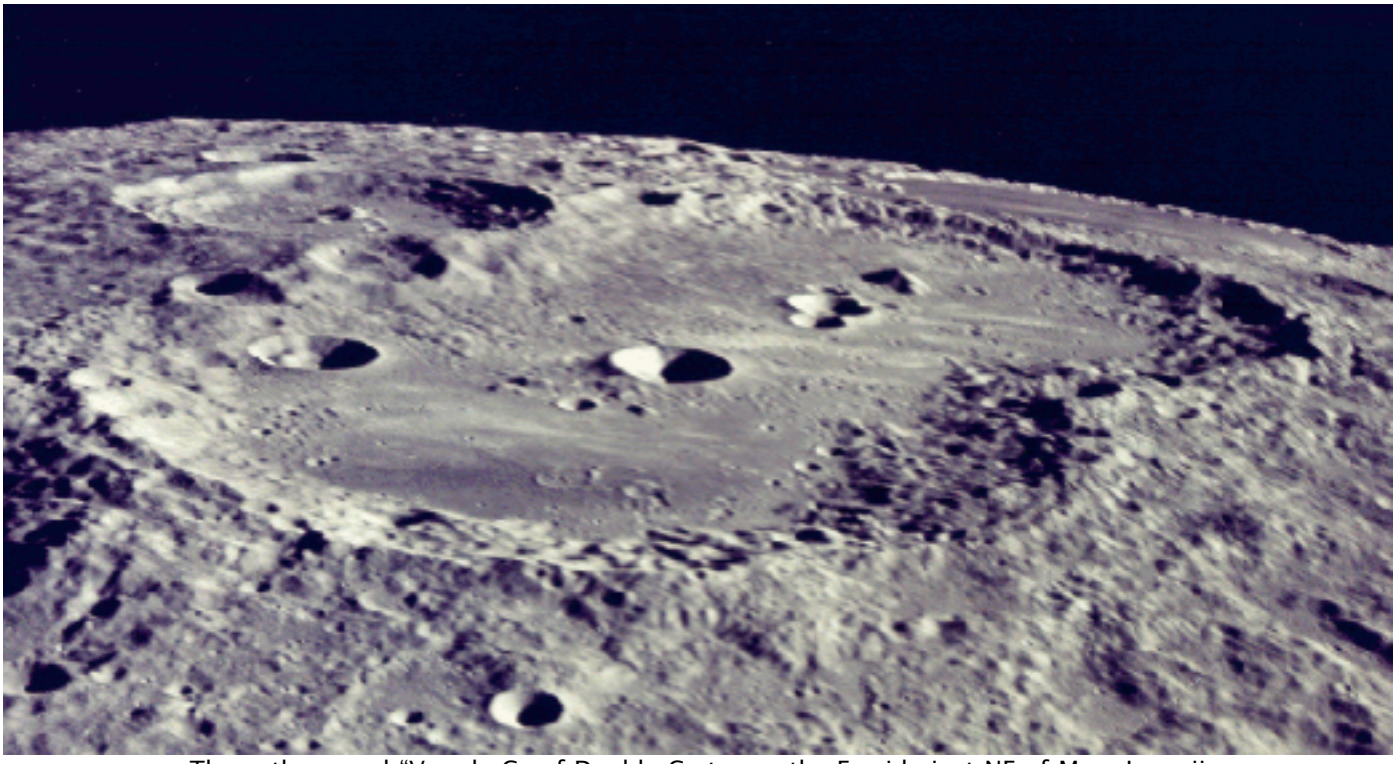
"Towards an Earth-Moon Economy - Developing Off-Planet Resources"

Moon Miners' Manifesto

& The Moon Society Journal

www.MoonMinersManifesto.com

#250 | NOVEMBER 2011



The aptly named "Van de Graaf Double Crater on the Farside just NE of Mare Ingenii

Feature Articles in This Issue

The Moon's Dusty Surface Blanket: -> What is the "Regolith" anyway?

If lunar explorers and pioneers are going to deal with the "troublesome" moondust successfully, they will have to know what it is like and how it behaves, *in depth,* along with the practical problems it will pose for them. Without such knowledge, their efforts are likely to fail. We must learn how to turn every "problem" into an advantage, so that in time, we can deal with this stuff instinctively, as if by second nature, much as the Innuit deal with the arctic. Ron Brooks contributes the 1st of 3 installments, pp 7-9

In Focus NASA caught pushing Space Launch System for Wrong Reasons

Source: "Internal NASA Studies Show Cheaper and Faster Alternatives to The Space Launch System"
www.spaceref.com/news/viewnews.html?id=1577

While the instructions of the Administration and Congress to stop working on the Constellation Project were clear, it seems that NASA feels cuckolded without a "super rocket" program. [=> 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.

• **Moon Miners' Manifesto CLASSICS:** The non-time-sensitive articles and editorials of MMM's first twenty years have been re-edited, reillustrated, and republished in 21 PDF format volumes, for free downloading from this location:

www.MoonSociety.org/publications/mmm_classics/

• **MMM Glossary: new terms, old terms with new meanings:**
http://www.moonsociety.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.

[Opinions expressed herein, including editorials, are those of individual writers and not presented as positions or policies of the **National Space Society**, **Lunar Reclamation Society**, or **The Moon Society**. **Copyrights** remain with the individual writers. Reproduction rights, with credit, are granted to NSS & Moon Society chapter newsletters.]

• **For additional space news** and near-term developments, read ***Ad Astra,*** the magazine of the **National Space Society**, in which we recommend and encourage membership

• **The Lunar Reclamation Society** is an independently incorporated nonprofit membership organization engaged in public outreach, freely associated with the National Space Society, insofar as LRS goals include those in NSS vision statement. LRS serves as the Milwaukee chapterof both NSS & Moon Society: http://www.moonsociety.org/chapters/milwaukee/

• **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.

• **NSS chapter**s and **Other Societies** with a compatible focus are welcome to join the MMM family. For special chapter/group rates, write the Editor, or call (414)-342-0705.

• **Publication Deadline:** Final draft is prepared ASAP after the 20th of each month. Articles needing to be keyed in or edited are due on the 15th, *Sooner is better!* - ***No compensation is paid.***

• **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

Note: Typed hardcopy over 1,000 words will not be accepted.

• **MMM is mailed 2nd Class:** *Second Class bulk mail is not forwarded.* **If you move and rely on forwarding instructions at your old local Post Office, *you will not receive your copy.*** *It is the reader's responsibility to inform LRS, TMS or other organization through which the reader receives MMM as a membership benefit, of any change in their mailing address.*

⇒ In Focus Editorial continued from p. 1.

NASA's new "**SLS**" *"**Space Launch System**" is clearly a rehashed version of Constellation which Mike Griffin had proudly called "Apollo on Steroids" – a tag many of us hardly view as a compliment! When the Administration and Congress mandated an end to the Constellation Program, many space advocates hoped that the Commercial Launch Industry could come up with a simpler, faster, *and much less expensive* replacement – with the Space-X Falcon Heavy being a most promising example.

The savings in a Commercial approach come from two wellsprings: a non-bureaucratic way of doing everything, and new rocket transportation architectures. But it seems NASA does not want to give up its traditional primacy: new system architectures and non-bureaucratic project administration be damned!

There seem to be two drivers here: 1) the desire to keep control and do the work *in house* and 2) to satisfy the demands of key Senators and Congressmen to keep some NASA Centers and Aerospace Contractors in their territories busy and productive, the interests of the nation as a whole be damned.

That Bolden (the buck stops here) should present the "SLS" proposal to Congress is disheartening. President Obama handpicked Bolden as NASA Administrator to reform the Agency, not to salvage the status quo. Are we too harsh? We think not.

NASA's own internal studies show that "Launch to destination" is not the only architecture that makes sense, but indeed, that smaller, lighter, less expensive rockets that are refueled in orbit, can get any job done at less cost and far sooner.

> "On 26 September 2011, Rep. Dana Rohrabacher (R-CA) issued a press release regarding fuel depots. This included a letter to former Administrator Mike Griffin who had dismissed the notion of fuel depots and commercial launch vehicles as being a viable alternative to the Space Launch System (SLS) during Congressional testimony."

Boeing, certainly an authority not to be lightly dismissed, has been developing an orbital refueling system for some time. The Boeing team behind this project is headed by Dallas Bienhoff, to whom the Moon Society gave its "University of Luna" Award at ISDC 2010 in Chicago. We have cited his team's work in our front page "On the Lunar Upbeat" section:

http://blog.altius-space.com/wp-content/uploads/2010/11/101030_SSI_Valentine.pdf

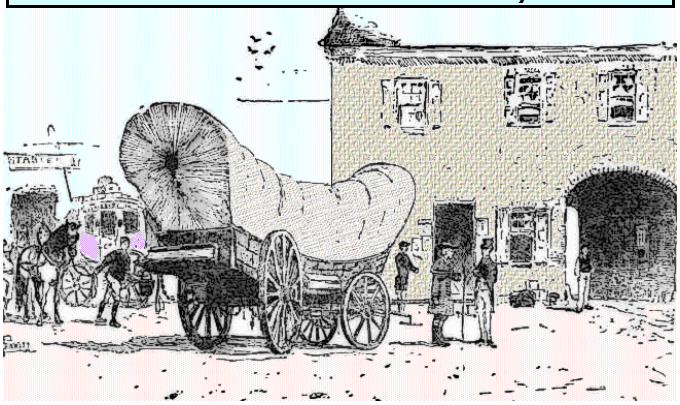
NASA clearly needs to reorder its priorities! **PK**

MMM #250 — A Milestone

With this issue, MMM completes 25 years of continuous publication, *at 10 issues a year.* Our next issue, #252 December 2011 will be our 21st anniversary issue. MMM continues to be a labor of love and we have no plans "to quit and retire" – unless, of course, we have the opportunity for a one-way move to the Moon as an early pioneer. Then we would launch ***The Mother Moon News*** as MMM's replacement. Thanks to all our readers!

Without you, MMM could not have survived. ***PK*** ☺

The Moon: What's in it for Earth? Part III: The Benefits of a Challenging Frontier; Availability of Frontiers to Settle as a Cultural Stimulant and Safety Valve



"Wild wild west" as a forcast of the "wild wild Moon"?

By Peter Kokh

I can't think of anyone who has better illustrated and explained with due passion the importance of human frontiers beyond Earth than **Robert Zubrin**, since then the founder of the Mars Society. I encourage all to read "The Significance of the Martian Frontier", an article published in the September/October 1994 issue of ***Ad Astra*** – a publication of the National Space Society. This essay is online at:

http://www.nss.org/settlement/mars/zubrin-frontier.html

Zubrin begins by quoting Walter Prescott Webb from his **The Great Frontier**, 1951:

"It would be very interesting to speculate on what the human imagination is going to do with a frontierless world where it must seek its inspiration in uniformity rather than variety, in sameness rather than contrast, in safety rather than peril, in probing the harmless nuances of the known rather than the thundering uncertainties of unknown seas or continents. The dreamers, the poets, and the philosophers are after all but instruments, which make vocal and articulate the hopes and aspirations and the fears of a people.

The people are going to miss the frontier more than words can express. For four centuries they heard its call, listened to its promises, and bet their lives and fortunes on its outcome.

It calls no more..."

Zubrin quotes Frederick Jackson Turner, a young professor of history at the then little known University of Wisconsin over a hundred years ago:

"To the frontier the American intellect owes its striking characteristics, that coarseness of strength combined with acuteness and inquisitiveness; that practical, inventive turn of mind, quick to find expedients; that masterful grasp of material things, lacking in the artistic but powerful to effect great ends; that restless, nervous energy; that dominant individualism, working for good and evil, and withal that buoyancy and exuberance that comes from freedom — these are the traits of the frontier, or traits called out elsewhere because of the existence of the frontier."

He frontier has been slipping into the past. If we do not open new frontiers, we risk our civilization and culture becoming stagnant, ossified, fossilized, an intellectual and spiritual prison.

Yet it is clear that the personal characteristics that lead some to pioneer are not at all universal in our species. It is only certain types of personalities, with certain types of talents, who are so driven. And I believe I have stumbled on the key some years ago.

Here is the gist of my "eureka moment."

Those raised in, or familiar with the Christian faith will have heard of "the Beatitudes – eight or ten depending on the source.

http://www.searchthebible.com/beatitudes.html

To this list I propose to add another:

Blessed are the Second Best for they are the ones who pioneer new frontiers!

Let me explain. Those who were doing well in Boston and Baltimore in the mid-19th Century stayed in Boston and Baltimore. Those talented and motivated individuals who found all suitable positions taken, no way to climb the ladder, were the more motivated to resettle in the wide-open West where they had a better chance of getting in on the ground floor. Their lives might be hard and difficult, but they would be rewarding, something that cannot be bought.

It was the same with talented and motivated Europeans who found little room to climb where they were, but with enough ability to reestablish themselves in the Americas or Australia and elsewhere. Indeed the paradigm can be found much further back, beyond the beginnings of humankind. Among lions, for example, and in other species, those capable males who were unable to successfully challenge the pack leader but still had leadership traits to offer were the ones who with their mates pioneered new territory and established new tribes.

It is not the best individuals, the cream of the crop, who pioneer. ***It is the second best.***

The availability of frontiers, however rough and wild and challenging, has served both animal species (plants as well) and humans as expansion space and as a safety valve from time immemorial. Population pressure is a factor as well, of course.

Meanwhile, new human frontiers soon develop fresh cultures and spirits, that through return visits to the homeland, revitalize stagnant cultures there. The opening of the Americas revitalized all sectors and aspects of European culture and civilization. Feedback from other national "diasporas" has done likewise, though sometimes this feedback is delayed.

Humans are a frontier-blazing species

And this began with the spread of human populations first throughout Africa, then "Out of Africa" to Europe and Asia, Australia and the Americas. The now more than 100 millennia long "**Epic of Man**" has taken us "Out of Africa" to one continent after another.

The Antarctic Exception

So far, Antarctica has been a frontier for explorers and scientists only, fisherman tolerated on the periphery. By international treaty, "settlement" and access to resources are excluded, out of fear that this pristine environment would be spoiled (as we have "spoiled" the other continents – fortunately not in their entirety!

While we have committed our share of environmental atrocities on other continents, that we cannot establish protocols and regimes that would preserve the most environmentally sensitive areas of Antarctic while opening less sensitive regions to controlled settlement and resource use is an assertion that desperately needs to be challenged.

If we allow the Antarctic Treaty to go unmodified, it could become a model for off-Earth non-expansion. Yes, we have sinned! No, ***humans can learn and adapt to environment-respecting and cherishing lifestyles and resource-access***. And unless we are allowed to try new paradigms off-Earth, we will be doomed cultural and intellectual stagnation. Then we can write the final judgment on the human experiment right now: "a brilliant start, an abominable failure to continue."

Antarctica would be a great proving ground for prospective Martian settlers, as the climate has nearly identical thermal range. Mars, with less fresh water, no breathable air, and no fish in a surrounding sea, will be the harder frontier. Those who can't make it in Antarctica need not apply.

"Of Dust," or "of Star Dust"

Those of us raised in the Judeo-Christian tradition, are very familiar with the line from Genesis" "Of dust thou art, and to dust thou shalt return." Yes, but that dust is star dust. Every atom in our bodies with the exception of hydrogen, has been forged in the interior of stars that have since exploded, seeding the interstellar gas clouds with the dust from which everything else has come, including our Sun and its family of planets. In that light, a correction is in order.

"Of stardust thou art,
and to the stars thou shalt return."

To close the door to frontiers beyond Earth would be the ultimate perversion, *the ultimate slap in the face to our Creator* or creative agencies.

Intercontinental > Interplanetary > Interstellar

Further, the Moon is not a sibling planet with its own orbit around the sun. It shares Earth's orbit and is bound to Earth. It is part of Greater Earth, and in a very real sense:

"another continent beyond another kind of sea."

We arose as an African species, and have since become an Intercontinental one. Settling the Moon will be the consummate chapter of our *intercontinental* epic, establishing the Keystone piece that prepares us for phase II: *Interplanetary* expansion starting with Mars. *Then, on to the Stars!* It is at once a human legacy, our birthright, and our destiny. And those remaining on Earth will benefit enormously just as those who stayed in Europe benefited form the settling of the Americas.

Lessons learned on the Moon of use on Earth

` Yes, planetary scientists and geologists learn a lot about the Moon that sheds light on the early Earth. But while intellectually interesting and illuminating, this new knowledge is unlikely to be of practical economic significance unless it indicated unsuspected resources in the upper mantle that could somehow be tapped – an unlikely scenario.

But pioneers, forced to adapt to an unfamiliar and a seemingly hostile and life-threatening environment on the Moon, would be facing the biggest test since early Siberians pushed into the arctic and conquered the ice and cold and snow as Eskimos and Inuit. Think of the phenomenal difference between the jungle-skirted plains of East Africa and the Arctic coasts of Alaska and Canada and you have some idea of the challenge that will face lunar pioneers. History says that with the right attitudes, determination, inventiveness and resourcefulness, pioneers can meet the challenge and turn life on the Moon into something rewarding and worth the sacrifices of favorite things about life on Earth that they leave behind.

They will have to develop new alloys of familiar metals, and new materials to substitute for wood and plastics and fossil fuels. In the process, they will come up with things we have never tried on Earth but would make welcome additions to our current stuff-inventories. New art forms, new sports that play to the 1/6th G but standard momentum that people on Earth might enjoy watching on TV, and yes, no dance forms too.

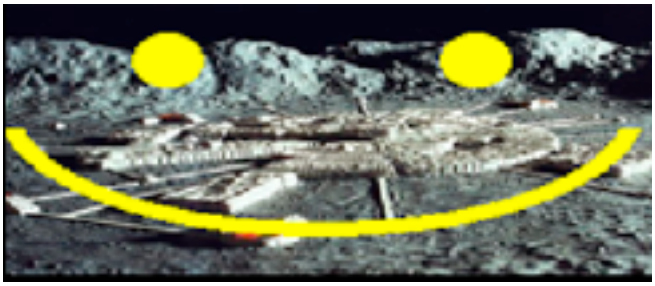
It is imperative that pioneers learn environment-preserving processes and techniques without delay under sentence of system collapse whereas we will not spend money and time learning such things as the punishing consequences of our environmental sins are long delayed. "Pioneers will live immediately downwind and downstream of themselves." There will be no lunar global water and atmosphere sinks to dis-perse pollutants, only local mini-biospheres.

The pioneers will have to learn to live with mischievous moondust and black skies and 2-week long dayspans and equally long nightspans, unbelievable nightspan cold and dayspan heat, cosmic rays and solar flares.. After some years on the Moon they may have to face the fact that they might not be able to readapt to life on Earth.

But they will not be alone. Pioneers will have brought along plants and animals, establish little "gaiacules." We must reencradle ourselves in pocket offspring of "Mother Earth."" Thus the pioneers will be spreading Earth Life ("Gaia"), not just humanity. To the extent that there is no other way for Earth-Life ecosystems to reproduce themselves beyond the atmosphere, humans are essential to any such reproduction. This gives settlements on the Moon a double mission, a mission with a significance that transcends human history. If we are children of Earth, we return the honor in midwiving mini-Earths wherever we go.

The effects and benefits on the life and culture of those who stay behind will be enormous. **PK**

Challenges Facing Would-be Lunar Pioneers

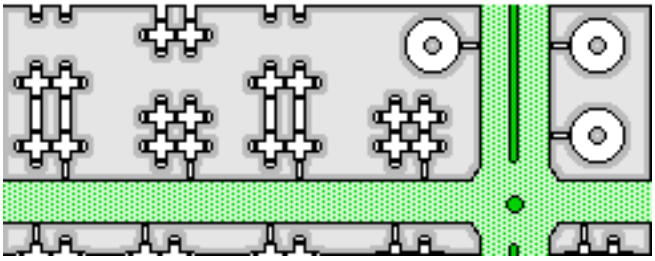


By Peter Kokh

• **Life-quenching surface vs. tightly shielded habitats.** As the Moon is airless and thus exposed to temperature extremes, cosmic radiation, and solar flares, pioneers must live in small, tightly sealed modules either underground or tucked under a blanket of moon dust. The "gap" between the life-squelching exposed surface (what we have dubbed **the "out-vac"** (outside on the surface and exposed to vacuum) (rhymes with Australia's "outback") and the pressurized, temperature controlled, shielded living and work spaces is daunting and enormous. But we propose two intermediate environments:

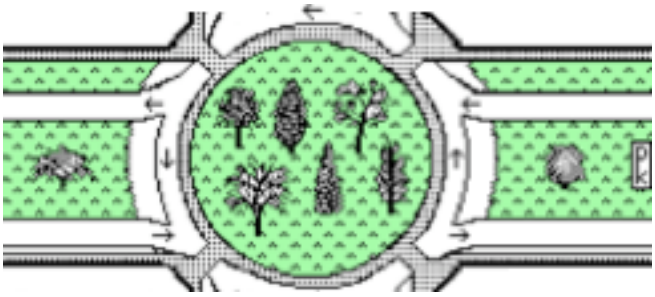
1. **The Middoors:** pressurized common spaces such as hallways, 'streets', parks, and squares with abundant vegetation, where the tempera-tures are allowed to swing between warm in dayspan and cool during nightspan) – Middoor spaces, along with agricultural areas. would hold the bulk of the outpost or settlement mini-biosphere and, as a hosting complex, would expand as the outpost or settlements expand. In effect, what we enjoy as enjoyable "outdoors" would be realized on the Moon. Thus the pioneers would not be confined to tight residential and work modules. The Middoors could even make use of water in the process of treatment for ponds, streams, and waterfalls. Each settlement could pick the climate, etc.

Read the entry "**Middoors**" in the **MMM Glossary** http://www.moonsociety.org/publications/m3glossary.html



A settlement residential "block" showing pressurized roads with considerable vegetation.

Both "street" tubes and housing units are modular. Residences also contribute to the biosphere by containing garden spaces, living walls, and primary blackwater recycling systems. Thus as the modular settlement grows, the "modular biosphere: grows apace.

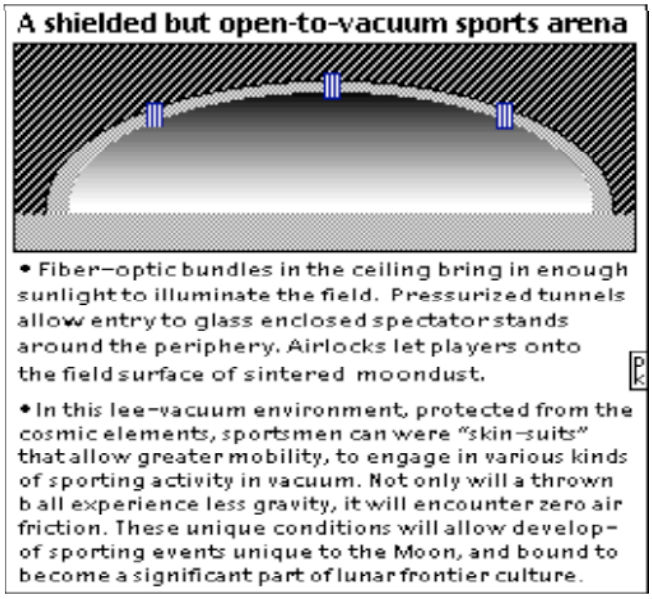


A vegetation-lush "round-about" intersection of the pressurized settlement road network

Read: Modular Biospherics II: "Middoor" Public Spaces – MMM Classics #21 pp 13-15 http://www.moonsociety.org/publications/mmm_classics/mmmc21_Jan2011.pdf

2. **Lee-Vac** or contained and shielded airless spaces protected from radiation and the micrometeorite rain that can be used for sports in vacuum with the need for mere pressure suits. Such spaces are also ideal for ware-housing and storing items that will be needed often.

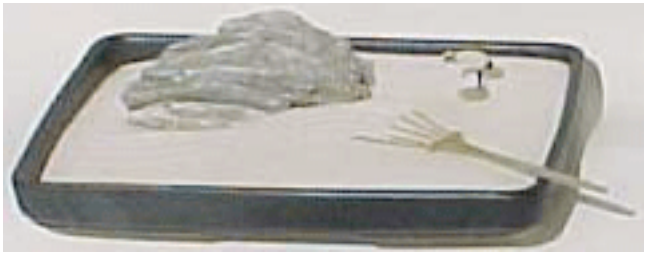
Read the entries "**Lee-Vac**" and "**Lee-Vac Sports Arena**" in the **MMM Glossary** http://www.moonsociety.org/publications/m3glossary.html



Nb. Robots and teleoperated devices will do a lot of the "routine" work out on the exposed surface, minimizing the amount of time humans need to be outside, at risk of excess radiation exposure, except in those situations where robots and robonauts are not able to perform adequately.

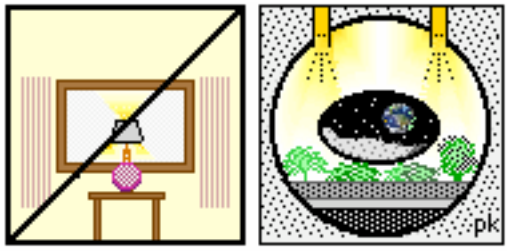
As to the hostile "Out-Vac", pioneers could humanize it with sculptures made of lunar materials near airlock entrances and along graded and sintered paths and roadways. These materials will include hewn and cast basalt, metal alloys, concrete, glasss-glass composites and ceramics. Road signs will also add.

And the pioneers can import inside "Zen Gardens" of raked moondust with carefully placed moon rocks.



More, they could place living plants and flowers in front of windows to filter their view of the desolation outside. ***Read:***

"**Picture Window Clichés**" in the **MMM Glossary**
http://www.moonsociety.org/publications/m3glossary.html



- **1/6th G:** No one has been on the Moon long enough to determine whether deterioration of muscle tone and physio-logical processes will level off at some sustainable point, or sink to the level they do on the Space Station. We have no intellectual respect for those who argue that what happens in zero-G will happen in 1/6th G (or the 3/8ths G of Mars. There is an infinite difference between 1/6th and zero. But pioneers who wish to visit or return to Earth must surely exercise to maintain muscle tone etc. ***Read:***

"**Native Born**" MMM Classics #5, pp. 34-36
www.moonsociety.org/publications/mmm_classics/mmmc5_Jul2005.pdf

Hexapotency Toning Centers,
MMM Classics #13 pp. 14-16
www.moonsociety.org/publications/mmm_classics/mmmc13_July2006.pdf

- **Tight mini-biospheres** without "sinks" to dissipate by wind or water: Pioneers will live immediately downwind and downstream of themselves, and that will be a challenge that will drastically change our familiar careless lifestyles.
- **The need to create space module by module:** Large pressurized volumes, such as domed cities, would be at extreme risk of decompression – we need to disperse risk, not share it. The inclusion of biosphere-maintaining systems in all habitat and activity modules (each toilet with its own blackwater systems, living walls, etc.) pioneer biospheres will grow naturally as more units are added.
- **Long dayspan/nightspan periods** each 14.75 Earth days long: With well-chosen and designed interior lighting systems-this should not be a problem except for energy-consuming activities. We can schedule energy-intensive tasks during dayspan, saving energy-light tasks for night-span – welcome and maintainable rhythm. Even with good power storage systems, we will always have more power during dayspan with direct solar, than during nightspan.

For the Lifestyle changes involved, *Read*
"**Dayspan**", "**Nightspan**", "**Sunth**"
pp. 10-13 MMM Classics #5
www.moonsociety.org/publications/mmm_classics/mmmc5_Jul2005.pdf

For the Energy supply challenges involved, *Read*
"**Potentiation:** A Strategy for Getting through the Nightspan on the Moon's Own Terms"
pp. 31-35, MMM Classics #13
www.moonsociety.org/publications/mmm_classics/mmmc13_July2006.pdf

- **Extreme thermal swings.** As we must heavily shield our living/work spaces, indoor temperatures will vary little. (2 meters ~ yards below the surface, temperatures vary no more than 3° C year around.)

Under a blanket of moondust, temperatures run -9°F (-23°C). So taking a clue from passive solar heating systems on Earth, we could store excess dayspan heat for nightspan heating and excess nightspan cold for dayspan cooling, minimizing power needs.

- **Water will be scarce** and must be recycled with care, keeping it all within our mini-biosphere.
- **The Moon is poorly blessed with carbon and nitrogen:** Organic materials such as plastics, wood, paper that have become the mainstay of our "throwaway" civilization will need to be used sparingly and only in easily recyclable forms. Civilization reached a high state before plastics were available. We can do it again.

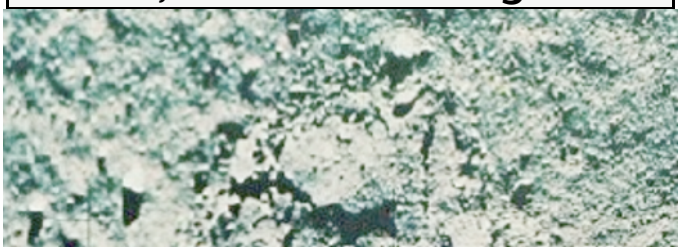
The Big Lesson

No matter what apparent obstacles, show-stoppers, and hardships that the Lunar Frontier might throw at us, our historic epic expansion into an amazing diversity of differently challenging frontier environments, we have been able not just to adapt and survive, but to adapt, learn how to turn any perceived drawbacks into advantages, and eventually thrive.

Lunar pioneers, self-selected for willingness to adapt and prosper, will overcome all these challenges and to "make themselves at home" as have all previous pioneers, having learned to deal with all "risks and drawbacks" as unsuspected springboards to a thriving, health culture. We have done it before, frontier after frontier. We will do it again!

But if we do not accept this challenge, our civilization will grow stagnant, no longer inspiring future generations to explore, master, and come to thrive beyond achieved limits. **PK**

Rock, Rubble and Regolith



By Ron Brooks

1. Introduction: “soil” vs. “regolith”

When we look at our Moon, what we are seeing is a type of “soil” covering resulting from billions of years of a complex “space weathering.” Meteoritic impacts have played a major role in this unique space weathering process that has molded a soil-like covering consisting of a fragmented, unconsolidated mass of rocky rubble, sandy grains, and dust. By no means should this “Moon soil” be compared to or thought of as the soil covering found on Earth, which was produced by processes uniquely terrestrial with the presence of oxygen and the additional influences of wind, water and the activities of life. In contrast, on the lifeless and airless Moon, the “soil” is a result of a very different unique process (McKay, et al., 1991a). To describe the concoction of material that covers almost all the Moon’s surface more adequately, researchers generally use the term "regolith" – [Greek for blanket [rego) – rock [lith] or rock-derived surface layer.

To those interested in the Moon, the Moon’s regolith has been an investigative and problematic topic for many years. As research into the lunar regolith proceeded, many ideas were proposed over the years; especially prior to the Apollo flights in anticipation of the upcoming lunar landings. One such idea was the questionable rigidity of the surface regolith and its capacity to support not only a landing module but the astronauts themselves. (Some thought that the surface was covered with a loose dust blanket that would swallow anything attempting to land on it or traverse it – cf. Arthur C. Clarke’s novel “A Fall of Moondut”) (Another idea was a concern that the astronauts may encounter debilitating physical problems or that their equipment and instruments might malfunction due to the extreme dusty consistency of the regolith. Some of these ideas were confirmed, some were altered, and some discarded with the information gained from research leading to and following the Apollo landings and up to the present day.

The reader needs to keep in mind that almost all we know about the Moon has been derived from its regolith (McKay et. al., 1991b). Great research efforts have been made and a great deal of data has been complied about the Moon through its regolith. Some research findings have been inconsistent from one individual to another. However, the reader needs to appreciate that the Moon is a very complex world, and obtaining sound, consistent, and verifiable information is a slow and demanding endeavor. This is not troubling to those with a real interest in our Moon, but it presents a challenge and adds an element of adventure in revealing the mysteries of our curious companion world.

We need to reset our thinking and accept that our companion is truly another world and does not follow, or need to follow, our earthly conceptions. Hopefully, this article will provide the reader with a better understanding of another piece of the puzzle of our magnificent Moon’s unique structure and environment.

This is the second in a sequence of readings about our Moon’s structure, geology and environment authored for the Moon Society. As with the first article, "Lunar Mascons, Masterpieces of Complexity," which appeared in the May 2011 issue of *MMM*, this article is written for those with varied levels of knowledge in lunar science. The information offered is not intended to be exhaustive or definitive. The references can provide a basis for anyone wishing to pursue more in-depth reading

2. The Difference between Soil and Regolith

As the reader will discover, the word "soil" is not the best to describe the unconsolidated material that covers the Moon’s surface. Even here on Earth we would not call such debris "soil." Because of that, as mentioned earlier, most researchers use the word "regolith" when describing this comprehensive covering. Regolith was first used to define the loose, unconsolidated material covering the bedrock on Earth and over time has been used for the Moon.

Regardless of its definition and descriptive inaccuracies, lunar "soil" has become synonymous with lunar "regolith" (Taylor, 2008a). With this synonymous use, most researchers work interchangeably with both soil and regolith with a general understanding that "regolith" more effectively conveys the idea for the entire mixed bag that covers the lunar surface. The word "soil" has been generally abridged to identifying the subcentimeter particles that actually make up the greater part of all regolith.

"Regolith" thus identifies the entire comprehensive composition from the largest boulders to the smallest microscopic grains, but "soil" refers to the grains that average 70μm which are the most abundant grains and form the bulk of the regolith. The finest grains or what is considered “dust”, in contrast to “soil”, lies as the upper most layer of the regolith and has been identified with a grain size < 20μm and possibly contains grains as ultra-fine as <0.01μm (Park, J., et al., 2006a). Dust, soil and regolith will be used interchangeably as the context requires. (For μm see Note 1.)

Before we begin to work with the terms soil, dust and regolith, the reader needs understand that the weathering environment of the Moon’s surface is very different from that on Earth. During the Moon’s earlier history, great bombardments took place resulting in the dramatically cratered surface. Some of the catastrophic impacts resulted in volcanic activity that produced the dramatic surface changes of the basalt maria. The early heavy bombardments pulverized the greater percentage of the early Moon’s surface, leaving behind a varying degree of near site melt and pulverization and an enormous amount of layered impact ejecta that was thrown in all directions and distances

and in all shapes and sizes. This jumble of rubble covered the Moon's surface. However, while this rubbly concoction was the covering for the early Moon's surface, it is not the regolith that presently covers today's lunar landscape.

3. What Produced Today's Regolith?

Today's weathered surface, as reflected in the regolith, has been shaped from outside cosmic forces or what is referred to as "space weathering." It is not the result of the Moon's atmospheric forces, but of a very different scenario from what happened on Earth.

The soil on Earth is composed of material that has been altered by chemical and environmental weathering produced by a thick, dynamic atmosphere. The Earth's atmosphere has left the soil rich in two major components, moisture and air. Moon soil is devoid in both moisture and air since the Moon does not have a gas and moisture laden atmosphere that could produce Earth-like soil.

The lunar weathering force is of cosmic origin. The dramatic lunar features left over from the great bombardment era, including the maria, have all succumbed in varying degrees to this relentless force.

The cosmic forces that produce the lunar surface are the same forces that significantly affect the surface of Mercury and that strike asteroids without any resistance. Mercury has a weak magnetosphere as a factor $<1000^{th}$ of Earth's and a tenuous non-collisional atmosphere. The Moon does not have a magnetosphere, but does have what is considered a non-collisional atmosphere (even thinner than Mercury's), where the molecules are so sparse that they do not collide or have the ability to interact with outside forces. In perspective, the Moon virtually has no atmosphere. This opens the Moon to all cosmic forces. Knowing this, we need to set aside preconceived ideas about weathering from our Earth-bound perspective.

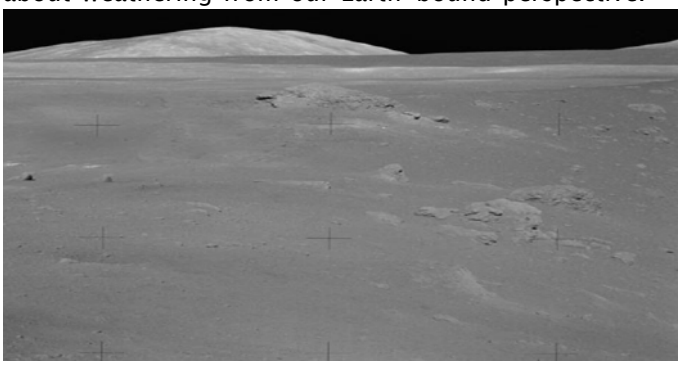


Figure 1. The Moon's Regolith Landscape. Credit: NASA

4. Regolith Grain: Size and Appearance

On average, a bulk lunar regolith sampling taken downward to approximately a 20m depth would reflect ≈95% of the soil that is finer than 1.37μm by weight and ≈5% finer than ≈0.0033μm. The median particle size of such a sampling is approximately ~72μm (Carrie, 2005). Spudis also supports the idea that the regolith soil grains, on average, are composed of grains of ~70 μm (Spudis, 2006a). With the soil grain sizes stated above, the reader needs to realize that the average grain size is almost impossible to be seen by the unaided eye. If one viewed the grains under microscopic enlargement, the shapes would be highly variable. In general, the particles would be somewhat elongated and ranging from spherical to extremely angular (Carrier, et al., 1991). Because of the limited effects of space weathering, most of the granules remain abrasive with jagged sharp edges and tend to pack together.

Below: examples of a very common lunar grain called agglutinates,good overall representations of lunar soil grains. But some grains will vary greatly from the examples given, e.g. the non-impact grains consisting of volcanic pyroclastic glassy spherical beads dispersed over the lunar surface. (See Fig. 2.) But compared to agglutinates, they are sporadic and do not contribute significantly to the bulk of the regolith.

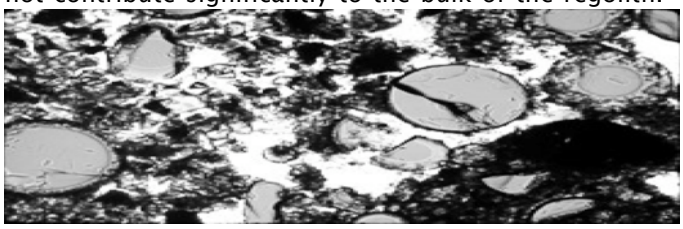
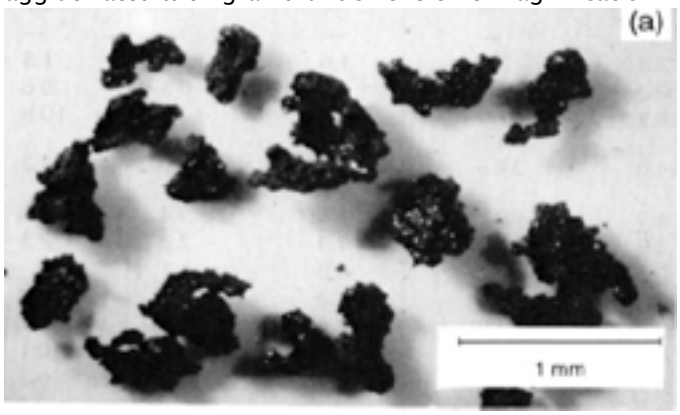
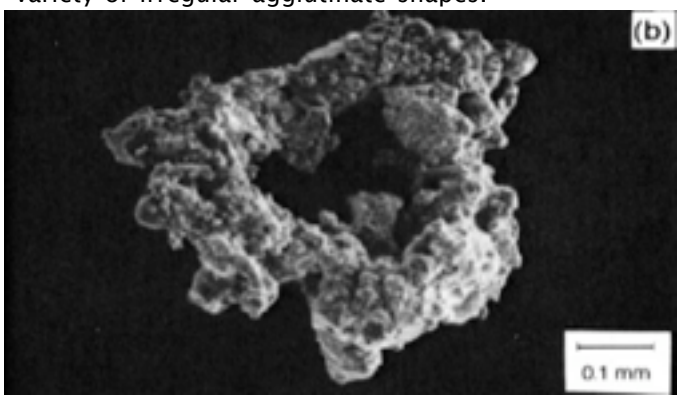


Figure 2. Cross-Section: Lunar Pyroclastic Beads: NASA

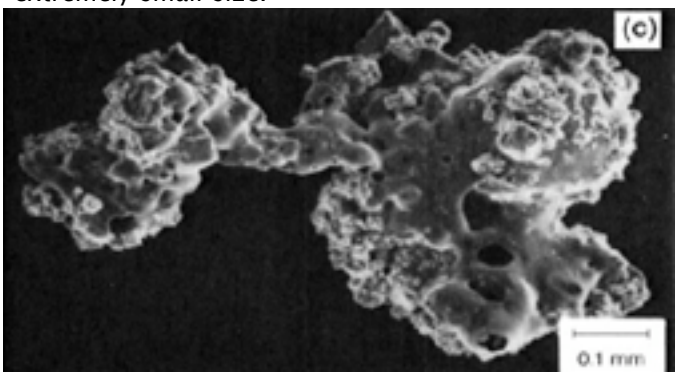
Agglutinates grains are aggregates of smaller soil grains or particles. The average agglutinate grain is usually <1 mm. Agglutinates are formed by heat generated by meteoritic impacts striking the lunar regolith, producing the melting, mixing, and bonding of mineral grains, glasses, and even older agglutinates. The soil grains take an endless array of shapes. An individual grain can have multi-faceted coatings and appendages, barbed and extremely abrasive. Figure 3 (a to f) ***below*** show examples of typical lunar agglutinates with grains under extreme magnification



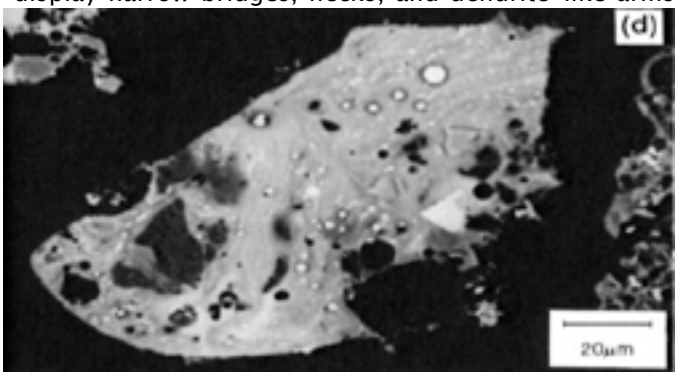
(a) An optical microscope photograph of a number of agglutinates from an Apollo 11 soil sample showing a variety of irregular agglutinate shapes.



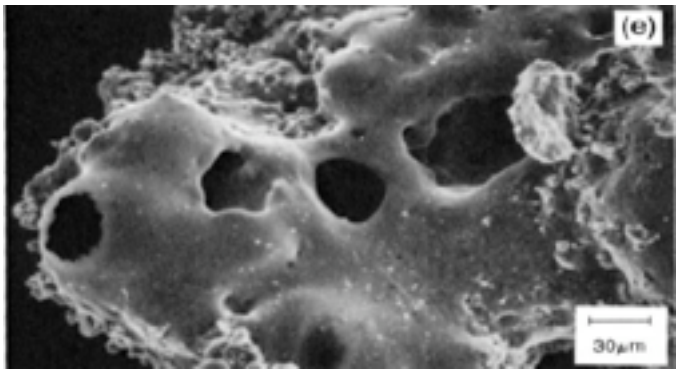
(b) A doughnut-shaped agglutinate. This agglutinate shows a glassy surface extensively coated with small soil fragments and a few larger vesicles. Notice the extremely small size.



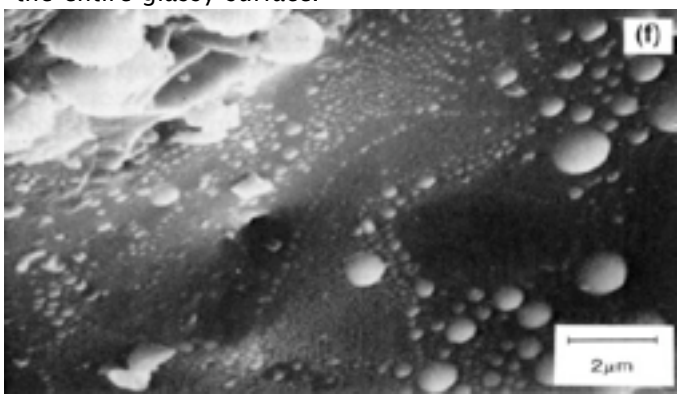
(c) Scanning electron photomicrograph of an irregular agglutinate soil showing some vesicular, glassy, fragment-free surfaces adjacent to fragment-laden surfaces. Some agglutinates are very delicate and display narrow bridges, necks, and dendrite-like arms



(d) Shown is a polished thin section of an agglutinate. The agglutinate particle contains a variety of vesicles with circular, elongate, and irregular shapes. Irregular mineral fragments in the glass include plagioclase (darker), pyroxene, and ilmenite (brighter). The bright circular features are metallic Fe (iron), which occurs as isolated droplets and trains and swirls of small droplets (<5 _m). Fe is not confined to surfaces, but is present throughout the volume of most agglutinates.



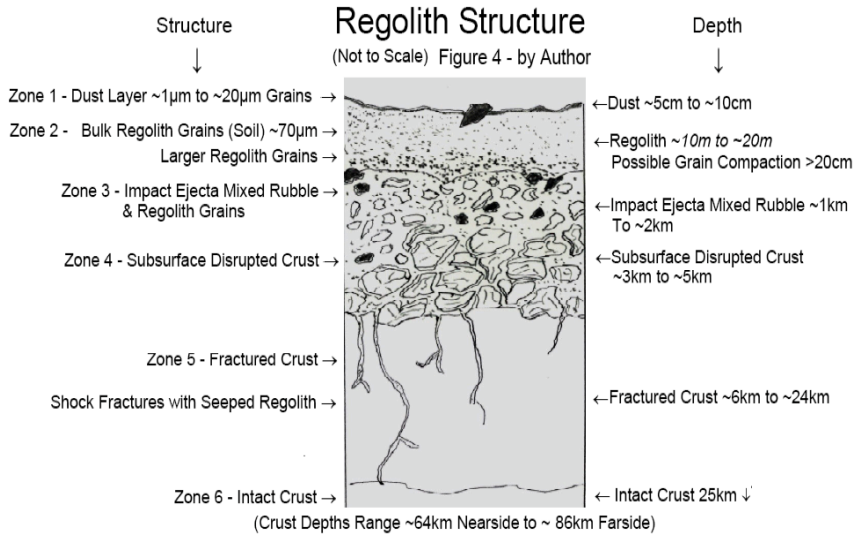
(e) Closer view of a glassy agglutinate surface, showing vesicular structure. Small mounds and trains of metallic Fe are visible as bright spots that occur over the entire glassy surface.



(f) Close-up view of a glassy agglutinate surface, with clusters of Fe mounds, with groups and trains of smaller Fe mounds (20-Å to 1-_m diameters).

5. Regolith Structure

As mentioned earlier, regolith in any one discrete area is a layered concoction of contiguous material and rock fragments and other impact debris possibly thrown in from adjacent and remote regions. After the large bombardment era and over time, in relative calm, this material tended to organized itself into a somewhat common structural pattern. Then again, even with these common structural dynamics in motion, any given pattern within varying radial distances will have its own unique variations.

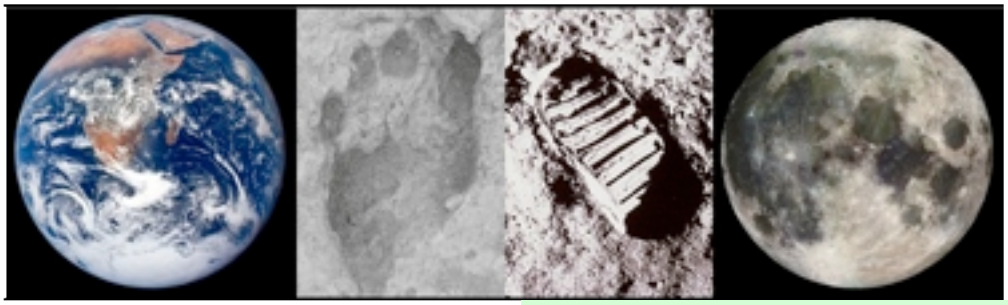


Keeping in mind the structural idea of variation and replication above, Figure 4 (left) shows a possible representational structure of a vertical section of the stratified regolith layers, which might commonly be found on the Moon. Figure 4 starts at the uppermost surface downward to the lunar crust. The structure, for ease of interpretation, is divided into six zones representing structural layers and their depths. Measurements are averages of available information.

TO BE CONTINUERD NEXT ISSUE,

* **Ron Brooks** is a new Director of the Moon Society, and brings with him 39 years of experience as an educator. This is his 2nd major article in MMM. In the May MMM #245, he contributed a very informative article about lunar "**Mascons.**"

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

Our objectives nclude, 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 and utilizing the Moon.
- Informing the public on matters related to the Moon
- Provision of suitable recognition and honor to indivi-duals and organizations which have contributed to the advancement of the exploration, research, develop-ment, 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

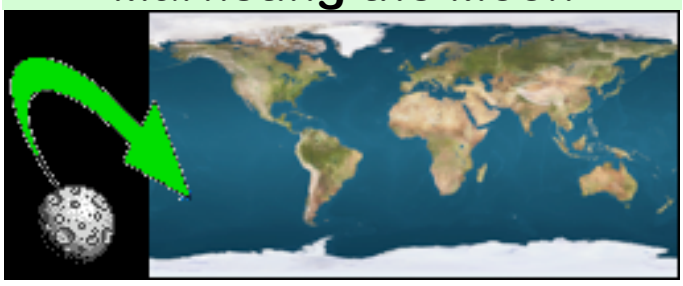
Our Mission is to inspire and involve people everywhere, from all walks of life, in the effort to create an expanded Earth-Moon economy that will contribute solutions to the major problems that continue to challenge our home world.

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.

Interested in having input? Any member may ask to join the Leadership Committee and attend our Management Committee meetings held twice monthly. You may even express opinions. Decisions are often made by consensus, so this input has value. Write president@moonsociety.org

Marketing the Moon



By Ken Murphy

Part II – Part 1 was published in MMM #248, page 3.

Getting Involved

There are many ways that members of The Moon Society (TMS) can get involved with educating people about the importance of our Moon. Just recently the author spoke at a local science and speculative fiction writer's conference, FenCon. Over the course of four panels over three days, many different aspects of real space were conveyed to the the audiencec, which in general were larger in the science panels than in most of the other panels covering more esoteric topics.

A Moon-specific panel was shared with NASA MSFC advanced propulsion concepts engineer (and author) Les Johnson. A later panel on settling the Solar system included Baen Books editor Toni Weiskopf, and Shuttle engineer Scott Padget. Of note is that Ms. Weiskopf was nodding her head vigorously at the suggestion of more near-Earth, near-future Solar Sci-Fi stories. This is why TMS hosts the short story e-zine ***Moonbeams***.

Science fiction conventions are common throughout the U.S., and TMS members are strongly encouraged to look up their local SF cons and see if they have a hard science panel. If not, suggest one!

A key advantage that TMS has in promoting its activities as compared with other space advocacy groups is that

the Moon has a long-standing tradition in human culture, from an ancient unattainable goal to a modern day testing ground, challenging the best and brightest.

Countless superheroes have faced some ulti-mate challenge on the Moon. Innumerable characters have had Moon adventures in any number of media, from vinyl LPs to Blu-rays. Lovers woo in the light of the Moon, not Mars (though sometimes meteors).

There is a strong cultural affection for the Moon, and TMS needs to take advantage of that.

Marketing The Moon: II cont.

Be Creative!

I would also hope that TMS members are creative in their approach to the challenge of exciting people about the Moon.

- There is nothing wrong with arranging a space float for a local parade – *it just takes some friends, some time, and a trailer.*
- Perhaps the local running club would be interested in helping arrange *a "Race for the Moon" fun run.*
- Local (non-conglomerate) newspapers are always desperate for content, and might be willing to run some editorials or *a series of articles on the topic of our Moon.*

The truth is that not every project would be of interest to every member, and thus the requirement to be creative.

The membership of TMS is a diverse lot, and these varied interests can provide for some amazing results.

It just takes effort – your effort.

The public thirsts for space knowledge, but they don't want to have to work for it.

That's why it is the responsibility of people like the members of The Moon Society, National Space Society, Mars Society, The Planetary Society, and others to

take space information to the public, digesting it, making it understandable even by school kids.

The space advocacy community is uniquely positioned for this by being distributed in communities across the country and around the world.

Taking a leadership role earns respect in the community, and a greater willingness by the community to support those efforts. It also makes it easier to attract new members...

One thing that is important is for TMS and its chapters to have an active membership. There are many things that we could be doing, but until members step up and contribute they will remain on standby. One of the most important things we need right now is some assistants to help Peter keep up the great work with Moon Miners' Manifesto to help ensure another 25 year run, and take the burden off a bit so he can work on getting a print edition of the back issues to market. Actually, Peter could probably use a hand with that as well. A great way to get some experience with small press publishing.

Let us know what you are doing, or plan to do, in your community!

We want to give you credit for your efforts,

but it's a lot harder when we find out about it second or third hand. So please, send a brief description of your project to my attention at:

President@MoonSociety.org , with the tagline "**MY MOON PROJECT**" in the subject line.

We might even have to give out some **awards** for exceptional efforts.

Make it your mantra to market the Moon!

Creating a Chapter Scrapbook

By Peter Kokh

Previously published online at:
http://nsschapters.org/hub/scrapbook.htm

Why Create a Chapter Scrapbook?

"Let me count the whys"

- A **Meetings & Activities Log** will be a big help in preparing your Annual Report, if one is needed, and a guide in laying out your calendar for the following year
- **A Record of Past Achievements *will help reignite the flames of inspiration during those times when your chapter seems to be in the doldrums, thus motivating you to reinvent yourselves***
- A **Hardcopy Scrapbook** is a good thing to have out **on your information table**. It tells visitors to your exhibit or information booth what you do and shows them how much fun you have doing it. What a great recruiting tool!
- **An Online Scrapbook** will not only help you **motivate visitors** to your website **to join the chapter**, it will work to inspire and encourage visitors from other chapters to do similar things.

What to include in a Chapter Scrapbook?

- **A Meetings & Activities Log**
- **A Section on Each Chapter Project** actually undertaken. The original project proposal and what it entailed. Who was involved at the start. Who joined in later. Challenges overcome. Challenges that are still a problem. Progress Report. Evaluation of the results.
- **A Photo Gallery**
  - o chapter officers, members, posing/engaged in activities
  - o chapter exhibits, models, etc.
  - o any chapter produced merchandise
  - o chapter events: exhibit booths, chapter member speaking before an audience, guest speaker at a chapter meeting, greeting VIPs, working on projects, creating a model, on field trips, at a movie outing – in fact, why not assign an official photographer, and give him or her a budget for film and processing

continued ->

Safekeeping is Job #1

- **The time to start – not on your scrapbook, but on preserving the things that might go in it one day – is now.** It may not be until a few years down the road that you realize that its been a story worth telling. The records may not be there.
- **Get in the good habit of safekeeping certain items from the start.** When the time is ripe to think about producing a scrapbook, either online, or in physical form or both, you will be in good shape if you do these two things:
- **Create a Scrapbook Folder on your Computer.** But continue to put every document, letter, flyer, photo where it should logically go. All you need put in the Scrapbook Folder is a bunch of aliases. When you save something like a new flyer, details of a new project, designs for an exhibit, photos, continue to save them where they should be. In each case, where the item represents an "achievement" or a "record of achievement," when you file it away, create an alias of the file and dump the alias in the Scrapbook Folder.
- **Have a special box,** well-marked and easily identifiable, **to hold printed photos, newsletter copies, program books, certificates of achievement** – anything physical that records where your chapter has been and what it has done or tried to do.

Online Scrapbooks – *Show 'em the goods!*

- **Option: a separate page or pages on your chapter website**
- **Option: A Yahoo Groups or E-groups page, where the Scrapbook can become a joint chapter project.** But do pre-agree on guidelines, to avoid embarrassing or disruptive contributions. This option allows discussion threads as well as galleries to which any member can post.
- **Online Scrapbooking Tutorials** – do a Google search for these

Time for honesty

- My own NSS chapter, (Milwaukee) **Lunar Reclamation Society**, started a chapter scrapbook from day one (**1986-88**) but then got out of the habit, We now deeply regret that. Yes, we could try to recreate a record of the two plus decades since, but the documentation is sketchy. It did not seem important then. Hindsight is always wiser.
- **Why do we regret stopping?** All the reasons above.

√ **It was a great thing to have on our outreach table** the first few years as it showed the curious exactly what we were about: our many activities, one or more of which may have been interesting enough to get the visitor to join.

√ **It would have kept inspiring our current member-ship to strive as diligently as we did at first,** to get the word out to the public and to reinvigorate ourselves to continue in the tradition we began.

√ Records of the intervening years are spotty, It would be hard to reconstruct a decent tecord.

Bext Month: San Diego Space Society's "**annual retreat**"

October Reports

Moon Society St. Louis Chapter

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

Contact: Robert Perry surfer_bob@charter.net

Meetings 3rd Wed monthly at Buder Branch Library
4401 S. Hampton, in the basement conference room
Next meetings – Nov 16th, Dec 21st, Jan 18th

The St. Louis Chapter of the Moon Society had its regular monthly meeting on October 19th at the Buder Branch Library – Tom Kullman, Rufus Anderson, David Heck, Dave Dietzler, Jim Merriman, and Keith Wetzel attending.

After our earlier email exchange about possibly assembling a chapter library, Keith brought in some magazines and NASA press releases. Bob, since he is holding our display materials, volunteered to add them to his collection of club items. He mentioned that he has several "lazer prints" from back when he and Rufus were part of the L5 Chapter, The St. Louis Space Frontier, and they sold them at Spaceweek (1980?) and other events. Bob has a personal collection of all 13 volumes of the SSI/NASA/AIAA books from SSI's Space Manufacturing / Space Colonization conferences and other books, brochures, and VCR and DVD videos. He and all the members should itemize their collections and offer to loan them out.

Dave Heck brought in his copy of a recent Ad Astra magazine from NSS and we discussed the subject of one article, the Mars Science Lab. Surprisingly, it is designed to be delivered to the Martian surface by a four part system, aerobrake, parachute, powered decent, and "the sky crane".

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

We went off on a discussion of sophisticated high tech versus good enough low tech, such as NASA's efforts with committees, subcontractors, and money to develop zero g ball point pens while the Soviets just used number two pencils. OK, is that an urban legend or is it really true? Dave Heck talked about the Bigelow modules in orbit, basically balloons, but they are holding air pressure just fine

http://www.bigelowaerospace.com/ba330.php

Bob said that the ISS is easy to see when it passes overhead at dawn or dusk or when it transits the sun or the moon. He intends to have a large poster printed of ISS to use as a conversation starter when we have a display.

http://apod.nasa.gov/apod/ap100523.html

Jim Merriman mentioned that he and Earl Mullins of the Space Museum in Bonne Terre, Missouri, will have a booth at the Scifest at the St. Louis Scince Center.

http://www.scifeststl.org/

He also said that Chris Nobbe is planning Moon Madness Night for the first Friday in January.

– Report by Bob Perrry

Moon Society Phoenix Chapter

http://www.msphx.org

Contacts: Craig Porter portercd@msn.com

Meeting the **3rd Saturdays of the month**

At **Denny's**, 4403 South Rural Road, Tempe

NEXT: Dec 21st, Jan 21st, Feb 19th

Our monthly meeting was held at Denny's, Saturday 10/15/11 at 3:00 pm. We had six members present for the meeting.

First hour of the meeting consisting of discussions the various projects in progress, Energy, Chapter shirts, displays for the up coming Conventions that we have tables reserved for. We also general discussions about the logistics to implement a minimum initial Lunar Settlement. We also discussed a possible project to define the hardware for a project we call "Catcher's Mitt".

Energy discussion consisted of Do-it-yourself Solar Power Panels and a possible magnetic motor that I will be looking into.

We are ordering, a minimum order of shirts with the old Moon Logo above the shirt pocket. -The logo will have our web site imbedded in the logo along with Phoenix. The order will consist of the minimum we can order with mixed size, medium, large and XX large. Two mediums, one large and two XX large are already spoken for.

The second hour was to be wet runs for the Teleprescience RC Racing in the Parking lot. As we were preparing to set up in the parking lot we realized that there was no Power available in the lot to power one of the Monitors. We then chose an alternate race site inside Denny's and proceeded to set up the equipment to do the wet runs. In the process of setting up, the equipment developed several glitches that Stuart and Don worked to rectify. One problem was the signals from the cameras breaking up. I took a video of the guys working to get everything working but we never got it to completely work. We had a good learning experience for the Racing venue. The video will be posted to the website, if it turned out okay, early in the week. Our next meeting will be the 16th of November at Denny's. - Craig Porter

Clear Lake NSS/Moon Society Chapter (Houston)

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

Contact: Eric Bowen eric@streamlinerschedules.com

The Clear Lake Area NSS/Moon Society chapter next regular meetings is set for **Mondays, Nov 14th** and **Jan** (date TBD) **at 7:00 pm** in the conference room of the Bay Area Community Center at Clear Lake Park. - Eric.

Chapters & Outposts Map (North America)

www.moonsociety.org/chapters/chapter_outpost_map.html

Chapters & Outposts Events Page

www.moonsociety.org/chapters/chapter_events.html

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

Bay Area Moon Society, CA Outpost – South Frisco Bay

http://www.moonsociety.org/chapters/bams/

Contact: Henry Cates hcate2@pacbell.net

Meeting the 1st Tuesday of the Month at Henry's home

Moon Society Nashville Outpost – Central Tennessee

Contact: Chuck Schlemm cschlemm@comcast.net

Moon Society Knoxville Outpost

Contact: Jason Tuttle

Rockford, IL Outpost

Contact: Bryce Johnson lesausl@sbcglobal.net

Moon Society Milwaukee Outpost (MSMO)

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

Contact: Peter Kokh kokhmmm@aol.com

Meeting monthly with the Lunar Reclamation Society (NSS) on the 2nd Sat. afternoon except July, August.

===== NSS Partner Chapters =====

(Portland) Oregon L5 Society
(Milwaukee) Lunar Reclamation Society
(Twin Cities) Minnesota Space Frontier Society
San Diego Space Society *See pages 17-19*

Other NSS Chapters are welcome to inquire

Either about getting MMM for their members or also about partnering with the Moon Society on a project of mutual interest – kokhmmm@aol.com

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 President's Office,
5015 Addison Circle #420, Addison, TX 75001

Moon Society Publications - Chapters Co-ordinator
PO Box 395, Milwaukee, WI 53208

< End Moon Society Journal Section >

Things Chapters can do: While the possibilities are many, ***each chapter will do best to focus on things that fit their combined interests and talents.*** **Regular Meetings**: Discuss current space news; upcoming launches, view videos, build up a shared library; updates on group and member projects; brainstorm public outreach opportunities; collect and make display materials etc. **Outreach:** provide speakers to other groups; look for exhibit opportunities, letter writing campaigns to newspaper and magazine editors; congressmen and senators; public observance of special anniversaries, etc. No one chapter can do it all, or has the talents and means to do it all. But anything a chapter does to help advance our vision and mission is appropriate. You will find many suggestions, helpful hints, and even detailed instructions on the Space Chapters Hub at **http://nsschapters.org** **This site serves the chapters of the Moon Society, the Mars Society, and the National Space Society.**

GREAT BROWSING

INTERNATIONAL SPACE STATION

http://www.disinfo.com/2011/09/**we-have-to-clean-up-outer-space-now-in-order-to-safely-launch-new-spacecrafts/**

COMMERCIAL SPACE

More on planned Russian Commercial Space Station
http://orbitaltechnologies.ru/

NASA Selects Companies to Study Storing Cryogenic Propellants in Space
www.spaceref.com/news/viewpr.html?pid=34280

TECHNOLOGY & ROBOTICS

http://www.newscientist.com/article/dn20779-**nasa-bets-on-metal-hydrogen-and-cosmic-gas-stations**.html?DCMP=OTC-rss&nsref=tech

http://www.space.com/12818-**future-spacesuit-astronaut-gravity-rehabilitation**.html

Humans and Robots - ten-year old advice
http://www.spacedaily.com/news/oped-01k.html

Successful test of 3D Prining in Aero-G
www.spaceref.com/news/viewpr.html?pid=34249

SPACE SOLAR POWER

http://space.alglobus.net/papers/**TowardsAnEarlyProfitablePowerSatPartII**.pdf

NEAR EARTH SPACE

http://spaceinfo.com.au/2011/09/05/space-junk-reaches-tipping-point/

ANALOG STATION RESEARCH

International Lunar Research Park proposed for PISCES Analog Research effort on Hawaii Island
https://sites.google.com/site/internationallunarresearchpark/the-international-lunar-research-park-concept
https://sites.google.com/site/internationallunarresearchpark/

THE MOON

Moon Express Hires NASA-mentored FIRST Robotics Champions to Develop Lunar Robots
www.spaceref.com/news/viewpr.html?pid=34579

MARS

http://cosmiclog.msnbc.msn.com/_news/2011/10/11/8274228-**three-years-on-mars-in-3-minutes**

ESA Orbiter Discovers Water Supersaturation in the Martian Atmosphere
www.spaceref.com/news/viewpr.html?pid=34832

Oxidizing Martian Soil Not Too Extreme for Life
www.spaceref.com/news/viewpr.html?pid=34502

NASA-ESA 1st Joint Mars Mission picks Instruments
www.spaceref.com/news/viewpr.html?pid=31352

Search for Life on Mars to get High-tech Instruments
www.spaceref.com/news/viewpr.html?pid=34516

EARTH FROM SPACE

First global portrait of greenhouse gases emerges from pole-to-pole flights
www.spaceref.com/news/viewpr.html?pid=34547

OTHER PLANETS & MOONS

MESSENGER Image of Mercury: Trails of Small Craters
www.spaceref.com/news/viewsr.html?pid=38616

Series of Bumps Sent Uranus Into Its Sideways Spin
www.spaceref.com/news/viewpr.html?pid=34885
http://www.newscientist.com/article/mg21128303.900-**plutos-icy-exterior-**

ASTRONOMY

http://machineslikeus.com/news/**kepler-reshaping-our-understanding-planets**

Funding Crisis for the James Webb Space Telescope
http://www.thespacereview.com/article/1926/1

Kepler Mission Discovers a World Orbiting Two Stars
www.nasa.gov/mission_pages/kepler/news/kepler-16b.html

How single stars (like the Sun) lost their companions
www.spaceref.com/news/viewpr.html?pid=34666

ASTROBIOLOGY

http://spaceinfo.com.au/2011/08/11/**made-in-space---dna-building-blocks/**

Alien Life More Likely on 'Dune' Planets
www.spaceref.com/news/viewsr.html?pid=38216

Strange Life forms at Hypothermal Vents
www.spaceref.com/news/viewpr.html?pid=34548

EDUCATION - OUTREACH - MEDIA

Shell, X PRIZE Foundation 3-Year, Multi-Million $ Prizes Promoting Exploration of Space, Oceans, Land
www.spaceref.com/news/viewpr.html?pid=34876

GREAT VIDEOS

Videos (3) of Russian Commercial Space Station (u.c.)
http://orbitaltechnologies.ru/en/**video-of-the-commercial-space-station.html**

Mini Jumping & Gliding Robot
www.youtube.com/watch?v=A8X9ULBTPdA&feature=share

Near-Earth Asteroid - Mission Animation
http://www.nasa.gov/multimedia/videogallery/index.html?media_id=101500641#

http://www.space.com/12744-lumpy-gravity-moon-grail-learn-luna**.html**

Inside the Space Station from one end to the other
www.youtube.com/watch_popup?v=H8rHarp1GEE

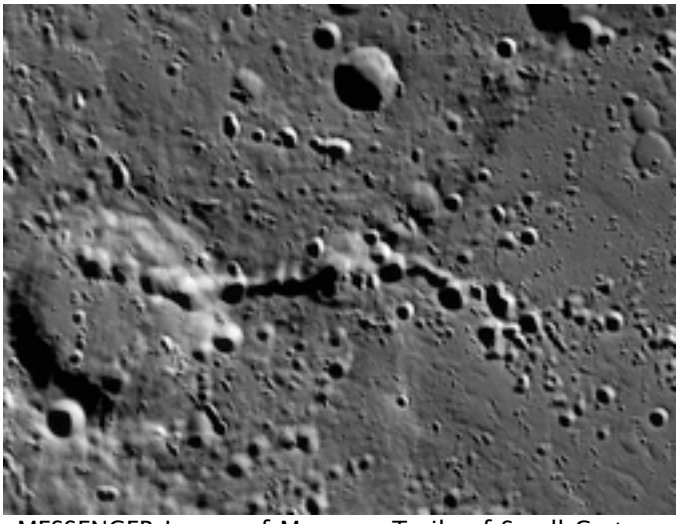
Russian Commercial Space Station Plans (3 videos)
http://orbitaltechnologies.ru/

Spaceport America Preview
http://www.youtube.com/watch?v=pHa8XatVUXA&feature=player_embedded

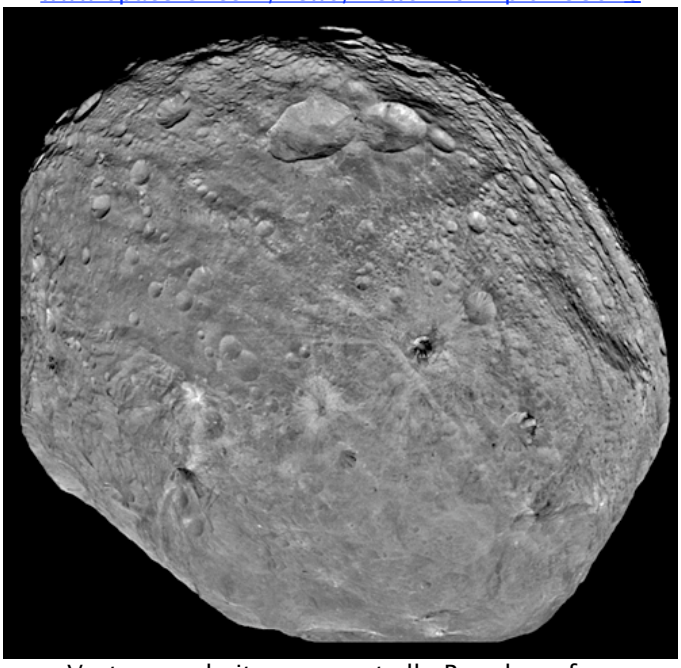
Preparing Russian Soyuz for launch at ESA's Kourou Spaceport in Guiana, South America
http://multimedia.esa.int/Videos/2011/09/Soyuz-dry-run-time-lap

Romancing the Cloud: The new **Indian**-French **Megha-Tropiques Satellite** to help forecast Tropical Weather
http://www.youtube.com/watch?v=_Mdpt4AByo4

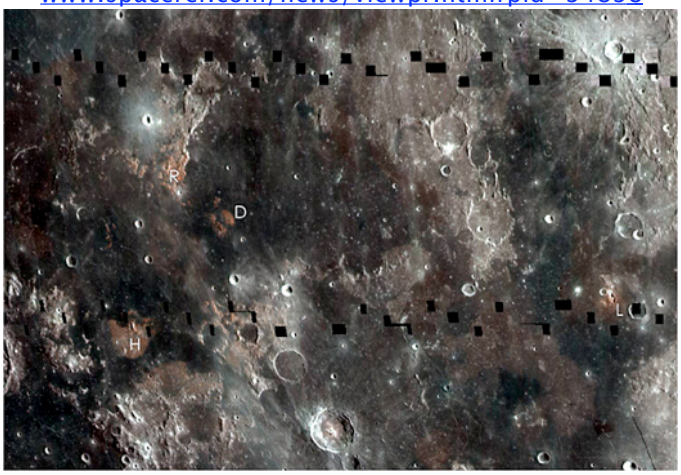
MMM PHOTO GALLERY



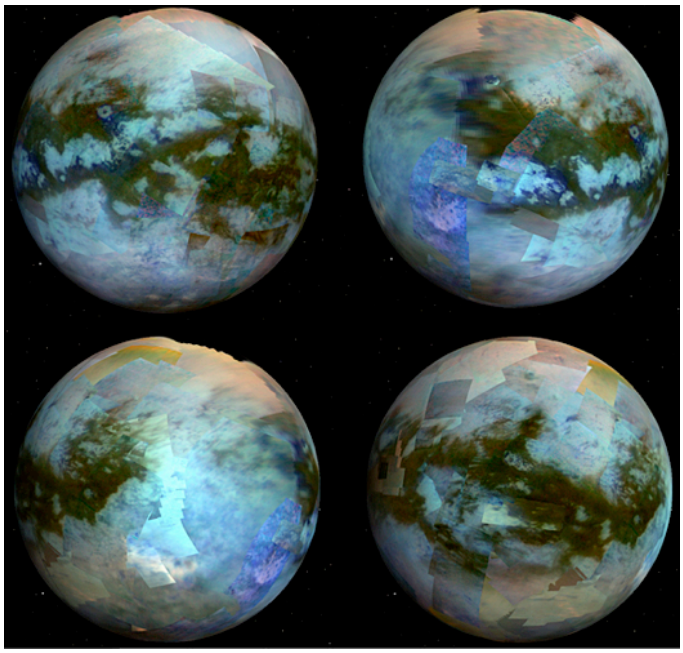
MESSENGER Image of Mercury: Trails of Small Craters
www.spaceref.com/news/viewsr.html?pid=38616



Vesta reveals its unexpectedly Rough surface
www.spaceref.com/news/viewpr.html?pid=34838



Subtly Shaded Moon Map Reveals Titanium Treasure
www.spaceref.com/news/viewpr.html?pid=34898



First Color Global Mosaic of Titan's Surface
www.spaceref.com/news/viewpr.html?pid=34854

309 end-of-day's-trek stills record Opportunity's 21 mile trek across Mars to provide "movie" record that transports you to Mars surface – unfortunately B&W
http://cosmiclog.msnbc.msn.com/_news/2011/10/11/8274228-three-years-on-mars-in-3-minutes

131x101x76 km Asteroid 21 Lutetia is very massive for its size and may have a core of once molten metal
http://news.yahoo.com/asteroid-lutetia-may-heart-hot-melted-metal-181402667.html

http://cosmiclog.msnbc.msn.com/_news/2011/10/11/8274228-three-years-on-mars-in-3-minutes

We put this link under the Great Browsing column on page 13, because we want you to read the accompanying article by Alan Boyle as well.

The video, unfortunately, is in black and white, but try colorizing it in your imagination and this will give you the closest experience any of us are ever likely to have of traversing the surface of Mars. But let Boyle tell the story.

> "It's been a long, lonely three years for NASA's Opportunity rover, which has just finished a 13-mile (21-kilometer) trek from Victoria Crater across the Martian wasteland of Meridiani Planum to Endeavour Crater. A newly released time-lapse video from NASA's Jet Propulsion Laboratory condenses the odyssey down to just three minutes.
>
> "The video draws upon a series of 309 images, each taken when the rover stopped driving at the end of a Martian day. The pictures give you a sense of the loneliness that an astronaut might feel while following in Opportunity's wheel tracks. Drifts of sand go on for miles and miles, interrupted only by craters or patches of bedrock."

Each person watching this "video" will have his her own impressions. Mine was that of an intensely lonely world, its surface whipped by the winds into apparently fixed waves punctuated by broken flat slabs of rock. After a while, it seems monotonous. But keep in mind that the terrain covered was quite limited and is characteristic of just a small area. Mars, with its mighty shield volcano mountains and deep wide canyons has a considerable diversity of terrain. Yet many stretches may seem as monotonous as did the plains of the US West seem to early settlers.

The casual traveler may be quickly bored. The settler will come to appreciate the subtle nuances and grow to love the terrain, whatever it is in the area to be settled.

We don't recall ever calling special attention to a video like this, much less to one that is a composite of stills. But watching it, even in black and white, had a profound experience on me, transporting me to Mars as never before.

We hope you enjoy it too! **PK**

ONWARD UPWARD
ISDC 2012
WASHINGTON D.C. MAY 24 - 28, 2012

International Space Development Conf. (ISDC) 2012

May 24-28, 2012 Washington, DC
Th-M, Memorial Day Weekend

Grand Hyatt Washington
1000 H Street NW,
Washington, D.C., USA 20001

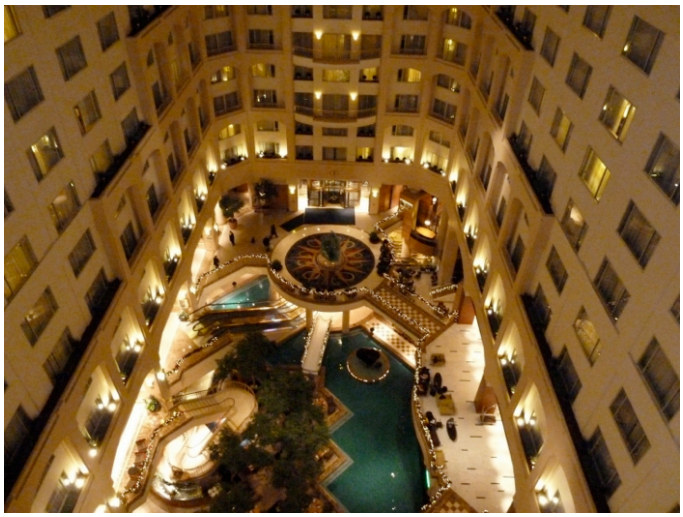
Tel: +1 202 582 1234 Fax: +1 202 637 4781

http://grandwashington.hyatt.com/hyatt/hotels/index.jsp?null

Registration form and rates:
https://www.nss.org/cgi-bin/register/tdregister?$Origin=ISDC12

Note: we could find no information on special ISDC hotel rates, nor information on tracks, programs, or presenters. Stay tuned.

Meanwhile ***circle the dates and keep them open.***



==========

ISDC 2013 will be in San Diego, CA

Previous ISDCs on the West Coast:

- **2006 Los Angeles (with the Planetary Society)**
- **2003 San Jose**
- **1990 Anaheim**
- **1986 Seattle**
- **1984 San Francisco**
- **1982 Los Angeles**

Lunar Reclamation Society, Inc.

P.O. Box 2102
Milwaukee
WI 53201

www.lunar-reclamation.org

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

2011 LRS OFFICERS | BOARD* | Contact Information

PRES. / MMM Editor – *Peter Kokh **NSS**
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

- **We cancelled our planned field trip to the Milwaukee Metropolitan Sewerage District facilities on Jones Island, scheduled for Saturday, September 24th,** because most of us had conflicts for the one Saturday this year that this facility was open for tours.
- **Peter has proposed that we dedicate an upcoming meeting, possibly the January 14th meeting if we have enough attending, to planning an "Event & Outreach Calendar for 2012.** We used to do much more outreach than we have in recent years. Yes, the opportunities arise much less often these days, but maybe we should create them, not wait for them.

LRS Upcoming Events

Next Meetings Saturdays: 1-4 pm

Dec. 10th – Jan 14th – Feb 11th

LRS Meeting, Mayfair Mall, Garden Suites Room G110

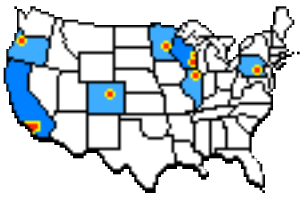
Our annual December Anniversary/Holiday Party – this year #25! - will be on Saturday December 10th :

√ **A PIZZA POTLUCK:** this year everyone is requested to bring **a 12" pizza (non-rising crust, please!)** of whatever variety they wish – we will have at least 2 pizza ovens on hand, along with paper plates, etc. You may bring beverages also, as you like.

√ **New Exhibits:** Peter's wish list includes a lunar settlement interior wall section made of steel studs clad with fiberglass-faced cementboard – painting experiments using simulated moondust of various natural and steam-rusted shades in a sodium silicate medium – a 3-D model of a lava tube; We will be fortunate if even one of these is ready!

√ Take-home materials as usual

√ The Science-Fiction film "**Paul**" if DVD is out. If not, we will show the comedy "**Spaced Out**"



News & Events of NSS "MMM" Chapters

Space Chapter HUB Website:
http://nsschapters.org/hub/

Feature Page: Project Menus Unlimited
http://nsschapters.org/projects.htm

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
NEXT: Dec 21st, Jan 21st, Feb 19th

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/

MN SFS 2011 Year in Review
http://www.mnsfs.org/2011-Review/

Schedule of upcoming MNSFS Meetings

Monday December 12th

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 ● **February 16th**

Note: In December, in lieu of a meeting in Kiel, we will travel to Milwaukee on **Saturday, December 10th** to join the Lunar Reclamation Society for its annual Holiday Party and this year, its 25th anniversary.
(see previous page for party details)

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 6:00 PM on 1at Thursdays
Dec 1st, Jan 5th , Feb 2nd

Englewood Public Library, Englewood, CO 80110
1000 Englewood Parkway, First Floor Civic Center

CALIFORNIA

San Diego Space Society
http://sandiegospace.org/
info@sandiegospace.org

Meeting the 2nd Sunday monthly
December 6th **Space Night Out**;
http://sandiegospace.org/?m=20111206&cat=3
December 20th **Space Night In**
http://sandiegospace.org/?m=20111220&cat=3
Read our Op Ed: There is Life after the Shuttle
http://sandiegospace.org/there-is-life-after-the-shuttle-op-ed/

CALIFORNIA

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: Dec 11th, Jan 21st, Feb 19th

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

Nov. 19, 3pm – OASIS Board Meeting at Home of Steve Bartlett and Tina Beychok, 7108 East Peabody, Long Beach, CA 90808

Nov 25-27 – LAX Marriott – LOSCON 38
http://www.loscon.org/38/
"Where's My Flying Car?"
Come join is for this annual science fiction con.
Writer GoH: John DeChancie
Artist GoH: Aldo Spadoni
This year's theme is, of course, *SCIENCE*

Science GoH: Rick Searfoss, USAF Colonel, USAF Retired. Searfoss became an astronaut in July 1991.

He served as pilot on **STS-58 Columbia** (October 18 to November 1, 1993) and **STS-76 Atlantis Shuttle-Mir SpaceHab** mission (March 22-31, 1996), and was the mission commander on **STS-90 Columbia** Final **SpaceHab** mission (April 17, to May 3, 1998).

Searfoss retired from the Air Force and left NASA in 1998. (Prior to the ISS Era)

Dec 10, 3 pm OASIS Board Meeting,
Holiday Potluck to Follow – Home of Bob Gounley and Paula DelFosse, 1738 La Paz Road, Altadena, CA

"To succeed in your mission, you must have single-minded devotion to your goal."

Abdul Kalam, former President of India, ISRO rocket scientist

"We're sorry, but the planet that you have dialed is not in service at this time, If you feel have reached this recording in err, please hang up and try your call again later."

- passed on by Ben Huset.

PENNSYLVANIA

NSS 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

● **NSS PASA** regular business luncheon/formal meeting 1-3 pm, the 1st Saturday of every month unless otherwise noted, 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.

NSS PASA Report for October 2011

Meeting notes: Our next meeting will be at The Cherry Hill, Crowne Plaza, instead of our normal location at Liberty One, as part of our outreach at Philcon between November 18-20. The December meeting will be back at Liberty One (16th and Market street building) from one to three p.m. The Philcon meeting date is to be determined.

I will present the speakers this month out of order: We had a guest, Ryan Milton, from The La Rouche Group, on that organizations thoughts on space exploration, and colonization especially, and why it had not happened yet. As I understand it: Ryan says that President Kennedy had more than the Moon in mind when he announced what his vision of our future in space was to be. He says that part of the plan would have been for us to have a base on the Moon, and, to be on Mars by 1984. This did not happen, from what Ryan was saying, because the funding was diverted to paying for the Vietnam War and other military programs (among other things. Earls note). This is only one of several areas that got short changed that would have given us a much more hopeful, and peaceful, future.

At this time the La Rouche Group is doing a public recruiting campaign to add to the staff to get us out of several conflicts and military actions, and to begin funding an expanded space program with some of the saved funds. The ultimate goal, in this case, is to spread humanity across the cosmos. The group's recent efforts include highlighting the Russian and Chinese actions and plans in this area. It was an interesting presentation.

Thank you, Ryan! (And Dennis Pearson for the initial connection).

Mitch Gordon was our other presentation, with material from The MUFON Conference held in Philadelphia October 15 and 16. This is a very different group that is also interested in space, but with the basic assumption that: the extra terrestrial life we are looking for is flying around us constantly in flying saucers (or some other very emissive structure). From Mitch's report it would appear that much of what we have in the way of technology is a gift on the one hand, or, reverse engineered tech. from these visitors who crashed (or where shot down). This report engendered some rather pointed questions and comments on some people's opinion of our human capabilities. We do have a simple way of looking at many of these ideas: grandiose claims, and statements of certainty in them, requires physical evidence and open contact.

After the presentation, especially the part about us getting our tech. from aliens, I asked that if that where so, then, when did we figure out that the clothes they wore where also there nano-tube computers and space suits? It was different from our normal space oriented discussions. On a more human note: Mitch got us in to the Drexel University visit of two former Drexel students on October 26th: Commander Chris Ferguson, the last shuttle flight commander, and Astronaut Paul Richards, who was on Discovery and the I.S.S. in 2001. We will have a table on campus during the period. Thank you Mitch! (and Elizabeth at Drexel for allowing our outreach).

Larry reported on our web activities and some modifications he will make to improve accessibility. Our hit rate was down to about 400 this month, and, Larry has solved a publishing problem he had in connection with our website. On the improvement: Larry will post our first web page in a format that will allow users of smart phones and tablets to view meeting dates and event information easily. Go Larry! (Ryan found us on his phone).

Dorothy brought material, primarily from Space.com, on various happenings, including the Nobel Prize announcement for Physics on the expanding universe, and, the fall of ROSAT (the German radiation sensing satellite). Much more from the site.

Janice pointed out that Apophis, a "small" asteroid (about 200 feet across) appears to have shifted paths and will come near Earth on a 2019 close approach: as close as the Clarke Belt. Janice will keep checking on this. And: Hank gave us more material from Philcon, and told us of plans to move it from The Crowne Plaza, in Cherry Hill, to a location still to be found, but possibly in center city Philadelphia. Or maybe Valley Forge.

Earl brought the November 2011 issue of Wired for the article" Are We There Yet?" on the 520 day Mars Mission simulation held in Moscow, Russia. Get the magazine for this pioneering experiment, which includes a "stay" of nine days. The report begins on page 180 and goes to 185 and jumps to 212. Bill Donahue did extensive interviews with several crewmembers during this experiment, which, will end on November fifth. – *submitted by Earl Bennett*

"Do not go where the path may lead.
Go instead where there is no path,
and leave a trail." Mongolian proverb

Moon Miners' MANIFESTO
Lunar Reclamation Society Inc.
PO Box 2102, Milwaukee WI 53201-2102

Address Service Requested
Mail Carrier, Time Sensitive Material <==

PRSRT STD
U.S. POSTAGE
PAID
MANASOTA FL
PERMIT No. 802

Please renew promptly so as not to miss an issue

NAME _____

STREET _____

CITY/ST/ZIP _____

PHONE#S _____

$45 National Space Society dues include ***Ad Astra***
$20 NSS dues if **under 22 / over 64.** *State age* ___
National Space Society
1155 15th Street NW, Suite 500
Washington, DC 20005

Moon Society dues include *Moon Miners' Manifesto*
Electronic MMM (pdf) **$35** Students/Seniors: **$20**
Hardcopy MMM: U.S. & Canada **$35** – Elsewhere: **$60**
The Moon Society
P.O. Box 940825,
Plano, TX 75094-0825, USA

INDEX to #250 NOVEMBER 2011

Member Dues -- MMM Subscriptions:
Send proper dues to address in chapter 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" > PO Box above

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