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

Moon Miners' Manifesto

& The Moon Society Journal

www.MoonMinersManifesto.com

#240 | NOVEMBER 2010

Above: a 1998 period mockup of a modular space station architecture at Johnson Space Center

Feature Articles in This Issue

Toxic Boosters – Shuttle SRB Boosters =>

Right: An ATK (formerly Morton Thiokol) Solid Rocket Booster. Each Shuttle uses 2 4-segment SRBs. *Constellation* would use 2 5-segment ones. "Each SRB produces 80% more liftoff thrust than one F-1 engine, the most powerful single-chamber liquid-fueled rocket engine ever flown." [WP] It is easy to see why we use them. The hush-hush problem is that the SRBs put our very dirty, even toxic, exhaust fumes. *See our "In Focus" Editorial.*

IN FOCUS "Green" Space-Based Solar Power Needs "Green" Rockets

One of the space projects supported by many if not most space enthusiasts is space-based solar power, that is, a multitude of solar power satellites in GEO, Geosynchronous Earth Orbit. And it is obvious that we have to begin with a demonstration unit built of materials and parts launched from Earth. Most of us see this as a solution to the growing shortage of "clean" energy. This is something we can sell to the public, and especially to the environmentally aware: [=> 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 20 PDF format volumes, for free downloading from either of two locations:
www.Lunar-Reclamation.org/mmm_classics/
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 NSS' Milwaukee chapter: www.Lunar-Reclamation.org

• **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.

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• **Submissions by email** to KokhMMM@aol.com - Email message body text or MS Word, Appleworks, pdf attachments
√ Mac compatible CD / 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.

If the demonstration unit convinces enough investors (power generation company consortia and national governments) that we need to deploy hundreds, even thousands of larger such units, to meet Earth's energy demands – in a clean way – then that raises an issue. Our current arsenal of heavy-lift rockets is not really very clean, especially those using SRBs. But to launch under a dozen such a year does not create an issue of high, much less immediate priority.

But to launch thousands of heavy lifters a year to deploy SPS systems at the rate needed, does raise the environmental impact question. Now, we do not pretend to know the answers, much less how to rate present rockets and boosters in this respect. We must determine:

a) Through what altitude range, does the engine in question release its exhaust plume?

b) How much higher does momentum carry that plume?

c) Through what altitude range do the chemicals in question pose a long-term environmental problem?

d) What alternative rockets and rocket fuels do we have that would pose less of a problem?

We do not pretend to be able to answer any of these questions. Rather, we present them as questions that should be given priority attention and investigation.

Many space supporters question the L5 thesis that using lunar materials would be a cheaper way of constructing SPS units. Granted there is a high-threshold intitial investment in setting up lunar industries that could meet such a demand. But once up, that investment could be amortized rather quickly if we are deploying not just a dozen, but hundreds, even thousands of units. The reasoning here is that it takes 1/22nd the fuel cost to launch the required mass of components off the Moon's surface, through its shallow gravity dimple, down to GEO than it will to boost the same payloads off Earth, up through its deep gravity well to relatively nearby GEO.

But the issue raised above adds another consideration. *By launching from the Moon, we avoid the issue of polluting Earth's upper atmosphere in a way that could be very hard to remedy.*

Now Space Elevators are an alternate way of taking things to GEO without using rockets. But say that we do succeed in deploying such an elevator under notoriously unstable tropical weather conditions. Its capacity, whatever it is, will be limited. *We might have to build many space elevators to meet the demand.* Will this be cheaper than setting up industries on the Moon? We don't know the answer, but we remain skeptical.

One point of this editorial is to point out that we have a lot of preliminary research, some technical, some economic, before we can come up with the best answer or a best mix of answers.

A second point is that we cannot pretend that SPS systems are the "Green Answer" to our growing energy problem, unless we do this research. Certainly, to launch "Green Power Systems" with rockets that are anything but "Green," will be transparent nonsense.

A third point is that if we need to earn the support of the growing environmentally-conscious constituency to win the political support, we need to present Space-Based Power as environmentally benign not only once deployed, but through the deployment process. **PK**

From Lava Tube Skylights To Lava Tube Settlements

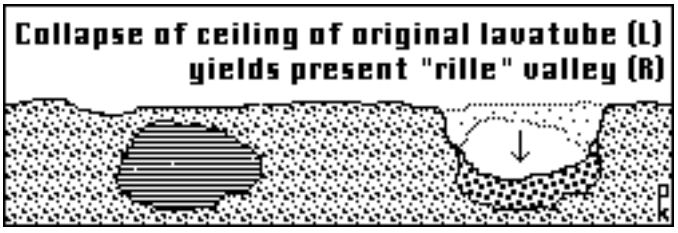
By Peter Kokh

Where we're at

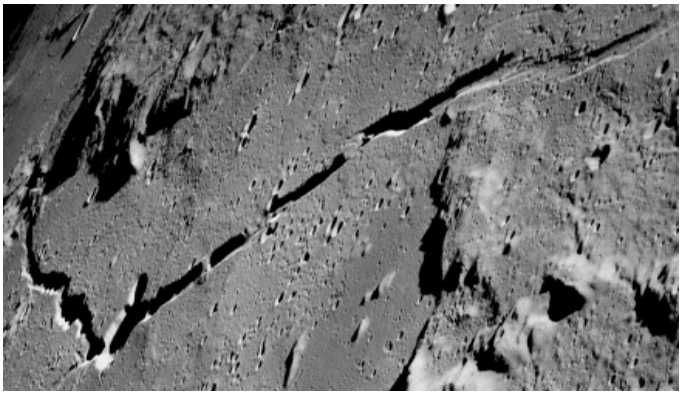
Chuck Woods (Lunar Photo of the Day, creator of http://the-moon.wikispaces.com) keeps track of all confirmed lunar lavatube skylights. To date (10.26.2010) there are 5 such sites, the first 2 found by Japan's Kaguya lunar orbiter, the last 3 by Lunar Reconnaissance orbiter. It takes very high-resolution photography to confirm such a feature, and LRO has found ten more dark spots around the lunar globe that need to be revisited with higher-res photography before they can be added to the list. Chuck suspects many more will be confirmed.

All of these locations are in lave flows, which spread by rivers of lava that soon crust over and as the lava flows out, create lava tubes. So we are finding these features in the lunar maria, frozen "seas" of lava. As the maria occupy 39 of nearside, and only a much smaller part of farside, we expect to find many more of these features on the nearside.

They are formed when a chance meteorite of sufficient size happens to hit right over a hidden tube, causing the tube ceiling to collapse. The reason we have been confident for decades that lunar lava tube networks pervade the mare areas, is twofold: that's the way lava sheets spread on Earth; and on the Moon we find many "sinuous rilles" for which the most logical explanation, given the basaltic nature of the terrain, is that they are the remnants of collapsed lava tubes: tubes too big and or with ceilings too thin to maintain their integrity.

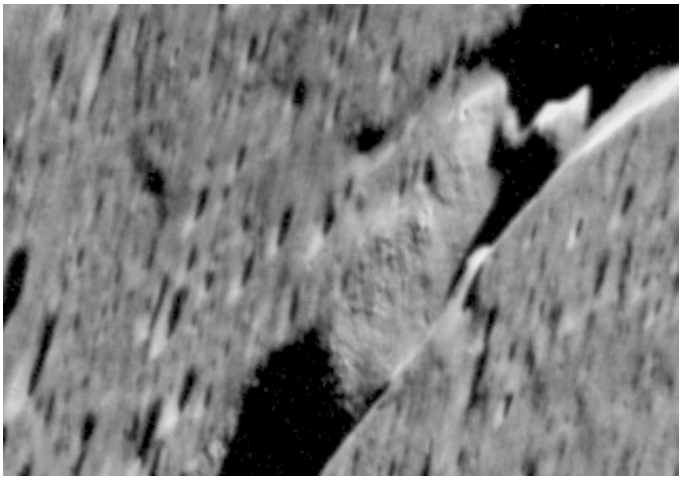


This argument is strengthened by the existence of long sinuous rilles that are "interrupted" by gaps miles long, interpreted as intact segments of the original tube.

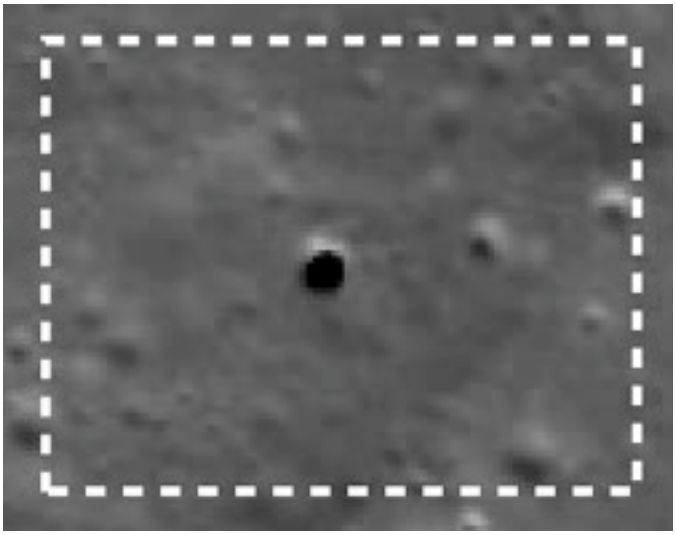


Starting at the bend to the left, 4 "bridges" are visible in this Apollo 10 photo of Hyginus Rille, central nearside.

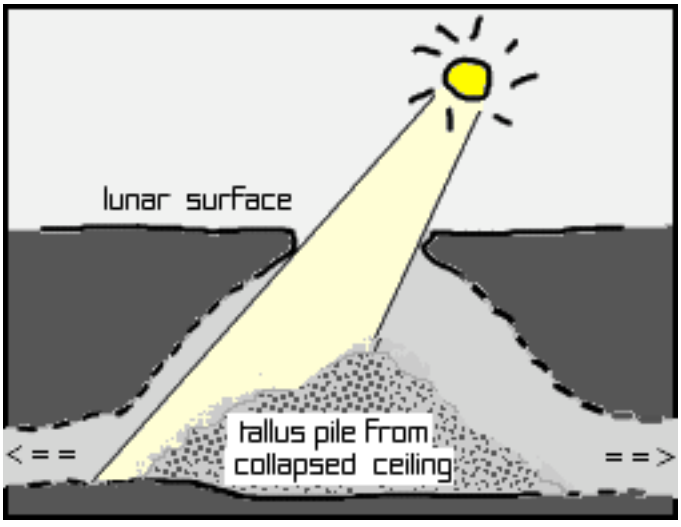
A very high-res 4.4 mb image of the above is at: http://spaceflight.nasa.gov/gallery/images/apollo/apollo10/hires/as10-31-4650.jpg Below is the area centered on the "bridge" interruption furthest right.



Lava tube "Skylight" "pits"



The first discovered, by a camera aboard JAXA's Kaguya (Selene) Orbiter is in the Marius Hills region of Oceanus Procellarum (Ocean of Storms) in an area known to have not only lava flows but also volcanoes.



This sketch, enhanced by to show the talus collapse pile, shows how these pit photos are to be interpreted

This webpage, maintained and updated by Chuck Wood, gives the current inventory of confirmed skylight pits.

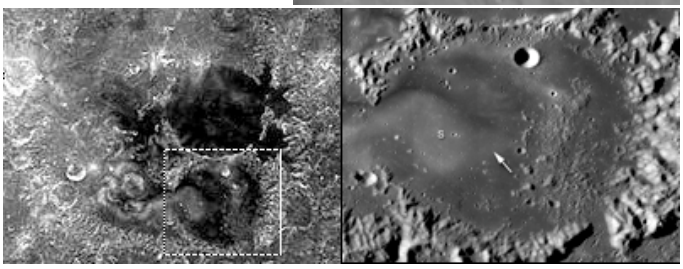
http://the-moon.wikispaces.com/Skylights

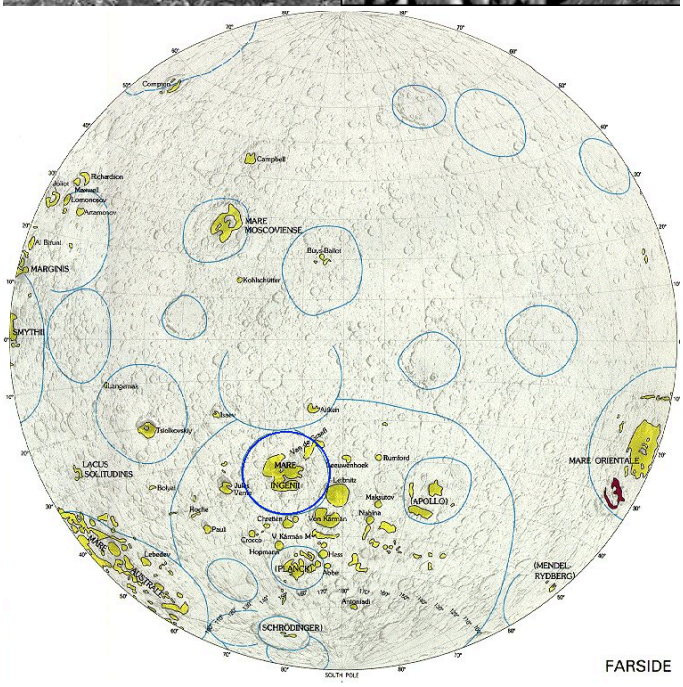
The Skylight found in Mare Ingenii, Sea of Ingenuity

Left: Discovered by the LRO team, this skylight pit is the first such feature discovered on the the Moon's farside.

Below: Locaton of this feature within Mare Ingenii, at 33.7°S 163.5°E. This mare is about 318 km (.198 mi) in diameter.

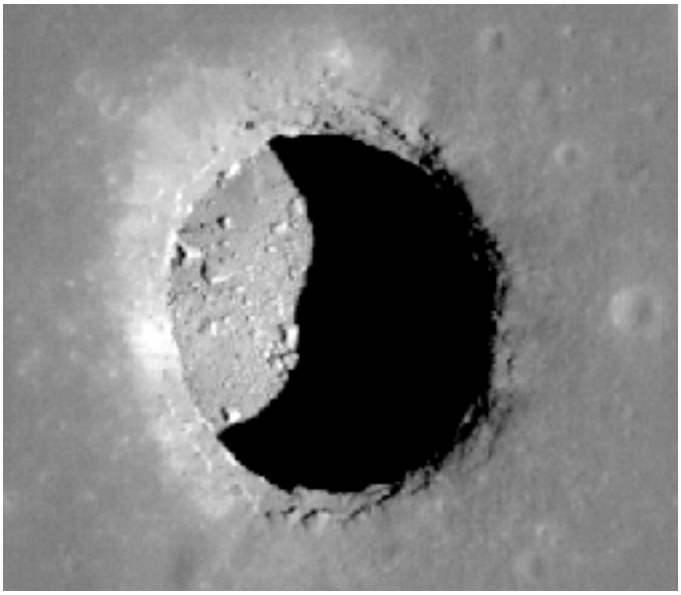
Bottom: locaton of Mare Ingenii on the Moon's farside





Three skylights found by LRO in M. Tranquilitatis

Yes, in the very mare in which humans first set foot on the Moon in the Apollo 11 mission July, 1961. The location of the first of the three found by Lunar Reconnaissance Orbiter is approximately 2° SE of the Sinas Crater and some 230 mi (380 k) to the Northeast of the Apollo site. This skylight has been unofficially named 'Sinas" by Danny Caes.



In this superb high resolution photo, what we are seeing lit by sunlight, is not the lavatube floor, but the tallus rubble pile from the collapsed lavatube ceiling. *See the illustration on the bottom of the previous page.*

Looking Forward

All those captivated by the implications of these recent discoveries look forward to the positive identification of more lunar lavatube skylights. Meanwhile, we must not deduce that these skylights mark the Moon's only lavatubes! These are lavatubes that, from a human point of view, won the cosmic lottery by being impacted just right to cause a local collapse. It would be more realistic to believe that we will find lavatube networks wherever there are lava plains. There may be hundreds, if not thousands of these features.

What's next – lunar lava tube skylight probes

The Moon Society is working on a design competition, which will be previewed at the **SEDS SpaceVision 2010** Conference at the University of Illinois Champaing-Urbana the weekend of November 5-7, 2010.

One design competition will be about modifying NASA's AXEL experimental rover (Google NASA AXEL for information and videos) which can winch itself down a crater rim, explore and then winch itself back. For our purposes, we need a much longer lighter weight cable, as well as some instruments that do not need sunlight to map and explore.

We will have a complementary competition for designs of probes that can enter the skylight and return data by means other than a cable and winch.

We are doing this in the hopes that NASA will consider fielding such a probe on both Moon and Mars. At stake is our need to modify public perception of both worlds as **dusty boulder-strewn rubble piles** to worlds with extensive networks of fascinating "**Hidden Valleys**" – the pre-shielded lava tubes ready for industrial parks, agriculture, warehousing, sports arenas, and archiving!

And, oh yes, lava tube Settlements!

Lavatubes: the possibilities

Please do check our earlier 1995 paper: "The Use of Lunar Lavatubes" – 2 parts
http://www.moonsociety.org/publications/mmm_papers/lavatubes_ccc.htm

A favorite vision for many members who were with us during the Artemis Society days (1995-2000) was that of settlements inside pressurized lavatubes. But this does not appear to be a near-term option for 2 reasons:

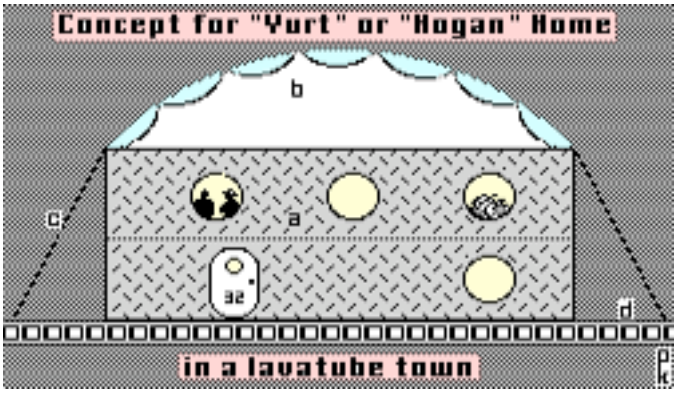
1. **Breathable atmosphere is 80% Nitrogen** – at 1 ATM – Earth-normal pressure. Of all the volatile elements most needed for biosphere purposes (Hydrogen, Carbon, and Nitrogen), Nitrogen if by far the least abundant in proportion to the amount needed. In the near term this will mean low ceilings and few pressurized "open spaces." One thing we can do to alleviate this somewhat is to try to make do with 0.5 ATM pressure, with all the hit (reduction) taken by Nitrogen, keeping the Oxygen partial pressure normal. Some point to disadvantages of this solution. But on the pro side, by simply reducing the partial pressure of nitrogen, the same tonnage of nitrogen will let us provide 2.73 times as much pressurized volume. For an article on this point, see pages 21-24, MMM Classic #16, a PDF file that you can download without username or password from www.moonsociety.org/publications/mmm_classics/
2. **Lavatube walls and surrounding basalt is most likely fractured.** If air moisture gets into these fractures and goes through repeated freeze-thaw cycles as the temperature inside the tube fluctuates, material is likely to spallate, break off and fall. We can probably deal with this on the lower walls, but spallation from the upper walls and tube ceiling could be a problem. So why not seal the walls? **Sealing a lavatube will not be easy.** Most suitable sealants involve scarce volatile elements. And they will be expensive for the pioneers to pruduce and use.

We are not saying "never," we are saying not in the near term. Our best bet and most practical nearer term option is to put pressurized structures inside the *unpressurized* lava tube. These "buildings" need not be shielded, unless we choose to do so for insurance against material breaking off the tube ceiling."

We should keep in mind that the most urgent need for pre-shielded space will be for industries and industrial parks, for protected warehousing, and maybe for extensive soil-farming. None of these uses will need the visual delight that would be provided by pressurizing the whole tube rather than the functional volumes inside. Residential areas can be more compact, but eventually we will move them into protected lavatube networks as well.

Brainstorming an early lavatube town

http://www.moonsociety.org/publications/mmm_papers/lavatubes_ccc2.htm

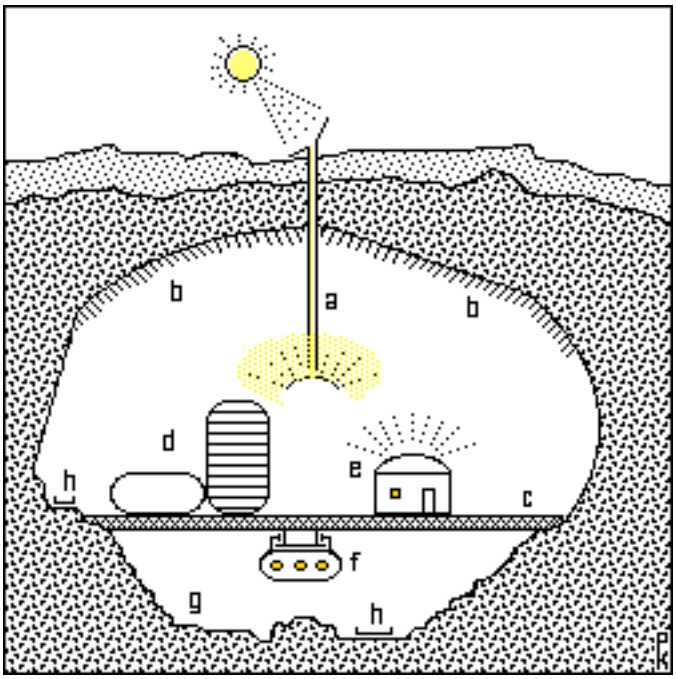


Concept for a lavatube single family home

KEY: (a) 2-story vertical cylinder section, bedrooms on the lower level; (b) lunar translation of the geodesic dome for a high translucent ceiling vault over the family room and other common areas including a central garden atrium; glass panes are neither flat nor concave, but convex; (c) cable stays prevent internal pressure from literally "blowing off the roof"; (d) the residential deck of the townsite, leaving the tube floor ungraded.

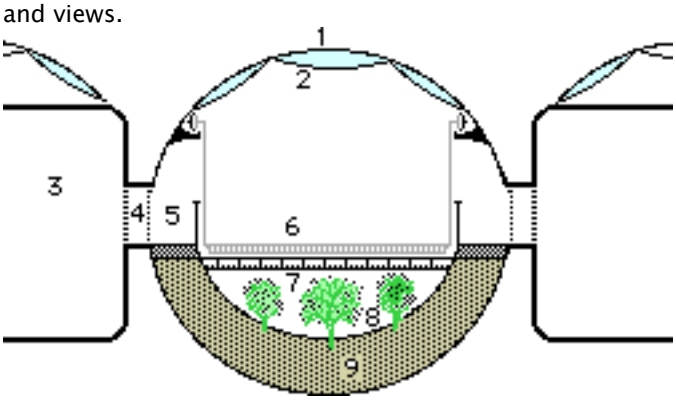
NOTE: upscaled, the yurt/hogan design will make a fine church, synagogue, or meditation chapel, with the simple use of stained glass convex panes in the roof dome. A dedicated shaft of directed sunshine on such a dome would surely help set the mood.

A variety of structures inside a lavatube



KEY: (a) sunshine access and defuser system; (b) white-washed "firmament" for best sunlight reflection; (c) "town deck" on tube-spanning beams; (d) assorted structures; (e) "yurt/ hogan" type home with translucent dome to flood interior with firmament-reflected sunshine; (f) monorail transit system; (g) lavatube floor left natural; (h) nature walks.

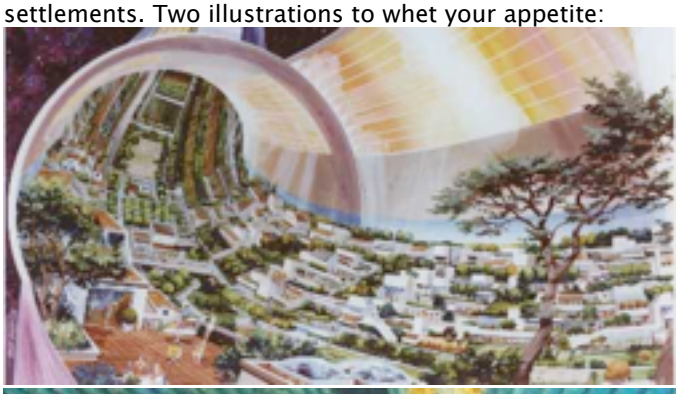
The early lavatube settlement will not be an assembly of individually pressurized buildings, but rather, like the in-surface burrowings, a maze of structures conjoined by pressurized walkways, streets, alleys, and parkways. In the netherspaces, roadway cylinders can be generously paned with convex windows to flood their interiors with ambient reflected and diffused sunshine and views.

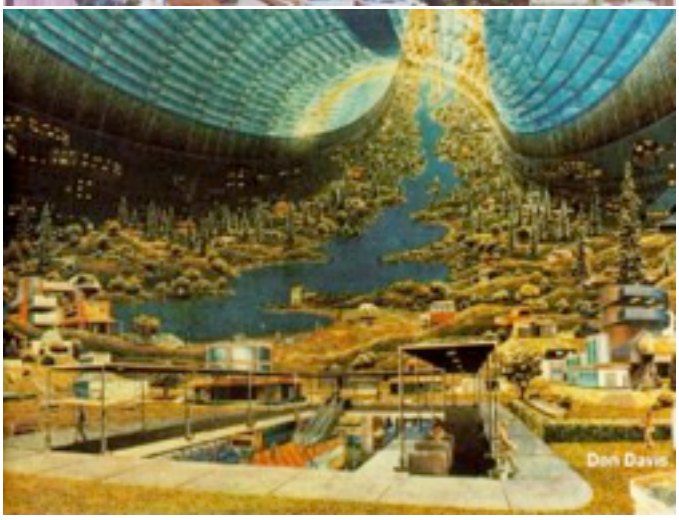


Fast forward to a can-do future:

Some maria experienced multiple episodes of lava sheet flooding. ***The walls of lower level lavatubes may be less fractured, and more easily pressurized****.*

We did a thorough Google Images search for "lavatube settlements" and found nothing. There are sketches, from the pre-internet era, which apparently have not been posted online. However, our lunar lavatube cross sections are pretty much the same ballpark, size-wise, with cross-sections of Stanford Torus type space settlements. Two illustrations to whet your appetite:





If you find some suitable sketches, color artwork or just black and white line drawings, please send them to us, electronically at kokhmmm@aol.com or by mail to:

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

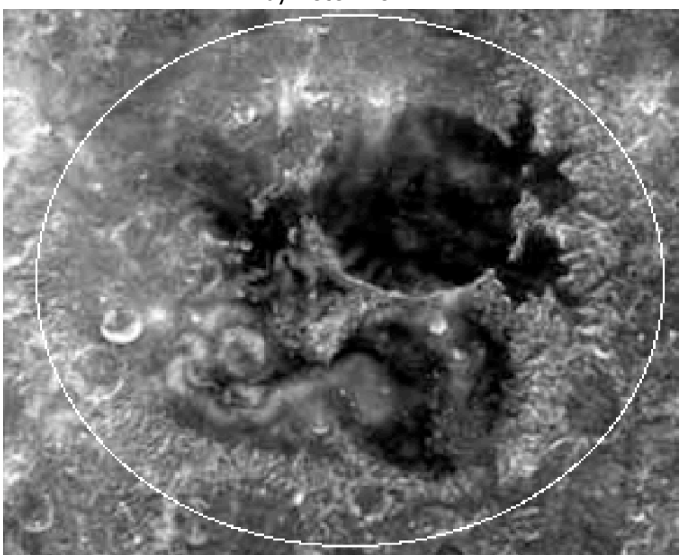
We need more appropriate artwork to enthuse the public at large about the possibilities that the confirmation of lavatube networks on Moon and Mars imply.

In the coming months, Moon Miners' Manifesto, and/or The Moon Society, may announce an art competition with several categories and attractive prizes. In the meantime, we look forward to additional confirmations of lava tube skylights on both Moon and Mars. We also hope for great entries to our AXEL-type probe design contest as well as for a wide open contest for practical lave tube skylight probes that NASA or other national space agencies may pick up, and build and fly.

To young people in the future, the possibilities of life on the lunar frontier will seem that much more interesting. There is more to the Moon than *"magnificent desolation!"* The Moon, and Mars too, have extensive and spacious protected Hidden Valleys that will one day be home to thousands, tens of thousands, and more pioneers. Keep the faith! **PK**

Mare Ingenii – "Sea of Ingenuity"
A Sweet Spot on the Moon's Farside

by Peter Kokh



The dark floor crater to the NE is 60 mi wide **Thomson**.
Can one think of a better place for a very large array radio telescope complex devoted to S.E.T.I.?
[Search for Extra Terrestrial Intelligence]

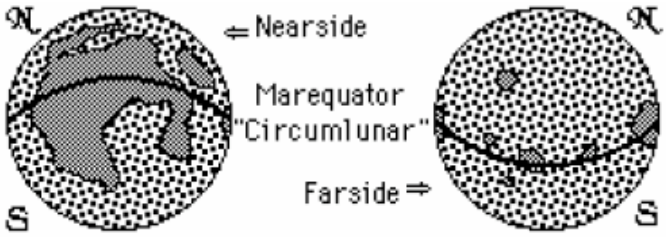
What's so special about Mare Ingenii?

Lunar Prospector detected strong mangnetic shields on the farside, at the antipodes of impacts that formed the Mare Imbrium basin centered on Mare Ingenii in south central farside, and the impact that formed the Mare Crisium basin, centered on the crater Gerasimovic in SE farside. What we think happened is at the moment of impact a magnetic plasma was ejected that surrounded the globe coming to a focus at the impact antipodes and permanently magnetizing the surface in those areas.

Such areas may be safer places for surface habitation, requiring less shielding for protection. On the other hand, there is new evidence that these areas also shield against the solar wind, so that the regolith in these areas may be relatively less rich in volatile particles attached to the regolith powder fines.

The "marequator" runs through Mare Ingenii

In MMM # 74, we coined the word Marequtor: "Some writers have proposed lunar equator-following roads, railroads, and even superconducting cables. The path of least resistance suggests a route that rises north of the equator on the nearside and south of the equator on the nearside to take advantage of the more easily-traversed stretches across the available lava-flow plains."



Unlike the crater Tsiolkovsky, which is another prime site, M. Ingenii is in the central farside slice of the lunar globe that is out-of-line-of-sight from both L4 and L55 Earth-Moon Lagrange positions where the Earth's and the Moon's gravities cancel out, the prime location for lunar communications satellites. **PK**

LUNARCRETE

Early lunar settlers will need an inexpensive, easy-to-use concrete for rapid construction of structures.

Introduction

The early pioneers who came to the "New World" brought with them all the tools they could afford. With this small initial supply of tools, they built homes, grew crops, hunted, engaged in trade, and produced new tools from the raw materials of the rich and virtually untouched wilderness. To build their houses, most early settlers used an axe and a great deal of muscle. The remainder of the building material came from the land around them: trees for walls and roofs; a mixture of mud, sand, and sometimes fine plant fibers for mortaring the cracks and joints in the wooden walls and roofs; dried vegetation for thatched roofs; and dirt for floors.

An early pioneer on the lunar frontier should also build his earliest structures using the least amount of imported tools and materials. The Moon lacks many material sources commonly used in terrestrial construction, such as water for concrete and brick mortar; trees for timber; organics and plastics for electrical wire conduit and plumbing; processed metals for load-bearing beams, reinforcing wire or grids, and electrical wiring; and processed concrete materials. The only major source of raw materials is the finely divided lunar regolith, or soil, which is most suitable for making ceramic building materials such as bricks, mortar, and concrete. Early lunar settlers will need an inexpensive, easy-to-use concrete for rapid construction of structures. For the widest possible use during this early development stage, the concrete must require only minimal initial processing and final placement time and effort. Since the lunar temperatures vary from well above the boiling point of water during the lunar day to well below the freezing point of water during the lunar night, a good concrete should be unaffected by these extremes of temperature during placement, curing and use.

"Concrete" usually refers to a mixture of aggregate, such as gravel; fines, such as sand; and hydraulic setting cement, such as Portland cement. These compounds are mixed together in many different proportions. Most mixtures are moistened with 5% to 25% water and cast into molds or forms.

Conventionally placed concrete mixtures must be kept in the very narrow temperature range of 40 to 80 degrees Fahrenheit for one To 21 days. Water content of the placed concrete must be held constant for this extended period of time to yield optimum strengths. If the concrete is allowed to freeze during the first day or two it will usually be very weak, and will crumble under very little stress.

During the early days of lunar settlement, water will not be abundant or cheap enough to leave large amounts tied up in housing structures. After a sophisticated and mature industrial base is established, conventional concretes may have limited application in some construction if a sufficiently large, inexpensive water supply is found. But, because of the temperature limitations caused by the water addition, conventional concretes will only have limited use in lunar and space habitats. Therefore, use of the term "concrete" to describe materials placed in a similar manner on the Moon would be misleading. It is proposed the term "lunarcrete" be used to describe concrete-like materials made from lunar raw materials and used as a building material in the settlement of the Moon.

Previous Proposals

Two feasible methods of constructing lunar dwellings largely from lunar raw materials have been proposed to date. One method 1 involves making precast and prestressed panels of lunar concrete bonded either with epoxy resin imported from Earth, with melted sulfur, or with fused rock. These types of building materials have many potential uses including lunar habitats, inside structures like floors and walls, industrial process equipment, and prestressed concrete for building a large space habitat. Sheppard? proposes using fused cast rock placed around steel reinforcing cables tensioned between anchorage points. Similar approaches to early lunar settlements would result in significant economy by reducing the use of expensive, highly processed materials such as various steel alloys. However, the first two binders are limited by the amount of resin that can be imported, and by the durability and strength of the sulfur concrete as well as the availability of indigenous sulfur. The third binder requires a great deal of energy, and a material to fill the joints between the panels to prevent loss of atmosphere.

A second method] involves driving heating rods into large piles of lunar soil. Fusion of the soil layer and subsequent removal of the underlying soil results in a "cave-like" structure. This type of structure also requires a great deal of energy to construct. Unless it is sealed, cracking of the internally fused structure could lead to slow leakage of some at mops here.

New Proposal

Table I lists the major requirements of a lunarcrete intended for widespread structural uses. This paper suggests an approach to development of lunarcretes that may satisfy the requirements in Table I.

TABLE I Requirements for a Lunarcrete

- Must be able to support its own weight plus the additional loads encountered during intended use.
- Must be able to contain air with virtually no loss.
- Must be abundant and therefore cheap.
- Must be easily and quickly prepared and placed.
- Must not require strict control of ambient temperatures during placement and curing.
- Must not contain water in any appreciable quantities.
- Must not fail catastrophically without warning.
- Must be structurally stable, environmentally stable, environmentally inert, impervious to external and internal stresses, such as micrometeriorite impacts.

In the terrestrial refractories industry, a novel type of material is gaining widespread acceptance. In many applications where monolithic construction is necessary and there is insufficient time for placement moisture to dry prior to use, dry vibratable compositions are gaining favor. These new products can be placed quickly and heated at rapid rates to very high temperatures, while yielding excellent strengths, densities, and low wear rates. Strengths well in excess of conventional, non-pre-stressed concretes are achieved every day, using many compositions of these materials. The terrestrial construction industry would have little or no use for such a product. However, a lunar construction industry

would find substitution of energy for water and no strict ambient temperature dependence to be desirable features.

It is proposed that as-mined lunar soils be screened and recombined in the proper grain size configurations to create dry vibratable lunarcrete compositions. These mixtures should compact much more readily on the Moon due to lunar vacuum, since entrapped air is the main reason why dry vibratables sometimes densify poorly on Earth. Due to the great similarity between the particle configuration of the lunar soils and dry vibratable products, it may be possible to build the early crude structures using lunar soils in the as-mined state.

Internal and external metal forms are erected and loose-filled with the lunar soil. Conventional vibrations equipment attached to the metal forms is used to compact the soil to high density. Additional loose soil is added as necessary to maintain structural volume. Because of the lower lunar gravity, we may need further development of vibration technology for optimum distribution of compaction energy. Studies would also be required to determine the effects of pre-stressing cables on the vibration and compaction technique, if pre-stressed lunarcrete is to be used.

Use of variously designed inserts and different arrangements of internal walls should provide considerable diversity.

For a low temperature binder to give structures sufficient strength to support their own weight when forms are removed, silica glass separated from the lunar soil in fine particle sizes could be mixed with a small amount of imported alkali or with indigenous iron to form lower melting phases than the aggregate. Only a very small proportion of binder would be needed in any composition. Because powders form a harder, stronger mass in a vacuum when compared with powders whose particles are surrounded by air, it may be possible that, after compaction, the structures could hold together without need of a low temperature binder.

After the lunarcrete is vibrated in place,heated moderately, and forms removed, a simple focusing mirror could be used to heat the structure. Since the metal form is removed prior to fully sintering the structure, it must be collapsible-which makes it reusable indefinitely. If properly built, the form could hold an atmosphere and be used as temporary housing until completed structures are available. The rigid structure of the form would allow for radiation shielding by lunar soil even before compaction or sintering.

During the lunar night, heat could be supplied by electric heaters fed power from a solar power satellite or by aluminum-oxygen burners using lunar-derived aluminum and oxygen. Obviously, the earliest settlements should be planned so that the critical early heating requirements are supplied by focusing mirrors during the lunar daylight. Knowing the thermal characteristics and thickness of the lunarcrete, the proper size of the mirror and the time for heating can be readily calculated.

It should be possible to heat the structure from the outside so that the exterior surface will become molten and glazed, the interior surface will be moderately well bonded, and the central core portion of the lunarcrete will be fully sintered. The glazed exterior will be impervious to gases so no loss of atmosphere would occur. With increased understanding of the thermal characteristics of the lunarcrete, it may be possible to crystallize a glass ceramic in the glazed exterior and induce a compressive stress to the exterior surfaces of the structure, increasing its overall strength.

A moderately well-bonded interior surface will not crumble, but will be easy to anchor internal fixtures into because of its lower strength and penetration resistance. The well sintered central core portion of the lunarcrete will bear the major portions of the loads on the structure including some of the load-bearing for anchoring floors. This sintered region will also protect the glazed surface from damage from the interior by its high strength and penetration resistance. This structure should be less likely to leak atmosphere because cracks in the exterior could not propagate through to the interior to cause a loss of atmosphere. Similarly, cracks in the interior could not propagate through the sintered region and affect the impervious glazed exterior. Since only a part of the structure is totally melted, this approach should use less energy than the other methods mentioned above. 4.

A foamed or fibrous insulation could be *L-5 News, April /983 10* sprayed on the interior or exterior of the structure to even out thermal loads inside the structure. Insulating the exterior will protect the glazed surface from uneven thermal stresses during the lunar day-night cycle, and from meteorite damage.

The finished surface would be concrete-like in appearance and in its physical properties. The structure would likely be very resistant to chemical attack, water damage, fire, and explosion. Small cracks in the structure will act to warn of potential failure. Proper design and construction should prevent catastrophic failure. Repair of the load-bearing portion of the structure could be performed from the exterior in a similar manner to placement or from the interior using conventional concrete repair techniques and materials.

Reuse of the same forms would greatly simplify construction, but would give a company-town appearance to the settlement. However, use of variously designed inserts could alter the external appearance significantly and, combined with different arrangements of the internal walls and furnishings, should provide considerable diversity within the community.

Future Research

The Pittsburgh L-5 Society has initiated research into this novel concept for rapid construction of lunar dwellings using the vibration formed lunarcrete described above. This research will involve further literature reviews; computer design and modeling of the particle configuration, chemical or mineralogical structure, mirror size, heating profiles, and building structure; and limited laboratory testing to confirm technical details.

References

I. Sheppard. D. J. "Concrete on the Moon." Spaceflight, Vol 17.pp. 91-93and p. 120, 1975.

2. Sheppard, D. J.. "Concrete Space Colonies," Spaceflight, Vol 21.1, Jan 1979, pp. 3-8.

3. Criswell, D. R., by personal communication with Amon, D., at the Lunar Colony Workshop, 1982 L-5 Space Development Conference. 4. Loewe, Julian, "Lunar Habitats," Omni, December 1982. pp. 172-174and 180-181.

5. Harbison-Walker Refractories Company, MODERN REFRACTORY PRACTICE, printed by the William Feather Company, Cleveland. OH, 4th Edition. 1961.

6. Kingery, W. D., INTRODUCTION TO CERAMICS, John Wiley and Sons. Inc., New York, 1960. Larry Beyer, a member of Pittsburgh L-5 Society, is a professional ceramicist.

The Moon Society www.moonsociety.org

An international nonprofit 501(c)3 educational and scientific organization formed to further the creation of communities on the Moon involving large scale industrialization 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
- Promotion of large-scale industrialization and private enterprise on the Moon
- 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 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, and 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, contests & competitions, workshops, ground level research and technology experiments, private entrepreneurial ventures, moonbase simulation exercises, tourist centers, and other legitimate means.

Our Full Moon Logo above:

The Moon in its natural beauty, empty and deceptively barren, waiting for human settlers to shelter and to mother as their adopted second human home world. We have work to do!

Masthead Design by Charles F. Radley

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 Honors Dr. A.P.J. Abdul Kalam, Former President of India

By Peter Kokh, Dave Dunlop, Pradeep Mohandas

On September 30th, the Moon Society presented its University of Luna Award to Dr. A.P.J. Abdul Kalam for his vision and advocacy of space solar power to meet global requirements for clean energy, economic development, and environmental restoration. David A. Dunlop, Moon Society Director of Project Development and our unofficial roving Ambassador, made the presentation at the prestigious McDonald Club in Toronto, Ontario after a two-day drive from his home in Green Bay, Wisconsin, stopping at the Milwaukee home of Society President Peter Kokh to pick up the award.

When we received word that Dr. Kalam would be in Canada, a quick search showed that we had one certificate frame ready to go. If it had been a special order taking a week+, this opportunity would have been lost.

Dave, already tall, was standing on the steps, making Dr. Kalam appear shorter than he actually is.

The Award Reads "to Dr. A.P.J. Kalam, for his vision and promotion of space solar power as a solution to global requirements for clean energy economic development, and environmental restoration. The award was also proudly given on behalf of Moon Society India.

Moon Miners' Manifesto #205 May 2007 featured a three-page article about Dr. Kalam's vision. More recently, MMM # 237, August 2010, featured a two-page article about Dr. Kalam's Space Solar Power Challenge to the NSS and to the World, an address delivered via telecom at the 2010 ISDC in Chicago this past May.

Award to Dr. Abdul Kalam continued

Unframed certificate prior to signing by Dave Dunlop
Artwork, Space "University" by Pat Rawlings, personally signed by the artist

But Dr. Kalam's credits go further. As President of India, he suggested to the Indian space agency, ISRO, that they carry a Moon Impact Probe with the idea of permanently placing the Indian flag on the Moon.

ISRO complied with the request and made the sides of the MIP (The Moon Impact Probe released by the Chandrayaan-1 Orbiter) of a special material which was meant to withstand the crash landing and it's sides was to fall apart rather than break. The scientists also considered putting scientific instruments in MIP which led to the first detection of water vapor and carbon dioxide along with heavier elements (e.g.. Iron) in the lunar exosphere (this was before the Moon Mineralogy Mapper was switched Ontario, and hence was much before M3 (NASA's Moon Mineralogy Mapper aboard Chandrayaan-1) found water on the Moon's surface).

President Kalam has also suggested carrying a penetrator with Chandrayaan-II, so that we can touch the lunar water ice.

Dr. Kalam is an ISRO (Indian Space Research Organization) "rocket scientist" who rose to prominence and was President of India 25 July 2002 to 24 July 2007.

Links: http://en.wikipedia.org/wiki/A._P._J._Abdul_Kalam

Dr. APJ Abdul Kalam - A Site for Inspiration and Nation Building - http://www.abdulkalam.com/

Previous Awards

The University of Luna Award was introduced at ISDC 2007 in Dallas, where we gave an award to **Phil Sadler and the CEAC team** (Controlled Environment Agricultural Center - U. Arizona) for the Food Growth Chamber at the South Pole Amundsen-Scott Station; to **Dr TD. Lin** for two decades or research on Lunar concrete; and to **Dr. Alan Binder**, P.I. for the Lunar Prospector mission.

At ISDC 2008 we gave the award to **Dr. Lawrence Taylor**, U-TN, for his research in controlling moondust through its magnetic properties. Earlier this year, at ISDC 2010 Chicago, we gave the award to **Dallas Bienhoff** and his team at Boeing for their work designing an orbital refueling depot to cut shipment costs to the Moon.

Average Age of Moon Society Members Reaches all time high, many over 100!

October 31, 2010- From Society President Peter Kokh

More than 10% of our members are an amazing 110 years old. That's a claim no other space advocacy society can make. How does the Moon Society attract so many centenarians?

It seems some members are shy about telling us their age, and leave the "date of birth" line empty when they fill out their registration form. As the database wants that line filled, in default mode, it automatically sets their date of birth as January 1, 1900. Why 1900 and not 2000? Probably because our database was inherited in 2000, along with the members of the time, from the Artemis Society, which had been launched in 1995.

We would like to honor these crusty old-timers and thank them for their persistence. But we suspect that they might not appreciate this attention. So we will just keep to ourselves the dirty little secret of those who may look like 25, or 36, or 47, or 58, or 69, but are really 110, going on 111! Is this an indication that longevity will be common on the lunar frontier? Hmmm.

Don't know if this qualifies as a Halloween story, but be advised! If you don't want to be thought of as a centenarian plus (110, not merely 100), just send us a note with your date of birth. Our database is not shared with anyone, so there is no reason to be shy, and one good reason not to be so: we might think that you look and act extremely young for one who will turn 111 next January 1! But we will keep this "dirty little secret" to ourselves. We won't tell anyone how ancient you are!

Meanwhile, if you are already 110, going on 111, and haven't left us anything in your will, let this be a reminder to make provisions. That none of our centenarians has passed away (so far) is no guarantee that you won't kick the bucket soon.

Hey, to a guy about to turn 73 on 12/11, you guys make me feel young! You are a treasure, and an inspiration that helps me keep trucking! *Lol!* **PK**

Moon Society-NSS Collaboration Continues to Grow on Chapter Level

By Peter Kokh

History:

- **ASI partnership with NSS chapters 1995** (1) Oregon L5 NSS (Portland) and (2) Lunar Reclamation Society (Milwaukee). This collaboration was continued when ASI Membership migrated to the new Moon Society in 2001. Oregon L5 has had a strong focus on *lava tubes*, and of course, LRS contributed *Moon Miners' Manifesto*
- Meanwhile, at ISDC 2005 in Washington DC, the Moon Society and National Space Society signed a mutual-Affiliation Agreement. Inter-chapter collaboration was one of the major recommendations in this document. www.moonsociety.org/reports/affiliation_report.html
- NSS MN SFS and NSS San Diego

Recent Moon Society-NSS chapter collaborations:

- **NSS & TMS Houston Chapters** have begun meeting together. Each chapter has strengths and weaknesses the other does not. They are now discussing formalizing this merger, along with an invitation to Mars Society Houston. *This has our blessing.*
- **Moon Society St Louis** sent 4 members to the recent ISDC in Chicago, one of them, Dave Heck, made a presentation on the concept of an International Lunar Research Park, with Moon Society Support. Overall, they were impressed! And one asked *what it would take for NSS to pick St. Louis as an ISDC host.* The answer, of course, is that NSS picks from bids submitted by a chapter. To date, only one ISDC was not hosted by an NSS chapter, Toronto, hosted by the Canadian Space Society. Our advice to MSStL was to invite chapter-less St. Louisians who belong to NSS, and become a merged chapter. MSStL is now in very preliminary consideration of taking on this ambitious project. chapter considers ISDC bid for 2014
- **Moon Society Phoenix & NSS Phoenix** - "December 4, 2010 - NSS Phoenix chapter Holiday Gathering at the home of Dave Fischer, Saturday 4 December from 4 to 8 PM. BYOB. Please bring your favorite recipe, but only bring enough for three people. This means that there will be a nice bite of each dish for 15 folks. Tasting is much more enjoyable than gorging. If you bring more than that, you'll go home with enough food for a week. The address is 3027 N 49th Ct, Phoenix AZ 85018."

Areas of Collaboration can include: Shared meetings, shared outreach events, shared newsletters, other shared projects too ambitious for either alone. Both chapters stand to gain and become more productive!

No Moon Society Chapter in your City? Take a look at the NSS list of chapters. If you metro area has an NSS chapter, consider joining it, and if you find others who are interested in the Moon and join the Moon Society, you can declare yourself a Moon Society Outpost, and continue to meet with the NSS chapter, and participate in their events and even *contribute to their exhibits and repertoire of presentations.* Once you are strong enough, you can earn full Moon Society Status, and choose either to meet jointly with the NSS chapter, and share events and projects, or to meet on your own but still maintain some level of collaboration with the NSS chapter.

Cities with NSS Chapters but no TMS Chapter

NSS Chapters that partner with The Moon Society and whose members get *Moon Miners' Manifesto*

Oregon L5 Soc. (**Portland**, OR)
Lunar Reclamation Soc. (**Milwaukee**, WI)
Minnesota Space Frontier (**Minneapolis-St. Paul**. MN)

NSS Chapters which *Moon Miners' Manifesto* get but do not partner with the Moon Society

Chicago SFS, IL,
Denver Space Soc., CO,
Philadelphia Area Space Alliance, PA, NJ,
OASIS, Los Angeles, CA)
Sheboygan Space Society, WI

NSS Chapters that partner with The Moon Society and whose members do not get *Moon Miners' Manifesto*

San Diego, CA

NSS Chapters with no TMS or MMM association

Atlanta (GA), Austin (TX), Baltimore (MD), Benton KY), Boston MS), Cleveland (OH), Dallas-Fort Worth (TX), Huntsville (AB), Kansas City (KS (MO), Long Island (New York), Memphis (TN,MS (AR), New Hampshire), New York City (NY/NJ), Oklahoma City-Norman (OK), Orange County (CA), Orlando Metro & Cape (FL), Raleigh / Durham Area), Rochester (NY), Sacramento (CA), Salt Lake City (UT), San Juan (PR), San Antonio (TX), Santa Fe (NM), Seattle (WA), Washington DC Metro (DC)

Cities that have hosted an ISDC

1982	Los Angeles, CA	1983	Houston, TX
1984	San Francisco, CA	1985	Washington, DC
1986	Seattle, WA	1987	Pittsburgh, PA
1988	Denver, CO	1989	Chicago, IL
1990	Anaheim, CA	1991	San Antonio, TX
1992	Washington, DC	1993	Huntsville, AL
1994	Toronto, ON	1995	Cleveland, OH
1996	New York, NY	1997	Orlando, FL
1998	Milwaukee, WI	1999	Houston, TX
2000	Tucson, AZ	2001	Albuquerque NM
2002	Denver, CO	2003	San Jose, CA
2004	Oklahoma City, OK	2005	Washington, DC
2006	Los Angeles, CA	2007	Dallas, TX
2008	Washington, DC	2009	Orlando, FL
2010	Chicago, IL	2011	Huntsville, AL

Some Major cities that have yet to host an ISDC

Boston, Baltimore, Atlanta, Jacksonville, Miami, Tampa, New Orleans, Memphis, Nashville, Detroit, Minneapolis-St. Paul, St. Louis, Kansas City, Salt Lake City, Austin, Phoenix, Portland, San Diego, and Sacramento to name a few.

Summary

There are many and varied opportunities out there, for chapters of both The Moon Society and The National Space Society (Mars Society too, for that matter) that could benefit from collaboration.

Why Moon, Asteroid and Mars enthusiasts should demonstrate fellowship and collaboration

View our Presentation,

"The Human Expansion Triway into Space

www.moonsocietyorg/spreadtheword/pdf/Triway1.**pdf**
www.moonsocietyorg/spreadtheword/ppt/Triway1.**ppt**

The Moon Society Chapters & Outposts Frontier Report

Moon Society Phoenix Chapter

http://www.msphx.org
http://www.moonsocphx.blogspot.com/
Contacts: Craig Porter portercd@msn.com
Chuck Lesher: chuckmiester999@yahoo.com
Meeting the **3rd Saturday of the month**
Next: Saturdays **Nov 21st, Dec 19th , Jan 19th**

Our Saturday, September 18th Meeting was attended by all save two. The meeting started with a review of the results from CopperCon30 and the Panels manned by the Moon Society of Phoenix, Science, Literature and Disasters. I congratulated those that participated successfully with their Panels.

We also discussed the Telepresence Remote Control Car Racing that we were trying to get started this fall but decided to reschedule the start of the racing for early next year. We also decided to see if something can be worked out with the Cub Scouts to demonstrate the TRCC racing to them at a Pine Wood Derby function if we can arraign it. The delay is due to amassing the hardware and modifying it for TRCC racing purposes and then gaining proficiency in racing the cars so that we can properly demonstrate them to those that are interested. We are also working on getting sponsorships in place to help pay for the Hard Ware.

We have two Conventions in the coming year that we are looking to be active in the programming area as well as having an out reach table, LepreCon37 and CopperCon31.

LepreCon37 will be in May at a Hotel in Tempe Arizona during the early part of the Month. We have already request an out reach table for it and we are looking to schedule Panels on the Moon and Science as well as supporting Panels already set up but not fully manned.

CopperCon31 will be Labor Day Week End at a Hotel in Avondale Arizona. We have already put in our request for the out reach table and we are working with the Program committee for Panels to help out on.

We have offered to help the NSS Chapter set up and man an Out Reach Table and to help them participate in Panels if they so desire. I will be contacting the Mars Society and the Planetary Society with the same offer. The only problem I see is that the Mars Society Chapter may no longer exist in Phoenix and the Planetary Society never did get a local chapter started although local members have in the past manned Tables for Out reach purposes.

Our web site has been down for some time and the Chapter has decided to move the web site to a new hosting service and change Web Master to take the work load off of the current Web Master. We will try to keep the old URL but if we have lost it we have a back up reserved and can use it thanks to Ben Nault. – Craig

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 Houston Chapter

http://www.moonsociety.org/chapters/houston/
Contact: Eric Bowen eric@streamlinerschedules.com

September 27th Meeting Report: Topics of discussion included a proposal to host a fundraising golf tournament, which was tabled for the present due to a shortage of active members.

We also discussed our planned merger with the local NSS and Mars Society chapters, which is still a "go" from our end but is waiting on action from the NSS chapter officers.

The next Houston Chapter meeting will be held in the conference room of the **Bay Area Community Center at Clear Lake Park** on **Monday evening, November 15, 2010 at 7 p.m.** The local NSS chapter and Mars Society chapter are invited to participate as well. As always, the meeting is open to all visitors and guests. We hope to see you there.

Moon Society St. Louis Chapter

http://www.moonsociety.org/chapters/stlouis/
Contact: Keith Wetzel <kawetzel@swbell.net>
Next meetings – Nov 17th, Dec 16th, Jan19th
Meetings **3rd Wed** monthly at Buder Branch Library
4401 S. Hampton, in the basement conference room

We might have a Christmas Party

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

www.moonsociety.org/chapters/chapter_outpost_map.html

Moon Society Nashville Outpost – Central Tennessee
Contact: Chuck Schlemm cschlemm@comcast.net

Bay Area Moon Society, CA **Outpost** – South Frisco Bay
http://www.moonsociety.org/chapters/bams/
Contact: Henry Cates hcate2@pacbell.net

Moon Society Longview, TX **Outpost**
Contact: James A. Rogers jarogers2001@aim.com

Moon Society DC Metro, DC-MD-VA **Outpost**
Contact: Fred Hills Fredhills7@aol.com

Milwaukee, WI **Outpost** (MSMO)
www.moonsociety.org/chapters/milwaukee/msmo_output.htm
Contact: Peter Kokh kokhmmm@aol.com
The monthly Lunar Reclamation Society meeting on the 2nd Saturday afternoon every month serves MSMO also

NSS Partner Chapter News – pp. 17-19

Oregon L5 (Portland), **Lunar Reclamation Society** (Milwaukee), **Minnesota Space Frontier Society** (Minneapolis-St. Paul), **San Diego Space Society**

Moon Society DUES with ***Moon Miners' Manifesto***
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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 BROWSING

Icebergs in Frigid Oceans of Ancient Mars?
http://www.space.com/scienceastronomy/ancient-icebergs-mars-oceans-101001.html

Photos from Failed Soviet Lunar Lander Program
http://jalopnik.com/5657385/rare-look-at-moscows-secret-failed-moon-program

Titan's Haze could hold ingredients for Life
http://www.physorg.com/news205749188.html

Big step taken toward Fusion
http://www.physorg.com/news205740709.html

"Billions and Billions"? Discovery of Habitable Planet Suggests Many More are Out There
http://www.planetary.org/news/2010/1006_Billions_and_Billions_Discovery_of.html

Unfinished Soviet Buran Shuttle Found rusting
http://english.pravda.ru/history/30-09-2010/115158-russia_space_power-0/

Russian firms unveil space hotel plans
www.reuters.com/article/idUSLNE69002J20101001

Dragon Cargo Capsule gets test flight in November
http://www.space.com/missionlaunches/spacex-dragon-capsule-test-flight-101011.html

Wind Power Growing Faster than Predicted
http://www.physorg.com/news/2010-10-20-pct-world-power-2030.html

Make Magazine: 10 Do-It-Yourself Space Projects
http://www.nasahackspace.org/2010/10/make_magazine_10_doityourself.html

Asteroids caught in collision by Hubble Camera
http://www.space.com/scienceastronomy/asteroid-collision-hubble-photographs-101013.html

NASA and Etsy launch 2010 Space Crafts Contest
http://www.etsy.com/nasa - http://www.aero-news.net/news/aerospace.cfm?ContentBlockID=4b49c2e7-8b61-4948-a670-dde456e37133&pageHtml

NASA Embraces Commercial Lunar Explorers; to be Customer of Google Lunar X PRIZE Competitors
www.spaceref.com/news/viewpr.html?pid=31866

NASA Awards Contracts For Innovative Lunar Demonstrations Data
www.spaceref.com/news/viewpr.html?pid=31868

Astrobotic Technology gets $10 million NASA Moon mission contract and announces Alliance
www.spaceref.com/news/viewpr.html?pid=31869

Chinese target Moon landers for Bay of Rainbows
http://www.moondaily.com/reports/China_Scouts_Moon_Landing_Sites_999.html

List: Lunar Lava Tube Skylights Discovered to date
http://the-moon.wikispaces.com/Skylights

Contents of LCROSS South Pole impact splash-out
http://news.yahoo.com/s/ap/20101021/ap_on_sc/us_sci_shoot_the_moon

Bigelow Testing Crew Life Support Systems
www.spaceref.com/news/viewpr.html?pid=31881

Bigelow Aerospace Private Space Station Deals
http://www.space.com/businesstechnology/private-space-station-first-clients-101019.html

100-Year Starship Concept to spread humanity
http://www.popsci.com/science/article/2010-10/'hundred-year-starship'-could-bring-humans-other-worlds-and-leave-them-there-forever

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.moonsociety.org/video/
or at:
http://www.mooncolony.tv/
http://www.stickymedia.com/

ASSORTED SPACE VIDEOS

Space Ship Two first solo test flight
http://www.space.com/common/media/video/player.php?videoRef=SP_101011_VSS-

Spaceport America Rimway Dedication
http://www.youtube.com/watch?v=qH4InXrYFUI&feature=player_embedded#!

Planetary Society's LightSail 1 under construction
http://www.planetary.org/programs/projects/solar_sailing/video_20101018.html

Video of 2nd largest asteroid Vesta Rotating
http://www.space.com/common/media/video/player.php?videoRef=SP_101021_VestaRotate

"10 to 20 percent of planetary systems in our galaxy could contain at least one habitable planet. "When you multiply that by the hundreds of billions of stars in the Milky Way, that's a large number. There could be tens of billions of these systems in our galaxy."

———Steven Vogt, professor of astronomy at the University of California Santa Cruz and co-leader of the Lick-Carnegie Exoplanet Survey

Help us put MMM in a Library near You!

Whether you are a member of an NSS Chapter or of a Moon Society Chapter or Outpost, or a Moon Society member at large, you all get Moon Miners' Manifesto as a membership benefit.

A library subscription to a library in your community will help spread the word, whether about local or national or international Moon-focused programs and projects.

For chapters and outposts such subscriptions will be good advertising for your local efforts.

For Moon Society members, as all copies of MMM include the Moon Society Journal centerfold section, community library or school library copies of MMM will help grow name recognition and invite readers to join.

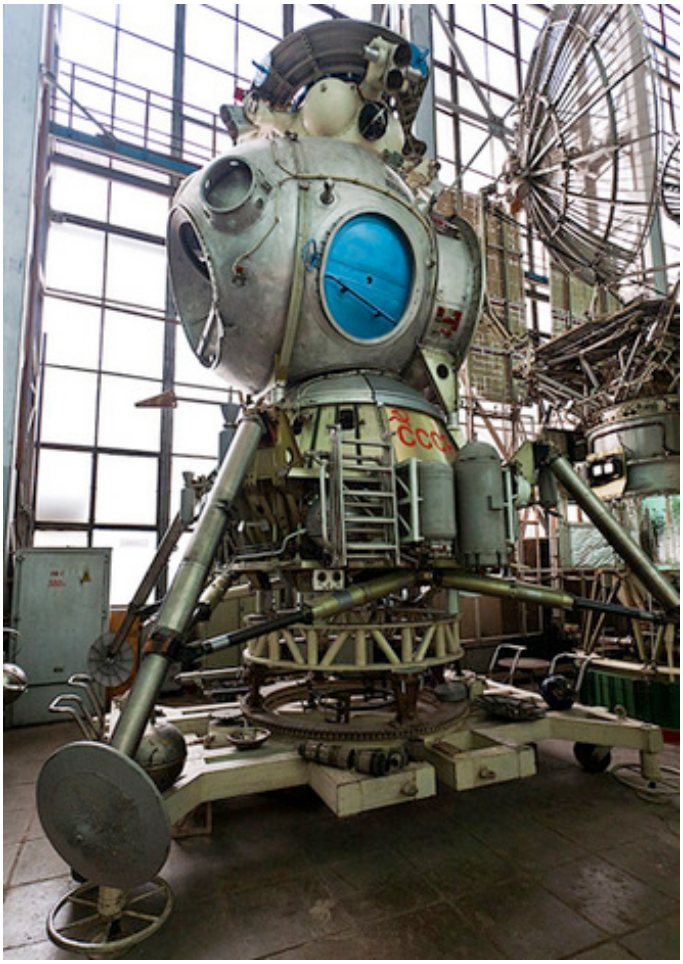
As membership services are not involved, the cheapest way we can do this is by submitting these subscriptions directly to the publisher at a cost-minus rate of $**13** a year, available for libraries only.

How to participate in this program

- Send *by postal mail only*
- Your check of money order for $**13**.00/per year
- With the complete name and address of the Library,
- Made out to **"Lunar Reclamation Society"**
  Attn: Library Subscriptions
  PO Box 2102 Milwaukee, WI 53102

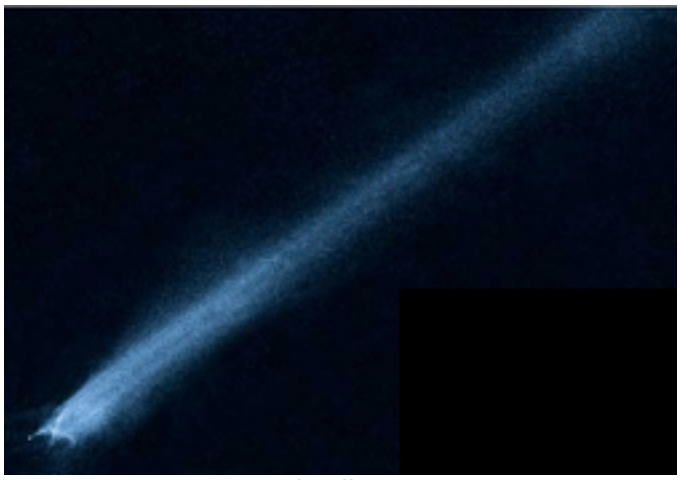
MMM PHOTO GALLERY

Chains of crater-marks on Mars such as these could have been made by icebergs rolling across ancient Martian ocean floors, researchers suggest. Credit: HiRISE

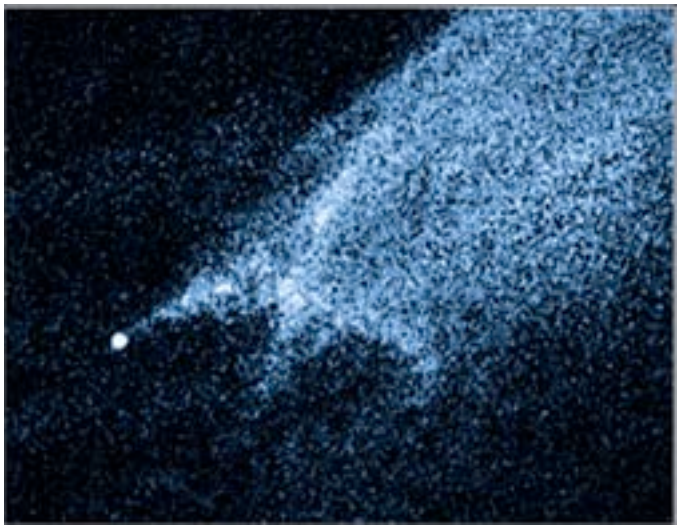


Above: the Soviet manned lunar lander that never flew
http://jalopnik.com/5657385/rare-look-at-moscows-secret-failed-moon-program
http://scienceblogs.com/sciencepunk/2010/10/soviet_lunar_lander.php
Note similarities and differences from Apollo LM design

Dragon Cargo Capsule being readied in Space-X hangar for November test flight - "For this first demo flight, Dragon will make multiple orbits of the Earth as we test all of its systems, and will then fire its thrusters to begin reentry, returning to Earth for a Pacific Ocean splashdown off the coast of Southern California. The entire mission should last around four hours." - *Elon Musk*



Asteroid Collision? See:
http://www.space.com/scienceastronomy/asteroid-collision-hubble-photographs-101013.html



detail of results - see article for explanation of the comet-like tail, and for estimates of the size of the two colliding objects and length of tail.

THE book WORM

The Wright Stuff

The Century of Effort Behind Your Ticket to Space

By **Derek Webber**

Forward by **Buzz Aldrin**

Apogee Books
Space Series
2010

ISBN: 978-1-926592-17-6

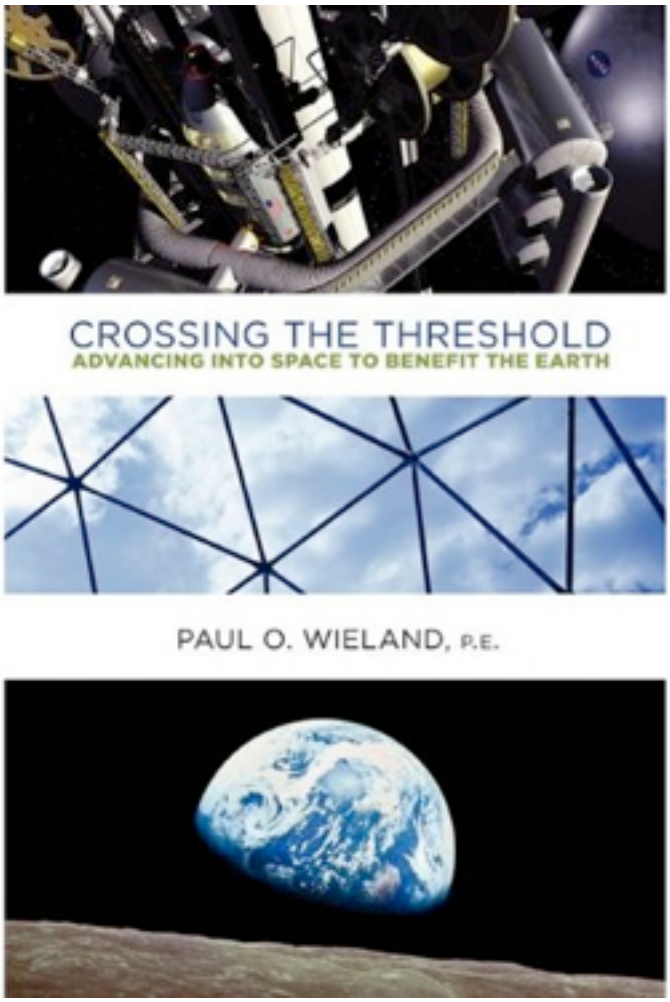
Publisher: The fact that some of the fortunate among us can afford their own personal ticket into space has been a long time coming. Find out who the main players were in making this ancient dream of personal spaceflight an actual reality.

"As the new industry of space tourism begins its rapid expansion phase with the introduction of Sir Richard Branson's Virgin Galactic spaceflights around end 2010/early 2011, the reader of this book will gain an understanding of how it reached this point. The story, told through a well-selected collection of photographs, is of a succession of developments and risk-taking that goes back a century to the almost simultaneous start of both aviation and rocketry. The key people in this story are highlighted - and are given "The Wright Stuff" Awards - for their contribution. Many of them are surprising, in that they would not previously been associated with space tourism, but the author makes their contributions clear. Readers will learn that their tickets to space have been made possible not just by the efforts of entrepreneurs and engineers, but also just as importantly by artists, regulators, politicians and some of the earliest aviators – all of whom had "The Wright Stuff". Some used copies

Availability:

- **Apogee Books: $25.95**
  www.cgpublishing.com/Books/9781926592176.html
- **Amazon.com: New $18.68,** Some used copies

Be a Doer, not a Watcher.
The watcher is likely to be disappointed.
The doer has the comfort of knowing
that he has tried, and perhaps laid foundations,
for others who follow, and may reach the goal.



Crossing the Threshold: Advancing into Space to Benefit the Earth

[Paperback] **Availability: Apogee Books: $15.25**

Paul Weiland is a former engineer from Marshall Space Flight Center.

"Forty-one years after Apollo 11 landed on the Moon, we seek clean energy sources, a healthy environment, and a peaceful world. To achieve these goals we must implement new approaches.

"Business as usual" is no longer acceptable. Energy and resources are limited on the Earth and acquiring them adversely impacts the environment. In space, however, they are present in abundance and can be acquired without damaging ecosystems.

"The book shows how we can achieve a secure, sustainable future with abundant energy, resources, and opportunities for all to have more fulfilling lives."

http://www.threshold2020.com/

http://arcosanti.wordpress.com/2010/09/25/crossing-the-threshold/

http://www.facebook.com/pages/Crossing-the-Threshold/103109346396461

"Vision without action is merely a dream.
Action without vision just passes the time.
Vision with action can change the world."
– Joel Barker, Futurist

Above: Bigelow-Aerospace Station & Boeing crew module

Bigelow Aerospace-Boeing Partnership to vie with new Russian Consortium in the Commercial Space Station Market

http://www.space.com/businesstechnology/boeing-new-capsule-concept-100625.html

http://www.space.com/businesstechnology/russia-space-tourism-commercial-space-station-100929.html

MMM Commentary

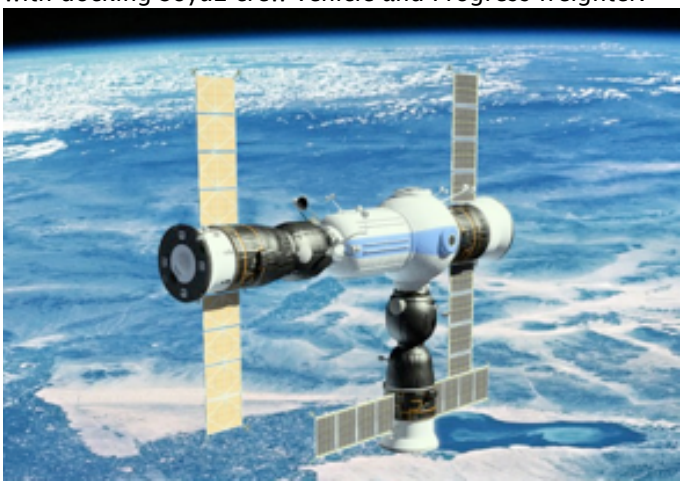
What could better hasten the dawn of the comercial era in low Earth orbit, LEO, than a competition by two partnerships very interested in making money and gaining a waiting list of customers? While at the space agency level, races tend to produce less than ideal products (can't afford extra features when being first is the overriding goal), that would not be the case where a growing line of customers are waiting for access. In this case, providers will keep upgrading and adding to the facilities offered. And as the number of customers grows, the real race will be to reduce costs and prices – exactly what we need.

Boeing's partnership with Bigelow is on surface to provide crew access, may also bring an infusion of money and complementary expertise.

In the Russian effort, lond-established Energia brings the technical and manufacturing expertise, while the new Orbital Technologies company will contribute design elements that cater to commercial customers.

In both cases, we are looking at 2015 or later.

Below: one (initial) module space station envisioned by Russian companies, Orbital Technologies and Energia, with docking Soyuz crew vehicle and Progress freighter.



ATLANTICA EXPEDITIONS MISSION BRIEFING

[**Editor's Note**: Undersea habitats and labs provide an excellent analog of the isolation of pressurized facilities on world's with no atmosphere or an unbreathable one.]

From Dennis Chamberland – Atlantica Expeditions Leader

Thursday, November 11th, National Geographic Naked Science will air **CITY UNDER THE SEA**. While it is not exclusively about the **Atlantica Expeditions**, the experience we have gained and our book **UNDERSEA COLONIES** is used as a departure point for their case for an undersea colony. It also features Atlantica Expeditions crew member, Lloyd Godson.

Three days later, on Saturday, November 13th we will be underwater in the MarineLab laboratory at Key Largo filming a documentary for Canada Discovery Channel. The next day, after a night in the laboratory, we will swim across the lagoon bottom and enter the **Jules Verne Undersea Habitat** for a day of filming with ABC News Nightline, hosted there by Bill Weir. After another overnight stay, we will (sadly) have to return to the land of the SABs *(Surface Air Breathers)* once again. Sighhh.... I will keep you informed as to when each of them will air.

We are unique as an organization because of our openness to accept anyone who is qualified to join us down in **Aquatica** and absolutely anyone who is willing to support us ABDs ("Aquatica Bottom Dwellers"), even though many are exclusively SABs. I see it every day – people who take advantage of our openness and join us day after day, with incredible talent, amazing backgrounds and talents that run the gamut of human experience. And allow me to take this opportunity to reiterate a part of our charter:

"One of our foundational principles is to guarantee participation by as widely a diverse team as is possible. We do not make any individual distinction based on ethnic heritage, religion, sex or sexual orientation. We, by personal experience, know that this guarantee of diversity is the guarantee of our greatest strength."

I also wish to thank Ron Peters personally for his amazing and incredible support to the expeditions. Ron has not only supported us faithfully for many years, he does so consistently and not just in one kind of support – but in MANY ways. It is always so good to hear from him just in the form of encouraging emails now and then and a constant stream of new ideas to consider. Thank you Ron Peters from ALL of us in the Expeditions!

And again, and I cannot express the necessary level of gratitude for the degree of assistance provided to us routinely by Bill Kasper – truly a hero of Aquatica!

Finally, I also wish to express my gratitude for the daily (and I mean daily) efforts and work of the Atlantica Expeditions world class media expert, Mr. Ted Eccles. At this point in the 38 year effort to make it where we are today, Ted is our scout helping guide us out of the wilderness and onto the final path to the promised land! The analogy may sound a little corny – but it is also amazingly accurate! **DC/AE**

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!

2010 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

● **DUES RAISE**: The publisher of our newsletter, MMM, who does a great job for us at very low prices and instant service, has given us his first price raise in several years, 20 cents a copy, $2 a year, but combined with recent and expected postage increases, we are forced to raise LRS dues and MMM subscriptions from $12 to **$15 a year**. But this is still a bargain as before we signed up with him we had to charge $18!

LRS Upcoming Events

Saturdays: 1-4 pm
Nov. 13th – Dec. 11th – Jan. 8th
LRS Meeting, Mayfair Mall, Garden Suites Room G110
www.moonsociety.org/chapters/milwaukee/meetings.htm

Saturday, November 13th 1-4 pm

Note: We will be joining the Northern Cross Astronomical Society at this year's **Holiday Folk Fair**, at State Fair Park, the weekend of **Nov. 20-21.**

We will our "**Gravity Bricks**" and perhaps our **two most recent "lunar folk art" paintings** made with materials we can derive from moon dust. Plus flyers.

Saturday, December 11th 1-4 pm

Our 24th Anniversary & Holiday Party
Potluck Luncheon & Exhibiits

Sci-Fi Movie (2 pm sharp)

SPACED INVADERS (1990)

When one saucer of an invasion force has engine trouble, it lands on Earth. It happens to be Halloween and it happens the invaders are only about 4 feet tall. As the bumbling aliens wander around the countryside they are taken to be children and they make friends with two children, one of whom is the daughter of the sheriff. As their troubles mount (it's difficult for five aliens to conquer a world) they begin to give up their plans of conquest, but then there is that nasty killer robot.

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
November 20th – December 18th – January 15th

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 2009 Past & upcoming chapter events
www.freemars.org/mnfan/MNSFS/2010-12-Review/

November 8th – MN SFS Meeting Board Elections meeting of MN SFS 31st Anniversary & Planning for 2011
November ??th – ISS-26 Display
November ??th – St. John's Lutheran School Science & Invention Fair 2010
December 13th – MN SFS Meeting
December ??th – All Ships Holiday Party

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

• December TBD

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
November 9th, December 14th, January 11th

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 **1st Saturday 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.

November meeting times & location: Our next meeting will be informal, as was the October meeting at Philcon, the annual science fiction convention in our area, under the umbrella of The Philadelphia Area Science Fiction Society. The exact day and time during the 3-day event, **Nov. 19 to 21**, will be determined on the weekend of the event. We should have two or three tables in the main hallway and will post the meeting notice there.

Our **December meeting location** has not been selected, but will probably be at The Liberty One Food Court, our usual meeting location. This is also when officers are selected and plans for next year are discussed.

Next Meetings: Nov 21st, Dec 19th, Jan

October Activity Report: instead of a meeting, we did public outreach at The Franklin Institutes last day of World Space Week activities. For this event we had Mitch Gordon, Dennis Pearson, Hank Smith, and Earl Bennett. We had three tables, supplied by the Institute, for our displays. The event was from eleven in the morning till four p.m. [*see **photos**, next page*]

Our tables where laid out just off the Atrium next to the stair well that led to the basement area where the other weekend event, a robotics competition, was also occurring. Visitors first encountered the display Mitch set up which included his "future history" book (what people hope will happen, and some of the past events) our Mars display, and the Space Bricks game. And lots of literature, both free and for discussion and illustration.

Further down the tables I had the Lunar Lava Tube Display with figurines of lunar explorers and various vehicles and a wheeled habitat occupying the tube. Another model of a lava tube, based on the large tube discovered on the Moon, was used as a way to explain how big tubes can be, and to demonstrate the instrument that found it (the laser altimeter). There was also much literature along the table at that end, mostly handouts that Earl had created. The Most recent addition, "R is for Rocket, T is for Transport", was well received, as was the other material on Lava Tubes, Space Solar Power as a solution to some of our energy problems. And scattered throughout where our member-ship forms, Moon Society bumper stickers and Mars Society pencils. All free reminders of what we are working toward.

Many visitors came by and talked to Mitch, Dennis, and Hank as they came to the first part of the table, with many engaging over the Mars globe and the possibility of being space tourists, after viewing some of Mitch's' material on near term activities, like the Branson Hotel, and Virgin Galactic's plans to transport people to its orbit. And of course: Space Ship Two.

Derrick Pitts made a cameo appearance this time, as he had another event to attend to, but we had support from other staff in his absence, and interest in our ideas on the future of space exploration, including some questions on the Google Lunar X-Prize! This time we where able to get pictures of our activities because Michelle Baker came to the event to help us in that regard, and by Earl Bennett. Everyone had a good time, and I think this will help us to prepare for next years spring events at the Institute and Super Science Weekend in April 2011. – Submitted by Earl Bennett

Above left: is Dennis Pearson, who is also NSS Chapters Coordinator; **right:** Henry ("Hank") Smith, PASA Science Fiction outreach coordinator. Second table below

CALIFORNIA

SDSPACE.org

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

Meeting the 2nd Sunday monthly
Meetings: Nov 14th, Dec 12th, Jan 9th 2:30-4:30 pm
Serra Mesa Branch Library 9005 Aero Dr, San Diego
Quarterly Newsletter: ***The Bussard Scoop***

SDSS is celebrating "Carl Sagan" Day

Nov. 7th Favorite episodes of Sagan's Cosmos series

Nov. 9th Viewing the Sci-Fi film "Contact" based on Sagan's novel by that name, at the Space Travelers Emporium, 1947 30th St. San Diego

"The surface of the Earth is the shore of the cosmic ocean. On this shore, we've learned most of what we know. Recently, we've waded a little way out, maybe ankle-deep, and the water seems inviting. Some part of our being knows this is where we came from. We long to return, and we can, because the cosmos is also within us. We're made of star stuff. We are a way for the cosmos to know itself."

- Carl Sagan, Cosmos, 1980"

View our own Derek Nye on this USAF Everyday Sci-Fi video at XCOR's Mojave facilities (EasyRocket, X-Racer) & Masten Space System's **Zombie** vertical take-off lander http://www.youtube.com/watch?v=Nwe2iJbp9k4&feature=player_embedded#!

CALIFORNIA

OASIS

OASIS: Organization for the **A**dvancement of **S**pace **I**ndustrialization and **S**ettlement
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: Nov 20th, Dec 11th, Jan 15th

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

Saturday, November 20, 3 pm - OASIS Board Meeting, Home of Steve Bartlett and Tina Beychok, 7108 East Peabody, Long Beach, CA 90808

November 26-28, Thanksgiving Weekend
***LOSCON* Science Fiction Convention**
Once again, OASIS will have a table, be providing programming and host a Space Party. Come join us!

Saturday December 11, 3 pm - OASIS Board Meeting and Holiday Party
Home of Bob Gounley and Paula Del Fosse
1738 La Paz Road, Altadena, CA 91001

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Members of the STS-129 Atlantis crew share a meal with the ISS crew while on the space station - Nov. 26, 2009

Most MMM readers would be delighted to have such an experience, even if the feast was something less than what we have been used to here on Terra Firma.

As we look forward, the most important thing is to

Accept the Past
(we can do nothing about it other than to learn)

And then Choose the Future

Moon Miners' MANIFESTO

Lunar Reclamation Society Inc.
PO Box 2102, Milwaukee WI 53201-2102

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Mail Carrier, Time Sensitive Material <==

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National Space Society dues include ***Ad Astra*** (4/yr)
- **Join at $20 – renew at $55 adult rate**
- **Join $18 – renew $25 dues if under 22/over 64.**

State age ____ Mail to: 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**
P.O. Box 940825, Plano, TX 75094-0825, USA

INDEX to #240 NOVEMBER 2010

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)
- $12 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

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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