

# Medicine for

# MARS

“Outside one is in touch with the sternest of Nature – one might be a lone soul standing in Precambrian times or on Mars – all is desolation and hard in the durest.”

—*Sir Douglas Mawson*  
9 April 1912

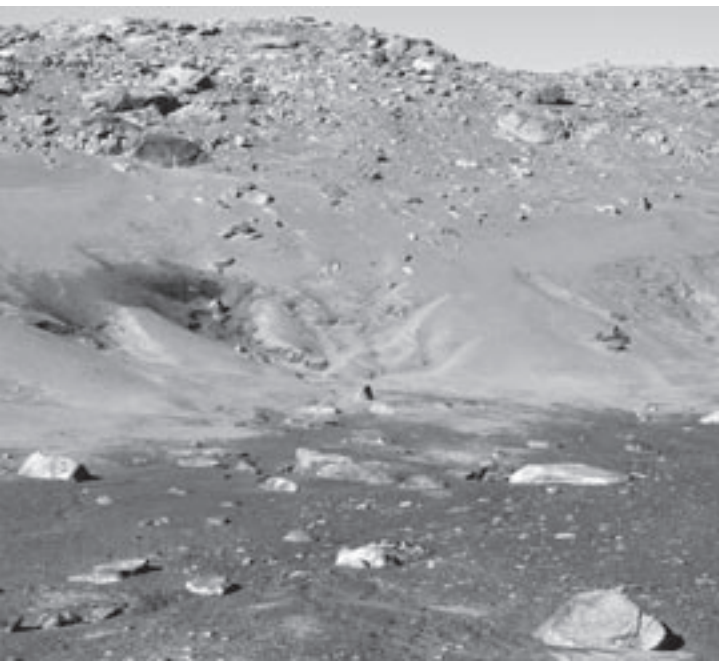
Antarctica or Mars? Sir Douglas Mawson drew parallels between Antarctica and the red planet in 1912. Today, researchers are applying the lessons learnt in the cold and isolated Antarctic environment to preparations for space missions. Photographs 1 and 3 were taken at Antarctica's Marine Plain, between Crooked Fjord and Ellis Fjord in the Vestfold Hills (near Davis Station). In photograph 2 NASA's Mars Exploration Rover *Spirit* looks back on its tracks across a rock-strewn landscape reminiscent of the Vestfold Hills. The image in photograph 4 was captured by the *Sojourner* rover during NASA's Mars Pathfinder mission

This entry in Sir Douglas Mawson's diary shows early Antarctic explorers and scientists saw parallels between Antarctica and space, many of which have been demonstrated as our exploration of space continues. The National Aeronautics and Space Administration's (NASA) Mars Exploration Rovers, *Spirit* and *Opportunity*, have transmitted pictures of the surface of Mars that show characteristics of many Antarctic localities. It would have astonished Mawson to know that 90 years later, Antarctic medical practice and human biological research would assist NASA in its planning for expeditions to the Moon and on to Mars.

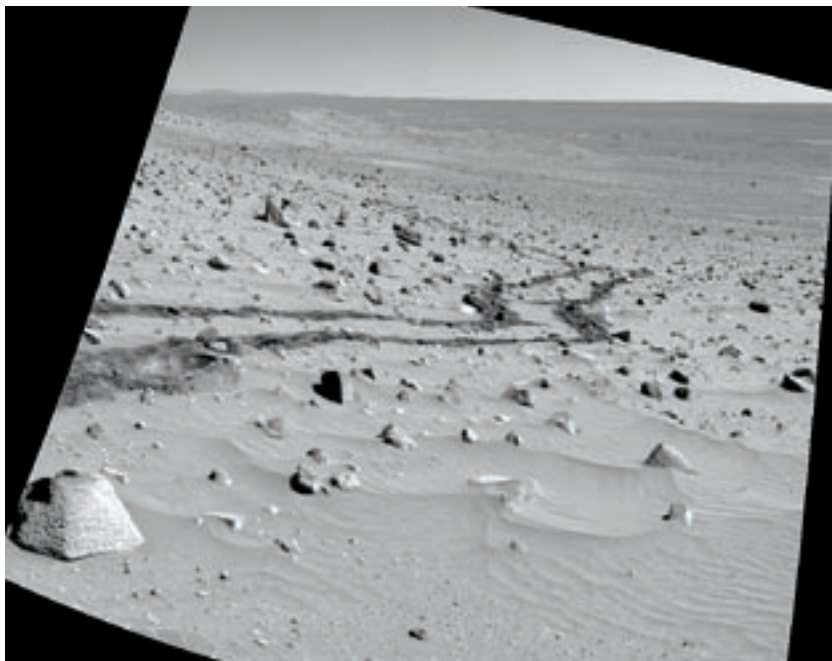
The hostile, dangerous and unfamiliar Antarctic environment, with its isolation, cold, and changing light regimens, is arguably the most extreme on Earth. Small, confined groups who winter for up to a year, have to travel great distances to reach their stations, are totally self-sustaining and require complex maintenance operations. There are many analogues for space, such as undersea, mountains, caves and deserts. However, Antarctica provides an excellent high fidelity, physically isolated, non-simulated analogue for groups travelling on long-duration space missions, even though it does not replicate the space-specific effects of altered gravity and radiation.

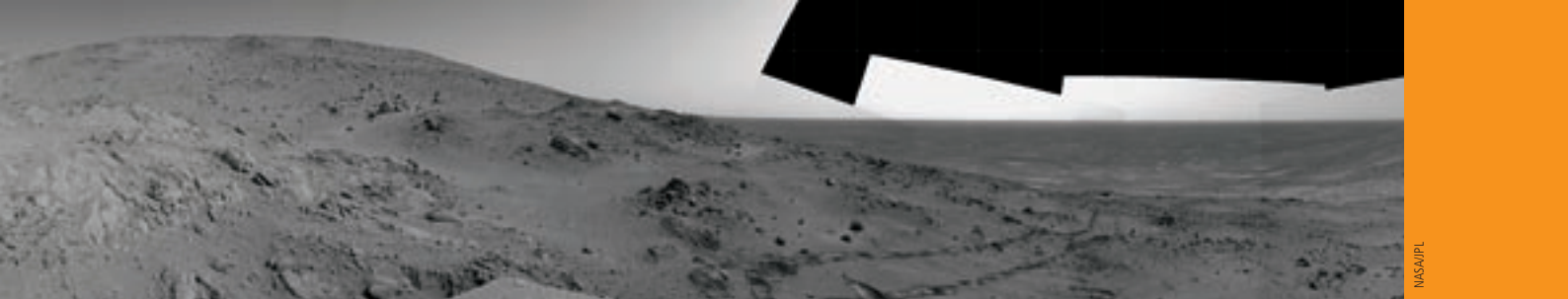
This is especially true in the area of polar medicine as practiced by the Australian Antarctic programme for over 50 years. Such practice had its beginnings on Mawson's Australasian Antarctic Expedition (1911–14) where McLean, the chief medical officer and bacteriologist, combined medicine and research. This gained him the first doctorate for Antarctic immunology and bacteriology.

1 DENNIS CRAWFORD



2 NASA/JPL





NASA/JPL

NASA's Mars Exploration Rover *Spirit* used its navigation camera to take the images combined into this 360° view of the rover's surroundings, with the summit of 'Husband Hill' at the centre.

Australian Antarctic programme epidemiology shows that even with intensive pre-departure medical screening there is no certainty that staff in Antarctica will be free of all medical problems. An example of this is the occurrence of appendicitis on expeditions which led to a policy of pre-departure prophylactic appendectomy for all wintering doctors. Such evidence-based practice will assist NASA in making decisions on policy and the level of medical services, equipment and pharmaceuticals required.

Much of the preventive, clinical and emergency medicine in space will be similar to that faced by the sole Antarctic medical practitioner, although the space physician will have additional space-specific problems. Both scenarios have a scarcity of resources and trained personnel, isolation and confinement. The evolution and use of telemedicine in the Australian Antarctic programme provides significant lessons for its use in space. Conversely, equipment designed for space ultimately ends up in extreme Earth environments; just as intensive care monitoring owes its genesis to telemetry designed for the space programme.

Since 1992, collaborative research between the AAD and NASA has generated some interesting findings in a number of areas, all of which have relevance to long-duration space expeditions. For example, although Antarctic expeditioners exhibit altered immunity and herpesvirus reactivation, they have not contracted any known disease states, and are able to produce antibodies to antigens previously unknown to them, allowing the necessary immune response when needed.

Studies on psychology and behavioural health in both station and field groups, reinforce the need to study

individuals, and not aggregate data at the group level.

Psychological issues, including problems in team interaction, do not affect all members of groups equally. Individual personality factors, the unique combinations of these in each group, and local events, were the primary cause of changes observed, with the degree and length of isolation being important. Most of the staff cope well most of the time and the risk of a major psychiatric problem is low. But if it does occur it is of great consequence, due to the demands on the team to achieve a successful outcome when resources and pharmaceuticals are limited.

One current study is looking at sun deprivation in Antarctica and whether this causes irreversible bone loss (page 29). The aim of the study is to determine if markers of bone turnover increase in expeditioners. As the microgravity of space induces bone atrophy, evidence of bone changes from sun deprivation may be an important additional factor on space missions of several years duration.

A solid foundation has been established between NASA and the AAD for further research, testing of equipment and procedures, and medicine in extreme environments. This will be important to expeditioners wintering in Antarctica or travelling to Mars in the decades to come; the Antarctic analogue for Mars as envisioned by Sir Douglas Mawson.

—DES LUGG

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3 DENNIS CRAWFORD



4 NASA/JPL

