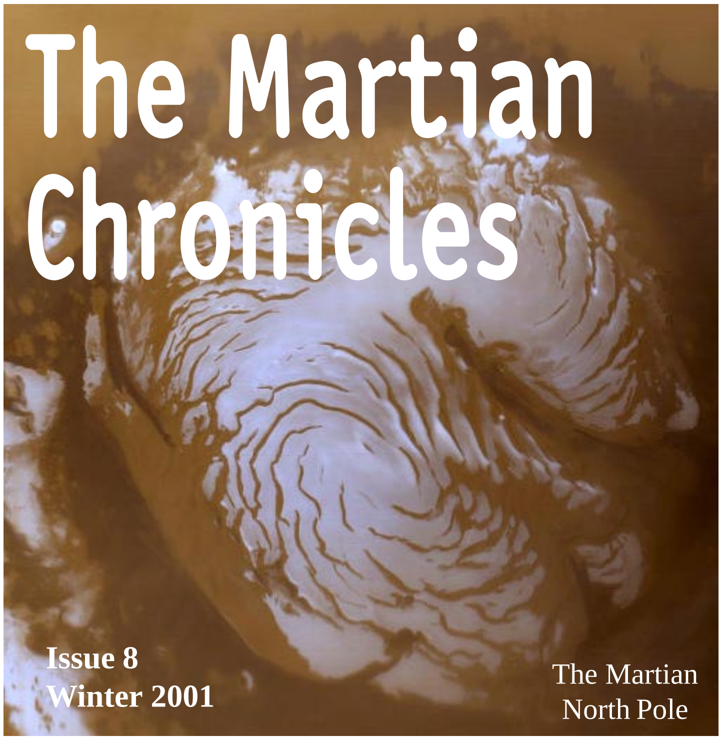
http://chapters.marssociety.org/youth/

The Martian Chronicles



The Martian North Pole

Contents

Dear Reader,

The Martian Chronicles are an outreach effort, aimed at exciting youth about the exploration and near-future human settlement of Mars.

Please distribute The Chronicles freely!!! To be added to the announcement list, or to receive paper copies for distribution, contact MarsYouth@mit.edu .

This newsletter is produced by the **Mars Society Youth Chapter** and the **MIT Mars Society Chapter**.

Send us your submissions to MarsYouth@mit.edu .

Enjoy The Martian Chronicles!

Margarita Marinova, Editor

MIT has 2020 Vision for Mars

Erika Brown

Who are NASA's customers? Why should they care about the NASA 20-Year Mars Plan? And how do you engage them for the adventures of the next two decades?

These questions and many more were on the minds of college teams nationwide as they prepared their first-round proposals for this year's NASA Means Business Competition. And as the dust cleared earlier this month, five National Finalist teams were left standing: University of Colorado, Georgia Tech/Emory/Georgia State, University of Illinois at Urbana-Champaign, Purdue University, and MIT.


Mars Direct Lander

Many approaches were taken to this challenge, including MIT's focus on engaging the public in various outreach activities that propose to build connections across disciplines, generations, and national boundaries. Our team looked at all levels of learning, from kindergarten through senior citizens, to design our proposal, 2020 Vision: An Educational Outreach Plan. From our study, a series of recommendations were made to NASA, including creating a space-centered scouting organization, publishing a book of Apollo-generation memories, and developing a traveling Mars exhibit for schools.

Now that the MIT team has been selected as a finalist, we will develop a detailed and viable business plan behind these ideas. But in order to make a real difference right now, we are also working on outreach efforts in the surrounding Boston area: helping Boy and Girl Scouts earn their space-related merit badges, teaching a weekend class on Mars for high schoolers, and coordinating a multi-university celebration of "Yuri's Night" - the April 12th anniversary of both the first manned space mission and the first US Shuttle flight. (MC)

Links:

Main Page - http://www.tsgc.utexas.edu/nmb/

MIT Team's page - http://web.mit.edu/mars/2020vision.

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Mars Society MIT Chapter

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The Mars Society

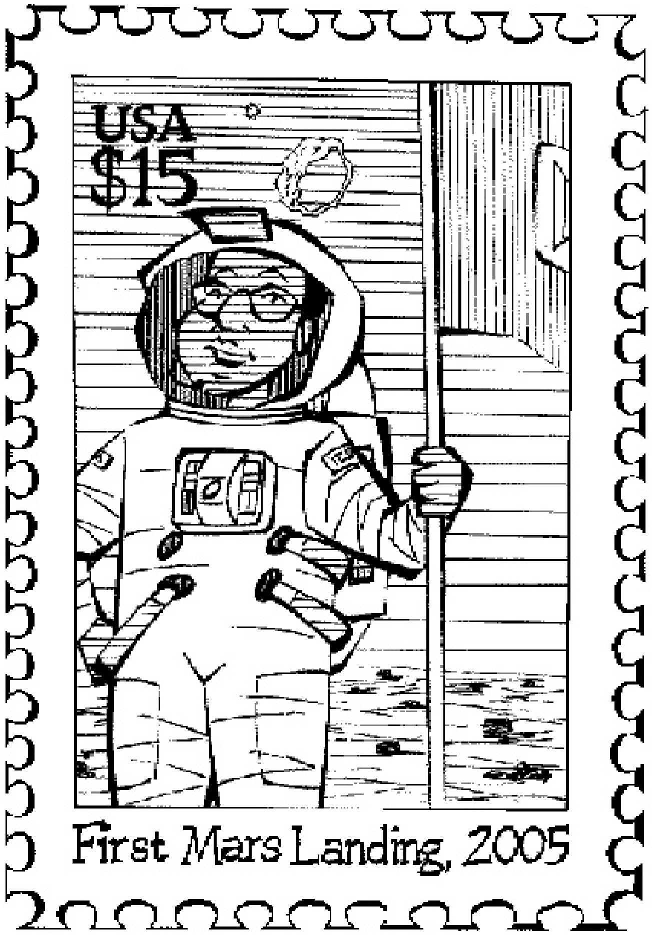
Radiation Hazards on a Mars Mission

Richard Reifsnyder

The sun is currently in a period of increased dynamic activity, with frequent sunspots and flares. As a result, the magnetosphere and atmosphere of Earth have expanded slightly, accelerating the orbital decay of satellites in low Earth orbit. Flares can also cause communications satellites and power grids on Earth to go haywire. Luckily, the Earth's magnetosphere is good at shielding life against the radiation released during increased solar activity, thereby preventing any noticeable medical effects. But how will the crew of a Mars mission adapt to the problems of radiation?

It is widely known that rapid, heavy doses of radiation cause severe cellular damage or even cancer, so the crew needs to be protected against the occasional solar flare. This can be done with a "storm shelter" about the size of an elevator, with food racks and water tanks packed around the walls to absorb the radiation. Most of a solar flare's energy is in alpha and beta particles which can be stopped with a few centimeters of shielding.

Cosmic rays are a different story. They are constantly present, coming from all directions. The radiation consists of heavy, slow-moving atomic nuclei that can do far more damage to more cells than alpha and beta particles. This radiation requires several meters of shielding for complete blockage, and since the nuclei come from all directions at all times, unlike the brief solar flares that last only a few hours or days, a storm shelter would be insufficient to protect the crew.



Yul Tolbert

One possible defense involves using a loop of electrically charged wire to create an artificial magnetosphere around the ship. However, the wire would either be ordinary conducting copper wire and need a massive power supply, or superconducting wire and need a massive cooling system. Nevertheless, in just a few years, advances in high-temperature superconducting wire could enable low-mass magnetosphere systems to protect the ship.

But even if such a system proves difficult to engineer, some scientists and doctors believe that the cosmic ray doses can simply be endured. Exposure to a thin, continuous stream of radiation does far less damage than an equal magnitude of radiation delivered in one day. There is still the possibility of cancer, but this probabilitity is rather low.

The astronauts will spend about six months traveling to Mars, eighteen months on the surface, and six months returning to Earth. The permanent habitats of the Mars base can be covered with thick layers of soil to provide full-time radiation protection, so nearly all the crew's radiation exposure would occur during the year of interplanetary travel. 50 rem per crew member is one estimate for total exposure in that time. This dose leads to a 1% increase in probability of contracting a fatal cancer later in life, compared to an already existing 20% cancer risk for non-smokers on Earth, and would probably be acceptable to the volunteers on this mission. However, since the biological effects of cosmic radiation are poorly understood, the resulting cancer risk may conceivably be off by as much as a factor of 10, and thus jump to 10%, or drop to 0.1%.

Not much research can be done safely on Earth to investigate these radiation effects, since cosmic rays are difficult to generate, and no one would consent to being exposed to a theoretically fatal dosage. The International Space Station could provide a good testing ground, since large numbers of astronauts will be exposed to modest amounts of radiation in their six-month tours of duty, but a full investigation might require waiting decades until these astronauts retire and die either of natural causes or of cancer. Obviously Mars mission advocates have no intention of waiting that long. It actually makes the most sense to accept the radiation risk on the Mars mission, since after all this is a journey into the unknown, and the risk of radiation is mild compared to the dangers that explorers on Earth have faced in the past — and overcome.

Psychological Effects on a Mars Mission

Brian Finifter

The first group of human explorers (4 to 6 people) heading for the Martian frontier will be confined within a spacecraft that has roughly the same amount of internal volume as a trailer home, for the longest space mission in the history of human exploration . Mankind has experienced this type of isolation before, and under much worse conditions in some cases. But never before will so few people be confined together for so long a time. We know what sort of problems the crew will encounter, but there are still many unknowns in how humans will adapt to face them. In these conditions, trivial idiosyncrasies, which would otherwise be tolerated and dealt with, become sources of significant conflict. Daily habits that we are ourselves not aware of, such as knuckle cracking or table manners, may anger our fellow crewmates to the point of causing a serious rift in crew relations and even risks to the mission.

Likewise, some people are more suited for the forced confinement than others. Somebody who is not carefully screened could lapse into depression and antisocial behavior. The habitat also plays a major role in the mindset of the astronauts. It must be carefully designed, taking into account the affect our environment has on us (such as lighting, communications, floor layout, etc). If humans are to be the strong link in a human Mars mission, we must explore and understand these variables very well. Some of the variables can be explored on the International Space Station. Additionally, studying the astronauts' response to an extended mission stay on the Martian surface can be better simulated and explored in the Flashline Mars Arctic Research Station (FMARS) in the Canadian High Arctic, where the geomorphological environment is very similar to what is likely to be encountered on Mars. Utilizing these new simulations scenarios, we are better able to determine the best measures to be employed in sending the best-suited crew, ensuring the maximum possible efficiency, effectiveness, and success in a critical situation. (MC)

Word Search Puzzle

The Tharsis Region, Mars

Julie Edwards

Find the words from this list in the puzzle. Words can be right to left, left to right, top to bottom, bottom to top, or diagonal, and can overlap other words. Category words are included.

MONS
- OLYMPUS
- ARSIA
- ASCRAEUS
- PAVONIS

PATERA
- ALBA
- BIBLIS
- ULYSSES

FOSSAE
- MAREOTIS
- CLARITAS
- TANTALUS

PLANUM
- SOLIS
- SYRIA
- SINAI

THOLUS
- URANIUS
- THARSIS
- JOVIS
- CERAUNIUS

CHASMA
- CANDOR
- HEBES
- IUS
- OPHIR
- TITHONIUM
- MELAS

VALLES
- KASEI
- MARINERIS

LABYRINTHUS
- NOCTIS

T	O	P	H	I	R	M	A	R	I	N	E	R	I	S
H	E	L	T	S	U	L	O	H	T	H	A	L	S	H
T	U	L	Y	S	S	E	S	A	R	S	C	A	U	E
I	M	I	S	M	I	Y	I	R	S	I	L	B	I	B
T	E	E	A	G	P	S	R	I	O	B	A	Y	N	E
H	N	M	L	A	R	U	R	I	A	R	R	R	U	S
O	S	U	E	A	R	C	S	A	A	S	I	I	A	U
N	I	A	N	I	S	H	A	E	H	T	T	N	R	L
I	A	H	E	S	T	A	A	N	M	T	A	T	E	A
U	R	A	N	I	U	S	N	H	D	O	S	H	C	T
M	E	A	E	N	S	M	R	O	S	O	N	U	S	N
I	T	S	S	O	R	A	E	G	C	I	R	S	I	A
O	A	N	F	V	A	L	L	E	S	T	M	A	L	T
K	P	R	M	A	R	E	O	T	I	S	I	V	O	J
I	U	S	S	P	L	A	N	U	M	T	H	S	S	E

Meet the Scientist

Dr. Matthew Golombek

Geologist

Mars Pathfinder Project Scientist

Vesna Nikolic

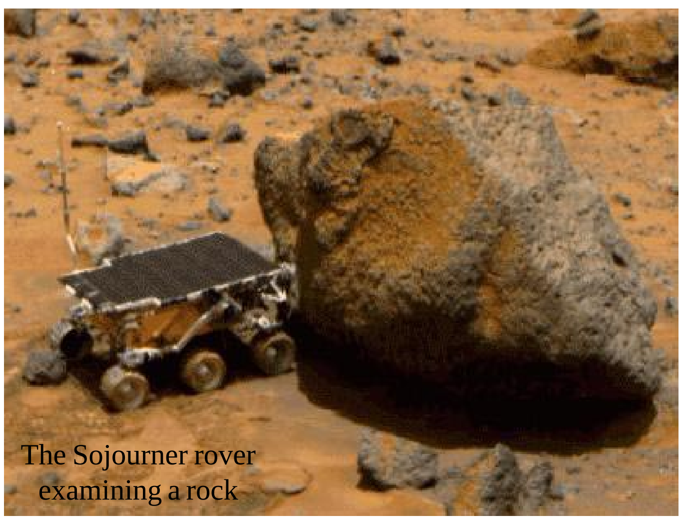
Dr. Matthew Golombek

Q: What are your main research interests?

A: I'm a planetary geologist, and basically, I've been mostly interested in Mars geology. Right now, the research I'm doing involves interpretation of data from the Mars Global Surveyor, and Mars Pathfinder mission. Specifically I'm working on structural features that are seen in the MGS data, and I'm interested in surface characteristics and rock distribution as seen in the MP data.

Q: How did you choose your field of interest?

A: I started as structural geologist, and I started looking at structures on Mars. That sort of developed for a while. Then with a chance to work on the mission, I started really thinking about how surfaces vary on the Red Planet and how you can predict what that surface would be like based on remotely sensed data. That's of particular interest when you're selecting a landing site for a spacecraft, because you want to make sure to the best of your ability that the surface that you're going to land on is acceptable for your lander and it's capabilities. I spent a tremendous amount of effort on Pathfinder worrying about the landing site, and I'll be working on the future landing sites for the upcoming Mars mission, using the same sorts of techniques.



The Sojourner rover examining a rock

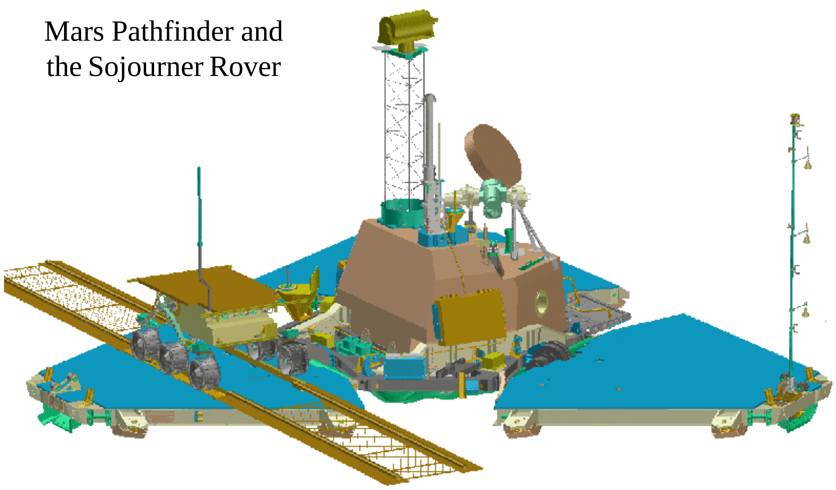
Q: How do you choose a landing site?

A: A lot of it is determined by the engineering capabilities of the spacecraft. For example, for Pathfinder, it arrives at the outermost atmosphere of Mars, and it goes through a complicated phase of using an aeroshell to lower itself down, then a parachute comes out, and basically, you need a certain amount of time and the density of an atmosphere to slow the spacecraft to the correct terminal velocity. So, elevation is very important, because you need enough atmosphere to slow your vehicle down to the speed that it needs to be going at. So, you can't land above the certain elevation. In addition, most spacecraft are solar-powered, and so you want as much power as you can possibly get, and so you wind up landing near what we call "sub-solar latitude" on Mars, which is basically near equatorial within 25 degrees or so. And then, you go through all the other things. If the spacecraft is susceptible to landing on a rock, and hurting its underside, if it has legs like Viking, or the airbags on Pathfinder qualify to a rock of a certain height, then you worry about the total number of rocks, and their distribution and their height. And that's a trick, since you don't have a lot of information about that. Then you worry about dust. Too much dust is probably not a good thing. It might foul up the solar panels; your rover might sink into it for example. And you may want rocks for analysis and so on. Then you worry about science that it'll do and that's terror to what instruments you have on board the spacecraft. So, it's a very involved task.

Q: You were the Mars Pathfinder project scientist. How was the job assigned to you?

A: Basically, with each project there's a project manager selected, and a project scientist selected. Those are the first two people, and they are the two people that lead the mission and the project effectively. Basically, the project manager is typically an engineer who has overall responsibility for the fabrication of the spacecraft, keeping it on schedule. And a project scientist to make sure that the science basically stays on the mission during that building process. In a sense, it's two different groups of people - there's a whole group of engineers that know how to build things, but really don't know much about Mars or what you want to measure there, and a whole group of scientists that probably couldn't build anything even if they had to, and don't really know how, but they're really interested in learning something about Mars. And obviously there has to be a marriage of those two. Basically the project scientist and the project manager work together to make sure that happens properly. Now, in a more detailed sense, the engineers for example need to know the environment that they will be landing in - what are the temperatures, what are the pressures, how much atmosphere is there, where can you land, what are the surface characteristics. Those all go in the design criteria for a spacecraft and basically the best people to answer those questions are scientists that know about the planet. Alternatively, as I said, engineers are the best for building things and clearly, the scientists need to work with them to make sure the instruments can function properly on the spacecraft. So basically, those two people are appointed by JPL and NASA to carry out that function.

Mars Pathfinder and the Sojourner Rover



Q: What were some key discoveries by the Pathfinder mission and why are those discoveries important to us?

A: I'd say there's about half a dozen key things that were really critical that we learned with Pathfinder. To put them in the broadest perspective, I think the Pathfinder is showing us a planet - Mars - that may have been more Earth-like early on in its history than it is now. Right now, Mars is a cold, dry, dessicating place and we found quite a bit of evidence to suggest that it may have been warmer and wetter in the past. And those key discoveries involved looking at the surface and interpreting the history of how that surface developed. And we believe that surface was deposited by catastrophic floods in the past and so the rocks that we saw on the surface actually looked as if they were water worn and deposited by running water in the very distant past. We found very magnetic dust that suggested that that magnetism occurred by deposition of the liquid water. We measured the moment of inertia of the planet, which gave us bounds on what the diameter or the radius of the internal core of Mars is and if it had one. We really had no direct measure of that prior to Pathfinder. And those were the key things. We found that the atmosphere was much more dynamic than we ever expected, with small dust devils as well as clouds and variety of other things.

Q: Now that NASA has slowed down with Mars missions, what do you think is the future of the Mars exploration?

A: We lost two missions in '98, and in a sense it has slowed down - for example we'll have only one orbiter in '01. There's a period going on now where there's a re-evaluation of what we ought to be doing next that fits within the budget and that won't obviously fail as the '98 missions did. So maybe we *paused*, maybe that's the right word, to make sure that we're doing the right thing in the right order, and I'm sure we'll be pressing on. I think the reason that Mars is such a compelling place to study is that we may be able to answer one of the most fundamental questions that we as people would want to know, and that is: are we alone in the universe, will life form anywhere that has stable liquid water, which is the absolute key to life, or is something else required? So, if we go to Mars and we see that the early environment wasn't in fact warmer and wetter and life did not develop there, well then we'll have to pause and say "Well, gee, what was so hard about it? Why didn't it?" On the other hand, if we go there and find that it did develop and that the conditions didn't persist, then we would know that life can form pretty much anywhere, and so it allows you to study in a scientific matter what I think is a compelling question that many, many people would want to know, and I don't think we'll stop doing that just because of a little set back here.

Q: Do you have any final words of wisdom for youth interested in Mars?

A: Follow your heart. Everyone develops at different levels, speeds, at different times in their life. I don't think I was a particularly outstanding high school student. That's OK. If you're really interested and excited in planetary exploration, you should go for it, but you should also be very aware of what the limitations are of any career path that you decide on. If that's a thing that really makes you happy, then you should do it, but you should make sure you've learned as much as you can about it, before you just leap into it. MC

Permafrost Springs on Earth and Mars

Chris McKay

Recent images from the camera on Mars Global Surveyor show evidence recent liquid water outflows in the Southern Hemisphere. These flow features occur on surfaces with no craters, and in one case the flow crosses a sand dune. Thus the water must have flowed fairly recently: less than a million years ago. This is recent enough that the liquid water must have flowed under the same climatic conditions we see on Mars today. How can liquid water flow when the average surface temperatures is -60 C and there is permafrost extending for many kilometers depth. It is not the case that these flow features are driven by volcanos since they are not located near any of the martian volcanic features.

Jen and Dale at Little Black Pond spring on Axel Heiberg Island

One part of the solution to this puzzle may be found on Earth in the Canadian Arctic. There are two sets of perennial springs located on Axel Heiberg Island that flow through 600 m of permafrost and these springs are not associated with any volcanic heat sources. Located at nearly 80N these are the most poleward springs known, and to our knowledge the only example of cold springs in thick permafrost.

Axel Heiberg Island is mostly bare ground, with less than 35% covered by glaciers or ice caps The average air temperature at the springs sites is approximately -17C. The two springs both discharge a brine with measured discharge temperatures that range from -2 to +6.5 C and remain constant throughout the year despite air temperatures that fall well below -40C. Flow rates are also constant with little variation.

We think that the springs are the results of a subsurface salt aquifer. Water enters and leaves this salt reservoir by way of the salt domes which reach the surface. The water flows down into the salt dome from a large lake -Phantom Lake- that sits on top of one of the surface salt deposits at high elevation. After flowing through the salt to deep underground, the current seeps back up through the salt to the surface, forming a spring.

The Arctic springs demonstrate that liquid water is capable of reaching the surface in regions of thick, continuous permafrost without strong volcanic heating sources. This could have happened on Mars. However the question of the source of the water on Mars remains unclear. In the Arctic the source of the water is essentially summer glacial meltwater conveniently stored in a large lake that happens to sit on a salt structure at high elevation. So in the Arctic there is a constant supply of water and a hydrostatic pressure to drive the flow. For Mars this is obviously not the case. The water must be a remnant of an early period or recently melted ice or both. Where did the water come from and why did it flow recently? We don't know. Mysteries remain and until we can get to Mars studies of water flow and springs in the Arctic may provide us with our best clues.

This work is done by a team lead by Wayne Pollard of McGill University and this year the field team included Dale Andersen, Chris McKay, Jen Heldmann, and Margarita Marinova. MC

"Nuclear" Is Not a Four-Letter Word

Richard Reifsnyder

There have been numerous Mars mission development teams over the past few decades, and there is one thing on which they agree: a human mission to Mars - or to anywhere else - would be far easier using nuclear power.

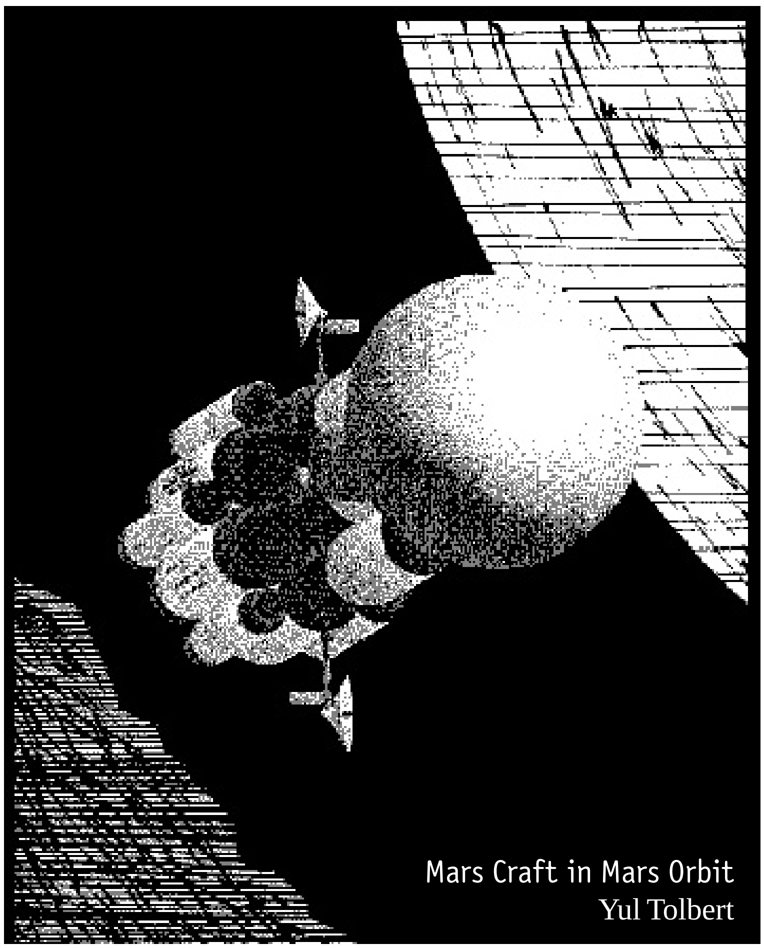
Yet for many environmental groups, "nuclear" is a four-letter word. When they hear that word they think of Hiroshima, Chernobyl, and Three Mile Island. They often forget that nuclear power supplies a significant fraction of America's electricity, is the only source of power for many cities, and that there is a tradeoff between the risk of radiation from disposed nuclear fuel and the millions of tons of carbon dioxide and smog produced by fossil fuel plants.

In space there is a similar tradeoff between enormous power reserves provided by nuclear energy and the relative safety of chemical and solar technologies.

It is understood that nuclear propulsion, either thermal rockets that heat hydrogen propellant, or nuclear-powered ion drives, would both significantly increase the amount of payload that can be sent to Mars. However, since these vehicles are fission-powered, the risk of meltdown is nonzero - and is actually higher during launch into Earth orbit, when the rocket beneath the payload can explode. Using chemical propulsion would require more launches to orbit, and launch costs are a significant fraction of total mission costs.

But while nuclear propulsion is not vital to a Mars mission in the near term, nuclear power almost certainly is. The only known alternative to nuclear power is solar power, which works well in space and can be used in the human habitat during the outbound transit.

But solar power is perhaps less useful on the Martian surface. Consider: first, the luminous intensity of sunlight in Mars orbit is less than half that in Earth orbit. Second, there is no sunlight at night. Solar panels are already only one-quarter as effective on the Martian surface as in Earth orbit.



Mars Craft in Mars Orbit
Yul Tolbert

Even more importantly, there is the matter of dust storms - which not only appear without warning, but can last for weeks or even months. The concentration of sunlight reduces by another factor of four. There is no way to store months' worth of solar power using batteries or fuel cells. Considering the maze of solar panels adorning Mir or the International Space Station in Earth orbit, attempting to carry sixteen times that much area, to produce the same power output, to the Martian surface, and set it up, is an outlandish proposition. The array would cover several football fields, and outweigh the human habitat itself. To top it off, dust deposition gradually reduces the effectiveness of photovoltaic panels. A human could dust these panels off with a broom every so often, but sweeping several football fields would waste valuable exploration time. The Viking landers were powered by nuclear reactors that kept them transmitting for three years, while the Pathfinder with its solar panels ran out of power within three months.

Anti-nuclear activists filed several lawsuits to protest the launch of the nuclear-powered Cassini space probe on the grounds that a launch failure would pollute the planet. In reality, the few pounds of plutonium oxides onboard were chemically inert, having a half-life of 88 years (not hundreds of thousands of years like ground-based nuclear waste), and would release only about one ten-thousandth of the radiation of an atomic bomb - and into the ocean, at that.

The fact is, the risks to Earthlings of using nuclear electric power on any space mission are trivial. By choosing NASA as a scapegoat for the nuclear-related maladies caused by reactors on Earth, these activists would only condemn the human race to the surface of Earth. MC

Mars Q&A

Q: What type of planet is Mars?
A: Mars is part of the inner Solar System, and therefore is a solid planet. Its composition and structure are similar to that of the Earth. Some notable differences are that it is less dense than the Earth, its interior is much cooler than Earth's, and it is half the size of the Earth. - Margarita M.

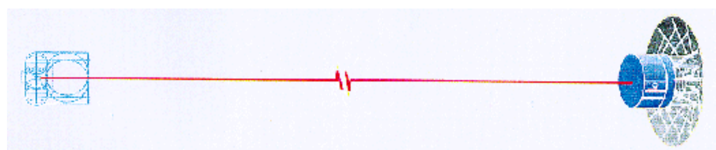
Q: Are the Lander Instruments of Mars Surveyor 2001 Lander able to take readings and analyze distant rocks, boulders, and soil?
A: The Mars Odyssey 2001 Mission has only an orbiter. The instruments onboard are: Thermal Emission Imaging System (THEMIS) for mapping the mineralogy and morphology of the Martian surface; Gamma Ray Spectrometer (GRS) for global mapping of the elemental composition of the surface; and Mars Radiation Environment Experiment (MARIE) for characterizing aspects of the near-space radiation environment as related to the radiation-related risk to human explorers. For more info, visit http://mars.jpl.nasa.gov/2001/instruments/index.html - Vesna Nikolic


2001 Mars Odyssey

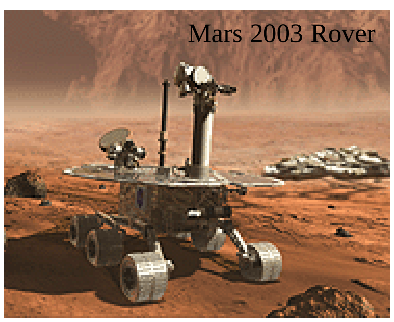
Cool Links

Vesna Nikolic

1) http://spacelink.nasa.gov/Instructional.Materials/Curriculum.Support/Technology/Educator.Guides.and.Activities/ - Activities and Guides for Educators
2) http://www.space.com/spacelinks/ - Links to various space organizations and topics
3) http://nssdc.gsfc.nasa.gov/ - Lots of Space Science data



Q: How would tethers be used on a human Mars mission. Is there a good chance they will be used?
A: The Mars Direct mission plan includes the use of a spinning tether system, hundreds of meters long, to provide artificial gravity in interplanetary space with the empty rocket stage as a counterweight for the manned habitat. However, NASA has some grievances with the tether's deployment - one experimental tether broke while being deployed from the Space Shuttle - so all current mission plans search for medical countermeasures to zero-gravity effects rather than using artificial gravity. However, further experiment could validate this concept. - Richard Reifsnyder


Mars 2003 Rover

Q: Is there a Mossbauer Spectrometer on the Lander of the 2001 Mission?
A: I believe the lander you are talking about is 2003 mission. Here is the list of instruments the rovers will have: Pancam camera, Mini-TES infrared spectrometer that will survey the scene around the rover and look for the most interesting rocks and soils; Microscopic Imager, Moessbauer spectrometers and the APXS spectrometers that can be placed against these rock and soil to get their composition; Rock Abrasion Tool (a.k.a the RAT) for scraping away the outer layers of a rock to see what lies beneath. For more info, visit http://athena.cornell.edu/ - Vesna Nikolic

To ask a question, visit http://chapters.marssociety.org/youth/ MC

The Mars Society is an international non-profit organization committed to furthering the goal of robotic exploration and human settlement of the Red Planet. www.marssociety.org

The Mars Society Youth Chapter was created to provide Youth the opportunity to become more involved in the Mars Society and other Mars-related issues, and to provide a more effective outreach effort to other Youth. http://chapters.marssociety.org/youth/