

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

Moon Miners' Manifesto

& The Moon Society Journal

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Above: Japan's Kaguya Probe Catches Earth in HDTV over Moon's North Pole

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Elevated Monorails vs. Surface Trains

In back to back articles, Chris Carson opens the debate by pointing out the many advantages of elevated trains, especially over the wide temperature range of the lunar dayspan and nightspan. Peter Kokh concedes the point and adds further advantages, but then lists considerations that favor surface rail systems. Upshot? Over time, we'll see both on the Moon. See pages 3-5.

IN FOCUS A Part of the US Section of ISS has been a "National Lab" as of August 14th, '07 - How is it working?

It is now a year and a half since part of the US portion of ISS was set aside for "U.S. Non-Government Entities for Research and Development and Industrial Processing Purposes" and declared to be a "National Lab." In our mind, that was a very important and historic step forward in the integration of ISS into the life and work of the nation. But how is it working? [= > p. 2, col. 2]



Moon Miners' Manifesto

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www.Lunar-Reclamation.org/mmm_classics/

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

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• **The 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, 1620 I Street NW, Suite 615, Washington, DC 20006; Ph: (202) 429-1600 - www.NSS.org

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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:

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⇒ In Focus Editorial continued from p. 1.

Since that announcement, on September 7, 2007 NASA signed a Memorandum of Understanding with the National Institutes of Health on Space-Related Health Research at ISS. On July 23, 2008, NASA signed a Memorandum of Understanding Between the U.S. Department of Agriculture on Space-Related Biological and Environmental Research. And this past December, NASA signed a Non-Reimbursable Space Act Agreement with Ad Astra Rocket Company for Demonstration of the Variable Specific Impulse Magnetoplasma Rocket (VASIMR™) on board the International Space Station.

It is clear that NASA is moving forward with this plan. But did they forget to tell the Department of Energy about this? DOE runs most of the other "National Labs," and as yet their list of 22 labs does not yet include ISS.

www.energy.gov/organization/labs-techcenters.htm

In our opinion, that is a lost opportunity to secure ISS as a functioning part of a larger system, as part of the functional organization that keeps our nation advancing into the future. As it is quite clear from NASA's order to cease using the Shuttle to service ISS, NASA has had its resources reassigned to functions beyond low Earth orbit - i.e., beyond down-looking "yoyo" space.

After NASA's last shuttle mission to ISS to install the final budgeted component, NASA ought, with fanfare, to turn over ISS to the Department of Energy. As part of the ceremony, DOE should christen the US parts of the station to be used as a national lab as "Name_____" National Lab, and put it on its posted list. We don't care whom they name it after, largely because if we did, that would have no effect. But the public effect of this dedication and naming, though subtle, would be positive.

The world "Econosphere" already has a diameter of nearly 50,000 miles, encompassing all of GeoSynchro-nous orbit space. It is time to get the public to realize that near-Earth space, at least a sizable part of it, is an integral part of "The World." As of 2007, \$139 billion worth of business worldwide was conducted via GEO and LEO including a wide variety of things: satellite-to-home and GPS amounting to 50%.

To all this, will soon be added space tourist activities, orbital tourist facilities, point-to-point hyper-sonic flights, and in time Space Based Solar Power, which may well involve the Moon. We will then have an Earth-Moon Econosphere!

PK

LUNAR ENTERPRISES AND DEVELOPMENT

We hope our readers enjoyed our informative lunar series by Dr. Philip R. Harris, serialized in the last five issues of MMM.

To share more of his futuristic thinking, go to the website: www.drphilipharris.com.

Or you may wish to read his latest book, *Space Enterprise - Living and Working Offworld in the 21st Century* (www.springer.com).

His other classics are the novel, *Launch Out* on lunar industrialization (www.buybooksontheweb.com), and *Managing Cultural Differences*, 7th ed.

(www.elsevierdirect.com). His writings are also available on

www.amazon.com/books/philiproberrharris.... Next month our newest series will feature...."

Elevating Lunar Railways Above the Surface

By Christopher D. Carson

I have read with interest the discussion of lunar railroads published in recent MMM issues and on the Google Group: Railroading on the Moon and Mars.

<http://groups.google.com/group/railroading-on-the-moon-and-mars?hl=en>

The idea that, at some stage of lunar settlement, a high-capacity means of transportation for personnel, goods, and raw materials between sites on the lunar surface will become desirable appears a sound one; nevertheless, the significant differences between terrestrial and lunar conditions perhaps make it desirable to deviate from established terrestrial practice more than your contributors have generally proposed.

In particular, I would suggest that some form of elevated carriageway is desirable. Firstly, the lunar surface is very uneven, and that unevenness is distributed very differently from the unevenness of the terrestrial surface, having been (in the main) produced by very different processes.

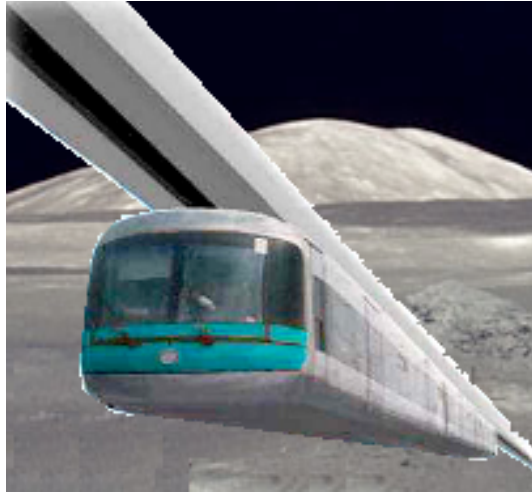
Considering the low lunar gravity, which increases the allowable unsupported span length, the operational problem of erecting a suitable support structure which is only in contact with the ground at intervals may well be less than that of grading and blasting hundreds of kilometers of right-of-way across cratered terrain.

[Ed. for passengers and tourists, elevated systems will provide a better view, over a more pristine landscape.]

Advantages: dust control and thermal management

Secondly, elevating the carriageway introduces at least two major advantages, with respect to dust and to thermal management. The lunar surface is dusty, and a passing train can be expected both to disturb the existing surface dust by its vibrations and to generate new dust by mechanical breakdown of the ballast. This dust will tend to foul rotational joints such as wheel bearings. As the rate of dust collection on a surface can be expected to decrease rapidly as that surface is elevated above ground level, and no definite requirement for a ballasted roadbed appears in an elevated system, this problem can be reduced significantly. Again, although the soil is a relatively good thermal insulator, a ballasted rail system laid across the surface will tend to approach the surface temperature.

The diurnal variation in temperature, especially in low latitudes, is large in comparison to terrestrial norms, and issues related to thermal expansion (already significant in terrestrial experience) are correspondingly magnified. Conductive heat transfer can probably be limited to a much smaller value in an elevated system than in a ground-level system, and if the surfaces of the carriageway are mostly metallic (polished where possible), their low emissivity will limit radiative transfer as well. The use of electrical heating at night, and passive or thermoelectric-assisted radiative cooling during the



day, will permit maintaining the carriageway close to a constant temperature without impairing its mechanical properties (unlike keeping it heated constantly to its peak daytime temperature).

There are two general arrangements that are especially suitable to elevation, namely the monorail and the cableway. Either would permit high angles of bank, as required for stability in sharp turns under low gravity. The underslung monorail, having pendulum stability, is arguably preferable to the superincumbent type but either can exhibit

more lateral stability than the ordinary railway, if constructed with the wheels or rollers necessary to apply moment reactions against a rail in the form e.g. of a box girder.

Of course, under lunar gravity the permissible column length will be extended considerably, so that an elevated carriageway will not need to follow the terrain elevation as closely as a surface carriageway, and curves can in general be made much shallower. While a lunar cableway can probably be built for much heavier traffic than its terrestrial counterparts usually see, it will tend to have greater frictional losses than a rail system (due to the cable working against wheels or skids at each support), and the cable will require frequent inspection and renewal against the danger of abrasion by trapped dust grains. For most purposes, therefore, the monorail will probably prove superior.

Powering the system

As an alternative to the usual mechanical type of railway, the magnetic-levitation carriageway also deserves consideration. In particular, the "passive" maglev guideway, which need be little more than an aluminum trough, would be relatively simple to fabricate and install. This throws the burden of support and propulsion upon the train, but the one can be provided using rare-earth magnets in the car structure, and the other by a linear induction motor, probably in the foremost (for driving) and rearmost (for braking) cars, although in practice all cars would probably be motor-equipped to ease the problems of train assembly.

As with all forms of lunar transport, power will have to be supplied either internally, from batteries or some form of generator, or externally from a feed. The external supply in all cases may be a cable energized with single-phase alternating current and tapped by pantograph, although the return will largely be by way of the rail rather than the ground as in terrestrial applications. (Capacitive coupling between the car and the guideway makes this possible for the maglev.) For the maglev, as frictional losses are small, propulsion is ordinarily required only intermittently, which in principle would permit power pickups (fed, perhaps, by spot beams from a power satellite) to be located at intervals, eliminating the need for a continuous cable. Safety and other considerations, however, probably render this a questionable economy.

In general, human nature remains the same, and the generic problems of living are the same in Luna as in Terra ; but by as much as conditions differ on the two planets, so much will our solutions need to differ. Keeping sight of these principles, if we apply imagination and good engineering sense, we should be able, not only to survive, but to thrive.

Christopher D. Carson

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

Lunar Railways: Surface & Elevated

By Peter Kokh

In the above article, Chris Carson lays out a number of considerations that arguably favor an elevated approach to lunar railways. But he himself says that he is looking at "some (future) stage of lunar settlement, (when) a high-capacity means of transportation for personnel, goods, and raw materials between sites on the lunar surface will become desirable."

Lunar Railroads not as a later development, but as an early means of settlement expansion

David Dunlop and I, believe that railroads should be part and parcel of lunar settlement expansion from day one. If there is a central spaceport feeding a growing beachhead of habitation, commerce, and industry, a rail system will be the easiest way to move heavy modules around. The chosen location, unless we are insane, is likely to be a level one (*oops! I guess that leaves out the Shakedown rim!*) and laying rail beds should be fairly straightforward.

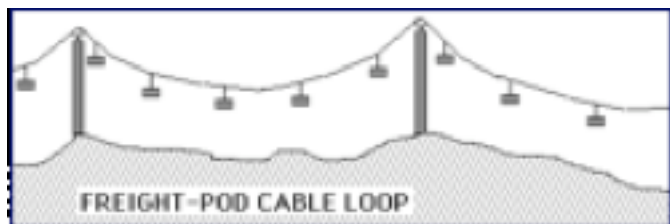
If our initial site is in a lunar mare basaltic plain, expansion to new settlement locations by rail will be easy as well. There are, of course, some mare features that pose problems: wrinkle ridges and rilles. The forme will need to be cut or tunneled through, the latter to be bridged or detoured altogether. But in general the near-side mare-plex is relatively flat. Elevation changes are of low grade.

Beyond the Flats

Where railroad routing will pose a challenge is in the cratered highlands. I say "pose a challenge" because mid-nineteenth century railroad engineers managed to conquer the Rockies and, in Europe, the Alps.

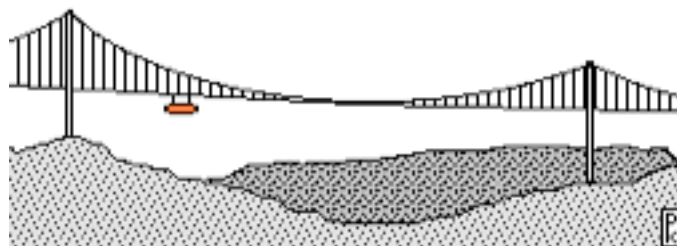
Still, there are clearly cases where elevated rail systems are more desirable, for example through very scenic and geologically special terrain that we will want to disturb as little as possible.

In situations like this, especially with railways designed principally to cater to the tourist trade, elevated monorail systems may not be the initial choice. Cableways, with cars descending and rising between the cable towers might be less expensive to build.



As population and tourist traffic grows, a suspension cable systems in which cars ride a horizontal cable suspended from a tower hung cable much like the

roadway of as suspension bridge, might be a welcome upgrade even though it would be more expensive, requiring more steel.



Rights of Way: expensive on Earth, free on the Moon

Elevated monorails and maglevs, as opposed to cableways, will be built when high speed passenger traffic grows in volume. Today, these systems are still too expensive, because they need all new road beds and rights of way, which tilts economic decisions in favor of high speed trains on traditional tracks along established rights of way. On the Moon, securing new rights of way will not be a problem, and decisions will be made on other grounds.

Terrain stability and "moonquakes"

Another consideration may come into play: one thing that we did not realize until sometime after the Apollo period is that some areas of the lunar surface are subject to "moonquakes." These events are analogous but different from "earthquakes." On the Moon, quake epicenters lie very much deeper below the surface, and the quake lasts not seconds, not just a few minutes but for periods as long as an hour or more. While on the Richter scale, these events are of mid-range, c. 5.0 at most, the damage that they can cause because of the duration, could be very serious. Now we don't really know. On Earth, the greatest damage is where the ground is soft, wet, or fluid in the first place. On the Moon, the surface is compacted regolith over fractured bedrock almost everywhere. We will be learning some hard lessons from experience.

While on Earth, quakes are caused by the build-up of tectonic stress, on the Moon, where there is no such thing as plate tectonics, the cause seems to be in instabilities very deep inside the Moon.

Now to our present knowledge these quakes are much more common in some areas than in others. In many areas, concrete maglev roadbeds suspended on pylons may have an indefinite problem-free lifetime. In other areas, surface systems may be more prudent.

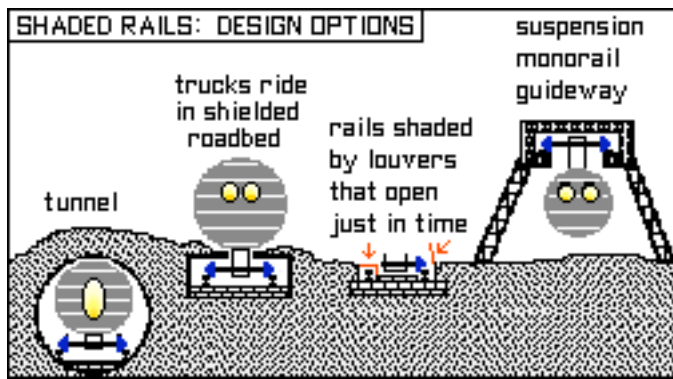
Expansion / contraction with heat / cold

Chris brings up the problem of thermal expansion and contraction of rails exposed to the lunar heavens. This is a problem that we recognized early on in our 1993 paper, "Railroading on the Moonn."

http://www.lunar-reclamation.org/papers/rr_moon.htm

In this paper we discussed various ways of shielding the rails from direct sunlight:

- Putting them underground, in tunnels.
- Using a suspension system that allows the trucks or bogies to ride on rails in a shaded box,
- Putting each rail in a box covered with shutters that swing aside just in time, and
- Suspending cars from an inverted box beam supported by pylons, much as Carson suggests.



Over time, even the two “shaded” ground systems would absorb enough light by radiation from other surfaces. That is also a design problem.

Economics

On the Moon there will be an ever changing equation which will indicate which way to go. Into this equation we put the current cost of producing the various structural elements needed:

- Sections of steel rails
- Rail ties of concrete or some other stable material.
- Pylons for elevated systems
- Concrete maglev guideway sections
- Superconducting guideway elements
- Construction equipment for surface roadbeds
- Construction equipment for erecting pylons
- Cable
- Cable towers
- Construction equipment for erecting towers

Evolving local industry

The system that is cheapest and the cost ranking of the above elements will be constantly changing as we expand from a first outpost beachhead into an initial settlement and then to outlying settlements. Expansion will be driven by the constantly shifting economic and resource advantages of diverse locations.

So what comes first? Initial industries or imported components? The classical chicken or egg dilemma derives its mystery from overlooking the rooster’s role. There has to be a pump primer, and Dunlop and I are convinced that the first elements of a railway system must be reused parts of lunar landers and cargo holds, designed specifically with such reuse in mind. That makes them “stowaway imports” if you will, their cost being absorbed as part of the cost of the lander. We have written before of this trick of thinking outside the mass fraction box by simply finding a way to count everything arriving on the Moon as payload. We do that by presdesigning everything needed to take the “listed payload” to a safe landing on the Moon, for subsequent reuse on the Moon. For example, the lower platform of the lander, to which the landers legs are attached, could be designed for a second, longer lifetime as a four-wheeled overhead crane.

What industrial products come first will depend in part on where the site is located. A site along a mare-highland coast with access to both suites of regolith, will have some advantage when it comes to industrial diversity. To those who think only in terms of iron and aluminum. That advantage is nil. That is self-limited thinking, the kind that will get us started only to putter out prematurely. The “easiest” place to start may not be the best place to start. We need a long-range view.

The most important thing to keep in mind, that the most important role of lunar railroads, will be, as on Earth, carrying freight and raw materials. At first these systems will carry people too. In time, along heavily traveled passenger routes, dedicated high speed luxury systems will be built. The pioneers will need both just as we do.

It will make sense, for example, to place a plant that manufactures pressurized modules for habitat and activity use, for school, office and commercial use, for pressurized walkways and roadways in one central settlement, and to carry them by rail to where they will be used. These modules will be what we’d call “oversized,” Seriously so. But on a world where right of way acquisition will be easy and cheap, there is no reason not to build rail systems with generously wide track gauges.

Without such a rail factory to market system, every little settlement would have to build its own modules. One result would be much less diversity in module types, leading to cookie cutter towns and neighborhoods. Only this kind of railway, serving three kinds of needs can build the kind of frontier we’d want to live on.

Iron rails and cables

Iron is available everywhere. Finding alloy ingredients to turn it into a serviceable iron or even steel will be a challenge because the usual stable of alloy ingredients are not abundant enough on the Moon, in either highlands or the maria (although the titanium rich mare areas confer an advantage) and we have a lot of “path-not-taken metallurgical research to do. So far, no one seems to be looking at this. We have been sounding this trumpet for two decades. There are sure to be new lunar-producible alloys that will have a market on Earth, justification enough for a “spin-up” R&D effort.

So when it comes to cables as well as rails, rail car trucks or bogies, and many other railroad needs, we are back at square one having to start from scratch to build a stable of serviceable alloys using only elements that can be economically produced on the Moon.

Concrete ties, guideways, and pylons

So can we build concrete railway ties? Can we build concrete maglev guideways, concrete pylons? Research by T.D. Lin over the past two decades seemed to have demonstrated that concrete twice as strong as the common variety in greatest use could be made from highland regolith. Now suddenly there is doubt about this, as the work of others leads to the suspicion that Lin overlooked the fact that curing concrete sucks a lot of carbon dioxide out of the air. On the Moon that would be a problem. Carbon is too precious on the Moon, needed for food production and other biosphere needs, to allow it to be sucked up by curing concrete, no matter how useful that concrete may be. There is magnesium-based concrete but here on Earth, its uses are limited by its properties. The vast bulk of the building material research that needs to be done has as yet received very little attention outside of the pages of MMM. PK



Investigation of Iron Mine Tailings as a Lunar Regolith Analog Material

A Project of the CMC Moon Society Campus Chapter

By David Dunlop dunlop712@yahoo.com
And Dan Hawk hawkd_0212@menominee.edu

Sustainable Development Institute,
College of the Menominee Nation–Green Bay

The limited amount of lunar material available for research purposes makes the use of analog materials necessary especially when large volumes of material are required. Of course lunar regolith has many unique properties which make exactitude in replication impossible from source rocks on Earth.

Some Characteristics of Lunar Regolith

Lunar regolith has never been subjected to air and water weathering, and so the fragmented particles are quite jagged through the entire size scale. This makes the mechanical handling properties different than bulk rocky materials familiar from terrestrial mining and industrial handling. A large fraction of the volume of the lunar regolith is comprised of a glassy fraction resulting from shock melting from in falling meteorites. Many small particles of glass and glassy agglomerates of melted glass fused with melted rock particles with Lunar regolith is also comprised of variegated particles which is literally “far flung” from of the point of collection due again to meteor impacts at all scales.

Lunar regolith has been subjected to comminution from minute meteorites, which produce “zap pits” in very small particles, and which excavates and shock melts and distributes deposits on adjacent particles. This deposition of splashed materials of ferrous content on surrounding particles results in regolith particles having a layering of nanophase iron composition. This makes regolith particles susceptible to attraction by a magnet. Lunar regolith will jump toward a magnet which is moved adjacent to a test tube containing a sample. Regolith is also couples very efficiently with microwave radiation and can be heated very rapidly in a microwave oven.

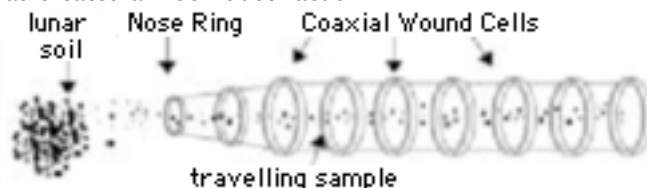
The fact that 80% of the volume of lunar regolith is less than 1 micron in diameter makes these particles easily air borne. Transport of this extremely fine grained material makes facilitates ingestion of these “nano-pollution” particles into the lungs where exposure to the humid tissue can induce chemical reactions. The deposition of these jagged on the skin and eyes also makes irritation a significant risk for astro-naughts.

The pervasiveness of these highly abrasive particles also risk compromise of working surfaces of machinery, and the materials of space suits worn by the astronauts can be quickly degraded. This dark gray material covered the Apollo space suits and was easily transported into the Lunar Excursion Modules by the astronauts from where it went everywhere.

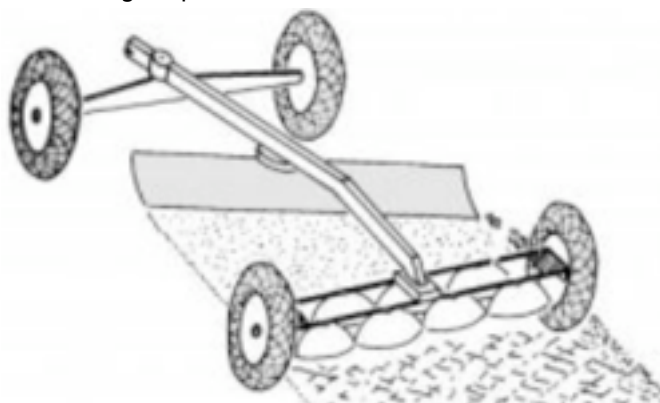
As our understanding of the properties of lunar regolith has increased its appreciation as “nasty stuff” remains undiminished. Human ambitions to return to the Moon therefore inevitably collide with the realities of dealing in an environment where this material is both everywhere and pervasive. –

Yet this prognosis only holds so long as we have not developed methods to domesticate or tame moon dust by using its own properties. Lawrence Taylor of the University of Tennessee in Knoxville, has made use of the

fact that all samples of moon dust contain nanophase iron to fuse samples of it into glassy slag simply by putting the stuff in a common microwave iron. Using the magnetic properties of this ubiquitous iron portion, he has created a moon dust vacuum.



He also envisions a lunar paver fitted with microwave generators that could sinter, or melt, lunar soils into landing strips or roads.



Various Lunar Simulants

A renewed interest in the utilization of lunar simulant materials for a variety of purposes has resulted in the production of these materials by a number of different companies and groups. NASA has contracted for the commercial production of a lunar Stimulant JSC-1 by Orbitec, of Madison, Wisconsin. NASA has sponsored a Centennial Challenge Contest with a \$ 750,000 prize as of 2009 in order to induce university engineering teams to construct efficient equipment capable of operating on, excavating, and moving volumes of JSC-1 as a simulation of moving this material on the lunar surface.

In the 1990s, Dr. Paul Weiblen of the University of Minnesota developed Minnesota Lunar Simulant, MLS-1 which used titanium-enriched basalt mined from a quarry in Duluth and pulverized the rock into a mix of sizes comparable to moon dust, then processed the particles in free fall through a 6,000 degree F plasma reactor to produce small thermally shock melted glass spherules and glassy agglomerate. Another group at U. New Brunswick has produced a simulant of lunar highland rock. Japanese scientists have also produced a number of lunar simulant formulations.

A serendipitous encounter

Dan Hawk and I noticed dark mine tailing deposits at the Groveland Mine near Feltch, Michigan 20-some miles north of Iron Mountain in Michigan's Upper Peninsula where we were attending an educational high power rocket launch event. We collected several 5-gallon buckets out of curiosity about the characteristics of this coal black material. Now this material had more than likely been exposed to weathering in Michigan's harsh winter climate for over 30 years since the closure of the mine. In digging out this material, we had noticed its extremely fine grained nature instantly adhered to hands, shoes, gloves and skin and we were quickly covered with this material. A 5-gallon bucket of mine tailings is no

easy task to transport and collecting 6 buckets produced noticeable difference handling of the Honda Civic were using for out trip to the UP.



We wanted to investigate this material and to compare its use with that of JSC-1 for purposes of plant growth. We noticed that the tailing fields near the Groveland Mine are mostly covered in grasses and that trees had not reestablished themselves in much of the more than 1 square mile area of the tailings terrain after a period over 30 years since the mine closing. The lack of large trees makes this site one of the few favorable locations or recovery and retrieval of amateur sport rockets.

Plant responses: Radish seeds planted in the dense iron particles sprout and support young shots but do not survive longer than about two weeks. Those planted along the side of a clay pot seemed to do a little better as well as those where the iron tailings were mixed with small rock particles. In all cases however it appeared that the small plants could not establish their roots in this dense material. Watering the plants several times during the two weeks further compacted the fined grained.

Additional Questions

Plant Growth medium and substrate for plant growth

We are interested to see what type of soil amendments may improve the potential for plant growth in the mine tailings. At this point in our investigation we are uncertain whether the physical characteristics of the iron tailing are the primary reason for plant failure, or whether this is caused by a lack of plant nutrient in the materials. Possibly there are components of the tailing that are toxic to these radish plants.

Magnetic properties investigations and questions

We were interested in the magnetic properties of this material and placed small bar magnets in the surface of the tailings in pots where plants were growing to see if there might be some response to the magnetic fields surrounding the plants. None of the plants growing adjacent to the magnets survived. We are not sure why.

There may be several reasons. (1) The density of the material. (2) Elements of the material that are toxic to plant growth. (3) Insufficient macro and micro nutrients

to support plant growth. (4) the effects of the magnetics on the soil surrounding the small plants may have interfered with the CEC cation exchange capacity.

We did notice that the tailings surrounding the small magnets seem to show conformance to magnetic force lines and showed a linear layered patterning.

The fine tailing also clumps and forms small magnetic chains attached to the head of the small magnets. We wonder how these fine-grained particles would perform in comparison to the actual nanophase iron of genuine regolith particles coupling to microwaves. We intend to explore this as another area of investigation. We wonder if the fine grained material might provide a test of magnetically-based air filters, magnetic surface cleaning devices, and transport of magnetic particles by devices designed and produced by Dr. Taylor.

The work of Dr. H. Kawamoto of Japan in creating self cleaning surfaces might also utilize these materials to test his technology which has emerged his work on engineering xerox copiers with electrostatic materials.

One might also wonder if this material might be used as a component of a feedstock by "Fab machines", stereo lithographic printing machines used to build up solid forms.

Cement/Concrete formulation

Another area for exploration is the use of these tailing in combination with commercial cement materials to determine how effective this material might be in concrete construction. In short, there seem to many avenues of experimentation.

We are attempting to find information from existing sources on the chemical and mineralogical composition of these tailing in the hopes that this information has already been determined, as our budget for independent testing is limited.

Potential uses as a lunar regolith analog

Now there may be some useful comparisons of this material with lunar simulants already characterized. This material may offer a relatively inexpensive analog of lunar regolith useful for certain limited purposes. It is also worthwhile to experiment with this material to see if there are some useful products that might be developed from these tailings. There are numerous sites in the Upper Peninsula of Michigan and in Minnesota where iron taconite mines can be found. Are there other economic uses for this material? We are aware that in Minnesota certain western locations have supported road paving utilization, but concerns about the hazards of asbestos of eastern Minnesota mines has limited this application. Similar questions exist about asbestos in association with irons formation in Iron and Dickinson Counties in Michigan's Upper Peninsula and we have requested information from Michigan's DNR in this regard.

Summary: Our serendipitous discovery and acquisition of iron tailing at an upper peninsula mine site has made us curious about its properties and if in some regards it might serve as an accessible and inexpensive analog material for lunar engineering simulations for:

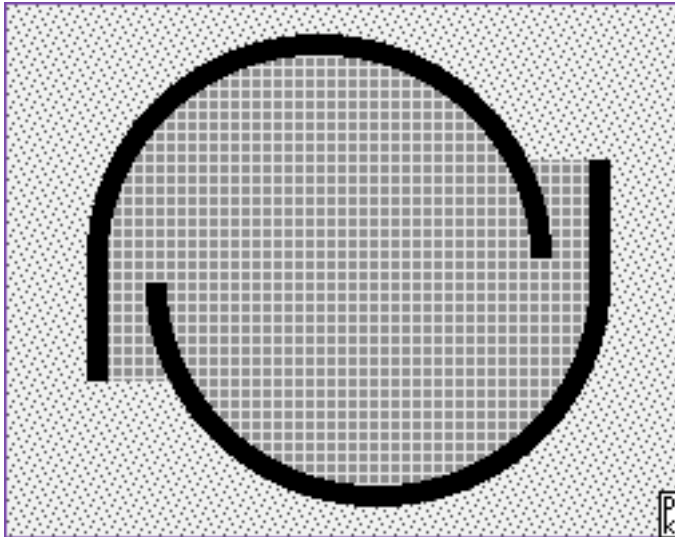
- In situ utilization technologies,
- Plant growth in evolving lunar soils or on its own
- Establishment of an economic way of "reforesting" lands barren due to a mine tailings overburden.
- As a means of carbon sequestration.
- Finding economic utilization for it in manufacturing and construction

<DAD>

Berming Lunar Spaceports to Contain Abrasive Rocket Exhaust Splashout

By Peter Kokh kokhmmm@aol.com

A major concern that has arisen that will affect how we locate moon bases, outposts, or settlements with relation to the spaceport(s) that serve them, is the abrasive spray of moondust that spreads out in all directions parallel to the surface from descending or ascending rockets engines. The effects of the Apollo 12 lander, *Intrepid*, on Surveyor 3 just 600 ft away, while not damaging, were an indication of the problem. Larger rockets landing and taking off more frequently could adversely affect various installations. We wrote about this in MMM #214, April 2008, p. 8, suggesting a bermed spacepad, with a fused or tiled surface, and protected exits.



Natural features as barriers: Craters?

To most readers, putting a spacepad in a nearby crater of the right size seems the obvious solution. But there are several problems with this. Craters smaller than several kilometers in diameter have bowl-shaped floors, not flat ones. And if the floors were flattened after a lot of work, you would still be faced with having to carve or tunnel a way out of them. The exits would be sloping as crater floors are lower in elevation than the surrounding area. Another problem is that the area surrounding a crater rim is often rugged with boulder-sized splash-out.

Mare wrinkle ridges

In many maria, we find **wrinkle ridges**.

A **wrinkle ridge** (Latin designation **dorsum**, plural **dorsa**) is a common feature in lunar maria. They are low, sometimes winding ridges formed on the mare surface that can extend for up to several hundred kilometers. Wrinkle ridges are tectonic features created when the basaltic lava first cooled and contracted. – *condensed from Wikipedia entry*

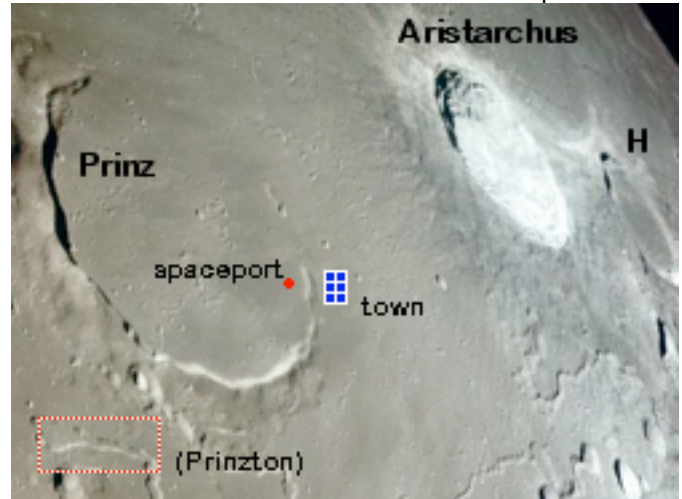


In the photo at left we see both a sinuous rille (left) a remnant of a collapsed lavatube, and a segment of a wrinkle ridge to the right of the rille. We could place a spaceport and outpost to either side of a wrinkle ridge near its terminus, for easy access around the end from the

pad or spaceport to outpost or settlement, and vice versa.

“Reefs” (suggested Latin *saxum*, *saxa*)

This is not a selenographic term in common use, but it should be. Throughout many maria where the lava flooding is shallow (one episode of flooding rather than several, one atop the other) craters on the original impact basin floor from impacts after the basin was formed but before lava flooding began, are commonly only partially buried. Mare Smythii on the Moon's Eastern Limb is a good example, but such features occur in most maria in lesser abundance. The Crater Prinz is an example.

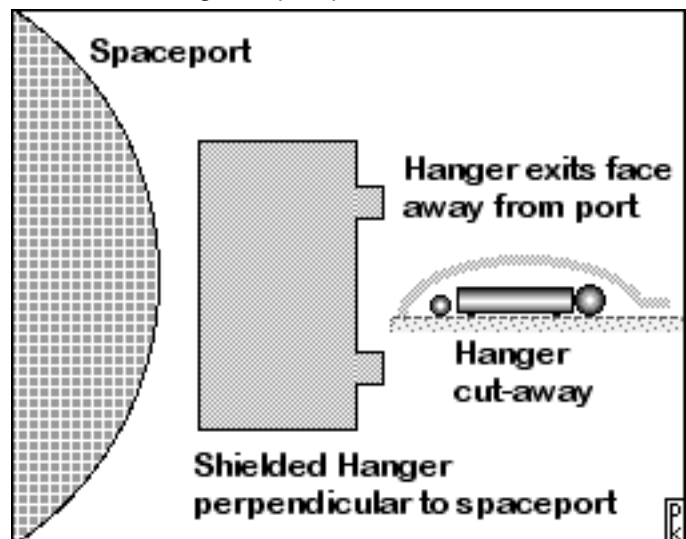


For sense of scale the diameters of Prinz (left), Aristarchus (right) and Herodotus (H)(far right) are 46, 40, and 35 km respectively. Prinz' rim is completely buried in part, and this provides an opportunity to place a spaceport and a settlement on either side of one end of the projecting crater rim fragment. We've outlined the location for our 1989 “Prinzton” lunar rille-bottom settlement, runner-up in the NSS design contest. See:

www.lunar-reclamation.org/papers/rille_paper1.htm

A better idea, design settlement to absorb splashout

The settlement itself can be built under shielded hangers perpendicular to the line of exhaust blast. The use of hangers instead of direct shielding of each module allows easy access to module surface service ports as well as ease of adding additional modules or even of rearranging them. The hanger *is* the buffer, exit is in the direction away from the space pad or spaceport. This allows indefinite growth of the settlement in all directions even surrounding the spaceport on all sides. – <PK>





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 individuals and organizations which have contributed to the advancement of the exploration, research, development, and habitation of the Moon, as well as scientific and technological developments related thereto.

Our Vision says Who We Are

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

Moon Society Mission

Our Mission is to inspire and involve people everywhere, 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: Charles F. Radley, Society Vice-president\

Input to the Obama Transition Team

From Peter Kokh

The Management Council, mindful that different members have different ideas about how the nation's space program could be better run and better targeted, has not as yet officially endorsed the position paper put together by Director of Project Development **David A. Dunlop**. We have, however, urged him to send it on to the Transition Team!

Dave's paper is extremely comprehensive and commands considerable respect for all the work put into it. We urge our members to look at Dave's idea of how US Space programs and initiatives could be reorganized to better lead to the open civilian frontier and Earth-Moon Economy to which the Society pledges its efforts. Dave's recommendations are nothing short of revolutionary.

www.moonsociety.org/whitepapers/3rd-generation-space.html

The Moon Society has endorsed the Space Renaissance Initiative

<http://www.facebook.com/group.php?gid=47570694477>

This is an effort to get people around the globe behind a vision that solutions to many terrestrial problems may be found in space; our message, precisely!

The 2008 Questionnaire

if you haven't sent in the Questionnaire (How and where did you first hear of The Moon Society) please take a few moments to do so. Those of you who receive a hard copy of Moon Miners' Manifesto should have found it in the centerfold of the December 2008 issue.

You can download the questionnaire here:

www.moonsociety.org/register/Questionnaire2008.pdf

We have gone through the trouble of composing this questionnaire and sending it to current and past members as well as to other subscribers to MMM, in the expectation that the results will help us aim our outreach efforts more efficiently. At stake is continued strong growth. The larger and more talented our membership grows, the more exciting and numerous the projects that we can undertake. That benefits you!

Completed questionnaires should be sent to:
Moon Society, PO Box 080395, Milwaukee, WI 53208

Keep up with what the Society is doing!

Read the online **monthly Frontlines report**.

You will find the (bold yellow) link on our home page!

TOWN MEETING - WED FEB 11th

ASI-MOO 9-11 ET, 8-10 CT, 7-9 MT, 6-8 PT

INSTRUCTIONS FOR ATTENDING

Same as at:

www.moonsociety.org/reports/1st_annual_meeting.html

www.moonsociety.org

Should our Website be more Interactive?

From Peter Kokh

We have received several well-intended suggestions to that effect. We *have* done something about it! **Actually**, we offer plenty of opportunity for interaction, not on our main site but on several auxiliary sites.

Did you know that the Moon Society has an established and well developed presence on:

- ❑ **MySpace**
http://www.myspace.com/moon_society
- ❑ **Facebook**
www.facebook.com/group.php?gid=6457556893
- ❑ **Orkut**
www.orkut.com/Main#Community.aspx?cmm=50862236
- ❑ **Twitter**
<http://twitter.com/moonsociety>
- ❑ **Yahoo Groups**
<http://tech.groups.yahoo.com/group/moonsociety/?yguid=35944282>
- ❑ **Moon Society Forum**
<http://moonocietyforum.com/phpBB3/index.php>

More opportunity for interaction on our Project Teams

<http://www.moonsociety.org/projects/projectteams/>

The Moon Society now has 10 Project Teams that are working on step by step projects with finite goals in ten comprehensive areas. Some of these Project Teams now have new locations on the Moon Society Forum where one can post comments and give input.

<http://moonocietyforum.com/phpBB3/viewforum.php?f=20>

- LUNAX – Lunar National Agricultural Experiment
- Space and the Environment
- SPS – Lunar Materials
- Lunar Surface Logistics
- Lunar Analog Research Team

While some of the interactive sites listed above are more for social interaction, these Project Teams have serious roll-up-your-sleeves and rev-up-your-brain-juices-and-get-busy work to do. Give them a look! Each of these Project Teams is looking for more help.

Is Community Action Your Thing?

Take a look at our Chapter and Outpost map.

www.moonsociety.org/chapters/chapter_outpost_map.html

Some of our chapters are very active, others could use a shot in the arm. If there is no Moon Society chapter or outpost in your area, but you are near one of our NSS partner chapters (red dot) why not hook up with them. If you are all alone, why not start an outpost? chapters-coordinator@moonsociety.org

Our Website is Evolving

We are rethinking our website and it will begin to look less static in the near future. But a static appearance belies the facts. Whether you have found a way that suits your interests and pushes your buttons or not, we are a busy society, and have ambitions to become much more so. Our goals are too important to rest with giving them mention and waiting for someone else to advance the day when our reality begins to catch up with our vision.

Do explore our website. There is a lot on it, and many complaints come from those who have given it a very quick superficial glance. <MSJ>

Our Blog comes to Life!

Welcome new guest blogger Darnell Clayton!

www.moonsociety.org/blog/

At the Jan. 21st Management Council meeting, it was decided to do something with our blog. This blog was created to handle daily news from our simulation crew at the Mars Desert Research Station, Feb 26–Mar 11, 2006.

After the simulation was over, I tried to keep it going and for a time I was posting 2–5 times a month. Even that pace is insufficient to keep blog watchers interested. In between there has, I believe, been one post by Charles Radley and another by James Rogers.

In response to this decision, we added **Bloggers** to the list of positions for which we needed volunteers on our volunteering page, and added a job description well-crafted by James Rogers.

“There are always new and exciting developments and activities taking place within the Moon Society and within the scientific, academic, and space communities.

“Bloggers are needed to post news and information about Society activities and external developments pertinent to the Moon and the goal of creating a space faring civilization.

“Area of interest would be entirely up to the blogger, with approval from a designated coordinator, and quotas/deadlines are non-existent.

“If you would like to blog about your Moon Society activities and other Lunar developments that you enjoy, we would be happy to host your work.”

On January 23rd, we posted a blog, “Calling all Bloggers” and had a quick response.

Darnell Clayton has been blogging for some time at www.colonlyworlds.com. Both James Rogers and I have been subscribed to his blog for quite a while. His posts are original, thought provoking, and just right for readers used to the article fare of Moon Miners’ Manifesto.

We welcome additional bloggers. Darnell is a great addition to the team, and has already made his first post on our blog, “Keeping Your Moon Base Dust Free (Without Hiring Martha Stewart)” on January 28th.

It is likely that given the long intervals between fresh posts in the past few years, that many members are not in the habit of checking our blog. One of the things we have discussed doing, as blog posts become more frequent, is to put the current space news on its own page and use this lower central portion of our homepage to mirror the current blog(s).

This discussion is part of a larger effort to keep refreshing our homepage so that visitors can more easily find what they are looking for, and that goes for members too, especially members looking to get involved in one or more of the many directions the Society is taking an initiative.

This is your society! Do feel free to send us input on this or any other question. You paid dues and we want to give you *more* than your money’s worth!

Email kokhmmm@aol.com or president@moonsociety.org

Mail: The Program Services PO Box see page 12

Phone: 1–888–266–2385 (Peter) 7 am – 10 pm CT

The Moon Society Journal - Free Enterprise on the Moon

Something New: Recognition for our Renewing Members

As of January 1st, 2009, we have begun mailing our "**Certificates of Continuing Membership**" to all who renew for the first time. But not to leave out those who have already renewed for the first time last year or many years ago, we are mailing these certificates to everyone who renews this year. Next year we will mail them only to those who joined us in 2009 and so on, in years hence.

We do appreciate that you have decided to renew and have thereby given us a vote of confidence. We will keep looking for more ways to earn it.

If something is wrong with your membership, your username and password doesn't work, your contact information has changed, we aren't pushing your special buttons, let us know.

In the system we inherited, emails are sent to: info@moonsociety.org – a mailbox that is not checked regularly enough because it belongs to no one in particular. **Instead, go to the top:**

president@moonsociety.org (which goes to)
kokhmmm@aol.com

Don't have email, write to:

Moon Society Program Services
PO Box 80395
Milwaukee, WI 53208 USA

Rather call?

1-888-266-2385 (toll free) (Peter)
7 am – 10 pm Central (UT-6)

Visit our Downloads Center New Goodies to Download & Print

<http://www.moonsociety.org/downloads/>

Towards the bottom of the page, you will find
Bookmarks, bumper stickers, and calendars

2 sheets of 3 bookmarks each – download and print to card stock and cut

2 sheets of "Out of Africa" theme 2 bumper stickers each – download and print to peel and stick paper

5 one-sheet 12 month calendars, 2 in horizontal landscape layout, 3 in vertical portrait layout, *each with different artwork* – download and print to card stock, frame if you wish. These calendars all mark the meeting dates for the Management Council and Board, and the dates for Town Meetings and for the Annual Membership meeting

These items are not professionally printed, but we think that you will like them. **Contributions of artwork** are *most welcome* for future additions to these product lines. And if you have an idea for additional "download & print" products, we'd be glad to look at it.

And, of course, explore the Downloads Center page for other goodies to download! That's what it's there for!

One more question: "Why download & print? Why not just have the professionally printed in quantity and mail them out as perks for renewal or for joining? Good question. At this stage of our membership growth, we need to save funds for more important projects! <MSI>

Hot off the Virtual Press

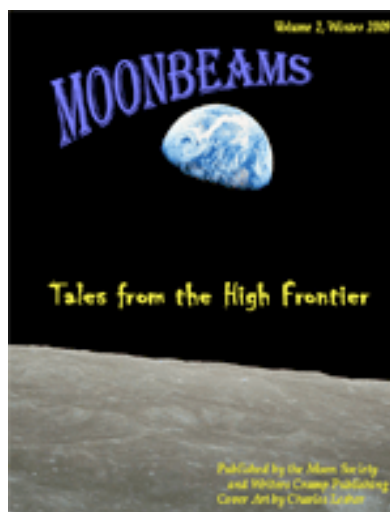
MMM Classics Volume #19

In each Classics issue you will find all the non-time sensitive articles from ten monthly issues, reedited, re-illustrated, and republished. This issue covers MMM #s 181-190, our 19th year of publication, all in one volume in PDF format.

As with the previous 18 volumes, anyone may download these files freely, and distribute them freely. No username and password login is required. The download address is:

http://www.moonsociety.org/publications/mmm_classics/

Moonbeams #2. Tales from the High Frontier



Our adventure into realistic space frontier science fiction has real momentum! This second edition is wholly the work of Chuck Leshner of the Moon Society Phoenix chapter. We hope to put out one issue a quarter, but Chuck may get carried away and put them out more often. After all, as this is only a PDF file, no costs of publication are incurred.

We hope you enjoy this issue as well as the first.

Our underlying purpose is to illustrate the many possibilities of space frontier life, thereby making the future more realistic. In the process, undoubtedly the various authors will come up with some good ideas worth pursuing. The download address is:

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

Coming Up: MMM-India Quarterly #2

We have been sufficiently encouraged by the very positive reception the first issue has had from people in India, and from Indians living abroad, to continue this publication venture. We are looking forward to contributions from Indian writers. Again, as an electronic publication in PDF format with free download access, "M3IQ" is poised to grow significantly in circulation.

We expect that some M3IQ readers will be motivated to join the Moon Society and receive the regular MMM edition as well. M3IQ readers, of course, will have access to all the MMM Classics files as well.

The whole idea is to help foster the growth of a strong popular pro-space movement in India. India has much to contribute to our future in space.

On a lower note, the idea, briefly entertained, of producing an MMM-Euro-Quarterly has been abandoned. The market and the need are there, but the personnel resources at this end are not, barring the invention of a thirty-six hour day. Our energies can only take us so far. We plan to produce M3IQ#2 sometime in February. ###

The Moon Society Chapters & Outposts Frontier Report

Moon Society St. Louis Chapter

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

Contact: Keith Wetzel kawetzel@swbell.net

Meetings **2nd Thursday** monthly, Buder Branch Library
4401 S. Hampton, in the basement conference room

Next meetings Feb. 12th Mar 12th Apr 9th

Moon Society Phoenix Chapter

<http://www.moonsoctphx.blogspot.com/>

U.C. - <http://www.moonsociety.org/chapters/phoenix/>

Contact: Craig Porter portercd@msn.com

Meeting the 3rd Saturday of the month
Saturdays **Feb. 21st, Mar 21st, Apr 18th**

January 17th Meeting: at Chuck Leshner's House, 1982 N Iowa St, Chandler, AZ. Present: Chuck Leshner (Exec VP), Don Jacques (Webmaster), Patti Hultstrand (Webmaster), Mike Marron, Stuart Scott.

Elections: Don submitted a formal Statement of Intent he would pursue as President of our society. Chuck will post it on the website and attach it to this email.

Chuck nominated Patti for VP - Promotions and it was seconded by Stewart. This finalized the nominations for chapter officers. We vote next meeting.

Don Jacques	President
Chuck Leshner	Executive VP (Webmaster)
Mike Mackowski	Treasurer
Bonnie Ann Burgard	VP - Promotions
Patti Hultstrand	VP - Promotions
Open	Secretary

February 21st Meeting: Possible lodations: Southwest Regional Library in Gilbert or Scottsdale Senior Center.

MSPHX.org Website: Passwords were sent to all our members on Jan 8 giving them access. I am still working on getting a forum installed on the website to help us coordinate our projects. This will not take the place of our Yahoo group which gives us high visibility.

Promotions: Mike Marron is scheduled to give a presentation at our March meeting on Lunar Resources.

Patti discussed a book deal that she and her company can sponsor that would serve as a fund raiser for us. A formal proposal should be ready in February.

Chuck proposed using models to create small displays that show our message. Don wants to put them in some very visible places like the Challenger Center and the Science Center downtown Phoenix.

Last Word: Craig, again we missed you at the meeting and extend our warmest wish for you to get well soon! We hope to see you at the February meeting.

Minutes by Chuck Leshner

Moon Society Houston Chapter

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

Contact: Eric Bowen eric@streamlinerschedules.com

Next Meeting Place & time: TBA

Jan. 26th Meeting Report: We had a pretty good discussion of obtaining 501c3 status for the Houston Chapter, and also brainstormed some thoughts on chapter activities. Larry Friesen, Ken Sweeny and Ken Sweeny II, Wayne White, and myself were in attendance.

As far as the issue of 501c3 is concerned, I think that is still how we all want to proceed, based on sentiments last night. Being that it was a truncated meeting,

I'm not sure how to formalize that sentiment into action. Can we work motions via this forum?

Also, the barnstorming session was very productive, and generated a fairly long list of possible activities for the chapter to engage in. I was the scribe for the meeting, and have the notes. The results of our conversation will be posted as a list for a broader forum discussion a little later today or tomorrow. - J. Craig Beasley

Moon Society Tucson Chapter

Contact: Avery R. Davis tuslan@earthlink.net

NOTE: The Tucson Outpost now has three members and are organizing as a chapter. We expect to receive their chapter application and approve it shortly. *Welcome!* In recognition of this effort, we already show Tuscon as a chapter on our chapters & outposts map.

www.moonsociety.org/chapters/chapter_outpost_map.html

College of the Menominee Nation-Green Bay* Student Chapter (Formerly, Green Bay, WI Outpost)

Contacts: Dan B. Hawk hawkd_0212@menominee.edu

David A. Dunlop dunlop712@yahoo.com

Meeting some Friday afternoons at the College of the Menominee Nation, 2733 South Ridge Rd, Green Bay, WI

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

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

Currently, in the US, we have 4 Community-based Chapters, 1 Campus Chapter, and 4 Outposts.

See Map: http://www.moonsociety.org/chapters/chapter_outpost_map.html

**Why not start a Moon Society Outpost in Your area?
All it takes is one person - you!**

Write: chapters-coordinator@moonsociety.org

Get ideas from: <http://nsschapters.org/hub/>

Moon Society DUES with *Moon Miners' Manifesto*

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

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

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

Moon Society Mail Box Destinations:

Checks, Money Orders, Membership Questions

Moon Society Membership Services:

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

Projects, Chapters, Volunteers, and Information

Moon Society Program Services:

PO Box 080395, Milwaukee, WI 53208

◀ End Moon Society Journal Section ▶

GREAT BROWSTING

Venus may have had continents & oceans long ago
www.phenomenica.com/2009/01/venus-continents.html

To Mars in just three days?
<http://www.colonyworlds.com> – Jan 19th post

Titan's Active "Cryo-Volcanoes"
http://media-newswire.com/release_1083043.html

Griffin's commercialization legacy
<http://www.thespacereview.com/article/1266/1>

India and Germany in space: common motives?
<http://www.thespacereview.com/article/1265/1>

Mohave Air & Spaceport: Silicon Valley of NewSpace
<http://www.thespacereview.com/article/1273/1>

COTS, the Next Generation
<http://www.thespacereview.com/article/1277/1>

Griffin on Constellation Alternatives & Prospects
<http://www.thespacereview.com/article/1285/1>

Mars Consortium approach to fund Mars Missions
<http://www.thespacereview.com/article/1286/1>

Orbital Express: the Space Elevator
<http://www.cosmosmagazine.com/features/print/2435/orbital-express>

Methane means Mars is not Dead
http://science.nasa.gov/headlines/y2009/15jan_mars_methane.htm

New device to solve Mars Methane Source Mystery
<http://www.space.com/scienceastronomy/090115-am-mars-methane.html>

How we found buried glaciers on Mars
http://www.marsdaily.com/reports/Satellite_Antenna_Enables_Discovery_Of_Buried_Glaciers_On_Mars_999.html

Oxygen, Fuel, and Water from moon dust
<http://www.space.com/scienceastronomy/090108-am-pisces-hawaii.html>

Penelope Boston: look in Maars Caves for Life
http://www.ted.com/index.php/talks/penelope_boston.html

Mars Polar ice Water is Pure
http://www.marsdaily.com/reports/Mars_polar_water_is_pure_study_999.html

Scott Maxwell's new Mars Exploration Rover blog
<http://marsandme.blogspot.com/>

Lunar dustbuster to keep moon base spotless
<http://www.newscientist.com/article/mg20126926.500-lunar-dust-buster-will-keep-moon-base-spotless.html>

A look at Buran, the Soviet Space Shuttle
<http://news.bbc.co.uk/2/hi/science/nature/7738489.stm>

Could EELVs cost less and lift more than Ares1?
http://www.orlandosentinel.com/news/space/orl-nasa3008dec30_0,3322725.story

China building world's largest Radio Telescope
http://english.china.com/zh_cn/news/society/11020309/20081226/15255407.html
<http://english.people.com.cn/90001/90781/90876/6583163.html>

China's Tiangong 1 space station unveiled
www.engadget.com/2009/01/26/chinas-tiangong-1-space-station-unveiled-for-tiny-taikonauts/

GREAT SPACE VIDEOS

MOON COLONY VIDEOS – The Moon Society
 50 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/>

ASSORTED SPACE VIDEOS

Five Years on Mars
<http://www.jpl.nasa.gov/video/index.xfm?id=795>

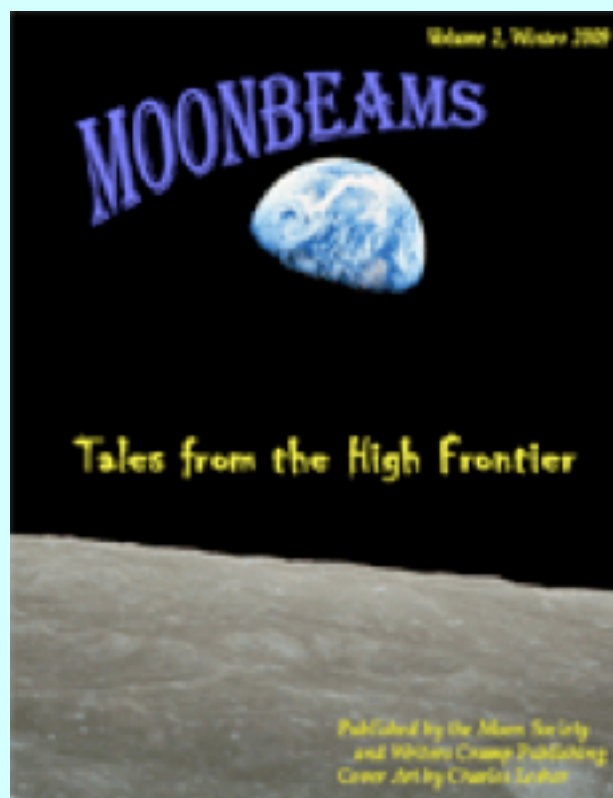
#D Flight over/through Tycho Crater
http://wms.selene.jaxa.jp/selene_viewer/en/observation_mission/tc/013/tycho_anaglyph.html

Richard Gariott Videos from ISS Visit
<http://www.richardinspace.com/>

Sci-Fi noir – Tranquility Dome – Pilot (Chip Proser)
www.strike.tv/show/tranquility-dome/pilot/

Live From The Moon: The Story of Apollo Television (HDTV Trailer) – excellent
http://blip.tv/file/get/CollectSpace_LiveFromTheMoonTheStoryOfApolloTelevisionTrailer887.flv
 (story) www.collectspace.com/news/news-012709a.html

The cure for boredom is curiosity.
 There is no cure for curiosity!
 - Ellen Parr



The 2nd issue of Moonbeams, Tales of the High Frontier Science-Fiction, is out.
 Free access download:

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

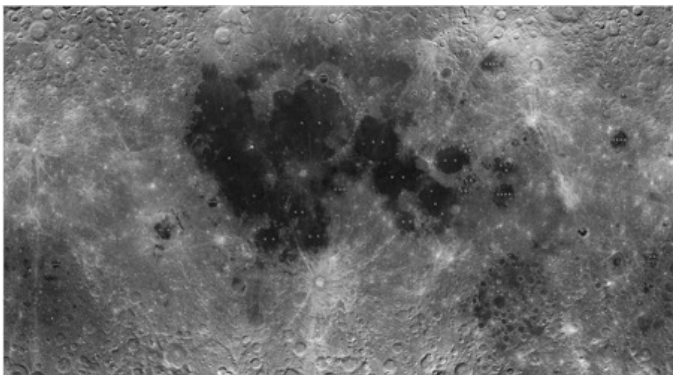
MMM PHOTO GALLERY



Not exactly Opera Glasses, this 22" pair of binoculars is at the Commanche Springs Observatory, Crowell, TX



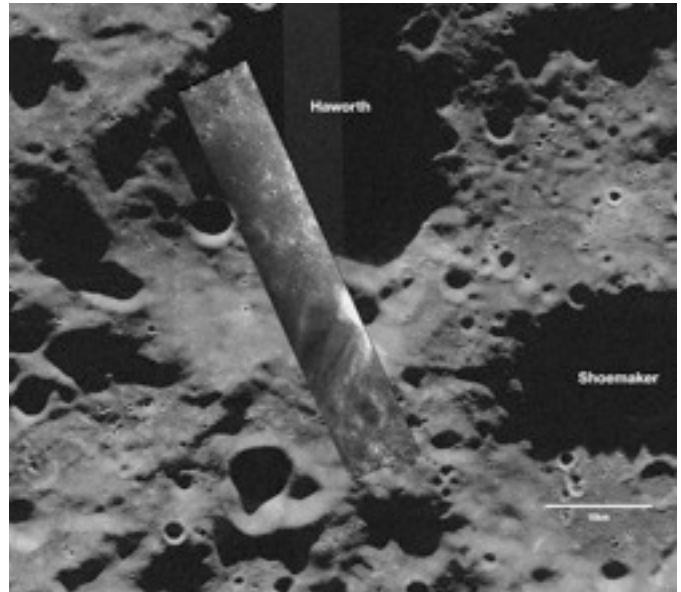
Family Portrait of Mars Rovers: Spirit/Opportunity left, Pathfinder center, Mars Science Lab right



China publishes Change-1 Moon Map - a mercator projection that is increasingly distorted horizontally at latitudes increasingly far from the equator.

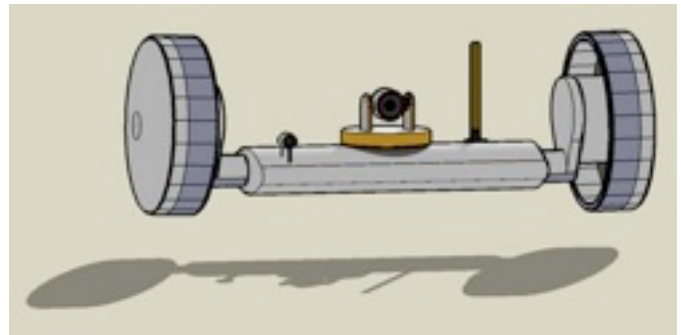
The polar regions are not included in this shot. This map shows how very uncharacteristic of the Moon as a whole is the great maria complex (main dark area) on the near side, centered north of the equator. Planners take heed.

<http://images.spaceref.com/news/2008/chinamoonmap.1.jpg>



This image is a Mini-RF synthetic aperture radar (SAR) strip overlain on an Earth-based, Arecibo Observatory radar telescope image. Taken Nov. 17, 2008, the south-polar SAR strip shows a part of the moon never seen before: a portion of Haworth crater that is permanently shadowed from Earth and the sun.

Credit: ISRO/NASA/JHUAPL/LPI/Cornell University/Smithsonian



The small, two-wheeled Jaluro rover is one example of a design currently under development by one of the groups within Team FREDNET. By keeping the number of components at a minimum, this design seeks to keep mass as low as conceivably possible. (Source: Tobias Krieger)



One of latest shots of Mercury by Messenger



Dear Lunatics,

The **Tranquility Dome** pilot is on line! You can check out the pilot episode on [www.strike.tv](http://www.strike.tv/show/tranquility-dome/pilot/)
<http://www.strike.tv/show/tranquility-dome/pilot/>

As you are well aware, conventional Big Media hasn't even attempted a dramatic show about lunar colonization since the failed pilot, **Plymouth**, in the last century. That's bad, because most young people think space is a place filled with evil aliens.

Not that it's at all important that we open up a new frontier to create jobs, wealth, new industries and a whole new economy, harvest abundant resources from space, develop space solar power, lunar solar power and helium 3 fusion to reduce climate change, no, we just like science fiction, or in this case, science "faction."

It's our aim at **Tranquility Dome** to get as many people to see the pilot as possible -- not only to spread the word about Space Colonization but because the more hits we get, the better we are able to market the series and attract advertisers and Hollywood types who might pay us... and to get people thinking about the importance of the High Frontier.

So, by now you are saying to yourself "How can I help get the word out about **Tranquility Dome**?" Well, I'm glad you asked. And if you didn't ask, go ahead, ask.

Okay, there are a couple things you can do. Spread the word by emailing friends. You can craft your own personal, or you can just copy and forward this letter.

A third way to help is to contact people you know with blogs or websites or newspaper columns and get them to talk up **Tranquility Dome**.

Promoting Tranquility Dome on the web

Fourth, and most effective: go on YouTube:
http://www.youtube.com/watch?v=SRN5dnElK48&feature=channel_page

Give it a good rating and a nice comment. If we get enough people to do this, it'll be featured on youtube and then the sky's the limit.

Finally, if you are on Facebook or Myspace, you can change your status to reflect your newfound love for Tranquility Dome. My status, for instance, reads "Chip is watching Tranquility Dome on <http://strike.tv>".

You can Twitter about it. For those on gmail, you can mention Tranquility Dome in your chat phrase (what is below your name in the "chat" section).

Thanks

Chip Proser

Writer/Director/Producer/Cinematographer
 Celestial Mechanics, 2394 Astral Drive Los Angeles, CA 90046. Ph: 323-876-1885; 323-459-8177 Cell



Chip Proser, a Director-Cameraman and Producer for 7 years at WCVB-TV in Boston, won multiple awards and Emmys at the Peabody Award-winning ABC Affiliate, called "Arguably the Best TV Station in America" by the New York Times. He was captured by Gypsies and forced to become a screen-writer in 1980 after selling his original feature screenplay **INTERFACE** to Zoetrope Studios. Called "One of

the Best Films Never Made" by American Film Magazine, the project resides at Paramount.

Proser did the major page 1 rewrite on **TOP GUN**, wrote **ICEMAN**, created and wrote **INNERSPACE**. He Created, Wrote, Produced and Directed "Sworn To Secrecy (Secrets Of War, Int'l), a documentary series for A&E; History Channel and Pearson Television. He has written projects for CBS, NBC, HBO, Warner Brothers, Paramount, Columbia, Disney, ABC, and wrote the interactive game **"Top Gun - Fire At Will"**.

He recently Wrote/Directed/Produced **GAIA SELENE - Saving the Earth by Colonizing the Moon**", a feature documentary on climate change, the energy crisis and the harvesting of clean, renewable energy from Lunar Solar Power and Helium 3 Fusion.

As a Strike TV member, he's shot the projects **"Urban Cowgirl"**, **"Smartest Man in The World,"** **"Don't Get a Boner"** and **"The Write Environment."** He is producing/directing a documentary on the Strike, and his own Strike TV online series, **"The Crew"** in addition to **Tranquility Dome**.

[Note: Chip Proser is a Moon Society Advisor and on the Moon Society's behalf, has produced all of the **Moon Colony Video** series linked to from our homepage.]

Message from the President on NASA's Day of Remembrance, Jan. 29, 2009

"The arrival of a new year reminds us that life is a journey, one that takes us on many unexpected paths. NASA's role is to pioneer journeys into the unknown for the benefit of humanity. Along the way, we sometimes experience tragedy instead of triumph.

'Today, we pause to reflect on those moments in exploration when things did not go as expected and we lost brave pioneers. But what sets us apart as Americans is our willingness to get up again and push the frontiers even further with an even stronger commitment and sense of purpose.

'On this Day of Remembrance, we remember the sacrifices of those who dared to dream and gave everything for the cause of exploration. We honor them with our ongoing commitment to excellence and an unwavering determination to continue the journey on the path to the future.' President Barack Obama

http://www.nasawatch.com/archives/2009/01/message_from_th.html



The Great Debate over Destination of the next major Outer Solar System Mission

NASA, probably in conjunction with ESA, must decide in the next few years between the Jupiter Icy Moons mission that would involve sending a lander to Europa, or a mission dedicated to further in depth exploration of the mysteries of Titan.

There can be little doubt that Europa and Titan are the two most intriguing and mysterious worlds beyond the asteroid belt. Europa most certainly has a deep water ocean under a global cap of ice. Its ocean is larger by far in millions of cubic kilometers than ours, and on the ocean floor we think it may be likely that there are tectonic ridges where hot gasses bubble up. These should be similar to the hot vents on Earth's oceanic floors which many now suspect may have been where life first appeared and evolved here.

The proposed Europa probe would not drill through the ice crust, but look for organic remains on the surface where water from below has oozed up through fissures in the ice. If we found positive signs of evolved organic life, the race to build a much more ambitious and costly an ice-drilling probe would be on.

Titan, twice as far from Earth, is a quite different world, one much much colder, where we expect seas of liquid methane or ethane, not water. The elements needed for organic life are there. But whether life could originate in such cryogenic conditions in which a Wisconsin winter wind chill of minus 60° F would be literally scalding, is another question.

Life if it exists on Europa could well bear a lot of similarities to some forms of Earth life. Life if it exists on Titan would be something quite different, beyond what we can picture. Imagining Titan life to have evolved beyond microbial or even one celled life is a venture in pure science fiction. We'll have to wait and see what we find, if anything. We may only find a lot of "chemistry."

So, if we can't afford to go to both worlds in the near future, which should we choose? Titan holds the biggest surprises. But I think that there are **two good reasons why we should choose to go to Europa first.**

(1) Worlds like Europa are likely to be much more common in the universe than worlds like Titan, and also much more common than worlds like Earth.

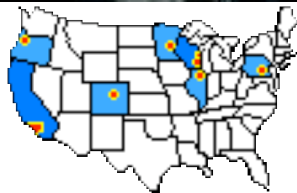
"Europids" – ice-crustured worlds covering oceans kept liquid by tidal force of a gas giant primary should be very common, *as they do not depend on their primary being at any set distance from its sun.* If we find life on Europa, whether it is only microbial, or on the other end of speculation, has evolved multi-cellular metazoan forms analogous to those in our own oceans, is likely to tell us much more about how common life is, and in what sort of forms, *throughout the universe.*

The existence of life in Europa's ocean allows us to more fully understand what has evolved in our own oceans, and thus will help us reach a much better understanding and appreciation of what and who we are.

(2) Worlds like Titan are likely to be very rare.

Life found on Titan would reveal a greater versatility to life, including "Life *other than as we know it,*" but would shed little understanding of the possibilities of "life as we do know it" beyond the examples on Earth.

Tom Heidel, Milwaukee, WI



News & Events of NSS "MMM" Chapters

Space Chapter HUB Website:

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



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!

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TREAS./ Database – *Robert Bialecki

bobriverwest@yahoo.com 414-372-9613

LRS News

• **Dave Dunlop** is getting ready for another month-long excursion to Texas, New Mexico, and Arizona and points along the way at the end of February to talk to experts busy in many fields of investigation.

• **Peter Kokh** is scheduled to go to MarsCon Feb 27th to March 1st to speak and to man a booth courtesy of the Minnesota chapter

• **January 10th LRS meeting:** Peter talked about new ideas for lunar shelter. Bob Bialecki brought a video.

LRS Upcoming Events – March, April, May

Saturdays: March 14th, April 11th, May 9th, 1–4 pm

LRS Meeting, Mayfair Mall, Garden Suites Room G110

AGENDA: www.lunar-reclamation.org/page4.htm

• **February 14th:** Program to be decided

• **March 14th:** Program to be decided

MINNESOTA



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

February 21st – March 21st – April 18th – May 16th

Chicago Space Frontier L5

610 West 47th Place, Chicago, IL 60609

INFORMATION: Larry Ahearn: 773/373-0349

Larry Ahearn and Geri Harocz plan on being at MarsCon Feb 28th in the Twin Cities to help MN SFS's Ben Huset with the Science Track. They will be picking up Peter Kokh in Milwaukee on the way.

ISDC 2010 Chicago planning is in full swing

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/2009-12-Review/

Pix: All ship holiday party Jan 10th pix

www.freemars.org/mnfan/AllShip/2009-Holiday-Party/

Intern'l Astronomy Year 2009 kick-off celebration pix

[www.freemars.org/mnfan/MN-Planetarium/2009-01-](http://www.freemars.org/mnfan/MN-Planetarium/2009-01-IYA-Kickoff/)

[IYA-Kickoff/](http://www.freemars.org/mnfan/MN-Planetarium/2009-01-IYA-Kickoff/)

Scheduled Chapter Events:

• **MN SFS General Meeting** Tues, Jan 13, 7 pm at Craig Rostal residence: Centre Village, 433 S 7th St, apt 1808. Discussion topic -- things we should be doing this year.

• **MN Space Frontier pot-luck dinner.**

Sat, Jan 31, 7pm, Centre Village party room 433 S 7th St

• **Science Room at MarsCon**, Feb 27th –March 1st: Larry Ahearn and Geri Harocz of our Chicago chapter and Peter Kokh of the Milwaukee chapter will be Ben's guests

WISCONSIN



Sheboygan Space Society

728 Center St., Kiel WI 54042-1034

c/o Will Foerster 920-894-2376 (h) <willf@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

• **Feb 21st – Apr 17th – Jun 19th – Aug 21st – Oct 16th**

PENNSYLVANIA



Philadelphia Area Space Alliance

PO Box 1715, Philadelphia, PA 19105

c/o Earl Bennett, EarlBennett@erols.com

215/633-0878 (H), 610/640-2345(W)

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

[<http://phillypasa.blogspot.com>]

• **PASA regular business luncheon/formal meeting 1-3 pm, the 3rd 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.

Next Meetings: March 21st – April 18th – May 16th

Meeting times and location: Our January and February meetings will be held at the Liberty One food court on the 17th and 21st respectively. Go up the escalator to the second level, where the food court is, and go towards the 17th street side windows. Look for our group on the left side of the "tee" at that location.

November Meeting notes: We had a good meeting with the inclusion of a guest: **Wallace Kemp** is in the area from New York, although he enjoys Boston and visiting M.I.T. and the Boscon Science Fiction Convention too. He is an aspiring director and acts occasionally. He met our members at Philcon and decided to audit our monthly meeting. He is currently looking for work in the courier service.

of two prominent people at the meeting: in the sci-fi area **Majel Roddenberry**, actress in several shows including Star Trek, and was the wife of the creator of that story group. The other individual was known as "Deep Throat" to the baby boom generation, and later identified himself to the public as Assistant Director of the F.B.I. **Mark Felt**. Both were inspiring figures to many people. Their passing was part of the meeting and led to further talk about people who had affected our lives who have passed away which included Arthur C. Clarke and Gerard K. O'Neill.

Mitch Gordon discussed the movie "The Day the Earth Stood Still" and thought the new version had an interesting (and I think far fetched) premise: that aliens would destroy Man to save the Earth's environment.) And in Time Magazine: "Back to the Moon" about our eventual return (2015 maybe?) and "Mars: Population 6" with our robot proxies being the inhabitants. Hopefully we can add to the list in the next two years! He also gave highlights of his recent article "The Three Duties of Science Fiction" which included "To Promote creation of new hero Myths", "To inspire Invention among young people", and "Create cautionary tales". These and other topics Mitch brought up caused extended discussion of several societal concerns with Wallace contributing in a number of areas.

During this time Mitch opened the floor to ideas for our activities in 2009. **Hank Smith** contributed the suggestion that we look to **The University of the Sciences** for a speaking venue. Mitch also wants to contact local Sci-Fi clubs to expand our membership. **Hank Smith** expounded on upcoming sci-fi event which includes going to **Boscon** mentioned above, which Wallace will also attend, in February, and the debriefing of the Philcon Committee. Hank has asked to be head of Science Programming and will hopefully get the job this time.

The talk by **Derrick Pitts** of the **Franklin Institute**, on the 12th, was well received at the **P.S.F.S.** meeting. The subject was "The Science in Science Fiction". Hank wants us to promote the presence of an astronaut, or group of them, at venues including the Franklin and at Philcon as a way to honor the 40th anniversary of the Moon Landing this year. Guest of Honor would be appropriate he believes.

Dotty reported on an event called "**The Space Monster Mashup Ball**" in New York in October. This was The Space Tourism group's "Out of This World Party". She also reported on the New York museum scene. **Larry** talked on how to add material to our website and blog which included scanning pictures into our website. This came up, as some of our events were photographed by Mitch's friend **Sondra** who takes pictures of some of our activities that the rest of us have not. Larry also brought more business cards that Mitch and Hank will pass out.

Earl brought material on our **Bernal Sphere Project** and discussed the difficulty of trying to make any reasonable scale model in cutaway form. Possible use, by other people, of **Stereo Lithography** machinery to grow such a structure with internal features. A college group with access to such a machine could create such a display from a set of blue prints or C.A.D. files fed to the controller of the process. I will suggest it to our member, who is a Professor of Architecture, **Simon Koumjian**. This would be great for both a student project and as a publicity item. For our people, Mitch and I will continue

to work on an exterior model, and I have asked our other members to work on interior views and models for the display. Additional and post meeting material: the group building rocket mentioned in the November report where written up in the November "Wired" magazine: "Rocketheads" is the title (by Preston Lerner). One of the racketeers, **Gene Nowazck** built a rocket with 9,000 pounds of thrust. The rocket that **Alan Shepard** rode to space delivered 78,000 pounds. Members of the groups mentioned in the piece do hope to reach orbit some day.

Earl recently received **Product Design and Development** that included two parts fabrication machines, being called "3 D printers" in the review and ad read. The only drawback of such devices, at present, is the size of the objects fabricated, with one unit specifying a 26 by 26 by 20 cm finished object size. This is from the December issue of the magazine. And finally: from **Robot Magazine** for January/ February "Lunar Robot Fleet Coming" on the various Possible explorers that may be sent to the Moon in the near future. NASA is heavily mentioned but as a customer for privately developed devices as well as a primary creator. Older designs are shown and the **Google Lunar X-Prize** is described, as well as follow on jobs: planting relays of various kinds and U-Drive It™ for those who wish to do personal exploration. This would be cool. Interesting publication. -- Submitted by Earl Bennett

January Meeting Notes: We had limited attendance due to very cold (for us) weather: the high in Philadelphia was 20 °F. First Hank Smith reported on science fiction activities including his opinion of the way the Management of the Philcon organization is doing and his continued participation helping with events. Hank would like to stay on as assistant to whoever replaces the retiring head of publicity. He does not want to do this himself, as he also wants to be free to help in other areas of the event. He dislikes the long term Operations being neglected (in his opinion) especially the booking of guest for the event several years in advance. On the up side: Hank hopes to see a favorite authoress, Mercedes Lackey at Lunacon, in March, When we will also lose Dotty and Larry for that event.

Earl Bennett gave a short report at the meeting but will include more here: I brought Robots and Servo Magazines for Jan./ Feb. 2009 for general interest and to point out that I have begun purchasing small robots to give to our George Washington Carver Science Fair winners. These are shown in the Robots Publication, specifically the devices from Vexrobotic.com. Check availability.

In addition Material was brought in for our Bernal Sphere model project, from the Space Studies Institute version of "The High Frontier" which was an illustration of the comparative size of this habitat and several better known objects. One is the Empire State building, of which Mitch Gordon has a scale model, and we will have that as part of our exhibit. Even the small model we are building will be over 16" long. At the scale of 1" per 200' people would be tiny so it will be an external view display with a diorama for a limited internal view. I also reported on the upcoming Science Fair and brought up our future event that I hope we can be part of: The 40th Anniversary of the Moon Landing in July. Mitch Gordon will contact The Franklin to see if they will fit our members into the celebration. He will ask several of our members if they would like to be speakers. More as this develops.

And finally, a post meeting addition: The Nov/Dec 2008 AMSAT Journal had several good articles including a high efficiency amplifier design using a Gallium Nitride power device operating in "Class E" mode. This means it is basically a fast switch with a filter after it. The result is efficiencies as high as 83.5% (measured) at 145 mhz. This in turn means other experiments can be powered or the solar array can be smaller.

There was also an article on the father-son team, Astronaut- ham radio operator Owen Garriott (W5LFL) and his son Richard (W5KWQ). Owen initiated the first ham contacts from space on the STS-9 Sarex mission. Richard operated during his ten days at the ISS. in October 2008, and much more as usual.

I will also mention the February Nuts and Volts which has a description of The Great Plains Super Launch held last year in August. This time the Amateur Scientist and Near Space enthusiast L Paul Verhage focused on the talks at the event including "The High Altitude Research Program" and its work with an ISM. band radio for its' telemetry signals. The ISM. is a group of frequencies set aside for special applications. The work of HARP in 2008 included an attempt to create a mesh network to transfer measurements and signals over a large area. Jeff Daily, of Taylor University developed this program.

Mitch Gordon talked of possible speakers for our outreach, mentioned above, in July for the Moon Landing anniversary. He will check with Gary Fisher and Alex Howerton to be speakers for this Event. Mitch will report as we move forward. He is also working on a presentation at The White Dog Café with Alex presenting on The Overview Effect experienced first by the Apollo astronauts. Since This is a spiritual experience to many it may be a subject that the owners of the Café may approve of.

Mitch also reported on Rocket Dreams that he is reading, by Marina Benjamin pub. 2003), on what happened to the dreams of the Space Age. The subtitle is "How the Space Age Shaped our visions of a world beyond". Many people who we're familiar with where interviewed and the book focuses on the philosophy of space exploration and asks about the grand dreams of colonies in space with the O'Neill Colonies as examples of such dreams. Flight to the planets and stars too. (In my opinion only. The star flight is still a dream, the other two are engineering activities. Pick your billionaire and the process can start to do these things).

On the Bernal Sphere front, Mitch is considering asking art students to work on some aspect of this project. The interior views associated with this sort of habitat, also known as "Island One", might attract them, as well as the chance to try *trompe l'oeil* ("to fool the eye") in their class projects. – Earl Bennett

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, every 2nd Monday, 7 PM

Next: February 9th, March 9th, April 13th

Englewood Public Library, Englewood, CO 80110

1000 Englewood Parkway, First Floor Civic Center

CALIFORNIA



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

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

Odyssey Ed: Kat Tanaka – odyssey_editor@yahoo.com

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

oasis@oasis-nss.org

Odyssey Newsletter Online

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

Regular Meeting 3 pm 3rd Sat. each month

Microcosm, 401 Coral Circle, El Segundo.

Next Meetings: March 21st – April 18th – May 16th

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

Sat March 21st 3pm – OASIS Board Meeting

**Home of Craig and Karin Ward, 1914 Condon Ave.,
Redondo Beach, CA 90278.**

No other event information available at press time.

Monthly Star Parties

LAAS (Los Angeles Astronomical Society) maintains an active calendar of Public Star Parties in front of Griffith Observatory Satellite. **Griffith Observatory, 2800 East Observatory Road, Los Angeles**

Plan *now* to take in ISDC 2009

May 28th – 31st

Orlando, Florida

**hosted by the NSS Florida Space Coast chapter
at the Omni Orlando Resort at ChampionsGate**

Registration Information

<http://isdc.nss.org/2009/register.html>

Hotel Information

<http://isdc.nss.org/2009/hotel.html>



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

• \$20 NSS dues if under 22 / over 64. State age ____
600 Pennsylvania Ave SE #201, Washington DC 20003

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

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Send proper dues to address in chapter news section

=> For those outside participating chapter areas <=

- \$12 USA MMM Subscriptions; • US \$22 Canada;
 - US \$50 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

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

Moon Miners' MANIFESTO

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PO Box 2102, Milwaukee WI 53201-2102

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