

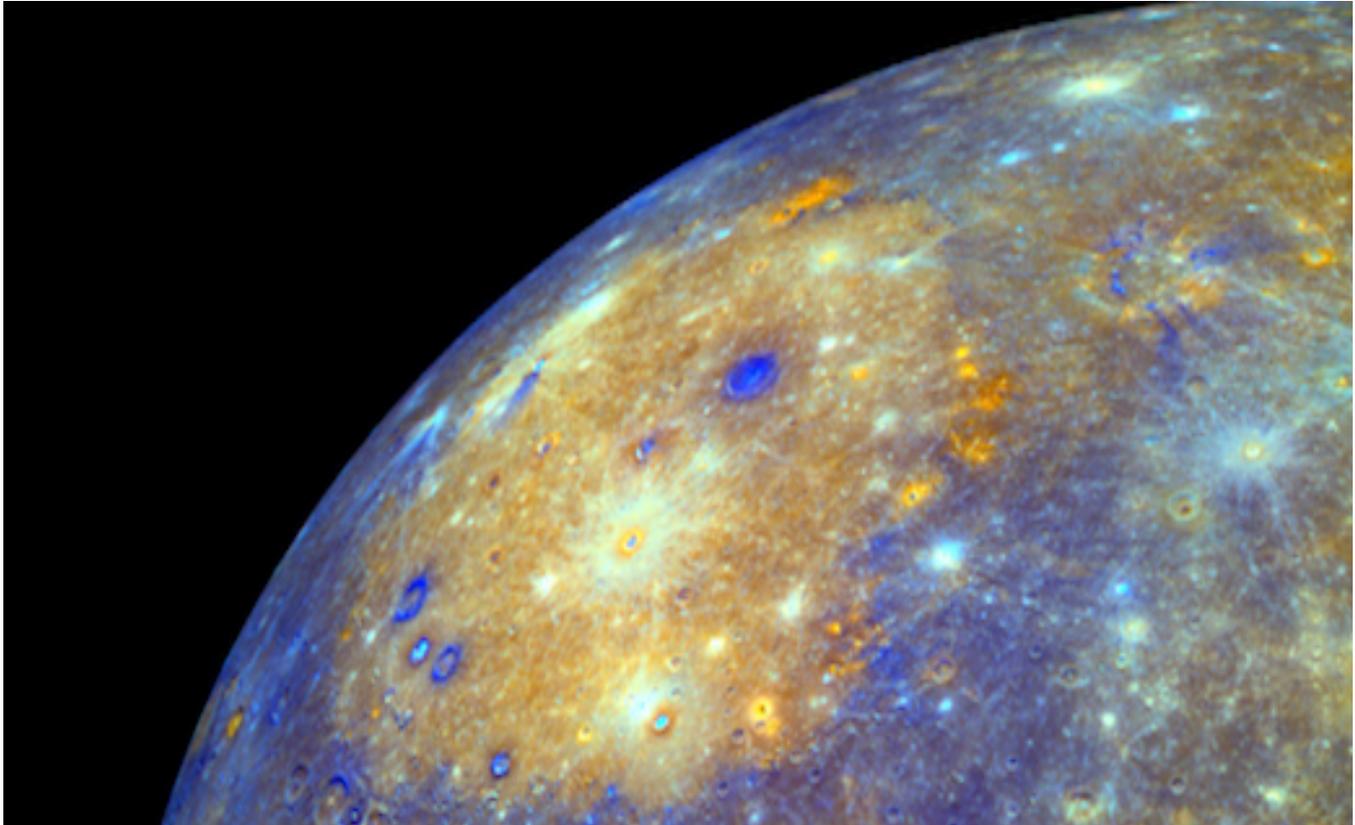
“Towards an Earth–Moon Economy – Developing Off–Planet Resources”

# Moon Miners’ Manifesto

& The Moon Society Journal



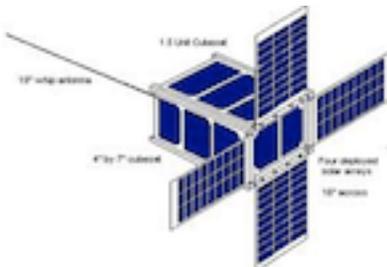
www.MoonMinersManifesto.com



Mercury would be a lot more inviting if this were not a **false color image** – See our Mercury Update below.  
[This is our 26th Anniversary Issue – MMM #1 was published December 1986](#)

## Feature Articles:

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Above: “Hitchhiker” lunar “cubesats” are our best bet for getting more lunar science for less money!

For past articles by themes, Visit [http://www.moonsociety.org/publications/mmm\\_themes/](http://www.moonsociety.org/publications/mmm_themes/)

## About Moon Miners' Manifesto – “*The Moon - it's not Earth, but it's Earth's!*”

- **MMM's VISION:** “expanding the human economy through off-planet resources”; early heavy reliance on Lunar materials; early use of Mars system and asteroid resources; and 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.
- **Moon Miners' Manifesto CLASSICS:** The non-time-sensitive articles and editorials of MMM's first twenty years plus have been re-edited, reillustrated, and republished in 23 PDF format volumes, for free downloading from this location: [http://www.MoonSociety.org/publications/mmm\\_classics/](http://www.MoonSociety.org/publications/mmm_classics/)
- **MMM THEME Issues:** 14 collections of articles according to themes: [....publications/mmm\\_themes/](http://www.moonsociety.org/publications/mmm_themes/)
- **MMM Glossary:** new terms, old terms/new meanings: [www.moonsociety.org/publications/m3glossary.html](http://www.moonsociety.org/publications/m3glossary.html)
- **MMM retains its editorial independence** and serves many groups, each with its own philosophy, agenda, and programs. Sharing MMM may suggest overall satisfaction with themes and treatment, requires no other litmus test.
- **Opinions expressed herein**, including editorials, are those of individual writers and may not reflect positions or policies of the **National Space Society**, **Milwaukee Lunar Reclamation Society**, or **The Moon Society**. **Copyrights** remain with the individual writers. Reproduction rights, with credit, are granted to NSS & TMS chapter newsletters.
- **MMM color online downloadable PDF file version option for Moon Society Members** using their username and password – do write [secretary@moonsociety.org](mailto:secretary@moonsociety.org) if you need help with your password.
- **For additional space news** and near-term developments, there is a daily RSS feed space news section on <http://www.moonsociety.org>. You can also read **Ad Astra** magazine mailed to **National Space Society** members.
- **Milwaukee 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. MLRS serves as the Milwaukee chapter of both **The National Space Society** and **The 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 (202) 429-1600 – [www.NSS.org](http://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 chapters** 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 to writers.**
- **Submissions by email** to [KokhMMM@aol.com](mailto:KokhMMM@aol.com) – Email message body text or MS Word, Text files, and pdf file attachments or mailed CDs, DVDs, or typed hard copy [short pieces only, less than 1,000 words] to:  
Moon Miners' Manifesto, c/o Peter Kokh, 1630 N. 32nd Street, Milwaukee, WI 53208-2040

## In Focus 14 new and refreshed MMM Theme Issues capture it all

We are happy to announce the following 14 publications

- [http://www.moonsociety.org/publications/mmm\\_themes/mmmt\\_LunarEconomy.pdf](http://www.moonsociety.org/publications/mmm_themes/mmmt_LunarEconomy.pdf)
- [http://www.moonsociety.org/publications/mmm\\_themes/mmmt\\_EdenOnLuna.pdf](http://www.moonsociety.org/publications/mmm_themes/mmmt_EdenOnLuna.pdf) \*
- [http://www.moonsociety.org/publications/mmm\\_themes/mmmt\\_construction.pdf](http://www.moonsociety.org/publications/mmm_themes/mmmt_construction.pdf)
- [http://www.moonsociety.org/publications/mmm\\_themes/mmmt\\_ArtsCrafts.pdf](http://www.moonsociety.org/publications/mmm_themes/mmmt_ArtsCrafts.pdf)
- [http://www.moonsociety.org/publications/mmm\\_themes/mmmt\\_surfaceactivities.pdf](http://www.moonsociety.org/publications/mmm_themes/mmmt_surfaceactivities.pdf)
- [http://www.moonsociety.org/publications/mmm\\_themes/mmmt\\_tourism.pdf](http://www.moonsociety.org/publications/mmm_themes/mmmt_tourism.pdf)
- [http://www.moonsociety.org/publications/mmm\\_themes/mmmt\\_analogs.pdf](http://www.moonsociety.org/publications/mmm_themes/mmmt_analogs.pdf)
- [http://www.moonsociety.org/publications/mmm\\_themes/mmmt\\_research.pdf](http://www.moonsociety.org/publications/mmm_themes/mmmt_research.pdf)
- [http://www.moonsociety.org/publications/mmm\\_themes/mmmt\\_Mars.pdf](http://www.moonsociety.org/publications/mmm_themes/mmmt_Mars.pdf)
- [http://www.moonsociety.org/publications/mmm\\_themes/mmmt\\_asteroids.pdf](http://www.moonsociety.org/publications/mmm_themes/mmmt_asteroids.pdf)
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- [http://www.moonsociety.org/publications/mmm\\_themes/mmmt\\_transportation.pdf](http://www.moonsociety.org/publications/mmm_themes/mmmt_transportation.pdf)

\* **Why the title “EdenOnLuna?”** – To survive, pioneers living “downwind and downstream of themselves” will learn lessons that could help people remaining on Earth to significantly restore their failing environment.

For past articles by themes, Visit [http://www.moonsociety.org/publications/mmm\\_themes/](http://www.moonsociety.org/publications/mmm_themes/)

## (lava)Tubers and (lava)Tubophobes

By Peter Kokh

Here on Earth we have people who live on a farm and wouldn't dream of living anywhere else. The same holds true for those who live in small crossroads towns, in downtowns of major cities, or in their suburbs. Ditto for some who live inland rather than along Great Lake or Ocean coasts, or in the hills or mountains as opposed to the plains. Likewise for those who live in high-rise apartments or condos and those who live in single homes, each on its own lot. Yet perhaps most people can adapt to anywhere so long as they have a job.

Some space enthusiasts dream of living in a space settlement island rather than on a surface of a planet or Moon, floating free in the void. Others, described by the latter as "planetary chauvinists" prefer a planetary surface with natural scenery rather than fake zoo-type mini-mountains. Count me as one of those planetary chauvinists!

Many Moon and Mars enthusiasts foresee life inside a large spacious pressurized lavatube as the ideal. Paradoxically, that dream may be realized on Mars before it is practical on the Moon, for the simple reason that Martian tubes are smaller, thus taking less to pressurize them, as well as the much sooner availability of the needed buffer gas Nitrogen on Mars in comparison to the Moon.

While pressurizing a lavatube to create an Earth Like Eden down under is a gargantuan undertaking, building modular settlements within a lavatube, with the same kind of construction we will use on the surface, minus the shielding overburden – the thick ceiling-roof of the lavatube supplies that function – is a relatively near term option. Certainly, lavatubes are ideal where extensive acreage is needed e.g. for warehousing, industrial complexes, and agriculture.



Artist's view of the inside of a Stanford Torus or Island II type Space Settlement. "Unroll" this scene, and you have the kind of settlement inside a lunar or Martian Lavatube that many would-be "tubers" envision. Such a dream may be realized someday, but it is not realistic in the near term on the Lunar or Martian frontier.

But it is a mistake to believe that all lunar and Martian settlers will check (✓) a lavatube town as first preference. After all, while "tubers" will not have the burden of "shielding" their living and working spaces, and thus the architecture of the homes and other buildings in a tube settlement will be much more visible, and have much more attention given to them. But tubers will pay a penalty, almost as stiff as those who live in space settlements. They will not be able to look up and see the heavens (at least not spinning by once a minute!), nor the "magnificently desolate" Moonscapes or Marsscapes.

Now for some lifelong city dwellers, where nighttime light pollution has gotten to such an advanced stage that many never get to see more than the Moon, Jupiter, Mars, Saturn and a few dozen of the brightest stars, that might not be a big loss. But for those raised in the countryside, or who have split their time between the country and the city (as myself), giving up the nighttime sky, and the beautiful rural landscapes, will be much too much to bear. We need the beauty of nature, both as expressed in planetary surfaces and in the heavens as soul food.

I myself could visit, but never live in either a space settlement or a lavatube. I prefer living on the shores of space – such as places on Earth with natural scenery, not designed by landscape architects (or zoo architects) and be able to look up, at least now and then, and be sucked up into the star-spangled heavens.

It takes all kinds of people to make a world, and all kinds of places too.

Lavatube settlements will come, and urban undergrounds such as PATH in Toronto and RESO in Montreal, give some idea of what they may feel like. I'll settle for these previews and take a pass on the real thing. But by all means, those of you who want to shrink the universe to the confines of a "spacious" lunar lavatube, be my guest.

Links:

**Toronto PATH:** [http://en.wikipedia.org/wiki/PATH\\_\(Toronto\)](http://en.wikipedia.org/wiki/PATH_(Toronto)) Google images "Toronto PATH"

**Montreal RESO:** [http://en.wikipedia.org/wiki/Underground\\_City,\\_Montreal](http://en.wikipedia.org/wiki/Underground_City,_Montreal)

Google images "underground city Montreal"

**For Previous MMM articles on Lunar Lavatubes,** read the online report:

[http://www.moonsociety.org/publications/mmm\\_papers/lavatubes\\_ccc.htm](http://www.moonsociety.org/publications/mmm_papers/lavatubes_ccc.htm)

**Or check out** [http://www.moonsociety.org/publications/mmm\\_themes/mmmt\\_construction.pdf](http://www.moonsociety.org/publications/mmm_themes/mmmt_construction.pdf) PK

For past articles by themes, Visit [http://www.moonsociety.org/publications/mmm\\_themes/](http://www.moonsociety.org/publications/mmm_themes/)

## The Planetary Society's Bold "PlanetVac" Mars Sample Return Project

By Peter Kokh

During the six Apollo surface excursions, 2,415 samples weighing 382 kg (842 lb) were collected, the majority by Apollo 15, 16, and 17. To date, 50 years later, not one tiny particle of Mars dust has been returned to labs on Earth. NASA designs for such a project would require a mission much more expensive than Curiosity.

It is time to go back to the drawing board with the order to make it **simple, elegant, effective, inexpensive, minimal size and weight**. With nothing but dreams on the drawing board, and the prospects for budgeting a very expensive mission unrealistic, the Planetary Society has adopted this assignment. Three Cheers!

<http://www.planetary.org/explore/projects/planetvac/>

[http://www.planetary.org/blogs/bruce-betts/20121030\\_PlanetVac-Intro-Blog.html](http://www.planetary.org/blogs/bruce-betts/20121030_PlanetVac-Intro-Blog.html)

[http://www.planetary.org/multimedia/video/20121026-honeybee\\_robotics\\_planetvac.html](http://www.planetary.org/multimedia/video/20121026-honeybee_robotics_planetvac.html)

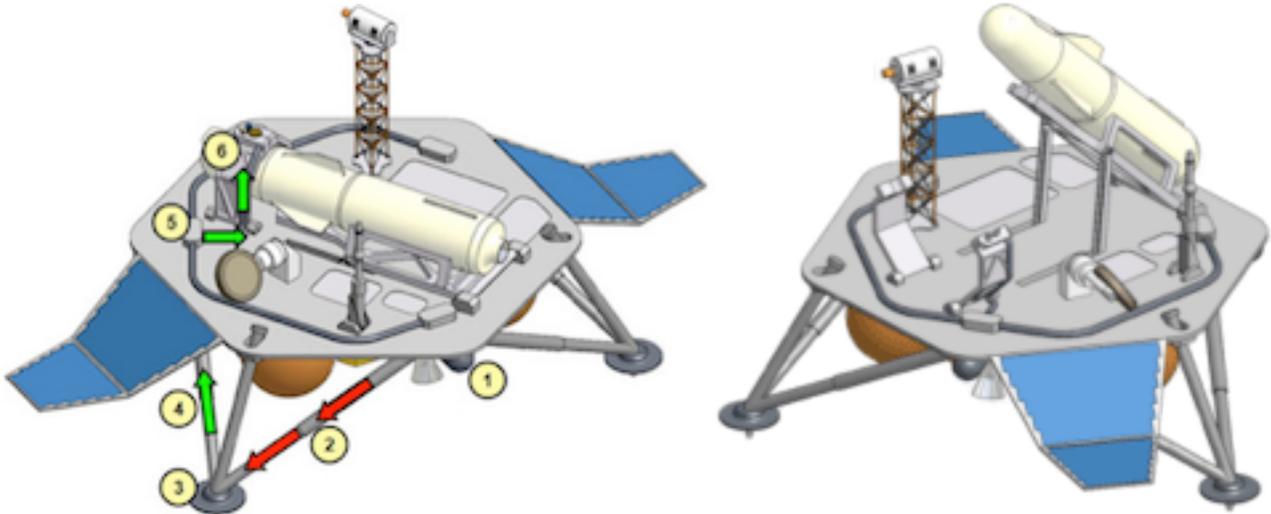
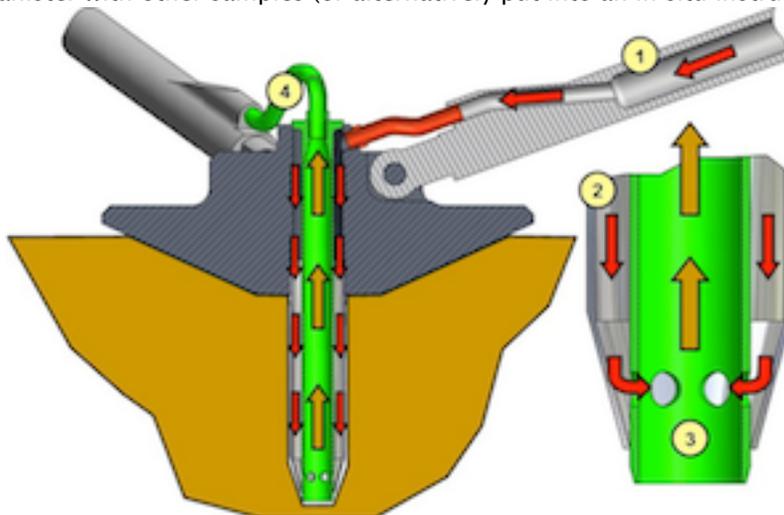


Diagram of how PlanetVac works showing a sample spacecraft: (1) Compressed gas cylinder releases a pulse of gas that (2) travels down lander leg strut and is (3) expelled through lander leg pad nozzle into regolith, (4) pushing regolith up a second leg strut to (5) sample intake manifold where it is then put into (6) sample return canister with other samples (or alternatively put into an in situ instrument).



(1) Gas flow down lander leg strut from gas cylinder, to (2) outer tube of collection nozzle, to (3) side holes in inner tube of collection nozzle, forcing regolith up the inner tube through the lander leg strut (4), and up to a science instrument or to a sample return capsule container.

The Planetary Society is trying to raise funds to build and test the prototype. Then, hopefully, they can hitchhike a ride to Mars. Mars Scientists have wanted to do this for years. NASA would come up with something much more expensive, and, yes, it might do a better job – but many years later! To do it now, it has to be simple, workable, and lightweight. This is a very interesting project which deserves wide \$upport. **MMM**

## Could we put an Outpost on Mercury? If so, why would we?

By Peter Kokh

For previous articles on Mercury, check out our Solar System Theme issue:  
[http://www.moonsociety.org/publications/mmm\\_themes/mmm\\_t\\_solarsystem.pdf](http://www.moonsociety.org/publications/mmm_themes/mmm_t_solarsystem.pdf)

### Mercury is significantly closer to the Sun:

- as a result, its surface temperature range is much higher
- a trip from Earth's surface to Mercury's surface takes more energy than to reach any other planet surface

### The Mercury Slingshot:

So why would we want to go there? By the same token, a solar power satellite of given size in orbit around Mercury would produce 4.6x as much power as it would in Earth orbit when Mercury was furthest from the Sun and 10.6 as much power when Mercury was closest to the sun. That power could be used to **decelerate arriving space ships and accelerate departing ships**, more than neutralizing the disadvantage of Mercury being deeper down the Sun's gravity well. Such assistance could make Mercury the Grand Central Station of the Solar System with the added benefit of the shortest interval between launch windows to and from anywhere in the Solar System. A ship bound from Earth to Callisto around Jupiter might get there faster and with less fuel by using this "**Mercury Slingshot**." Trips to Jupiter, Saturn, Uranus, and Neptune would be shorter.

Read "**Mercury Gateway: Grand Central to the Outer Solar System**" in MMM #78 Sept 1994 reprinted in [http://www.moonsociety.org/publications/mmm\\_themes/mmm\\_t\\_solarsystem.pdf](http://www.moonsociety.org/publications/mmm_themes/mmm_t_solarsystem.pdf) and in [http://www.moonsociety.org/publications/mmm\\_classics/mmmc8\\_Jan2006.pdf](http://www.moonsociety.org/publications/mmm_classics/mmmc8_Jan2006.pdf)

These advantages provide ample economic incentives to establish a settlement on Mercury whose primary purpose would be to ramp up the volume and frequency of interplanetary travel and trade in the Solar System.

### But isn't Mercury too hot to live on? (on the surface, yes, but ....)

**Not only are the polar areas significantly cooler on the surface, but extensive thick lava flows** (maria, like those on the Moon) ("enough to bury the state of Texas under 4 mi/6.4 km of once-molten rock" **have been found "at high northern latitudes"** i.e. near the North Pole – and that means that there must be lavatubes whose interior temperatures may be more than cool enough to support human activities in comfort. Human and industrial activities produce heat, so we want those "tubes" to be on the cool side. See Photo of Mercury lava fields page 14.

Mercury's axis is tilted even less than the Moon's. **Mercury could have double or more the total floor surface of permanently shaded craters**, and yes, **radar has detected water ice deposits in those craters**.

<http://news.yahoo.com/blogs/sideshow/nasa-says-enough-ice-mercury-encase-washington-dc-194415297.html>

So we have a **quadruple bonanza**:

1. **Water ice**
2. **Extensive and cool underground sheltered living spaces**, enough to house a considerable population
3. **Basalt**, a key industrial resource as it is on the Moon
4. **Iron and other key elements** in abundance

### The Rhythm of life on Mercury:

- **Mercury's axis has the smallest tilt of any planet, but Mercury's orbital eccentricity is the largest.**
  - As a result the seasons on the planet's surface are caused by the variation of its distance from the Sun, rather than by the axial tilt, which is the main cause of seasons on Earth and other planets. At its closest to the Sun (perihelion) the intensity of sunlight on Mercury's surface is more than twice the intensity at than at its farthest distance (aphelion)
  - Because the seasons of the planet are produced by the orbital eccentricity instead of the axial tilt, the season does not differ between its two hemispheres.



**Mercury's day-night/year follows a totally different paradigm:**

- Radar observations in 1965 proved that the planet has a 3:2 spin-orbit resonance, rotating three times for every two revolutions around the Sun. **As a result, its dayspan/nightspace cycle is twice as long as its year**, 176 Earth days long vs. 88 Earth days. And Mercury's set of seasons coincides with the that cycle.

For past articles by themes, Visit [http://www.moonsociety.org/publications/mmm\\_themes/](http://www.moonsociety.org/publications/mmm_themes/)

- Image Link: <http://www.eso.org/public/outreach/eduoff/vt-2004/mt-2003/mt-mercury-rotation.html>

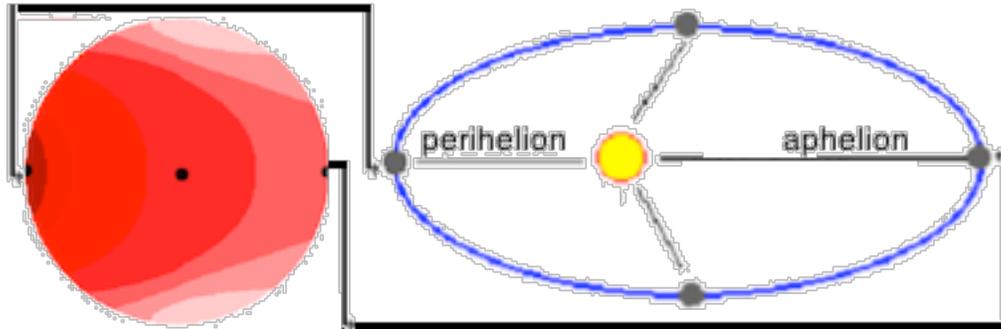
A “logical/practical” Mercury “Calendar” for settlers and temporary personnel should then be 176 Earth Days long, not 88. But, as 2 such cycles come very close to our year, 352 Earth days (vs. our 365), settlers on Mercury may want to use a calendar that is two day/night = two season cycles long. Such a calendar would be similar in length to our Jewish and Muslim 12–Moon–cycle calendars (354 dates).

These 352 dates could be subdivided into 8 “seasons” of 44 dates each. As to weeks, a sequence of 2 seven day weeks, one 8 day week (x2=44 dates) with the 8th day being part of a 3–day weekend every 22 days, such a calendar might be very popular with the Mercury’s settlers.

- Link: <http://www.eso.org/public/outreach/eduoff/vt-2004/mt-2003/mt-mercury-rotation.html>

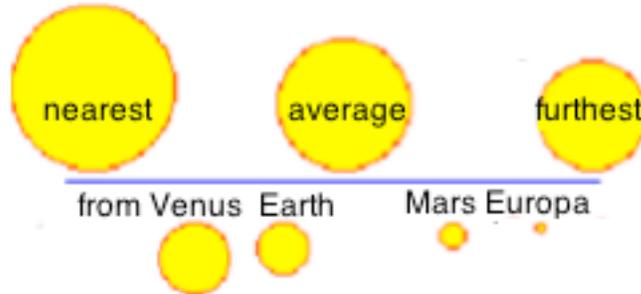
### Climate Zones on Mercury

As one face of Mars is always facing the Sun when Mercury’s distance from the Sun is at its minimum, and the antipodal face is always facing the Sun when Mercury distance is at its greatest, the planets thermal climate zones are unique. I have tried to get the point across in the following illustration.



**Above:** The deeper the shade of red, the hotter the climate zone – Graphic by the author

Note that northern and southern climate zones are the same. The lightest pink areas are where we want to be. Here we have the four things needed – “water, basalt, lavatubes, benign temperatures” – all in close proximity. Trips outside these areas would be practical only in most benign conditions (seasonal darkness)



**Above:** How big the Sun appears from Mercury in comparison to from other planets – Graphic by the author

**How far in the future is any such development?** The best way to answer such a question is to list missions and technology developments that must come first.

**Missions:** Currently, NASA’s Messenger probe is in orbit around Mercury giving us an enormous amount of knowledge that we did not have previously. Messenger is photographing Mercury from various altitudes at various resolutions. What we need is a **Mercury Reconnaissance Orbiter** on a par with the Lunar and Mars Reconnaissance Orbiters, able to photograph the innermost planet at a resolution great enough to reveal any lavatube skylights in this “far northern latitude basalt sea.” Finding one or more such skylights would help pin down candidate locations for a subteranean outpost.

Next, a “skylight explorer” on the model of JPL’s Axel probe, able to winch itself down into the skylight and scan what it sees to give us an idea of the cross–section size of the lavatube in question, and a sense of what would be involved to set up an outpost within the tube.

Meanwhile, sampler missions could analyze on location samples of the surface regolith around the skylight area and at various distances from it.

**Technology Development:** We will have accumulated extensive experience in design and construction of modular outposts on the Moon, and maybe on Mars by this time. What else? We need to be already building upgrade versions of **Solar Power Satellites**, as they will be key not only to supplying power to the outpost, but for using to decelerate incoming craft and then accelerating them in a new direction. SPS units could also spot–illuminate areas of Mercury’s surface currently in darkness for exploration of the rest of the planet under the best conditions.

Yes, these developments are a long time off. But we have taken step one: exposing the possibilities! PK

## An Affordable Paradigm of Hitchhiker Lunar Cube Spacecraft & Lunar Cube Labs for Exploration and Commerce

Dave Dunlop (Moon Society, National Space Society) and Dr. Rene Laufer (Baylor University)

### “Hitchhikers Paradigm”

A number of teams of are defining a new paradigm of low cost spacecraft missions which “hitchhike” to their cislunar objectives on larger rockets heading to GEO or a translunar injection trajectory and which use a variety of approaches for affordable exploration. (1). These save considerably on the launch costs of such secondary payload missions. Significantly lower prices can in turn make more frequent cislunar exploration and commercial missions possible. Strictly speaking the hitchhiker paradigm is defined by the secondary payload requirements and technology for large launch vehicles. Their mass range includes Mini-satellite (100kg to 500kg), MicroSatellites 10kg to 100kg), Nanosatellites (1kg to 10kg), PicoSatellites (.1kg to 1 kg).

### Small Sat History

In the United Kingdom, the University of Surrey pioneered this Microsat. approach in 1981, subsequently spinning off Surrey Satellite Limited, now a part of EADS. Many universities followed with microsatellite projects during the next twenty years. These spacecraft are also termed “University Class projects” connected to University Engineering and Science programs and small agile teams which include students in the design and construction effort and most often faculty as Project Principal Investigators.(2)

About 12–13 years ago the low cost cube sat architecture and PPOD launch system developed initially at Stanford University and the University of California State University, Santa Luis Obispo and the development of the Small Satellite Workshop Conference at Utah State University influenced many new projects. This Hitchhiker paradigm applied to lunar missions has also been recognized in recent Conference such as the International Astronautical Conference in CapeTown South Africa, 2011. The First Interplanetary CubeSat Conference was held at MIT in May to address the extension of the Cubes Sat architecture to destinations such as the Moon and Mars. Several workshops have also been held on “Lunar Cube” which focus on the application of this architecture to Lunar Missions by Flexure Engine/.

### Low Cost, Mass, Power and Volume Architecture

This Hitchhiker–Cube Paradigm involves technical challenges of reducing the volume, mass, cost, and range of microdevices instrumentation, as well as short development time line for such satellites. Many cube sat initiatives are not only educational but scientific, military, and commercial. As such it also draws in many additional elements that are part of this design paradigm. Not all projects will include all of the elements listed below and some elements listed are at the edge of technological feasibility. Together these Hitchhikers define a pattern that will reduce the cost of cislunar and Mars operations with a low cost, low mass, low power, low volume architecture and an array of adjunct technology approaches:

- 1 Utilization of the design standards developed for cube satellites and associated launch systems as secondary “low cost spacecraft mission paradigm < \$10M.
- 2 Development of reusable large booster systems, such the Falcon 9, may drop the cost of launch costs for both primary and secondary missions.

### Navigation

- 3 Utilization of of weak stability boundary navigation and low energy trajectories to define low mass ion propulsion system requirements for mission object
- 4 Advanced autonomous intelligent navigation, hazard avoidance and landing technologies.

### Propulsion

- 5 Development of micro thruster systems for active spacecraft orientation. (Many cube sat now have a passive gravity gradient orientation)
- 6 Small ion drive spacecraft propulsion systems that are solar powered. (Thrusters with expensive xenon may be replaced with less expensive propellant)
- 7 Development of solar sailing technologies

### Communications

- 8 An in-space communication and navigation infrastructure for communication relay in cislunar space. (Small spacecraft with low power and low bandwidth rely on large dishes for Direct communication with Earth or on a relay of weak signals to other spacecraft with more power which may be in Lunar or Mars orbit
- 9 In space multi-spacecraft neural net communication system.
- 10 Low cost global web connected small dish low bandwidth tracking networks.
- 11 Development of an integrated solar array and refractory antenna system (4)
- 12 Integrated optical communications and proximity sensors (4)

### Electronics

- 13 Ultra low power electronics utilization.
- 14 Ultra low temperature electronics utilization.
- 15 Long duration radiation hardened electronics.
- 16 On board data storage and compression capability.

For past articles by themes, Visit [http://www.moonsociety.org/publications/mmm\\_themes/](http://www.moonsociety.org/publications/mmm_themes/)

- 17 On board data analysis.
- 18 Micro devices sensors systems constrained by 1 U scale mass,power and volume design standards.\* (5)

#### LEO Testing

- 19 Spacecraft testing including utilization of LEO test missions and flight qualification in the LEO space environment providing space flight heritage for subsequent selection in deep space missions.

#### Smart Autonomous Systems

- 21 Advances in artificial intelligence will enable small labs and space craft to be situationally aware of their environment, to monitor their own performance, to make certain levels of autonomous decisions, and to also process data and analyses result in situ. “Systems on a chip” or “lab on a chip” technologies will make the capabilities of these small craft quite formidable and also provide a capability to obtain analysis of phenomenon that are far distant from Earth observers. Surface navigation across challenging terrains is another pioneering aspects of this paradigm that can results in both more affordable and capable missions.
- 20 Multi-strand funding development in the United States from NASA OCT, OEMD, AFRL, DARPA, Commercial NASA Space Grant, NASA's Small spacecraft Technology Program. Similar cube sat scale missions are being funded by non-US funded universities around in Europe, Korea, Japan, China, and elsewhere around the world.

#### Hitchhiker/Lunar Cube Evolutionary Development

##### Generation 1.0

This generation builds on the design experience and use of commercial off the shelf hardware. NASA or other navigation software is used to define propulsion requirement and to utilize existing chemical propulsion systems to reach cislunar space. The use of LEO cube sats as a means of testing instruments, electronic, and power systems for second generation is a cost effective means of developing space qualified hardware. Convention communications systems are used. and passive gravity gradient orientation is used.

##### Generation 2.0

Cube satellites designs provide newly developed micro thruster thruster for space craft orientation. Low cost global web-connected communications systems reduce costs of tracking, communications, and missions operations. Low energy trajectories are selected which match mission requirements with the abilities of ion propulsion systems which use xenon gas or alternative less expensive fuels. Integrated solar and reflectory antenna systems are used to increase available power and communications capabilities. Rad hardened electronics are used to meet requirement for long duration mission.

##### Generation 3.0

Cube sat scale space craft are developed for the cyro-environments in deep space, lunar cold traps, and other cryo-destinations. Ultra low temperature electronic and ultra low power electronic and cryopower systems mature so that these environments are opened to exploration. Optical communications and sensor proximity systems enable coordinated space craft operations. More reliance on on-board processing and data analysis and make these space craft more adaptive. The maturity of these advances in autonomous intelligent navigation, hazard avoidance and landing technologies will allow these small spacecraft to investigate the surfaces of the Moon, Mars, and the asteroids. These later missions may also utilize solar sail propulsion systems for very low mass advanced spacecraft.

**Cost Evolution:** Hitchhiker “Cube lab” and modular cube scale spacecraft in the microsatellite mass range (2) may grow a significant customer base and a larger volume of lunar missions which can deploy to a variety of cislunar destinations or ultimately to the lunar surface. The Cube Sat architecture has provided mission costs of tens of thousands of dollar to several hundred thousand so dollars to exceptional projects which have cost in the low millions. Nanosatellite Class cube sats will remain a significant training ground for student engagement.

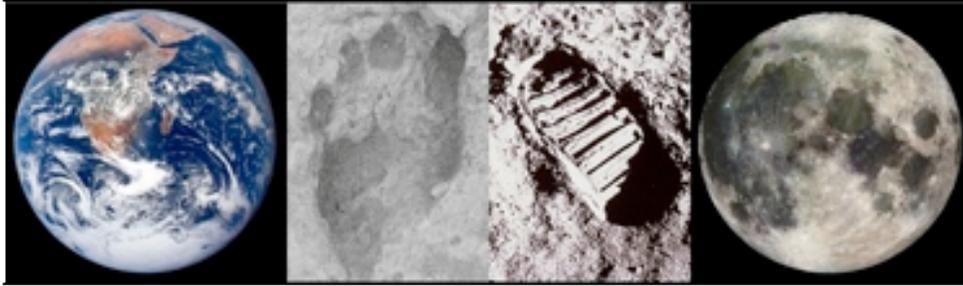
Picosatellite scale design may offer a low risk approach to the exploration of challenging surface environments where the deployment of numbers of nanobots may be a cost effective strategy. Mission components may benefit from common design standards but space qualified components increase the costs. A larger market for such mission may also mean some economy of scale in production and purchase of components. Even small scale micro landers with a price point in the low tens of millions of dollars are likely to be demonstrated well before the end of this decade. A these technologies mature, with additional experience and lower mission costs may result in a much wider number of countries and companies that can support these missions. Micro Sat and Lunar Cube lander missions in the \$ single digit millions range may become a common place.

**Summary:** Mission price points in the low tens of millions dollars or even single digit millions are now projected to be within reach for cislunar missions due to the creative use of a variety of approaches enumerated and described above. While not replacing larger scale missions that have been developed in the past this new paradigm will define a new era of affordable exploration missions to many destinations including cryo-destinations in the solar system and of the potential of a commercial market mechanism driving affordable commercial missions in cislunar space and to the surface of the Moon itself.

DD/RL

**LINKS:** <http://prod.nais.nasa.gov/cgi> – <http://prod.nais.nasa.gov/cgi> – <http://www.nasa.gov/home/hq>  
<https://sites.google.com/a/slu.edu/swartwout/home/university-class-spacecraft>  
[http://www.nasa.gov/home/hqnews/2012/aug/HO\\_12274\\_Small\\_Tech\\_Demo\\_Missions.html](http://www.nasa.gov/home/hqnews/2012/aug/HO_12274_Small_Tech_Demo_Missions.html)

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.

## The Moon Society Journal Section (pages 9–12)

## About the Moon Society

### Objectives of the Moon Society include, but are not limited to:

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

Our Vision says it all – “Who We Are and What We Do” – [www.moonsociety.org/spreadtheword/whowhat.html](http://www.moonsociety.org/spreadtheword/whowhat.html)

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, 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](mailto:president@moonsociety.org)

## From Moon Society President Ken Murphy

One acronym that is becoming increasingly common in the public dialogue is **STEM**, for Science, Technology, Engineering and Math. It represents an increasing effort to focus kids on the fields of study that the U.S. needs if it is to maintain or even grow its technological leadership in the world.

This is an initiative in which members of The Moon Society can play an active role. Just by being a member of The Moon Society you are showing that you have an above-average interest in our Moon, and as a consequence probably have an above-average knowledge of things Lunar. Especially if you read MMM every month.

The main way to get involved in your community is to network and start letting people know that you know about the Moon, and can be called upon for lectures and talks on Lunar topics.

There is interest in the Moon out there, but no one knows where to go for information and so often end up with poor substitutes. One example is a planetarium talk on the Moon where a local university geologist is invited to speak. Someone asked about the green glass beads found by Apollo and the geologist couldn't explain them, offering several incorrect options. Two words enlightened her: fire fountain.

For past articles by themes, Visit [http://www.moonsociety.org/publications/mmm\\_themes/](http://www.moonsociety.org/publications/mmm_themes/)

The Moon Society – Lunar Frontier Settlement – [www.moonsociety.org](http://www.moonsociety.org) p.2

President's message cont.

Similar examples are abundant, and since members of The Moon Society represent a unique store of knowledge in our culture, we kind of have a responsibility to fight the ignorance that abounds in society. Ignorance that holds us back, and keeps us in the dark.

While having dinner with a number of the SEDS kids at the SpaceVision 2012 conference, one topic that they particularly harped upon was how sick and tired they were of teachers who didn't know or understand the subject matter they were teaching. Again and again they would ask a question pertinent to the lesson, and the teachers would again and again respond "I'll have to get back to you on that" or "Let me google that". Clue by 4: the kids know how to google too. What they need is teachers who know their subject matter, and not just the teach-to-the-test curriculum.

In that kind of environment, it's no wonder that industry after industry in the U.S. has been looted of its current and future productive capacity, and the nation finds itself struggling economically. New value creation has stalled under the burden of the nation's slow climb out of economic stagnation, and the nation is uncertain from whence its future prosperity will arise. That's where the nascent space industry comes in, and why being a member of The Moon Society is so important.

We are the knowledge that will help turn the space industry into a growth industry that provides interesting jobs, challenging projects, and opportunities for glory. People are cautious about investing their hard-earned capital, and too little is known about space for it to be a compelling investment. Blame it on the media, blame it on the financial community, blame it on whomever. It doesn't matter where the problem lies, because we are part of the solution. The light of knowledge in a dark void of ignorance.

Let's spread the light, and banish the fear.

Ken Murphy

## Member Retention is a Challenge facing all "1.0" Organizations

Part I: By Peter Kokh

I personally belong to a number of organizations, not all "space-related" and I have been a member of each for 1-4 decades. In each case, the organization is "graying." If new younger members join, it is well below the rate needed to maintain the "old numbers." Everyone I know reports the same phenomenon. Times have changed and younger people are finding new ways to connect, almost always via the internet as opposed to "in person."

The advantage of the internet is obvious. No travel costs are involved going to and from local meetings, and long distance conventions and conferences. More importantly, one can participate on one's own schedule, and from home or from wherever they happen to be. "No holds bared participation." The weather, the traffic, needs that divide one's attention – none of these are a problem online. One can be in sleepwear, etc., in bed, etc.

**If we want to maintain person to person group activities, we have to offer incentives that online meetings cannot provide.** We have to find ways to get around individual personal time conflicts. We have to get around bad weather. And so on.

Perhaps the answer is for a chapter to have **two general types of projects and activities: (1)** those that require some physical co-presence, and **(2)** those where individuals can contribute at their own schedule, and from whatever location they find themselves in. In other words, "if we can't beat organizations 2.0 (however you would define these new critters we ought to take a page from what they do. That's quite a challenge, but with a change of attitude and some imagination and free thinking, any of our chapters should be able to come up with a **mix of activities, some of which best proceed through in person scheduled meetings, and others to which anyone who wants to contribute can do so at his/her convenience from wherever they happen to be.**

**Activities which do not require physical meetings:**

- Maintaining a chapter scrapbook
- Maintaing a chapter website
- Putting together exhibit materials
- Creating videos
- Giving presentations to outside groups
- Ad hoc meetings online of those working on a project jointly
- Gathering news reports from various sources
- Organizing a letter-writing campaign
- More ideas? send them to [mmm@moonsociety.org](mailto:mmm@moonsociety.org) or to [kokhmmm@aol.com](mailto:kokhmmm@aol.com)

Continued, next page

Activities at physical meetings at pre-set times and locations:

- **Not all chapter members belong to the same set of organizations.** The NSS–PASA (Philadelphia Space Alliance) has a unique arrangement. Some (not the same) local members belong to NSS, the Moon Society, the Mars Society, the Planetary Society, the Futurist Society, and Science–Fiction clubs. At each meeting, someone reports on each of these groups, and that is an incentive for any member who does not belong to all of these groups to come to the meeting to find out “what else is going on.” You will notice that for years, PASA, now NSS–PASA contributes by far the most interesting chapter report in MMM issue after issue. In addition to news of various groups, the PASA report includes what is noteworthy in the latest issue of various publications. We tried such an arrangement in Milwaukee some years ago, but after a few months some of the key contributors disappeared and this stopped. Its time for us to try this formula again.
- **There is no need to limit shared chapter activities to one monthly meeting.** Each meeting should be an opportunity for anyone interested in taking in a special event to see if others are interested. Science fiction meetings or events; planetarium events; congressional representatives or senators constituents meetings; various open houses; let your imagination roam freely. When is the last time someone in your chapter said, “I am going to X and Y at Z, anyone want to come along? Make arrangements to meet or carpool.
- **If your chapter meeting begins to become the place for members to find other interesting things to do,** then attending the chapter meeting begins to become more attractive, something to look forward to. Ask each chapter member present what he or she did/is doing that may be space relevant. Good ideas spread!

**It’s not too late to observe the 40th Anniversary of Apollo 17  
“The End of the Beginning”**

By Peter Kokh

Apollo 17 lifted off from the Moon on December 14th 1972 at 5:55 pm EST. It was the “End of the Beginning.” Forty years have gone by, and the only concrete proposal to return to the Moon was cancelled by the Obama Administration in 2009 – it is just as well, as like Apollo – the architecture of this plan was such that it could only have ended just like the first “Flags and Footprints” effort. A very expensive transportation system, no orbital refueling, and the only thing permanent about it would have been an empty shelter on the Moon, should someone else ever want to visit and use it.

**Tapping your brains, yes, yours! You too!** – How do we launch an effort to redesign “Chapter II” into one that would become a permanent, “designed to grow” “beachhead” (from which a campaign to occupy the surrounding territory) could be launched? MMM has endeavored to point the way.

1. It should be an **International Effort**
2. It should involve **business and industry**
3. It should be at a **location from which all needed resources can be accessed** (not just water ice)
4. **Personnel should have the right to “re-up”** – to volunteer for an extended stay, indefinitely
5. It should be supported by a **transportation system in which every element is either reusable as is or can be cannibalized for parts needed on the Moon**, or reassigned to a different usage on the Moon

To this end, we floated the **International Lunar Research Park** concept which has now already begun its **Earth phase on Hawaii Island**. We have also published a series of articles on avoiding “**the outpost trap**”  
**Your turn:** What local, regional, national, international projects can we undertake to help get others aboard and to excite the public in general about integrating the Moon into a larger, more prosperous Earth–Moon economy. What can we do to bit by bit help people to look at the Moon as a waiting frontier whose opening will benefit all of us, generations to come. **Send your ideas to [mmm@moonsociety.org](mailto:mmm@moonsociety.org)**

March **Chapters & Outposts** 2012

**ORGANIZING OUTPOSTS** (one or more members seeking to start a chapter)

**Bay Area Moon Society, CA Outpost – South San Francisco Bay** – <http://www.moonsociety.org/chapters/bams/>

Contact: Henry Cates [hcate2@pacbell.net](mailto:hcate2@pacbell.net) Meeting the 1<sup>st</sup> Tuesday of the Month at Henry’s home

**Moon Society Nashville Outpost** – Contact: Chuck Schlemm - [cschlemm@comcast.net](mailto:cschlemm@comcast.net)

**Moon Society Knoxville Outpost** – Contact: Jason Tuttle – [tuttlepc@gmail.com](mailto:tuttlepc@gmail.com)

**Moon Society Milwaukee Outpost (MSMO)** – [http://www.moonsociety.org/chapters/milwaukee/msmo\\_aboutus.htm](http://www.moonsociety.org/chapters/milwaukee/msmo_aboutus.htm)

Contact: Peter Kokh [kokhmmm@aol.com](mailto:kokhmmm@aol.com) – [http://www.moonsociety.org/chapters/milwaukee/msmo\\_output.htm](http://www.moonsociety.org/chapters/milwaukee/msmo_output.htm)

**ORGANIZED CHAPTERS****Moon Society Phoenix Chapter** - <http://www.msphx.org>

c/o Mike Mackowski [michael.mackowski@gmail.com](mailto:michael.mackowski@gmail.com) Meeting 3rd SATs at Denny's, 4403 S. Rural Road, Tempe  
**Plan for November 18th Meeting:**

"Next Saturday is our monthly meeting date and we will be trying something a little different this time. Last month we only had three people show up at the meeting at Denny's. The same day, the local National Space Society meeting essentially didn't happen because no one showed up at all. So we will try combining the meetings, and alternating locations. Both groups meet on the third Saturday. The NSS chapter was already meeting just every other month. I am proposing that this month, everyone meets at the NSS time & location. On Friday, December 14th, I am inviting everyone to a Christmas party at my home in Gilbert, in lieu of the Saturday meeting(s). That will be the day before the normal Saturday date (which I can't make due to another group's holiday party). Some of us have also talked about mixing in field trips every other month, either instead of or in addition to meetings. In January we would be back at the NSS location for a morning meeting. The next evening meeting at Denny's will be in February.

"The Phoenix NSS meets at Humanist Community Center in Mesa, at 627 W. 8th St (a few blocks west of Country Club) at 10 am. Al Anzaldua, president of the Tucson Space Society and a person very interested in lunar lava tubes, among other topics, will be the guest speaker. Other ideas are welcome, of course but let's see how this works. What we (both groups) are doing now is not working." Mike Mackowski, MS Phoenix – President (acting)

**November 18th Meeting Report:** The meeting was held in conjunction with the meeting of the Phoenix chapter of the National Space Society. Acting president Mike Mackowski is a member of both clubs, and with minimal attendance at each group's most recent meeting, it made sense to try combined gatherings, at least for a while.

Even with that, there were only five attendees, including guest speaker Al Anzaldua from Tucson. Al is also active in both the Moon Society, NSS, and NSS-Tucson and gave an interesting talk on near Earth asteroids.

Planning for upcoming events was another topic of discussion. The January 19 joint meeting will have Dr. Pete Swan talking about the International Space Elevator Consortium. Since traditional meetings don't seem to be very popular (hopefully more specific programming and speakers can help that), ideas were proposed for possible field trips or tours. These included the planetary research labs at both Arizona universities as well as places like Biosphere 2. The group still needs ideas for Yuri's Night. It was announced that the 2013 national convention of the Students for the Exploration and Development of Space (SEDS) will be in Tempe, AZ next November, to be hosted by ASU, providing another good outreach opportunity.

Our webmaster Don Jacques had to cease hosting the clubs website ([msphx.org](http://msphx.org)) on his server for various reasons, but Mike Mackowski got a simpler site back up with most of the original content back by Thanksgiving weekend at the same URL. Mackowski will also host a holiday party on Dec 14 for space exploration supporters.

**Holiday Party, Friday, Dec. 14th 8pm** Please shoot Mike a note if you plan to attend. Let Mike know if there are others to add to the invitation list. Bring a snack or drink to share if you like. Home phone is 480-926-4765 At 1022 W. Juanita Ave, Gilbert AZ 85233, near US60 and Cooper Road. **Next meeting – JAN 19**

**Clear Lake NSS/Moon Society Chapter (Houston)** <http://www.moonsociety.org/chapters/houston/>

Contact: Eric Bowen [eric@streamlinerschedules.com](mailto:eric@streamlinerschedules.com) – Meeting 7 pm in the conference room of the Bay Area Community Center at Clear Lake Park – Odd# months: **Next Meetings JAN 21 – MAR 16**

**November 12th Meeting Report:** The Clear Lake Area chapter held its annual business meeting and election of officers on Monday, November 12. Last year's slate of officers and directors was re-elected unanimously: Eric Bowen as chapter president; Jay Lewchanin as chapter treasurer, and Marianne Dyson and Murray Clark as directors. The position of chapter secretary remains open, and the chapter vice-president position is currently dormant pending more chapter activities. If you are or know of a member who might be willing to fill these positions, we'd love to hear about it.

Chapter member Larry Friesen informed us of his plans to attend the WorldCon science fiction convention in San Antonio over Labor Day weekend (Aug. 29 – Sept. 2) next year. He is willing to be a point of contact and would like to partner with other space enthusiasts for outreach to the larger community. If you're going or know someone who is and would like to participate as well, reply to me and I'll forward him your contact information.

The weekend following our meeting, the National Space Society Board of Directors met in Houston, in the Clear Lake Area. Our chapter helped to sponsor a party and mixer for the board in the home of NSS board member Anita Gale in Nassau Bay. We had homemade barbeque and fixins, supplemented by a banzai run to Red River BBQ when we ran short (we had close to forty people in attendance). We were glad to have this opportunity to show the board members some Texas hospitality and we hope that they will return to the Houston area in the not-too-distant future. Our chapter's next regular meeting will be at 7 p.m. on Monday evening, January 14, 2013. As usual, we will meet in the conference room of the Bay Area Community Center in Clear Lake Park. We hope to see you there! – Eric Bowen

**Greater Fort Worth Space Chapter** Patricia Ferguson [tricia3718@gmail.com](mailto:tricia3718@gmail.com) **Online Meetings: DEC 15, JAN 19**

## GREAT BROWSTNG LNKS

### SPACE STATIONS + COMMERCIAL SPACE

<http://www.space.com/18283-spacex-dragon-capsule-recovery.html>

<http://www.space.com/18378-nasa-space-station-text-messages.html>

<http://www.space.com/18537-soyuz-spacecraft-rare-night-landing.html>

NASA Selects American Small Businesses for Continuation Of Innovative Research and Technology Projects

<http://www.spaceref.com/news/viewpr.html?pid=39174>

Bed rest experiment may suggest ways to deal with effects of weightlessness, and lower gravity

[http://www.esa.int/esaHS/SEMYK072Q8H\\_index\\_0.html](http://www.esa.int/esaHS/SEMYK072Q8H_index_0.html)

### MOON

<http://www.space.com/18276-moon-dark-spot-ocean-storms.html>

<http://www.space.com/18361-linne-crater-moon-nasa-lro.html>

<http://www.space.com/18380-nasa-moon-missions-obama-election.html>

[http://www.space-travel.com/reports/Proof\\_at\\_last\\_Moon\\_was\\_created\\_in\\_giant\\_smashup\\_999.htm](http://www.space-travel.com/reports/Proof_at_last_Moon_was_created_in_giant_smashup_999.htm)

[http://www.space-travel.com/reports/Astrium\\_presents\\_results\\_of\\_its\\_study\\_into\\_automatic\\_landing\\_near\\_the\\_Moons\\_south\\_pole\\_999.html](http://www.space-travel.com/reports/Astrium_presents_results_of_its_study_into_automatic_landing_near_the_Moons_south_pole_999.html)

[http://www.space-travel.com/reports/European\\_mission\\_to\\_search\\_for\\_moon\\_water\\_999.html](http://www.space-travel.com/reports/European_mission_to_search_for_moon_water_999.html)

<http://www.space.com/18549-moon-water-private-spaceflight.html>

\*\*\* NSS Road Map to the Moon: <http://www.nss.org/settlement/roadmap/RoadmapPart4.html#.UKtwlVF5nzi>

### MARS

<http://www.space.com/18286-mars-rover-curiosity-soil-analysis-chemin.html>

<http://www.space.com/18339-mars-methane-alien-life.html>

<http://www.space.com/18333-mars-rover-curiosity-methane-measurements.html>

<http://www.space.com/18546-mars-caves-sample-return-mission.html>

<http://www.space.com/18596-mars-colony-spacex-elon-musk.html> – (story & 3 videos)

Curiosity analyzes Martian soil sample –

[http://www.nasa.gov/home/hqnews/2012/oct/HQ\\_12-383\\_Curiosity\\_CheMin.html](http://www.nasa.gov/home/hqnews/2012/oct/HQ_12-383_Curiosity_CheMin.html)

Curiosity find clues why Mars lost most of its atmosphere

[http://www.nasa.gov/home/hqnews/2012/oct/HQ\\_12-387\\_Mars\\_Atmosphere.html](http://www.nasa.gov/home/hqnews/2012/oct/HQ_12-387_Mars_Atmosphere.html)

Making Mars a Nicer Place <http://www.thespacereview.com/article/2152/1>

### ASTEROIDS

<http://www.space.com/17827-vesta-troughs-asteroid-collision.html>

<http://www.space.com/18326-asteroid-belt-evolution-alien-life.html>

<http://www.space.com/18373-presidential-election-obama-nasa-future.html>

### OTHER PLANETS + MOONS

<http://www.space.com/18272-jupiter-io-volcano-eruptions-pizza-moon.html>

<http://www.space.com/18308-saturn-moon-titan-glow-cassini.html>

<http://www.space.com/18363-venus-express.html>

### ASTRONOMY + ASTROBIOLOGICS

<http://www.space.com/18474-alien-planets-multiple-stars-tilted-orbits.html>

<http://www.space.com/18461-rogue-alien-planet-discovery.html>

<http://spaceref.com/astrobiology/seti-institute-receives-35-million-donation.html>

Asteroid Belts at Just the Right Place, Friendly to Life [www.astrobiology.com/news/viewpr.html?pid=39111](http://www.astrobiology.com/news/viewpr.html?pid=39111)

A “first baby book of names for the billions of planets in our galaxy” – <http://betaclone.uwingu.com/>

## GREAT SPACE VIDEOS

<http://www.space.com/18328-curiosity-x-rays-mars-soil-first-results-video.html>

<http://www.space.com/18375-stars-the-life-and-death-of-stellar-fusion-engines-video.html>

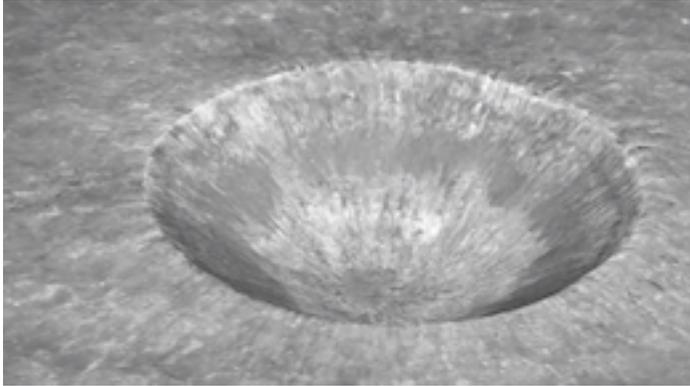
<http://www.space.com/18400-jupiter-s-moons-some-icy-some-volcanic-and-some-larger-than-our-moon-video.html>

<http://www.space.com/18436-curiosity-inhales-mars-gets-carbon-dioxide-buzz-video.html>

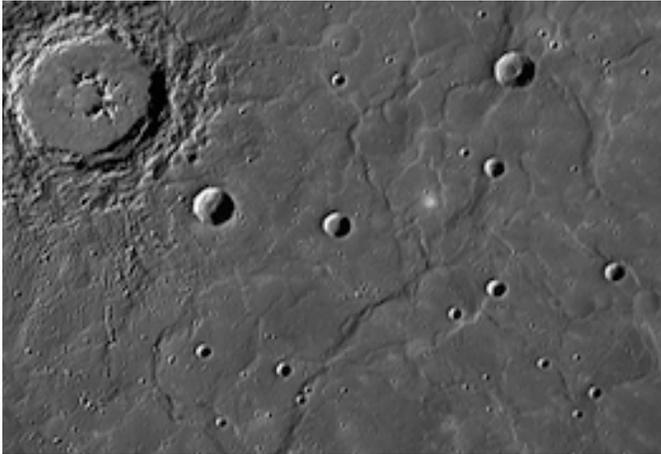
<http://www.space.com/13139-space-fully-reusable-rockets-works.html>

Cassini 15 Years Exploration – [http://www.nasa.gov/multimedia/videogallery/index.html?media\\_id=154837611](http://www.nasa.gov/multimedia/videogallery/index.html?media_id=154837611)

MMM PHOTO GALLERY



L: Linne Crater has its pristine perfect shape – [http://en.wikipedia.org/wiki/Linné\\_\(crater\)](http://en.wikipedia.org/wiki/Linné_(crater)) R: Asteroid Mission



**Left:** This view from NASA's Messenger spacecraft orbiting **Mercury** shows a region of smooth, volcanic plains heavily modified by tectonic “wrinkle ridge” structures, low, sinuous features that form when lavas cool and subside, causing the crust to contract. This area is likely to have many intact sheltering lavatubes. See pages 5–6 above. **Right:** Messenger, looking down over Mercury's North Pole, has confirmed abundant ice deposits.



[From name withheld]

“Latest MMM [#260 p. 8 “NASA/Contractor Throwing Culture vs. Space-X’ Reusability”] triggers a thought---fat cat defense contractors have sold NASA throwaway spacecraft all these decades for one reason--GREED....we all know that throwaway products are cheap in the short run but costly in the long run...anyone who ever had a Dixie cup dispenser knows that...disposables are a trick to make more money off people.....like borrowing so you can have now and pay later...i hate borrowing money and paying back with high interest rates....Quality and long life are more important in any product....So the whole space program has been run like a scam on the taxpayer and you have to wonder about some of the defense systems the gov has bought over the years also....”

What impressed me was the Reusability of the Space X Dragon space craft system....Next the need to parachute back the booster stages and cannibalize the upper stages in orbit and we will essentially have 100% reusability....In the same way that we had envisioned space uses for the Shuttle ETs (space station modules, ship hulls, surface habitat, scrap metal) we must look at space uses for the Falcon rocket upper stages

**Sign up for NASA's new free "Spot the Station" e-mail alerts or text messages**

**Whenever the space station may be visible overhead a few hours before the actual sighting opportunity tailored for an observer's location based on their home country, state and city,**  
<http://spotthestation.nasa.gov/> – <http://www.space.com/18378-nasa-space-station-text-messages.html>



## Marshall Mike Moondust and the Sinister Selenian Subterfuge

[MMM Fiction by George von Mond]

### Chapter IV:

With his engines screaming at a nightmare pitch, Mike took a quick glance at the approaching Moon scape and ran some insane mental calculations. As things stood, his flight was terminal. There was no way he would survive the lithobraking. Or could he?

His fingers dancing over the controls, he adjusted the trajectory as he scanned for just the right...there! Just then, a loud kafump! was heard as much as felt in the spacecraft and his last Merlin engine disintegrated under the impossible demands. Mere seconds remained until his death. His finger poised unbidden over the switch for the damaged #1. "Why not?" he thought grimly. He would die one way or another. As the harsh Lunar landscape rushed toward him he closed his eyes and punched the control.

A cough, sputter and then roar was the response as the last engine kicked in...and then died. Opening his eyes, he watched as the crater loomed ever larger. "Not the glaxis, not the glaxis" he kept repeating as his OMS tweaked the trajectory in their last seconds of service and he tightened his straps ever tighter and triple checked the seals on his suit.

"Not the way I wanted to get into the history books..." he thought as the Lux Lumen smacked into the crater wall and all went black.

Pain!

"That means I'm alive!" he thought through a haze of drugs and malfunctioning body parts before the blackness again consumed him.

"Even my eyeballs hurt", Mike thought, as he struggled to open his eyes against the sharp glare he recognized as hospital lighting. He felt a touch on his hand, and his head throbbed as he looked to the side. There he saw Deputy Diane Selenesdottir standing next to his bed, a concerned look in her eyes. Deep brown eyes that he fell into, and passed out again.

"So what can I move or not?" he asked himself when he awoke some unknown amount of time later. Everything was agony, and he wasn't sure if his big toe was moving or not through the battlefield of pain that was his body. He slowly looked around the room, and saw his CO, Marshall John Murphy, staring down at him.

"You are damned lucky to be alive" he said flatly. "Food is on its way, as I'm sure you're famished."

"I didn't expect to live" Mike replied weakly. "How...?"

"Lunar Search and Rescue scrambled as soon as they heard, and we knew about where you were going to come down. They got to the crash site pretty much immediately, lucky for you. You owe a lot of people a lot of drinks, you know."

"But..." Mike tried to continue.

"Your little maneuver was insane but brilliant at the same time. According to our statisticians it should not have worked, and our analysts have already labeled it the 'Moondust Manoeuvre'" Marshall Murphy replied with a smile. "What they can't figure out is how you came up with the idea of sliding down the side of a crater?"

"Uhhh" replied Mike. "As best I can remember, I had a brief flashback to a judo lesson when I was six, and about how you're supposed to tumble when thrown to disperse the impact energy. For some reason, that translated into 'slide into a bowl'."

"An inelegant solution, but it worked" replied John. "I can tell you the guys at Orbital Outfitters are ecstatic at the way their suit held up in the destruction going on around you when you crashed. They've already got a half-dozen improvements in mind. As for you, Mike, you're a complete mess. The Lux Lumen is totaled, but the engineering boys are

having a field day with the forensics. We should have a new ship ready for you by the time you're climbing out of this bed."

"I can tell you," continued Marshall Murphy, "that the press is clamoring to speak with you. Video of the impact has gone viral, and no one believes that you're actually alive. First on your agenda, though, is food. The boys in the greenhouses have been sending all of their best produce over to the hospital for you, and local chefs are clamoring to have the distinction of preparing your meals, so expect some excellent fare for your recuperation. The nurses over in the physical therapy ward also seem quite anxious to assist you in your road to recovery. You seem to have acquired something of a superhuman aura as a result of your stunt."

"Hunh," replied Mike, "whatever. Did any of the material I brought back from Archaea Mines survive?" "Some of it" replied his CO, "but I don't think you understand how thoroughly you trashed your ship. They're still finding pieces scattered around the crater. Some of the data may yet be recovered, but our CSI guys have been going over what we do have."

"And?" asked Mike?

"Oh, that's where things get really interesting" replied Marshall Murphy. ----- GvM

**What secrets were uncovered from the evidence?** What mysteries await Mike Moondust as he recovers from his crash? And who is Deputy Diane Selenyddottir? **Tune in next time as Marshall Mike Moondust continues to unravel the malevolent machinations of the Sinister Selenian Subterfuge!**

**MISSED PREVIOUS INSTALLMENTS?** The whole series is now online, up to the latest issue at:

<http://www.moonsociety.org/publications/fiction/MMSS.pdf>

### No MMM Newsletter next month

Our schedule is 10 issues a year, with a break in January and July – the editor's burnout prevention breaks, and time to renew and refresh.

MMM returns in February with issue #262



***The Stardust Revolution: The New Story of Our Origin in the Stars*** [link to Amazon.com]

<http://www.thespacereview.com/article/2181/1> [link to Review]

By Jacob Berkowitz, Prometheus Books, 2012, hardcover, 376 pp., illustrated, ISBN 978-1-61614-549-1, US\$27

"Berkowitz argues that we're undergoing a scientific revolution as profound as the Copernican Revolution four centuries ago that shifted the Earth out of the center of the universe and the Darwinian Revolution of the nineteenth century.

"What The Stardust Revolution demonstrates is that those essential building blocks are commonplace, but the real revolution – the discovery of life beyond Earth – is yet to come."

## NSS' 32nd annual International Space Development Conference

**ISDC 2013 – San Diego, California**

**Thursday–Monday, May 23–27th (Memorial Day Weekend)**

***"Global Collaboration in the 21st Century Space"***

**Hyatt Regency La Jolla at Aventine** - (about 15 mi north of downtown San Diego)  
3777 La Jolla Village Drive, San Diego, CA 92122 - Phone: 402-592-6464 / 888-421-1442

Hotel Registration rates start at \$130/night

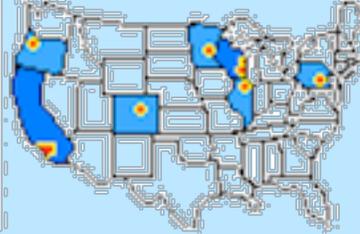
ISDC Registration: [https://www.nss.org/cgi-bin/register/tdregister?\\$Origin=ISDC13](https://www.nss.org/cgi-bin/register/tdregister?$Origin=ISDC13)

(The earlier you register, the less you need to pay)

Best Rate for NSS Members - Students under 22 half price - no senior rate

For past articles by themes, Visit [http://www.moonsociety.org/publications/mmm\\_themes/](http://www.moonsociety.org/publications/mmm_themes/)

## NSS Chapters that share Moon Miners' Manifesto



Space Chapter HUB Webiste: <http://nsschapters.org/hub/>  
Feature Page: Project Menus Unlimited <http://nsschapters.org/hub/projects.htm>

### WISCONSIN



**MLRS – Milwaukee Lunar Reclamation Society**  
PO Box 2101, Milwaukee, WI 53201 – [www.moonsociety.org/chapters/milwaukee/](http://www.moonsociety.org/chapters/milwaukee/)

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

**2012 LRS OFFICERS & BOARD Contact Information**

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TREASURER/Database - • Robert Bialecki (414) 372-9613 - [bobriverwest@yahoo.com](mailto:bobriverwest@yahoo.com)

**NEXT Meetings - JAN 12 - FEB 9 - MAR 9 - APR 13 - MAY 11 - JUN 8 - (JUL-AUG Break) - SEP 14**

- ✓ Our December 8th meeting is our 26th anniversary (we organized in the fall of 1986) and we had a pot-luck pizza event and a 2 pm showing of Iron Moon, a new sci-fi flick about an invasion of Earth by Nazis hiding on the far side of the Moon since 1944. It is also the 26th anniversary for Moon Miners' Manifesto
- ✓ Our January 12th meeting will tackle the schedule for the new year, 2013

### WISCONSIN



**SSS – Sheboygan Space Society**  
728 Center St. Kiel, WI 54042-1034 – [www.sheboyganspacesociety.org](http://www.sheboyganspacesociety.org)

c/o Will Foerster 920-894-2376 (h) – [astrowill@charter.net](mailto:astrowill@charter.net)

SSS Sec. Harald Schenk [hschenk@charter.net](mailto:hschenk@charter.net)

DUES: "SSS" c/o B. P. Knier, 22608 County Line Rd, Elkhart Lake WI 53020

Meetings are at The Stoelting House, 309 Indian Hill, Kiel WI 53042 - 3rd Thurs even # months

**NEXT MEETINGS: FEB 15 - APR 18 - JUN 20 - AUG 17 - OCT 21 - DEC 14 (SAT in Milwaukee)**

### CALIFORNIA



**SSDS – San Diego Space Society**  
8690 Aero Drive, Suite 115, #77, San Diego, CA 92123 – <http://sandiegospace.org>

### COLORADO



**DSS: Denver Space Society fka Front Range L5**  
1 Cerry Hills Farm Drive, Englewood, CO 80133

Eric Boethin 303-781-0800 [eric@boethin.com](mailto:eric@boethin.com) – Monthly Meetings 6:00 PM on 1st Thursdays

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

**NEXT MEETINGS - JAN 2 - FEB 7 - MAR 7 - APR 11 - MAY 9 - JUN 6 - JUL 4 - AUG 1 - SEP 5 - OCT 4**

CALIFORNIA



**OASIS: Organization for the Advancement of Space Industrialization & Settlement**  
**Greater Los Angeles Chapter of the National Space Society**  
PO Box 1231, Redondo Beach, CA 90278

Events Hotline/Answering Machine: 310-364-2290 – Odyssey Ed: Kat Tanaka [odyssey\\_editor@yahoo.com](mailto:odyssey_editor@yahoo.com)  
<http://www.oasis-nss.org/wordpress/> - [oasis@oasis-nss.org](mailto:oasis@oasis-nss.org) – Odyssey Newsletter [www.oasis-nss.org/articles.html](http://www.oasis-nss.org/articles.html)  
Regular Meeting 3 pm 3<sup>rd</sup> SAT monthly – DEC 15 – JAN 19 – FEB 16 – MAR 16 – APR 20

ILLINOIS



**CSFL5: Chicago Space Frontier L5 – 610 West 47th Place, Chicago, IL 60609**

MINNESOTA



**MNSFS: Minnesota Space Frontier Society – <http://www.mnsfs.org>**  
c/o Dave Buth, 433 South 7th St. #1808, Minneapolis, MN 55415  
<http://www.mnsfs.org/2011-Review/>

**The Minnesota National Guard has found an Apollo 11 sample of lunar soil gifted to the state by Richard Nixon.** The rediscovery leaves 11 states (including Wisconsin) which can't find their Apollo souvenir.

The Guard turned the rocks/pebbles/grit/dust over to the MN Historical Society on Wednesday, November 28th. The tiny samples, encased in plastic, were found in a state Building in St. Paul. The search began 10 years ago.

The handoff will take place at an event with students at **STARBASE Minnesota**, a math and science program.  
<http://minnesota.publicradio.org/display/web/2012/11/26/news/moon-rocks-from-apollo-11-found-in-minnesota/>

OREGON



**ORL5 – Oregon L5 Society – <http://www.OregonL5.org>**  
PO Box 86, Oregon City, OR 97045

(LBRT – Oregon Moonbase) [moonbase@comcast.net](mailto:moonbase@comcast.net)

Meetings 3rd Sat. each month at 2 p.m. - Bourne Plaza, 1441 SE 122nd, Portland, downstairs  
Regular Meeting 3 pm 3<sup>rd</sup> SAT monthly – DEC 15 – JAN 19 – FEB 16 – MAR 16 – APR 20

PENNSYLVANIA



**NSS-PASA: NSS Philadelphia Area Space Alliance – 928 Clinton Street, Philadelphia, PA, 19107**  
c/o Earl Bennett, [Earlisat@verizon.net](mailto:Earlisat@verizon.net) - 856/261-8032 (h), 215/698-2600 (w)  
<http://pasa01.tripod.com/> - <http://phillypasa.blogspot.com>

**NSS-PASA Report for November 2012**

Annual Meeting at Liberty One Food Court: **December 8th** 1–3 p.m. This is our officers election meeting. All members and associates should attend. We may have a guest or two at this meeting.

November Fun! In place of our usual meeting, we were part of the Philcon Science Fiction Convention, from 11/8 to 11/10 2012. We had a half table in the Dealers Room, and, Mitch and Earl volunteered for several panels. Mitch has a preference for religion and futurism (a good fit for people who “live in the future”, in their own mind, if not physically) and Earl tends towards the science and engineering side of discussions. Dotty and Larry were both there for the panels, the masquerade (and workshops on how costumes are developed) and the science

*For past articles by themes, Visit [http://www.moonsociety.org/publications/mmm\\_themes/](http://www.moonsociety.org/publications/mmm_themes/)*

talks (and community). Hank Smith was there both to help with operations when he could, and, for his interests in gothic and horror stories and authors. The Con is an event where you can meet the people who create the material you read and can question them directly on why they did something and why they left things out. Wallace from our group, and, Dr Tobias F. Cabral, a friend from the Mars Society, and Frank O'Brien (who is working on his second Apollo era spacecraft book) NSSPASA member where there as part of a number of events.

A good reason to attend a Science Fiction convention is the people you talk to before and after the presentations (One of my friends likes to talk during the talk and that can be distracting and rude to the speakers. Enough said.) with fleshing out, or alternate, points related to the events being discussed. Then there is the mention of something that opens a new vista (literally in this case) on something of interest: Frank talked of an amateur astronomer who was imaging the I.S.S. and put what he saw, with modest, off the shelf, equipment on the Web. It was amazing to see a shuttle docking and astronaut doing a space walk from an on the ground instrument. The Station showed up with some detail visible, the shuttle was just visible, and, the space walker was a moving dot. But this guy had an idea and went out and tried it and you can see the results! Several of us, George, who has a space center in northern New Jersey (astroman\_cd47@yahoo), and Evan, who works on space related software in Exton, Pa., marveled at what was seen and when I get the website, or if Frank would post it to Larry, our webmaster, we can all share this experience. And sharing is another important aspect of going to such an event. George informed us that one of the Philadelphia high schools, Northeast Public High, had a simulated control room, mock ups of an Apollo style capsule, and a shuttle flight deck mock up as well. The school built the building around the hardware. It has been in operation for decades! Did anybody else mention this fantastic operation? No. When time permits, and with school systems' permission, I will try to arrange a tour (or have Dotty and Larry run with this as they are better at it). Right in our back yard.

There where a number of great panels and stand alone presentations, and memorial circles and meetings to commemorate some great authors like Ray Bradbury and Harry Harrison, and our childhood Hero, Neil Armstrong. The Higgs Boson and ongoing research was featured, and the great questions of the cosmos where discussed by people who where researchers and participants in the sciences. And sometimes we get pulled out of our normal speaking fields at these events: Earl served on two very different panels, one hard science, the other historical, this time. The first was on the view of the handicapped and disabled that appears in science fiction (with fellow panelists who are, or have, worked with, the challenged) and the changing vision of robots since they where described as mechanical people at the end of the 19<sup>th</sup> century. Well attended with knowledgeable audiences. Mitch was on The Future of Private Enterprise in Space and had a lot to say on the subject, and, had material to show the audience a number of sources to peruse.

As usual, there where a number of panels we visited, including on Mars and the Moon, and, some we missed due to conflicts. I regret not seeing the comically titled "50 Shades of Grey Goo- Nanotechnology" on the rather serious topic of the possible benefits and dangers of this form of manufacturing technology. Initially, from the panelist request form, there where to be several more panels on manufacturing and the future developments in software and the use of 3D printers, but, there where just too many events scheduled to include them as well. As it was there where few openings for lunch or dinner for our group to gather during due to the number of interesting activities at the Con. Well done Folks! We will volunteer again next year!

Speaking of our meeting: We met Saturday night at the in hotel restaurant with people popping in and out. During our meeting we had two guests: Ozzie Fontecchio and friend (wife?) who joined us to learn more about our group. Oz, as he is called, has been with the P.S.F.S. organization for a number of years and has decide to attend our meeting in December. Excellent! And I will note that Sondra, a friend of Mitch Gordon's, brought her mother to the convention this year.

And finally: Dotty and Larry presented me with material for publication. Some of it, on The Intrepid Museum events, may be held on the pier due to the Sandy storm causing damage on the ship itself. At the Smithsonian: "A Universe of Data: How we get Science out of Space Telescopes" in Washington on December 1<sup>st</sup> (Albert Einstein Planetarium), and " The Mission of the Mars Science Laboratory, Curiosity" on December 15. You have to request stand-by tickets for these presentations. The Maryland Science Center has a large number of family oriented hands on events including the use of its Clark Telescope, that has been recently restored, and sub shows connected with the "Life Beyond Earth" exhibit. And the Goddard Space Flight Center has a number of ongoing indoor exhibits and talks on recent Earth and Space activities (including Curiosity). They also have a virtual tour of the facility. See the sites for more. Dotty also supplied her most recent touring activity in the form of "Dotty's Dimensions: The Column Issue #1, available by contacting Dotty at [dottymk@yahoo.com](mailto:dottymk@yahoo.com). Since this is a compendium of places toured it includes trips from March to July 27 and has both space and general interest material ( Dotty and Larry's interests).

**Last notes:** I have joined a small but significant technical minority: I am now a ham with the call (no jokes please) KD2CYA. Yes I got an easily recognizable call. No, I don,t know if this could be used on a license plate! And: Make magazine has put out a special publication: 3D Printer Buyer's Guide. Which One is Right for You? It has a lot of reviews and things people have created from descriptive files they, or others, have created. \$ 9.99 plus tax. The future of manufacturing ( and in flight repairs?)? – Submitted by Earl Bennett

Moon Miners' MANIFESTO  
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