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

Moon Miners' Manifesto

& The Moon Society Journal www.MoonMinersManifesto.com

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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. EDITOR: Peter Kokh, c/o LRS, PO Box 2102, Milwaukee WI 53201. Ph: 414-342-0705. **Submissions:** "MMM", 1630 N. 32nd Str, Milwaukee, WI 53208; Email: kokhmmm@aol.com

In FOCUS Space Agencies of 14

The culmination of an effort that began early last December with the release of NASA's Global Exploration Strategy, has been an announcement on May 31, 2007 of a framework agreed upon by fourteen national space agencies, spanning the globe. In alphabetical order:

ASI (**Italy**)	BNSC (**United Kingdom**)
CNES (**France**)	CNSA (**China**)
CSA (**Canada**)	CSIRO (**Australia**)
DLR (**Germany**)	ESA (**European Space Agency**)
ISRO (**India**)	JAXA (**Japan**)
KARI (**Rep. of Korea**)	NASA (**USA**)
NSAU (**Ukraine**)	Roscosmos (**Russia**)

"Space Agencies" refers to government organizations responsible for space activities. There are a good number of additional national space agencies, some of which may in time choose to come aboard. Italy, France, Germany, and the United Kingdom signed individually even though they all belong to ESA.

"This Framework does not propose a single global program. Rather, it recommends a voluntary, non-binding forum, the international Coordination Mechanism, through which nations can collaborate to strengthen both individual projects and the collective effort."

Cooperative measures:

- Exchanging information on respective plans.
- Helping identify √ gaps, √ overlaps and √ synergies in their respective space exploration plans.

Nations to Coordinate Space Effort

"Sustainable space exploration is a challenge that no one nation can do on its own."

More than one thousand individuals from the fourteen national space agencies, as well as non-governmental organizations and commercial interests, collaborated in the shaping of this agreement.

Two Overarching Issues:

1. "Why we are returning to the Moon? "
2. "What we are planning to do when we get there?"

Lunar Focus

1. To use the Moon to **prepare for** future human and robotic missions to **Mars** and other destinations
2. To **extend human presence to the Moon**
3. To **expand Earth's economic sphere to encompass the Moon** and to pursue lunar activities **with direct benefits to life on Earth**

NASA's Priorities in promoting this collaboration:

"Such priorities include, but are not limited to, space transportation (including the Orion crew exploration vehicle, the Ares I and Ares V rockets, and the Lunar Surface Access Module), initial communications and navigation capabilities, the development of a suit for extra-vehicular activity on the lunar surface, providing a closed-loop life support system, and obtaining knowledge about the effects of the lunar environment on humans."

[⇒ p. 2, col. 2]

Modular Biospherics Key to Menu Variety

In a first static or expanding outpost that is merely *structurally* "modular", growing space will be at a premium and food variety will be relegated to a "wish we could afford it" luxury. In an outpost in which biosphere and physical growth are integrated (Modular Biospherics) there will be no shortage of opportunities to grow a greater variety of vegetables, fruit, herbs and spices, pharmaceutical plants, even dyestuffs. See p. 5 .

Moon Miners' Manifesto

Moon Miners' Manifesto / Moon Society Journal is published every month except in January and July.

• **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. Any presumption that participating organizations can be labeled by indirect mutual association is unwarranted.

• **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.

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•• **The Moon Society** is "dedicated to overcoming the business, financial, and technological challenges to the establishment of a permanent, self-sustaining human presence on the Moon." — Contact information p. 9.

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

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

• **Submissions**

√ EMAIL to KokhMMM@aol.com (***preferred***)
√ Mac compatible CD / typed hard copy to:
Moon Miners' Manifesto, c/o Peter Kokh,
1630 N. 32nd Street, Milwaukee WI 53208-2040

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⇒ IN FOCUS Editorial continued from p. 1.

Among forty objectives identified by NASA, these two would seem to be most relevant:

a. **preparing for human missions to Mars**
b. **enabling an extended/sustained human presence on the moon**, such as by demonstrating the **use of in situ resources** and measuring lunar phenomena, **measuring lunar resources**

SOURCES:

http://www.nasa.gov/home/hqnews/2007/may/HQ_07126_Exploration_Framework.html

http://www.nasa.gov/pdf/178109main_ges_framework.pdf
(25 page PDF file)

Commentary

This "voluntary" agreement is a very welcome semiofficial response of the world's major space agencies to the Beijing Declaration proclaimed last August 2, 2006 by the attendees of the 8th ILEWG (International Lunar Exploration Working Group) Conference. That declaration called on all space agencies initiating lunar missions to coordinate their efforts, including calibration of instruments and mission goals.

That these fourteen national space agencies have now adopted this directive bodes well, to maximize the complementarity of missions and their instruments and mission goals, avoiding duplication of efforts and maximizing the comprehensiveness of the combined findings about the Moon.

What is *our* role?

The Moon Society, the National Space Society, and The University of Luna Project, all dedicated to the establishment of human settlements in space, do have a vital role to play. All too often when a new mission is announced, a call goes out for proposals for instruments to fly on that probe. The scientists (investigators) who answer this call do not necessarily share our vision. Many are interested in science for science sake. *Our need is to complete a comprehensive **Economic Geography** of the Moon's resources and of its geological and topographical features of potential economic significance.* If we fail to lobby successfully for the needed instruments, all the probes in the world will not adequately prepare us to open the Moon as a frontier. PK

No MMM Next Month (July 2007)

When we launched Moon Miners' Manifesto with issue #1 way back in December 1986, we announced that there would be ten issues a year, monthly except for one winter and one summer month in order to provide a "burnout prevention/battery recharge break for the editor. This has proved to be the secret behind this rag's longevity.

January and July are our current months off.

We may try to put out another volume or two of Moon Miners' Classics during this time, (that would be #s 16 and 17) but we do not promise that.

Writing and editing MMM is a labor of love for the editor, admittedly, sometimes more labor than love. But here we are in the middle of our 21st year.

Look for the August issue, MMM #207, next.

by Paul Swift <pswift@shaw.ca> Calgary, AB Canada

Rick Tumolinson's oft quoted remark that *"NASA should open the door to space, not be the door to space,"* puts me in mind of some of the steps achieved in early Aviation development to which there seems to be a parallel here.

Admittedly this is just a rant on the transportation segment of a much more comprehensive initiative to settle space, but it's not hard to extend the train of thought to several of the settlement and development areas that bear addressing.

When the Wright Brothers flew on Dec. 17, 1903 at Kittyhawk, they did not instantly achieve worldwide fame, nor did they establish as of that date even in aeronautical circles a widespread acceptance of the possibility of manned flight. It wasn't until they visited France five years later and demonstrated on 08/08/08 before an enormously skeptical but excited crowd of aviation experts and enthusiasts that flight was possible and immediate and attainable by two chaps working in their bicycle shop that the ignition took place.

Within a period of about two years, some hundred and fifty different designs in dozens of countries were airborne, because some upstarts from nowhere had basically spit in their face. The rest is history.

In 1935, twenty two years to the day from the Wright's first flight, the DC-3 became the workhorse aircraft of the world. It opened up vast stretches of Alaska, Africa, India and Burma, The Phillipines and Indonesia, South America, and got the USA into large scale airline operations. Donald Douglas' Cargo or passenger plane was an 'opening door' to the world, and we did whatever we did with it. And we still do. One thousand (of the thousands made) are still in use over seventy years following their construction. Douglas didn't say how to design the airports or terminals, what cargo to carry, how to paint them, or who could operate them. He just built them, established spares and maintenance programs, and had his manufacturing facilities churn out a rather ungainly, awkward, lumbering beast that worked. (Actually I love the airplane; I think it's a thing of beauty and would dearly love to own one.) [1]

Incidentally, there is no more economical way of transporting twenty eight people and their baggage a hundred and fifty miles per hour over inaccessible terrain than the DC-3, and this is being written in May, 2007.

The Boeing 707 did the same for fast international travel, and the Piper Cub of 1947 did the same for everyman and his spouse. These are standards, milestones, and icons for us to refer to when we think of space systems.

In 'Blood Diamond' recently they used a Russian MI-8 helicopter (the white one) to move people and supplies around the impossibly hilly terrain of Sierra Leone (Madagascar in the movie). It is bulky, fuel inefficient, and ungainly, but it works like hell! My pilot friend Don who flies a Bell 212 with an empty weight of about 5,500 lbs and gross of 11,000 says the MI-8 can only lift about five or six thousand pounds, just like the 212, but weighs 16,000 pounds empty. Not too efficient. But in a world in which no helicopter at all, or a slightly ungainly, inefficient monstrous sixteen thousand pound beast lands to transport you and your family to a safer region, I think it is safe to say that 'optimum' is not the keyword; the best phrase we can find is 'functionally adequate'.

We need a Space Piper Cub, a Space DC-3, and a Space MI-8. Note that none of these, like their namesakes, are expendable or discardable, they would not be optimally efficient, they would not carry the most the fastest or the furthest but they would work.

They would work on the Moon and they would work on Mars. They would work in the asteroids, and they would work in space itself.

In 1946, the government of Newfoundland on the east coast had a group of nine ships built called coastal freighters. Their job was to transport cargo (mainly coal and fish) to and from all the little outposts around the island. They were a far cry from the state of the art in boats at the time, being built of wood and using massively overbuilt clunky old diesel engines. But they worked. With a top speed of about eight knots, they could take all the Atlantic could throw at them, and survive.

Sometimes the craft for the job has to match the job requirements in such a way as to preserve the structure as carefully as the crew. The ships were only about 500 gross tons and 127 feet long, but for years were the mainstay of support of those little coastal villages. I was fortunate enough to own one of them, the Avalon Voyager II, a few years back.

We are talking here about a family of transportation devices. For getting around the Moon or Mars or the asteroids, the same solution may be unlikely, but the solutions should have some common characteristics. All need a crew cab, a life support system, a power system, a navigation system, a fly-by-wire system, a control system, a running gear system, a communica-tion system. Why should effort be expended on custom solutions for each of these requirements when they can all be the same, admittedly tailored for the specific implementation?

Today we can see some small efforts in this direction by Airbus, or EADS, in the cockpit design of several of the A3xx series of aircraft in which the layout and functionality of cockpit controls is almost identical from model to model.

The point is this: a big problem can be divvied up into smaller ones. And small problems are just challenges.
Case in point: getting into orbit. (One of the trivial ones :)

Why have six motors of a million pounds thrust each to lift up a four million pound vehicle to the twenty percent point of orbital velocity, then throw them all away as the next stage cuts in? I'm not sure what a million pound thrust motor (rocket engine) would tally these days, but I'll bet I'd have to pay a hell of a GST (Goods and Services Tax) at the U.S./Canada border to get the suckers through. In any case, their cost becomes the base 'nut to crack' to generate revenue from, or simply pay for the launch. At ten million dollars each, there's sixty million of revenue just to cover their direct costs. The Shuttle of course is just as bad. 35 Million or so for the External Tank, and about the same to refurbish the SRB's. *Incomprehensibly stupid.*

Go for the launch system that doesn't use up anything except fuel. Reuse it every day, several times a day. Like the DC-3. Yes, it could be more efficient, but let's make it cost effective for the one who hires the launch service. There's the difference between #3,000-$4,000 a pound to LEO and $15-#20 a pound.

In the early 90's, a friend of Mine, Donny, got a job with Ethiopian Airways flying a cargo Boeing 707. He was the co-pilot. They had the pilot, a grizzly old veteran of African air operations, Donny, and a mechanic back at Addis Ababa. About once a week the mechanic changed the oil. Since they had four of everything, they just kept flying until they only had three, then had the offending piece replaced. Admittedly, this maintenance philosophy wouldn't quite cut it in North American airline operations, but Africa is Africa. Bottom line is: they operated the hell out of that plane to make money and move goods.

The name of the game is Operations, not experimental launches. You do experimental launches with 3,000 personnel on the ground to prepare for the next launch; when you operate, you use a dozen, or in Donny's case, three. Take up another load; land, refuel, reload, and repeat until the maintenance manual enforces an hour shutdown for scheduled inspections and replacements. Then continue. That's how to do it, and so what, like the MI-8, if it isn't quite so efficient in its payload to weight ratio? ***It works. It's cheap. and it gets the job done.*** And like the coastal freighters that stayed afloat in 1949's worst storm at sea in a century, where over fifty ships were sunk, the nine coastal freighters survived to work again the next day.

Robert Zubrin's Pioneer may have gone back to sleep until a better design comes along, and to some extent Andrews' Two Stage To Orbit, runway based, Alchemist system could step up to the plate. So industry and entrepreneurs are the ones to watch for the new ideas about getting into space. **<PS>**

[1] **Ed.** I had *my* first plane ride in a DC3 also, in 1948. PK

THE LUNAR MINERALS RAP

(with back-up lyrics) April 4, 2007

*Moon Society Director of Project Development
**Roomer in Home of Moon Society President, Peter Kokh

Back-up lyrics indented

You the man! Bring the Band,
When you land on the lunar strand.
On the lunar strand!

When you land you got rocks:
Silica and hematite
Bring the Mare girls!
Olivine & Pyroxene
Olivine and Pyroxene!

Take them out for a bite with
Cubanite and Whitlockite
Satisfy their Apatite for
big Mackinawite.
big Mackinawite!

No copper band on their hand?
They all upset? Don't lose your bet
Get Tranquilletyite.
Get Tranquillete!

Zircons hard and Garnet too and
Iron, Tin, Brass to name a few.
To name a few!

The Baddeleyite Boys are Corrundum rough
with Spinels made of volcanic tuff
Geothite, Ilmenite, and Rutile too, with
Armalcolite and Magnetite, to name their crew.
To name their crew

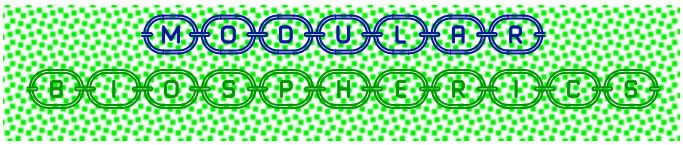
Don't Sphalerite or Chalcopyrite and keep it clean
Amphibole Troilite to make the scene
Amphibole Troilite to make the scene

Pentlandite and Zirkilite may play the fool but
Plagioclase feldspar is way too cool
Plagioclase feldspar is way too cool!

Is Pyroxferrite on the Moon?
Just drag your magnet and you'll see real soon.
You'll see real soon!

I'd like to Rock and I'd like to Roll but
I really can't stay 'cause I got to go.
I like to Rock but I got to go!

NB. Dave (white, 62) and Torrey (black, 20) may seem like an unlikely combo, but you should hear them! Too bad we couldn't get Torrey to ISDC in Dallas ! - PK



VI. Food Production with Diversity: vegetables, dwarf fruit trees, herbs & spices

by Peter Kokh

Most of the "Experimental Lunar Agriculture" projects I am aware of, were attempts to show that we could grow various staples, notably wheat and potatoes, under lunar greenhouse conditions. While it is essential that personnel on the Moon receive adequate nourishment, the "human system" requires more than just nourishment. If humans are going to be productive in frontier situations, they must be reasonably content.

Now a lot of factors come in here, but one thing is not debatable. Tasty and varied menus are indespensible to keep personnel productively content.

From that point of view, we need a variety of vegetables and carbohydrate sources. Those that can be prepared in a number of different ways rise to the top in priority, potatoes, for example, but also several others.

Nor do most people long tolerate bland food, unless you happen to be British :-)

Vegetables and Salad Stuffs are not enough. Most of us would dearly miss occasional or regular fruits. Now the problem with fruit is that most fruit plants take longer to mature than vegetable plants do, significantly longer. Short bushy fruits like blueberries and strawberries might be the place to start. Apples, for example, would not be available very soon. Cultivating dwarf fruit trees makes sense, not only for quicker maturation, but to fit limited cubic greenhouse space.

Herbs & Spices must not be neglected. These additions can be added by each person to prepared and pretested food items, to suite their taste. Some cannot tolerate spicy foods at all. Myself, I can consume XXXX buffalo hot wings with no problem.

Cultivating plants with medicinal and pharmaceutical value would be a smart choice, if only to cut down on the import of over-the-counter remedies.

Beyond the Greenhouse

The communal greenhouses will of necessity concentrate on the key staples and principal vegetables. But if our outpost morphs into a settlement by modular additions, and if we follow the principles of "Modular Biospherics," we will have many opportunities to grow supplemental crop varieties.

If each module has a Wolverton type toilet waste graywater system, some of the plants involved could be herb, spice, and pharmacopeia varieties. Living walls in connector passageways give ample opportunity for growing supplemental crop varieties. But it is important to realize that these passageways are "commons" areas. The personnel (and pioneers) will have to respect an honor system not to help themselves. And, there must be a person or group of persons who adopts each living wall and cultivates its plants.

If private quarters contain some well-lit spaces in which small private gardens can be maintained, this will provide a special opportunity for cottage industry enterprises that specialize in adding special treats to the diet.

Weekend or sunthly (following the cadence of the lunar month: dayspan, nightspan, dayspan, etc.) markets could feature both cottage industry stalls and consignment areas, where produce (and produce products such as preserves, salsa, prepared condiments, cut flowers, floral arrangements, ornamental houseplants, and organic dyestuffs) can be marketed. In this way, free time hobbies will provide a variety that could not otherwise be made available, while jumpstarting an indigenous pioneer economy of goods and services.

Integrating Architecture and Life

We cannot stress enough that these developments will require a commitment to "Modular" Biosphpherics," by which the biosphere and biosphere mass will grow automatically with the addition of each new module. Yes, if we proceed with sheer physical expansion, and add neighborhood air and water and waste biomass treatment facilities as needed, we will eventually reach a population size threshold, a much bigger population and higher threshold, at which food varieties will begin to appear.

But if we adopt the Modular Biospherics plan from the gitgo, in the architecture of the first core outpost, we will be able to benefit from food and menu and byproduct variety much sooner, from the very start. The earlier constructive traditions are adopted the better.

Modular Biospherics in a Lunar Analog Station

Modular Biospherics is something that can't wait. That is why we have worked this special architecture into the preliminary planning of our own (Moon Society - NSS) Lunar Analog Research Station proposal.

Click on "Proposal Slide Shows" at the top of:
www.moonsociety.org/moonbasesim/proposals/index.html

If we do not start off on the right foot from day one, the delay could easily grow to a decade or more. Of course, adopting "modular biospherics" implies a commitment to continuous occupancy. That is what we all thought was implied in President Bush's call for NASA to "Return to the Moon to Stay." Unfortunately, Mike Griffin is committed only to producing and landing a core lunar outpost that would be enduring, but not continuously occupied. But then he has also scrapped all NASA advance life support projects. Advanced = biologically assisted. Shut down are both the BioPlex in Houston and Purdue's NSCORT research program. We are clearly off on the wrong foot. This may be a gamble by Griffin to force Congress to raise NASA's annual budgets, but it is a game of "chicken" that can only lead to a program crash.

Private and Private Enterprise efforts to deploy lunar outposts are the only real hope that things will be done as they should be, and that we will locate them in an area where all the needed resources are available, not just water and sunlight, a place out of which we can rationally expand. But I digress to grind my favorite ax.

Modeling "Modular Biospherics" is the only way to test out the vision outlined above. In an open-ended modular lunar analog research station, where each module contributes something to life support, many options can be tested to see which work best, better, and good enough: graywater system options; living wall system options; supplemental food and other plant growth options. Without a Modular Biosphere type analog station, our dreams are unlikely to come true. **<MMM>**

Making BLISTER STEEL on the Moon

by David Dietzler <pioneer137@yahoo.com>

Lunar Iron Fines

Iron in pure form is not very useful. It could be used for habitat if the plates are thick, but it is to soft for any kind of machine part like gears, chains, drive shafts, axles, etc. These must be made of hard steel. Before we can have large scale ore smelting by Direct Reduction and CO recycling for iron and steel on the Moon we can get lots of iron from molten silicate electrolysis and iron grains separated magnetically from mare regolith. Regolith is 0.5% iron grains by mass by some estimates and this iron contains some nickel and cobalt because it is of meteoric origin (1). A more recent report states that iron fines are present at about 0.15% (2). We will use the latter figure, although there may be regions in the mare where iron fines are more abundant.

Some of this iron is in elemental form and some is □ combined with glass in particles called agglutinates. Magnetic extraction will remove the agglutinates as well as the free iron. Grinding, sieving and further magnetic refining will be required to break up the agglutinates and separate failry pure iron grains.

A Simple Way to Convert Iron to Steel

This iron can be converted to steel by heating it with carbon for several days. Steel obtained this way is called blister steel because blisters form in it when gases escape from the coke; however, on the Moon we will by using very pure carbon instead of coke so blisters might not form. Blister steel can then be melted, mixed with flux (CaO and possibly MgO) that removes impurities like silica (left over from the agglutinate glass that might still contaminate some of the iron) to get a high quality steel. So we will be able to obtain steel before we are able to build blast furnaces and CO2 recycling systems for really large scale steel making on the order of several hundred thousand tons per year for SPS, helium-3 mining machines and lunar populations and tourist resorts.

Iron from solar or electric furnaces that the beneficiated iron grains are melted in will be poured out in trenches about a foot wide and 15 feet long to get slabs a few inches thick. These slabs will then be hammered to drive out any silica contaminants and cold rolled to strips less than an inch thick. A box made of ceramic blocks from magma electrolysis that melt about about 1500 C. will be constructed and embanked with regolith. A solid ceramic lid with iron reinforcing bars and a carbon black surface will cover the box. Alternating layers of iron strips and carbon dust will be placed in the box. Solar energy will be applied to heat it up until the iron is red hot at about 1100 degrees C. Or, electric heat will be used.

At a concentration of 0.15% there are about 4800 tons of iron grains in 3.2 million tons of regolith that can be removed magnetically. Let us say simply that we want 2400 tons of steel per year. That would represent a reasonable 50% recovery rate. To make 2400 tons of 1% carbon medium steel we will only need 24 tons of carbon, so we will not starve our biospheres for CO2.

Then we need 200 tons per month or Sunth if you like that term. Two hundred tons of iron will have a volume of about 5m x 5m x 1m or about 16ft x 16ft x 3.2ft So we would need a chamber about 17ft wide x 17ft long x 3 or 4 ft deep to allow expansion of the iron and have room for the thin carbon dust layers between the strips of pure iron. Solar rays or microwaves would be used to heat this until it is red hot and the carbon will be slowly absorbed. It will take 7 to 10 days to convert iron to steel this way. Thus, more sophisticated and more productive methods of smelting iron and steel will someday be called for on the Moon.

See: The Damascus Project
http://www.moonminer.com/Damascus-Project.html

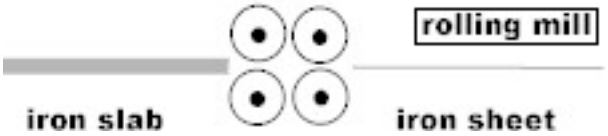
A 40 MW thermal power tower can concentrate the equivalent of 3.4 million BTUs or about 106,000 kilocalories in one hour, enough to heat almost a ton of iron from zero C. to 1000 deg. C in one hour. Some complex engineering regarding heat flows and stresses is called for to make this seemingly simple system work effectively. Don't want the ceramic box to crack!

Links to more information about blister steel

http://en.wikipedia.org/wiki/Cementation_process
http://www.tilthammer.com/timeworks/steel.html
http://www.channel4.com/history/microsites/T/timeteam/2004_sheff_steel.html

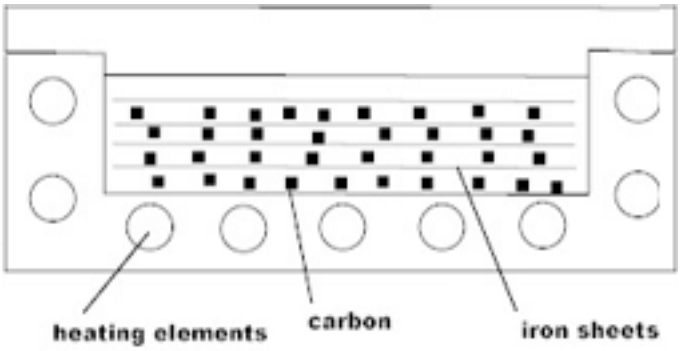
The Process is as Folows

1. Harvest solar wind implanted carbon by heating regolith. Carbon will react with oxygen in regolith and form CO and CO2 that will be reacted with H in Sabatier reactors to get methane that will be pyrolized for pure carbon black.
2. Take Liquid iron from molten silicate electrolysis and mix with free iron fines and pour out into slabs in compacted regolith molds similar to sand molds. Slabs a few inches thick
3. Roll slabs into sheets

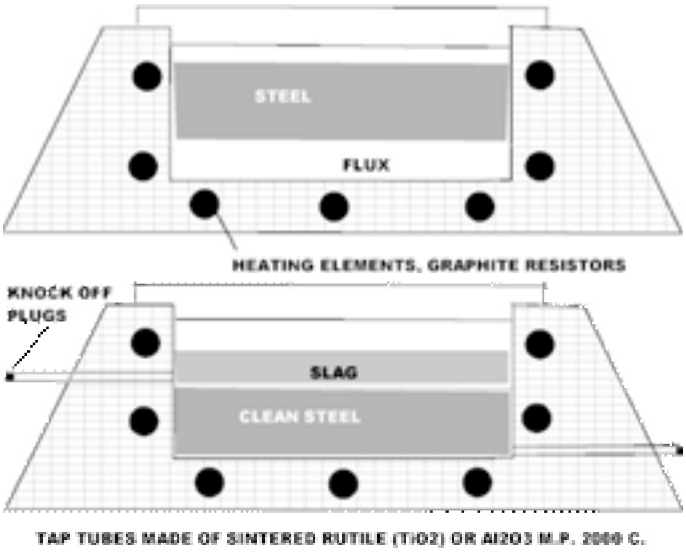


A rolling mill will be a heavy piece of equipment to upport to the Moon, but no heavier than a mining harvester/tractor, and later we will make rolling mills as well as other heavy equipment.

4. Place sheets of iron in cast basalt or ceramic block box with carbon between the layers of sheet iron. Heat to cherry red, about 1,000 °C, for 7 to 10 days. The iron will take up carbon and form blister steel. This is also called “crucible steel.”



5. After 7 to 10 days, steel will form. Use robot crane with electromagnet to lift steel out of “furnace.” Place steel in electric furnace (below) with flux.



6) Flux of CaO and MgO obtained by fluxed molten silicate electrolysis and acid leaching will remove impurities of silicon and sulfur and high quality steel will result.

Upshot

It seems reasonable that we could obtain 2400 tons of iron in the form of fines containing a few percent nickel from 250 acres mined to a depth of one meter. This would be about two million tons of regolith. At 0.5% free iron fines 10,000 tons of iron would be present, but recovery rates never equal 100% and some moondust might contain less that 0.5% iron fines. So 2400 tons is a safe bet.

Reserving Carbon for Biosphere Needs

Major objections have been raised by those who feel that steel making will deprive Moon base biospheres of precious carbon that is so rare on the Moon.

As stated above, only 24 tons of carbon will be needed to make 2400 tons of 1% carbon steel. That's a fairly high carbon content for steel. At 0.33% carbon, we would need only 8 tons of carbon per year. To protect the Moon's natural carbon resources, could we justify upporting 8 tons of carbon per year to the Moon even at $10,000 to $30,000 per pound or $160 million to $480 million??? Perhaps.

In ten years we would produce 24,000 tons of steel. How much is that? Well, the Eiffel Tower's iron structure amasses 7300 tons. So we are talking about three Eiffel Towers worth of steel in 10 years!!! That's plenty.

See: http://en.wikipedia.org/wiki/Eiffel_Tower

Note: Calcium aluminate can be used as flux in the steel cleaning furnace. It could be likened to a ladle furnace. Only 10-15 kg of $CaAl_2O_4$ per ton of steel might be needed. See:

http://www.fuzing.com/vli/002021123289/HOT-Calcium-Aluminate-For-Refined-Steel_making-Fused-Type

Calcium aluminate might be obtained by solar thermal decomposition of anorthostie. See: Flux

1) Phinney et al., 1977.
http://www.islandone.org/MMSG/aasm/AASM5E.html#5e

Comments welcome as always <DD>

Sweet Spot for Lunar Surface Sports?

by Peter Kokh

So you want to go to the Moon for a month, long enough to experience a full dayspan-nightspan cycle and perhaps a bit more. Sure you want to explore the sheltered spaces of the settlement town, and experience the Moon's light gravity.

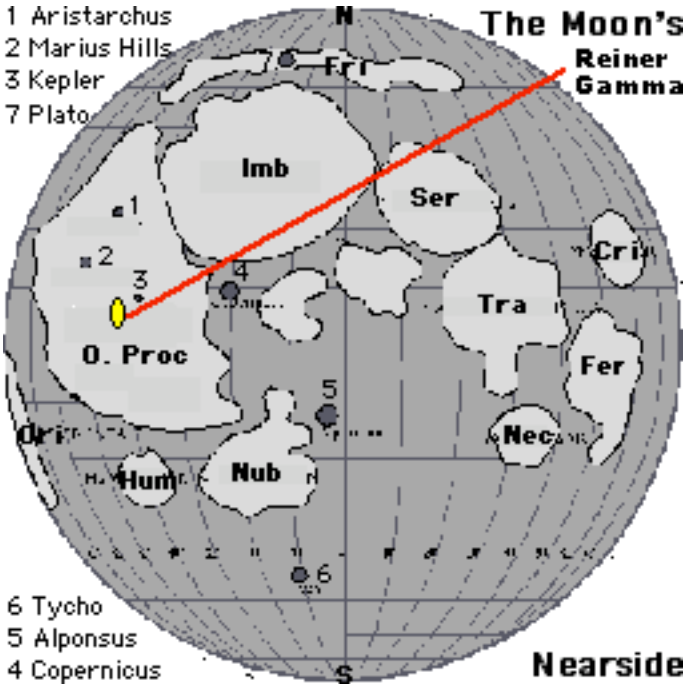
But you also want to run, romp, and play in the moondust while looking at the stars in the Moon's black sky. You want to try riding a lunar motorcycle, climbing hills, throwing a football. In short, you want to "do the outdoors" or "out-vac" as the Lunans call it, and not just the "indoor and middoor spaces" safely tucked away under a moondust blanket."

But, ...! But you could be risking your health with a little too much "unnecessary" exposure to cosmic rays. Best to limit that to necessary travel to and from the spaceport and to an outlying settlement or two.

Sweet Spot Discovery?

Well, scientists have discovered one area on the nearside that has a small residual magnetic field, an area located at 57.8° West, 8.1° North, in the Ocean of Storms, Oceanus Procellarum, on the near (visible) side of the Moon, and has an extension of approximately 30 by 60 kilometers. (18x36 miles). This area is known as Reiner Gamma.

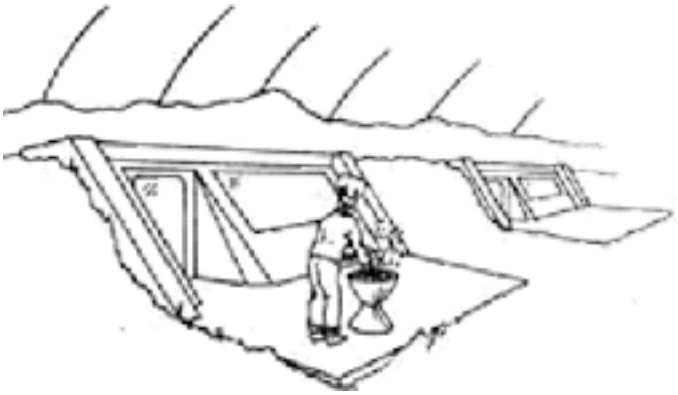
http://www.space.com/scienceastronomy/061114_reiner_gamma.html



Now the magnetic field here is weak. It would provide some protection, but not a lot. But for tourists, for whom perception is 90% of fact, this spells "oasis." Will Reimer Gamma become a lunar tourist "recreation mecca?" Will it also become a favorite vacation spot for settlers as well?

Possibilities for this "Out-vac Recreation Mecca"

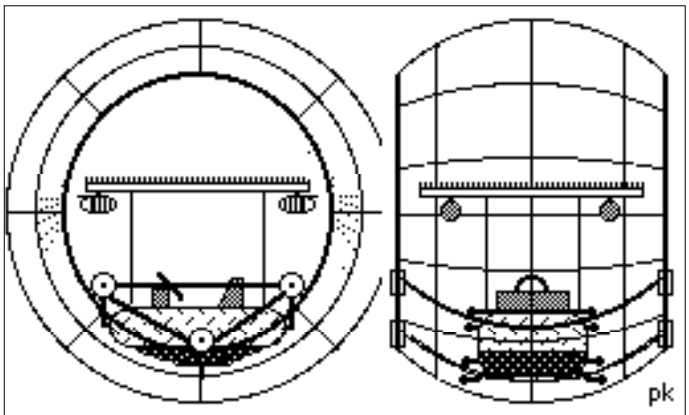
Hotels in the Reimer Gamma "radiation-lite area" might sport larger windows in hotel guest suites, looking out directly over the terrain and various activity areas, as well as direct views of Earth itself 32° over the horizon.



Vacationer barbecuing on cottage patio
under glass vault to expose the lunar skies

Illustration by David E. Cremer
©1989 Lunar Reclamation Society

Various human powered conveyances, like the unicycle surrey and three wheeled low center of gravity, leaning tricycles, lighter weight, more flexible, less constraining spacesuits, observation domes, etc.

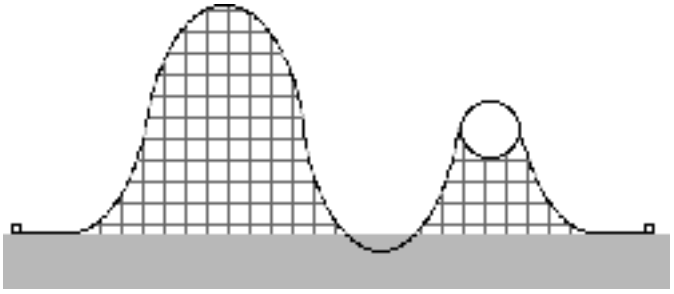


Lunar "surrey with the fringe on top"

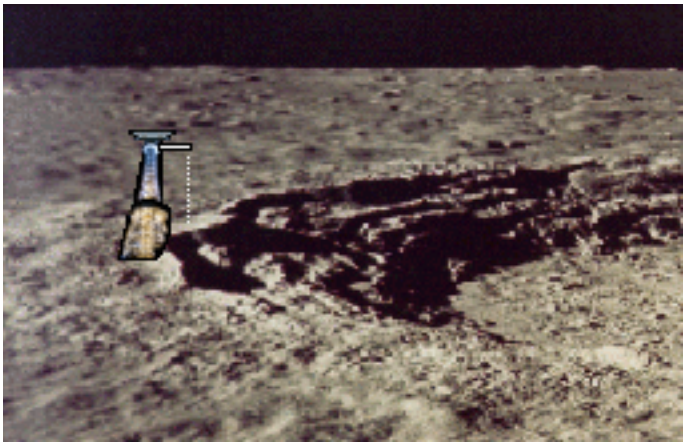
Watched *"American Gladiators"* lately? Have you seen the "Atlasball" segment? Next time picture space suited lunar thrill-seekers working their geodesic cages along a rally course of craterlets etc. Might be fun if the sweat of exertion and the overheating inside one's space suit could be handled!

Similar solar powered spheres could be equipped with a track riding buggy capable of generous side-to-side movement or banking. Such an "off-road vehicle" - call it a unicycle, an auto-tracker, a cyclotrack, or whatever - could open the vast lunar barrenscapes to the sports-minded "outlocks" types and help avoid cabin fever.

Heck, why not an out-vac recreation park, the kind with rides, of course. *Combine low gravity with zero air resistance and greater heights!* Hurtle down a roller coaster slope a hundred yards/meters high to disappear into a pitch dark tunnel and back up.?



Or doing a bungee cord jump from a tower a kilometer high. And, of course, a lunar golf course.



Observation Towerer with Revolvinv Restaurant
at Crater edge, with bungee cord jump point
Copernicus shown, but could be anywhere

Well, maybe that's all stretching it. The residual magnetic field at Reimer Gamma may not be strong enough to warrant that much freedom in out-vac activities and exposure. But it is fun to think about a lunar oasis where one of the downers of the Moon's harsh environment is a little bit less harsh.

Confirming or debunking this Daydream

What is needed is a lander/rover to to measure the radiation flux inside and outside of this oval area, starting at the center, then proceeding to and past the edge on the shortest route along the ellipse short axis.

Would a future lunar tourist company pay for such a survey? If a billion dollar resort complex was at stake, of course! On the other hand, NASA might be interested in the data for "science' sake," and pick up some of the tab.

Daydreaming should be fun! And there is an out-doorsman in most of us! **<MMM>**

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!

2007 Moon Society Elections Ballot

from the President

Dear Moon Society member,

We are now conducting the annual election of officers and directors in the Moon Society. This election is being conducted by both email and paper mail ballots. You may vote either way.

Your ballot must be received (email) or post-marked (postal mail) August 1, 2005.

Two directors will be elected this year to maintain the total of five. Officers whose terms expire this year are Vice President and Treasurer. All posts are two year terms.

An electoral statement for each candidate is included at the end of the ballot [page 10]. Please consult these statements for guidance in voting.

This is a preferential ballot. Indicate your preference with numbers, [1] being your first choice, [2] your second and [3] for third choice using the form below. Do not skip or duplicate any numbers. If you prefer, you can stop voting before you have reached the total number of candidates for any one office. If you do so, and during the counting that point in your ballot is reached, your ballot will be counted as "no preference" for that position.

We have sent an email ballot out to all current Moon Society members with valid email addresses on file. If you did not receive them, it may mean that we do not have your current address or it was blocked by your spam filter.

If voting by email, please include your membership number, if you know it, and email your completed ballot to the Moon to the elections email address:

elections@moonsociety.org

If you vote by mail, send the paper Ballot to **Moon Society, PO Box 940825 Plano, TX 75094-0825**, postmarked by August 1, 2007.

OFFICERS VOTE

Vice President (Vote for one)
[ ] Charles F. Radley #868
[ ] write in candidate

Treasurer (Vote for one)
[ ] Dana Carson #10
[ ] write in candidate

BOARD OF DIRECTORS VOTE (in alphabetical order)
Vote for only 3 candidates: Place 1 - 3 beside each name (in order of preference)
[ ] Scotty Gammenthaler # 393
[ ] James Gholston #929
[ ] Randall Severy. # 125
[ ] write in candidate

Voter's Signature_____
Membership # (if known) ___

President's Comment: All of the above candidates have been very productive during the past year. While we have no contests this time, we are fortunate to have an outstanding slate, and *I urge all members to vote as an indication of confidence and support.*

Members who would to have non-voting input on the deliberations of the Leadership Council, are welcome to email me with their request for Council access: kokhmmm@aol.com.

Candidate Statements

OFFICERS:

Vice-President Charles F. Radley #868

Former Moon Society Director, 2005.

I have been working on lunar development for 40 years.

In 1968 I read about Solar Power Satellites and said ... Yes, this is THE solution. In 1976 I read about Gerard O'Neill so in 1977 I read the High Frontier, and said, yes, finally a plan which makes sense. In the last 30 years I have not heard a better plan, so I am continuing to work on the original O'Neill vision. I joined the original L-5 Society in 1979.

I have an extensive track record in NSS, L-5, AIAA and many other organizations.

The American Institute of Aeronautics and Astronautics made me an Associate Fellow of their prestigious society, primarily because of my contributions in revitalizing their Venture Pacific Section, as well as my professional record.

Began posting to the usenet sci.space.* newsgroups in 1989. I operated an NSS BSS on fidonet from 1990 through 1992 Was a regional director of the National Space society from 1994-5 and have been active in the following NSS Chapters: Ventura County (CA), Cuyahoga Valley Space Society (OH), Oregon-L5; as well as active in the California Space Development Council and Midwest Space Development Corporation.

My professional background includes B.S. Physics, M.S. Systems Engineering, 10+ years aerospace experience. Was a part time technical consultant for Transorbital Corporation, the first private company licensed by the U.S. government to explore and land on the moon. Was a member of the subcontractor teams for the Galileo and Magellan space probes, the International Space Station, Spacelab-MSL-1 and several communications satellite projects.

Treasurer Dana Carson #10

I'm a computer consultant dealing in web based systems. Previously I worked for Westinghouse Aerospace building tools for the embedded systems developers. I've been a space enthusiast since Apollo and have been on the board of the Moon Society since its founding.

BOARD OF DIRECTORS VOTE (in alphabetical order)

Scotty Gammenthaler # 393

I was one of the founders of the Moon Society and have previously served as Treasurer, a Director, and Chairman of the Board. In my capacity as Treasurer from 2000 through 2005, I was responsible for collecting and depositing funds, paying bills, and preparation of financial statements.

I also led the effort to obtain 501(c)(3) non-profit recognition from the IRS, and I developed most of the on-line membership registration system and other parts of the web site.

For the past two years as Chairman, I have led meetings of the Leadership Council and Board of Directors and participated in organizing and supporting our MDRS mission, our presence at ISDC 2007, and many other activities.

I feel that my previous experience as an officer, Director and Chairman of the Moon Society will be valuable to the Society in understanding our history and deciding future actions. I remain committed to the goals of the Moon Society as expressed in our organizing documents and in public statements of our position on various issues.

James Gholston #929

Things have gotten a lot busier in the Moon Society in the year since I was appointed to fill an unexpired term. I am proud to have done my part in this rising momentum of productivity.

Mike Delaney and I launched Lunarpedia (www.Lunarpedia.org) and that effort now includes four other wikis, including one for Mars development.

I have also instigated a project that began with video-interviewing fifteen people at the 2007 ISDC and plan to continue to play an active role in the editing and use of this material to promote the Moon Society and its goals. Hopefully you will read more about it soon.

I look forward to causing more productive mayhem and invite you to join in. It's as easy as visiting www.Lunarpedia.org and making an update to something or adding a few sentences on something for which we don't yet have an article.

Randall Severy. # 125

In several leadership roles in Artemis Society International since late 1995, I have worked hard to help build the society into an effective world-wide organization.

When the Moon Society was founded, I joined the board of the new organization to continue that effort. I also founded CyberTeams, one of the early program participants in the Artemis Project. To help other program participants get started and develop, I formed the Artemis Project Business Team. If re-elected to the Board, I will continue to devote my time to growing the organization and supporting projects launched by the Moon Society.

We are now on *MySpace.Com*

New member **James Rogers**, who has been very active in submitting articles to **www.Lunarpedia.org**, has now created a MySpace.com Profile for the Moon Society, with the blessings of the Leadership Council. Check it out:

http.://www.myspace.com/moon_society

All organizations in *all* fields of interest, are "graying" as once younger members get older and as younger people are not joining in replacement numbers. What worked for us older members, no longer works for today's youth, and we "don't have a clue."

If you have ideas on how the Moon Society can more effectively reach out to young people, please pass them on to James Rogers at:

< ***jarogers2001@aim.com*** >

The Moon Society at ISDC 2007

Our activities at the annual International Space Development Conference, this year in Dallas, were by and large successful, but with some disappointments.

Videotaping Project

On the plus side, we videotape-interviewed some 15 persons, mostly of considerable noteworthiness, on a wide variety of topics related to the Moon. A partial list included Dr. Paul Spudis, Rick Tumlinson, Dr. T.D. Lin, Kirby Ikin, Dallas Bienhoff, ISDC co-chair and Moon Society member Ken Murphy, Michael Bakk of the Calgary Space Workers, and others. Retired Hollywood screenwriter and Moon Society member Chip Proser did the videotaping while Moon Society Director of Project Development, David A. Dunlop, supplied the questions, tailored to each individual's areas of interest.

With over 7 hours of tape, all shot against a green screen, we now need to supply appropriate backgrounds, and make a selection of the interviews and script it into a DVD and a series of pod casts that can go on YouTube.com.

This project was the brainchild of Board member James Gholston (Denton, TX) and approved by the Board with a sizable budget. The idea is to produce materials that can reach out to a wider audience, both to let them know we are here, and to encourage them to join.

The Moon Track & our Presentations

Chaired by Society President Peter Kokh, this track was one of "way to many" competing events, with the result that attendance at the talks was very light. Peter talked on Lunar Analog Station plan s and both Peter and Dave Dunlop presented The University of Luna Project. Peter's talk on the Human Expansion Triway into Space, in the Space Settlement track, was better attended.

Our Displays

In the exhibit area, we had a table with a multi-panel display about the Society, our goals, and our projects. Co-Chair Ken Murphy added his 3-dimensional contribution including a moonbase and meteorites to the front. Three Society flyers (general, Lunarpedia and The University of Luna Project) were included in the registration packets prepared for each attendee, and we had more material at our table.

Some of this material was also available in our hospitality suite, which was well attended the first two nights, less so the third night, and by Sunday night, we were all out of steam and packing. The suite served as well as a place to videotape our interviews.

Awards

There were three rounds of awards. In the first round, I surprised James Gholston and MIke Delaney (not present) and David Dunlop with Moon Society certificates of appreciation for outstanding service to the Society. James and Mike for their work in creating and launching www.lunarpedia.org, Dave for his 7 week & 7,000 mile long road trip, at his own expense to contact movers and shakers around the country about the Moon Society and about the University of Luna Project.

Next, The University of Luna Project, spun off as an entity with its own board and governance, presented three awards to persons who, on their own, with some but not major NASA support, did the kind of research and development that the University of LUna Project wishes to encourage. These were:

- **Dr. T.D. Lin** for over twenty years of research on **lunar concrete**, which he is continuing in retirement with collaborators from several universities in his Taiwan. (Area of In Situ [local] Resource Utilization
- **Phil Sadler** of Sadler Machine Company and the entire team at the Controlled Environment Agriculture Center (**CEAC**) at the University of Arizona, Tucson, for their work on the Food Growth Chamber at the south pole (area of Biological Closed Life Support)
- **Dr. Alan Binder** (not present) for his work in the design of Lunar Prospector, and in holding his team together through several lean years until NASA picked up his **Lunar Prospector** mission for a Discovery slot (area of orbital prospecting for resources)

These awards were "classy" including a print of Pat Rawlings' "Space University" with each print personally signed by him, a special certificate paper background, and a color-coordinated metal frame.

PHOTO location

Finally, **Peter Kokh** was caught quite by surprise when Board Chair Scotty Gammenthaller, presented him an award for his achievement of reaching the 20th anniversary of **Moon Miners' Manifesto**. This award will be dearly treasured! It was signed by eight persons: (available) officers, directors, and members of the Society

Disappointments

There was simply too much to do to get ready for this big event. We had prepared a membership drive offer for those who had not previously been a member of the Society: "If you register during the ISDC, your first year's dues will get you two years membership, to be renewed at the regular 1 for 1 rate." Our registration flyer was done at the last minute, and inadequate, and we had not put together a strategy to collect the registrations. One of those "learning experiences."

Members attending

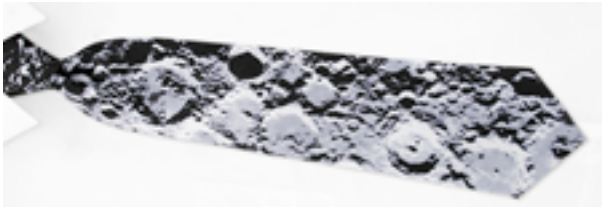
It is quite possible that there were Society members on hand who did not identify themselves to us. But known to have attended are: Peter Kokh, Scotty Gammenthaller, Randall Severy, James Gholston, Dale Amon, David A. Dunlop, David Heck, James Rogers (who joined the day ISDC opened), Michael Bakk, Ken Murphy, Larry Friesen, and former members Marianne Dyson and Guido Meyer (one of our crew members at MDRS last year.) Our apologies to anyone we missed.

It would unreasonably tax our resources, both financial and human, to put on our own conference. It is far more effective for us to "piggyback" on the widely known and respected ISDC sponsored by the National Space Society with whom we now have an affiliation.

Next year's conference will be in Washington DC, this time, the weekend *after* Memorial Day Weekend. The 2009 event was undecided, but Orlando seems to have the edge over Toronto, because the Canadian sponsors did not present an acceptable hotel contract.

[Member Service Announcements]

Attention Speakers & Enthusiasts



Moon Cratered Surface Tie

At ISDC 2007 in Dallas, we noticed a speaker with a tie showing a very interesting slice of the lunar surface. We asked him where he got it, and after much searching, found the exact link:

http://www.wildties.com/ties/WS228446.html

If you do a lot of speaking for your chapter or otherwise about the Moon, you may want to invest in one of these striking ties. (~$25) All the information you need is on the link above. *No part of the cost of this item goes to the Moon Society treasury.* What's in it for us is that little extra effect you may have on your audience.

"The level of detail at the surface will provide you with a breathtaking visual experience. You will believe you are on the Moon!"

New Software created by Moon Society member Manny Pimenta, now being used by NASA Ames! Quite a recommendation.

The program is based on a breakthrough software architecture called RADE that powers the entire Moon simulation to run in real time on home computers / laptops..

"We use the best available 3D lunar topography data from NASA derived from the 1994 Clementine mission. You will be walking on the actual terrain model of the Moon! On this underlying terrain model we created additional detail layers that are gradually switched on as you approach the surface."

http://www.lunarexplorer.com/

Lunar Explorer is available for **$39.95**. If you identify yourself as a Moon Society or NSS member, that organization will receive a $5 kickback. **News Story:**

http://news.com.com/Taking+a+ride+on+the+moon/2100-11397_3-6111838.html

System Requirements : Windows XP or 2000, DVD Drive

Minimum Configuration: 800 MHz Pentium 3 CPU, 384MB RAM, 4 GB Hard Disk Space, 64MB Video

Recommended Configuration: 1 GHz Pentium 4 CPU, 512MB RAM, 8 GB Hard Disk Space, 128MB Video

*__Note:__ Only NVIDIA and ATI graphics chipsets supported.

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 **3rd** Wed. monthly at Buder Branch Library 4401 S. Hampton, in the basement conference room

Contact: Keith Wetzel <kawetzel@swbell.net>

On Wednesday, May 23rd, MSStL members Bob Perry, Dave Dietzler, and Mark Rode joined Moon Society Pres. Peter Kokh and Moon Society Director of Project Develop-ment David Dunlop, both en route to ISDC 2007 in Dallas, at Washington University in St. Louis.

First we met Margo Mueller in the Geology Bldg. Her aide gave us a tour of the **Regional Planetary Image Lab**. We saw a full scale mock-up of the MER rovers (Spirit & Opportunity.)

Then we met Dr. Paul Carpenter, also in the Geology building to see the microprobe lab. After that we took Dr. Carpenter to lunch at a spot of his choosing, before Peter and Dave continued on their road trip to Dallas.

MSSTL member Dave Heck of Boeing St. Louis also attended the International Space Development Conference in Dallas.

Meanwhile, Moon Society President, Peter Kokh has challenged our "talent-laden" chapter to enter the **Apophis Mission Design Competition**, see p. 14, below.

Moon Society Phoenix Outpost

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

Contact: Craig Porter <portercd@msn.com>

We are gearing up for Spacefest 2007, Aug 17-19, at The Mesa Convention Center. Join us! Information: 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.

GREAT BROWSING !

Alternative Trajectories for Getting to the Moon
http://www.thespacereview.com/article/845/1

Details of Bigelow Aerospace Game Plan
http://www.thespacereview.com/article/852/1

Bigelow Aerospace Inflatabe Module Growth Chart
http://www.bigelowaerospace.com/out_there/complex_modules_size_up.php

Importance of Space for the Poorest Nations
http://www.thespacereview.com/article/850/1

What are we learning from ISS Medical Research?
http://www.thespacereview.com/article/856/1

Budget & Techincal Obstacles to the VSE
http://www.thespacereview.com/article/859/1

Space Solar Power: Why? and How?
http://www.thespacereview.com/article/868/1

Space solar power: opposition and obstacles
http://www.thespacereview.com/article/881/1

Getting around the Political and Technical Obstacles to Sending Humans to Mars
http://www.thespacereview.com/article/872/1

A Spaceport on the Shores of Lake Michigan?
http://www.thespacereview.com/article/876/1

The Bombardment of Sheboygan
http://www.thespacereview.com/article/880/1

Mars Rotaion movie
http://www.astronomy.com/asy/objects/mm/2005marsrotationdp.wmv

Create your own My NASA page
http://www.nasa.gov/home/
√ click on the My NASA link at the top
√ click on Register for My NASA now!

"Molniya" Research & Industrial Corporation (Buran, and other Experimental Craft)
http://www.buran.ru/htm/molniya.htm

Walking the Moon on the Earth: Newberry, Oregon Geologic Fieldtrip
http://mywebpages.comcast.net/picspace1/newberry-fieldtrip1.htm

Hawking's Warning & Creating a Solar Civilization
http://www.tdf.it/2006/2/peart_eng.htm

Book Review: Distant Worlds (solar system updated)
http://www.thespacereview.com/article/879/1

The challenges of funding space startups
http://www.thespacereview.com/article/887/1

Mars rover's disability leads to big water discovery
http://www.jpl.nasa.gov/news/news.cfm?release=2007-061

The Myths of Spaceflight
http://www.thenewatlantis.com/archive/6/simberg.htm

Lunar Commercial Communications Workshop July 27, Santa Clara, CA
http://www.spaceagepub.com/ilo/July2007WorkshopAnnouncement.htm

"The Best Way to Predict the Future — is to Invent It!"

Welcome to the Mars Underground
Sing to the Red Martian Sky

By Bob McGown *version3*

***W**elcome to the Martian Underground*
We've come 200 million miles
and its time to party
Martian landing on Vallis plain
We're here to learn and have some fun

Rover gone to Olympus Mons
Post midnight by my monitor
Snow capped Tharsis is asleep
Spelieo lava tubes icy weep
Come to the martian underground

We're here and we're not going back.
A life of Mars discovery
Northern sea early mystery
Chip off micro fossils in red rock
Great cosmic mysteries to unlock

We reached out our hand
To a planet of life so red
Some where up ahead
Far beyond our reach
The future will reach back

Discoveries abound through the years
Ships will come like thunder
The martian winter's long night
We're working for love in star light

After the nova reaches Earth
On Mars our steel spirit will shine
Exploring the boundary of life
Beyond the gate of dawn was man
We have walked on z martian sand

***W**elcome to the Martian Underground*
We've come 200 million miles
and its time to party
Martian landing on Vallis plain
We're here to learn and have some fun

From a desert in Oregon red sand
Where she peered through the sky
At star parties below on Earth
We hold the deed to martian land

Her mama hunted space rocks
Her papa searched a system solstima
time under the stars taught her well
A yearning for unseen lands to tell

I will miss you mother Earth
We are traveling out there
We are working toward another dawn
Sing to the red martian sky

***W**elcome to the Martian Underground*
We've come 200 million miles
and its time to party
Martian landing on Vallis plain
We're here to learn and have some fun

[I had renewed inspiration from my friends at the Mars society conference 2003 in Eugene Oregon. After observing the ice caps on Mars with my friend astronaut John Grunsfeld, I wrote this song. This song is to be performed with spacey sounds. – ***Bob McGown***]

Mail For MMM

Lunar Lander Design Remarks

05/01/'07. I seem to recall, in a couple of recent issues of MMM, some fussing about some choices that have been or are being made about the design of the vehicles for the Moon-to-Mars initiative. Perhaps your readers would be interested in hearing how things look from a designer's point of view.

On February 22, our Houston AIAA (American Institute for Aeronautics and Astronautics) Section held a dinner meeting. The featured speaker was John Connolly, who is heading up the design effort for the Lunar Lander vehicle for the initiative on the NASA side. Here are a few of the things he had to say about factors that drive design decisions that have been made and are being made. (The design is still in progress. Decisions and idea considerations are still being made; it is not a "done deal" yet.)

NASA deliberately sized the larger of the two launch vehicles for the initiative (I believe it is currently being called Ares 5) much larger than it would need to be just to get cargo to LEO. They sized it big enough to send payloads to the Moon, and to launch later Mars mission vehicles in large chunks, to minimize the amount of on-orbit assembly that will then be required. It is to be a 125 ton to LEO class launcher.

They have selected liquid oxygen and liquid hydrogen as propellants for the descent stage of the Lunar Lander for one major reason. No other propellant combination has the performance to deliver the payloads they want to the lunar surface, within the lift capacity of the Ares 5 launcher.

The ascent stage of the Lunar Lander has what John calls a "large gear ratio". By that he means that every kilogram of ascent stage multiplies into many kilograms of previous stages required to get it to the Moon. The ascent stage has one of the largest, perhaps the largest, such mass multiplier of any element in the launch stack. This fact tends to drive the designers to make the ascent stage as small as possible, within the performance requirements given for it.

NASA director Mike Griffin has told the design team there will be an airlock on the Lunar Lander. When the team approached Griffin with the idea than an airlock is one possible solution to the problems of crew egress/ingress, minimizing loss of breathing gasses, dust control, etc., he told them "there will be an airlock."

The previous concept for the manned lunar program of sorties first, followed by establishment of an outpost has been reconsidered. The plan now is to begin to establish an outpost from the first crewed landing, with possible sorties to other locations later. The rationale is that if we really want to learn how to live and work on another planet, so that we will be ready when our chance to go to Mars comes, then let's get started.

During the question and answer period after John's talk, I asked: If we really want to start setting up an outpost right away, what would happen to his stage sizing, propellant selection, and other design choices, if one of the first payloads we land at the outpost site is a piece of equipment to start producing propellant on the Moon - say liquid oxygen?

John responded that in his mind, one very early thing we ought to do is produce some water from lunar materials - whether by melting polar ice, by combining solar wind hydrogen with oxygen from the soil, or some other means. Then we should show an astronaut drinking it on live television. He said that he is a great believer in in-situ resource utilization for making the program more efficient and less costly. (I have known John for several years; I know this to be true, he wasn't just trying to sound good.) But in his mind, it doesn't seem to be real to the people in charge of funding. He believes that a demonstration such as an astronaut drinking lunar water is what it will take to get the people in charge of the purse strings think of in-situ resources as something realistic to pursue.

Larry J. Friesen, Houston, TX.

[Editor: Larry has been contributing valuable and much appreciated technical commentary to MMM for many years, and is a Moon Society Advisor.

We had the pleasure of meeting him in person at ISDC 2007 in Dallas, TX, over the Memorial Day Weekend.

Thanks, Larry, and keep it coming!]

Apophis Mission Design Competition Update: *"Find it! Track it! Tag it!"*

Asteroid Tagging Contest Getting Wide Interest

from The Planetary Society [See Report, MMM #203 p16]

More than 100 teams and individuals from 25 nations are developing plans that could helps save Earth from a killer asteroid. All have sent The Planetary Society notices of their intent to enter the Apophis Mission Design Competition, which invites participants to compete for $50,000 in prize money by designing a mission to rendezvous with and "tag" a potentially dangerous near-Earth asteroid.

Read more >>

http://planetary.org/programs/projects/apophis_competition/20070523.html

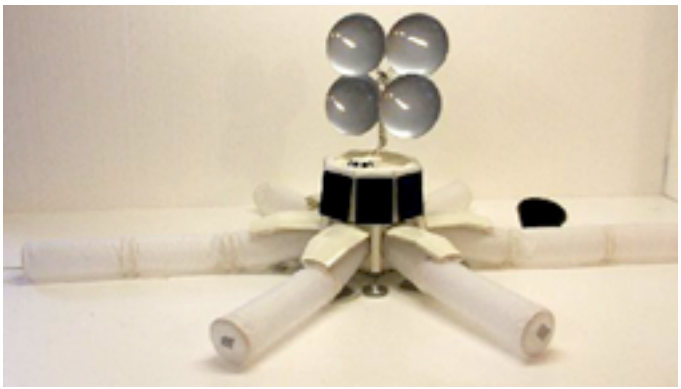
MMM PHOTO GALLERY

ISDC CoChair Ken Murphy (L)
and Michael Bakk (Calgary Space Workers) (R)
It's not that Mike is so short but that Ken is so tall!

Bigelow Moonbase Concept

Above, we have a complex which, to judge by the Soyuz module docked with it, is in space. But note the feet on the outrigger modules. Bigelow plans to assemble a lunar station in space, then land it preassembled. EVA labor, if needed for assembly, would be cheaper in LEO than on the Moon. Everything could be checked out before descent to the lunar surface. Unlike the TransHab design which may have influenced the current Zubrin Mars Hab design, Bigelow's modules would have floors that run parallel to the main axis of the inflatable rather than perpendicular to it. See illustration to the right.

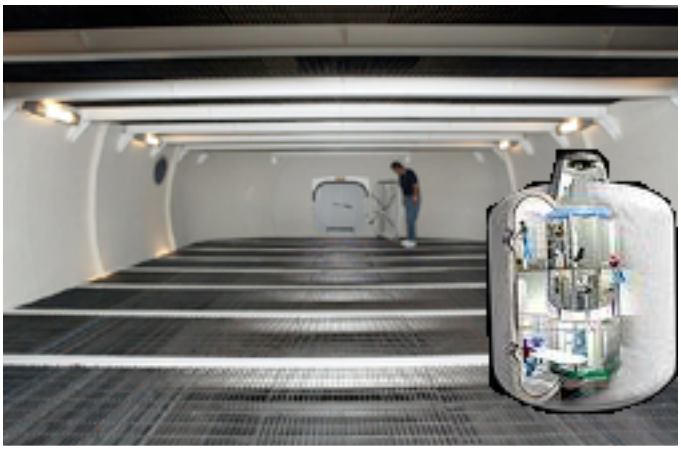
Model for a Lunar Analog Station proposed for the Antarctic South Pole - by Phil Sadler



This model includes solar power arrays (top) above a hard hull crew module (top floor) and a lower module which houses six inflatable arms for greenhouses and all other outpost functions. It is ingeniously designed and unfolds from just one lunar descent module.

We saw this unfolding (with the encouragement of human hands) in the ISDC 2007 exhibit area, and later,in an animated film. The lander first deploys a remote-operated bull dozer which immediately sets about digging trenches for the six inflatable arms. Then the whole thing (prior to inflation of the arms) litterally walks (on its six controlable landing legs) over to the center of the star shaped tench network, ans settles down. Then the arms unfold through air pressure, and finally the bulldozer covers them with regolith. *Ingenious and elegant and absolutely amazing!*

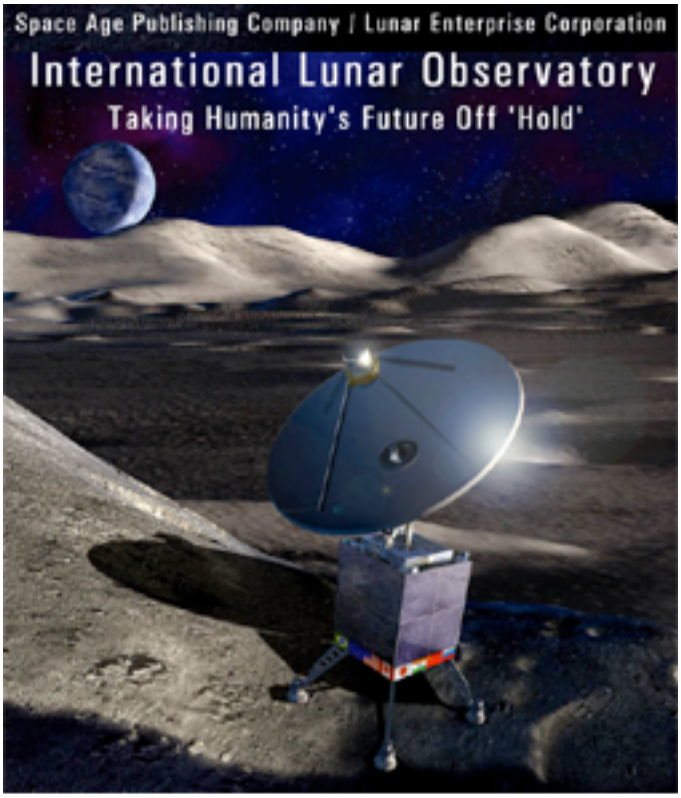
Phil Sadler had spent 13 years in Antarctica at the Amundsen-Scott South Pole Station, prior to building the Food Growth Chamber there that supplies two salads a day for all 75 crew members. One of the advantages he gives for placing this proposed analog station there, is that snow in full Earth-gravity, has the same weight per given cubic amount, and lunar regolith in one-sixth gravity.



Main floor of a Bigelow 330 Module

Compare floor orientation to that in the TransHab inset.

Apparently, Bigelow Aerospace has weighed the advantages of both orientations and come down quite solidly on the side of the horizontal one, for various reasons, including ergonomic ones. <ED>



In mid-2003, SPC's subsidiary, Lunar Enterprise Corporation (LEC), commissioned SpaceDev, Inc., a Poway, CA-based, low-cost space industry solutions company, to conduct a Phase-A study for an ILO concept. SPC wanted to see if an ideal lunar-based astronomy mission could be accomplished within a short period of time, with today's technology and for low-cost.

SpaceDev's Phase-A study, finished in late-2003 and presented at the International Lunar Conference (ILC) 2003 / International Lunar Exploration Working Group (ILEWG) 5 / International Conference on Exploration and Utilization of the Moon (ICEUM) 5 in Waikoloa, Hawaii Island, (which SPC organized) concluded that such a mission was indeed feasible - - for remarkably low-cost.

According to the study, it could take less than 2 years to develop the ILO and place it on the lunar surface, utilizing what's been learned from many previous Moon missions. In helping create the ILO, SpaceDev can utilize its experience from developing and operating the revolutionarily low-cost CHIPSAT mission for NASA. The ILO can be constructed using the lowest cost, highest quality parts and materials that the space industry has to offer. It can be ground tested in and operated from the most affordable facilities. SpaceDev's Phase-A study suggests the dependable, low-cost Ukraine Dnepr rocket as the ILO's launch vehicle. After blasting off from Baikonur or Russia 's Dombarovsky base, the ILO mission is flexible. It could reach the Moon in less than a week or else take one to two months to reach the Moon, inspecting the landing site and taking valuable Earthrise imagery. This would actually lower the overall mission cost by reducing the number of necessary ground stations.

Based on the Phase-A study's suggestion to learn more about landing aspects of the mission, a Phase-B study, which LEC commissioned from SpaceDev in July 2004, focused on landing capabilities to ensure that the ILO arrives at the Lunar South Pole safely , precisely.This second study was completed in Nov. 2004 and presented by SpaceDev CEO Jim Benson at the ILC2004 / ILEWG 6 / ICEUM 6 in Udaipur, India.

The study opted against the added expense of an orbiter to aid the ILO's navigation, instead providing the option of using several reliable methods that employ the lunar surface. It concludes that using one or any combination of these methods would allow the ILO to land within about 100 meters of a specific target location - accuracy that has never before been achieved. ILO Display modelscan be seen in Poway, CA or Kamuela, HI.

As currently envisioned, the ILO will be about a two-meter dish, multi-wavelength observatory standing at **about three meters tall**, with communications and solar powered. Several missions and payloads can be added to the ILO to increase the scope of its overall mission. An arm with a water ice ground truth detection capability or a lunar rover are among these possibilities.

ILOA Steps Up Global Outreach Campaign In Preparation For Nov. 4-8th Founders Meeting

Information on the Preliminary Meeting in India (26 Sept.), and a focus on the ILOA Spectrum of Support. Potential ILOA supporters and participants around the globe will receive the Announcement in early June. ILOA is also stepping up its global outreach with presentations at Conferences in Asia, Europe and America, and increasing interaction with the ILOA Advisory Committee.

ILOA plans to be fully engaged at the 58th IAC (International Astronautical Congress) Hyderabad, India, to gain endorsements, reach MOUs, and secure contracts with participating national space institutes and agencies. ILOA acting Directors Steve Durst, Charles Bohannan and Leilehua Yuen will be promoting the ILOA with a display booth and poster presentation, highlighted with a Founders Meeting Preliminary Session on Wed., 26 Sept. India may also provide the ILOA chief lunar astrophysicist; prominent space scientist UR Rao.

The 9th ILEWG ICEUM / International Lunar Conf. 2007 (Sorrento, Italy, 22-26 Oct) provides ILOA with the chance to hold a Founders Meeting Preliminary Session in Europe. Further confirmation and details available in July.

Plans for a Mauna Kea Bureau: ILOA acting Directors met with Mauna Kea Support Services Ranger / Hawaiian cultural practitioner Kimo Pihana who gave the ILOA his official endorsement, approval and Hawaiian blessing to proceed with a mountain bureau and related plans for Hawaii island processing facilities.

At the 'Rutgers University Symposium on Lunar Settlements' (New Brunswick, NJ, 3-8 June), acting ILOA Director Steve Durst will speak on the ILOA dual mission, distributing the Founders Meeting 2nd Announcement.

Support for th:e ILOA mission from Japan and China During Steve's science, technology and business meetings and conferences in Tokyo (at JAXA w. Kohtaro Matsumoto) and in Beijing, at the America-China-Japan ISCOPS technical meeting and the Humans in Space IAA symposium.

A **Lunar Commercial Communications Workshop** in **Santa Clara**, CA **July 27**, should identify ILO commercial investors, catalyzing a new communications industry.

Check the ILOA "virtual dynamic nexus" online at www.iloa.org for latest news, announcements, endorsement opportunities and Founders Meeting registration information. **</MMM>**

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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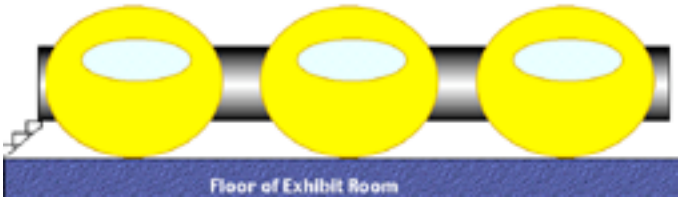
(*Board Members & Ken Paul <kenpaul@cape-mac.org>)

LRS News

• **Peter Kokh & Dave Dunlop take in ISDC 2007**: It was quite a conference and both productive and encouraging. So much is now happening. Report at the June meeting.

• **Lakefront Aquarium "Seabed-Lab" won't be ready until later in the summer.** Peter paid a visit on May 30th. The exterior of the 3 pods and the connections between the pods are done. But interior finishing and outfitting remains, before it will be tour worthy. Peter showed a sketch of the unfinished lab at the June 9th, meeting.



A seabed facility is analogous to a moonbase, water substituting for the vacuum of space. This version is beside the aquarium and not really in the water, which will make touring it much easier. We will be approaching Discovery World about leaving some relevant literature tracing these comparisons. The location is just across the drive from Pieces of Eight. Tickets to Discovery World and the Aquarium (only in combination) run $15 for an adult.

• **Melinda May Mastel**, a 6th grader from Brookfied, and her family, and new member **Elizabeth Beasly**, from New Berlin joined us, greatly enlivening our June 9th meeting!

July 7th Picnic at Charlotte & Gene's

6219 Jay Street, Myra WI 53095 (E of West Bend)
3 pm on, Pot-Luck info <grdupree@netwurx.net>

Saturday, September 9th, 1-4 pm

LRS Meeting, Mayfair Mall, Garden Suites Room G110
AGENDA: www. lunar-reclamation.org/page4.htm
Reports on Summer events, Updates on space and space mission news, conferences etc. The calendar ahead.

MMM 7 NSS Chapters Strong

NSS Chapter Events

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

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
June 16 – July 21 – Aug. 18

Chicago Space Frontier L5

610 West 47th Place, Chicago, IL 60609

INFORMATION: Larry Ahearn: 773/373-0349

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

Tuesday June 12th MNSFS meeting was held at Craig Rostal's at 7 pm, 433 So. 7th St #1808 Minneapolis. The plans for the Convergence science room were discussed

Pics from Onan friday nite, June 8th.
www.freemars.org/mnfan/MAS/2007-06-Onan-June-8/

All Ships Picnic Invitation from USS Nokomis (StarTrek)
Indian Mounds Park in St. Pau
Sunday, August 4th, 5-9 pm rain or shine
Bring Potluck Items enough to feed MNSFS gtoup
Questions? Call Madline **651-338-6954**

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

June 21st; The Stoelting House, **Kiel**
JULY 19th: UW-Sheboygan, Room 6101, **Sheboygan**
AUGUST 16: The Stoelting House, **Kiel**

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 from **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 or Mitch 215-625-0670 to verify all meetings.

Next Meetings: June 16 - July 21 - Aug. 18

Meeting Location and Dates: The July meeting could be at the Jersey shore but may take place at The Nastar Center, thanks to an offer from Alex Howerton of the Center, where we could meet and tour the facility. This would be on July 21, just after Moon Landing Day. Call Earl to vote on this change. Note that the date may be shifted to accommodate Alex and the Centers schedule.

Event Notes: we had no formal meeting in May, But did we have fun? You bet! Our first activity was the annual public outreach and science education program at the New Jersey State Museum in Trenton where Super Science Weekend is held. This happened May 19 and 20 with a number of members giving demonstrations of various space related concepts and cool "hands on" experiments. The famous Space Bricks where very popular with several members, and a guest, supervising the experimenting as children figured out where gravity would make the bricks feel the way the samples felt compared to the Earth reference brick. This exhibit was manned by Richard Horsfall, visiting from Texas , Dennis Pearson, a member of our group and NSS, Michelle Baker, our Treasurer and very active member (NSS, Mars Society, more). and Dorothy Kurtz and Larry Pezutto, who advise on travel and museum events, and our Webmaster respectively, all supporting our outreach that promotes education in science and technical education. We do this with demonstrations and activities for children and talks with teenagers and adults. Some things, like Michele's' " Would you like to make a rainbow?" showing the effect of thin films on light, are not "Space Science", but encourage interest in the sciences by example. Much of our talk is for the general public normally but we add material for the more technically savvy people at an event like this. A number of the children where explaining consequences of what I was saying before I did!

As Technical Director I brought many of the "show and tell" items connected with my areas of interest and what I think would be cool. to show. This time I reworked our "Kilogram of Science" into a mockup of a CubeSat miniature satellite currently being built by a number of organizations. Speaking of these satellites led to what could be done with them (whatever you can come up with within the standards for the program) and the connection to Ham Radio as your ground control/technical advisors. I brought The AMSAT Journal to support this part of the talk.

We showed magnetic levitation and repulsion and tied it into the Mass Driver concept as a way to reduce materials cost for space projects. Cost limits were explained and how our "linear motor" could cut, that drew a fair amount of comment as did another display I developed called "The Tumbleweed". This structure was built to encourage people to think outside the normal lines or channels that we often stay in. In particular: this example has no motors, no wheels, and no large power pack to push it. Using this structure made of soda straws, glue, and some plastic end pieces, I was able to explain the ideas of "conceptual models", massive redundancy, and swarms of simple rovers. I explained some of the mistakes I made developing the design and different materials investigated (Science Fair projects anyone?). The best part was rolling the Rover across the floor after allowing the crowd to hold the rovers string ("Why do I have it on a string? last year it was outside and it worked! It got all the way to the lower parking lot before we caught it. You could use it anywhere there's' an atmosphere"). Besides the demonstrations we also brought a Mars Globe, courtesy of Gary Fisher of the Mars Society and The Mars Homestead Project), and a Moon Globe, courtesy of Mitch Gordon (National Space Society and The World Future Society), that came in handy with our audience. Some thought the Mars globe was a color coded Moon until they saw the other globe

We had a lot of questions, during our two day outreach event, about the Space Ship One and its carrier (The White Knight) and other Human Spaceflight activities as well as the exploratory probes, such as Messenger to

Mercury, and talk of Pluto and the Discovery probe going to it. Many of the younger audience wanted to hear of these because they where "robotic" nd any robots that might be going in our place or as companions as well. This would be a good "draw" if you could have a "demonstrator" to show and tell the visitors about. In our case maybe next year.

And last of all: we had a visit by Michael Stewart, one of our busy members who is involved in education as a profession and an avocation, who came with several children and was delighted to see our exhibits and to be able to gather ideas for his own work.

As always, I would like to thank our hosts at the New Jersey State Museum, the event being coordinated this year by Dr. Bill Gallegher, and the staff of the museum that where a great help.

Reported by Earl Bennett

SOLAR SYSTEM AMBASSADORS
www.jpl.nasa.gov/ambassador/

Miki Baker
Princeton/Philadelphia
MikiBis@gmail.com

Bill Higgins
Chicago, IL
higgins@fnal.gov

Bill Hensley
Kenosha, WI
bil_h51@yahoo.com

Harold Schenk
Sheboygan, WI
schenk@excel.net

Planning Ahead!

ISDC 2008

The National Space Society's Annual International Space Development Conf.

May 29 – June 1, 2008
(one week *after* Memorial Day Weekend)

at the Capital Hilton
1001 16th Street NW
just two blocks from the White House
1-202-393-1000

Washington, DC.

http://www.isdc2008.org/
http://www.isdc2008.org/register.html

Early Bird Registration Rates ended June 15

"Our goal is to end the exclusivity attached to manned space travel, which means designing a privately-built vehicle which can fly almost anyone to space safely *without the need for special expertise or exhaustive, time consuming training,"*

Virgin Galactic

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/]
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.
• June16th – July 21st – August 18th

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

Upcoming Events

- **Sat. June 16th, 1 pm** – The next OASIS planning meeting will be Saturday, June 16, 2007 starting at 1:00 pm at the Los Altos Branch of the Long Beach Public Library, 5614 Britton Dr, Long Beach. This meeting will be followed by the presentation *Astoria: First Space Colony in the Astroid Belt*.
- **Sat June 16th, 3:30 pm** – OASIS hosts *Astoria: First Space Colony in the Asteroid Belt*, a presentation by students of Cerritos High School, Long Beach Public Library, Los Altos Branch, 5614 Britton Drive, Long Beach. Call the *OASIS Hotline,* 310/364-2290, for more information.
- **Sat. July 21st, 11:00 am** – OASIS Monthly Business Meeting, Pollywog Park, 1601 Manhattan Beach Blvd, Manhattan Beach. The Annual Pot Luck Picnic follows at 1:00 p.m. (See below.) Call the *OASIS Hotline,* 310/364-2290, for more information.
- **Sat. July 21st, 1:00 pm – OASIS Annual Pot Luck Picnic**, Pollywog Park, 1601 Manhattan Beach Blvd, Manhattan Beach. Look for the Big National Space Society Sign. Call the *OASIS Hotline,* 310/364-2290, for more information

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/.

Note to readers: As OASIS does not publicize its events on its website more than a few weeks in advance, we regret that we cannot give you advance "heads up" on upcoming events in the month or two ahead. Do consult the website for the latest information. – The Editor

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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*

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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

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

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