THE MARS QUARTERLY

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On the Cover – Crew member walking back to MDRS

FROM THE FLIGHT DECK

For the past twelve years, the Mars Society has been organizing annual Mars analog studies at the Mars Desert Research Station (MDRS) in southern Utah. MDRS has become a key source of research for human mission planning to the Red Planet, providing hundreds of scientists and students over the years with access to the most authentic Mars simulation facility on the planet.

Although the Mars Society is headquartered in Colorado, our organization is international in scope and involvement. MDRS is at the forefront of our effort to garner international cooperation on Mars exploration. In this year's MDRS field season, researchers from Germany, Russia, Peru, New Zealand, Japan, the Netherlands, to name just a few, are visiting our MDRS site and working side-by-side to learn more about living in a Mars-like environment.

The Mars Society firmly believes that the most effective way for humans to reach the Red Planet is by cooperating on a global scale. Like MDRS already has, the leading space-faring nations – the United States, Russia, Europe, China, Japan and India – need to find a way to collaborate on this important mission, to create a future home for humanity on the planet Mars.

Michael Stoltz
Editor-in-Chief

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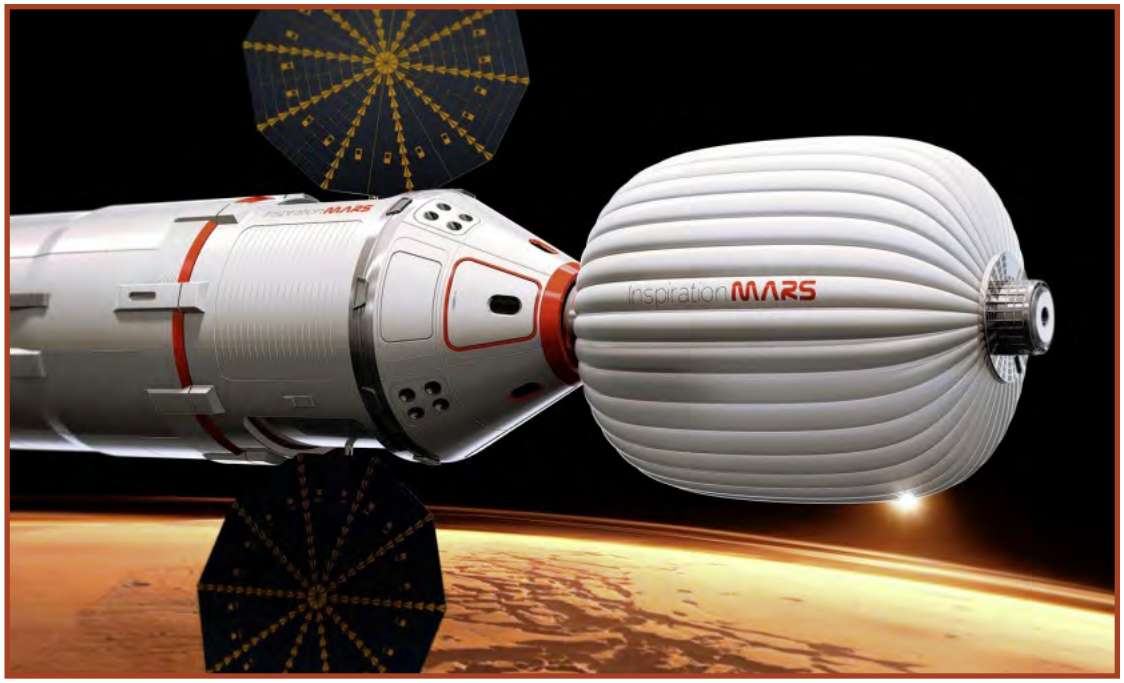
Inspiration Mars Takes Off

Robert Zubrin



Tito spacecraft above Mars

Last week, Inspiration Mars, a group led by millionaire entrepreneur Dennis Tito, announced its intention to fund, develop and launch a two-person Mars flyby mission in 2018.

This development is a potential breakthrough of extraordinary importance.

The issue is not one of novelty. The idea of a minimalist Mars flyby mission has been around for some time. In fact, I pitched one such concept, the Athena mission, directly to NASA Administrator Dan Goldin in his office in 1995, and subsequently published it widely (http://home.marssociety.org/athena-redirect/). The critical difference is that while Goldin found excuses to pass, Inspiration Mars has decided to take the challenge head-on.

To be sure, there are technical differences. Athena would have employed Proton and STS launches. Inspiration Mars aims to use the Falcon Heavy. Athena made use of a space station module and an Apollo capsule for habitation and final bailout; Inspiration Mars uses an inflatable module and a Dragon. Athena employed artificial gravity, whereas the Inspiration Mars mission does not. While both plans travel to the Red Planet on a Hohmann transfer, and then make use of Mars gravity assists without further propulsive maneuvers, the Inspiration Mars plan uses a single assist to turn the spacecraft immediately on a trajectory that leads back through the inner solar system, passing as close to the Sun as Venus, thereby enabling a return to Earth just 501 days after departure.

In the case of the Athena mission, a first gravity assist upon Mars arrival is used to change the elliptical Hohmann transfer orbit into a near circular one with the same orbital elements, but with its orbital plane inclined about 9.5 degrees with respect to that of Mars. The spacecraft then tracks Mars halfway around the Sun, staying within 12 light seconds for 50 days, and 70 light seconds for 300 days, thereby allowing the crew to do a lot of teleoperated exploration of Mars using surface rovers during the trip. After half a Martian year, the craft would encounter Mars again, and executing another gravity assist, swing its orbit back into an in-ecliptic Hohmann transfer for return to Earth.

Compared to the Inspiration Mars mission, the Athena plan would accomplish significantly more Mars exploration science, and also avoid the need to fly into the hot inner solar system or hit Earth with as fast a reentry velocity (12 km/s for Athena, vs. 14 km/s for Inspiration Mars.) However the Athena roundtrip time would be 870 days, compared to 501 for Inspiration Mars, which is a major countervailing advantage for the latter.

Both mission plans are technically feasible, with a moderate amount of development, and a program cost of about $2 billion. Both plans require taking cosmic ray doses that imply a few percent risk of cancer later in life. But a number of astronauts and cosmonauts have already taken comparable doses in cumulative service on ISS and the Mir and survived just fine. The chief question mark that hangs over the Inspiration Mars mission is whether they can raise the amount of funds required to pull it off.

But NASA could easily budget $2

billion over 5 years. The question is why haven't they done this already? Why have they been stuck in low Earth orbit for the past four decades? Goldin's excuse was that "when we go to Mars, we should go with more than two people, and we should land, and do real science" and so forth and so on. Without question, such a more capable expedition would be far preferable to a two-person flyby. But given that NASA is not doing anything of the sort, such remarks amount to little more than bluff. This is particularly so, since NASA has been using the alleged dangers of long-duration spaceflight as show stopping reasons not to go Mars at all until some future fantasy space drive is invented - which brings us back to the central value of the Inspiration Mars mission. Far from answering Goldin's complaint about Athena's limited Mars exploration capability, it would do even less. Yet, that said, it would do what really counts, which is to prove that human interplanetary travel is possible.

As the Athena write up put it, nearly two decades ago:

"The demonstration of such a prototype piloted interplanetary spacecraft would be a visible step that NASA could take now, within current fiscal constraints, which would directly enable sending humans on deep space missions. It could be used to kill forever the dragon of zero-g space sickness that is barring us from the solar system. …

"Once the fundamental feasibility (both fiscal and technical) of human interplanetary spaceflight has been demonstrated by the Athena mission, there would be little standing in the way of follow-on Mars exploration missions in which humans travel to and explore the Red Planet on its surface.

"Before Copernicus, Ptolemaic astronomers believed that humanity was walled off from the heavens by a set of crystal spheres. In a way those spheres are still there, made not of glass but of fear. It's about time we smashed them."

Go for it Tito. Bash those spheres to smithereens. We'll help you any way we can.

Dr. Robert Zubrin is president of the Mars Society and author of The Case for Mars. His latest book, Mars Direct: Space Exploration, the Red Planet, and the Human Future has just been published as a Kindle and Audible original by Penguin.

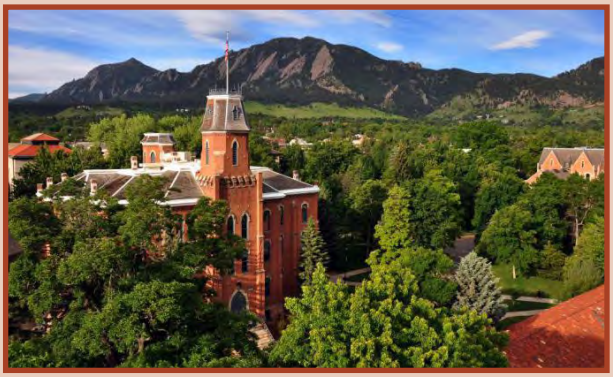
News Brief

Online Registration for 2013 Mars Society Convention

The Mars Society is pleased to announce that online registration is now available for the 16th Annual International Mars Society Convention, scheduled for August 15-18, 2013 at the University of Colorado at Boulder.

To register for the convention or receive more details about the four-day event, including the confirmed speakers list, sponsorship opportunities and general information, please visit the Mars Society's web site – www.marssociety.org.

Please join us this summer!



News Brief

Call for Papers for 2013 Mars Society Convention

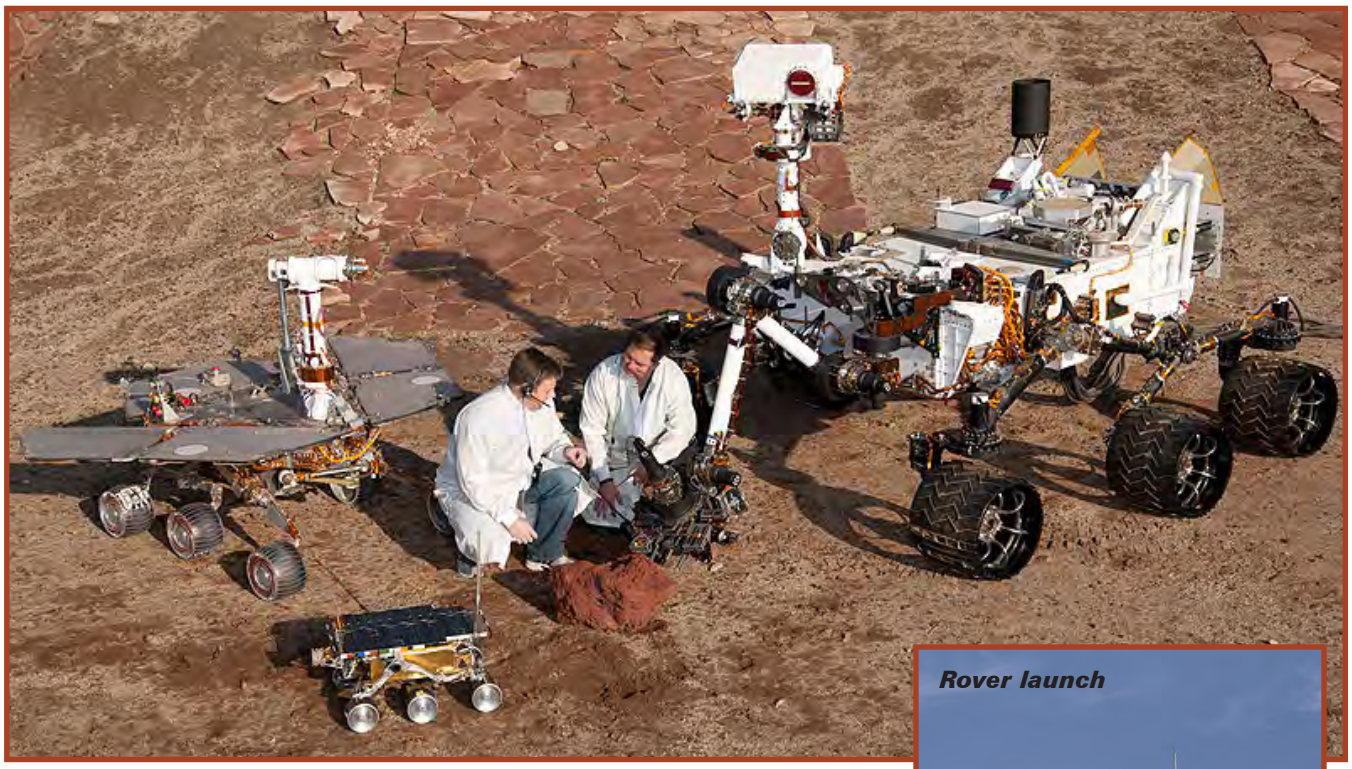
The Mars Society invites presentations for the 16th Annual International Mars Society Convention, scheduled for August 15-18, 2013 at the University of Colorado at Boulder.

Subjects for discussion can involve all matters associated with the exploration and settlement of the Red Planet, including science, technology, engineering, politics, economics, public policy, etc.

Abstracts of no more than 300 words should be sent by May 31, 2013 to: The Mars Society, 11111 W. 8th Avenue, unit A, Lakewood, CO 80215 or via email to: abstracts@marssociety.org (e-mail submissions are preferred).

Martian Evolution: From Sojourner to Curiosity – A Legacy

Jason Rhian



(MER) NASA

On July 4, 1997, Sojourner, a rover the size of a remote controlled car, touched down on the surface of the planet Mars. A part of NASA's Mars Pathfinder mission, Sojourner was the space agency's first unmanned rover sent to explore another world.

Some sixteen years later, two of Sojourner's descendants are currently exploring different sections of the Red Planet. These two Mars Exploration Rovers (MERs) and others planned for the future, while far different from Sojourner, bear striking similarities to the little rover that touched down on the rock-strewn plains of Ares Vallis all those years ago.

Sojourner was part of the Mars Pathfinder mission, which also comprised a stationary landing platform. Pathfinder was launched in December 1996 atop a Delta rocket from Cape Canaveral Air Force Station's Space Launch Complex 17 in Florida. Once it touched down on Mars, the lander opened its panels, much like a flower, exposing the Sojourner rover and its various scientific experiments. After arriving safely, the lander was renamed the Carl Sagan Memorial Station in honor of the famous astronomer who championed space exploration.

While Pathfinder and the Sojourner rover were sent to the Red Planet to learn more about the planet's atmosphere and geography, they were also technology demonstrators. After the rover and Carl Sagan Memorial Station fell silent in September of 1997, NASA began looking at ways to beef up its rover design.

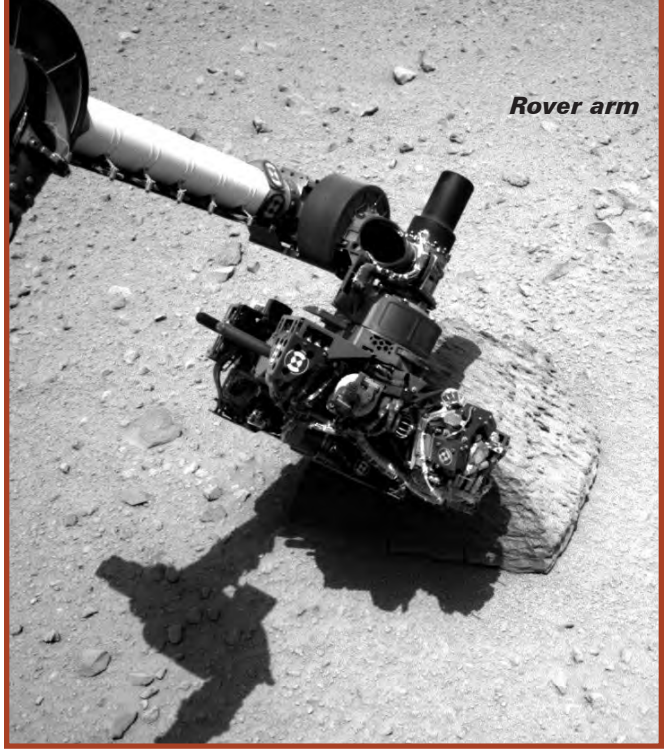
In the 1970s, to increase the chances that a Viking lander reached the Martian surface, NASA launched two of them. In 2004, NASA revisited this policy and launched two MER rovers, named Spirit and Opportunity.

Rover launch

(MER) NASA

They were given these names by a young girl named Sofi Collis through a naming contest held by NASA in 2004.

The "next step" was to take the lander out of the equation and design a rover that did not need a landing platform. It, or rather they, would use



Rover arm

Curiosity - NASA

several pieces of technology which were proven on Sojourner.

The method of landing a spacecraft on another planet via an airbag had been proven on the Mars Pathfinder mission. Launched from the same launch complex and type of rocket that Sojourner used, the twin MER rovers deployed these airbags to touch down on the surface of Mars in January 2004.

Besides using an airbag system like Sojourner, the twin MER rovers also employed a wheel design similar to the one that proved successful on the Mars Pathfinder mission.

"Sojourner was the first rover to incorporate the rocker-bogie suspension system (as designed by JPL's Don Bickler), that effectively enabled the rover to drive over obstacles higher than its wheels, while minimizing the tilt of the rover's main body," said JPL's Mars Science Laboratory Integrated Planning and Execution Team Chief Andrew Mishkin. "The rocker-bogie suspension design has been adapted for both the MER and MSL rovers to maximize their mobility performance."

Realizing that the rover template tested on Sojourner and proven on the twin MER robotic explorers worked very well, NASA decided to take the next step. The space agency's efforts in this regard would produce the largest unmanned, wheeled robot to safely land on another world and conduct scientific research. This rover would carry its own laboratory, hence its name, the Mars Science Laboratory (MSL).

The Mars Science Laboratory rover was later dubbed Curiosity through another of NASA's naming contests, this time by schoolgirl Clara Ma. Unlike the other Mars rovers, Curiosity launched atop one of United Launch Alliance's venerable Atlas V rockets, in the powerful 451 configuration. With four Aerojet-supplied solid rocket boosters, Curiosity needed the extra added punch to send the one-ton rover, about the size of a compact car, to Mars.

The nuclear-powered robot was far too large to use the airbags that its ancestors did. Instead, NASA used a sky crane to drop Curiosity safely onto the Martian regolith. This might seem similar to how the Viking landers touched down, but there were important differences. The sky crane carried Curiosity tucked underneath it; the rover was then lowered to the surface via umbilical cables. Once the sky crane detected that the rover was safely on the surface, the cables were cut and the sky crane traveled a safe distance away where it impacted the surface.

Sojourner tested other technologies that later rovers benefitted from. For example, the tiny robot employed a hazard avoidance system that has been used on all of her descendants. This could be described as a simplistic artificial intelligence, one that sometimes counters the intentions of controllers on the ground. This helps them from making a mistake that could end a multi-million or even billion dollar mission.

"All of the rovers, from Sojourner to MER to MSL, have used vision-based obstacle detection. However, Sojourner relied on a relatively simple light-striping system, while MER and MSL have used stereo vision to construct obstacle maps," Mishkin said. "Sojourner introduced the approach of event-driven sequencing to rovers, in which each command is executed when the prior command completes, rather than at a specified time. This method significantly reduced the time for command sequencing and validation, and has been employed on the much more complex MER and MSL rovers."

Things have not always gone the rovers' way, but the basic design concepts that were tested out on Sojourner have proven to be highly successful. For example, Opportunity, one of the twin MER rovers, was scheduled to last a mere ninety days. She is now on her ninth year roving the Red Planet. Her sister, Spirit, got stuck in 2009 and was converted into a stationary research station. She lasted almost another year before ceasing operations.

There is no doubt that Sojourner and MSL are very different. Sojourner was a small rover that was dependent on the landing station. All total the mission lasted about a month. Curiosity, on the other hand, has a planned lifespan of two years, has no station holding it in place, uses a nuclear power pack, arrived on Mars via a "James Bond" jet pack and has a mast that is as tall as a man. However, if one looks closely enough, one can see characteristics that were passed on from the tiny rover and will also be evident in future NASA missions.

NASA has announced plans to launch a rover very similar to Curiosity in 2020. When this occurs, the legacy begun by Sojourner in 1997 will have lasted nearly a quarter of century. There can be little doubt that the tiny rover's legacy will empower future robotic explorers for years to come.

Jason Rhian is Editor of AmericaSpace.com.

Life in Mars Sim

Melanie Newfield

It's early morning at the Mars Desert Research Station (MDRS), and I sit writing reports at my computer, considering whether I can go yet another day without a shower and wishing I had a cup of coffee. I'm enjoying what constitutes a peaceful moment, as everyone else is still in their staterooms, and I'm the only one sitting at the table where four of us work and eat. The desert outside appears monochrome and lifeless in the early light; it's easy to believe that we are an alien oasis on a barren planet.

Admittedly, it's a strange kind of oasis, our habitat or "hab" in the desert. Life here is filled with odd quirks and compromises. But that really is the point. We are simulating life in a Mars base – "in sim" – and it's these quirky little details that give realism to our simulation.

One of the first things I noticed when I walked into MDRS was the noise. Upstairs, there's a heating duct blowing warm air, a noisy server and a ventilation fan. There's no escaping downstairs or in the GreenHab: the fans run there too. When we head outside, there's the ventilator blowing in our helmets. My first thought when I heard the noise was not annoyance, but, "It's probably quite noisy on a spaceship." I checked, of course, and discovered that the average noise level on the International Space Station is over 70 decibels, which means that often it would be hard to hear a conversation. It takes a lot of technology to keep people alive in such an extreme environment, and that means noise. For me, constant noise is a constant reminder that our situation here is precarious, and that we exist only as part of a complex survival system.

There are many components to this survival system, and each of them has its lessons on life in sim. The GreenHab, where I've successfully grown a few greens to supplement our dehydrated diet, is more evidence of our vulnerability. I'm used to the less precise art of gardening outdoors in mild New Zealand, but here, climate control is delicate. Heaters and fans are needed to balance the extremes of cold and heat encountered even on a winter's day, and dry desert air sucks moisture from the plants frighteningly fast. A day or two of inattention could kill most of our crop. We won't starve without our salads, but one day future Mars colonists will rely on similar GreenHabs to sustain them.

Crew member (author) repotting plants

Caring for the GreenHab is one of several different roles I've taken on as a part of this crew – I'm also the journalist and cook, although I hold the rather ironic title of Mission Specialist. It's correct in that I was assigned to a specific part of the mission: - I'm a biological risk analyst and I'm here to look at the risks associated with Mars exploration. However, we only have a crew of four and there's no shortage of work to do.

The crew workload is another insight into life on a future Mars mission. As well as keeping ourselves and each other alive and undertaking our rather ambitious research program, reporting is a major job. There are up to eight reports a day to be submitted by the commander, engineer, health and safety officer, science officer and journalist. I'm responsible for two reports, the journalist report and the GreenHab report. I'm grateful that there isn't a kitchen report, since I'd be responsible for that, too. This reporting takes me two or three hours every day, and must be submitted to Mission Support within our communication window of 7pm to 9pm. That turned out to be something of a juggling act for me, since I've got 2-3 hours of reports to write at the same time as preparing dinner for four, which is why I'm up early writing.

Far from being a bureaucratic inconvenience, the reporting is an essential part of being in sim. No agency is going to spend billions sending people to Mars and then

expect nothing back but the space equivalent of a few postcards. Future Mars crews will be reporting on everything – every action, every sneeze, every mouthful and quite a bit more – but we won't go there. Sure, computers can automate a lot of this, but if the only data to come back are what a computer can record, we might as well have sent another rover.

The human side adds layers of insight that no machine can possibly emulate; the problem is, we're awkward and inconvenient creatures. We requiring regular recharging – during which we don't work. We have size and shape variations, meaning that everything has to be adjustable or provided in a range of sizes. If provided with the same fuel day after day, we can get bored to the point where we stop eating enough for adequate nutrition, to say nothing of the toxic waste we produce.

The challenge of using human beings instead of robots is never more obvious than when we step outside. This was brought home to me during the "Antipodes" experiment, run by the Austrian Space Forum. Here, teams in Austria, Morocco and New Zealand worked with our crew at MDRS to simulate field communication. It was a simple experiment in principle: crew engineer Emma and I leave the hab, find a suitable site and collect a soil sample for biological analysis, while following instructions relayed via voice chat from Morocco. However, nothing is simple in sim.

The first challenge came before we left the Hab. Establishing a connection with so many sites – one a camp in the desert even more remote than MDRS – took a lot of work. Then we had to get into our space suits and out of the Hab. It's routine for us by now, but I was suddenly conscious of the time it took, knowing that ten people were sitting at the end of our silence.

Once we were outside, I had the easy job, just watching and photographing, but Emma received a series of detailed and precise instructions that had to be followed exactly. Part of the experiment was for the situation to be unfamiliar, so it was the engineer and not the biologist

Crew member cooking

collecting the samples. I watched somewhat anxiously as she clumsily coordinated my laptop (the only device I could get connected), a toolbox containing sampling gear and plastic bags, and her phone (to photograph the site). She moved through the sequence with robotic focus, totally connected to the voice on the computer.

When we discussed the exercise later, she described it like being remote-controlled. With the time lag, future Mars explorers won't be communicating with Earth in this way, but I realise that this is exactly what astronauts experience during space flight. It makes me wonder how they feel about it, how those temperamental human emotions respond to being controlled like a robot.

Human emotion is one of the most challenging aspects of our life in sim, and it will be even more so on any mission to Mars. Putting a group of people together in a confined space like MDRS breaks down normal behaviour in so many ways. I consider myself very lucky to have a good-natured crew, but even then my diplomacy and tolerance is challenged daily, simply because I normally have much more time alone.

It's clear that this issue was a serious consideration when MDRS was designed to provide every crew member his or her own small room, known as a stateroom. The word conjures up an image of something rather grander than reality, but it deserves the title. I've spent time in many different field bases around the world, and the only other time I had my own room was in a tent. My closest experience to MDRS was Scott Base in Antarctica, which is as close to life on Mars as you get on Earth. There, the bunkrooms shared between two were bigger than two MDRS staterooms combined, with comfortable mattresses, windows and wardrobes. But I can feel the difference when I enter my stateroom and have that sense of personal space. I never considered windows a luxury before, but I realise that personal space is worth more to me, and I'm grateful that the designers thought of it.

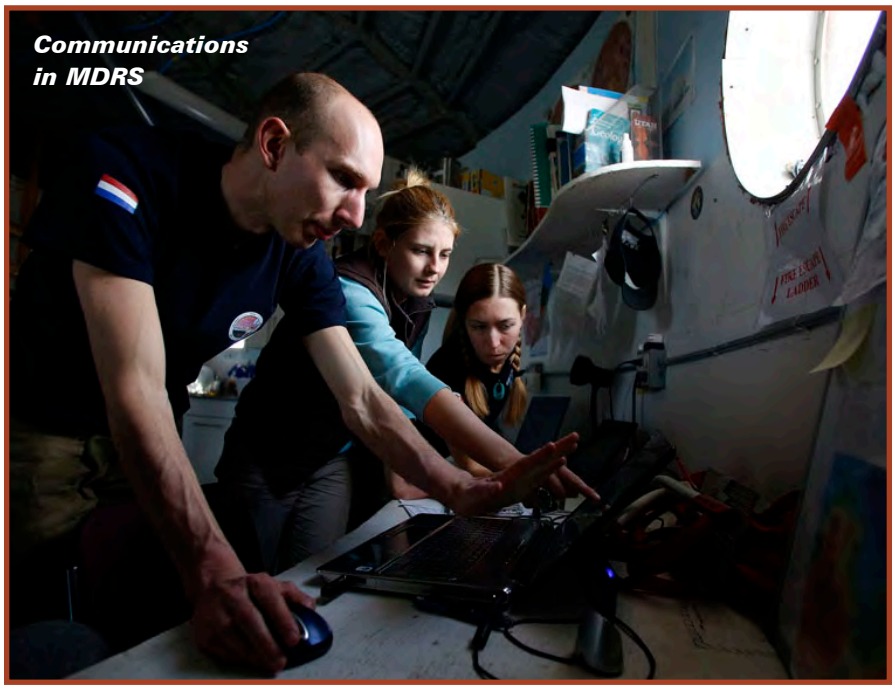
Personal space is another reason I'm up early writing my journalist reports. I miss coffee, but for that I'll have to wait until the rest of the crew are up, since the water pump is above the staterooms, and when a tap is turned on it sounds like someone is drilling the pavement above our heads. Part of me wonders if it's intentional. It's certainly an effective water conservation technique – you can't fail to be aware of using water.

That's why I'm debating whether to take a shower. We have a perfectly good one, sitting temptingly downstairs, newly tiled and with six shelves allowing each crew member space to store toiletries – another concession to personal space that I appreciate every time I brush my teeth. But we are living in the desert where water is difficult and expensive to get. Ours comes in on a trailer, rather than being extracted from the regolith, recycled from our waste or mined from below ground, but, just as on Mars, it is a precious resource requiring careful management.

It's been some days now, and I've been using wet wipes – an effective, if unsatisfying, trick I use while hiking. It does the job and nobody has complained. This morning, contemplating just how many kilograms of wet wipes will be required when we finally launch a mission to Mars, I decide to pass on the shower again. Maybe tomorrow.

Supporting the Human Factor "on Mars"

Jason P. Kring



Communications in MDRS

Jim Urquhart - Reuters

Many elements must come together perfectly for humans to travel in space. From the technology and systems aboard the spacecraft to the mission organization and procedures to the functioning of the crew, every mission relies on a delicate balance between a multitude of factors. Although each piece is crucial to overall mission safety and success, I would argue that the most important element of human spaceflight is, well, the human element.

As an educator and researcher in the field of human factors psychology, I have a particular interest in how men and women work together and perform in extreme environments like long-duration spaceflight. As in many domains, like the military and aviation, space operations depend on teams. There is the team comprised of the crew onboard the spacecraft. Another team is made up of engineers, doctors and scientists back on Earth at Mission Control. Yet the most important team is the one encompassing both the crew and mission support personnel. This "Crew-Support" team must work together for any mission to be a success.

The same is true for operations at the Mars Desert Research Station (MDRS), the Mars Society's Mars simulation facility in the Utah desert. When I joined the MDRS Mission Support team last year as a new CapCom, I was immediately impressed by how much time and work each member of this team devotes to supporting the crews. This is not an easy task. There is the pre-season preparation in terms of selecting crews, upgrading the habitat and ensuring that all of the systems are primed for another season.

Once the first crew arrives at MDRS, the work just intensifies. Every two weeks, a new crew of amazing people arrives at MDRS. There are questions about habitat facilities, planning safe and productive extravehicular activities (EVAs), conducting studies in the GreenHab and using the excellent Musk Observatory, and the MDRS Mission Support team is there every step of the way. When anomalies crop up or if a crewmember has a specific need or request, Mission Support is always ready to help. But above all, Mission Support is there to ensure that each crew member is safe, that an accurate simulation of a Mars mission is maintained and that crews conduct quality science.

Under the excellent leadership of Shannon Rupert, Mission Support is actually a collection of specific teams each devoted to a critical aspect of MDRS. The Engineering Team, for example, is responsible for the smooth operation of many systems and technologies at the habitat, including the all-important Internet link with the outside world, the related server crews use to generate reports called HALp and the suits and vehicles crews use on EVAs. Similarly, the Remote Science, Astronomy and Greenhab Teams work with crews to best utilize MDRS as a research test bed and support the incredible diversity of studies conducted every season, typically from December through May.

Our Administrative Support Team helps spread the word about activities at MDRS via the web, social media and organizing other media opportunities. Another critical team is the Flight Surgeons who monitor and support the physical health of every crew member. This group of medical doctors is on call 24/7 for advice or to provide guidance in the event of an emergency. Fortunately, their services are rarely needed, but each crew can rest assured help is just an email or call away.

Finally, there is the team I have been fortunate to join; the CapComs. The name CapCom, or Capsule Communicator, actually dates back to the Mercury program and refers to the individual designated as the single communication link between Mission Control and the crew. This same approach is used for MDRS. Every evening, CapComs interact with the crew during a "Comms" window of approximately two hours. During this time, we receive several key reports

Crew entering Mars hab

Jim Urquhart - Reuters

from the crew, send important announcements or updates or help facilitate communication between the crew and other members of the Mission Support Team.

In the short time I have worked as a CapCom, I quickly learned it is the interaction between the crew and Mission Support that makes MDRS a great success. The "Crew-Support" team is fundamental to achieving our goals of simulating life on Mars. Mission Support is the crew's link to the outside world, its connection to "Earth," just like the crew is Mission Support's link to life at the habitat. Only by working together, as a single team with a shared vision of the mission, can we ensure that MDRS remains one of the world's safest, most accurate and scientifically valid simulations of life on the Red Planet.

News Brief

Tremendous Growth in Mars Society Facebook Presence

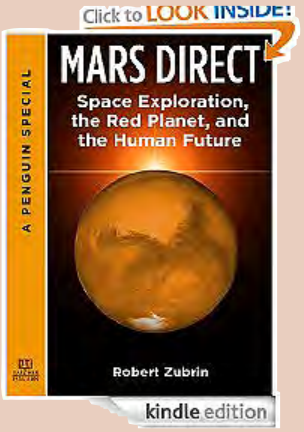
With social media continuing to grow in popularity and influence, the Mars Society has focused on expanding its involvement with major online social networking services, including Facebook, in order to promote its cause.

The Mars Society's presence on Facebook, in fact, has nearly doubled since the beginning of last year, with its current number of "likes" now topping 5,605 (as of March 10th).

More and more people are connecting with our group's Facebook page in order to receive daily updates about the Mars Society, as well as the latest news on Mars-related research. Members also participate in wide-ranging discussions on Mars exploration strategy and planning.

Come join us online! https://www.facebook.com/TheMarsSociety

'Mars Direct' - Read Robert Zubrin's New 50-Page Kindle Edition



The human race is at a crossroads. In the coming years, we will make key decisions about our human spaceflight program that will lead to one of two familiar futures: the open universe of *Star Trek*, where we have the opportunity to spread our wings and flourish as an interplanetary species, or the closed dystopia of *Soylent Green*. If we ever hope to live in the former scenario, says Mars Society founder and president Dr. Robert Zubrin, our first stepping stone must be a human mission to Mars.

In MARS DIRECT: Space Exploration, the Red Planet, and the Human Future, a new 50-page Kindle edition by Penguin Publishing, Dr. Zubrin investigates the challenges and benefits of a manned Earth-to-Mars mission. These are challenges which, according to Dr. Zubrin, we are technologically more prepared to overcome than the obstacles of missions to the Moon in the 1960's and 70's. Dr. Zubrin's plan could feasibly have humans on the surface of Mars within a decade. MARS DIRECT also discusses:

- The current predicament and bureaucracy of NASA and how it is crippling our space program.
- The promise of privatized space flight from companies like SpaceX and how they are making more progress than government programs.
- The larger importance of opening the final frontier to humanity and how it could be integral to our survival.

Dr. Zubrin posits that man's future as a species is intertwined with our ability to explore space and specifically Mars. In order to ensure humanity's survival, we must take the necessary baby steps away from the cradle that is planet Earth or face the possibility of our ultimate extinction.

Follow the Martian Salt

Paul Scott Anderson

You may be familiar with the phrase "follow the water" when it comes to the search for life on Mars, and for good reason - any place on Earth where there is liquid water, there is life. So logically, the best places to look for evidence of past or present life on Mars would be where there has been liquid water in the past or perhaps even still is, underground. But now there is also another approach being taken, in terms of possible present-day habitability in particular: follow the salt.

For a long time now, it has been postulated that liquid water may still be possible on Mars today, thanks to salts. From the various lander and rover missions, it is already known that salts such as perchlorates are common and widespread on the Red Planet. Bright deposits have even been churned up from just below the surface by the rovers' wheels (see image above). These deposits are evidence for liquid water on or near the Martian surface in the distant past, but what about the present?

On Mars' surface, it is normally too cold and the air too thin to support liquid water. But water with a high salt content, i.e. brines, can remain liquid under lower atmospheric pressures and in lower temperatures than pure liquid water can. To scientists, the perchlorate salts are an exciting discovery. As Chris McKay from NASA Ames Research Center puts it, "I would say it is probably the most important astrobiological discovery since Viking - the discovery of perchlorate." The perchlorates could explain why the Viking landers in the 1970s failed to find any organics in the soil, even though the other life-detection tests (for microbes) gave seemingly positive results. When the soil was heated, the perchlorates would have reacted to destroy any organics present.

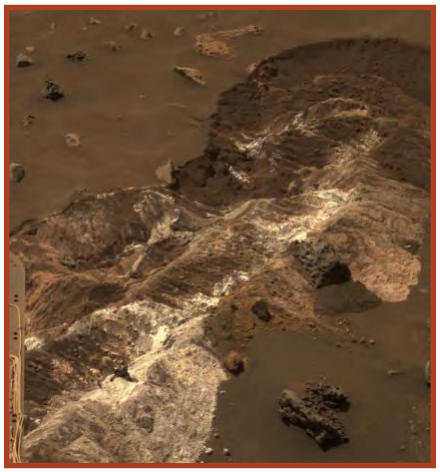
Salts could also help the soil to better retain water absorbed from the atmosphere, a process called deliquescence. This would be very beneficial for any putative microorganisms, as more moisture would be retained during humid periods.

But these salts have other implications for possible microbial life: if there are any pockets of liquid water still underground, they might provide an ideal niche for life to survive. Such briny water can be very inhospitable for most life forms, except perhaps for some extremophiles. But on a dry planet like Mars, any water might be better than no water at all.

As it turns out, these brines may have already been observed from orbit. The Mars Reconnaissance Orbiter has found several locations where briny water seems to be coming to the surface from below. These dark streaks flow downward on sun-facing slopes; known as recurring slope lineae, these streaks are seasonal in appearance and always form on such warmer slopes. Briny water is still considered to be the best explanation, since these types of streaks are different from others thought to be caused by dry dust avalanches. It is also thought possible that some salts less toxic than perchlorates may be involved.

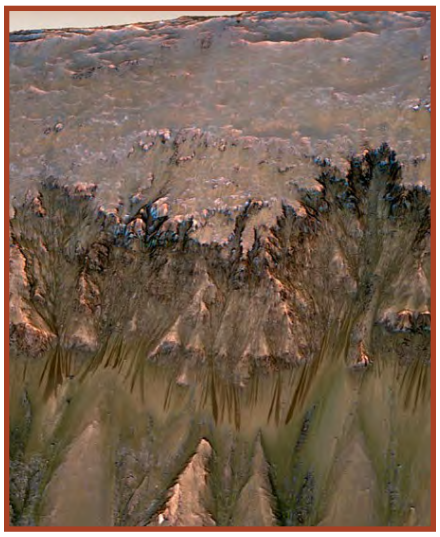
This discovery has changed ideas about the best ways to search for evidence of life on Mars. David Page from the University of California sums it up this way: "I'm struck by how different this discussion is than just a few years ago. There are clearly places that water activity does appear to be occurring on Mars." And as Alfred McEwen from the University of Arizona adds, "Now we have some very strong ideas about where to go and what to look for."

It is also possible that non-salty water may still exist on Mars, deeper below the surface where temperatures would be warmer. Subsurface aquifers would indeed be an exciting find.



NASA / JPL-Caltech

Bright, salt-rich soil churned up by the Spirit rover's wheels on January 12, 2006.



NASA / JPL-Caltech / University of Arizona

Recurring slope lineae in Newton Crater, as photographed by the Mars Reconnaissance Orbiter. They are the best evidence so far for briny liquid water currently flowing on Mars.

Either way, given all of the new evidence we now have, it would seem prudent to follow both the salt and the water in the quest to discover past or present Martian life.

Paul Scott Anderson is a writer at AmericaSpace.com.

A Dangerous Journey: Antarctic Team Braces for `White Mars'

Q&A with Alexander Kumar, by Matt Camara

As a group of modern day Shackletons prepare for the most audacious — and dangerous — journey of their lifetimes across the barren ice of Antarctica, The Mars Quarterly had a chance to sit down with one of team's lead researchers for an in-depth look at the upcoming trans-Antarctic crossing known as The Coldest Journey, which includes a fascinating element entitled White Mars.

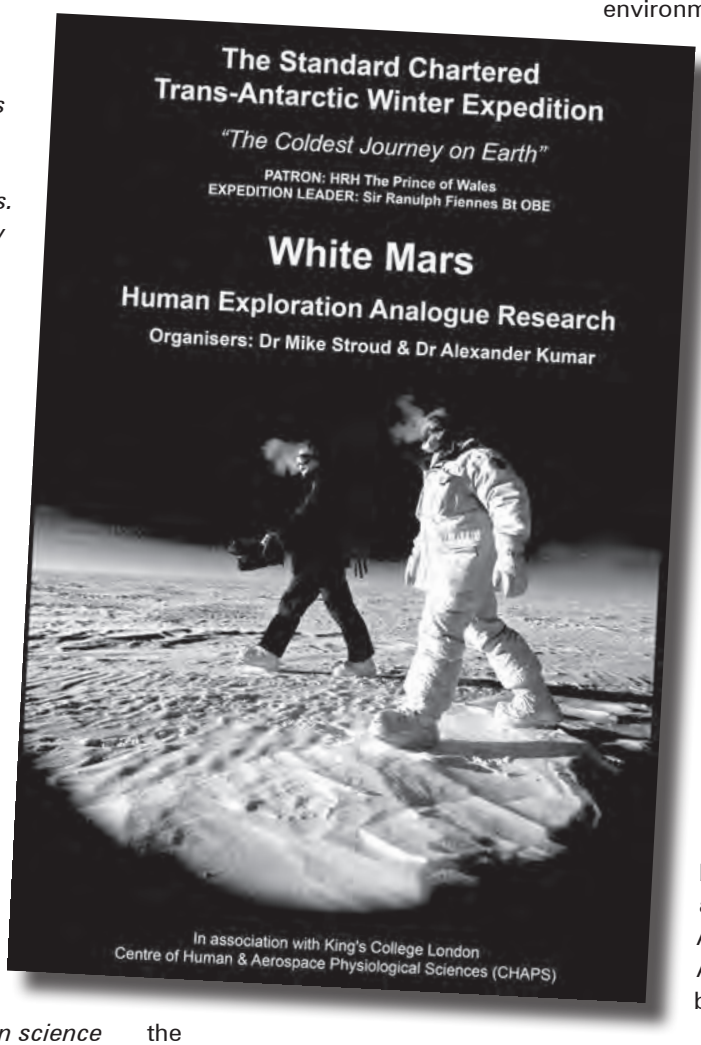
White Mars — inspired by the title of Kim Stanley Robinson's novel Red Mars and billed as a way to see how humans handle the worst isolation the planet can throw at them — will see six of the world's most experienced and dedicated explorers depart on March 21st from the eastern coast of Antarctica on a frigid transcontinental journey that will study the limits of human endurance in an environment where there can be no mistakes.

In early December, as the teams were preparing to leave for the Antarctic, The Mars Quarterly spoke with Dr. Alexander Kumar, a doctor who has served on the frozen continent before and is one of the two organizers of the human science research to be conducted during the expedition (although he will not be going himself), to get a sense of what White Mars is about and if it's really as dangerous as it sounds (it is).

TMQ: Can you just give us a brief rundown of what The Coldest Journey and White Mars are and what our readers need to know about them? What's your role?

Kumar: Sure. The Coldest Journey is the first attempt at crossing the Antarctica during the winter. It will involve a long extended period of complete physical isolation.

Sir Ranulph Fiennes (the leader of the expedition until severe frost bite forced him to pull out of the journey in late February) has made the impossible for the rest of us seem perfectly possible, and in the same way that thinking applies to a manned mission to Mars.



I'm working with Dr. Mike Stroud (the expedition's medical advisor) to put together a scientific human science protocol that will help study the six crewmembers as they navigate what will be one of the most difficult, isolated, remote and extreme expeditions ever undertaken.

For the protocol, we wanted to use this polar traverse as a space analog environment because it offers many parallels with long-haul space flight missions, including perhaps traversing on another planet.

It was my idea to make this, well, the title, White Mars.

TMQ: How long have you been interested in space travel and in studying extreme environments?

Kumar: Ever since I was a boy, really. I've always traveled and found myself in extreme environments. It's only since becoming a medical student and later as a doctor that I've been able to work in those environments. I'm interested in how different people cope, adapt and survive in those extreme conditions, and I've been privileged to serve in areas from the Amazon to the Arctic and now to the Antarctic and many places in between.

It's been interesting watching how the different elements between human physiology and psychology react and cope. In the winter I just endured at Concordia Station, I watched human psychology crumble to the point of breakdown. It is rather predictable, without adequate pre-screening and training.

TMQ: Why Antarctica? What can we do there that can't be done on, say,

Devon Island or other extreme places?

Kumar: Actually I'm very keen on working on Devon Island because I think it's going to come up into its own in the future. It's only in its infancy really.

Different places offer different advantages and disadvantages. For example, the station I was on in Antarctica, you can't control everything so it's good you have the isolation, it's good you have the altered daylight cycle, but you also have chronic hypobaric hypoxia — that's to say, a lack of oxygen — and that lack of oxygen brings up even more additional factors to study. Whereas if you take somewhere like Devon Island, if you were to do winter studies there, for example, you would be able to control certain factors which don't exist elsewhere.


A.Kumar

But the White Mars study is crucial in terms of offering a real degree of isolation. A degree of physical isolation that would be interesting from a microbiology point of view. And, from a psychological point of view, that (sense that in an analog study elsewhere that) at the end of the day if anything went wrong, you are still on planet Earth and you are still able to exit the capsule and go to a hospital. What the White Mars project makes interesting is that that assurance is gone.

The crew will be completely alone, completely cut off, completely isolated.

TMQ: Just to be sure, when we say "complete isolation" we mean that no one can come and rescue this team, correct?

Kumar: That's absolutely right.

Nine months – from February to November – means that no one will come and get me, no one can come and get me … The temperatures are so cold that planes can't fly. Fuel freezes, hydraulics break and planes can't get in. You have to realize that, yes, you are completely cut off.

TMQ: What are the chances the expedition will get across?

Kumar: Like we said, we're trying to get across to see if it's possible and that's very admirable. Trying to see what's possible ends up pushing the limits of the human mind and body in what we know to be our contained world and pushing out the boundaries into space and beyond. I hope they do it for that.

TMQ: What sort of scientific experiments will the explorers bring with them?

Kumar: The interesting thing about The Coldest Journey is that White Mars is only the human science side. In fact the team has a whole load of other environmental science projects from calibrating satellite data, which has never been done, to collecting samples for microbiology in the ice all the way across Antarctica, to various geology sampling.

We could learn more about the environmental sciences, the planetary sciences if you will, that will drive people over to Mars and that they'll be studying on the Red Planet.

There's also the human science side, that's White Mars within the larger expedition. We're trying to find the effects of true isolation on the human body, also the altered daylight cycle and also to see whether such a traverse is possible in terms of human health impact. We expect to see changes in everything from understanding vitamin D levels to psychology to how the heart reacts and we're studying all elements of the human body and mind.

TMQ: Why is the project's name inspired by Stan Robinson's work? Why go to Mars? Do you think you'll see humans, maybe yourself, go to Mars in your lifetime?

Kumar: White Mars seemed almost a natural title.

In terms of whether man will get to Mars, I hope we do. There is a lesson I learned in McMurdoe Sound on top of Observation Hill (where the Tennyson quote is written on a cross in memory of Sir Robert Falcon Scott's ill-fated expedition): "To strive, to seek, to find, and not to yield." That says it all, in terms of the fact that many will argue against going to Mars, but it's just human nature to go to Mars.

There will be people down at one end who don't want to go and who feel that it's not a good way to spend money, not a good way to place resources, but on the other end it could be that … It's something that helps us discover where we've come from.

I hope that humans do go to Mars. I've been told that a manned mission to Mars may be put together for around the 2030s, but I can only hope to see that in my lifetime.

But I think, 'Would I want to go to Mars myself?' and I think probably not. I've realized from being down in Antarctica on the Cape of Concordia that there's a lot more on Earth to enjoy and a lot more that we need to look after. So my time is now, my life will be investigating those things, but I think I'll always dream of Mars.

THE MARS SOCIETY

THE MARS SOCIETY is a 501(c)3 tax-exempt non-profit organization with headquarters in Colorado, USA, committed to furthering the goal of the exploration and settlement of the Red Planet, via broad public outreach to instill the vision of pioneering Mars, support of ever more aggressive government funded Mars exploration programs around the world, and conducting Mars exploration on a private basis.

THE MARS SOCIETY

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