

"Towards an Earth-Moon Economy - Developing Off-Planet Resources"

Moon Miners' Manifesto

& The Moon Society Journal

www.MoonMinersManifesto.com

#243

Annual Mars-theme Issue

MARCH 2011



Above: The debut of R2 and telepresence-operated "robonauts" on ISS, on the Moon, and on Mars and beyond, is here!

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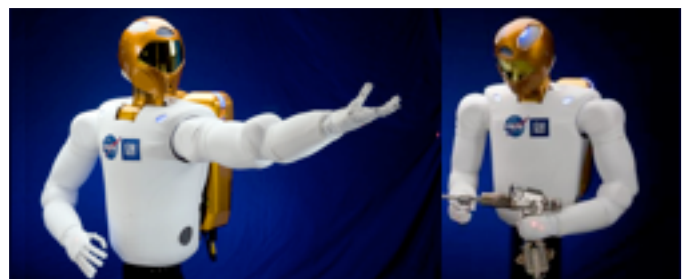
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Robonaut 2 or "R2" joins Space Station Crew →

In last month's issue, we wrote about the future of robonauts on the Moon; their role in construction of the first outpost and how they will work side-by-side with humans in future settlements. In this issue we write about how robonauts can accelerate the deployment of a first, more capable Mars outpost. That's the future! But on **February 26th, 2011**, the very first robonaut arrived at the International Space Station aboard the shuttle Discovery. *Remember the date! This changes everything!*

IN FOCUS Welcome the *new* Space Age Era of Human-Robonaut Synergy

in late, 2004, after having just been elected President of the Moon Society, I brought up the idea of the Society sponsoring a workshop on "Human-Robotic Synergistics" only to be ridiculed by a newly elected director. Shortly after, he resigned. The point was, and is, that the debate over whether humans or robots should explore space is pointless and absurd. Our respective assets are complementary! [= > p. 2, col. 2]



Moon Miners' Manifesto

Published monthly except January and July., by the **Lunar Reclamation Society** (NSS-Milwaukee) for its members, members of participating **National Space Society** chapters, members of **The Moon Society**, and individuals worldwide.

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www.MoonSociety.org/publications/mmm_classics/

• **MMM Glossary: new terms, old terms with new meanings:**
<http://www.moonociety.org/publications/m3glossary.html>

• **MMM's VISION:** "expanding the human economy through off-planet resources"; the early era of heavy reliance on Lunar materials; early use of Mars system and asteroidal resources; and establishment of permanent settlements supporting this economy.

• **MMM's MISSION:** to encourage "spin-up" entrepreneurial development of the novel technologies needed and promote the economic-environmental rationale of space and lunar settlement.

• **MMM retains its editorial independence.** MMM serves many groups, each with its own philosophy, agenda, and programs. Participation in this newsletter, while it suggests overall satisfaction with themes and treatment, requires no other litmus test.

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• **The National Space Society** is a grassroots pro-space membership organization, with 10,000 members and 50 chapters, dedicated to the creation of a spacefaring civilization. National Space Society, 1155 15th Street NW, Suite 500, Washington, DC 20005; Ph: (202) 429-1600 - www.NSS.org

• **The Moon Society** seeks to overcome the business, financial, and technological challenges to the establishment of a permanent, self-sustaining human presence on the Moon." - Contact info p. 9.

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• **Submissions by email** to KokhMMM@aol.com - Email message body text or MS Word, Texr files, pdf attachments ✓ CDs, DVDs, /or typed hard copy must be mailed to:

Moon Miners' Manifesto, c/o Peter Kokh,
1630 N. 32nd Street, Milwaukee WI 53208-2040

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⇒ In Focus Editorial continued from p. 1.

Robotics has come a long way in the past six years! And the promise is becoming real. Robotic assistants can relieve humans of tasks that are dangerous, boring, tiring, repetitious, etc. And they do not need life support, rest, entertainment, or socializing. They will not only pave the way for humans, but work side-by-side with humans after crews arrive, with future settlers also.

Whether the word "robonaut" sticks, or becomes replaced with the earlier "droids" (short for androids) is immaterial. The evolution of humans and robots working together is now well underway. Robotic assistants can take care of chores that are boring, tedious, repetitious, and/or dangerous. They do not need food, rest, sports, relaxation, or entertainment. They do not require life-support in transit or on the job. They do not produce wastes that need to be treated and recycled.

As for **R2, now aboard ISS**, the coming year will see it undergoing tests to make sure the trip to the space station caused it no trouble. Astronauts aboard the station will have a chance to get used to R2 and learn to work with it/him. In time, both will become comfortable working together. We need to get to the point where we can trust robonauts as reliable helpmates. No one can predict how long that will take, as adjustments in the robonaut's capacities and abilities may be needed. In the real world, needs emerge which might not have been foreseen.

One big challenge for NASA engineers has been to retrofit all of the robot's electronics to withstand radiation in space. They also worked to make Robonaut 2 as "smart" as possible. R2 has some 38 Power PC processors, including 36 embedded ones. The embedded chips are running in the machine's joints: its hands, shoulders, waist, elbows, neck and five large joints in each arm.

NASA also plans on periodically upgrading R2, it will be attached to a pedestal on the space station and it will work in place. By year's end, one or two legs may be installed to allow R2 to move around the station. A single leg could be easily attached to the robotic arm outside the space station so it can assist astronauts during spacewalks. In time, R2 could relieve astronauts of EVA assignments. Unlike humans, robonauts will not have to go through time-consuming pre-breathing steps. EVAs are risky and tiring.

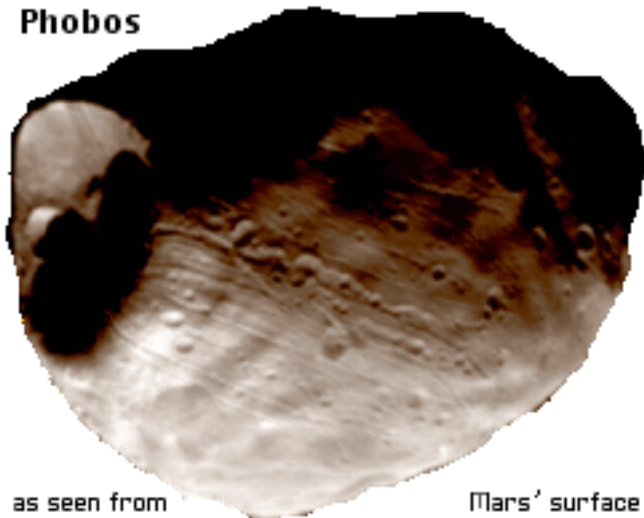
What's ahead?

We can expect to see robonauts fully integrated into ISS crews, becoming comfortable and reliable as partners, with a significant increase in overall mission productivity. Meanwhile, we will probably see robonauts become common in upper income households (as in the Jetsons cartoon series.) The "humans vs. robots" debate will become a curiosity of history. Both sides will have won, and the future of space activities will unfold more quickly and at less expense.

Some science fiction scenarios foresee humans in danger of replacement. Some see "Borg-like" transformations of humans. We see robonauts becoming faithful and enabling companions to humans, a path that dogs have been down long ago. Robonauts will hasten and deepen the pioneer settlement of space frontiers. Science-fiction stories that do not include this partnership will become dated. We have lived to see the day when this brighter, more promising future was introduced!

PK

Phobos



as seen from

Mars' surface

The Most Economic Way to Open Mars: Construction Equipment and Robonauts, Telepresence-operated in near real-time from Phobos directly, and via co-orbital relays

By Peter Kokh

In the previous issue of MMM, #242, we talked about how pre-human missions to the Moon, bringing teleoperable equipment and telepresence-operated "robonauts" could speed up realization of a first human outpost, and do so at greatly reduced expense. Human crews would arrive ready to do what they came to do. All the site preparation and construction chores would be done beforehand by robotic predecessors who do not tire, do not get bored, do not need rest or relaxation, do not need life-support, etc. And now, with the arrival of Robonaut 2 or "R2" at the International Space Station, to join the crew, the new Space Age 2.0 of human-robonaut synergy is upon us. This is an historic moment!

If robonauts can speed up the realization of a Mars outpost and get it ready for the first humans, at a similar savings, then we must rewrite our Manned Mars Mission scenarios accordingly. ***But there is a significant difference between where we are at on the Moon and where we are at on Mars.*** Our orbital mineralogical exploration of the Moon is much more advanced. But more to the point, rovers on the Moon can be teleoperated from Earth in near real-time. On Mars, which varies from 35 to 400 times as far from Earth as the Moon, time delays are measured not in single digit seconds but in minutes: from 6 minimum to 40 maximum, as Mars distance from Earth varies greatly. What has taken 7 years for **Opportunity** and **Spirit** to do on Mars, would have taken perhaps a month to accomplish on the Moon.

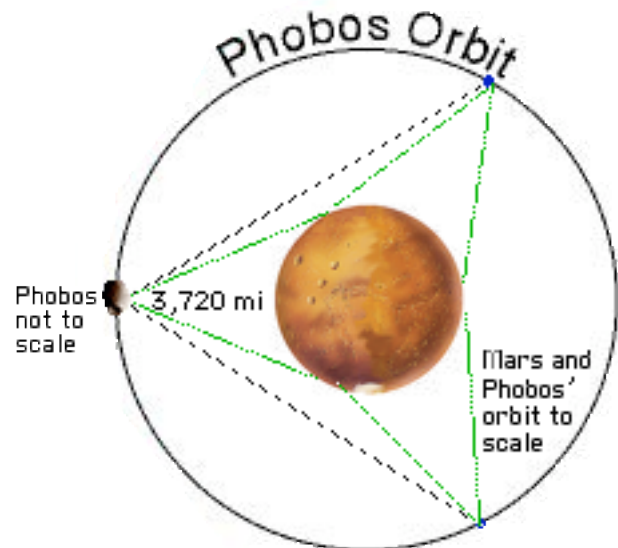
If we are going to really explore Mars – so that we know better where the resources are and where best to set up shop – a **Forward Teleoperations Base in orbit around Mars is absolutely necessary.** And not just anywhere in Mars orbit, *on Phobos!*

Why an Outpost on Phobos?

Wouldn't a small "Space Station" in some other orbit around Mars do just as well? Back around Earth, ISS gets significant shielding from cosmic radiation and solar flares from the Van Allen Belts. Mars lacks a magnetosphere and hence lacks similar belts. Astronauts in a Mars orbit space station would be much more exposed.

An outpost "on" the surface of Phobos would be less exposed (to just one half of the celestial sky). But, given Phobos' mini-gravity, its "regolith" dust blanket has been much less compacted than that of the much more massive and significantly larger Moon. It should be relatively easy to pile up a blanket of protective Phobos dust powder over the modules of any complex.

From Phobos a bit less than half of Mars is visible at any time, but a pair of unmanned relay satellites in Phobos orbit 120° ahead and behind Phobos respectively, would allow teleoperation of probes, rovers, and robonauts anywhere on Mars surface except at either pole.



The time delays involved are minimal, and even if relayed, would be much less than the time delay between an Earth-Moon L1 station and the Moon's surface. In fact, the perceived delay would be much less than that of global telecasts on Earth via Geosynchronous orbit. The near "real-time" control of rovers, construction equipment and telepresence-robonauts would allow extensive global operations on Mars. In contrast, a manned outpost on Mars would (without satellite relays) be confined in its reach of operations to a very local area.

[http://en.wikipedia.org/wiki/Phobos_\(moon\)](http://en.wikipedia.org/wiki/Phobos_(moon))

Phobos is 7.24 times as massive as Deimos. It is named after the Greek god Phobos ("fear"), a son of Ares (Mars). Phobos orbits about 9,377 km = 5,827 mi from the *center* of Mars, 3,719.5 miles *above Mars' surface*, closer to its primary than any other known planetary moon. Its orbital period is 7h 39.2m. It orbits so close to the planet that it moves around Mars [more than three times] faster than Mars itself rotates. As a result, from the surface of Mars it appears to rise in the west, move rapidly across the sky (in 4 h 15 min or less) and set in the east.

[Because it orbits so close to the surface, at moonrise and moonset, from on the surface of Mars, one would peer a bit around one side of Phobos, then the other.]

Clearly, a manned outpost on Phobos would immensely speed up *global exploration* of Mars, as well as pre-human-arrival *site-preparation and construction* of a first and any additional outposts so that when the first pioneers do arrive, *they can get down to the real business of establishing a viable and enduring frontier presence.* MMM

Only 'Going to Mars To Stay' Makes Sense

By Peter Kokh

"Marstostay does not segue from Marsandback. Marstostay must be pursued instead of Marsandback."

It is only to be expected that that people, even *seasoned space advocates*, would imagine "the first" manned mission to Mars to be a "souped-up version" of the first manned Moon-landing mission. *But there is one critical difference.* No matter how we do it, a "first" manned Mars mission will be an order of magnitude more expensive, even in 1969 dollars. In fact, the cost may be larger than the entire set of 6 manned Moon landing missions; and throw in the 2 non-landing missions, Apollo 8 (flyby) and Apollo 10 Snoopy (descent to within ten miles of the surface).

Humans are notorious for not learning the lessons of history. The Apollo program came to a not so glorious "Flags & Footprints" conclusion after the 6th successful landing. The lesson is that any expectation that there would ever be a 2nd Manned Mars landing, let alone an endless succession of landings, is an exercise in fairytale daydreaming. The odds are that the "been there, done that" shallowness of Aldrin and Obama will set in immediately after the first mission, or before work on a 2nd mission gets too far. "Flags & Footprints II" – this time on Mars, will be all the history books have to relate.

Unless ...

- **Unless** we pre-land equipment to produce (and keep producing) a nest egg of fuels, plastics, and other supplies from Mars' atmosphere before the first crew arrives
- **Unless**, we pre-prepare the landing site, and pre-construct a modular outpost ***not confined to the landing crew compartment*** as the FMARS and MDRS Mars Society analog research stations presuppose. That complex should be livable long term, not something a crew can tolerate for a limited time.
- **Unless** we preland a greenhouse operation that has vegetables and salad stuffs ready to harvest when the first crew arrives
- **Unless** we design the first mission to leave crew members behind
- **Unless** the return crew capsule is large enough to return home with only a fraction of the crew
- **Unless** all crew members who volunteer for the mission are prepared to stay, free of personal and other ties to Earth, with the mindset of our forefather pioneers on the *Mayflower*

Past MMM Articles on "Mars to Stay"

Download from

www.moonsociety.org/publications/mmm_themes/mmmc_Mars1.pdf

Mars: Option to Stay, pp. 10–13

Mars: Plenty of time to wait, but none to waste, pp. 26–27

[mmmc_Mars2.pdf](#)

Mars: the Audacity to Stay, pp. 3–5

In a word, Marsandback, No! Marstostay, Yes!, pp. 8–9

MMM Mars Policy Statement, page 10

Yolk-sac Logistics, page 11–13

Pantry Stocking: the role of creative smuggling in the Building of Marsport, page 13

More to Mars, pp. 13–15

A stay behind scenario

If no one stays behind on Mars from the "first" manned mission, there is a strong possibility that there won't be a follow-on mission, and if there is, the chances of no further follow-up increase each time. Witness Apollo. Those watching the public purse will cry "enough already" louder and louder each time. There is only one way to make a commitment, and that is for at least some of each crew, starting with the first, to stay behind.

Then, between departures and fresh arrivals, in order to accommodate fresh incoming crews, the outpost will have to grow and grow and keep growing. Again, per the previous article, equipment and robonauts operated from a forward base on Phobos would handle much of the expansion work, while remaining crew members handle things only humans can do.

Inflationary Expansion

The larger the percentage of crewmembers of each successive crew who stay behind, the faster the permanent population will grow. Here is the population growth chart for 5 incoming crews of 12 (over 11 years):

If half of each crew go home each trip

1st crew: 12 arrive (6 return) perm pop 6

2. 12 arrive (6 return) perm pop 12

3. 12 arrive (6 return) perm pop 18

4. 12 arrive (6 return) perm pop 24

5th crew: 12 arrive (6 return) perm pop 30

If only a quarter go home, then

1st crew: 12 arrive (3 return) perm pop 9

2. 12 arrive (3 return) perm pop 18

3. 12 arrive (3 return) perm pop 27

4. 12 arrive (3 return) perm pop 36

5th crew: 12 arrive (3 return) perm pop 45

If more ships arrived each window, growth would be exponential. So if only a quarter return each time:

1st mission: 12 arrive (3 return) perm pop 9

2. 24 arrive 8 return) perm pop 25

3. 36 arrive 12 return) perm pop 49

4. 48 arrive 16 return) perm pop 81

5th mission: 60 arrive (20 return) perm pop 121

not counting children born on Mars! – Plymouth, MA was settled in 1620 by 101 pilgrims on the *Mayflower*

Recommendations

- Pioneers with an increasing genetic
- New recruits have an increasing diversity of occupational talents, educational backgrounds, and aptitudes.
- The physical complex of the outpost–becoming–settlement grows to support development of indigenous arts & crafts, sports and recreational activities

The Right Mix – Men and women, single, unengaged, without dependents, and with diverse talents

Perks for those committing to staying

- Security benefits for anyone left behind on Earth
- Weight and volume import allowance on next flight for personal items (furnishings, hobby supplies, etc)
- Pick of better quarters, furnishings, hobby supplies

This plan prioritizes build-up of recreational, hobby, and other facilities, continued diversification of food, entertainment options, personal vehicles on Mars, getaway retreats and changes of scenery options, etc.

Outlying Outposts are needed

A settlement effort must be broad-based, access different resources, provide cultural, architectural and horticultural diversity, for insurance against catastrophes, and to begin appropriating the planet at large.

If you think this scheme is unworkable or outrageous, don't volunteer! Consider the siren call Ernest Shackleton placed in the London Times in 1905:

MEN WANTED FOR HAZARDOUS JOURNEY

Small wages, bitter cold, long months of complete darkness, safe return doubtful. Honor and recognition in case of success."—Ernest Shackleton

Five thousand eager men answered that ad! Are those with such "right stuff" a vanishing breed? Has our society become so risk averse that no one will answer a no-punches-pulled call to pioneer the frontier? We think not. Forget the Earth-lullabied majority. Blessed are "the second best" – those of us who are restless despite everything life in these times can offer us, who sense we don't quite fit in, who yearn for a chance to start fresh, those of us willing to make space a place. That is the history of human expansion, first within Africa, then "out of Africa." As always, pioneering is the work of those who accept the considerable risks, the large chance of failure, and the hardships sure to come. – There will be plenty of volunteers, even after vigorous vetting.

"Mars to Stay" gains support

Robert Zubrin's "Mars Direct" steers clear on this issue, but his rhetoric and passion make it clear, that establishing a new frontier, not mere exploration of an intriguing planet, is the passionate dream that drives him. His novel, *First Landing*, makes that clear. A woman astronaut discovers that she is pregnant and refuses to return home; then the astronaut involved, owns up to his responsibility and insists on staying behind with her.

That said, Zubrin has not adjusted his "Mars Direct" scheme to provide for the possibility that some crewmembers may make such a decision. To get to Mars in the first place, requires support from those too timid to wrap their minds around such options.

Type "Mars to Stay" in your Google search box



About 72,500,000 results (0.14 seconds)

72,500,000! MTS advocates are a minority, yes, but are becoming ever less shy about their conviction. *And we need to return to the Moon in the same fashion, with the same preparation, and with the same determination.*

Now government space agencies, which must proceed with the approval of the majority who will surely ridicule such ideas, will not plan for such scenarios. That is why any outpost plans which freeze out corporations and the private sector must necessarily fail. Constellation was such a sterile program, and "sterile" is the apt word. We need a program for both Moon and Mars, that in its design is "pregnant" with open-ended possibilities and preparations. *Space is for the bold, not the timid!* PK

Schackleton's Crew



ACCESS TO MARS: A Fully Re-usable Mars Ferry – Logistics and Transport for Crew and Cargo

John K. Strickland, Jr. (jkstrick@io.com) 2-28-2011

Engineering analysis and support by
Engineer Raghavan Gopalaswami, Hyderabad, India

This article is a **preview** of a fully detailed presentation and paper for the 2011 ISDC in Huntsville. It will focus on the Mars Ferries themselves. These ideas originated about 20 years ago during the NASA Outreach 1990 and after the advent of Mars Direct. Since 2005, the full extent of the Mars EDL (Entry, Descent and Landing) problem has become very apparent. Much of the credit for the work to identify and focus attention on it must go to Dr. Robert Braun and his colleagues at Georgia Tech. Dr. Braun is now Chief Technologist for NASA.

Human Mars Exploration Concepts

When Robert Zubrin's Mars Direct concept burst on to the scene over 20 years ago, it was clear he had made a very major advance in thinking about Mars Missions, with the concepts of using local materials like CO₂ to produce propellant and pre-positioning of equipment for redundancy. Zubrin intended his concept to be used for permanent occupation of Mars. However, his original design maintained no active operational base in Mars orbit and is based on all-expendable launchers and vehicles, which virtually forces any human Mars program based on them to be an unsustainable *flags and footprints* type program *as conducted by a government*, no matter the sincere intent of the designer.

Rationale for a Low Mars Orbit (LMO) Base to support Mars surface base Logistics

A space-faring civilization needs to be able to operate both on planetary surfaces and in orbit for maximum effectiveness, such as increasing payloads to Mars per ton delivered from Earth. The Ferry concept assumes the creation of a LMO Base to support the crew and continuing orbit to surface base logistics operations. It would also maintain a redundant cryogenic propellant supply in the LMO Depot for the departure from Mars orbit to Earth. A special transit vehicle would carry each Depot from Earth Orbit to LMO while full of propellants, using aerocapture and an orbit trim maneuver. The Depot allows the continuing storage of cryogenic propellants in LMO without loss to boil-off using a combination of sun-shields, super-insulation, and active cryo-coolers.

Why We Cannot Land Humans on Mars Right Now

Right now, in 2011, we **cannot** land anything larger than the ~1 ton Mars Science Laboratory rover on the surface of Mars. This is called the Mars EDL problem (Entry, Descent and Landing). No combination of available parachutes, re-entry shields and terminal descent rockets can land even a 10 ton payload on Mars. This problem first got serious attention in 2005, so the field is only about 5 years old. Things decelerate differently in a thin atmosphere. (On the Moon, we just decelerated and landed with pure rocket power since there was **no** atmosphere). Earth's dense atmosphere slows re-entering spacecraft to about Mach 1 at about 25 miles high. The atmosphere density of Mars at the surface is like that of Earth at 36 miles up. It slows objects from orbital velocity to about **local** Mach 5 – assumed to be about 543 mph).

Below that speed, it is too thin to continue to slow a spacecraft enough *all by itself*. You could use *expendable* parachutes, ballutes or hypercones to slow down, but the object here is to produce a fully re-usable vehicle.

It is really hard to slow down after entry, since we would be about to hit the surface at supersonic speed. We are glad that Mars has an atmosphere, but if Mars had no atmosphere, it would be easy to land on; it just would take a lot more fuel. With an atmosphere, the descent engines probably cannot fire during the peak period of re-entry. However, they may be able to fire during or at the end of re-entry (starting at about 3200 mph or about local Mach 6.)

Supersonic Retro Propulsion (SRP) requires rocket engine thrust firing directly *through* the heat shield and against the supersonic flow of air pressing against the base of the vehicle as it decelerates. The rocket engines must be *fixed* in position with the nozzle ends *flush with and sealed* to the heat shield and thus they *cannot* gimble for steering. Instead this is done by varying the thrust of individual engines or by using small side-mounted vernier engines. SRP appears to be crucial to future access to Mars. No rocket vehicle has ever flown backwards at high speed in the same direction as its thrust. SRP's viability could be proven with a few inexpensive sub-orbital tests.

Think Re-Usable: The Case for Re-usable Mars Ferries

The debate over re-usable launch vehicles has been going on for decades while the debate over re-usable spacecraft or IN-space vehicles is just starting. Current scenarios for Manned Lunar or Mars landings envision a large lander which has, inside it (Mars) or on top of it (Moon), another **entire** vehicle for the ascent with its own engines, tanks, controls, structure, etc. I call this a Matryoshka-style architecture, after the traditional sets of Russian Nested Dolls, (*Matryoshka*) which are a metaphor for *an object with another similar object inside*.

Thus every new trip to the surface requires an entire additional *pair* of vehicles with *all* of the descent propellant, all of which has to be brought from Earth. It wastes all of the perfectly good *descent* equipment, leaving the crew dependent on the *ascent* vehicle. This exposes them to a loss of crew risk caused by a single vehicle failure, since there is no practical escape system, especially during ascent. Apollo astronauts were exposed to this risk on liftoff from the lunar surface 6 times. This architecture leads to the extremely marginal "one-way" Mars trips currently being proposed by some of those desperate to see any kind of Manned Mars Mission occur during their lifetime.

With a **fully re-usable vehicle**, nothing is thrown away. The descent engines, fuel tanks, and vehicle structure can also be used for the ascent. Fewer ferries would need to be built and shipped from Earth to Low Mars Orbit. . It increases reliability & safety after the **first** use of each vehicle (which is the riskiest use). Having the vehicles after the first use provides additional backup vehicles for rescue. It allows replacement of failed internal equipment modules (which would all be designed for rapid swapping) from older (retired) vehicles. It does require an integral (to the vehicle) aero-shell for re-entry, since the entire exterior of the vehicle would be exposed to some entry heating during descent. Cargo items would be inside the ferry, fully protected from entry.

New information about Mars affects the ferry design

20 years ago, we had *no knowledge* of the wide-spread existence of water on Mars in the form of relatively pure sub-surface ice deposits and ice regolith, some fairly close to the equator. Mars Direct (1989) and related concepts assumed we would bring hydrogen to make methane fuel from all the way from Earth. Now we know that hydrogen can be obtained from Mars ice in large enough quantities to use as a fuel *directly*.

Producing liquid oxygen and hydrogen propellants at a Mars *surface* base would **not** be an exotic zero-gravity technology that still needs to be developed. Since we will have the ability to maintain the cryogenic (LOX-H₂) propellant supplies *both* in orbit and on the surface, we should use them, due to the huge advantage they give in allowing a surplus of Mars-derived propellant to be delivered to and used in orbit.

The SSTOAB Fully Re-Useable Mars Ferry - Transport and Logistics System

The Mars Ferry is essentially a Single Stage to Orbit *And Back* (SSTOAB) vehicle for Mars. Mars has about 1/10th of Earth's mass, and is about 8 times the lunar mass. Mars gravity is 38% of Earth's, so achieving low orbit is much easier than on Earth - about 2.1 miles per second (4.1 km/sec) instead of *over* 5 miles per second. This means reaching LMO it takes only about 1 of the energy needed to reach LEO. (On Earth, an SSTO can barely reach orbit even with zero payload). If there is no staging, then there is no first stage to recover - the entire vehicle goes to the orbital "base" and back to the surface base - intact. Much less fuel is needed to land than to return to orbit since re-entry sheds up to about 2.4 km/sec of speed (out of the initial 3.36 km velocity).

What would the Ferry look like? Since the air on the surface is so thin, air resistance and "Max Q" (maximum dynamic pressure) on ascent are not significant issues. This means we do not need to make the vehicle narrow like the pencil-shaped boosters used on Earth. During descent, propellant tanks would be only 16% full, reducing vehicle density. Wide base vehicles with more cross section exposed to friction, and with lower density slow down more during re-entry, and thus need less propellant to land than a narrow base vehicle. During entry, a conical, capsule like shape is known to be stable, and would require less internal structure and less external shell surface than a long, narrow vehicle. The current design has the ferry shaped somewhat like a giant Apollo capsule, slightly taller (18 meters) than wide (14) meters if the crew capsule is included. It would have a cargo hold capable of carrying a 25 ton payload to the surface. The hold is a horizontal box-shaped area which would be located just above the engine compartment and extending through the middle of the vehicle to accommodate cargo or containers about 4.5 by 4.5 by 8 meters long.

Two types of fully re-usable Ferry vehicles are proposed: a Cargo Ferry and a Crew Ferry. They would be identical, except that the Crew ferry would carry a 5 ton combination crew cabin and escape capsule for abort to surface or abort to orbit self-rescue during in-flight emergencies, so it can only carry 20 tons of cargo down. The crew would never be exposed to a single failure leading to a fatal crash. In case of a vehicle failure or loss of control in flight, the crew cabin would separate from the ferry and the crew would descend to the surface

or return to orbit under power This capability could be used during both descents and ascents.

Payload *to orbit* for both vehicles is 20 tons, including the crew capsule for the crew version. The cargo hold for both versions would normally be *empty* during ascent. A ferry can carry either 15 or 20 tons of LOX-Hydrogen back into to orbit for use on the next trip down, because there is little or no cargo other than propellant to go up. Rock samples for return to Earth would amount to a few hundred pounds at most. About 5 tons of extra propellant would be loaded into the orbiting Depot for use by other vehicles by the cargo ferry only. Each vehicle would be retired after about 10 flights depending on engineering calculations of overall system reliability compared to safety on the very first flight.

The Ferry's main rocket engines would be mounted in a unique way: fixed in position, not gimbled. The nozzles would be flush with the base heat shield and integrally attached to it, to prevent entry of hot air flow and rocket exhaust gases into ferry's interior. Steering would be done by varying the thrust of individual engines. With 8 main engines, there would still be three pairs left to power and steer the vehicle, in the case of a single engine failure providing an engine-out capability. The engines would be mounted in a ring close to the outer rim of the base heat shield and would probably be canted out at an angle of about 20 degrees.

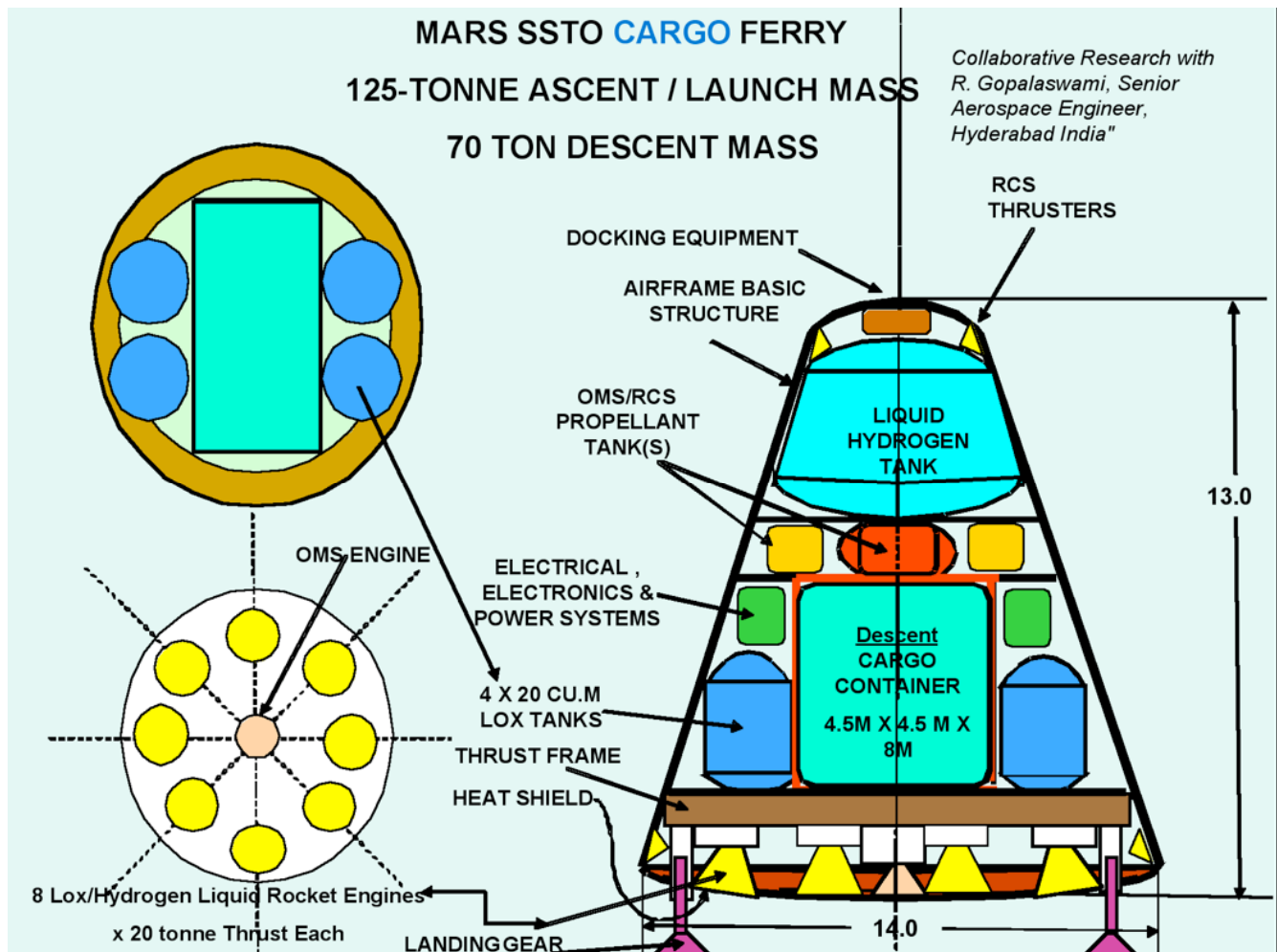
Approximate Mass Mars Cargo Ferry Configuration

(The Crew Ferry carries a 5 ton crew capsule and thus carries only 20 tons of payload Down and 15 tons of propellant Up)

Rounded Values in Metric Tons				
CONFIGURATION	DESCENT		ASCENT	
Component	Mass	%	Mass	%
Payload	25 tons	36	20	16
Structure	30 tons	43	30	24
Fuel	15 tons	21	75	60
TOTAL:	70 tons	100%	125 t	100%

A trip to the surface would start with a loaded ferry with 15 tons of propellants in the 400 mile LMO. It would perform a small de-orbit burn about 180 degrees around Mars from the surface base site. The resulting elliptical Hohmann transfer orbit would intersect the atmosphere and have an "aim point" (deliberately inside the atmosphere) of about 60 km or less, depending on the exact trajectory design. The following table shows the descent sequence. NOTE the difference between *absolute* and *relative* (to the surface) velocities! [see table p. 8]

After landing and unloading its cargo at a fully operational base, a Ferry would be re-fueled with 75 tons of LOX and LH2, along with 15 or 20 more tons of fuel as payload and begin its ascent back into Low Mars Orbit at 400 km high. This requires a delta-V of 4.2 km/second with a circular orbital speed reached of 3.36 km/second using an ascent mass ratio of 2.52.



Mars Entry Descent & Landing Sequence (DETAILED DECELERATION BUDGET FOR EDL)

Descent Delta-V Requirements met with mass ratio 1.39

NOTE the difference between absolute
and relative (to the surface) velocities!

Velocities at each stage of EDL	Delta-V Remain.	Velocity
Starting V. 400 mi circular orbit (absolute)		360 m/s
ΔV de-orbit burn fr Low Mars Orbit - 82 m/sec		3282 m/s
Approx entry V. at 118 km (absolute)+ 260 (gravity)		3542 m/s
Subtract Mars rotational velocity (not ΔV) -		240 m/s
Relative Vel. to shed to Mars surface at Entry - Total		3302 m/s
Approximate Total Velocity shed from passive entry drag		
- 2406 m/sec		896 m/s
Delta-V to perform S.R.P. from ~Mach 4 to < Mach 1		
606 m/sec		290 m/s
Entry Drag simultaneous with SRP Phase (1/4 of total)		
- 202 m/sec		88 m/s
Remaining V. removed during final Landing Phase		
- 88 m/sec		0 m/s
Total passive drag deceleration:		2608 m/s
Total Propulsive Descent ΔV (H ₂ -LOX):		776 m/s
Reserve ΔV (for hover and translate margin):		328 m/s
Total ΔV Capacity of descent configuration:		1104 m/s

Surface Base Integration and "Bootstrapping"

It is important to realize that the LMO base, the surface base, propellant production equipment and transport vehicles are an integrated system, which is **not** complete until fuel production begins and ferry vehicles can return to LMO. To support continued construction of the surface base, you need the source and store of LOX and liquid hydrogen on the surface (ISRU) and a large propellant supply in orbit (stored in the Propellant Depot) to operate the Ferries repeatedly, once fuel production begins. This means the base site must be where ice exists underground. Once a base site was picked, fuel producing equipment would be the first payloads sent down to the surface by cargo ferries. The equipment could be offloaded and set up via tele-operations by crew in LMO.

Mars Ferries compared to expendable landers

Without re-usable vehicles, you have to bring to LMO from Earth an expendable cargo lander and all of its propellant for every 20-25 ton cargo you want to use on the surface.

With re-usable vehicles, you can make repeated trips, saving 1.8 tons brought from Earth for every 1 ton delivered to the surface. Duplicate crew Ferries would also be available for emergency flights back to orbit. They would also allow a larger crew (a minimum size of 12), with a greater range of skills such as medical, for improved safety.

This also means more exploration and science will get done. The ability to bring fuel back to Mars orbit means the Earth return vehicle can use cryogenic fuel for its departure from Mars. Most importantly, re-usability tips the balance of mass brought from Earth away from vehicles and fuel and towards usable payloads landed at the surface base.

Permanent orbital and surface bases can thus be established with the very first human mission, bypassing the "*Flags and Footprints*" architecture phase. The bases can then be counted on as existing refuges for the next mission, with equipment health monitored from Earth or Mars surface (or Phobos).

What do we need to support such a plan?

- Define and accept clear, supportable goals for the Mars expeditions, such as deep drilling for life.
- Agree on a clear, *politically and financially sustainable budget commitment* for the program.
- Agree that the **initial** architecture fielded to access a new destination (Mars or the Moon), ***needs to be re-usable from the very beginning.***
- Agree on an *internationally supported* Mars program effort, with each participating country getting to build major segments of the equipment depending on their commitment level.
- Create an HLV manifest to *clarify the demand for large payload launchers.*
- Develop fully re-usable private HLV boosters capable of launching *payloads with a wide diameter* to get the large mass of equipment and propellants into LEO and keep the launch costs down.
- Create an *integrated IN-space transport and logistics system* consisting of standardized vehicles, equipment, modules and stationary nodes, such as propellant depots to support the LEO zone effort.
- Continue a *multi-arena basic Technology Development program* including flight tests of Supersonic Retro-propulsion using sub-orbital vehicles in Earth's atmosphere.
- Design and Integrate the Mars mission vehicles and bases.

Lets Keep Going to Mars

Our objective is to create a capability for continuing Manned Mars exploration. Let us use the time until the First Mars Expedition to *make sure that once we go there, we can afford to keep going there.* Assuming the first expedition would take place after 2030, we have over 20 years to create Re-usable space vehicles. Surely that is time enough to do it.

Major SRP Papers:

<http://soliton.ae.gatech.edu/labs/ssdl/>

(Go to SSDL papers / Conference Papers)

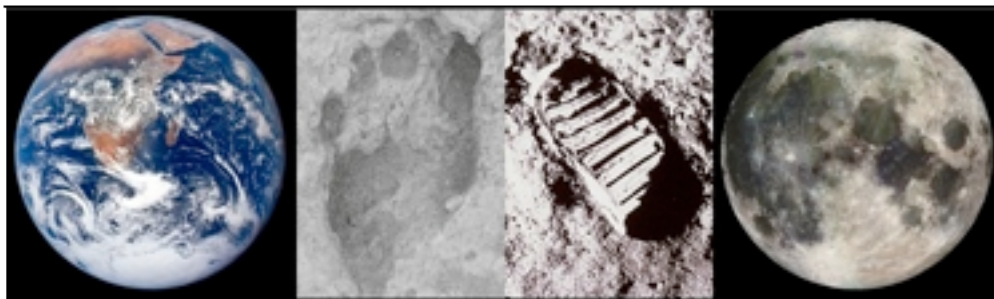


Artist rendering of Mars seen from Phobos

Note the city lights of settlements.

Mars will look very large from Phobos, many times the apparent size of the Moon from Earth. [We've had this painting in our files for years, but have never been able to determine the identity of the artist. If you know, contact kokhmmm@aol.com

From Africa
to the Moon,
the Human
Epic, told in
footprints,
Continues
to the Stars!



Our Goal is
Communities
on the Moon
involving
large scale
industrializa-
tion and
private
enterprise.

Objectives of the Moon Society

include, but are not limited to:

- Creation of a spacefaring civilization, which will establish communities on the Moon involving large-scale industrialization and private enterprise.
- Promotion of interest in the exploration, research, development, and habitation of the Moon, through the media of conferences, the press, library and museum exhibits, and other literary and educational means
- Support, by funding or otherwise, of scholarships, libraries, museums and other means of encouraging the study of the Moon and related technologies
- Stimulation of the advancement and development of applications of space and related technologies and encouragement their entrepreneurial development
- Bringing together persons from government, industry, educational institutions, the press, and other walks of life for the exchange of information about the Moon
- Promoting collaboration between various societies and groups interested in developing & utilizing the Moon.
- Informing the public on matters related to the Moon
- Provision of suitable recognition and honor to individuals and organizations which have contributed to the advancement of the exploration, research, development, and habitation of the Moon, as well as scientific and technological developments related thereto.

Our Vision says Who We Are

We envision a future in which the free enterprise human economy has expanded to include settlements on the Moon and elsewhere, contributing products and services that will foster a better life for all humanity on Earth and beyond, inspiring our youth, and fostering hope in an open-ended positive future for humankind.

Moon Society Mission

Our Mission is to inspire and involve people everywhere, from all walks of life, in the effort to create an expanded Earth-Moon economy that will contribute solutions to the major problems that continue to challenge our home world.

Moon Society Strategy

We seek to address these goals through education, outreach to young people and to people in general, competitions & contests, workshops, ground level research and technology experiments, private entrepreneurial ventures, moonbase simulation exercises, tourist centers, and other means.

Monthly Moon Society Progress Reports: visit our Homepage <http://www.moonsociety.org> and scroll down the center of the page to the prominent yellow **Frontlines** link. This report has been issued monthly since April 2008.

Society establishes new membership class: space-focus campus organizations

Mindful that we either attract more young members or we become increasingly irrelevant, we have been discussing a new approach to **student chapters**. In the past, a student or faculty member contacted us about setting up a student chapter at a college or university. This is an uphill affair.

We will continue to allow Student Chapters in the traditional sense, where three students and/or faculty members, who join the Society or already belong to it, can establish a chapter. In this case, the individuals involved are the members listed in our database. We have had two such chapters: at Brigham Young University in Provo Utah, and at the Native-American College of the Menominee Nation – Green Bay campus. Both became defunct as their leaders left the campus.

Inspired by our visit last November to the University of Illinois at Urbana-Champaign (main U-IL campus) to attend the annual **SEDS SpaceVision Conference**, we have been considering how to attract existing chapters of national or international organizations such as **SEDS – Students for the Exploration and Development of Space**, and **FIRST Robotics**, an organization of thousands of chapters at the High School Level. Here the chapter, not individuals, will be listed in our Database. This class of membership is very similar to that of "Institutional Members" allowed by the Moon Society Bylaws, but an option we have neglected to pursue to date. (Now an action item!)

At the February 16th Board Meeting, the Moon Society board voted unanimously to "amend the Moon Society's bylaws to institute this new class of membership called a "student organization membership."

The Management Committee (Society Officers and Directors) will have the task of setting rates and rules. For more, read

<http://www.moonsociety.org/reports/frontlines/Frontlines2011-02.html#board>

The National Space Society and SEDS have signed an MOU [Memorandum of Understanding] to govern their interrelationship, and we will endeavor to do the same. It is clear that such organizations of students already self-selected as interested in Space Exploration and Development is a much more fertile hunting ground than are student populations in general. Our goal is not to increase our membership (though we hope that some SEDS graduates will choose to join us) but to increase our reach, the reach of our message, our vision and mission, our projects, etc. This is all about pushing the Society's agenda, not our treasury (though that would be nice as well, as it would enable us to accomplish more.)

We'll keep you posted!

PK

Call for Nominees for Elections 2011 Moon Society Office & Board Openings

From Moon Society President Peter Kokh

It is time to begin the annual Moon Society Elections Ritual once again. Each year, we vote for two of our 4 officers, and in odd # years, such as this one, we vote for 3 of our 5 directors, voting for the other 2 in even # years. Respond to president@moonsociety.org

Three (3) Moon Society offices are up for election or re-election are **Vice-President** (inc. **Jason Tuttle**) and **Treasurer** (inc. **Dana Carson**.) Their terms will end in 2013. The office of **Secretary** has been vacant for some time, and nominations are most welcome. Election would be to the balance of a 2-year term ending in 2012, when a nominee could run for reelection.

Moon Society Directors positions open for election or re-election are the seats currently held by **R. Scotty Gammenthaler**, **David Dunlop** and **Bryce Johnson**. We have also been operating without a Chairman of the Board for sometime. Any director may volunteer. The Board is scheduled to convene once a quarter, (the 3rd Wednesday of the second month of every quarter (**Feb, May, Aug, Nov**) but may be convened at any time

Eligibility: Anyone who has been a member of the Society for a full year as of August 1, 2011 is eligible to run for a board seat or officer position. This year **all members with a membership number of 1600 or lower** are eligible for election.

Recommendations: (1) Anyone unable to attend our meetings on a regular basis should not run for office. The Management Committee (*officers and directors meeting together*) meets the 1st and 3rd Wednesday evenings *monthly*, 9–11 pm Eastern, 8–10 pm Central, 7–9 pm Mountain, 6–8 pm Pacific. Times will be earlier in Hawaii and Alaska. Times in the Eastern Hemisphere will be on the following Thursday: wee morning hours in Europe, morning in India, and early afternoon in Australia. Our meetings are held in a private and dedicated chat room, in the ASI-MOO environment.

Recommendations: (2) Anyone who has not previously served in a Moon Society leadership capacity and who wishes to run, is encouraged to join us in our meetings *now*, so that you will be up to speed by election day. To gain access to the Management Committee meetings, please send an email to president@moonsociety.org so that access (restricted) can be granted.

At least 1 new person is needed! As we have no incumbent in the Secretary position, we need at least one new candidate! Of course, *anyone is welcome to run against any incumbent*. In total there are 6 positions open. And if we have some contests this year, that will liven things up!

To all members not running: You are not restricted from giving input on matters of any kind that pertain to Society goals and directions, projects and programs, the website or newsletter. Do feel free at any time to send an email to president@moonsociety.org sharing with us your concerns, opinions, and suggestions. We enjoy hearing from you, and are encouraged by your taking interest in this way. **Many thanks!**

Nominations are due April 15th along with a candidate statement (250 words maximum) stating what you bring to the office in question, background, etc. ●

Moon Mars Atacama Research Station in Northern Chile edges towards reality

Report by Maria Catalina and Peter Kokh

The University of Antofagasta (in Chile's major northern port city by that name) has taken ownership of the project and is providing initial funding at the \$500k level. The location has shifted off the Chajnantor plateau (site of the ALMA Radio Telescope array) to a location only "a half-hour's drive" out of Antofagasta. The exact site should be selected. A crew of eight including Peter Kokh from the Moon Society and famed astrobiologist Chirs McKay from NASA Ames had been tasked with this, but it is possible that the UA will pick the site on its own.

The Moon Society has been instrumental in the development of the proposed program and architectural concepts, but now that the U-Antofagasta has ownership, the program and the architecture may change. Yet without Moon Society assistance, the project may never have advanced to this stage.

Moon Society Chapter Exhibit Kits?

Paid for by the Society, free of charge to chapters

Chapters-coordinator@moonsociety.org

The Society is looking into the feasibility of providing each of our chapters and outposts an Exhibit Kit that might contain some or all of these elements:

- A **Moon Society Banner** – probably using the new logo–banner artwork featured on our homepage
- A Moon Society **podium sign** for use at conferences and other speaking engagements
- Other exhibit materials relating to various Moon Society Projects and Proposals
- **Show & Tell items** such as the Gravity Bricks http://nsschapters.org/hub/gravitybricks_howto.htm (if we can find a source of the needed bricks) or Gravity Jugs <http://nsschapters.org/hub/gravityjugs.htm>
- Masters of Flyers and Brochures (already online)

More information should be available next month.

Chapters that have produced exhibit items worth replicating should call these items to the attention of the chapters–coordinator – email address above.

If you have an idea for another exhibit items that might be included in the proposed Kit, please contact the chapters co–coordinator at the email address above.

It is important that we share our ideas, and our acquired collective experience in the area of public and student outreach

Are you getting our monthly *Moonscapes* formatted email Newsletter?

If not, it may be because we do not have your correct current email address in our database. Or, if you have a Verizon email address, it is because you have not "whitelisted" Moon Society email addresses, and as a result, *Moonscapes* email ends up in your spam folder.

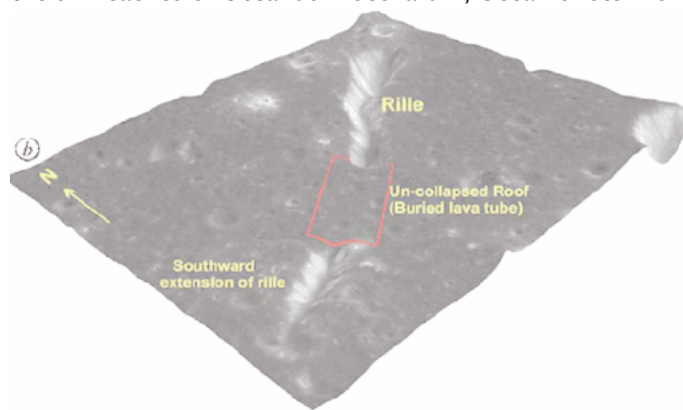
For any problems, just send us a letter at:

moonscapes@moonsociety.org

Moon Society Congratulates India's Chandrayaan-1 Team for Discovery of Intact Lava Tube Section on Moon

www.moonsociety.org/reports/ISRO_Lavatube_Discovery.html

February 25, 2011 – ISRO [Indian Space Research Organization], has released a paper detailing the discovery of a 1.72 kilometer long (5,733 ft.) intact lava tube section in the SW reaches of Oceanus Procellarum, Ocean of Storms.



The data was gathered by **Chandrayaan-1's Terrain Mapping Camera (TMC)**, one of **eleven science instruments** on board India's first lunar orbiter, launched October 22, 2008.

<http://www.isro.gov.in/chandrayaan/htmls/tmc.htm>

"The TMC image is in the panchromatic spectral range of 0.5–0.75 μ m with a stereo view in the fore, nadir and aft directions of the spacecraft movement and with a high spatial resolution of 5 m at an orbital height of 100 km (ref. 1), to enable three-dimensional viewing of the lunar surface with crisp and clear surface features and morphology.

"The Digital Elevation Model (DEM) generated from the three look angles enables morphometric study of various lunar features, thus furnishing topographic relief and dimensions of various morphological entities.

"Identifying sites for permanent base stations for possible human settlement on the Moon is important for long-term perspective of lunar exploration."

Japan's **Kaguya** probe had previously discovered the first of several lavatube "skylights" now known.

<http://www.planetary.org/blog/article/00002173/>

The Chandrayaan-1 finding reinforces the long prevailing assumption that the basaltic lava flow areas of the Moon (the maria, pronounced MAH-ria, Latin for seas) that occupy 39% of the Moon's nearside, and a lesser portion of the Farside.

These are substantial and voluminous spaces well-shielded from the cosmic elements, and as such provide ideal locations for area-intensive developments such as warehousing, industrial parks, agriculture, archiving, and settlements.

We have dubbed them "**The Moon's Hidden Valleys**." Public perception of the Moon is of a barren rock-strewn rubble pile. But this perception is superficial.

Lavatube Skylight Explorer: Building on the previous discovery of lavatube skylights on the Moon, the Society has announced its intention to sponsor an engineering competition to design a probe that could lower itself

down into one of these skylights and explore what it sees. You will find our "LavatubeExplorer.ppt" powerpoint presentation on this competition [here](#).

<http://www.moonsociety.org/competitions/engineering/>

Read this **collection of articles on Lunar Lava Tubes** published in Moon Miners' Manifesto over the years.

http://www.moonsociety.org/publications/mmm_papers/lavatubes_ccc.htm

A discovery long predicted: More than two decades ago, Cassandra Coombs and B. Ray Hawke had published a list of such "interruptions" in various lunar rilles, suggesting that they represented "uncollapsed" sections of an original long lava tube.

www.moonsociety.org/research/LB2-208-LavaTubes.pdf

It was the Apollo 15 mission, which back in the summer of 1971 set down along the edge of Hadley Rille, that convinced lunar geologists (selenologists is correct, but out-of-favor term) that these features were the remains of collapsed lavatubes of gigantic proportions.

Perhaps the most familiar of these suspected "interrupted" rille sections are those along Hyginus Rille in central nearside. (See the slide in the LavatubeExplorer presentation mentioned above)

What has been needed is a very high-resolution view taken from just the right angle facing one "end" of such an "interruption" and that is what Chandrayaan-1's high-resolution Terrain Mapping Camera has provided. We look forward to the release of similar findings elsewhere on the Moon.

It is a "top level" priority of the Moon Society to change public perception of the Moon from that of a "been there, done that rubble pile" to "a fascinating world of Hidden Valleys" ideal for human settlement and begging to be explored. The purpose of our Lavatube Skylight Explorer engineering competition is to motivate NASA or some other space agency to begin exploring these hidden but promising features. We do this in the tradition of the Lunar Prospector grass roots effort that ultimately resulted in the NASA mission of this name. As advocates, we cannot launch missions. But we can pave the way for "those who can" to see the importance of doing so.

We are encouraged that, while NASA seems to have turned its back on the Moon, to go with the flow to Mars, the space agencies of other nations have not done so. The International approach, with or without NASA, is more likely to "go the course" and prepare the way for the establishment of a permanent human pioneer frontier on this "Eight Continent."

TMS

Note: With the opportunities for publicity afforded by NSS' International Space Development Conference, this year in Huntsville, Alabama, The Moon Society will award key individuals and teams a "University of Luna" Award for their role in advancing the future. In our deliberations about possible awardees, two current developments loom large"

- We are crossing the threshold into a new age of **human-robot synergistics** on the space frontier
- We need to change public perceptions of the Moon as a barren and useless wasteland to one of a **world with hidden valleys and safe "anchorages"** where a thriving human frontier can take hold. *Stay tuned!*

Chapters & Outposts

Moon Society St. Louis Chapter

<http://www.moonsociety.org/chapters/stlouis/>

Contact: Keith Wetzel <kawetzel@swbell.net>

Next meetings – Mar 16th – April 20th – May 18th

Meetings 3rd Wed monthly at Buder Branch Library
4401 S. Hampton, in the basement conference room

Moon Society Phoenix Chapter

<http://www.moonsocietyphoenix.org/>

The site has been designed by Mike Mackowski
and put up by Ben Nault

Contacts: Craig Porter portercd@msn.com

Chuck Leshner: chuckmiester999@yahoo.com

Meeting the 3rd Saturday of the month, 3 pm,
at Denny's on Rural Rd just south of US 60.

Mar 19th – April 16th – May 21st

February 19th meeting report by Craig D. Porter:

Telepresence Racing: Don reported that Stuart is still
searching for the rest of the equipment needed for our
racers to be assembled and tested for the Racing venue.

Lunar Habitat: Don did a visual presentation of his water
filtration system for his habitat, and presented a
detailed list of the equipment and its performance.

LepreCon37: We are still putting together our presenta-
tions and will detail them our April meeting. We are
also updating our table display for the Convention.
New "Stand Ups", perhaps a detailed model of Don's
Moon Habitat and maybe models of new LEMs.

CopperCon31: We will use what works at Leprecon37
and add new items and ideas as we develop them.

New "Website": Mike's Website is up and running,
www.moonsocietyphoenix.org, and we are looking for
ways to add content and improve the site.

Yuri's Night: Mick's company is thinking about hosting a
Yuri's day party at the company headquarters along
with appropriate **presentations**. We are also looking for
a place where we can really party. **More below**

Links for information for upcoming events:

www.leprecon.org Leprecon37, first weekend in may
in down town Tempe, AZ.

www.casfs.org or www.coppercon.org Coppercon31,
Labor Day Weekend in Avondale, AZ.

Clear Lake Area (Houston) National Space Society & Moon Society Chapter

<http://www.moonsociety.org/chapters/houston/>

Contact: Eric Bowen eric@streamlinerschedules.com

The Chapter held its last regular meeting on
January 24. Our big event in the past month was the
SpaceUp "Un-conference" (<http://spaceuphouston.org>) at
the Lunar & Planetary Institute in Houston, Feb. 12–13.
We co-sponsored the event and manned a table in the
exhibit area; Peter's "gravity bricks" and Marianne Dyson's
"gravity eggs" (for the little ones) were a big hit and we
were able to reach out to several new prospects. The
highlight of the event was probably astronaut Clay
Anderson's presentation on Saturday evening, which was
followed by a commercial spaceflight panel. The SpaceUp
organizers have hopes of scheduling similar events

elsewhere in the country, so I encourage everyone to be
alert for possible future events in your own area.

Our next regular meeting will be 7:00 p.m. Monday
evening, March 21, in the conference room of the Bay
Area Community Center in Clear Lake Park; 5002 NASA
Road 1; Seabrook, TX 77586. Among our topics of
discussion: We are thinking about planning a "film fest" in
the home of one of our friends on a Saturday in April with
plenty of popcorn, soda pop, and space movies, possibly
a few classics from the '50s like *Destination Moon*,
possibly some of the official NASA PR films from the
Mercury and Apollo days, and maybe some modern
classics such as *Apollo 13* and Tom Hanks's *From the
Earth to the Moon* miniseries. The home we're looking
into has several TVs, so we could have multiple movies
going at once—pick your pleasure! There will be no
charge, of course, other than perhaps a little "potluck"
contribution of drinks or snacks. Guests welcome.
Updated information will be posted on the Moon Society
Forum in the Houston Chapter section –

(<http://www.moonsocietyforum.com>)

and on the chapter web site– Eric Bowen

Chapters & Outposts Events Page

www.moonsociety.org/chapters/chapter_events.html

===== Moon Society Outposts =====

www.moonsociety.org/chapters/chapter_outpost_map.html

Bay Area Moon Society, CA Outpost – South Frisco Bay

Contact: Henry Cates hcate2@pacbell.net

Informal meeting at Henry Cate's home in San Jose

The 4th Thursday every month

DC Metro, DC–MD–VA Outpost

Contact: Fred Hills Fredhills7@aol.com

Indianapolis, IN Outpost

Contact: Doug Keenan dougkeenana@gmail.com

Milwaukee, WI Outpost (MSMO)

www.moonsociety.org/chapters/milwaukee/msmo_output.htm

Contact: Peter Kokh kokhmmm@aol.com

The Lunar Reclamation Society meeting on the 2nd
Saturday afternoon every month serves MSMO also

Nashville Outpost – Central Tennessee

Contact: Chuck Schlemm cschlemm@comcast.net

Rockford, IL Outpost

Contact: Bryce Johnson lesaus@sbcglobal.net

Moon Society DUES with Moon Miners' Manifesto

Electronic MMM (pdf) \$35 Students/Seniors: \$20

Hardcopy MMM: U.S./Canada \$35 Elsewhere: \$60

Join/Renew Online - www.MoonSociety.org/register/

Moon Society Mail Box Destinations:

Checks, Money Orders, Membership Questions

Moon Society Membership Services:

PO Box 940825, Plano, TX 75094-0825, USA

Projects, Chapters, Volunteers, and Information

Moon Society Program Services,

PO Box 080395, Milwaukee, WI 53208

< End Moon Society Journal Section >

GREAT BROWSTING

SPACE TRANSPORTATION

<http://nextbigfuture.com/2011/01/summary-of-nuclear-propulsion-for-space.html>
http://news.yahoo.com/s/ac/20110208/us_ac/7808054_nasas_ares_1_to_be_reborn_as_the_liberty_commercial_launcher
<http://www.defense-aerospace.com/article-view/release/122424/darpa%2C-nasa-launch-future-starship-study.html>
<http://io9.com/#!5757489/how-to-build-a-space-elevator-and-become-an-interplanetary-civilization>
<http://www.space.com/business/technology/spacex-dragon-capsule-inside-look-101206.html>
Long-term planning for interstellar missions
<http://www.thespacereview.com/article/1765/1>
How you can train to be a Commercial Astronaut
<http://www.astronauts4hire.org/>
Solar Aails and Thinking Big
http://www.centauri-dreams.org/?p=16145&utm_campaign=sails-and-infrastructure-thinking-big

THE MOON

<http://uk.ibtimes.com/articles/110483/20110209/robot-moon-google-lunar-prize-space-mission.htm>
Top 10 Technologies for Reusable Cislunar Transportation
http://ssi.org/2010/SM14_presentations/101030_SSI_Bienhoff-Goff.pdf
Catalog of Existing Microrover designs
<http://www.planetary.org/microrovers/>
Canadian group to develop a new Luna Exploration Light Rover (LELR)
<http://www.financials.com/info/story.cfm?storynum=4637651>

MARS

http://www.marsdaily.com/reports/Tool_Makes_Search_For_Martian_Life_Easier_999.html
http://news.yahoo.com/s/ac/20110220/us_ac/7901496_using_asteroids_as_space_ships_to_voyage_to_mars
<http://www.physorg.com/news/2011-02-china-mars-probe-november.html>
An autonomous Marsplane is not far off
www.bbc.co.uk/news/science-environment-12074162

ASTEROIDS & COMETS

Comet Temple 1 flyby photos taken by Stardust-NEXT
http://www.nasa.gov/mission_pages/stardust/multimedia/gallery-index.html

OTHER PLANETS

NASA needs super radiation-hardened instruments for Jupiter-Europa-Ganymede mission
http://www.militaryaerospace.com/index/display/article-display.articles.military-aerospace-electronics.online-news-2.2010.11.nasa-approaches_industry.QP129867.dcmp=rss.page=1.html
Will WISE Data detect hypothetical Tyche Planet?
<http://www.space.com/10952-nasa-giant-planet-tyche-faq-wise.html>

ASTRONOMY - OTHER SOLAR SYSTEMS

Cosmic census finds crowd of planets in our galaxy
50 billion planets, 500 million in "eco-zones"
http://news.yahoo.com/s/ap/us_sci_cosmic_census

SPACE STATIONS

<http://alspacesettlement.blogspot.com/2011/02/bigalows-national-customers-revealed.html>
www.newscientist.com/article/dn19949-fledgling-space-firm-will-use-old-soviet-gear.html
Views from the ISS Cupola
www.esa.int/esaHS/SEM2856JGG_index_mg_1.html
Space Adventures to fly 3 tourists to ISS starting 2013
<http://www.spaceadventures.com/index.cfm?fuseaction=news.viewnews&newsid=817>
NASA NAUTILUS-X: multi-mission exploration vehicle includes centrifuge, which would be tested at ISS
<http://hobbyspace.com/nucleus/?itemid=26786>

GREAT SPACE VIDEOS

MOON COLONY VIDEOS - The Moon Society

30 plus thought-provoking videos, produced for the Moon Society by Chip Proser (Celestial Mechanics, Inc.) can be found at:
<http://www.mooncolony.tv/>
<http://www.gaiaselene.com/>

NOTE: Some of these videos were produced by Chip on his own, such as the one on "Global Warming" on which the Society has taken no stand because the leadership is split on this issue

Featured this month:

Will Chinese be the language of the lunar frontier?

- Buzz Aldrin

<http://www.youtube.com/user/mooncolonytv#p/a/u/0/DQc4Yn0A2Lk>

The Moonhatten Project 1

<http://www.youtube.com/user/mooncolonytv#p/a/8C1DA029520F52B6/0/cnVt8QCYC0w>

ASSORTED SPACE VIDEOS

Get inspired by visions of the future from science fiction's "second golden age" - in 5 parts
<http://io9.com/#!5766434/get-inspired-by-visions-of-the-future-from-science>

NSS' International Space Development Conference 2011

<http://isdcs.nss.org/2011/index.shtml>

Huntsville, Alabama - May 18-22, 2011

The weekend before Memorial Day Weekend

Von Braun Center & Embassy Suite Hotel Spa

<http://www.embassysuiteshuntsville.com/home.aspx>

Registration Rates through September 30th

Non-member \$230, NSS member \$180,

Student up to age 22 with I.D. \$40

Huntsville Tourist Destinations include the famed U.S. Space and Rocket Center: NASA's Marshall Space Flight Center: home of the Atlas, Saturn rockets and Space Shuttle Main Engines, and possibly the United Launch Alliance (ULA) Decatur, Alabama plant.

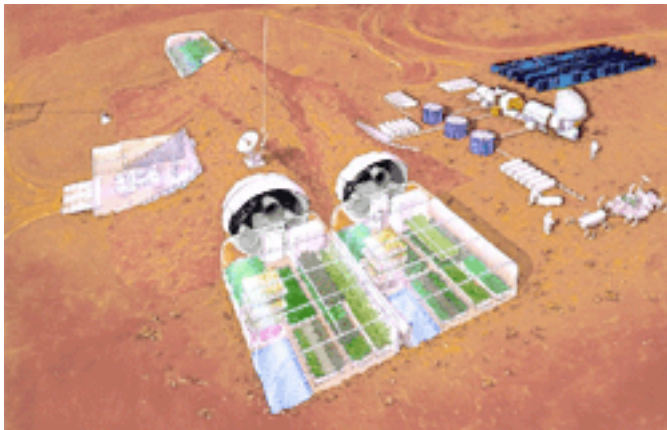
Call for Papers

<http://isdcs.nss.org/2011/callforpaper.shtml>

Space Investment Summit

<http://isdcs.nss.org/2011/SpaceInvestment.shtml>

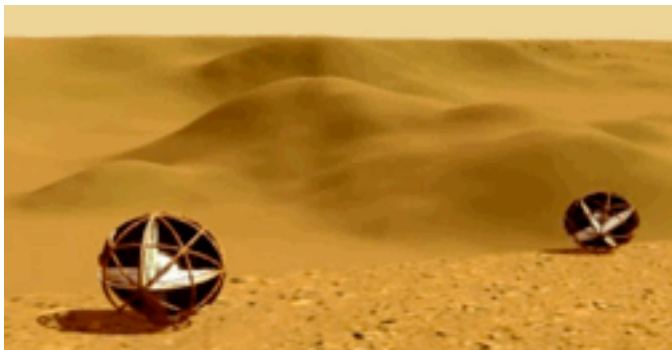
MMM PHOTO GALLERY



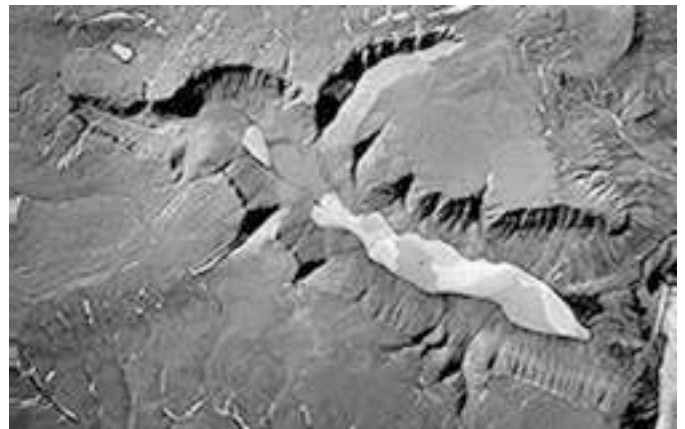
Depiction of a trio of Mars Greenhouses



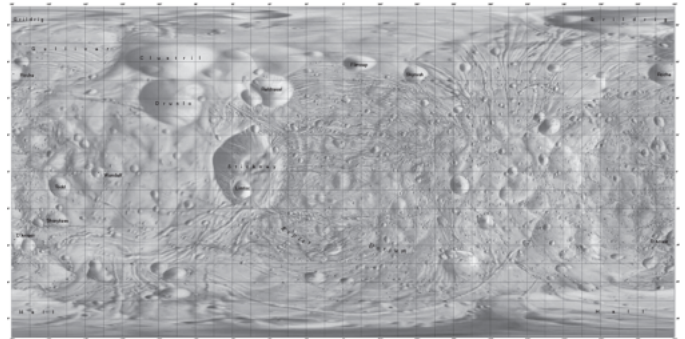
Tumbleweeds Mars Rover concept above
A similar concept below



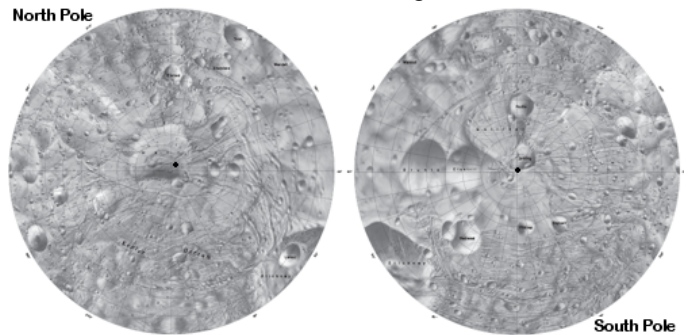
Houghton-Mars Analog Station on Devon Island
Where channels carved by sub-glacial water better resemble “river” valleys on Mars than do real rivers



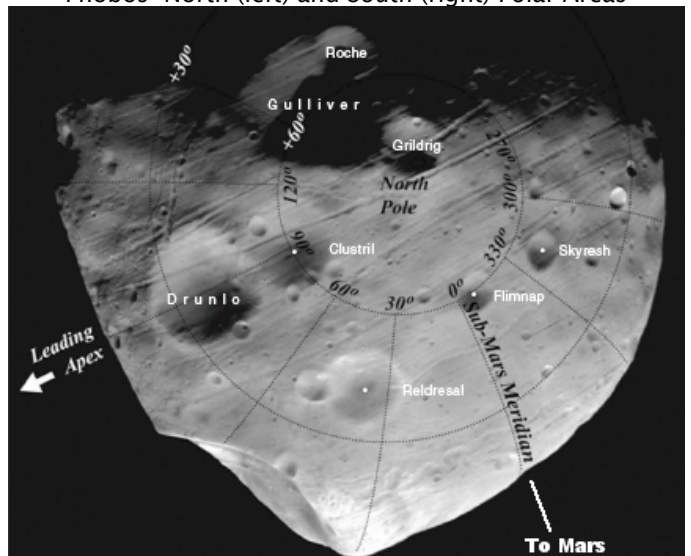
Sub-glacial formed channel on Devon Island



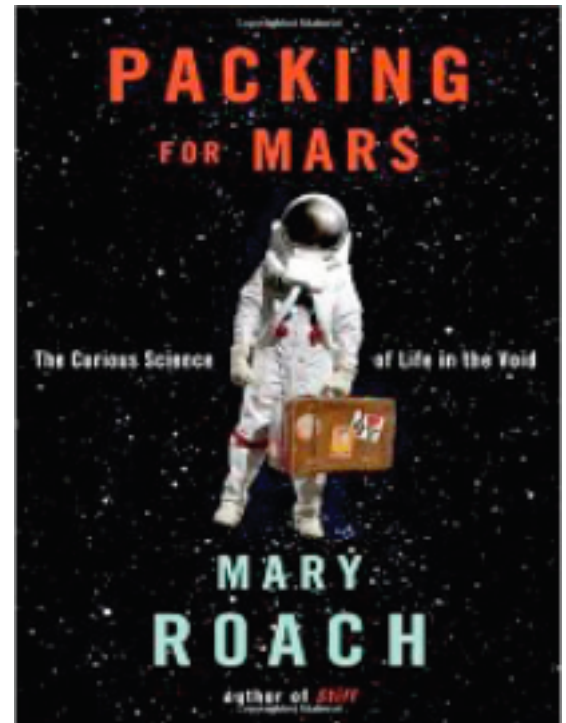
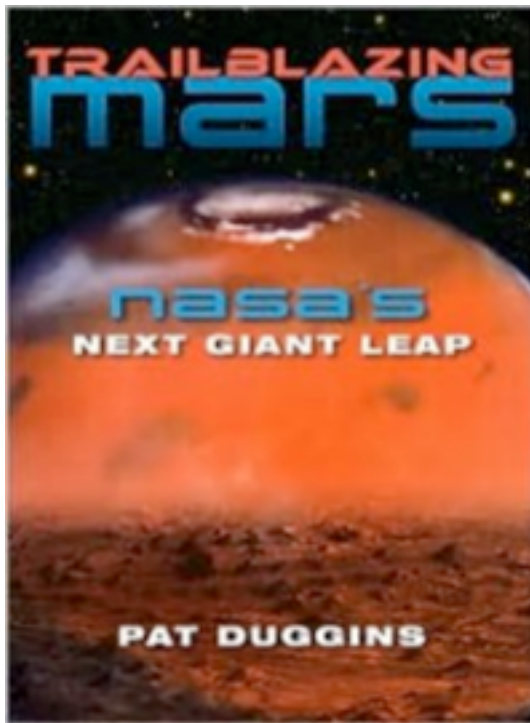
Mercator Projection map of Mars' largest moon **Phobos**
Nearside in middle including big crater **Stickney**
Portions of farside to right and left



Phobos' North (left) and South (right) Polar Areas



photographic view Phobos' North Polar area



Trailblazing Mars: NASA's Net Giant Leap

By Pat Duggins

University Press of Florida, 2010
hardcover, 224 pp., illus.
ISBN 978-0-8130-3518-5_US\$24.95
\$15.69 on Amazon.com

http://www.amazon.com/Trailblazing-Mars-NASAs-Next-Giant/dp/081303518X/ref=sr_1_1?ie=UTF8&s=books&qid=1288717687&sr=1-1

Book Review: By Jeff Foust, Nov. 11, 2010.

<http://www.thespacereview.com/article/1717/1>

Excerpt:

"What technology, planning, and other preparation needed to be able to successfully mount human expeditions to the Red Planet is at the heart of *Trailblazing Mars*.

"Pat Duggins, a longtime National Public Radio reporter who covered the space program from Florida, digs through the history of space exploration as well as the various issues associated with the exploration of Mars. He takes on a broad range of issues in a relatively slender book, from the experience of building and working on the ISS to the biological and psychological lessons learned from the Biosphere 2 project in the early 1990s.

"He also examines some of the criticism for human Mars exploration from those who think such exploration is better done by robots and/or think NASA's priorities should be focused elsewhere, such as (in the opinion of Gregg Easterbrook) protecting the Earth from asteroid impacts."

"Given the book's subtitle ("NASA's Next Giant Leap") and its timing, one might think that the book covers the shift in direction in space policy towards human Mars exploration that came earlier this year. Unfortunately, that's not the case."

Excerpt from Amazon.com review: "The reader will be enlightened to find out that going to the moon and visiting Mars are not the same and why."

Packing for Mars:

The Curious Science of Life in the Void

By Mary Roach

Available on Kindle

W. W. Norton and Company, New York, London

ISBN 978-0-393-06847-4 (hardcover)

\$14.80 from Amazon.com

New & Used from \$8.99

http://www.amazon.com/Packing-Mars-Curious-Science-Life/dp/0393068471/ref=sr_1_2?ie=UTF8&s=books&qid=1288717750&sr=1-2

128 Reviews on Amazon.com – Average Review 4+ stars

At the top of the list are "the most helpful favorable review" and "the most helpful critical review"

<<<←→>>>

ISS MARS DC Conference

<http://iss.exploremars.org/>

Washington, DC – April 6–7, 2011

Jack Morton Auditorium

George Washington University

ExploreMars.org and National Space Society

Registration <http://issmars.eventbrite.com/>

Melrose Hotel in DC – Room rate for the conference is \$199/night April 5, 6, and 7. Mention Code: "Explore Mars" or "MARS040511". There are a limited number of rooms. Please book by March 10.

<http://www.melrosehoteldc.com/index.aspx>

Can ISS be used to advance the goal of sending humans to Mars?

Topics to be discussed include human factors, technology development for beyond LEO, can ISS be used for mission analog work?, commercial participation, and whether the ISS international partnership model can be used for missions beyond LEO – specifically Mars

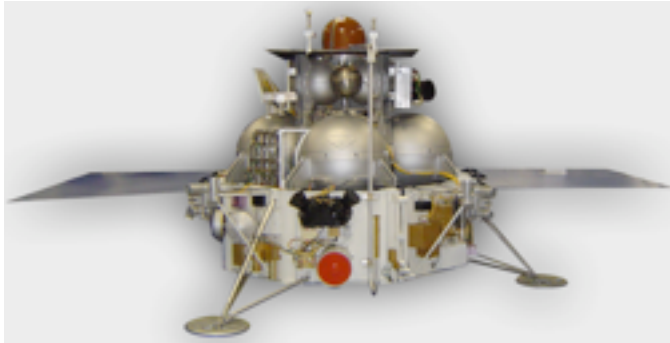
Upcoming Mars Missions

3 Mars probes to be launched late in year

November 2011 Launch window

China-CSNA Yinghuo-1 / Roscosmos' Fobos-Grunt

First Chinese interplanetary mission will hitchhike a ride to Mars on Russia's Fobos-Grunt Phobos orbiter mission. **Yinghuo-1** (an ancient Chinese name for Mars (literally "shimmering bewilderment") will orbit Mars and do atmospheric studies. The main scientific objectives include (1) detailed investigation of the plasma environment and magnetic field; (2) study of Martian ion escape processes and possible mechanisms; (3) ionosphere occultation measurements between Yinghou 1 and Phobos-Grunt, focusing on the sub-solar and mid-night regions; and (4) observation of sand storms.



Fobos-Grunt would be the first Russian interplanetary mission since the failed *Mars 96* mission. This would be the first macroscopic extraterrestrial sample from a planetary body brought back to Earth since the last sample return mission by Luna 24 in 1976. [Wikipedia] <http://en.wikipedia.org/wiki/Yinghuo-1> <http://en.wikipedia.org/wiki/Phobos-Grunt>

USA-NASA Mars Science Laboratory "Curiosity"

During the same launch window (Earth>Mars launch windows occur at 25+ month intervals) NASA hopes to launch the largest and most capable Mars Rover yet. Curiosity weighs four times as much as Opportunity or Spirit and can cover much more ground in the same amount of time, and perform much more elaborate tests on samples, aimed at the search for living or fossil samples of living indigenous Mars life-forms. This "Morris-Mini-sized" rover will be lowered to the surface by a hovering "sky-crane" so that the rocket exhaust will not scour the surface around the landing site.



http://en.wikipedia.org/wiki/Mars_Science_Laboratory

China to launch its own solo Mars Mission in 2013

during the next launch window. The probe will be based on the Chang'e-1 and -2 lunar probe models.

14th Annual International Mars Society Convention

"Mars, The Next Frontier"

August 4-7, 2011

Embassy Suites Grapevine_Dallas, Texas

<https://sites.google.com/a/marsociety.org/www/home/membership/convention>

Convention Rates:

	<u>Members</u>	<u>Non-Members</u>
Full Convention + Banquet)	\$150.00	\$210.00
Student/Senior (- Banquet)	\$40.00	\$70.00
Banquet (adult)	\$50.00	\$50.00
Banquet (child)	\$25.00	\$25.00

Registration will be on the website soon, until then please Contact Patricia Czarnik to Register for the convention.

patt@marsociety.org



HOTEL: The Embassy Suites Hotel located in Grapevine, Texas will offer a first-class setting for the Convention. Grapevine is a thriving community in the DFW Metroplex, and is in close proximity to DFW International Airport.

With complimentary airport shuttle provided by The Embassy Suites hotel, attendees can enjoy the conference without the expense of a rental car.

The room rate of \$119.00 includes a cooked-to-order breakfast buffet and a reception each evening.

To book your room call 972-724-2600 and identify yourself as being with the Mars Society Convention.





*Ad Astra per Ardua Nostra
To the Stars through our own hard work!*

2010 LRS OFFICERS | BOARD* | Contact Information

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kokhmmm@aol.com 414-342-0705
VICE-PRES. Doug Armstrong NSS 414-273-1126
SECRETARY – *James Schroeter NSS
James_Schroeter@excite.com 414-333-3679
TREAS./ Database – *Robert Bialecki
bobriverwest@yahoo.com 414-372-9613

LRS News

• **First Fruits of a Generous Bequest:** Earlier this year, LRS received a bequest of \$7,700 from the estate of an elderly couple in Wallhalla, South Carolina. They had contacted Peter Kokh in the spring of 2005 for recommendations. Both the Moon Society and National Space Society have received equal amounts.

We have already pledged \$500 in prize money for the proposed **Lavatube Skylight Explorer** engineering competition, and an equal amount for a **Solar Sail cubesat** competition.

With LRS Board approval, Treasurer Bob Bialecki has purchased an LED Projector System that can project DVDs and PowerPoint presentations on the big screen in our Mayfair Mall Meeting room. We have used the new system several times already.

• **FIRST Robotics [F]or Inspiration and [R]ecognition of [S]cience and [T]echnology:** Last month, Peter Kokh and Dave Dunlop drove down to Rockford, Illinois to meet with the leader of the **Rockford Robotics** team. There are thousands of these teams in the US and worldwide, mostly at the high school level. There will be a Wisconsin Regional Competition event here in Milwaukee at the US Cellular Arena, Th-Sa March 10th-12th. We have emailed the organizers about cosponsoring the event and having a table. If they agree, and the cost is manageable, this event would preempt our March Meeting. We will try to email everyone likely to attend the meeting in advance.

<http://www.wisconsinregional.com/>

<http://www.rockfordrobotics.com/>

LRS Upcoming Events

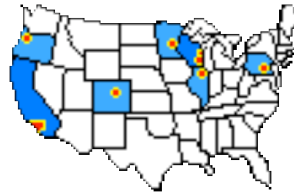
Saturdays: 1-4 pm

Mar 12th – April 9th – May 14th

LRS Meeting, Mayfair Mall, Garden Suites Room G110

AGENDA:

www.moonsociety.org/chapters/milwaukee/meetings.htm



**News & Events
of NSS
“MMM” Chapters**

Space Chapter HUB Website:

<http://nsschapters.org/hub/>

OREGON



Oregon L5 Society

P.O. Box 86, Oregon City, OR 97045

voice mail / (503) 655-6189 -- FAX (503)-251-9901

[<http://www.OregonL5.org/>]

Allen G. Taylor allen.taylor@ieee.org

Bryce Walden moonbase@comcast.net

(LBRT – Oregon Moonbase) moonbase@comcast.net

* **Meetings 3rd Sat. each month at 2 p.m.**

Bourne Plaza, 1441 SE 122nd, Portland, downstairs

Mar 19th – April 16th – May 21st

MINNESOTA



**Minnesota Space Frontier Society
c/o Dave Buth 433 South 7th St. #1808
Minneapolis, MN 55415**

David Buth (w) (612) 333-1872, (h) (763) 536-1237

Email: info@mnsfs.org

www.mnsfs.org/

Calendar: MN SFS 2011 Past & upcoming chapter events

<http://www.mnsfs.org/2011-Review/>

MarsCon 2011 Science Room March 4th-6th

“Mars Needs Moms” SciFi film debut Friday March 11th

MN SFS Meetings: Mondays March 14th – April 11th

Yuri’s Night, Tuesday April 12th

Minicon 46 Science Room April 22nd – 24th

Challenger Memorial, Veterans Park, New Brighton, MN

<http://freemars.org/mnfan/MNSFS/2011-01-Memorial-Dinner/>

ILLINOIS

Chicago Space Frontier L5
610 West 47th Place, Chicago, IL 60609

Larry Ahearn: 773/373-0349 LDAhearn@aol.com

WISCONSIN



Sheboygan Space Society
728 Center St., Kiel WI 54042-1034

c/o Will Foerster 920-894-2376 (h) astrowill@tcei.com

SSS Sec. Harald Schenk hschenk@charter.net

>>> **DUES:** "SSS" c/o B. P. Knier

22608 County Line Rd, Elkhart Lake WI 53020

[<http://www.tcei.com/sss/>]

• We meet the 3rd Thurs even # months 7-9pm

At The Stoelting House in Kiel, WI

Apr 21 - Jun16th - Aug 18th - Oct 20th

Sat. Dec 10th - Annual Holiday Meeting with Lunar Reclamation Society in Milwaukee, weather permitting

COLORADO

Denver Space Society
(FKA The Front Range L5 Society)

1 Cherry Hills Farm Drive
Englewood, CO 80113

<http://www.angelfire.com/space/frl5/>

Eric Boethin 303-781-0800 eric@boethin.com

Monthly Meetings 6:15 PM on 2nd Tuesdays

Mar 8th - Apr 12th - May 10th

Englewood Public Library, Englewood, CO 80110

1000 Englewood Parkway, First Floor Civic Center

PENNSYLVANIA



Philadelphia Area Space Alliance
928 Clinton Street, Philadelphia, PA 19107

c/o Earl Bennett, Earlisat@verizon.net

856/261-8032 (h), 215/698-2600 (w)

[<http://pasa01.tripod.com/>]

<http://phillypasa.blogspot.com>

• **PASA regular business luncheon/formal meeting 1-3 pm, the 2nd Saturday (unless otherwise noted) of every month at the Liberty One food court on the second level, 16th and S. Market. Go toward the windows on the 17th street side and go left. Look for table sign. Parking at Liberty One on 17th St. Call Earl/Mitch 215-625-0670 to verify all meetings.**

Next Meetings: Mar 12th April 9th May 7th

Our next meeting will be at The Liberty One Food Court on March 12, for April on the ninth, and May seventh (Super Science Weekend in **Trenton**). March and April at our regular location noted above: go to the second floor, The Food Court, and go left towards the windows. Look for our table display.

February Meeting notes: Michelle, Hank and Dennis as well as our regulars Dotty and Larry, and now Wallace, where able to attend this time. We extended our talks to include two new museum exhibits in our area, one on extreme life forms, and the other, at The Franklin Institute, on Da Vinci. If this comes to your area you should go to see this tribute to his genius. It is a proof by example of this statement. Much discussion on this and other exhibits, with more from Dorothy.

Mitch requested a change to our member ship dues structure: make the dues \$25 per year whenever they are paid to the next March (May to March, July to March etc.) on the website. Also, in this housekeeping mode, asking that Earls' phone number be changed to his current number.

He brought up an anniversary that many of us would have missed: the thirtieth of publication of James Oberg's "New Earths". Thanks to N.S.S., Mitch was able to give us, and later put out as free material at the main library, the Spring Ad Astra. There was a great deal of neat stuff in this issue starting with the cover feature: "Steps for Planetary Defense" as the main article. The cover also points to a "Private Spacecraft Portfolio" starting on page 38. Mitch, or Dennis Pearson also mentioned that Ad Astra would be available in book-stores again. Page 40 has a Google Lunar X-Prize Update feature as well. Lots of good material here! The I.S.D.C. in May is also described in this issue.

Dotty Came with descriptions of various exhibits at the museums in our extended area: from the just opened Da Vinci exhibit, to book signings at the Udvar Hazy branch of The Smithsonian (in Virginia), to "Women in Space" at the Washington Air and Space site, and Family Day at Air and Space, on April 16.

Larry, our webmaster, did a Q&A on the website and we talked about how we might improve it. He reported that we are getting 500 hits a month now. This is up quite a bit. He reports that some of this may be a result of our Face Book presence. He discussed, with Mitch initiating the conversation, the possible linking of our site to the major newspaper sites in our area. They will check on the required permissions and report in the next few months.

Hank brought news of the science fiction group's activities centered on the Philcon annual convention in our area. They still have no major guests to announce (in early February) and this in spite of two meetings, in January, of the committee that is working on this. A week after our meeting the Philcon group was to continue this work. Hank will continue his advocacy for Ben Bova (whose book "Faint Echoes, Distant Stars" I am reading)

as the Guest of Honor, and Dr H. Paul Shuch as both a science and artistic guest of honor.

Hank also pointed out that it might be possible to have talks at Philcon related to the fiftieth anniversary of manned space flight. This extends the concept associated with Yuri's' night to a special celebration period of the rest of this year! Why didn't I think of this?

Dennis talked of the upcoming I.S.D.C. and the shuttle flight to launch on February 24. The senators' husband is going on this retirement flight for a shuttle. And then there will be two. Then one. Then none. Then?

Earl reported, briefly, on several topics at the meeting. I will extend the report a bit here: first I just received a great pro space publication that is not glossy, and is published rather frequently, this one. I have only skimmed it so far, but see a lot of things I, as a hardware oriented reader, find interesting. The "how" things are achieved is one of the reasons I support our members getting this publication. This "how" changes with technology: the cover feature of Moon Miners for February exemplifying this fact: now NASA is looking into what has been wonderful speculation, as an alternative to a large laboring human force, for getting things ready on the Moon: tele-operated (and semi self directing?) avatars. They are called "Robonauts" but, as interface technology advances (see February issue of Wired magazine for example) the melding of the actions of the operator and the robonaut can become seamless. And there is lots more on the concrete 'how'.

And other tech topics: Today's Medical Developments has two short reports on new devices for medical, and other applications: the specific one, for repair of damaged nerve paths, is a device called "an active book" an electronically active implant that can give the user the capability to exercise limbs that would otherwise require hand on frequent physical therapy. See "Small World" on page 68. The other technological device is on memetic material in the F.Y.I. column: "Revolutionizing the Manufacturing Process". This is applied material science where the different areas of the part have different properties that come into play at different temperatures. The part could assume different shapes under different conditions, a property that doctors, and space structure designers, would find useful. Page 74. And there is Amsat, with an improved telemetry software package for the ARISAT-1 satellite transponder. And more. The Nov./ Dec. issue.

And two thoughtful articles from Analog: one a story on what SETI is facing "Astronomic Distance, Geologic Time" (March 2011) by Bud Sparhawk, and "Smart SETI (a Science Fact report) on a different reason we haven't heard any signals: we may have but our categorizing assumptions may have made us ignore what we had seen! The Benfords, Gregory and James, look at the problem from a different angle than many. The major question is on the transmit side, not the receivers: how do "we" set up transmissions with the maximum cost benefits ratio? See the article in the April issue, starts on page 33.

And in closing: Frank O'Brien is donating a signed copy of his book "The Apollo Guidance Computer" as one of the awards for the senior level winner of The Oscar H. Harris Award at The George Washington Carver Science Fair in March, and our Super Science event is now in May (7th) not April. Earl Bennett

CALIFORNIA

SDSPACE.org

San Diego Space Society

<http://sandiegospace.org/>

info@sandiegospace.org

Meeting the 2nd Sunday monthly, 2:30 to 4:30 pm

Next Meetings: March 13th, April 10th, May 8th

Serra Mesa Branch Library 9005 Aero Dr, San Diego

Mars Science Laboratory Rover: SD Space and Mars Society San Diego are working to build a quarter-scale model of the Mars Science Laboratory rover. For more information: <http://sandiegospace.org/projects/msl/>

On **January 29th**, members participated in the RHFleet Science Center's public **Challenger Mission**. This two-hour mission was in honor of the Challenger disaster of January 28th, 1986. Dave, Scott, Rylee, Adrian, Gerry and Jesse joined children and adults from the community in a simulated manned mission to Mars, set in a future where voyages to Mars are routine, each "crew" member had to perform specific roles to contribute to mission success. This included building a probe to Phobos and a landing at the Mars Base. There we encountered a Martian sand storm which hastened the crew exchange and departure of the return flight. Flight navigation, remote geology sensing and life support were a few of the other important roles, each with it's own activities and tasks.

CALIFORNIA

OASIS

**OASIS: Organization for the Advancement
of Space Industrialization and Settlement
Greater Los Angeles Chapter of NSS
P.O. Box 1231, Redondo Beach, CA 90278**

Events Hotline/Answering Machine:(310) 364-2290

Odyssey Ed: Kat Tanaka - odyssey_editor@yahoo.com

<http://www.oasis-nss.org/wordpress/>

oasis@oasis-nss.org

Odyssey Newsletter Online

<http://www.oasis-nss.org/articles.html>

Regular Meeting 3 pm 3rd Sat. each month

Next Meetings: Mar 19th - April 16th - May 21st

Information: OASIS Hotline, 310/364-2290; website.

Saturday, March 19, 3 pm - OASIS Board Meeting,
Home of Phil Turek, 7611 Alhambra Drive, Huntington
Beach, 92647

Saturday, April 9, 3:30 pm OASIS LECTURE SERIES,
USC Small Satellite Lecture, Location: TBD

Saturday, April 16, 3 pm - OASIS Board Meeting, Home
of Bob and Paula Gounley, 1738 La Paz Road, Altadena,
CA 91001

Saturday, May 14, 3 pm - OASIS Board Meeting, Home
of Lisa Kaspin, 3206 Summertime Lane Unit 206, Culver
City, CA 90230

Moon Miners' MANIFESTO

Lunar Reclamation Society Inc.

PO Box 2102, Milwaukee WI 53201-2102

Address Service Requested

Mail Carrier, Time Sensitive Material <==



Please renew promptly so as not to miss an issue

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PHONE#S _____

• \$45 National Space Society dues include *Ad Astra*

• \$20 NSS dues if under 22 / over 64. State age ____

600 Pennsylvania Ave SE #201, Washington DC 20003

Moon Society dues include *Moon Miners' Manifesto*
Electronic MMM (pdf) \$35 Students/Seniors: \$20

Hardcopy MMM: U.S. & Canada \$35 – Elsewhere: \$60

P.O. Box 940825, Plano, TX 75094-0825, USA

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Crew & Cargo Logistics & Support, J. Strickland

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Member Dues -- MMM Subscriptions:

Send proper dues to address in chapter news section

=> For those outside participating chapter areas <=

• \$15 USA MMM Subscriptions; • US \$25 Canada;

• US \$55 Surface Mail Outside North America

Payable to “LRS”, PO Box 2102, Milwaukee WI 53201

CHICAGO SPACE FRONTIER L5

• \$15 annual dues

LUNAR RECLAMATION SOC. (NSS-Milwaukee)

• \$15 low “one rate”

MINNESOTA SPACE FRONTIER SOCIETY

• \$25 Regular Dues

OREGON L5 SOCIETY

• \$25 for all members

O.A.S.I.S. L5 (Los Angeles)

• \$28 regular dues with MMM

PHILADELPHIA AREA SPACE ALLIANCE

• Annual dues for all with MMM \$25, due in March
or \$6 times each quarter before the next March

SHEBOYGAN SPACE SOCIETY (WI)

• \$15 regular, • \$10 student,

• \$1/extra family member

“SSS” c/o B. P. Knier, 22608 County Line Rd,
Elkhart Lake WI 53020