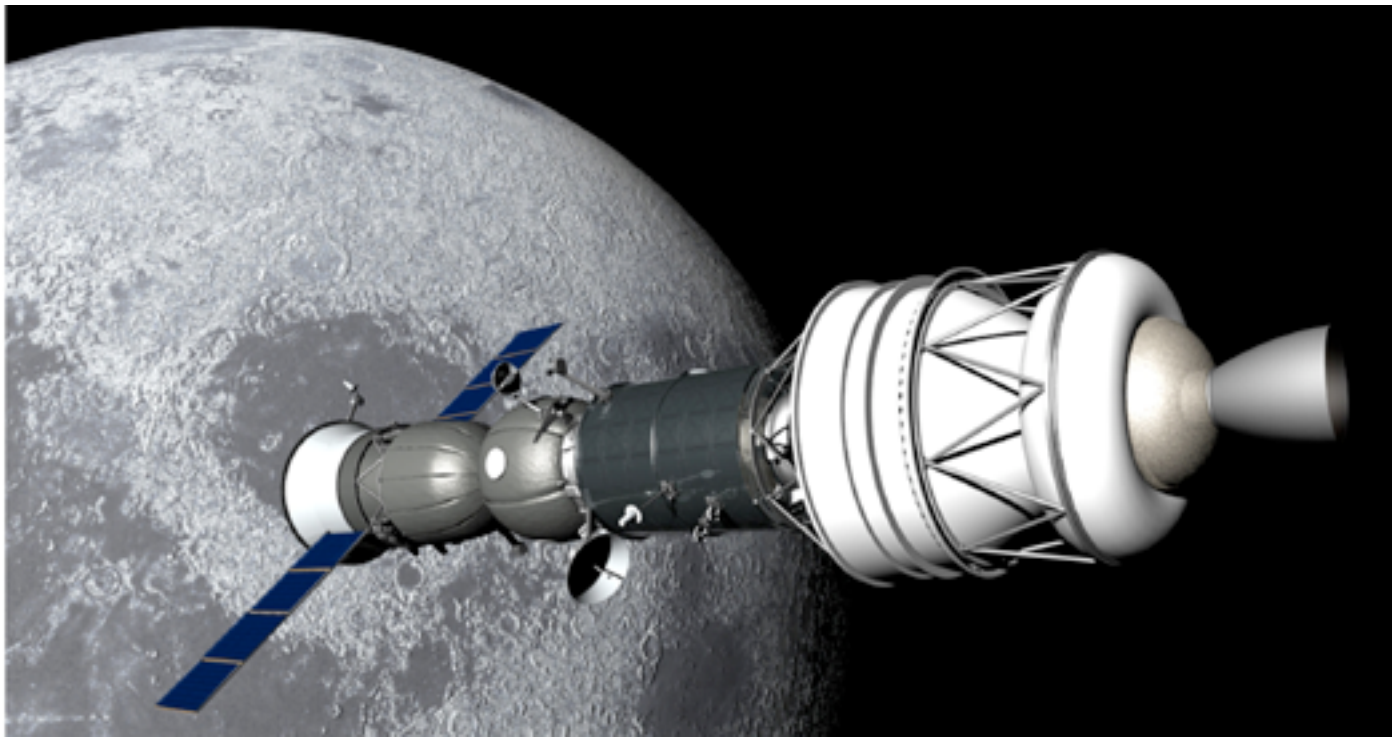
"Towards an Earth-Moon Economy Developing Off-Planet Resources"

Moon Miners' Manifesto

& The Moon Society Journal www.MoonMinersManifesto.com

207 AUGUST 2007



Feature Articles in This Issue

In FOCUS ◎ $100,000,000 ticket sold to skim over Moon's Farside

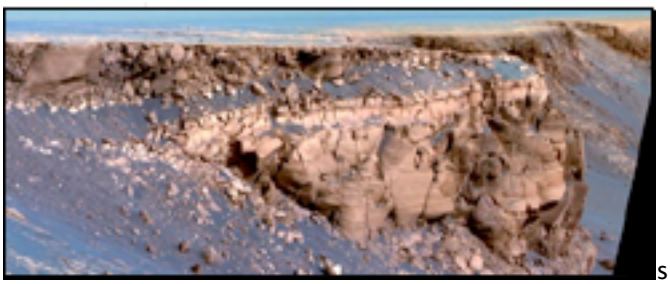
Above: a Soyuz docked with a Russian made logistics module and propulsion module nears the Moon. Mare Crisium lies behind the engine bell of the Soyuz, Mare Tranquilitatis to the center left, Mare Fecunditatis to the lower left.

The craft is on a trajectory that features a close pass over farside. The trip could be planned at first or second half moon to feature both nearside and farside.

Commentary, *next page, Column 2*

To go *"where no rover has ever gone before"*

As our fascination with space takes on more and more of the trappings of tourism, even if only armchair tourism, it seems fitting that ***Opportunity***, which has been exploring the rim of **Victoria crater** for the past nine months, has gotten the green light to descend into the crater. Mission controllers are fully aware of the risks that "the little rover that could" might not be able to climb out later. But we stand to learn so much!



Moon Miners' Manifesto

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

• Moon Miners' Manifesto CLASSICS: The non-time-sensitive articles and editorials of MMM's first fifteen years have been re-edited, reillustrated, and republished in 15 PDF format volumes, for free downloading from either of two locations:

www.Lunar-Reclamation.org/mmm_classics/
www.MoonSociety.org/publications/mmm_classics/

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

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

• MMM retains its editorial independence. MMM serves 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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• For additional space news and near-term developments, read ***Ad Astra,*** the magazine of the **National Space Society**, in which we recommend and encourage membership

• The Lunar Reclamation Society is an independently incorporated nonprofit membership organization engaged in public outreach, freely associated with the National Space Society, insofar as LRS goals include those in NSS vision statement. LRS serves as NSS' Milwaukee chapter: www.Lunar-Reclamation.org

• The National Space Society is a grassroots pro-space membership organization, with 10,000 members and 50 chapters, dedicated to the creation of a spacefaring civilization.

National Space Society, 1620 I Street NW, Suite 615, Washington, DC 2006; Ph: (202) 429-1600 - www.NSS.org

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

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

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

• Submissions by email to KokhMMM@aol.com - Email message body text or MS Word, Appleworks, pdf attachments

√ Mac compatible CD / or typed hard copy must be mailed to:
Moon Miners' Manifesto, c/o Peter Kokh,
1630 N. 32nd Street, Milwaukee WI 53208-2040

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IN FOCUS MMM Editorial

by Peter Kokh

1st Loop the Moon Tour Ticket Sold

{Route illustration on MMM Gallery Page, page 14]

When it was first announced by the Russians that they were willing to take a paying passenger on a flight around the Moon and back, with a one week stop at the International Space Station, and that they could be ready with the needed equipment within two years of a $100 million ticket purchase, we heard some snickers. But Space Adventures, there commercial partner jumped in and now has an unidentified paying customer.

Some thought that no one would come up with the money, but there are now a thousand billionaires worldwide, and surely more than one of them would be quite willing to part with 10% of one of those billions for the ride of a lifetime. Assuming that the experience, possibly in 2009, was televised and videotaped, it would wet the appetite of others. And, oh, by the way, demonstrate for how little money one could actually mount such a mission, if you were not NASA, and willing to use simpler, demonstrated technologies and existing components, i.e. if you didn't insist on starting from scratch and proceeding with state of the art.

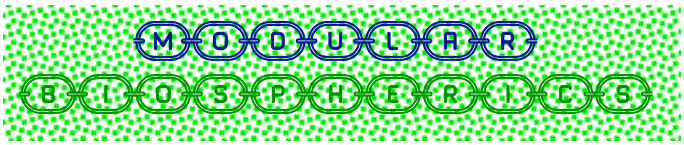
We have been saying for years that looping the Moon was an easy step beyond getting to orbit. The vehicle or cabin that brought you to orbit, mated with a logistics life support module (food, toilets, a berth) in short provisions and fuel for a one week journey, could do the trick. (See MMM #21, "Lunar Overflight Tours")

www.asi.org/adb/06/09/03/02/021/lunar_overflight.html

As Heinlein was famous for pointing out, "once you are in low Earth orbit, you are halfway to anywhere." In about the same timeframe, 2009-2010, we may begin to see routine suborbital hops to the edge of space, at a price many people could afford simply by refinancing their homes (no, not you and me, but many people.) Even though Bigelow Aerospace's current business plan is not tourist centered, commercial use of Bigelow inflatable stations is sure to involve tourism even if Bigelow is not the direct provider. The George Jetson age will no longer seem so far away. Going to an Orbitel will not be out of line with going on an Around the World Cruise, which is currently a sustainable market of perhaps 50,000 tickets annually. Some will say such expenditures are obscene given that there is so much need for charity. Yet for some, they have enough to give plenty for the sake of the needy, and still have a bit left over for themselves. All in reason, and in due proportion.

The next stage, and again, the Russians along with their Space Adventures partners are likely to be the first to bring it to us, is self-contained lunar lander surface visits, complete with a moonwalk experience. And let us go out on a limb and say that we'll see this five years before NASA or anyone else deploys a permanent structure whether permanently of sporadically attended. Tourism will be "a" driver for lunar development.

Space Agencies have to plead with their governments, democratic or not, for money. Commercial Experience Providers do not. Demand is all that matters, and demand is clearly there. Giggle all you want. May you live long enough to say, "Golly, they actually did it!" **<PK>**



V*. "Tritreme Drain Plumbing" – By separating drainage by source type, each can be more efficiently treated.

by Peter Kokh

[*The last installment, in MMM #205, was misnumbered Part VI (6) instead of IV (4). The pdf file, but not the hardcopy, has been corrected.] [*Treme* (Greek) = hole]

Cf. MMM #40 NOV '90, "**Cloacal vs. Tritreme Plumbing**" p. 4 [reprinted in MMM Classic #4, pp. 65-66]

Except in "new towns", it would be prohibitively expensive to switch to a new 'multi-treme' system which keeps different types of sewerage separate from the beginning in order to benefit from simpler and more efficient source-appropriate forms of treatment, with the fringe benefit of enjoying whatever valuable byproducts such separate treatment may promise. Lunar and space settlements *are* "new towns". Infrastructure is 'change-resistant'. Thus it is of *supreme importance* to choose it wisely from day one.

Purging ourselves of the MIFSLA habit

The "MIx-First-Separate-LAter" (MIFSLA)* attitude to waste water management" has gone virtually unquestioned since the invention of urban sewage systems in a city whose name we do not know, but whose ruins we refer to as Mohenjo-Daro, on the Indus River, about 200 miles NNE of modern Karachi, Pakistan, in 2,500 BC, four and a half thousand years ago. Another case of infrastructure being the most difficult thing to change, and thus the thing that deserves the most attention.

MIFSLA is so ingrained, it is taken for granted, almost never questioned, never thought of. "It's just the way we have always done it." How many times have you heard someone say that about something?

*** Waste Water treatment by Source Separation**
www.holon.se/folke/projects/vatpark/Kth/guntha.shtml

On the Moon, where we are starting fresh, we have not only the ideal opportunity to do so, but an urgent imperative. Creating and maintaining a functional biosphere is daunting enough. Creating one that will keep operating as both the settlement and its biosphere keep growing ever larger.

> "The conventional waste water management system is unable to purify the sewage water to a higher grade than the nutrient content of the grey water. Biological plants are not well adapted to the purification of a mixed sewage, but if source separating toilets are used, the urine and feces could be used for agriculture, and the grey water could be efficiently purified with biological methods to a grade that it can be reused in the settlement."
>
> *Folke Günther*, Stockholm – URL above

Obviously, if we are going to build and grow settlement biospheres in modular fashion, with contributing components in each new habitation and activity module, we don't need to make it more difficulty simply for the sake of "the easiest (most familiar) way."

The MIFSLA Way of Doing (or not doing) **Business**

- Clean water is mixed with urine and feces to a polluting mixture, both regarding plant nutrients and pathogens.
- This mixture is in turn mixed with a fairly clean grey water (sinks, bathtubs, showers, laundry).
- The resulting mixture is diluted with drainage water (rain) (About 80 m3/person*year [19]) in an extensive web of piping.
- Finally, the mixture is expensively purified to a quality comparable with the original grey water, but with a doubled volume.

Folke Günther, Stockholm – URL above

Wetlands-type systems accepting MIFSLA loads do not do as good a job, especially in reducing phosphorus content, as would be possible if the differing loads were treated separately.

Common Toilets mix wastes also

In the common water closet, urine and feces are water-flushed together. But there are several designs which separate most of the urine from the feces, so that both can be treated and recycled as agricultural fertilizers separately. There are several types of composting toilets designed for off-the-plumbing-grid use, and they function well, if instructions are followed.

At the Mars Desert Research Station, the original toilet was a composting one, operated poorly, with high odor problems. This may have been the result of improper installation, but more likely was the result of higher load (more users) than it was designed for.

We personally favor the Wolverton System, in which combined urine and feces are flushed into a tank inoculated with microbes to destroy the pathogens and break down solids, the effluent feeding a runoff planters producing clean fresh odor-free air, green foliage, under sunlit conditions. Such systems are load-restricted, but if used in every habitation or activity module in a number to match expected loads, would both turn the black water into gray water while contributing to the biosphere mass and function. This seems the best match for "Modular Biospherics" that we have seen, however, improvements and alternatives are always welcome.

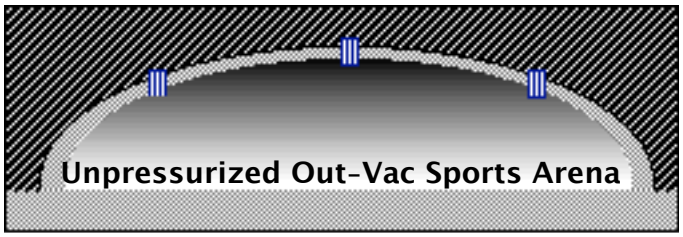
In our earlier article, written long before we heard of the Wolverton system, we suggested that toilet wastes be collected in changeable holding tanks. You would put a full one "out front" to be replaced with an empty one, by a municipal utility service. Utility personnel could make the switch in your home at an extra fee for convenience.

Separate drainage can be carried much further. Waste water from various types of industrial operations each have varying types of adulteration, each suitable for a special kind of treatment. Mixing industrial waste waters makes no sense and compounds the problems.

To insure proper installation and connections, drainage systems meant for different types of effluent could be color-coded. This is a system that we can make work. We need only the will to do it right.

Separate Gray Water Benefit

Pretreated odor-free gray waters irrigate "Living Walls" and can feed waterfalls, fish streams, fountains, and other delightful water features. The result would be a more pleasant settlement. **<MMM>**



Sporting Activities in airless vacuum on a moondust surface in 1/6th gravity in a thermally mild, radiation-free environment

by Peter Kokh

In the illustration above, a shielded dome (it could be any architecturally practical shape capable of supporting a couple of meters~yards of sheltering moondust (as much of a load as a foot of equivalent material in Earth gravity). The dome-vault-shed could be of any size. The first one might be small, for demonstration purposes, but eventually "stadium-sized" out-vac areas could be erected for inter-settlement league team sports.

Advantages of this environment:

- it does not need to be filled with air (that much nitrogen as a buffer gas would be expensive and extravagant)
- it allows sports in vacuum, on the moondust surface, giving the authentic feel of the lunar surface, but without exposure to cosmic rays, intense ultraviolet, and micrometeorites
- it is isolated from the dayspan/nightspan cycle and is thus thermally mild or benign. Expected playing surface temperature, and temperature of the dome ceiling would be the same as two meters~yards under the lunar surface, c. -4° F = -20° C (it is better for the environment to be cooler than the players, so as to absorb their excess radiated heat.

We've seen photos and video of the Apollo astronauts, encumbered as they were by very heavy life-support packs, and very cumbersome space suits, hop and romp on the lunar surface. We wonder how high and how far we could jump, without all that excess weight.

In this more benign "lee vacuum" environment, we might have a chance to find out. Not only are the dangers of radiation, ultraviolet, micrometeorites, intense sunlight all avoided, but by raking the moondust floor free of rocks down half a foot (15 cm) we remove risk of suit and/or visor puncture. In the process, we could also remove most of the troublesome powder component if we wished.

Lighter Sports-suits

We have previously recommended shielded but unpressurized sheds for warehousing items needing to be regularly accessed or serviced as this would allow the wearing of lighter pressure suits allowing greater agility, for less tiring prolonged work activities. Let's take this up a notch. For sports activities we could wear what is called a counterpressure "skinsuit" much like a modern diving suit. It would be lighter and far less constricting of arm, leg, and torso movements.

Helmets could have more ample visors that extended the field of view to what we normally experience on Earth without any headgear. If we are going to have out-vac lunar sports, we need the right outfits.

The "moonskin" counterpressure suit made for himself by Artemis Moonbase Sim 1 health & safety officer, William Fung-Schwarz. It has a light-duty backpack and it allows greater agility with less fatigue but that helmet has to go!

Kinds of supported activities

Larger shielded but unpressurized arenas would be ideal if we were to develop exciting lunar surface team spectator sports, as we will, in time. Volley Ball, anyone?

But we can also imagine a whole lineup of lunar surface track & field events from sprints, relays, hurdles, pole vaults, javelin throws, to long jumps, -- you name it.

Gymnastics too! We could have trapeze setups and trampolines to see how high we can really bounce! And why not circus type acrobatics on the flying trapeze!

The first of many

A facility like this could be created by one major settlement, with a loval settlement-wide league for team sports. But as the rules of the various games matured as we became more experienced with what we can do inside such an environment, and as other settlements grew in size, it would be sure to be copied, and become a truly lunar experience. When otherwise unused, this could be the testing ground for new moonboots, moon bikes, etc.

A must-see, must-do tourist experience

Supported activities would quickly become a signature part of lunan culture. Glass-walled pressurized areas along the perimeter would house ticketed spectators and VIPs. Events in these arenas, if they evolved to a stage were they were truly exciting to watch, might be televised to Earthside audiences by ABC's Wide World**s** of Sports on Sunday afternoons. Even tourists would want to get in on the act, using the facility when teams were not. A chance to get the full experience of lunar gravity on a somewhat natural lunar surface would rank high on the list of draws.

Unprotected Out-vac Sports

We have written previously, in several articles, about various ways the incurable "outdoorsman" might find some satisfaction on the Moon. We especially recommend the following read:

MMM # 111 DEC. '97, p 6. Opportunities on the Moon for the Incurable Outdoorsman [also in MMM Classic #12 p4]

There will still be yearning and support on the part of the more rugged and unfettered outdoorsman for sporting experience of moonscapes "in the raw." Some of these will be road rallies, long distance races over rugged courses, mountain climbing, lavatube spelunking, just plain hiking, and more. We are not all cut of the same cloth, nor should be the ways we let loose. **<MMM>**

A Spartan 11-Step Industrialization Scenario for a Lunar Mining Base

© 2007 David A. Dietzler <pioneer137@yahoo.com>

The late Dr. Larry Haskin wrote about **"A Spartan Scenario for Use of Lunar Materials."**

http://articles.adsabs.harvard.edu/cgi-bin/nph-iarticle_query?bibcode=1985lbsa.conf..435H

In my view, this would consist of using:

1) unfluxed molten silicate electrolysis to produce oxygen, iron, iron-silicon alloy, silicon and ceramic blocks. Silicon could be zone refined to high purity for solar panels. Zone refining does not require chemicals that must be upported [shipped up the gravity well] from Earth and will be done more easily in the low gravity and vacuum of the Moon than on Earth where it must be done in inert gas filled chambers and rods can't be too massive lest they fall apart at the molten zone.

2) cast basalt tiles and linings. Cast basalt can resist 96% sulfuric acid so it could be used to line metal chambers used for acid leaching of regolith, but first we must develop the base to a point at which we can make H2SO4 leaching equipment on the Moon We'd have to mine sulfur present in regolith at about 500 ppm from vast areas of the mare to make the sulfuric acid.

3) sintered basalt bricks/blocks. It's my impression, based on discussion with an associate, that experiments were done on large cast basalt bricks or blocks and as they cooled various minerals solidified and settled at different temps, ruining their quality. However small cast basalt bricks have been made. See:

http://www.lpi.usra.edu/publications/reports/TR98-01/98-01.abstracts.pdf

BRICKS AND CERAMICS. C. C. Allen, Lockheed Martin Space Mission Systems and Services, 2400 NASA Road 1, Houston TX 77058, USA.

Thus, sintering basalt may be the better ways to make large bricks and blocks. These would be porous enough to bond with cement mortar for wall construction. We must wonder how well cement mortar will hold up under the temp extremes of the lunar day/night cycle. While indoors this might not be a problem, out vac [out on the vaccum-washed lunar surface] we might want to stack sintered basalt bricks and blocks and sinter them together with microwave heat to build radia-tion shields for habitat, solar furnaces (support structure for graphite crucibles), foundations for mounting machines, etc.

It may eventually be possible to hew large solid basalt blocks out of the walls of lava tubes.

4) Glass, fairly clear, from nearly pure beds of highland anorthosite, made by melting this regolith with concentrated solar energy. Glass could also be made from volcanic glass deposits. It may also be possible to extrude these glasses into fibers and bind them with a glass matrix to make glass-glass composites also called GGC or Glax [Glass-glass composites].

5) Nickel. There are from 0.15% to 0.5 % elemental iron fines containing some nickel of meteoric origin in the regolith that could be extracted magnetically. Some of these iron particles are fused with glass (called agglutinates). Grinding could break up the glass and metal particles and magnets used to draw off the iron. This iron could be melted with solar heat and cast into various forms. Iron powders could be pressed into molds and sintered to make various parts.

6) Crucible steel. Iron from electrolysis and iron fines could be melted, cast into slabs in sand molds, then hammered to drive out silica, then rolled into thin sheets. The sheets would be laid in a box made of ceramic blocks from molten silicate electrolysis and/or sintered basalt with correct amounts of carbon dust obtained by volatile harvesting in between them. This would be heated to red heat. about 1100 C. for 7 to 10 days and the result will be steel. To clean it up further the steel could be melted along with some CaO flux if necessary. This steel could be alloyed with titanium and/or silicon produced on the Moon.

7) Titanium. Ilmenite (FeTiO3) could be extracted electrostatically from mare regolith and reduced with hydrogen in a fluidized bed resulting in titanium dioxide and iron. Water produced would be electrolyzed to recover hydrogen and gain oxygen. Fused slag particles of TiO2 and iron could be ground up or the iron could be extracted with acid leaching. The TiO2 makes and excellent high temp ceramic and particles of it could be sintered in forms heated by microwaves. TiO2 could also be put into FFC cells to get titanium metal and oxygen. Titanium powder could be used to manufacture all sorts of small complex parts with electron beam of laser 3D additive sintering.

8) Volatiles. *This should be at the top of the list!* Dr. Kulcinski of the University of Wisconsin and his associates have designed volatile harvesting machines that could extract **H2O**, **He**, **CO2**, **CO**, **CH4**, **N2** from the mare. Solar wind implanted **H**, **C** and **N**** will react with oxygen in regolith and carbon will react with hydrogen to form these compounds when heated to about 900 C. in the miner's on board furnace. See:

http://www.nasa-academy.org/soften/travelgrant/gadja.pdf

9) Cement, concrete. According to Dr. T. D. Lin cement can be made by heating anorthostic regolith to 2000-2200 C. to drive off oxides of magnesium and iron and some silica too to increase the CaO content for cement. See:

http://articles.adsabs.harvard.edu/cgi-bin/nph-iarticle_query?bibcode=1985lbsa.conf..381L

Solar energy would be used to heat the anorthosite. Low mass foil or sheet metal reflectors could be used. Of course, to make cement and concrete we need water and that could be obtained by volatile harvesting and possibly from ice deposits in permanently shaded polar craters. Ice on the Moon has yet to be verified, and this is one of the most tantalizing indications made by Clementine and Lunar Prospector.

** **Solar Wind Volatiles** to be found in the upper meter or two of the regolith also include the noble gases: **He**lium (including the fusion fuel **He-3**), **Ne**on, **Ar**gon, **Kr**ypton.

10) Aluminum, aluminum-copper alloy and lithium-aluminum alloy from scavenged ETs or other rocket upper stages. Producing aluminum on the Moon is not simple. Purified (by heating) anorthosite must be melted, cooled and ground fine, leached in H2SO4, the Al2(SO4)3 filtered off, roasted to aluminum oxide, then electrolyzed. Fluxed electrolysis (LiF/CaF flux) of purified anorthosite can produced O2, Si, Al and Ca. These processes are complex and require equipment that must either be upported or made on the Moon, but more challenging is that they require chemicals from Earth that must be recycled efficiently. Solar carbothermal reduction of Al2O3 obtained by acid leaching is also possible and seems simpler than these other processes.

We must have electrical wires and cables. The Moon has almost no copper. If we can recover ETs (Space Shuttle External Tanks) or upper stages of a rocket like the Falcon 9 should it ever go into production, transport them to the Moon and melt them down and extrude aluminum and Al-Cu wire, we can get started wiring the Moon base. A 30 ton ET will yield a lot of electrical wire!

11) Precious metals and other materials from scavenged satellites. Orbital debris is becoming a real problem. It threatens expensive commercial and defense satellites. Any future space program must involve orbital debris removal. There are thousands of pieces of space junk from old upper stages to dead satellites in orbit.

Proposals have been made to zap them with lasers and such, but it would be better to use electrodynamic tether systems to snare these objects and collect them and deliver them to lunar orbit. ED tethers require no propellant; only solar energy. A veritable mountain of gold is already in high orbit!

The development of electrodynamic/momentum exchange tether systems would be of immense value not only for orbital debris removal but for transportation of cargos to LLO without propellant. See:

http://www.spacetethers.com/

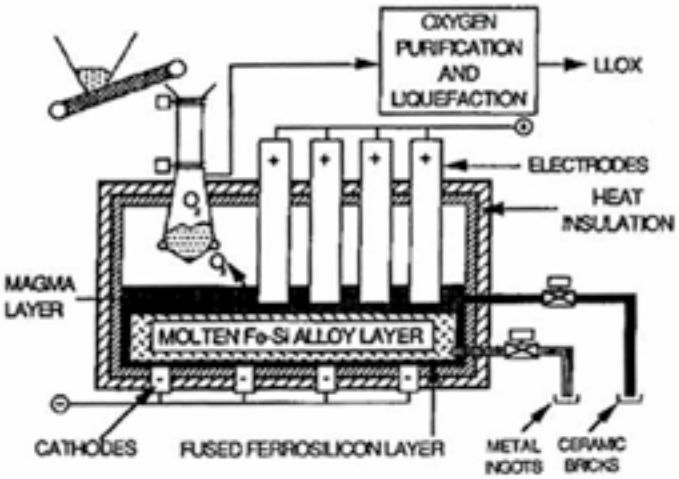
Eventually, lunar industry will progress to a point at which very sophisticated machines can be built like cascade electrostatic mineral separators, perhaps CO direct reduction furnaces that can smelt large amounts of iron from silicates, high temperature plasma separators, electrophoresis devices for extracting trace elements, even bioleaching in microbial farms under well controlled conditions.

Bootstrapping our way to More Sophisticated Levels of Industrialization

But what good are these materials? We will use them to build fleets of helium-3 and solar wind volatile mining machines, drag lines, vehicles, more processing devices to increase materials production without upports from Earth of molten silicate electrolysis units, microwave furnaces, solar furnaces, fluidized beds, FFC cells, grinders, crushers, extruders, rolling mills, tilt hammers, etc. We will build modular underground manned bases with iron, titanium, steel and glass with interior furnishings, floors, and everyday items made of cast basalt. We will build extensive solar panel farms and eventually ring them around the Moon, first at high latitudes in polar regions where the Moon's circumference is not so great, connected by calcium cables (Ca is a better conductor than copper) for constant power during the lunar day/night cycle. We will build dirt roads with bulldozers and graders built on the Moon, cut and fills into rilles, perhaps even roads paved with basalt slabs and someday even monorails on the Moon.

We will build mass drivers to launch lunar materials into space for the construction of solar power satellites, robotic asteroid mining ships and even space ship fleets for the colonization and terraforming of the planet Mars and exploration of the solar system. Some day we will even engage in megascale engineering in space and interstellar travel. The Moon truly is our platform to the galaxy.

Many Other Useful Products Can be Derived From the Molten Silicate Process

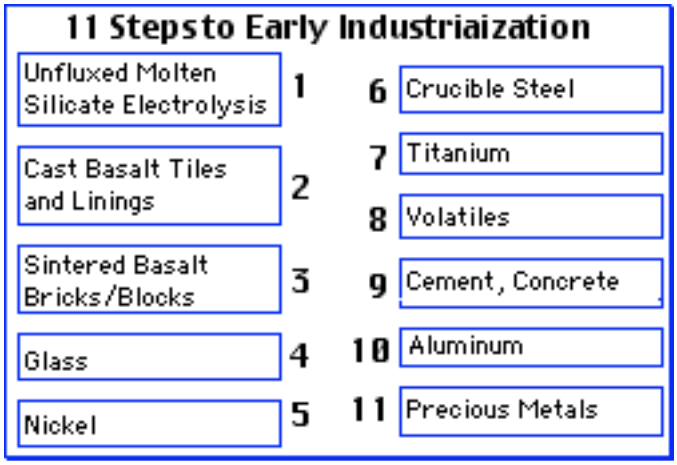


This device requires no chemical reagents and has no moving parts. Oxygen purification will of course involve a gas cleaner and liquefaction will require pumps and space radiators shielded from the Sun and storage tanks. It operates at 1400-1600 C. and produces iron, Fe-Si alloy, silicon and ceramic bricks as well as O2. To extract Mg, Al and Ca would require higher temperatures and voltages and this leads to container and electrode materials problems as the molten silicate is very corrosive.

<DD>

From the MMM Glossary [a work in progress]

* upported - shipped up Earth's gravity well
* out-vac - out on the vacuum-washed lunar surface
* Glax® - glass-glass composites



MAGNESIUM

Workhorse Metal for the Lunar Frontier?

by Peter Kokh

Magnesium is one of the most abundant elements in the lunar crust, the 6th most abundant element (6%) and the 3rd most abundant metal, after iron (15%) and aluminum (7%). Its powerful affinity for oxygen makes it the energizer in fireworks. We have only fairly recently learned to produce a magnesium alloys (car wheels, etc.) that resists oxidation.

From Hopper Fuel to Structural Elements

Powdered Magnesium could possibly serve as a rocket fuel for lunar surface hoppers.

For use on the lunar surface, where exposure to oxygen is minimal, magnesium, easier to produce than aluminum, might find many structural and other uses.

Cement Production

Dr T.D. Lin demonstrated the feasibiity of making lunar cement and concrete using the abundant calcium. Calcium-based cement is the basis of Portland cement, widely used around the world, and in terms of sheer tonnage, the world's number one construction material.

But long before the discovery of calcium-based cement, people were making cements made from magnesium. And in some parts of the world, they still are. Could magnesium-based cement and concrete become a major construction material on the Moon? That is certainly one ISRU (in situ [on ocation] resource utilization) area of research that is worthy of major attention. It will be intresting to compare production costs and performance parameters for various uses.

Magnesium Oxychloride Cement

Magnesium oxychloride has many superior properties compared to Portland cement. It does not need wet curing, has high fire resistance, low thermal conductivity, good resistance to abrasion. It also has high transverse and crushing strengths, 7-10,000 psi are not uncommon. It also bonds very well to a variety of inorganic and organic aggregates, such as, saw dust, wood flour, marble flour, sand and gravel, giving a cement that has high early strength, insectcidal properties, resilient, conducting and is unaffected by oil, grease and paints.

www.premierchemicals.com/corner/articles/cements.htm

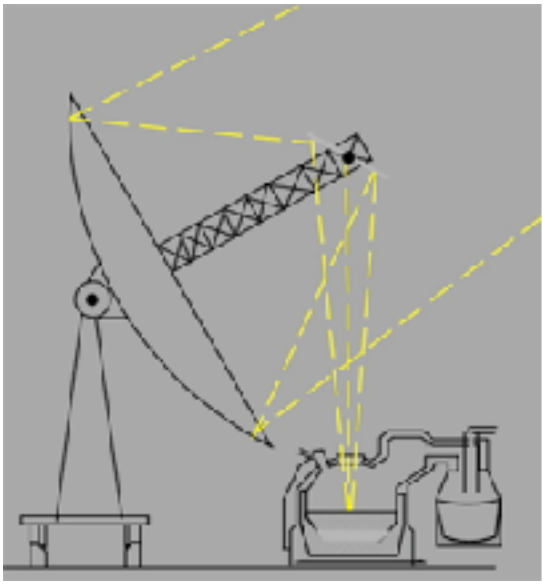
Here on Earth, *popular myth to the contrary,* production of calcium-based cement out of limestone, calcium **carbon**ate, is not greenhouse gas neutral but one of the largest offenders. On the other hand, production of magnesium cements soaks up CO2.

http://www.laleva.cc/environment/rainforest.htm

On Earth, we could see a major revolution in the works for the future.

On the Moon, this is not an issue, as calcium is not present in the form of limestone but in anorthisite minerals common in the lunar highlands. However, renewed research on magne-sium cements for terrestrial use, could help advance this technology for lunar applications. **<MMM>**

LUNAR MAGNESIUM PRODUCTION



Solar energy is focused into retort containing Mg ore, flux and silicon reductant

Producing magne-sium on the Moon might be as simple as heating mare regolith in a solar furnace at 1500 C. and higher to volatilize magnesium oxide. In air at 1 ATM pressure MgO does not melt and volatilize until much higher temperatures; however, in the vacuum of the Moon magnesium bearing minerals will decompose and evaporate at much lower temperatures.

MgO can be used as a iron and steel making flux when mixed with CaO and it can be reduced with silicon to magnesium metal that evaporates and is condensed to obtain magnesium metal. Magnesium can be used to alloy aluminum and it might be used as an explosive when made into a slurry with LOX contained in magne-sium tanks detonated by a high energy electric spark.

Silicon for MgO reduction can be obtained from FeSi obtained by molten silicate electrolysis. Some CaO or CaO-Al2O3 flux is also required. Iron does not participate in the reduction.

What if producing magnesium was even easier? Aluminum can reduce silicon from anorthite in a lithium fluoride and calcium flouride flux (1). What if magne-sium bearing olivines and pyroxenes after electrostatic sepearation of ilmenite from mare soil that also separates anorthostie, agglutinates, etc. was done (2)? This would be followed by magnetic extraction of iron bearing olivines and pyroxene. What if the magnesian olivines and pyroxenes (forsterite-Mg2SiO4 and Enstatite-Mg2Si2O6 and Diopside-MgCaSi2O6 respectively) were simply mixed with a CaO-Al2O3 flux and FeSi and roasted with solar energy? More research must be done. **<DD>**

References:

1) Christian W. Knudsen and Michael A. Gibson
Processing Lunar Soils for Oxygen and Other Materials
www.belmont.k12.ca.us/ralston/programs/itech/SpaceSettlement/spaceresvol3/plsoom1.htm

2) William N. Agosto "Lunar Beneficiation"
www.belmont.k12.ca.us/ralston/programs/itech/SpaceSettlement/spaceresvol3/lunarben1.htms

More info about silicothermic magnesium production:
http://en.wikipedia.org/wiki/Pidgeon_process
http://members.tripod.com/Mg/mggen.htm

ASMO - American Student Moon Orbiter

http://asmo.arc.nasa.gov/

Report & Commentary by Peter Kokh

It was not to long ago, that NASA Administrator Mike Griffin announced that after **Lunar Reconnaissance Orbiter** (LRO) and a piggyback **Lunar Crater Observation and Sensing Satellite** (LCROSS) lunar impactor were launched late next year, there would be no more robotic Moon missions by NASA. But inspired by an innovative **European Student Moon Orbiter** (ESMO) project being supported by ESA, and perhaps also weighing claims by Pete Worden (Director NASA Ames) that micro missions in the 'under $10 M' range were feasible, NASA, to its credit, has introduced an American Student Moon Orbiter project.

Not only has Congress mandated NASA involvement with students, but, with the bulk of NASA's current leadership in the about-to-retire age range, it became obvious to the agency that it had to proactively recruit the next generation of NASA engineers, scientists, and managers. The ASMO project is designed to do just that. While using NASA resources to get started, ASMO will rely on university and private funds to carry the project forward.

This is a win-win project for NASA, as it stands to gain much more from this project than it has to put into it. In addition to inspiring the next spacefaring generation, and captivating the interest of the public with a project sure to popular in Congress, NASA stands to gain information about the Moon gleaned from instruments on a successful student Moon orbiter, that will be useful in planning the human return to the Moon.

Project Details

- **Like** the planned European Student Moon Orbiter, ASMO carry **a 10 kg payload** in a highly elliptical 2 year lunar orbit
- **ESA willing** (a big "if"), ESMO and ASMO could have some interoperable parts, and involve some degree of international scientific and technical collaboration. It is even conceivable, again, ESA willing, that ASMO and ESMO could share the same ride to orbit - the ESMO target date is 2011.
- **NASA's Office of Education** provides startup support
- **NASA Ames Research Center** (Mountain View, CA) through its Strategic Communications and Development Directorate, and **John H. Glenn Research Center** (Cleveland, OH) will provide engineering support
- **ASMO** will be "a new form of a NASA-supported participatory education project"
  1. NASA will perform Pre-Phase A startup functions
  2. In 2008, the leadership reins pass to a selected university-based management team to develop and manage the distributed engineering and design process, to be conducted by university students and their faculty advisors.
  3. NASA will provide consistent yet arms-length project and engineering oversight and designated support functions including two workshops per year and facilitating design reviews.
- **University participants**, and not NASA, will design, build and own the ASMO spacecraft and its payloads
- **Obtaining the necessary funding** and in-kind donations to carry out the ASMO mission will be the responsibility of the university teams

Precedents

While NASA has never done anything quite like this before, there are two other government assisted programs that are blazing a path ASMO could follow:

1. The **CubeSat** university program, initiated as a completely independent venture without benefit of government support
2. The University **Nanosat** Program sponsored by the US Air Force the American Institute of Aeronautics and Astronautics.

Commentary

Moon Society Director of Project Development and Executive Director of The University of Luna Project, David A. Dunlop, and I have looked at the ASMO project and believe it is the right project at the right time. ASMO, we believe, is a NASA launched University and Student run project that deserves the endorsement of Moon-focused groups and individuals everywhere.

Accordingly, we are developing a statement of endorsement that articulates ways in which, under the rubric of NASA-welcomed public comment, can suggest ways to improve this project and enhance its chances of a productive outcome.

When ready, we will present this statement, for endorsement, by the Moon Society, the Lunar Reclamation Society, The University of Luna Project, and the National Space Society. Our recommendations will include:

- Supporting NASA in its "arms-length" assistance to the ASMO project
- Supporting NASA's overture to the European Space Agency to coordinate the ASMO and ESMO projects
- Encouraging favorable Congressional support including initial kick-off funding of $200,000 (the equivalent of Air Force support of the Nanosat project) to the University picked to lead the project
- Finding ways to ensure that instruments picked are capable of filling in significant holes in our knowledge of the Moon relevant to the needs of human presence
- Making room for entrepreneurial contributions and partici-pation similar to that suggested by the Space Data Purchase Act

Collaboration and/or Competition

NASA has clearly signaled that it would like to collaborate with the ESA ESMO project in several ways. Some Europeans may find this proposal attractive, others may scorn it, preferring to "go it alone" in hopes of showing up the Yankees. Who could not forgive them, as arrogant as this country sometimes is, even when it does not intend to be.

But whether ASMO and ESMO compete or coordinate, we all have much to gain, if our knowledge of the lunar frontier is furthered in a way that better prepares us for a more lasting presence on the lunar frontier.

Your Suggestions are welcome: If you have an idea of how the Moon Society, LRS, or NSS could support this project, email (subject line ASMO) to kokhmmm@aol.com

The Moon Society

J O U R N A L

http://www.MoonSociety.org

http://www.MoonSociety.org/blog/

Please make NEWS submissions to KokhMMM@aol.com

The Moon Society was formed in July, 2000 as a broad-based membership organization with local chapters, to spearhead a drive for further exploration and utilization of the Moon in cooperation with other like-focused organizations and groups.

Artemis Society International was formed in August 1994 as a forum for supporters and participants in the **Artemis Project™** quest to establish a commercial Moon base as a first step to a permanent, self-supporting lunar community. **ASI** does not engage in any form of commercial business directly, but seeks to build a Project support business team. Registered trademarks of **The Artemis Project™** belong to **The Lunar Resources Company®**

PROJECTS: www.MoonSociety.org/projects/

Moonbase Simulations - Lunarpedia wiki

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/

Mail Box Destinations:

□ **Checks, money orders, membership questions**
Moon Society Membership Services:
PO Box 940825, Plano, TX 75094-0825, USA :

□ **Projects, chapters, volunteers, information, etc.**
Moon Society Program Services
PO Box 080395, Milwaukee, WI 53208, USA

OUR 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!

Moon Society 2007 Elections Results

from Elections Chair, Charles F. Radley

The ballots are in and have been counted. As we had no real contests, though write-in alternative candidates were allowed, there are no surprises. We congratulate those elected or re-elected to office or position.

Vice President: Chalres F. Radley #868
Treasurer: Dana Carson #10
Directors:
R. Scotty Gamenthaller #393
Randall Severy #125
James Gholston #929

We thank all members who voted, including those who voted for write-in candidates. Our society is 100% volunteer run. Even our small staff are unpaid volunteers.

As **the position of Secretary has now been declared vacant**, the Board will appoint a volunteer to serve out the balance of the 2-year term for which Ben Smith was elected last year. *If you are interested* in this position, and want to know more, write the President, at president@moonsociety.org

We've got our work cut out for us!

from Society President, Peter Kokh

Houston, we have a problem! Our goals are very ambitious, and we have two few volunteers. Our near term goals this year are both to significantly grow our membership, and to encourage a greater percentage of our members to offer some of their time and talents.

We want to offer exciting, new projects to our members and get them involved. But to do that we need a critical mass of volunteers. Meanwhile, we are doing what we can to make the experience of membership a more fruitful one, one worth renewing to maintain. In this light, we have spent some time revamping our operations to make sure members know their membership numbers and have a username and password and know how to use them, to access all the membership benefits available. We are taking a hard look at the weaknesses in our system to remind members that it is time for them to renew.

There are ways to leverage the resources of others, however, and we have attempted to do this in our various efforts at collaborating with other societies and groups where our interests converge or overlap.

We are starting to produce short catchy videos to get new people involved and to spur present members to a deeper commitment.

Our new Lunarpedia (www.lunarpedia.org) is in need of contributors to realize its promise as the online resource for information about the Moon, past, present, and especially future. Our new University of Luna Project is all the buzz in the lunar-focused community. The ULP has great promise, but it will take dedicated commitment to start producing results in terms of Research & Development of technologies needed to survive and thrive on the Moon, progressing swiftly from a visitable outpost core to economically viable civilian settlements.

Member feedback is important. Tell us what you would like to see and do. Just don't say "you ought to," as there is no paid "you" in the Society, just an unpaid "we."

We're glad you are aboard! Remember, "we" can do it, and you are part of that "we." **<MSJ>**

At last!
Printable Society Membership Cards

From Scotty Gammenthaller, Chairman of the Board

On request, I have created software for the Moon Society's Team Director database management system which will create a printable membership card on member request.

Simply go to the Moon Society home page:

http://www.moonsociety.org

Now scroll down the left hand menu to **Members Menu** and click on the link:

Members Only

On that page you have several options for access to newsletter files.

The 4th option reads:

"**Get printable Moon Society membership card in pdf format.** Wallet-size Moon Society membership card. (Requires a PDF reader such as Adobe Acrobat Reader)"

Click on this link. If your browser recognizes you and has stored your Moon Society username & password, your membership card will download immediately.

If not, you will get a request to enter your user name and password, and if you enter it correctly, your card should download right away.

You can then print your card on any kind of paper or card stock in any color.

The idea is that by carrying this card, you will remember your membership number and expiration date.

We are proud to have you as a member!

New Members now assigned Usernames & Passwords

We have noticed that many new members never bother to set up personal usernames and passwords. With these loggins, you can download our newsletter in pdf format, check and correct your contact information in our database and more. Without these loggins, members miss out on many of the advantages of membership.

Therefore we have installed software that will pick these for you automatically. You can change your password at any time you wish to something easier for you to remember. Questions? email kokhmmm@aol.com.

Moon Society home page has new Video link top front center

The Leadership Council has taken on a major new project, production of video segments that promote the Moon Society and its goals. With the help of member Chip Proser, retired Hollywood screenwriter and creator of the Gaia-Selene Documentary ("There are three ways to save the Earth and two and a half of them involve going back to the Moon") [www.gaiaselene.com], we videotaped interviews of fifteen notable persons at the recent NSS International Space development Conference in Dallas, Texas.

Among those interviewed were Dr. Paul Spudis, General Pete Worden (head of NASA AMES), and Rick Tumlinson, founder of the Space Frontier Foundation. Moon Society Director of Project Development and Board Member James Gholston asked the questions.

The first product of this effort, many more to come, is an interview with Esther Dyson. This video is one of the selections now playing. Just click on the video link.

New videos will keep appearing, at a pace much slower than we would like, but a lot goes into the production of each: selection of interview material, choosing backgrounds, and putting everything together into a smooth flowing product that keeps one's attention and gets the message across.

"Moon Colony Videos" is a name chosen by Chip Proser. Let it be your multimedia gateway.

You will notice that side by side with the column "Great Browsing Links" which we have been running in MMM for almost four years now, we are introducing a column of "Great Video Links."

Not all of us have the patience of interest in video material. Many of us may never have installed Flash, Quick Time, Windows Media Player or other video software. On the other hand, for perhaps most younger people, video is the best way to catch and hold their attention and to pique their curiosity. We have everything to gain and nothing to lose by "getting with it!" **<MSJ>**

Summer Fall 2007 Membership Drive
Launched July 28, 2007

At its July 18th meeting, the Society's Leadership Council put together a dual incentive plan for this year's membership drive. The drive is aimed not only at encouraging new members to join the Society, but to encourage former members to rejoin us.

New Members get a great book

The first thirty persons to join the Society will receive a copy of Andrew Chaikin's **A Man on the Moon**, 1998 paperback edition. This 670 page book, ISBN-10: 0140272011, has a reader rating of five stars, and is 8x5.4x1.6 inches in size (20x13x4 cm). The book details the triumphant story of the Apollo Space Program and was a basis for the HBO® mini-series, "From the Earth to the Moon." The book has a forward by Tom Hanks. Retail value $18. Average customer review: *****

Restrictions: This offer is restricted to persons living in the United States and Canada, as it is not possible for the Society to pay the high shipping charges to members outside this area. We are working to identify incentives for new members outside this area.

DATES: This incentive program starts on the day of publication on our website and ends with the 30th person to take advantage of it.

Inclusions: ***Existing members may take advantage of this program by giving gift memberships*** to relatives, friends, schools and libraries. An existing member registering a gift membership may choose to have the book sent to him/herself or to the recipient of the gift membership (including schools and libraries.)

Returning Expired Members get a great CD

Former members, expired for three months or more, are encouraged to rejoin the Society and support our growing list of new projects and programs.

The first twenty expired persons to rejoin the Society will get the Moon Miners' Manifesto 20th Anniversary CD pdf file collection. These files can be read on any platform with the free-download Adobe Acrobat Reader.

- **MMM Classics** include all the non-time-sensitive material from the first 17 years of MMM, reedited, reillustrated, and republished, in collections, one per publication year
- **The MMM Samples** include pdf files for the Editor's Selection of issues since May 2001
- **MMM -derived papers** – some of these combine a series of articles on set topics; others are the result of brainstorming efforts
- **Presentations** – these power point presentations are included as pdf file slide shows – just ask us, and we will email you any of the corresponding Power Point files.
- *and more!*

..and a chance to win a 12" Moon Globe

Yes, the names of the first twenty expired persons to rejoin the Society (and they only) will be eligible for a drawing to win a twelve inch Globe of the Moon with a stand.

Originally sold at $99. Includes Farside features and names.

Future Membership Drives

This year's membership drive is an experiment. The results and experiences from this drive may lead to future time-limited efforts.

The larger our membership, the larger our talent pool, and the larger our networking reach. So membership growth is a top priority.

The Society has launched two ambitious projects this year, the first being our wiki-type online **Lunarpedia** Encyclopedia, www.lunarpedia.org.

At ISDC 2007 we introduced the **University of Luna Project** – www.u-lunaproject.org. This project is aimed at entrepreneurs, students, and faculty and will involve many things including envelope-breaking workshops, design competitions and engineering competitions, and much more.

We continue to work on design and definition of our proposed **Lunar Analog Research Station program**, www.moonsociety.org/moonbasesim/proposals/

The larger our membership, the more neat mischief we can get into. You may have an exiting idea for a Moon Society Project. If so, visit:

www.moonsociety.org/projects/project_guidelines.html

and help us find more enthusiastic members!

Our Goal in adopting and pursing projects

The Society's goal is ***to help advance the day when*** human pioneers will return to the Moon to establish civilian settlements using local resources to help tackle Earth's stubborn energy and environmental needs.

You can help!

Join, Rejoin, or give a Gift Membership!
www.moonsociety.org/register/

Questions? Write the Society President, Peter Kokh
email: kokhmmm@aol.com
or (not and) president@moonsociety.org

postal mail: Moon Society Program Services
PO Box 080395, Milwaukee, WI 53208, USA

Note: In helping us recruit new members, keep in mind this MasterCard advice.

As much as we value any member's support,
one active person ready to roll up his/her sleeves,
is *priceless!*

check out
www.moonsociety.org/volunteer.html
for a list of talents in great need.

www.Marspedia.org

A gift from Moon Society Members to Mars Enthusiasts everywhere

It is no secret that many Moon enthusiasts also share a fascination for Mars. And that makes sense as looking at the economic cases for both worlds, it becomes clear that each frontier becomes more viable if the other is developing apace as a trading partner.

Moon Society members Michael Delaney (Dublin. Ireland) and James Gholston (Denton, Texas) who created **Lunarpedia**, went on to create **www.Lunarpedia.org**. Moon Society Pressident Peter Kokh used his influence with the Wisconsin Mars Society chapter to get them to pop for the purchase of the domain name for ten years.

Then we turned the site over to the people at **The Mars Foundation**, which include long time Moon Society friend Bruce Mackenzie and Moon Society Director Randall Severy, to manage and operate.

They have been slower to get started, but spent some time considering just how they want to handle this resource. One of the delicate tasks was deciding which potential cosponsors to list and in what order. So check it out at **www.marspedia.org**

The Economic Case for Mars

Another gift from the Moon Society to Mars Enthusiasts everywhere

Whoa, you say! That's going a bit too far! But consider! Mars, for all its many resources capable of sustaining frontier settlement even if support from Earth were cut off, is still a very hard frontier nut to crack.

- Becasue of orbital dynamics, launch windows between Mars and Earth, in either direction, open up only every 25+ months, more than two years apart. A Mars frontier cannot grow through gestation at the end of an umbilical cord, but needs a Yolk Sac supply of all possible needs to fall back on, capable of meeting any conceivable emergency in timely fashion
- Mars has nothing s far identified as a resource or potential product that it can sell to Earth directly and make a profit.

On the other hand, the Moon, readily accessible from Earth, even on a daily basis if need be at a maginal fuel penalty, has the triple "real estate" advantage of "location, location, location." That it does not have all the resources it needs to be materially (we did not say economically) independent, will be no more of a showstoper for the Moon than it was for Japan. One of the markets the Lunan economy needs to develop is Mars. Mars and its moonlets can supply volatiles and other needs at a cost saving over shipment up Earth's deep gravity well.

Meawhile, unlike Mars, the Moon *does have* things it can export to Earth, and more significantly, to in space markets in Earth orbit: energy and raw materials, even finished products (anything the Lunans can make for themselves.) So we have a potential triangle of trade. Mars sells to Luna which sells to Earth and Earth orbit. The upshot is that both lunar and Martian frontiers will be more viable together, than either could be separately!

Introducing our new email newsletter

Moon Society *Frontlines*

Want to sign up? *Simply go to:*

http://list-manage.com/subscribe.phtml?id=0006e65d5b

Chapters & Outposts

Bay Area Moon Society

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

Meeting **4th** Thurs. montlhly at Henry Cates' in San Jose

Contact: Henry Cates <hcate2@pacbell.net>

Moon Society St. Louis

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

Meeting the **2nd** Wed. monthly at Buder Branch Library 4401 S. Hampton, in the basement conference room

Next Dates: **August 8, September 12, October 10**

Contact: Keith Wetzel <kawetzel@swbell.net>

Moon Society St., Louis has challenged their members to come up with design ideas for sintered lego-like bricks or blocks made from moondust to use in unpressurized construction needs. Several members have taken up the challenge seriously and are coming up with some great ideas. There may be a report or article for MMM in the future on their results and recommendations.

There is nothing like a project to motivate a chapter and to hold it together.

Moon Society Phoenix Outpost Blog

http://www.moonsocphx.blogspot.com/

Contact: Craig Porter <portercd@msn.com>

Join us at Spacefest 2007

Aug 17-19th at The Mesa Convention Center
http://www.novaspace.com/Spacefest/

Moon Society San Diego Outpost

Contact: David Schrunk <DOC SCILAW@aol.com>

Every two months, Phil Harris, Tom Matula, Dennis Laurie and David Schrunk meet for a space-discussion luncheon.

Mid-Atlantic Outpost Gets another Recruiting Opportunity

Next year's International Space Develpment Conference, Sponsored by the National Space Society, and cosponsored by the Moon Society will be in Washington, DC, this time *the weekend after* Memorial Day, May 29 - June 1, 2008. Moon Society planning has already begun.

GREAT BROWSING !

Mars Gravity Biosatellite
http://www.marsgravity.org/main/

The Archimedes (Mars) Balloon Project
http://www.marssociety.org/portal/groups/
GermanyCH/archimedes-balloon-project

NASA and the case for Earth: a bad marriage?
http://www.thespacereview.com/article/889/1

Space Travel & Tourism: Two Book Reviews
http://www.thespacereview.com/article/888/1

Virtual Reality and Armchair Exploration
http://www.thespacereview.com/article/896/1

Biomedical Considerations for Space Tourists
http://www.thespacereview.com/article/893/1

Predictions of ISS in your NightSkies
http://www.heavens-above.com/

Toward a Spartan Scenario for Use of Lunar Materials
http://articles.adsabs.harvard.edu/cgi-bin/nph-iarticle_query?bibcode=1985lbsa.conf..435H

Robert Heinlein's belief in the future of spaceflight
http://www.thespacereview.com/article/901/1

Europe's (EADS) new space tourist vehicles
http://www.thespacereview.com/article/900/1

Technical issues designing, developing, and launching robotic solar system missions
http://www.thespacereview.com/article/897/1

What the Space Tourist Experience is like
http://www.thespacereview.com/article/905/1

Book Review: Contact with Alien Civilizations
http://www.thespacereview.com/article/902/1

JSC's Saturn 5 to be restored
www.flatoday.com/apps/pbcs.dll/article?AID=/20070718/

Coming to a theatre near you, September 7 2007:
"In the Shadow of the Moon"
www.apple.com/trailers/thinkfilm/intheshadowofthemoon/
http://www.imdb.com/title/tt0925248/

World's largest Optical/Infrared Telescope ready
http://www.itwire.com.au/content/view/13520/1066/

Landing large payloads on Mars will be tricky
http://www.universetoday.com/2007/07/17/the-mars-landing-approach-getting-large-payloads-to-the-surface-of-the-red-planet/

Using Copernican Principle to calculate longevity of the human race and justify space exploration
www.nytimes.com/2007/07/17/science/17tier.html

PHoto Dicumentation of long Arctic FMARS mission
http://engineering.marssociety.com/fm-refit-200704-index.html

Public Discussion Blog focus on Space Solar Power
http://spacesolarpower.wordpress.com/

Preparing for the first space tourist vehicle crash
http://www.thespacereview.com/article/922/1

GREAT SPACE VIDEOS !

THE FUTURES CHANNEL - www.futureschannel.com

Revisitng The Moon - Dr. Paul Spudis
http://www.thefutureschannel.com/dockets/space/revisiting_the_moon/swf/video.swf.

The Orion Capsule - NASA
http://www.thefutureschannel.com/dockets/hands-on_math/orion_space_capsule/swf/video.swf

The Surface of Mars
http://www.thefutureschannel.com/dockets/realworld/surface_of_mars/swf/video.swf

SPACE.COM VIDEOS - *(all start with commercials)*

Space Station Construction - STS
http://www.space.com/interplayer/sts117/index.html

Chandra X-Ray Telescope - Heart of our Galaxy
http://www.space.com/php/video/player.php?video_id=CfA_XRay_300806

Space.com ARCHIVE of Hundreds of Space Videos
http://www.space.com/php/video/

MISCELANEOUS

Directory of free, public domain space videos
http://www.space-video.info

AOL Research & Learn Space Videos:
Mercury, Gemini, Apollo missions (hundreds);
Shuttle Orbiters: Mars: Unmanned Missions; X-Prize
http://reference.aol.com/space/main_video

NASA Space Settlement Video Library (40 clips)
http://www.nas.nasa.gov/About/Education/SpaceSettlement/Video/

MMM's NEW LOOK

from the editor

MMM has used the same front page format for over fifteen years, since issue #42 in February 1992. Only the selection of fonts has changed over the years.

- Masthead with stylized moonscape
- In Focus Editorial
- Bottom "Teaser," an illustration or photo relating to an article or essay in that issue, and explanatory text

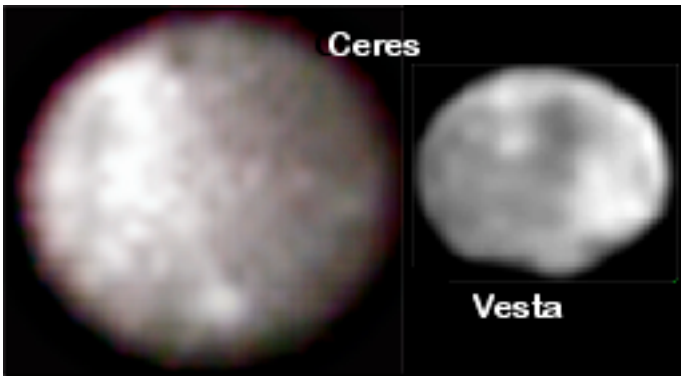
Now we are making a change. **Two things stay:**

- Masthead with stylized moonscape
- Bottom "Teaser" illustration and legend

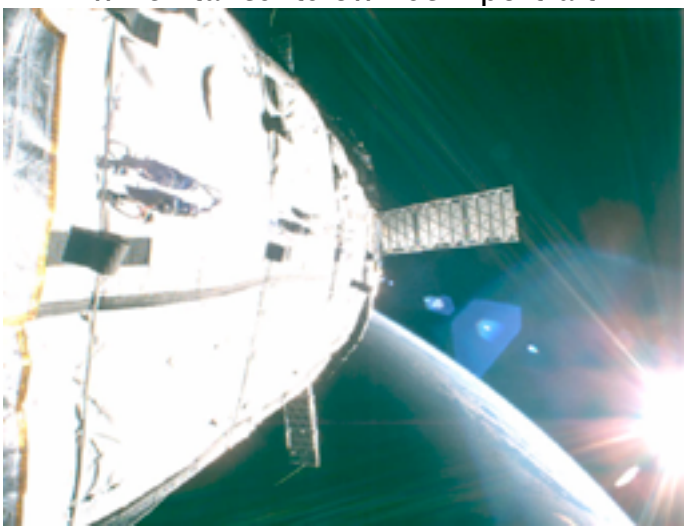
The big change is that the In focus editorial will only be *introduced,* and the saved text space used for a feature photo. In addition, you will find a list of the major articles in this issue. Feedback welcome:
kokhmmm@aol.com

MMM PHOTO GALLERY

Hubble snaps portraits of Destinations for the Dawn Probe set to orbit Vesta in 2011, then leave for Ceres, going into orbit there in 2015. They are the two largest asteroids.

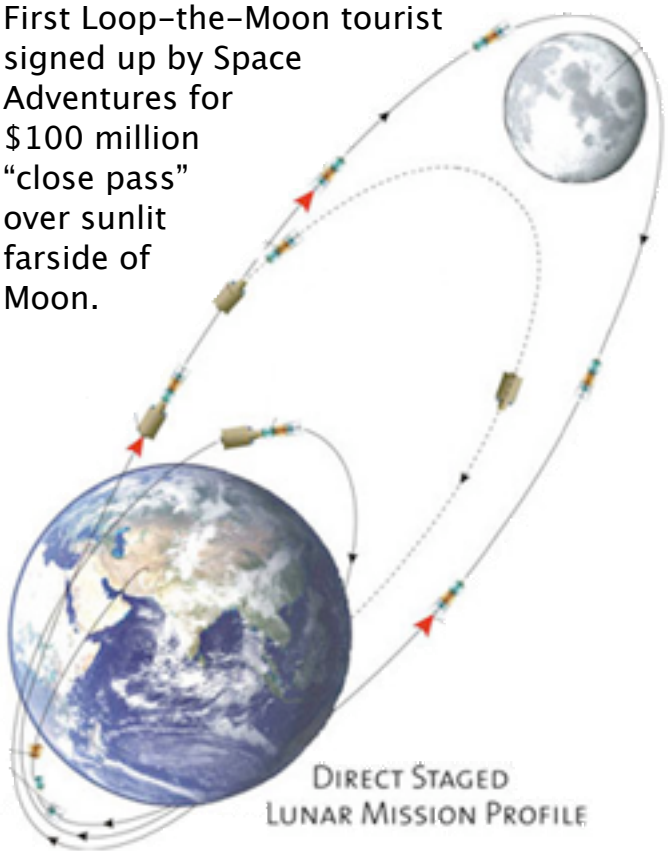


Bigelow Aerospace launches Genesis 2 which takes its own self-portrait



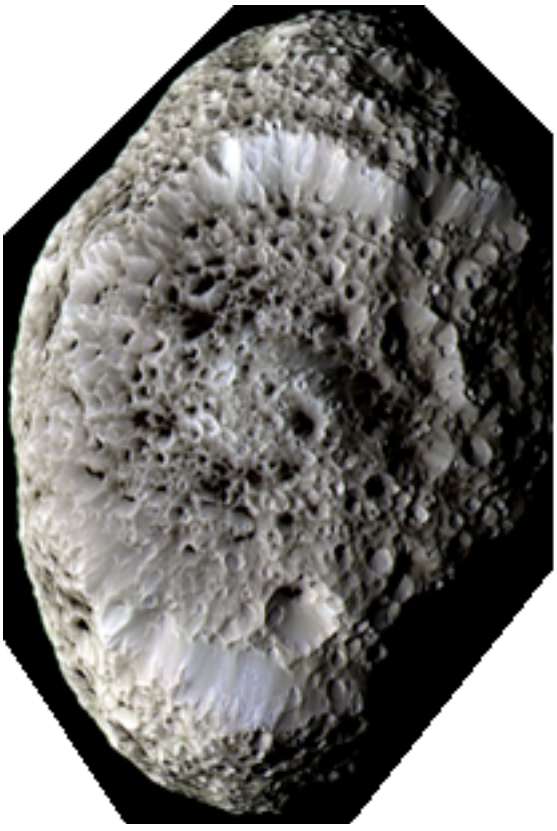
Europe's EADS corporation's design for a tourist space plane with obvious corporate jet heritage, to give 90 minute rides

First Loop-the-Moon tourist signed up by Space Adventures for $100 million "close pass" over sunlit farside of Moon.



Details: http://a52.g.akamaitech.net/f/52/827/1d/www.space.com/images/050810_dse_direct_02.jpg

Saturn's "sponge-like" Hyperion, the largest "irregular" shaped moon in the Solar System



www.space.com/scienceastronomy/070704_sponge_moon.html

New Ice-Drilling Method Tried in Antarctica
Could this be tried on Europa?

[Various sources and Google Search: "IceCube Antarctica"]

www.sciencepoles.org/index.php?articles/ice_cube_antarcticas_crystal_ball&s=2&rs=home&uid=305&lg=en&pg=8

"Buried deep within the East Antarctic ice sheet at the South Pole, a giant high-energy neutrino observatory due for completion in 2009 could provide scientists including from Europe with an unprecedented window to the Universe, as well as a means to answer some of the most fundamental questions of astrophysics and cosmology."

The NSF Center Station, *below*

You can read more about the neutrino observatory from the link and search listed above.

www.sciencepoles.org/pics/projects/rtd_info/rtd_49_icecube_or.jpg

What caught our eye was an article in the Marquette University (Milwaukee) quarterly about the experiences of a co-alumni in creating a "basketball" cross-section drill hole through 8,000 feet of ice (2,438 meters). Andrew Wagner, Eng '83 created the software that guided a high-pressure hose full of boiling water. The apparatus itself was designed and built on anoither state campus, University of Wisconsin in Madison.

http://www.news.wisc.edu/8134.html

The apparatus, a 33-foot long hose reel and sledge, is quite large, and weighs in at 23 tons, but then it holds 2.5 km (1.5 miles) of 3.75" (9.c cm) diameter hose. It would take a pretty hefty rocket to boost something like that to Mars, and an even hefiter one to get it out to Europa, the target that seems most logical. But this is a first version. The apparatus had to be rugged, as it would be used to dirll not one but eighty holes for the neutrino detectors.

Fast Forward: Europa 2035

On Europa, we may also want more than one drill hole, to sample the water, confirm the ice crust thickness, at various locations. Surely we could design our test apparatus to fit down narrower holes! Half the hose diameter, if hose wall thickness is also diminished, could cut the weight to a fraction. By that time, we should have nuclear-thermal rockets (the kind we could have had in the 1980s if Nixon had not been so space-averse.)

Obviously, a source of power is needed to boil the water required. Europa's crust consists of water ice with sundry interesting impurities on which a "Live off the Ice" bootstap operation could be used to create an outpost for future visiting crews. See:

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

Running on Mars Time
During 4-Month Crew Stay
at the Mars Arctic Research Station on Canada's far north Devon Island

by Peter Kokh and Steven Winikoff

During the lead up to this years precedent-shattering mission at the Mars Society's northernmost Analog Outpost, I made two suggestions, the first to the FMARS Engineering team, the second to Robert Zubrin and the analog program director, Tony Muscatello.

1) During the early mission, before spring thaws provided running water in a nearby stream, snow could be melted efficiently using the *waste heat of the station's generator* that would be running full-time anyway.

2) Given that during the whole duration of this mission, the Sun would be above the horizon around the clock this far north of the Arctic Circle (about 75°N) this would be an ideal time to test crew adaptability to Mars Time, using a clock that reset to midnight after 24 hrs and 39 min. Most observers have suggested that the Mars day (or sol) being just 2.7% longer than our familiar Earth day, this would present no problem. But I felt that while this might be true of late sleeping night people, for morning people who can't wait to get each new day started, like myself, this extra 39 minutes a day (0.65 hour), day after day after day could induce a perpetual mild sense of jet lag.

Both of these suggestions were so logical that they must have occurred to others as well, so while I did make them, I would hesitate to claim that both experiments were pursued as a result of my input

But when I read , in a *Mars Daily* report,

http://www.marsdaily.com/reports/US_Canadian_Team_On_4_Month_Simulated_Mars_Mission_999.html

I was delighted to read that the FMARS Crew had indeed decided to run on Mars Time, with a 24 hr 39 minute day.

Communicating the news to my fellow Crew #45 (Artemis Moonbase Sim-1) crewmates from our two weeks at the Mars Desert Station in early 2006, I heard back from one of them, my crew engineer Steven Winikoff of Montreal, about his role in all this, which came as no surprise. Steven writes:

"I actually got to help them do that :-), by writing the code for the FMars clock and the separate FMars/Earth time calculator. The clock needs Java, and can be seen in 4 different sizes at the following four addresses:

www.fmars2007.org/FMarsClock.php?width=790&height=420&size=large

[ditto]width=625&height=250&size=medium

[ditto]width=440&height=200&size=small

[ditto]width=370&height=144&size=tiny

"These all present the same information, the only difference is in how easy it is to read and how much space it takes up on your screen. Personally I like the last one, but your mileage may vary. :-)

"As for the calculator, that's"

http://engineering.marssociety.com/scripts/timeconvert.pl

As of August 4, 11 am Central Time, the mission had run 34 Mars Days, 13 hrs vs 35 Earth days 11 hrs. That is 37 Mars days nearly equals 38 Earth days. Will we age more slowly on Mars! That'd be nice, but trivial. ###

MMM Welcomes back Denver's Front Range L5 Society NSS Chapter

by the editor

With this issue, Denver, Colorado's Front Range L5 Society chapter of the National Space Society rejoins the MMM Family of NSS Chapters. There have long been two chapters in the Denver area. Mile High L5 Society had been founded to serve members from Martin Marietta, and still serves the southern portion of the Greater Denver area, while the bulk of FRL5 members come from the northern Metro area.

Front Range L5 had joined the MMM family starting under the leadership of Jill Steele, with MMM #52, in February 1992 and remained aboard through issue #97, in July, 1996, a period of four and a half years.

It's good to have Front Range L5 back aboard!

Current President is Eric Boethin. Eric approached us in Dallas at ISDC 2007 over Memorial Day Weekend, and we gave him a dozen copies of MMM #201, our 20th anniversary issue, to take back home.

Other Front Range L5 Officers:

- Bill Nelson Vice-President 303-330-2888 billfrl5@hotmail.com
- Robert Eagan Secretary 303-755-2653 (Bob made the phone calls to set up MMM copies for the chapter)
- Dawn Jackson Treasurer 303-437-339
- Rich Westfall Web Editor 303-433-1978

Any chapter's output is limited by the talents and donated free time of its members. This chapter (like most chapters) is looking to fill some specific needs:

- □ Volunteers to build Space Models.
- □ Models to display at schools and libraries.
- □ Volunteers to work display tables at conventions.
- □ A Photo Copier.
- □ Donations to help build our reference library.
- □ People to load data into databases.
- □ Speakers for meetings and public events.

Getting "Caught up"

Front Range L5 members can catch up on most of the good stuff they missed in MMM issues past at:

www.lunar-reclamation.org/mmm_classics/

Here they will find all the non-time-sensitive material from issues #1 through 170 (the first 17 years) reedited, reillustrated and republished in 17 collections, one per publication year, in pdf format, ready for free access downloading. We will add volume 18 next January.

Other NSS Chapters and Local Groups are welcome

NSS chapters can arrange for their members to receive MMM as a membership benefit, at a discounted group rate. NSS hapters in **Los Angeles**, **Philadelphia**, **Chicago**, **Minneapolis-St. Paul**, **Portland**, and **Denver** now belong. Inquiries welcome. Contact Peter Kokh:

(414) 342-0705 (Peter) kokhmmm@aol.com

Moon Miners' Manifesto
1630 N. 32nd Street
Milwaukee, WI 53208-2040

MMM is the longest-running continuously published NSS chapter newsletter, now into our 21st year, with ten packed issues annually. **<MMM>**

Intenational Lunar Observatory Association (ILOA) - Update

5th Contract Between International Lunar Observatory Assoc. & SpaceDev Commences Operational Stage for ILO

Private efforts in space are not just about satellites and new launch systems! They also include this effort to land an automated telescope on the Moon!

The ILOA mission has advanced another step towards realization with the 20 July signing of the 5th contract between ILOA / Space Age Publishing Company and SpaceDev Inc.

The Lunar Lander Demonstrator contract is focused on achieving risk reduction in the critical area of lunar lander technology, as well as initial hardware development. SpaceDev will also provide a 1/6 scale model of the ILO to be presented at the Preliminary Founders Meeting at the 58th IAC in India.

With logistical and promotional support of representatives of the Space Generation Advisory Council, most notably Kevin Stube, the ILOA Preliminary Founders Meeting in India is set for September 26, as organizers of the 58th International Astronautical Congress are confirming the necessary facilities for the meeting.

Along with seeking commercial investors for the multifunctional ILO, the ILOA is also encouraging healthy competition and cooperation among the many Aerospace / NewSpace companies currently aspiring to send humans to space and to the Moon. With this intention, the ILOA is exploring various MoUs with these pioneering companies for the ILO Human Service Mission.

Preparations for the 4-8 November 2007 ILOA Founders Meeting on Hawai'i Island are now well under way. Influential international leaders from the world's major spacefaring nations including Canada, India, China, Russia, Japan, Europe and USA have confirmed their intentions to take part in this historic meeting. Regular registration for the Founders Meeting is still available until October 1 for US$975. Contact the ILOA today to register for the meeting and participate in humanity's next step to becoming a multi-world species.

The 2nd Lunar Commercial Communications Workshop, July 27, was held by Space Age Publishing Company / ILOA at the Santa Clara Hilton. Representatives from Cisco Systems Inc., Ball Aerospace, Space Systems / Loral, SpaceDev, NASA, and other pioneering businesses, made progress in advancing a new field of communications industry and enterprise. The ILO lunar commercial communications function was a central focus of the meeting. A 3rd LCCW may be held this fall.

In early July, the ILOA team visited the Mauna Loa Observatory at 3650m elevation to study its viability as an analog for a future lunar "robotic village". The ILOA is still considering suitable locations for a bureau on one of Hawai'i Island's two major mountains.

ILOA and its affiliate Hawai'i Island Space Exploration Society (HISES) are communicating with Pacific International Space Center for Exploration Systems (PISCES) representatives about possible cooperation. The Hawai'i Island based, lunar focused projects are developing productive synergies that will draw support from the State of Hawai'i, as well as shared participants at their back-to-back November meetings. **<SAP/ILOA>**

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 414-372-9613
Newsletter Mailing - Carol Nelson 414-466-2081

LRS News

• **LRS Picnic in rural West Bend**: On July 7th, 3pm on, LRS members and guests descended on the "dark skies" homestead of Charlotte and Gene Dupris. Attendance was lighter than expected, perhaps because of the high heat, but we had a great time, Our hosts have nearly two acres in a semi-rural setting, and had a host of their telescopes on display. We got to look directly at the Sun through a Lyman Alpha filter and saw a prominence.

• **Gene Dupree gets cameo on Channel 6 news:** On Wednesday, August 1st, Gene and other members of the Northern Cross Science Foundation had their telescopes at Bayshore Mall/Town Center in advance of their "Sidewalk Astronomy" event at that location on Friday Night. Veteran weather forcaster Vince Condella provided a brief peek at this great telescope selection, many of them of a unique design.

• **Discovery World Aquarium Sea-Lab not ready**: as of Sunday, August 5, the underwater Sea-Lab (analog lunar outpost) is still not ready for walk through touring. We are looking into having an exhibit at its grand opening.

LRS Upcoming Events - September, October

Saturday, September 10th, 1-4 pm

LRS Meeting, Mayfair Mall, Garden Suites Room G110
AGENDA: www. lunar-reclamation.org/page4.htm

- Presentation by Peter: **Earth's city lights from space**
- Updates on space and space mission news
- Upcoming conferences and the calendar ahead.

Saturday, October 13th, 1-4 pm

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

Chicago Space Frontier L5

610 West 47th Place, Chicago, IL 60609
INFORMATION: Larry Ahearn: 773/373-0349

MMM 8 NSS Chapters Strong

NSS Chapter Events

Space Chapters HUB Website:
[http://nsschapters.org/hub/]

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 Thursday of the month 7-9pm

August 16: The Stoelting House, **Kiel**
September 20: UW-Sheboygan, Room 6101, **Sheboygan**
October 18: The Stoelting House, **Kiel**

MINNESOTA

Minnesota Space Frontier Society

c/o Dave Buth 433 South 7th St. #1808
Minneapolis, MN 55415

Tom Greenwalt (w) 763-784-6244 (h) 763-442-6015
David Buth (w) (612) 333-1872, (h) (763) 536-1237
Email: tomg@mnsfs.org

[www.mnsfs.org/]

MN SFS News & Pictures

Ben's Convergence pictures

www.freemars.org/mnfan/Convergence/2007/
www.freemars.org/mnfan/Convergence/2007/panos.html
www.convergence-con.org/extras/photos/photos.php

MMM hopes that no MN SFS members lost loved ones in the tragic I-35W bridge collapse!

OREGON

Oregon L5 Society

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

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

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

Allen G. Taylor <allen.taylor@ieee.org>
Bryce Walden <moonbase@comcast.net>
(LBRT - Oregon Moonbase) moonbase@comcast.net

Meetings 3rd Sat. each month at 2 p.m.
Bourne Plaza, 1441 SE 122nd, Portland, downstairs
August 18 - September 15 - October 20

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://www.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: Aug.18 - Sept. 15 - Oct. 20

Sunday July 22nd Meeting Notes: We met at our Liberty One location with good attendance of some of our often busy members.

Both Gary Fisher and Dennis Pearson brought news of events that they had attended and, in Gary's case, presented at, with support material: i.e. both brought computers and paper on several events. Gary brought material from a conference at Rutgers University, in June, on Lunar Settlement. A number of ideas on settlement and why we should go there. These included: Harrison Schmitt on mining Helium-3. This included a cost analysis to give an idea of the value of the resource. In the case of Helium-3 we shrink the size of the fuel containers and much more for the given payloads.

On other topics: there was a neat design for a double walled habitat, by Werner Grandel, that, by constraining the location of the shielding material, cuts the needed soil moving by two thirds! Of the many other talks Gary mentioned one was by Lawrence Taylor on the best place to put a base, where rescuers can reach it!, and Gary's' own on reconsidering hab orientation and coming up with a boxed cylinder design. This would result in significant reductions in shielding material needed. The orientation would be horizontal. In addition: The Mars Society Conference will be held at UCLA starting August 29. There will most likely be a report on the long term habitation at Devon Island, which will have run for four months at this point. And lastly from Gary: Phoenix is going! This is a rocket landing craft that will attempt a polar landing again. We hope this works.

Dennis brought news from The International Space Development Conference in Dallas. This annual event is held by our parent organization, The National Space Society, and will be in Washington DC next year. Dennis brought material in disk form that included: an Avatar Explorer that give the controller a physical proxy in the remote explorers images. As I understand this, if you command the exploring device to go to the left, it can be done by having the avatar point that way. This is a crude example. This may be better explained by people who are on line role players and users of "Second Life" and other interactive suites. The disk (DVD. ?) should be available from NSS as well as other interesting material: another talk was on experimental work done in Wisconsin on Helium-3 -- the material does what was theorized: fusion with very little bad byproducts. This is great! Go to the respective websites (Mars Society and NSS) for more. Note: This was the first year for the Lunar Settlement Symposium at Rutgers and when or if another will happen depends on what the sponsors decide.

Larry, our Webmaster, brought material on our web and blog activity (very little from members) and an article that appeared in USA Today on May 29: "NASA designs a 'roller coaster' escape" by Traci Watson. This new emergency escape system would be used for the new Orion style of crew capsule. In operation, the crew would exit the capsule and board a "tram car" that would plunge down and away from the possible hazardous condition. It looks like the extremely steep drop away part of a tall roller coaster ride. The escape is from over 300' up and will move the fleeing crew away in 85 secs. This from Ruth Gardener et al. Larry may put a link on our site.

In addition, Dotty brought material that Larry will put on the site about a number of events including one at The Franklin Institute, with a Robotic Challenge October 20. This should be a fun event since we like to encourage people in science and technology, and because we expect to use robots, or other semi autonomous constructs, as our proxies on other worlds. And earlier in the month, the Institute will be part of World Space Week, which we will be part of. there will be lots of events extending into the weekend when we will be there. She also mentioned the addition of material at The Hall of Science Museum, in Queens, in the form of an indoor rockets exhibit. We usually mention the outdoors exhibit there so this is an added attraction, at least for now.

Mitch brought material about The World Future Societies Annual meeting to be held in Minneapolis, MN this year. This is an interesting, if pricey, event. Check the WFS website for details. He also brought in NSS's official publication, Ad Astra, which has the results of the art contest, with the finalist picture collection. This looks great! See the magazine, Summer 2007, or the website.

Hank told us his new phone number (& voice mail): 215-724-2690. Philcon will be held November 16 to 18. He will help out but has not been given charge of a track this year, so we will have to individually offer to serve at the event. Hank may or may not go to the upcoming Worldcon which will be held in Japan. He has a paid membership but may not go due to high costs and the extent of the trip, which could cause physical problems. We don"t need free fall for these!

Earl brought material from several sources and added material in this post meeting report: several papers where downloaded from The SETI League website and the publication ***Contact in Context***, with "After Kardashev: Farewell to Super Civilizations" (by Zoltan Galanti Phd) on why we may not be detecting what are called Kardashev societies. We are actually going towards a possible reason: nanotechnology. This could drastically alter how, and why, we would do projects like restruc-turing the Solar System up to the Galaxy itself.

Another good article is " A Third Complementary, Microwave Search Strategy" (by Richard Factor of the League) which describes a clever application of gravitational lensing. We may need to use space craft, as in the original approach, but could do it at a much easier to attain distance from the sun (not at 550 A.U. as in the original concept). This technique could allow the reception of "leakage signals" not deliberately beamed at us at super high power levels. Excellent!

From Nuts and Volts for August, an article on amateur space hardware and a short piece on a liquid mirror telescope being developed at Laval University (www.ulaval.ca) that could make large, near infra red telescopes (66 to 300+ feet aperture) possible here and on the Moon etc. It could observe objects from 10 to 100 times fainter than the upcoming Webb instrument (for this device see: www.jwst.nasa.gov). The concept for this is from NASA Ames. Then there is: Flight Recorder for Model Rocketry by Mike Bessant. This design uses the "picaxe" micro controller and a recently developed memory based on a ferroelectric material. This combination gives a very low cost starting point for this work. And, there is more, of course!

And finally we have Analog Science Fiction and Fact with articles on " Nanotech Rocket Fuel" on the promise, and problems of developing a new family of fuel/ oxidizer mixes that could be ignited in a controlled, throttleable manner. Some of the mixes Dr Stephen L. Gillett mentions could really alter our present flight hardware needs. And, in the same October 2007 issue, Dr. John G. Cramer talks of "Real Nuclear Fusion on a Tabletop" with the techniques used to create high voltage fields using Piezo electric fields generated via thermal stressing of Lithium Tantalate. Excess neutrons where produced! See both the magazine and the UCLA research,

The meeting location was still not fixed at the time of this late posting. *posted by Earl Bennett.*

"No grimmer fate can be imagined than that of humans, possessed of god-like powers, confined to one single fragile world."

Kraft Ericke

COLORADO

Front Range L5 Society

[Greater Denver North]

1 Cherry Hills Farm Drive
Englewood, CO 80113

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

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

Meeting monthly, every 1st Friday, 7 PM

Denver University's Olin Hall, Room 105
http://www.du.edu/maps/olin.html
at **2190 East Iliff Avenue**, Denver, CO

- **Next Meetings: September 7, October 5**

MMM Welcomes back Front Range L5

CALIFORNIA

OASIS: Organization for the **A**dvancement of **S**pace **I**ndustrialization and **S**ettlement
Greater Los Angeles Chapter of NSS

P.O. Box 1231, Redondo Beach, CA 90278

Events Hotline/Answering Machine:(310) 364-2290
Odyssey Ed: Kat Tanaka - odyssey_editor@yahoo.com

[http://www.oasis-nss.org/]
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.

- **August 18 th - September 15th - October 20th**

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

Upcoming Events

- **No information was available at press time either from the website or from *Odyssey* or from the Hotline**
  about events after July, 2007
  (must be summer vacation!)

Recuring Events

- **Fridays** -- Mike Hodel's Hour 25 webcast. The world of science fact and fiction with interviews, news, radio dramas, artists, writers, stories, reviews, and much more. Information: http://www.hour25online.com/.

Vision without action is just a dream

Action without vision is just activity

Vision and Action together can change the world.

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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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Member Dues -- MMM Subscriptions:
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

FRONT RANGE L5 SOCIETY
No set dues, passing the hat as needed

Moon Miners' MANIFESTO

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