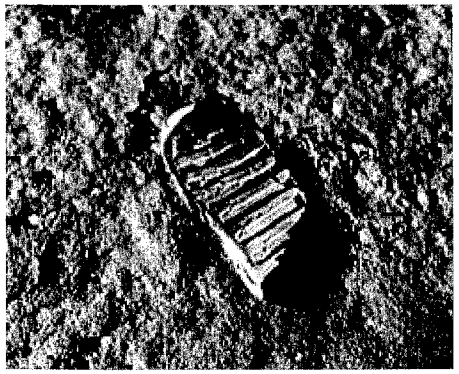

Figure 12.6 "Take only photographs, leave only footprints": an imprint left in the lunar dust by an astronaut during the Apollo 12 mission. © NASA and the NSSDC.

or Mars, but also the area around them that has been explored by rovers or by personnel. Crash sites, on the other hand, would include the point of impact of a spacecraft as well as its debris field.

Early in 1996, Charles Thomas remarked in an essay in *British Archaeology* that "It's a great pity that the poor old Moon seems to boast nothing in the way of artefacts beyond the rubbish we've left there ourselves". Thomas made this comment in the context of humans searching for artefactual evidence of sentient life on other worlds. It may be true that, on the Moon, such evidence is restricted to our own explorations, but why dismiss these artefacts as simply 'rubbish'? After all, is it not true that archaeologists spend much of their time searching for and analysing 'rubbish' here on earth? Surely now, twenty-five years after the landing on the Moon of the last spacecraft (*Apollo 17*) to bear human passengers to another planetary body, there is a case for initiating an international agreement to provide legal protection of the remains of our common heritage of early space exploration. We have the time to anticipate and legislate for the conservation issues that will undoubtedly arise once space travel becomes commercially viable. Let us not wait until our space heritage has been pilfered, vandalised or even destroyed before action is taken to preserve what is left of it.

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13
The Case for Exo-Archaeology

Vicky A. Walsh

Planets outside our solar system have finally been discovered. As we look farther into the universe, the probability of discovering planets or moons capable of supporting life increases. Given the inordinately long period of time necessary to produce intelligent life, and the comparatively short life expectancy of technologically advanced societies, it is much more likely we will discover the *remains* of past civilisations than living cultures we can actually communicate with.

Professional archaeologists must therefore be prepared, not only to respond to unsubstantiated claims of extra-terrestrial remains, but to be actively involved in the search for them. How they define the field of off-world or Exo-Archaeology, how they train themselves in this field to evaluate distant worlds for signs of intelligent life, and how they establish criteria for determining the existence of extra-terrestrial artefacts will be the basis for the future authenticity of archaeological claims on other worlds. In addition to the direct application of archaeological methodology to distant worlds, Exo-Archaeology can be an excellent exercise in space-based methodology for earth-bound archaeologists: attempting to assess remote sensing applications to the planet earth while minimising our human preconceptions. This exercise in objectivity may be a crucial element in training the archaeological students of the future.

What is Exo-archaeology?

Exo-archaeology may be defined as the search for and analysis, interpretation and presentation of, the artefacts and remains of intelligent life beyond the confines of the Earth. There are already in existence a number of professional exo-biologists and exo-palaeontologists (Blake 1995), and it seems likely that an exo-archaeologist cannot be far behind. Exo-archaeology is unlimited in spatial scope as it includes the moon, the planets of our solar system, asteroids and all the space in between, and, more especially, beyond. Such study could certainly include the debris of our own somewhat limited exploration of the universe, and in the future it almost certainly will (see Fewer's chapter in this volume). Some common acronyms currently associated with the search for life beyond earth are ET (extra-terrestrial), ETI (extra-terrestrial