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

Moon Miners' Manifesto

& The Moon Society Journal

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In FOCUS: It's a New Moon Race:

Recently, little Malaysia, consisting of the southern part of the Malay peninsula and the northern third of Borneo, population 26 million, and best known for its booming capital city, Kuala Lumpur, announced its ambition to beat NASA to the Moon. www.space.com/missionlaunches/ap_050829_malaysia_moon.html

With what technology?" you giggle. But these days, the technology is for sale. Not NASA technology which is only drawing board stuff, but Russian and Chinese technology which, however relatively unsophisticated, is quite capable of getting the job done. Were it not for the 30-40 year old Soyuz and Proton, the International Space Station would have had to be abandoned after the Columbia disaster, probably by stranding the crew then aboard to face death by starvation or asphyxiation or suicide.

Meanwhile, China's Shenzhou capsule, a much improved redesign of the venerable Soyuz, has proved itself in a series of unmanned and manned launches. Shenzhou is now the most sophisticated man-rated craft now flying.

The Russians and Chinese, after a decades long bitter divorce as each chose different paths to communism, are beginning to collaborate and plan joint unmanned probes to the Moon and Mars. India and Brazil want in as well. Only stumbling Japan is out there by itself wandering in the desert of its own self-doubts and fear of real commitment.

But will NASA take it Seriously?

Could any one of these upstart spacefaring nations, or any combination of them actually put together a Manned Lunar Landing mission and touch down before NASA does? We think that anyone who doubts the possibility is playing ostrich. Consider the facts:

Minuses for NASA or NASA/ESA:

- ☑ NASA is committed to state-of-the-art technology
- ☑ NASA's timetable can only slip, not tighten up, as successive administrations and Congresses play with its budget - both the amount of money, and what it is for
- ☑ In its commitment to technological innovation, NASA must design-fly, redesign-refly, until it gets it right.
- ☑ The US does not take competition seriously
- ☑ NASA is committed to a full-function lunar Outpost that is capable of growth and development of local resources

Pluses for Russia/China/India/Brazil/Malaysia:

- ☑ These players are willing to make do with what works, no matter how unsophisticated in comparison with NASA.
- ☑ The political structures of these nations allow making firm, no-looking-back decisions.

[⇒ p. 2, col. 2]

Will Lunar Pioneers every enjoy a Grilled Steak?

Certainly in the early period of Lunar Settlement, a protein-enriched vegetarian cuisine will be the easiest to realize. Meat production, as now practiced, hogs precious resources. Cooking methods that fill the air with odors, aerosol greases and particulates will be frowned on, if not against the law. Settlers will survive these strictures. But in "The Embers," pages 4-5, we explore the possibilities.

Moon Miners' Manifesto

Moon Miners' MANIFESTO/ Moon Soc. Journal is published every month except in January and July.

• **Moon Miners' Manifesto CLASSICS :** Beginning with 'July 2004, we have begun an effort to re-edit, reformat, re-illustrate and republish the timeless articles of MMM's first ten years, with the intention of publishing two issues, each covering one year, in PDF format only, for free downloading, each January and July.

• **MMM's VISION:** "expanding the human economy through off-planet resources"; the early era of heavy reliance on Lunar materials; earliest use of Mars system and asteroidal resources; and the establishment of the permanent settlements necessary to support such an 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 the current 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 non-profit 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 40 chapters, dedicated to the creation of a spacefaring civilization.

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• **MMM's desktop publication** has received computer hardware and software support from the **Space Frontier Foundation**, 16 First Ave., Nyack NY 10960; 800-78-SPACE - SFF seeks to open the space frontier to human settlement as rapidly as possible.

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• **The Moon Society** is "dedicated to overcoming the business, financial, and technological challenges necessary to establish a permanent, self-sustaining human presence on the Moon." — See contact information on page 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.

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⇒ IN FOCUS Editorial continued from p. 1.

- ☑ These nations have no problem relying on existing proven technology, no matter how "outdated" or "passé." And that works to "telescope" the timetable considerably.
- ☑ China et al. do not care if they are taken seriously or not
- ☑ The challenger only needs to land a crew on the Moon, flags and footprints style, to win the prize of being first back to the Moon.

When you look at these minuses or extra burdens on NASA and the correlative pluses for a challenging team that has no such burdens, restraints, or commitments, it becomes no more than a groundless act of faith to assert "don't worry, NASA *will be first to return to the Moon.*"

Why beating NASA to the Moon might be a good thing

While such a turn of events may be a blow to national pride, it would not be the end of the worlds. NASA will go on to deploy the first lunar science outpost, á la McMurdo Sound and other Antarctic outposts. Even if the "upstart" team does some real science, it is likely to be more limited. Much more importantly, NASA seems committed to tackling the development of local resources on the Moon, though that commitment, since it has a steep price tag, can be zeroed out by Congressional bean-counters at any time.

But the real boon will be for Commercial Space, A "win" by a non-NASA team will spur on the development of commercial = private enterprise outposts and even tourist facilities on the Moon, because these efforts are far more likely to be interested in the cheapest technologies that do the trick, be it now-on-the-shelf Russian and Chinese technology, or soon-to-be-on-the-shelf technology from Scaled Composites (Burt Rutan), SpaceDev, Bigelow Aerospace (inflatable modules) and others.

Let's face it, NASA's path is not one that private enterprise will follow, either as to technology, or as to outpost location. Some of NASA's newly developed systems may be adopted by commercial providers, however. But it is more likely that they will take a look at these and develop something simpler, cheaper, and much better, be it for dust control, life support systems, oxygen production, or the development of made-on-Luna building materials.

And the winner is __

We have been talking about the first return-to-the-Moon manned landing. NASA is looking at 2015-2018, but that date can only slip. A Chinese-Russian crew may well beat that date by an embarassing margin.

But the first humans to return to the vicinity of the Moon (no one has been beyond low Earth orbit since 1972) will be a crew of two Russians and a paying private citizen tourist willing to cough up $100 million, a small sum for a growing number of the world's most affluent.

This feat, as early as 2008, will test elements of a Russian landing mission plan -- and whet the appetite of hundreds of millions of us Moonstruck commoners. **<PK>**

Coloring the Moon: Three More Options

by Geoffrey A. Landis

Editor's Forward

We welcome this substantial contribution to the topic of introducing colors into our Lunar frontier outposts and settlements. In MMM #191, Dec. '05, we had updated our previous article "Color the Moon anything but gray" which appeared in MMM # 63 March '93, p 10 -included in MMM Classics Vol. #7. We had also touched on the subject in an article about how pioneers would learn to love the Nightspan in MMM #43, March '91, p. 4 "Nightspan" -now included in MMM Classics #5.

There will be many ways to introduce color in addition to oxide tints processed from the regolith: colored bulbs including neon tubing, clear water-filled bottles with drops of vegetable food dyes, stained glass, organic dyes for fabrics; and plenty of vegetation including multi-colored foliage and flowers. A carefully selected ecosystem for interlinked public spaces may include some songbirds, butterflies, and other animals. Aquaria with brightly colored fish will be popular.

Geoffrey Landis adds three chemical pathways to introducing inorganic colors that we had not thought of.

Colors on the Moon don't have to be mineral pigments based on iron, titanium, and aluminum oxides plus sulfur. Here are three additional sources of colors from lunar materials:

Color Centers

First, we can make colors by the use of color centers in glass. Think of rubies and emeralds. They are brilliant red and green, but the material itself, beryl, is almost colorless. The color comes from color centers (often known as "F-Centers", from the German), which are defects that interact strongly with light, created by doping with a small amount of a foreign element. Color centers don't need to be created only in precious stones, however, and it is easy enough to make colored glass using tiny amounts of a dopant to color a much larger amount of glass. Glass is likely to be one of the first things we make on the Moon, and colored glass could be an early product. Grind up colored glass, and you will make a pigment out of it; glue the colored glass to a surface, perhaps using a lower-melt-temperature glass as the binder, and you will be able to enamel or glaze a surface in many colors. Or, perhaps stained glass might end up being the decorative craft best suited for the Moon. One problem with color-centers in glass, is that they tend to bleach or blacken with exposure to ultraviolet. So,if you want a color that stays bright even after years of exposure, colored glazes and stained glass are likely to be a source of color for the inside of the habitat only.

Iridescence*

A second source of color that is a natural for the Moon is thin-film iridescence-- the "soap bubble" effect. A film of a transparent oxide can be made so thin that it reflects only a single color of light. Perhaps you've seen jewelry made by forming thin films of tantalum oxide on metals? That's iridesence. This forms the color for most butterly wings, as an example. As it turns out, this technology is incredibly easy on the Moon-- aluminum, silicon, and titanium are three of the most commonly available oxides on the Moon, all three oxides are quite transparent, and all of them can and have been used to make quarter- and half-wavelength films. And the method for making high-reflectance half-wave films are simply vacuum deposition-- a technology that couldn't be better adapted for the Moon, where vacuum is free. Almost any metal object could easily be colored in all the shades of the rainbow. The films will be hard (although, if you're coating aluminum, scratching the object will scratch through the film into the metal; there's no protection if the metal itelf is soft.) And, since the thickness of the films is so low (typically below a micrometer), they don't radiation darken very quickly-- an iridescent metal coating will stay colored for a long, long time.

[*from the Latin word for rainbow. Thus *Sinus Iridium* (Bay of Rainbows) in northern *Mare Imbrium* (Sea of Rains)

Nanoparticles

The third source of color to consider is nanoparticles. I'm not talking "real" nanotechnology here; it's not even really high technology. Small particles, with sizes ranging from a few tens of nanometers up to a micrometer or so, can interact very strongly with light, producing colors. To make a paint, you would have to manufacture these nanoparticles and then disperse them into a binder. In its most elementary form, nanoparticles of gold have been used from antiquity as a method of coloring stained glass (the mechanism is different from the F-center mechanism discussed above, by the way), and nanoparticles are being studied for a wide variety of other applications, of which paint is not the least. So it is very likely that, by the time we're looking for coloring agents, nanoparticle fabrication is likely to be available. **<GAL>**

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http://mit.edu/aeroastro/www/people/landis/landis.html

Landis is a member of the Moon Society Board of Advisors. He is also a published science-fiction author of note. The editor highly recommends his novel "**Mars Crossing**" Tor Science Fiction (2001) ISBN: 0812576489

The Settlement's first Controls-Exempt Open-flame BBQ-Grill Restaurant

by Peter Kokh

Sacrifice on the Lunar Frontier

Many of the things we enjoy in the modern world conditions in which we live, those who choose to join the lunar pioneer settlements will be consciously agreeing to kiss goodbye. One of those may be a charbroiled steak or a side of barbecued ribs. Meat eaters especially will have to make a considerable adjustment, and, as recruits, will probably be required to live in a settler candidate camp for few months. One of the reasons for this will be to see how well each of them can handle the heavily, if not exclusively, vegetarian diet. Those who miss meat too much may become disgruntled settlers, and should be discouraged from continuing.

The question of meat protein]

There are, of course, purely vegetarian sources of proteins: nuts and legumes, and especially soy products. At the Mars Desert Research Station, February 26-March 11, our Moon Society crew will get first hand experience of how well, or how poorly they satisfy a meat-lover's cravings. But in Laurel Ladd, we have an experienced vegetarian Chef! The crew will be invited to give thumbs up or thumbs down on each of her crockpot creations, approved menus and recipes going into our Lunar Frontier Cookbook. The crew does include a majority of meat-eaters, however. So this will be interesting. Modeling an Early Space Frontier (assuming a greenhouse in place for three months) is a mission project.

In time, but probably not anytime soon, the settlement will grow large enough to dedicate space and resources to raising the most efficient meat-producing animals: fish, cavies (guinea pigs), rabbits, and chicken, in that order, I believe. One teasing possibility, now still science-fiction, is that we might learn how to culture select meant tissues (chicken breast white meat, for example) in nutirent-laden vats. Not only would that be a vastly more efficient way of producing meat protein, it would be "meat without the face." That meat comes from living animals is a problem for many.

Food Preparation Constraints

But there are also constraints, once/if/when we do have a small meat or meat tissue supply, on how it is cooked. In our recent article, "Cooking on the Moon," MMM #189, OCT. 2005, pp. 7-8, we noted that cooking methods which released too much vapor into the air would pose a problem for ventilation and air refreshening and recycling systems in the small volume settlement with no great outdoors or world wide atmosphere to dilute odors and replace indoor air with outdoor "(relatively) fresh air." Boiling and frying (especially the latter) would not be long tolerated.

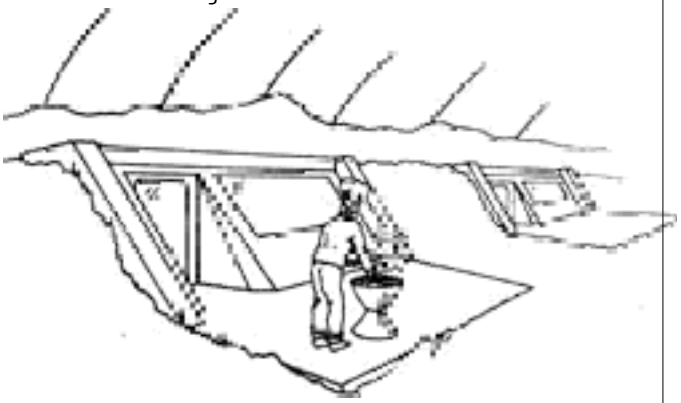
The problem with charcoal grilling

But grilling and barbecuing, backyard style or even indoor table-top Hibachi style would present the added problem of smoke, the very thing that gives us the flavor we want, as meat grease drips on the coals and back-splatters the grilling meat. Our porches, and we will have them, will open onto pressurized streets with a very limited capacity to absorb the vapors in comparison with Earth's vast atmosphere. Neighbors might like the odor for a bit, then resent being so teased.

From MMM #33 - March '90, PRINZTON: Part VII: Conclusion. A. Prinzton in a Multi-Site Lunar Economy.
Reprinted in MMM Classics #4 p. 18

RESORT COMPLEXES: More easily realized and sooner needed would be a resort complex offering safety-valve and escape features to make life on the Moon a little less harsh. Starting with the assumption that as individuals will spend only small fractions of their lifetimes in such a facility, we suggest that much less shielding mass be used. A much stronger single vault to hold the atmosphere with greatly reduced compensating overburden weight would be an attractive possibility ifthat overlayer were in translucent form. "Cracked" color-free or bluish glass above an air-tight sky-pane:? Layerof thermal expansion? Decisions for R&D.

Such a vault would offer a blue dayspan sky without heliostats. Combined with "country" cottages set into the rille slopes and having added shielding on their individual roofs, the shield mass above the vault could be kept to the minimum necessary to allow the desired degree of translucency. For not only would vacationers spend only a week or two a year in such a spot, call it "Lost Valley." they would spend perhaps a third or more of that time within the further-shielded cottages.



Vacationer barbecuing on cottage patio

Illustration © 1989 David Cramer - The 1989 LRS Prinzton Study. Republised in MMM Classics # 3 and 4; paper online at: http://www.lunar-reclamation.org/papers/rille_paper1.htm:

Under what conditions might grilling be allowed? Will there at least be restaurants where one can go to get a

decent char-grilled steak, even if one isn't allowed to cook this way in his own homestead? Perhaps not right away, but eventually? I suspect the answer will be "yes." by long-pent-up popular demand. And that is what this article is about.

Fast Forward: The Settlement's 10th Anniversary

January 1, 2025. The young settlement of Luna City now growing rapidly at the "North Junction" site along the northern coast of Mare Frigoris where a new road had been built northwards some 243 miles to a middling size crater near enough to the Moon's north pole to have a sizable permashade area, with confirmed water-ice impregnated regolith of minable concentrations. The settler's traced the city's foundation date right back to the landing of the first module of the commercial outpost, a full two years before NASA began erecting its south polar base, now long since abandoned. For in truth, the commercial outpost began expanding immediately, at first with Bigelow Aerospace inflatable modules but after the first two years, with modules made locally of glass composites and other building materials produced on the Moon.

The culture of protein-enriched vegetarian cuisines worked well with the greenhouse-based biosphere system, a modular one which grew as a system apace with the physical complex. Meanwhile, on Earth "vat meats" now vastly improved over the "textured mush" first produced in 2009, was winning many converts as more and more people had good results grilling "real" chicken, pork, and beef "faux" fillets, chops, and steaks - all boneless, of course.

Now Angus McAllister, developer of the Heaven's Gate resort complex just south and west of the lower entrance to the Alpine Valley (the main transportation corridor between Mare Frigoris and Mare Imbrium "and points West, South, and East" had applied to the Lunar Frontier Territory's Department of Global Expansion for a variance. Angus wanted his resort to feature a good old fashioned Steak House and BBQ grill. Not only would this satisfy the needs of meat-eating tourists from Earth, but it would serve as a real getaway attraction for settlers, rewarding them for their long patient toleration of the basic Lunan diet.

Somewhat of a Culture War skirmish ensued. But vat meats were already making a modest inroad in Luna City grocery sales, and it was more of a question over perceived threats to air quality and other quibbles. Well aware of the unreconciled political pressures, the Department issued a trial license for one year, with some strictures.

- this restaurant was to be a test prototype and no more "BBQ Grill licenses" would be granted until an environmental impact review was completed following the first year in business of "The Embers."
- If the review showed that the various environment-protecting measures had been unquestionably successful, a permanent license would be granted. If the review showed mix results, a one year extension of the temporary license would be granted, after all recommended corrective measures had been taken. The owner had the right to appeal those conditions on grounds of economic impracticality, but a successful suit would be pretext for shutting the place down. There was strong incentive for both parties to cooperate, but without compromise.

McAllister agreed. His establishment would not be connected to the rest of the resort complex, but stand alone at some protective distance within a half hour's ride in a motor coach. (For customer's the ride only whetted their appetites that much more. Free cocktails were served on the coach, of course!) The restaurant would have to have its own air and water recycling systems and an approved way to deal with solid meat wastes, greases and fats,. These systems would be much more elaborate and costly per volume serviced than those in Luna City or Heaven's Gate.

For McAllister, the obvious downside was that these constraints tripled his projected costs, and these would have to be passed on to customers just like all other costs-of-doing-business. The restaurant would have to charge proportionately steeper prices. On the other hand, Angus would be serving not just ordinary weekday or weekend customers, but people on luxury vacations, people for whom splurging for a good cause (and one's taste buds qualified) was not a problem> To the contrary, returning home to brag about having "the greatest steak of my life at the Embers" was worth the cost. After all, why do people watch their pennies day in, day out, week in, week out, if not to have something with which to splurge in earned release?

From one to many

This test enterprise was an unqualified success. The Embers was popular with tourists and vacationers, of course, but also attracted a fair share of the birthday-anniversary-wedding-retirement party business. Party rooms to cater to these customers were included in a first expansion. A second expansion housed a dinner theater complex.

Per permit, any fresh uncooked meat scraps were turned into sausages under the Embers™ brand, sold all over the Moon at a high premium. The Embers could not only grill and broil, but fry and boil, and more than a few customers ordered menu items prepared in these ways also.

The Embers was the first of what are now known as first-class licenses. Similar establishments have appeared at the Luna City spaceport, and at other tourist clusters as well as some of the more roadside inns. But stand alone first class restaurants remained the exception. Most such license holders were hotels, resorts, and inns offering overnight accommodations.

Life on the Moon slowly began to be a little less "frontier-harsh" and a little more "terrestrial." But the pioneers still had their share of special cultural features about which to brag, or complain, as individual temperament dictated. The moonfolk were becoming "citified!" **<MMM>**

WEATHER FORECASTING ON THE MOON

By Peter Kokh

Talk about the weather!

The very idea of a weather bureau issuing forecasts for Lunar pioneers at first blush seems absurd. "No atmosphere, no weather," it's a no brainer! Either the Sun is out and you can't see the stars in the black sky for all the glare, or it's Nightspan and stargazing still is not that good when Earth, 60 times brighter than the Moon is for us phase-for-phase, makes stargazing less than rewarding also. Unless you are on Farside during local Nightspan, where the Milky Way is so awesomely brilliant it wants to suck you up into its bosom! Talk about star travel!

But seriously, no thunderstorms, no lightning, no hail, no tornados, no hurricanes, cyclones or typhoons - no tropical storms period, no blasts of Arctic cold. Nothing but the boringly predictable cycling of Nightspan and Dayspan, of superficial heat and superficial cold.

All so true. On the other hand, the Moon is subject to Cosmic Weather events that for Earth, our atmosphere serves as a resilient shield. Cosmic Rays get through, of course, but on the Earth's surface, Solar Flares and meteorite storms are scarcely felt, though we can observe their rites of passage through the atmosphere: the auroras and the Meteor Showers - neither of which will be visible phenomena on the Moon.

Both Solar Flares and some of the denser Meteorite swarms will make the morning and evening news on frontier radio,television, and internet stations. For Solar Flare events, travel restrictions will apply. No one should be further than an hours drive from the nearest flare shelter. But perhaps there will be meteorite shower alerts only for spacesuit pedestrians out on the surface without the protection that even a covered rover can provide.

Sounds pretty boring. They better come up with a panoply of sporting events or else no one will have anything to talk about other than political scandals, and who got pregnant by whom. Weather for us, even when it is rather nice, is a great ice-cutter for starting up a conversation. Pioneers fresh from Earth will miss it. "Hey, what about this weather?" will become a popular inside joke.

We have nonetheless found enough to talk about concerning Moon Weather to feed two past articles:

MMM #5, May '87 "Weather" - find it in MMM Classics #1
MMM #148 Sept. '01, p. 7 "Music of the Lunar Spheres"
www.moonsociety.org/membeers/mmm/mmm148_Sep2001.pdf

Twin eternal dust storms, circling the Moon forever

Three decades of data from an instrument left behind by the Apollo 17 crew, intended to track dust from meteorite instruments, instead have revealed an unexpected phenomenon. The instrument, called LEAM for Lunar Ejecta And Meteorites, has been gathering data since 1972. As the rising Sun sweeps the surface that has been in darkness for almost 15 days, an electrostatic effect levitates some of the loose fine particles. Looking at the Moon along the sunrise terminator, imagine one long linear storm or suspended dust stretches from pole to pole, a distance of almost 3,400 miles. As the terminator advances, the storm follows, but like the phenomenon of a wave traveling through water, new particles rise at the front replacing others that settle at the rear. The storm follows the sunrise terminator around and around and around, circling every 29.5306 days. It has been going on, apparently, for billions of years.

All the Apollo landings occurred, complete with takeoff, during midmorning lighting conditions. NASA wished to avoid the long shadows of dawn, the high heat of midday, and the cold of night. No astronaut has experience this storm. We have a lot to learn about it. How dense are the particles? How much do they obscure vision? How much of a problem will they pose for astronauts, explorers, and settlers? Will the levitated dust insinuate itself into space suit joints, will it clog up vehicle lubricants? Will it abrade windshield glass? We don't know and we need to know.

NASA intends to send crews to a polar site, where, if there is a similar opposite effect along the sunset terminator, the two storms will link up playing crack-the-whip. Or they may peter out closer to the poles. We don't know.

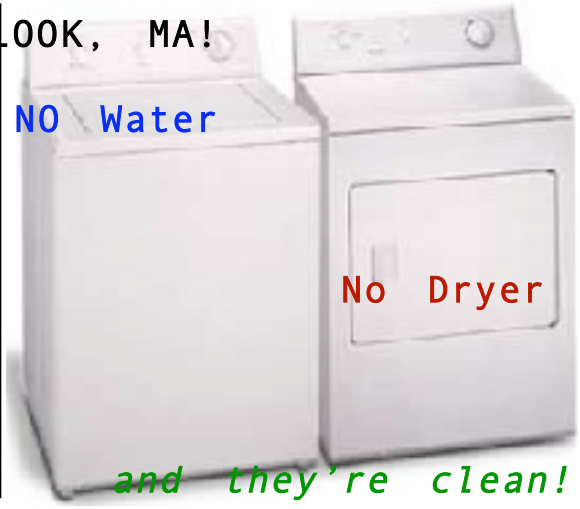
A commercial base, constrained by economic sense and the resource needs of diversified industrial development would hardly choose a polar cul-de-sac site only to developmentally handicap itself. So commercial astronauts are likely to experience this wispy sinuous dust storm rolls every morning, once a sunth (lunar month = 29.5306 days). But we are not even sure that they will see it without special equipment. The swirls of dust may be so wispy as to be invisible to the naked eye, at least to the untrained eye.

It seems we need to send a new instrument package designed to answer our questions. Right now all we have is some tentative theories. Timothy Stubbs of the Solar System Exploration Division at NASA's Goddard Space Flight Center suggests the explanation may be that "the dayside of the moon is positively charged; the nightside is negatively charged. At the interface between night and day, electrostatically charged dust would be pushed across the terminator sideways, by horizontal electric fields.'

But we don't really know. It's not just a matter of scientific curiosity. We need to know if it poses a problem for equipment and for personnel out on the surface. If it does, we need to figure out how to work around it. We will be at home on the Moon, only when all its dangers become so well known that we act appropriately as it by second nature. That day will come! **<MMM>**

Source: http://science.nasa.gov/headlines/y2005/07dec_moonstorms.htm

SPIN UP TECH UPDATE



by Peter Kokh

Washing Clothes and other fabrics on the Moon presents a challenge to closed water recycling systems. Detergents would have to be *quickly* biodegradable, and the remaining lint and soil must be filtered out of all graywater.

Fresh water not water already "gray" from sinks and showers, must be used. The amount of water in the clothes washing loop must be added to the amount needed for drinking, food preparation, hygiene, food production, household cleaning chores, and last, but not least in closed-loop industrial processes.

But what if you could wash clothes with air? No water would mean not only less demand on the limited settlement "hydrosphere" but less fabric degradation through linting! No water also means no drying, thus less consumption of energy. And if keeping the settlement cool, not warm, is the problem, as we expect, then not having to dry clothes with heat would be a big plus. Of course, there is always the old-fashioned way: hanging them out to dry. But either drying process adds to the humidity in the air, which we expect to be enough of a problem without help from clothes drying cycles.

While washing with air would have clear benefits for settlement environments, it would also be a boon for many places on Earth where clean water is quite scarce.

There may be such a way say two enterprising scientists in Singapore. Read the article online at:

http://www.heraldsun.news.com.au/common/story_page/0,5478,17965878%255E11869,00.html

Substitutions Key to waterless washing

What seems to be involved is a pair of substations that few would have been clever enough to try:.

~~swirling water~~ >>>>>>> ***jets of air***
~~detergents~~ >>>>>>> ***negative ions***

The negative ions work to clump dirt and dust together, deactivating bacteria and neutralizing odors. ***Electrolux*** is one company that has looked at the prototype with interest. Developing a needed-in-space technology for terrestrial profits is what we call "Spin-*up*" **<MMM>**

[SPIN-UP TECHNOLOGY CHALLENGE]

Troublesome Moondust May have an Achilles Heel

It Smells!

by Peter Kokh

Source:
www.redorbit.com/news/space/375271/the_mysterious_smell_of_moondust/index.html?source=r_space

Previous articles in MMM
MMM #89, Oct. '95, pp. 6-7 "Dust Control"

"It smells like burnt gunpowder,"remarked Gene Cernan. Apparently, every astronaut who made it the Moon's surface smelled it. Most felt it - "it's soft like snow, yet strangely abrasive (Cernan). Some tasted it -- "not that bad," (Young). Yet as they all soon learned, it gets everywhere, in every nook and cranny. It gave Jack Schmitt the first brief case of "lunar hay fever." Scientists are worried about Moondust playing havoc with equipment and machinery, getting into the tightest joints, wrecking ball bearings, junking up grease and lubricants. They worry to about it's long term effects on astronaut and pioneer longs. Will it be something like silicosis? of coal miners' black lung?

All of us who want to see the lunar frontier develop into another settled world, are optimistic without reason to be that this potential problem can be managed, that we can learn to live with moondust as we have with many irritants here on Earth. Hope and temperament-based confidence will not "make it so." We have to do several things:

- Use architecture and engineering to minimize amounts of moondust that infiltrate our habitation and work spaces.
- "Turtle-back space suits that remain outside while the occupant climbs out the clamshell back docked with a conformally shaped airlock. Throwaway paper coveralls might help but would have to be carefully designed and any tear or rip would compromise their effectiveness.
- Car-wash airlocks are another option, one drastically more expensive and complicated.

perhaps robot-insects small enough to get in most nooks and crannies and able to climb walls and ceilings, and with the capacity to sniff out even traces of moondust will serve as an early warning system of problem areas and suggest remedial design and engineering changes.

If some terrestrial entrepreneur developed such tiny, go anywhere sniff detectives, there should be ample Earth-bound needs for such devices to earn a fortune. And meanwhile, a technology we need on the Moon, would be ready for us, "on the shelf," thanks to "spin-up." **<MMM>**

Hmm? If the dust at the Mars Desert Research Station has a characteristic smell, a prototype sniffing device of this sort could "test" our Hab-tightening remedies!

MICROWAVE OVEN TECHNOLOGY
for Road Building on the Moon and for much, much more!

by Peter Kokh based on a report online at:

http://science.nasa.gov/headlines/y2005/09nov_lawnmower.htm?friend

A matter of perspective

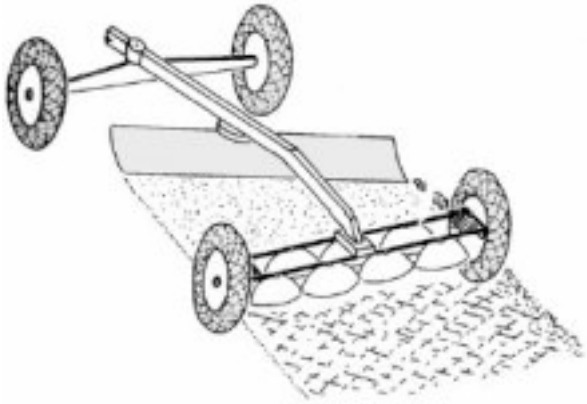
Sometimes, quite often in fact, the problem is its own solution. It's a matter of looking at it right. "If something seems like a disadvantage or a liability, you aren't looking at it from the right angle!," is a bit of wisdom from my Mother that I have found to be the key to paydirt many a time. Moondust is insidious. It gets into everything, and it is everywhere on the Moon, the product of four plus billion years of micrometeorite bombardment.

Larry Taylor, Professor of Planetary Sciences at the University of Tennessee, as he has a habit of doing with everything (including a bar of Irish Spring soap), put some moondust from NASA in his microwave oven, and within seconds, even at low power setting, it fused into a glob.

You see, one of the omnipresent ingredients of moondust is microscopic particles of iron. We all know well enough not to put metal in a microwave! The iron in the moondust absorbed the microwaves, heated up, and fused all the moondust! Eureka! The brainstorming began!

What can you do with microwave–fused moondust?

Well suppose you put your microwave magnetrons on a wheeled carriage and drove it (in person, or more likely, telerobotically) over the terrain?



Cartoon sketch by Larry Taylor

"With the right power and microwave frequency, an astronaut could drive along, sintering the soil as he goes, making continuous brick down half a meter deep--and then change the power settings to melt the top inch or two to make a glass road." Taylor calls this the lunar lawnmower, though that implies an operation that has to be done often.

Send us your suggestion for a more appropriate metaphor? email us at kokhmmm@aol.com

Taylor suggests that bricks could be made this way and that we could even fuse the inner slopes and floors of appropriately sized craters into reflective bowls that would serve as Arecibo like radio telescopes.

A family of applications - (suggestions by this writer)

A device like this could **"fix" the "apron"** surfaces around docking ports and airlocks, lessening the chances that moondust would get carried into the pressurized areas. That's really "job one" in road building. To paraphrase an historic quote, "all lunar roads begin and end at an airlock."

One can imagine **a hand held unit** that one would wave briefly over one's space suit, especially arms, gloves, legs and boots, fusing the dust into clumps that would shake off, and do no harm even if carried inside. But the settings would have to be low enough to cause no accumulative damage to the human inside. We all know that microwave ovens won't work with the door open, and there is a very good reason for that!

Inside, a takeoff on the hand held unit above would be magnetron-equipped **vacuum cleaners attachments.** The fused dust would be more easily and thoroughly sucked up.

Such a process might have architectural applications as well. Consider the lunar settlement's surface appearance as a collection of inter-linked molehill mounds - the regolith shielding piled on top of habitation structures being the public face of the settlement from outside. An affluent person could have his "mound" fused, and maybe in some pattern forged as the mobile fuser's route could be chosen for such special effects. As the microwaves can reach some distance down, a mold of some neutral iron-free material could be placed and tamped on the mound section by section and the soil fused beneath it. The mobile unit would then raise the mold, wheel to the next area, tamp the mold down, fuse, etc.

Mold fusing could become an inexpensive way to produce many products for both domestic and commercial use, for both lunar and off-Moon markets - where performance was not a critical issue. How brittle would such artifacts be? How susceptible to cracks? How susceptible to corrosion and decay by exposure to water, or even to humid interior atmosphere? We don't know the answers to those questions. How much experimentation can be done here on Earth (with lunar simulant?) and how much corroborating experimentation will have to be done on the Moon? All we can do is carry terrestrial experiments as far as we can.

Can you see a terrestrial application of such technology? Why not develop the technology for profits here and now, while putting a needed lunar technology "on the shelf," the research paid for by terrestrial consumers?

An invitation to brainstorm

What other possible applications are there? "The only limit is imagination," says Taylor. More importantly, the answer is really up to those of us who can take it to the next step. Might that mean you? **<MMM>**

The Moon Society

J O U R N A L

http://www.moonsociety.org

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/

The Artemis Project™ – Project LETO™ – Rent–MDRS

Moon Society DUES include **Moon Miners'Manifesto**

- **Electronic** (pdf) **MMM $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, shows the Moon in its natural beauty, empty and deceptively barren, waiting for human settlers to shelter and to mother as an adopted new human home world. We have work to do!

Moon Society Progress Report

January 30, 2006

All current and former members of the Moon Society and of Artemis Society International were emailed a Moon Society Progress Report. If the email address that we have on file for you is no longer current, or if you employ an overly aggressive spam filter or blacklist service, you will not have gotten it.

For those who did not get it, the report is online at: www.moonsociety.org/ reports/e-reports/update01-30-06.html

Report Highlights

Moon Society Mission to Mars Desert Station

The crew is selected, we have a mission patch, and are busy collecting needed equipment and with other preparations for our turn, February 25th to March 12th.

You can visit our website at:
http://www.moonsociety.org/moonbasesim/
where you can check out the crew and the research planned, and once the exercise is underway, find daily reports.

We also have an online logo/mission patch item store at: http://www.cafepress.com/moonbasesim/

We are making progress raising the needed funds, getting a big boost from the National Space Society which has come aboard as a principal sponsor (along with the Moon Society and the Lunar Reclamation Society) and are over 60% funded. An individual donor incentive program is announced in the report.

Affiliation News

In addition to wining the support for our exercise at MDRS from the National Space Society, we are now sharing publication pdf file access with the American Lunar Society and with The Planetary Society of Youth (India) - Use your Moon Society username and password to access these files at: www.moonsociety.org/members./selenology/ and at: www.moonsociety.org/members./tpsynews/

If you are a current member but do not have a username and password, siumply go to the special page www.moonsociety.org/mymoon/ and you will be prompted to select these, which are also needed for access to the Moon Miners' Manifesto pdf file archives (issues #145 ff.) at: www.moonsociety.org/members./mmm/

We are a small organization, but are now growing steadily. It is our hope that with these and other exciting projects, members will find greater reward in belonging and will keep renewing. We will continue to leverage our new affiliations and collaboration partners. Turf lines are not important. What gets done is important, and we are all in the business of helping open up the space frontier.

Alone, we can just gesture and posture. Together, we can achieve one exciting goal after another, and slowly, deliberately terrace our way, not to just a token lunar science outpost, but to real human frontiers on new worlds.

Keep the Faith! **‹PK›**

Artemis Moonbase Sim 1 Crew Projects

Crews at MDRS need to have a well-rounded mix of talents, some essential: We need someone to serve as Commander, someone as XO or Executive Officer ("Number One" if you will; somone as HSO or health and safety office,; a crew Engineer to maintain all the Hab systems and utilities in good working order; we also need a Crew Journlist to make daily reports (in this case, to the Moon Society and the Mars Society both, as well as to various media outlets.

Huset, Wickman, Kokh | Proser, Schwarz, Ladd | Gregory, Winikoff, Meyer

Most *Mars* crews also have a geologist and a biologist. But for us, the local "Marslike" sedimentary and water-carved geology is hardly an analog of what we will find on the Moon, so we have no geologist. Similarly, as there is no expectation of finding microbes or extremophile life on the Moon, we didn't really need a biologist, but we do have one who will be conducting studies involving the GreenHab to identify potential upgrade options in trying to model a Lunar Life Support System.

Some crew members play essential supporting roles:

- **Steven Winikoff**, Hab Engineer with computer expertise, form Montreal, Quebec, Canada
- **Guido Meyer**, Journalist specializing in space journalism for radio media outlets, from Bonn, Germany; Miami, FL.
- **Ben Huset**, Astronomer, asst. Engineer Jack-of-all-trades, from Minneapolis-St. Paul
- **Chip Proser**, documentary videotaping, Los Angeles, CA

Five crew members, while having team assignments, will be working on projects that will define our mission:

Projects of Peter Kokh, Crew #45 Commander

Setting a Moonlike Atmosphere in a very Marslike Setting

We have little control over the Marslike geology of the MDRS surroundings - sedimentary and water-carved. However, in a test performed in a brief visit on December 8, 2005, we found that wraparound green tint sunglasses worn inside the EVA Suit helmets do a lot to neutralize the orange hues, and to notably gray and whiten the landscape. We will also apply, in a clean-remove fashion, green auto window tint to the interior of the Hab upper deck portholes.

Another trick will be to suspend an Earth globe at the right distance outside one of the Hab portholes to show the apparent size and phase of Earth as it would appear suspended over the lunar horizon.

Inside the Hab, the table will be set with dishes that look like they might have been made on the early lunar frontier. For recreation, there will be Moon-theme films, games that could be manufactured on the frontier, "made-on-Luna" musical instruments, and Moon-"filk": lunar words set to well-known melodies.

Our diet and our menu selections, chosen by XO Laurel Ladd, will attempt to model what will be available on the early frontier. Crew thumbs up recipes will go into a Lunar Frontier Cookbook.

Lunar Analog EVA Outings Design

It will be a bigger challenge to conduct EVA, space-suited excursions, into the areas surrounding the Mars Hab, that maintain a "we're on the Moon!" illusion. Two particularly moonlike areas have been identified and will be visited during regular EVA excursions.

Nighttime EVA activities are traditionally discouraged for safety reasons. However, we will conduct several of these, all of short duration, and all strictly within sight of the Hab. We will try to simulate three situations.

1. The black sky, sunlit moonscape, with the sun at low angles as would be the case soon after sunrise, not long before sunset, or at any time near the poles.
2. A Nightspan outing on the Moon on a Earthlight surface.
3. A Nightspan outing on the Moon when the Earth is 'new' or unseen, or as it would be on the lunar farside.

Sim–Lite / EVA Lite Definition

Building on the work of Crew #41 which identified areas outside the Hab that, on Mars, might be linked by lightly pressurized tunnels, we will adapt their map and ribbon-marked tunnel route system. On the Moon, some outlying pressurized areas (the GreenHab/Greenhouse, etc.) would be linked to the habitat areas by fully pressurized tunnels or shielded connector tubes. Other areas for placement of utilities, fuel, and stored items that need to be accessed on a regular basis would be under a shielded canopy, but otherwise open to the vacuum. This would allow use of lighter weight pressure suits that would be more comfortable to wear and less cumbersome to work in, promoting productivity and morale. We will work in these areas using our own trial Sims Lite Suits. The experi-ence will suggest improvements both to the shielded canopy concept and to the Sims Lite suit idea.

Dust Control Study

The MDRS Hab is a dusty place. Gaps have developed between some segments, holes made for utility entrances but no longer used remain open. The airlock doors do not close tight. We will inventory and catalog all the places and ways dust, mud, and vermin get into the Hab and make recommenda-tions to the Mars Society for improvements that would allow cleaner simulations in the future.

Ergonomics Study

MDRS and the FMARS Hab on Canada's arctic north Devon Island have similar layouts. The shell is taken as a given, constrained by the way it will be transported from Earth, and the various needed functions crammed into it. We will attempt to study which functions need relatively more, or relatively less space, which functions now juxtaposed, would benefit from mutual isolation, and which functions needed on a Moon or Mars base are not modeled. The goal will be a design that starts with the definition of functions, and concludes with implications for a clean slate design in which form follows function, not vice versa, probably with a modular design. We expect that this study may conclude with recommendations and a list of options for a future MDRS Hab ANNEX module.

EVA Space Suit Modification Study

The current MDRS EVA spacesuits are marvels of design. They are meant to mimic the cumbersome-ness, the weight (on Mars) and the difficulty of putting on and taking off. The functional details other than communications and ventilation are not modeled. We will be on the lookout for further spacesuit improvements looking especially at dexterity and safety identification from a distance. Leslie Wickman with expertise in this area will have major input.

Logging Sims Breaks, Diet Breaks, Food Use

We will keep a number of log books so that what we learn can be passed on to future crews.

Lunar Dayspan–Nightspan Cycle Modeling Study

If we do a sequel mission in 2007, the rop priority project will be to moedlthe Lunar Dayspan-Nightspan Cycle. On this crew, a spare time project is to brainstorm how we might model the 29.5 day Lunar cycle, foreshortened to two weeks, in order to study power management and human resource utilization issues associated with this cycle.

Input on Project Ideas for a Sequel Moon Crew Mission

Our goals for this first mission are essentially twofold: (1) Learn some useful things about Lunar outpost operations; (2) set ourselves up for an even more productive and successful sequel mission next year. Input will be sought from all crew members for more ambitious projects in a future mission., including improved Diet Modeling and Lunar EVA simulations **<PK>**

M.A.S.T. – Mars (Moon) Analog Simulation Trainer

Hugh S. Gregory, Author-'Producer, Spaceflight Historian

[Commander's Forward: as a veteran of Crew 34, I know how invaluable this tool will be to future MDRS crews including those from The Moon Society. We are happy to have Hugh join our crew to complete his work. We hope someday that Hugh, now a Moon Society member, will be making a version for a Lunar Analog Station at a location to be determined!]

One of the key ingredients for planning any expedition be it on Earth or off Earth into outer space and out ward to another planet is pre-mission reconnaissance. Both FMARS and MDRS are missing this capability. Yes, incoming crews can look back over several years worth of web shots and reports, but that only gives new crews a peep through a key hole at selected tiny areas of the HABs and surrounding terrain who's exploration they are about to undertake.

Project M.A.S.T. is a Virtual Reality simulator of the MDRS HAB both inside and out and it's surrounding network of ATV trails and exploration routes. The MAST VR software will enable first time members of incoming crews to train for their MDRS rotation in the comfort of their own home on their personal computer. It will also allowing returning MDRS veterans to refresh their memories of what is where and help them plan their next MDRS mission. Annual updates will enable the latest version of the MAST VR simulator to reflect which ATV travel routes are currently open or closed to travel and what new exploration areas have been authorized for investigation. Finally it will graphically represent any changes have been made in the HAB since their last crew rotation.

The initial test of the MAST VR software using data gathered on MDRS Crew 35 (Pisces One Expedition) in Feb-March of 2005 was a complete success. A second privately sponsored data gathering mission to MDRS was approved and executed in mid June '05 as a part of Crew FLAME. A third data gathering mission was approved and executed in October '05, Crew MAST. The fourth and final initial data gathering mission will be executed on Crew 45 - The Moon Society Expedition February 26-March 11. '06 with Hugh joining that crew as a Crew Scientist-Surveyor.

The MAST VR simulator issponsored, funded and produced in house by SpaceBase™© - Astronomy & Space Sciences Educational Information Service, Vancouver, BC.

The MDRS Edition of MAST is the first of three planned MAST VR's. FMARS and EuroMARS Editions are in the preliminary stages of development. These will be available for purchase by both society members and the general public with a portion of the proceeds going to The Mars Society's Engineering Team to help fund their ongoing maintenance and upgrading of the Society's research stations. [benefits outside users such as The Moon Society, also.]

MDRS Water Research Project Description: Developing Systems for the Space Frontier & Earth

Leslie Wickman, crew biologist, Long Beach, CA

The overall water project is designed to research and develop efficient, cost-effective, and environmentally friendly methods for reclaiming or regenerating used waste water to high standards of purity using low cost, low energy processes and locally available resources. The methodologies so developed are intended to help advance the goals of exploring the near-Earth solar system as Earth's extremes).

They are also intended to simultaneously minimize adverse impacts on the local environment (whether Earth, Moon, or Mars) by reducing the use of scarce resources, minimizing waste products, and recycling water along with other so-called waste products. As well as protecting and preserving the extraterrestrial environments of the Moon and Mars, these methodologies could be employed around Earth within small remote communities (such as arctic bases, underwater research facilities, Earth-orbiting stations, or developing aboriginal societies) lacking adequate water purification technologies.

The explicit purpose of thestudy is to identify regenerable life support system methods and technologies for supporting human life in extreme or remote environments. Our research to date strongly indicates that by far the largest mass category of consumables for space exploration missions is water (and more specifically, wash water) (Wickman, et al, 2004).

If the failure to recycle water for space missions continues (as is the case on the International Space Station), large amounts of it will have to be launched on a regular basis, or possibly harvested from polar ice to support the national objective of deveoping a human base on the Moon, and later on Mars. Either source will be accessed at great expense. A more cost-effective and environmentally friendly solution would be to reclaim and recycle both wash and drinking water to the greatest extent possible in a closed loop life support system cycle. This regenerative approach would help to preserve resources on both the extraterrestrial body as well as Earth: consumables launch masses and frequencies would be reduced, with a concomitant reduction in the exploitation of natural extraterrestrial resources (such as water-ice and soil).

The elements of this study to be focused on during the Moon Simulation Mission at the MDRS are as follows:

1. Observe the operation of the current GreenHab water re-use system.
2. Measure water usage rates using the newly installed flow meters.
3. Test water quality at various stages in GreenHab system.
4. Recommend GreenHab upgrades.

William Fung–Schwarz: Occupational Psychosocial Factors in Mars and Moon Analog Environments

Occupational hazards such as job strain, work-related psychosocial distress, and interpersonal conflict can significantly impact crewmember health, emotional state, and work performance during long-term isolation and confinement. The aim of this study is to explore the effects of the Mars analogue environment, stress, and coping over time on volunteer crewmembers' functional status.

Utilizing a short timeframe prospective cohort design, this study will use a convenience sample from four Mars analog environ-ments. Methods will include computer-administered surveys and semi-structured individual crew interviews. Data will be analyzed by qualitative content analysis, analysis of covariance, and time-series regression.

A thorough, evidence-based knowledge of psycho-social hazards in analogs may be significant in understanding future Mars and Moon crews as well as assisting people in remote communities, public service personnel, military troops, incarcerated populations, and isolated elderly or disabled persons better cope with the stress of isolation.

Projects of Laurel Ladd, Crew #45 Executive Officer

General Principles

My ongoing work in the area of Component Integration into *Complex Closed/Semi-Closed Systems* (CICCS) is based upon three fundamental principles.

(1) The first is that although we cannot explore and colonize the space frontier without hardware and software, the exercise is futile without addressing the needs of the wetware. Manned spaceflight cannot exist without the humans.

(2)The second is that current management theory and practice have little or no relevance to the type of humans embarking upon those missions or the conditions with which they must cope. Using volunteers from the general population and maintaining a Terran lifestyle during research, does little to advance our understanding of the human problems.

(3) Finally, we must recognize that it is insufficient to create an environment where humans can survive. Instead, it is necessary to develop strategies so that humans can thrive. Without alert, highly functioning individuals one might as well send machines.

While a two week sojourn with a small crew will not yield data of statistical significance, it is important to remember that this is a small, but crucial, portion of a much larger whole. Each opportunity to bring the research to life brings us closer to the stars.

Modeling a Space Frontier Diet

Without appropriate nutrition and hydration, the most talented of crews will succumb to lethargy and even illness. In order to reduce the risks, a well-balanced diet must be available. Unlike the typical Terran, it is not enough

to juggle intake over several meals or even days. To maintain peak efficiency each meal should provide nutrient balance.

However, careful planning and preparation will be for nought, if people do not eat. Meal plans must include concern for appearance, aroma, variety, and interest. While I do not subscribe to the idea of using food as a morale booster, there is no doubt that the lack of interesting food is demoralizing. Obstacles withstanding, as a native of the frozen north, I do not believe that there is a substitute for bubbling soup and the smell of warm bread…yet.

Meal plans have been developed which contain recipes which can be made on site. These were chosen for adaptability to sim conditions and crew preferences. All can be created using lunar compatible tools and techniques. Ingredients are limited to items easily transported to the lunar surface or available from the greenhouse. The time frame for this specific simulation is three (3) months after initial set-up. Now we need to field test our work.

During the first week, a rotation of crewmembers will prepare meals with instruction and supervision by the chief researcher. Dishes will be created primarily according to instructions and ingredients listed in advance. Feedback will be collected on a daily basis.

By the end of the first week we should have a substantial amount of information. At this point, adjustments can be made to accommodate the reactions of the crew. Not every crewmember will come on board with culinary experience. By the end of this crew rotation we will have sufficient material to produce a space frontier kitchen manual, containing not just recipes but crew-friendly instructions.

Kitchen Garden & Greenhouse

The early space frontier diet will benefit from small fast-growing greenery. To those ends we will be growing several varieties of sprouts. The types chosen will be edible in three to five days.

In addition, we are delighted to carry on the greenhouse work of the Double X Crew. While we do not expect to consume produce from their efforts, we hope to ensure that crews later this spring will have that opportunity.

If this area of research is of interest to you, I recommend the work of Vik Olliver and his wife Suz, from Artemis, New Zealand. Among other topics, their work on lunar hydroponics is documented in the Artemis Data Book.

Physical Stress Management

While cardio-vascular concerns have been given a prominent place in manned spaceflight research, much less attention has been paid to smaller scale muscular and skeletal concerns.

Whether on the lunar surface or in sim, a proliferation of aches and pains are anticipated. Muscle aches, joint stiffness, and even repetitive strain injuries are common in extreme conditions. One does not need to have a chronic condition to experience neck and shoulder discomfort after a night in a new bed or a day at the keyboard.

Three methods of reducing the risk will be introduced during this crew rotation. An adapted form of seated Tai Chi, a routine of self-massage, and a list of appropriate isometrics will be at the disposal of the crew. Initially created to help participants in extreme low-impact camping, I anticipate a wealth of feedback from our crewmembers.

Chapters & Outposts

Bay Area Moon Society

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

[South San Francisco Bay Area]

Contact: Bill Clawson <billclawson@yahoo.com>
Contact: Jonathan Goff <jongoff@masten-space.com>

Meeting the 4th Thursday of the month
at various locations, usually in member's homes

Moon Society St. Louis

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

Contact: Keith Wetzel <kawetzel@swbell.net>
The regularly monthly meetings are at 7:30 PM on the 2nd Wednesday of the month at the Buder Branch Public Library, 4401 S. Hampton, basement conference room.

Making the Most of a Chapter's Audiovisual Library

Jan. 31, 2006 [from Keith Wetzel] <kawetzel@swbell.net>

"The other day I had made a passing comment to Lexi's teacher that I had taped A special about the Mission to Pluto, she said she would be interested in borrowing it.

"Then I got to making a list of all the space related stuff that I have on tape. And sending her a copy if there was anything else she might want to borrow. I thought I would share that with everyone. Maybe if we each went thru our tape collections and then we have a tape exchange kind of a personal tape library that members can share."

[list of tapes follows]

[Moon Society Chapters-Coordinator: this is a splendid idea and I'll pass it on to other chapters & outposts! -PK]

Two NSS Moon Society partner hapters to provide Moon Crew Mission Support / CapCom Service

MDRS Program Manager Tony Muscatello suggested that we might want to man CapCom for our crew. This online service via the MOO environment is provided 7-9 pm daily, Mountain Time. Bryce Walden and Cheryl York of **Oregon L5 Society** and James Schroeter of the **Lunar Reclamation Society** have volunteered and are in training.

GREAT BROWSING !

Priming the Pump for Mining Platinum Group Metals on the Moon
http://www.thespacereview.com/article/479/1

Auroras, of a sort, found on Mars
www.marstoday.com/news/viewpr.html?pid=18491

Send your name to the Asteroid Belt
http://dawn.jpl.nasa.gov/DawnCommunity/Sendname2asteroid/index_asteroid_blt.aspx

NASA's New Plans: Positives & Negatives: Zubrin
http://space.com/adastra/adastra_zubrin_051208.html

The Real Promise of Japan's Asteroid Mission
http://msnbc.msn.com/id/10400707/

Solar Sail Project II: Project Update
http://planetary.org/programs/projects/solar_sailing/ss_update_20051202.html

Pioneer Anamoly Update
http://planetary.org/programs/projects/pioneer_anomaly/update_200511.html

Science Fiction Paper Models
http://www7a.biglobe.ne.jp/~sf-papercraft/download/download.html

The Lunar GIS Project for Students
http://www.lunargis.com/home.html

Russia plans a ten day joy ride to Moon
http://www.financialexpress.com/latest_full_story.php?content_id=110146
http://en.rian.ru/russia/20051129/42253387.html

Review:The Space Tourist's Handbook
http://www.thespacereview.com/article/508/1

Mars Homestead™ Project Images
http://www.marshome.org/images2/displayimage.php?pos=-3188

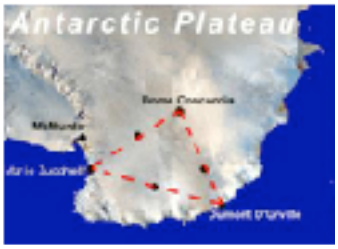
The case for smaller launch vehicles in human space exploration (part 1)
http://www.thespacereview.com/article/526/1

Astronauts and Area 51: the Skylab Incident
http://www.thespacereview.com/article/531/1

Quicktime Movie: Return to the Moon
http://www.orbitcode.com

Old Space Suits (should) **Never Die!**
www.universetoday.com/am/publish/suitsat_satellite.html

Scientific Benefits from Human Return to the Moon
http://www.thespacereview.com/article/538/1



Zubrin design plus Antarcitc analog sites

Concordia Station (R) To Receive 2nd Crew; Located High On Antarctic Plateau (L); 10 Italy-France Scientists Will Conduct Experiments To Prep For Human Moon, Mars Missions - (Credit: IPEV, PNRA)

from Lunar Enterprise D aily12-23-2005

Antarctic Concordia Station Site of Moon, Mars Research. An Italy-France crew is training at ESA Headquarters in Paris, France to prepare for a one-year stay in one of the harshest, isolated environments on Earth. Experiments will be conducted to help scientists plan missions on the Moon and Mars. Concordia, or Dome C, is located high on the Antarctic plateau, some 1,100 km inland from Dumont D'Urville and 1,200 km inland from Terra Nova Bay.

"During the winter the base is completely cut off with no visitors and no chance for rescue. In such an isolated location, the crew has to learn to be fully self-sufficient," says Oliver Angerer, ESA coordinator for the program. Three of the crew's ten scientists are already in Antarctica. The remaining seven will make the long journey later this month. One experiment will look at psychological adaptation to the environment and the process of developing group identity. The Mistacoba experiment, which started a year ago with the first crew living at the station, will continue to provide a profile of how microbes spread and evolve in an isolated and confined environment over time. Other activities include development of a system to monitor the crew's health and well being during long-term stays in harsh environments. **‹LED›**

If you need to keep Up to Date with Developments around the World related to a Return to the Moon, you might want to subscribe to

http://www.spaceagepub.com/

Disney/IMAX film "Roving Mars" Footage from Spirit & Opportunity

January 27, 2006: This latest IMAX space productionn will start rolling out to IMAX theaters around the world; check out this site for details:

http://disney.go.com/disneypictures/rovingmars/

The Planetary Society Report

January 20,2006 - http://planetary.org
from Louis Friedman, Executive Director

Looking back at the past year

In 2005, Our 25th anniversary year, The Planetary Society was involved with the highly successful Mars Exploration Rovers, Deep Impact, and Cassini-Huygens missions.

We brought sounds of Titan to Earth from the Huygens probe. We also set out to solve a great spacecraft mystery -- **the Pioneer Anomaly**. And, after years of political activism to convince NASA to do a mission to Pluto, we were finally able to witness the New Horizons spacecraft launch succesfully on January 20th.

Planetary Society members, acting hand-in-glove with the scientific community, saved this **mission to Pluto and the Kuiper belt** when bureaucratic behemoths in Washington tried to stamp it out, claiming it was of little scientific value and the public didn't care whether or not humanity ever got a glimpse of these icy worlds on the edge of our solar system.

The dominant event of 2005 for The Planetary Society, and for me personally, was the loss of **Cosmos 1**. Our solar sail was not just a test of innovative technology, it was also a step toward a private role in space development. Cosmos 1 was the first ever attempt by a public-interest organization to fly a space mission.

But we are also strong supporters of government space programs. We believe the exploration of other worlds is a worthy and valuable government enterprise, but we also see private initiatives like ours, can stimulate creative, novel contributions to exploration. We believe in partnership.

Looking ahead to 2006

We are pursuing a **Mars Microphone** experiment both on the Phoenix mission in 2007 and the Mars Science Laboratory in '09. We will be pushing hard for an international **Europa mission**, one that now seems beyond the capability of NASA or ESA to do alone.

We will be encouraging all the space agencies involved in **lunar projects** (US, Russia, Europe, Japan, India, and China) to try to accomplish more through international cooperation. This, we believe, is absolutely essential if there is to be public support for human space flight to the Moon on the way to Mars.

Also in 2006, we will complete our **extrasolar planet catalog**, continue working on the mysterious Pioneer Anomaly and begin the only dedicated **optical search for extraterrestrial intelligence**, and advance ideas for missions to **asteroids** that might potentially threaten Earth.

For 25 years, The Planetary Society has relied on our Members to enable us to build the kind of partnerships to make things happen. I thank you for your support and I look forward to a new year of exploring other worlds and seeking other life. **<LF/TPS>**

New Horizons Probe en route to PLUTO, CHARON, & POINTS BEYOND

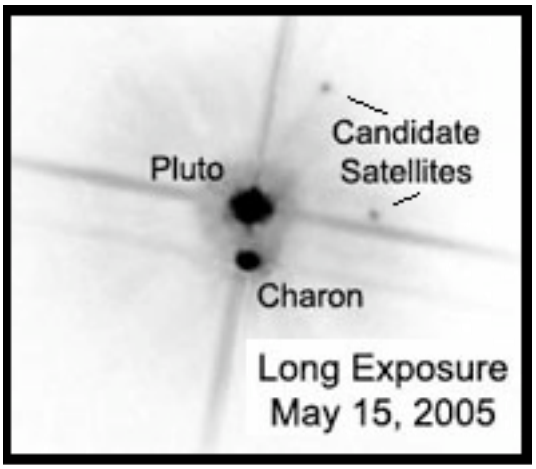
MMM Special Report

On January 20, 2006, mankind finally took the deep plunge into the vast outer reaches of the Solar System beyond Neptune. It was a launch that had been desperately wanted by planetary scientists for some time -- and they had an undelayable deadline. Starting in 2013, as Pluto in its elliptical orbit continues to return towards much further distances from the Sun, its mysterious and tenuous atmosphere will begin to freeze out. Next time around will be more than 200 years from now.

Budget overruns caused cancellation of one mission design after another until finally the present New Horizons craft passed muster. We are all relieved.

The probe will not arrive at Pluto until July 2015. To do this, New Horizons is taking a direct path, no flybys, at the fasted speed ever reached leaving Earth orbit.

As if that were not good news enough, in late October, the Pluto Companion Search Team announced the discovery last May of two smaller moons in the Pluto-Charon system. We are all intrigued that much more.



PLUTO SYSTEM

Hubble Space Telescope

NASA/ESA/ HST/JHU/ APL/SwRi

Pluto Companion Search Team

That Pluto, smaller and much less massive than the Moon, could have a system with three moons is surprising. But what we stand to learn about this distant mini system nine years from now, is just the beginning. Mission controllers are planning to put New Horizons on a Pluto flyby trajectory that will direct it towards two small Kuiper Belt Objects, KBOs, icy objects that apparently abound in the reaches beyond Neptune. Some of these KBOs rival Pluto in size and recently one was discovered that is larger than Pluto and seems on the path to recognition as the long sought Tenth Planet. Fifty years from now, we may know more about this Solar System fringe area than we did about the inner system planets fifty years ago! We live in amazing times, when new wonders are continually discovered.

The Solar System is a much more interesting place than any of us realized in our youth, whether that was 5,10, 20, 30, 40, 50 or more years ago! **</MMM>**

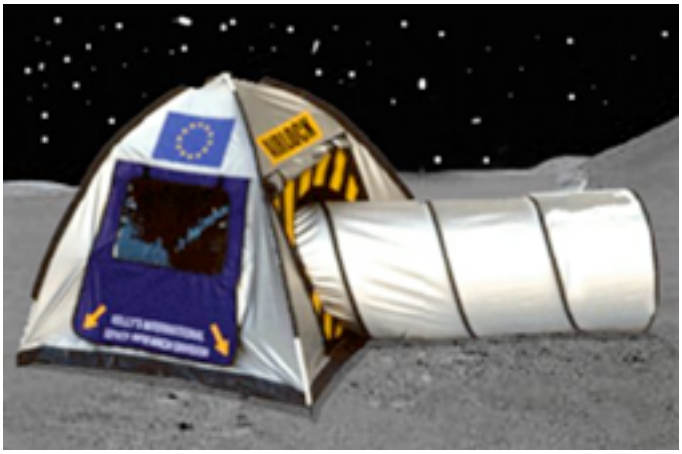
Under $100 Chapter Project: A LUNAR OUTPOST for Kids

by Peter Kokh, Lunar Reclamation Society

Perhaps, like the Lunar Reclamation Society, your chapter does not do much outreach to school age children, if any at all (LRS has done some, but not regularly). Unless we count a grade school teacher in our number (which we did, once upon a time) you just don't know what to do, how to present ideas, what sort of things will be sufficient to spark young imaginations.

The people at this British online store **Kelley's Eye** have an idea: http://www.kellys-eye.co.uk/

A common pop tent with a tunnel entrance attached to serve as the "airlock."



You can buy this outfit for the reasonable sum of £14.99 = US $26.42 plus shipping and handling, TBD.

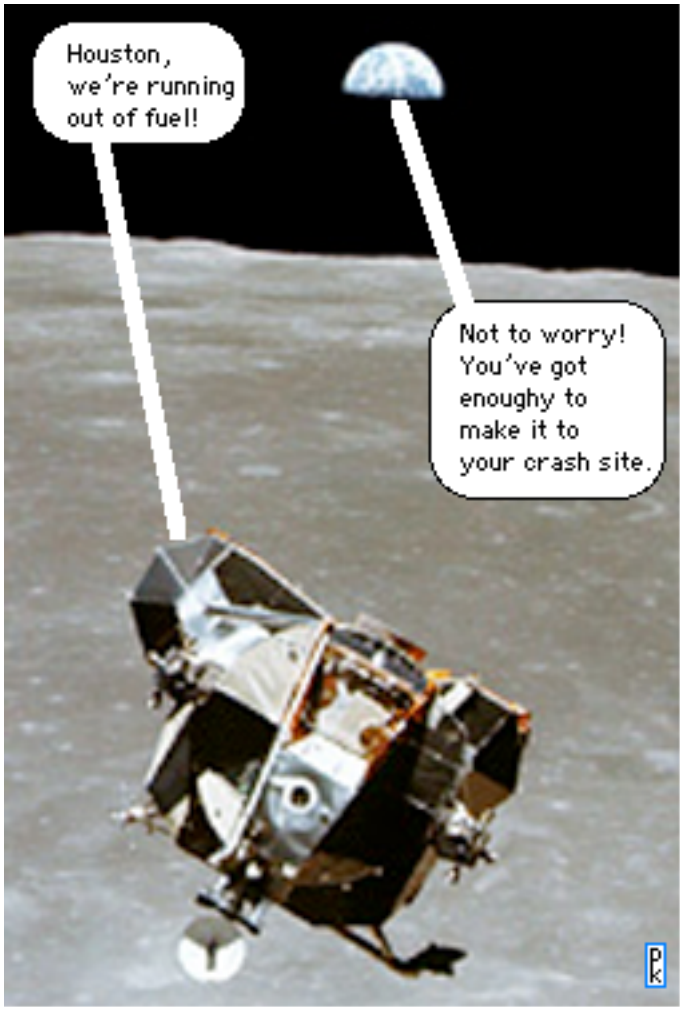
But you could also borrow this idea, finding a suitable collapsable tunnel tube and fit it to a larger, more spacious tent.

The "Lunar Playtent" shown is silver in color, a reasonable choice, I suppose. Gray would also do, spotted with gray/white/black fleck paint (Make-it-Stone™ by Krylon; American Accent "Stone Creations" by Rustoleum) to make it just that much more realistic, simulating the variegated tones of the lunar regolith.

Next, find a large painter's canvas, the bigger the better. Paint it a matte black or matte gray outdoor base coat, then have the artist in your group overpaint the shapes of little craters and boulders. Actually, real boulders, fleck painted to look like moonrocks, would be both more realistic and help hold the canvas down.

Depending on how spacious the tent is, you can decide how to outfit it: a couple of tents, a table, a computer/communications console - use your imagination and whatever furnishings you can find cheap or free.

The whole setup, less rocks, will be rather light and portable and not to much problem to store. Let schools know about it, train your people to answer kid's questions (How do you go to the bathroom is #!) and good luck!



How well does your Chapter use its AUDIOVISUAL Resources?

by Keith Wetzel, Moon Society St. Louis
Jan. 31, 2006 <kawetzel@swbell.net>

The other day I had made a passing comment to Lexi's teacher that I had taped a special about the Mission to Pluto. She said she would be interested in borrowing it.

Then I got to making a list of all the space related stuff that I have on tape, and sending her a copy if there was anything else she might want to borrow. I thought I would share that with everyone. Maybe if we each went through our tape collections [and collated the lists] we would have a tape exchange kind of a personal tape library that members can share. **<KAW>**

[**Editor:** not only would this be a great benifit for belonging to the chapter, but you would have a resource that could be made available to interested teachers. They could then teach their kids about space whether you could be there or not. Of course, if a chapter member were present for such presentations, you would be able to answer the many questions, some off the mark, some amazingly insightful.

The Space Chapter Hub http://nsschapters.org/hub/ would be interested in the results. email kokhmmm@aol.com

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

• **MDRS Moon Mission Funding Progress:** At the January 14th meeting, those present signed a letter to the Moon Society accompanying our donation of $1,400 towards the $7,000 rent for the two weeks, February 26-March 11th. This donation was from romaining proceeds earned through hosting ISDC 1998. We had announced this donation more than two months earlier to kick off the funding drive. Since then, the Moon Society has matched that amount from its general funds, and NSS has also matched the amount, out of funds in its Chapters Account bringing the total to 60%.

• **The Moonbase Simulation website is up:** go to:
http://www.moonsociety.org/moonbasesim/

• **LRS member to provide CapCom support for LRS/Moon Society crew at MDRS:** Our thanks to James Schroeter!

LRS Upcoming Events – February, March, April

Saturday, February 11th, 1-4 pm

LRS Meeting, Mayfair Mall, Garden Suites Room G110
AGENDA: www. lunar-reclamation.org/page4.htm
Reports on preparations for our Moonbase exericse in Utah..

Saturday, March 11th, 1-4 pm

LRS Meeting, Mayfair Mall, Garden Suites Room G110
AGENDA: www. lunar-reclamation.org/page4.htm
Reports on what has been happening the past two weeks atthe Mars Desert Research Station.. Peter will be flying home the following day. Bob Bialecki will be running the meeting. Peter will have a full report at the April meeting.

U.S. CHAPTERS

NSS
Chapter Events
MMM
6 Chapters Strong
Space Chapters HUB Website:
[http://nsschapters.org/hub/]

OREGON

Oregon L5 Society

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

voice mail / (503) 655-6189 -- FAX (503)-251-9901
[http://www.OregonL5.org/]
Allen G. Taylor <allen.taylor@ieee.org>
Bryce Walden <moonbase@comcast.net>
(LBRT - Oregon Moonbase) moonbase@comcast.net
Meetings 3rd Sat. 2 pm – Feb 18, Mar 18, Apr 15
Bourne Plaza, 1441 SE 122nd, Portland, **downstairs**

OrL5 News: Bryce Walden & Cheryl York to provie CapCom support for Moon Society Crew at MDRS, Feb. 26-March 11

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

AllShip/2005-Holiday-Party Pics
http://freemars.org/mnfan/AllShip/2005-Holiday-Party/

Ben Huset is Engineer on MDRS Crew #42

Get less email from Ben the last two weeks of January? Nope! Ben was busy multitasking, keeping us all informed while also keeping the MDRS Hab systems working, coming up with an ingenious fix for a new EVA space suit problem, and feeding Peter Kokh with measurements and photos need to plan the various projects for Moon Society's Artemis Moonbase Sim 1, Crew #45. He also installed flow meter valves on GreenHab lines to set up fellow Crew #45 member Leslie Wickman who will investigate the efficiency of the GreenHab and recommending upgrade options.

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 at **7-9pm**

FEB16th The Stoelting House, **Kiel**
MAR 16th: UW-Sheboygan, Room 6101, **Sheboygan**
APR 20th 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/]

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: February 18, March 18, April 15

December Notes: We did not have a formal December meeting this year at Philcon. This was a fun and interesting event (see below) but since we had no formal gathering, and Moon Miners has a publishing break in January, I have put together this note for our members. I will post the material to our other associates later.

Officers: We have not put together a quorum yet for our annual selection of officers. In accordance with our chartering organizations rules, we must have at least three directors (we call them coordinators) who are current members of The National Space Society. This should be done in January for inclusion in the annual report , which will be put together in the next few weeks.

Activity Summary: During the past year our group has had limited public outreach as a whole, but did participate in a number of activities if individual efforts are taken into account.

In February and March of 2005 we where allowed to be part of the special awards group at The George Washington Carver Science Fair. Several members, including myself, judged entries for The James H. Chestek and Oscar H. Harris Awards for Space Related Science and Technology at the Elementary and Senior School levels respectively. We gave a book on astronomy and several other items, including a kite for its historical connections with Philadelphia to Liznary for her elementary level research. The Senior level included a membership to NSS , a membership in P.A.S.A., a check to buy parts (Zachary Powers is building up a robot over several years) and other items. I was helped in giving the recipients there awards by Thomas Anderson, head of the Science Fair Committee.

In May our group split to present at the Super Science Weekend in Trenton , New Jersey, and also to attend the simultaneous occurrence of the I.S.D.C. in Washington D.C. The result was a spread of our people but a great return for our group as a whole. Many of our group attended the I.S.D.C. and came away happy that they did. They also came back that Sunday and helped make our Super Science event great. Dennis Pearson even brought DVDs back with Burt Rutan's keynote. He improvised a booth to allow viewing in our sunny location. And then many of us attended (or presented) Balticon!

We had a lull in the summer with the exceptions of Gary Fisher and his family going to Hanksville and Gary attending the Mars Society Convention as a presenter in August in Colorado Springs , Colorado. His interest this time was The Mars Homestead Project which he is part of. Lulls are relative: Hank Smith and Dotty and Larry where off to a number of events during this period both for tourist fun (in Canada, Massachusetts etc.) and fan activity. That can even be in Europe with Mike Fishers trip.

Fall picked up with help from Mitch Gordon. He worked for months to get us into The Franklin Institutes' weekend events for early October as part of International Space Week promoted by the U.N.. We had fun Saturday and on Sunday: Michelle Baker and Mitch Gordon came to help Sunday. Michelle and I saw Story Musgrave lecture in the afternoon. We had a great time promoting science education and our various affiliates interests. Many of the visitors enjoyed our answers to the questions they had and liked our frank discussion on many topics. Having access to the Institutes' Chief Astronomer (and Planetologist) Derrick Pitts for some questions, as he frequented the Franklin Rotunda, was really cool.

Our last activity of the year was at the Philcon event in December where a number of us had invitations to be panel members and presenters. Thanks to the efforts of

Hank Smith, our Science Fiction Outreach Coordinator, and the Chair of Science Programming Mark Wolverton. Michelle Baker gave here yearly summary of events in space exploration as a J.P.L. ambassador to the Solar System with emphasis on the probes we have going to, or at, other planets. The Voyager trip to the heliopause (interstellar space) was also brought up as a continuing mission. The revitalizing of the Icy Moons missions and talk of Pluto where hopeful signs for future missions. Mitch Gordon served on several panels on the Future including the cross-over areas between science and religion, especially the viewing of the conjecture that an intelligence was required to guide natural process to produce us. He also did fill in on another.

Earl Bennett (Me) served on some interesting panels varying from one on the future of invention as an individuals act, with two great panelists with a number of patents for there own inventions (one had thirty in food and pharmacutical products). A more relevant one on space exploration put some of the current talk into some perspective: until we have a bankable economic reason to go into space permanently all we will see, at least for the near future, is plans and discussions that do not have the fundamental goal of easy access to orbit for most possible users. I found myself as the most starry eyed of the panelists and I think that it will take about 20 years to put the infrastructure together for that goal. We had great audience participation and much cold water. The recent talk of Branson's investments and space hotels where put into great ideas and we,ll see what actually happens. Another was on the hunt for extra solar planets (standing room only).

And the presentation I was not on that I went to that was actually on applying scientific technique to claims of extra terrestrial contact that came in to an investigative group. The was called "SETI on the Web". Interesting and new.

Coming events: our next meeting will be on January 21st at our Liberty One location. In February and March we will be participants in the Annual George Washington Carver Science Fairs Elementary and Senior Level judging for a special group of awards we give. In May we will present at the New Jersey State Museums' Super Science Weekend. And whatever space related activity we can be involved in!

Earl Bennett

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

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CALI FORNIA

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.
- **February 18 th – March 18th – April 15th**

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

Upcoming Events

- **Sat. February 18th, 3:00pm –** OASIS Monthly Business Meeting at the home of Craig and Karin Ward, 1914 Condon Avenue, Redondo Beach.
- **Feb 23, 7:00 pm --** "New Views of Hidden Worlds: Revealing the Depths of Venus, Jupiter, Saturn, and Titan with 21st-Century Spacecraft," by Kevin Baines, JPL Planetary Scientist. Von Kármán Auditorium at JPL, 4800 Oak Grove Dr, Pasadena. Sponsored by Theodore von Kármán Lecture Series. Admission is free. Also broadcast and webcast on NASA TV. 818/354-0112 or http://www.jpl.nasa.gov/events/lectures/feb06.cfm.
- **Feb 24, 7:00 pm --** "New Views of Hidden Worlds: Revealing the Depths of Venus, Jupiter, Saturn, and Titan with 21st-Century Spacecraft," by Kevin Baines, JPL Planetary Scientist. Vosloh Forum at Pasadena City College, 1570 E Colorado Blvd. Sponsored by Theodore von Kármán Lecture Series. Admission is free. 818/354-0112 or www.jpl.nasa.gov/events/lectures/feb06.cfm
- **Sat. March 18th, 3:00pm –** OASIS Monthly Business Meeting at the home of Craig and Karin Ward, 1914 Condon Avenue, Redondo Beach.
- **Sat. April 15th, 3:00 pm –**OASIS Monthly Business Meeting at the home of Craig and Karin Ward, 1914 Condon Avenue, Redondo Beach.

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/.

NAME _____

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❍ **$45 National Space Society** dues includes **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 (pdf) MMM $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/MMR Subscriptions:
Send proper dues to address in chapter news section

=>for those outside participating chapter areas <=

❍ $12 Individual Subscriptions to MMM/MMR: Outside North America ❍ $50 Surface Mail -- Payable to "LRS", PO Box 2102, Milwaukee WI 53201

CHICAGO SPACE FRONTIER L5
❍ $15 annual dues

LUNAR RECLAMATION SOC. (NSS-Milwaukee)
❍ $12 for all

MINNESOTA SPACE FRONTIER SOCIETY
❍ $25 Regular Dues

OREGON L5 SOCIETY
❍ $25 for all members

O.A.S.I.S. L5 (Los Angeles)
❍ $25 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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