

Moon Miners’ Manifesto

& The Moon Society Journal

www.MoonMinersManifesto.com

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In FOCUS: Worrisome Bumps on

The Return to the Moon program is currently on hold. It appears that the NASA-preferred shuttle-system-derived CEV (Crew Exploration Vehicle) will not have the throwweight needed to enable it to carry to the Lunar south pole the downsized components of what is unflatteringly called “Apollo on Steroids.” That leaves three options:

- Go easy on the steroids and deploy an even more humble “Apollo upgrade”
- Abandon the south polar site and head for the Moon’s equator (in our opinion, that has merit.)
- Go back to the drawing boards, i.e. “listen” to the private enterprise contractors with minds open, not closed.

What NASA will do, and what it should do are two different things. In our opinion, NASA cannot think outside the cultural fishbowl it has been in for decades. The agency cannot switch paradigms, even under orders from the President and the Aldridge Commission.

Meanwhile, NASA “talks the talk” about needing to rely on local lunar resources to support the outpost and the need to find ways to make money by operating on the Moon. But that will take delivering more equipment and weight to the Moon than the current CEV architecture can support. The result? NASA can’t “walk the walk.”

the Roadway Back to the Moon

First, for transport, we need a family of vehicles with a whole range of lift capacities, from less than a ton to hundreds of tons. At the top end of this range, a Shuttle-derived heavy lifter is a must.

As to the rest, we suggested in MMM # 174, April 2204 “In Focus: Crew Exploration Vehicle Modularity Brings Opportunities” that NASA confine its role to identifying and defining the interfaces between modules, and let the private enterprise contractors compete for the best module for each stage or position in the CEV assembly. This plan would confine NASA to its proper role, allowing private enterprise to blossom into the vacuum so created.

The Administration has not given firm guidance, beyond enterprise-touting platitudes that leave too much escape room for an Agency that wants to do what it is used to doing. That is to be expected and natural. Change, real change, sometimes has to be forced down the throat.

We are kidding ourself anyway. Can’t have both endless war and space both. It is difficult to believe that the cancellation of the preent “vision” is not just a matter of time because we have gone too heavily into war-debt.

But we need to agitate to have the administration force needed cultural changes on NASA. [⇒ p. 2, col. 2]

From Laika to a Lunar Prospector’s Best Friend

As many a criminal has found out, dogs have a keen sense of smell. Could future prospectors put that talent to work on the Moon to find trace elements? Perhaps not, but maybe a robotic sniffer with senses even keener could help. We are using new “DART” technology here on Earth. What’s needed is for some inventive space enthusiast to adapt this new technology for lunar vacuum. See page 16.



Moon Miners' Manifesto

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• **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.

To the agency's credit, it *has been* looking for new technologies and inputs, through the Centennial Challenge and by other means. On this topic, we have suggested before, ad nauseam perhaps, that NASA award "Spin-up" prize incentives to identify technologies needed on the Moon (and Mars) and to predevelop them for any potentially profitable terrestrial applications. This is a process which would give entrepreneurs near-term return on investment for putting needed technologies "on the shelf" for when they are needed, paid for by you and me not as involuntary taxpayers but as voluntary consumers.

In our opinion, this is the *only way we will ever have* the technologies needed to *stay* on the Moon, and to *expand towards settlement*. Anyone who thinks that NASA will be funded by Congress for these "extras" has to be living in a fantasy land. Four decades of Congressional micro-management and forced cutbacks, downgrades, stretch-outs, and cancellations should have taught us something. Yet some enthusiasts seem to be living in a fairytale world.

We have to change the rules of the game! As long as NASA is *the player*, the *metacontractor*, it is difficult for industry to compete on a level playing field, and in fact, industry is demotivated in such a game.

Bit what has happened was foreordained by the Administration itself. How? By doing something demanded by the space enthusiast community - *setting a date, a timetable, a deadline* for a return to the Moon and for the deployment of a "permanent" outpost. Now that's an outrageous assertion, you may object. But by setting a deadline, the Administration put NASA in a position where the only way it could guarantee meeting the deadline was to depend only upon itself and not wait upon the mechanisms of free enterprise to produce the needed components. The party made responsible is *de facto* given the authority.

So in last analysis, we have only ourselves to blame. Our impatience, made quite clear to the Administration, set the stage. We cannot have it both ways, reliance on free enterprise and hard and fast deadlines. Impatience is the root of all failure, whether it comes swiftly, or belatedly.

Patience requires a step by step approach, a first things first approach, "terracing." What ever did happen to "terracing"? That's a road paved by private enterprise where the profitability of one step lays the groundwork for the next. Enterprise is a world neither bureaucracy or academia understands. There is a cultural divide. What most of us mean by private enterprise and what NASA or academia means by it is a case of apples, oranges, and pears.

If all three must work together to move humanity out into the solar system, it is enterprise that must call the shots. We ourselves may be too caught up in the paradigm of a national, socialized space program to understand this. Our role? We must control as free consumers, not as obliged taxpayers. There is an enormous difference. PK

Solar Thermal Rocket Engines

By Ben Smith <terranexplorer@yahoo.com>

Solar thermal rocket engines (abbreviated STRE in this article) are an exciting propulsion option, especially for Lunar settlement and Lunar-Earth space development. The great promise of STREs is the fact that the only inputs are sunlight and a reaction mass. Ideally the reaction mass will be obtained from Lunar resources (to cut down on launch costs and to provide Luna with an income producing export). Lunar produced liquid oxygen could be the propellant used to propel spacecraft throughout the inner solar system.

A solar thermal rocket engine is a form of spacecraft propulsion that uses concentrated solar energy to heat a reaction mass (the propellant used by the rocket to produce acceleration) to high velocity. The fast moving reaction mass is then expelled from the vehicle to produce forward thrust (According to Newton's 3rd law of Motion, for every reaction there is an equal and opposite reaction. Therefore, thrust equals the mass of the reaction mass times the acceleration of the reaction mass).

Unlike chemical rockets, STREs use sunlight to heat its reaction mass, instead of a chemical reaction. This makes STREs inherently safer than chemical rockets because they do not rely on a controlled explosion for heat, and liquid oxygen will not explode without a fuel source (oxygen is an oxidizer). Mirrors are used to concentrate solar energy which is then used to heat the reaction mass. The heated reaction mass is exhausted through a conventional rocket nozzle to produce thrust. The exhaust velocity of the reaction mass is related to the surface area of the mirrors, the local intensity of solar radiation, the thermal limits of the heat exchanger (if one is used), and the mass of the reaction mass. Relatively few moving parts are necessary, increasing the reliability and safety of STREs.

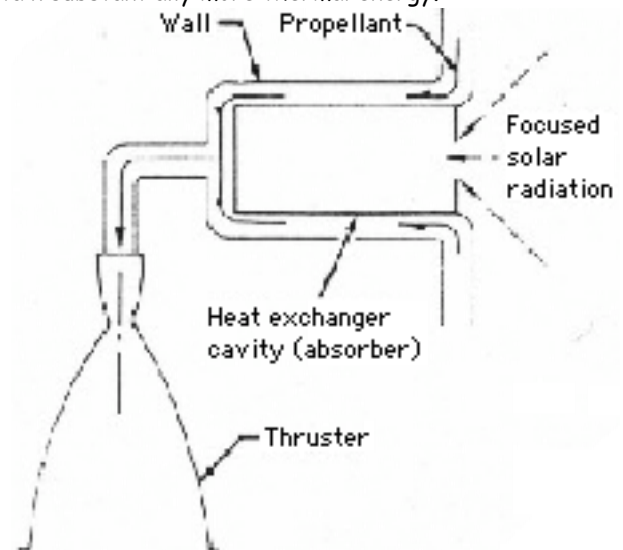
Hydrogen is often proposed as the reaction mass of choice because it has the lowest molecular mass (the sum of the atomic masses of all the atoms composing a molecule. Hydrogen has a molecular mass of 1.0 gram/mole.) of any element. Lighter reaction masses have higher exhaust velocities and give the rocket a higher specific impulse (the change in momentum per unit of mass of propellant. Noted as Isp). Specific impulse is a measure of how much thrust can be obtained from a fixed mass of propellant and is used to compare the efficiency of various propulsion methods, the higher the Isp the more efficient the engine. STREs using hydrogen as a reaction mass can reach a theoretical Isp of 900-1200 seconds depending on the design (WordIQ.com). In comparison, the Space Shuttle Main Engine, the most efficient chemical rocket engine in use, has an Isp of 465 seconds. The ion engine on Deep Space One produced an Isp of 3000 seconds but required a long period of acceleration to reach high velocity (Hirata). Hydrogen would be an unsuitable propellant due to its scarcity in Lunar

regolith. Data was unavailable regarding the potential Isp of liquid oxygen as a reaction mass.

There are two basic types of STREs, indirect heating and direct heating. Both types would use similar mirrors, reaction mass, and exhaust nozzles but differ on how the energy is transferred to the reaction mass.

The simplest type of STRE uses indirect heating of the reaction mass. This involves focusing the solar energy onto a heat exchanger. The reaction mass is then passed over and/or through the exchanger where it picks up energy, expands, and accelerates. Some designs have the heat exchanger open to space, but the more efficient designs have the solar energy pass through a high temperature quartz window instead of an open hole in the side of the rocket. Enclosing the engine increases the pressure inside the rocket and therefore increases the efficiency of the rocket.

The primary drawback to indirect heating is that the maximum temperature of the reaction mass is limited by the maximum material temperature of the heat exchanger. Almost all known engineering materials melt above 2500 degrees Celsius, making this the absolute temperature limit for the reaction mass also. Current designs use a refractory material such as tungsten, rhenium, or graphite and operate around 2200 degrees Celsius. Because of this limitation, indirect heating designs are limited to an Isp of 800-1000 seconds (WordIQ.com). There are several theoretical designs using fluidized silicon beds that may be able to retain substantially more thermal energy.



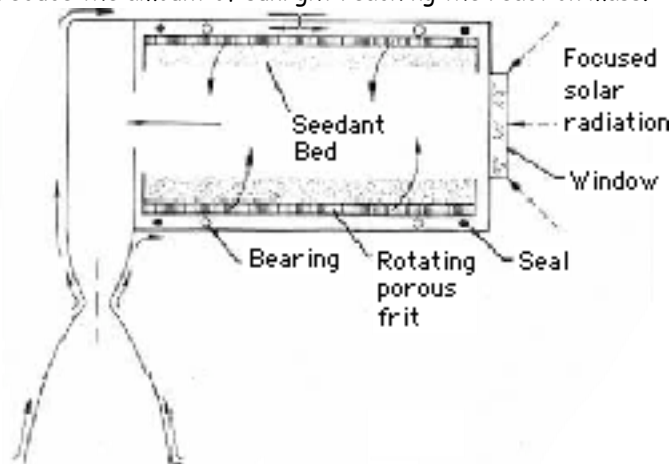
Indirect solar thermal engine. Source: NASA SP-509, "Space Resources – Energy, Power and Transport", 1992, p. 162.

Image: Permanent: <http://www.permanent.com/t-steam.htm>

The other type of STRE directly heats the reaction mass with concentrated solar energy. In this method, concentrated sunlight is directed through a high temperature quartz window directly into the reaction mass. Since there is no heat exchanger to limit the maximum temperature, specific impulses approaching 1200 seconds are

theoretically possible (WordIQ.com). The drawback of this method is that it is more difficult to heat a gas (the reaction mass) than it is to heat a solid (the heat exchanger). A solution to this problem is to seed the reaction mass with particles of tungsten or several forms of carbides. These particles absorb the energy and impart it to the reaction mass via convection and conduction.

The drawbacks to this solution are that the particles will reduce the Isp of the engine and have to be replaced if they are allowed to vent with the reaction mass. The current design to prevent the loss of the particles is to use a rotating bed (Shoji). In this design, the reaction mass flows through the porous walls of a rotating chamber where it absorbs the thermal energy from the particle seeds. The seeds are retained on the walls of the chamber through centrifugal force (technically not a force but the effect of the inertia of the seeds, causing them to move away from the center of the chamber). This prevents the particles from exiting the rocket along with the reaction mass. While more efficient than indirect heating, this design is considerably more complex, expensive, and massive. There is also the danger that the seed particles may stick to the quartz window, causing localized heating and potential failure of the window. Loss of pressure causes the engine to stop working. Contact with seed particles may also scratch the window and reduce the amount of sunlight reaching the reaction mass.



Direct solar thermal engine. Source: NASA SP-509, "Space Resources – Energy, Power and Transport", 1992, p. 163. Image: Permanent at <http://www.permanent.com/t-steam.htm>

As efficient as STREs are, they do have several operating restrictions. STREs produce less acceleration than chemical engines, making them unsuitable for boosting out of strong gravity fields (like the Earth's surface). Data was unavailable as to the possibility of using STREs to lift from the Lunar surface. This is an area we should investigate. Also, large mirrors are needed to concentrate the sunlight and generate the intense heat necessary for engine operation. While solar intensity in Earth space is 1.4 kW/m² the engine will still need mirrors that are up to 100 meters in diameter. Such large mirrors dictate that STREs can only be used in vacuum and beyond Low Earth Orbit (where atmo-

spheric drag is still a factor, and orbital debris a hazard.). The solar energy at Mars orbit is 45% of that at Earth orbit, making STREs less practical beyond Earth orbit.

Only two serious attempts have been made to turn STRE theory into flyable engines. NASA implemented the "Shooting Star" project in 1997 as a ground test system. The system was never built and the program was canceled in 1998 (NASA). However, in 1998 Boeing was awarded a U.S. Air Force contract to perform initial studies for a solar powered orbital transfer vehicle, designated "Solar Orbital Transfer Vehicle (SOTV)." The project is currently ongoing and has no flyable components yet. Currently there are no operational STREs (Boeing). Several other companies are working on STRE components.

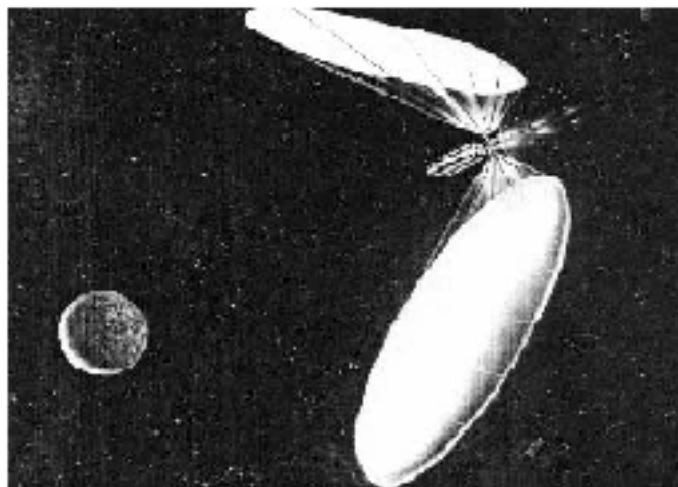


Image courtesy of Rockwell International. Image from Island One at <http://www.islandone.org/APC/Beamed/03.html>

Solar thermal rocket engines hold great promise for the development of near-Earth space and especially Lunar development. Their simple design, high efficiency, and safety; coupled with the possibility of the use of Lunar oxygen as the sole propellant, could reduce the high costs associated with Lunar settlement. Much basic research needs to be done to determine if STREs will have a place in space settlement. The Moon Society could be an active participant in this research.

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What a Lunar Analog Research Station Should Attempt to Demonstrate

by Peter Kokh and Moon Society Advisor David A. Dunlop

First let's clear the ground by pointing out that the goals of a Mars Analog Research Station are not necessarily the same as those of a Lunar counterpart, and vice versa. ***For Mars advocates, the goal to be defended, the feasibility to be demonstrated, is that humans and robots together can explore Mars much more effectively and thoroughly than robots alone.*** Mars advocates are trying to get the nation (and, hopefully, international partners) to commit to the manned exploration of Mars. Settlement, while a dream of most, is a goal well over the horizon.

In contrast, Lunar Advocates are operating with a given national commitment to a "permanent" manned outpost on the Moon, whatever "permanent" means.

We have many times pointed out that any outpost remains tentative until there is a permanent civilian population on the Moon raising its own successors, and supporting its own domestic needs as well as earning credits towards imports by products and services based on local, i.e. lunar resources.

We have already had humans on the Moon exploring limited areas. Manned exploration is not something whose feasibility we still need to demonstrate. Thus **our goals go beyond those of Mars advocates.**

- We do not need to demonstrate the methods and tools of human-robotic exploration,
- ☑ We do need to determine which operations can be done effectively by teleoperation from Earth in order to dedicate precious man-hours on location for those things that can not be done as well by teleoperation
- ☑ We do need to demonstrate the methods and tools of expansion of an outpost into a settlement.
- ☑ We do need to demonstrate the options for using local lunar resources to accomplish that goal.

Demonstrating Maximum Use of Teleoperations

Our long term goal is to ensure the creation of a viable lunar frontier where people of many walks of life can work, play, and raise families, supporting themselves by the production of export goods and services. To the point, there is one thing in common with all "new frontiers" in the early stages of establishment.

There is always more work to be done, than people to do it.

Our best opportunity to make sure that precious man-hours are most economically spent is to identify and demonstrate operations that can be effectively performed by personnel on Earth, "teleoperating" at far lower costs per hour. The Moon has the advantage of being only one and a fraction light-seconds from Earth, a manageable time delay.

Site preparation (grading, leveling, removal of boulders, trenching, etc.) and shielding emplacement are two

obvious areas where teleoperators working on Earth should be able to get the job done, leaving crews on the Moon for other things, not so easily "farmed out." But we need to determine the best equipment to be sent to the Moon for teleoperators to control with under 3 seconds time delay.

What other operations can be so farmed out? Here lies a whole world of things that can be tested at a lunar analog station. Every operation that can be done remotely, extends the productivity of those on location that much more. Advance scout rovers could be teleoperated; mining equipment, manufacturing equipment, agricultural tasks, perhaps even road construction. Let's find out!

Demonstrating Dayspan/Nightspace Power Generation

An outpost needs power, of course, but NASA is not currently committed to demonstrating a system to store power for use during nightspace. Instead, the agency seems committed to demonstrating that the need to do so is unnecessary, because the outpost will be at the South Pole, where allegedly sunlight is available all the time.

If we are going to bring *the whole lunar globe* into the realm of a Greater Earth-Moon Economy, we have to be able to set up shop wherever resources and other assets demand that we do so, not just at one of the poles. And that means demonstrating a Dayspan/Nightspace power system. Indeed, we should demonstrate several systems, not only for backup, but so that the technology can pick the winners.

The options are several. A small nuclear power plant is, however, something totally out of reach financially for a privately supported Lunar Analog Station here on Earth. But that doesn't really matter, because outposts and settlements will come in all sizes, while "nukes" may come only in one size, and at high expense, a non versatile solution.

Hydrogen/Oxygen Systems: Fuel Cells

Excess dayspan solar power could be used to electrolyze graywater and water in reserves into hydrogen and oxygen which can be recombined in a fuel cell to produce both power and potable water. Fuel cells could also be fed by hydrogen scavenged from solar wind volatiles by heating regolith soil being moved in the process of road construction, materials processing, site grading and excavation, and import of regolith into pressurized farm areas for use as soil. Fresh oxygen can be extracted from the regolith by several well understood and demonstrated processes. Harvesting hydrogen and extracting oxygen would be dayspace activities.

Hydrogen/Silicon Systems:

Silane-fueled Generators, Vehicles, and Appliances

Another entirely different possibility should be explored. Carbon is scarce on the Moon, much more so than hydrogen. Thus methane is not a fuel option. But Silane, SiH₄, a silicon analog of carbon-based methane, may be.

Silane could be called a "hydrogen extender," in as much as silicon, being much more common on the Moon than

hydrogen, is used to stretch the total power output of a given amount of hydrogen. Silane has been proposed as a lunar appropriate rocket fuel.

I had some time ago asked Dr. Robert Zubrin if the adiabatic process (occurring without loss or gain of heat) to be used in making methane from the Martian atmosphere could be applied to production of silane on the Moon. He answered in the affirmative. That leaves us with the belief that this is a direction worth pursuing.

- First we could demonstrate methods of producing Silane from regolith. Engineering competitions at the College-University level are an option worth pursuing.
- Then, by similar competitions, we could seek to demonstrate silane-fueled generators, silane-fueled vehicles, and silane-fueled appliances.

The Silane would be produced during dayspan in quantities sufficient to fuel appliances and vehicles at all times, and generators during nightspan. Silane-fueled generators could also be used at all times at small construction camps and other temporary installations where it makes no sense to deploy a large scale solar (or nuke) power system.

Continuing productivity through the nightspan by use of "change of pace" task sequencing

Few things need demonstration as much as the ability of pioneers to survive the two week long lunar night. Here on Earth, alternating fortnights of full daylight and total darkness (except for Earthlight and starlight) within a warehouse or arena with blacked out windows and total lighting control. But we can come close at an outdoor Habitation structure such as the Mars desert Research Station, by having the crew active for two weeks during local daylight hours, then shift to a schedule offset by 12 hours, awake and active only during the local Utah night. The portholes and windows could be blacked out, or uncovered, as needed to create the right atmosphere inside. Crews would go outside only during daylight, and nighttime hours alternately over a four week cycle.

We might learn more from week 1 dayspan, weeks 2 and 3 nightspan, week 4 dayspan. That way two transitions, from abundant power to rationed power, and from rationed power back to abundant power could be modeled. If we could only afford to rent the MDRS facility for two weeks, we could operate on a 4 day light, 7 day dark, 3 day light schedule, telescoping the lunar cycle into half the time.

In such a light/darkness regime, crew members could experiment with the management of operation tasks to suit the greater amount of power available during the two "daylight" weeks, and the lesser amount available during the two "nighttime" weeks. Various tasks could be separated or precipitated out into energy-intensive ones to be executed during the light period and energy-light and perhaps labor-intensive tasks to be taken care of during the night period. Some operations will lend themselves to such a sequential

execution, others may not. It will be a learning experience.

Meanwhile, we can demonstrate power generation during the dayspan period by use of photovoltaics, and solar concentrators, and other means. During this period, excess available energy would be used to electrolyze graywater, as suggested above. For backup to fuel cells, we could develop and improve silane-fueled generators, furnaces, ranges, refrigerators, and rovers.

For more on the topic of dayspan-nightspan task sequencing, confer these back articles:

- MMM #7 July, 1987 "Powerco"
- reprinted in MMM Classics #1, pp. 21-22
- MMM #43, March, 1991 "Dayspan," "Nightspan"
- reprinted in MMM Classics #5, pp. 10-12

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www.lunar-reclamation.org/mmm_classics/ or:
www.moonsociety.org/publications/mmm_classics/

Modeling "Modular Biospherics"

1. Modules for expansion

Expansion of our outpost(s) is(are) can not reasonably be supported by the prohibitively expensive import of habitat modules and connectors manufactured on Earth. With so astronomically expensive a cost pre square foot of usable space, the governing constraint will be to jam pack each unit with equipment, reducing crew quarters and recreation space to "sardine can" cubbyholes, and making many desirable activities much too expensive to support.

The next step would be to bring in inflatable structures packed uninflated and compacted for the ride to the Moon in constraining payload bays and farings, then finish outfitting them on location. These could be spheres, cylinders, or torus-shaped volumes. The latter provides a stable "no-roll" level footprint and the greatest volume to height ratio, making shielding easier. While inflatables designed for use in low Earth orbit must have foot-thick membranes to protect against puncture from orbital debris, inflatables designed to be covered with shielding on the Moon would need only a much thinner membrane, meaning that inflated, they could provide significantly more volume (with perhaps ten times the membrane surface area) than similar LEO-destined inflatables, when both are to be transported in the same size payload bay or faring. The real challenge of inflatables is to design interior systems that can be quickly and easily deployed, once the structure is inflated. Again, college level design competitions may prove useful in coming up with elegant solutions.

The real breakthrough, however, will be the achievement of the capacity to manufacture modules and module components locally on the Moon with made-on-Luna building materials: metal alloys, glass fiber reinforced concrete, glass-glass composites. The price of new space will be reduced drastically. The outpost will grow module by module, along with the crew - the population.

2. Making each module of the growing structure, also a Module of the growing biosphere

Meanwhile, we will have to grow the biosphere that supports the complex. The simplest and most elegant way to do this is to equip every lived-in, worked-in, played-in, learned-in module with a Wolverton* type toilet system that flushes sideways through the bathroom wall to water a row of planters beginning with water plants, swamp plants, marsh plants, bog plants and then soil plants. By the time the black water leaves the module, it is 95% pretreated, vastly reducing the load on a central water recycling system.

* To learn more about the Wolverton System, check out:
<http://www.wolvertonenvironmental.com/>

These "principles of modular biospherics" are something worth modeling and demonstrating at a Lunar Analog Research Station. Such a system will go well beyond whatever system NASA uses to refresh air and water in a fixed size outpost, and thus demonstrate the technologies needed for expansion of an outpost into a real settlement.

The modules would need to pipe in sunlight or alternately, banks of grow lamps. (The pathways provided for sunlight could be used by light from intensely bright external sulfur lamps during nightspan.) The plants within each module would largely refresh air within, and fill the interior with the greens of vegetation and the color of flowers: fresh air, greenery, color - not an add-on but an integrally designed feature of each module.

In such a system, the biosphere grows one module at a time. The settlement's physical plant does not outgrow the biosphere's capacity because the two are one and the same. Not just the major modules that comprise living, working, and recreation space, but also the connecting passageways and "streets" should do their share by hosting plant rows along their sides. We must always keep in mind that *it is not a case of humans playing host to house plants, but of vegetation playing host to humans, enabling our survival!*

We could build our Analog Station with a mix of hard hull modules, inflatable modules, and modules made of materials we should be able to process on the Moon. Perhaps the core operations would be in the hard hull starter units:

1. Crew Quarters - Library - "Quiet Spaces Module"
2. Computer workstations: communications, controls, monitors, reports, teleoperations, CapCom, Office
3. Kitchen, Pantry, Ward room, meeting space
4. Bathroom, showers, exercise & fitness area, First Aid
5. Lab space for work on geological and mineral samples
6. Utilities: power, thermal control, engineering workbench
7. Airlock and suit-up area. Dust decontamination

The above modules could be directly interconnected or connected via passageways, as the needs for isolation or of juxtaposition dictates.

This basic 7 unit complex contrasts with the all-in-

one approach illustrated by FMARS and MDRS. The Lunar Analog Station, by beginning as a modular complex, would be set to grow in like fashion. Additional modules could be added for recreation and sports, arts & crafts space, and areas for experiments with processing and materials. The complex would begin to look like a self-sufficient commune.

All units would house vegetation. This would be in addition to the Greenhouse, itself modular, which could grow as success, food demand, and the desire for more variety increases. A Greenhouse area could host a picnic corner, a get away reading spot, a biocrafts area, and so on.

Thus a Lunar Analog Station would not be a weak "me too" operation, but one with rather ambitious goals that go well beyond what the Mars Society is attempting to do. It is only fair to point out, however, that The Mars Foundation is moving in that direction also. This group is attempting to identify all the technologies needed to transition an outpost into a permanent settlement on Mars, and dreams of building a prototype Mars settlement somewhere on Earth.

Other things worth demonstrating at a Lunar Analog Research Station

- Teleoperable shielding emplacement systems
- Erection of shielded hangers within which to indirectly shield pressurized modules and/or to house supplies and systems that need to be accessed on a regular basis
- Greenhouse systems
- Early industries: cast basalt, glass, fiberglass, glass composite, concrete, metal alloys
- Art media using only lunar producible materials
- Refurnish the Habitat with objects made in the above demonstrations. And on and on.

Evolution of the Analog Complex with regular "Updating Makeovers" as new technologies are demonstrated

Of necessity, the initial complex modules will be built with available terrestrial materials. However, right from the outset, floors could be finished with cast basalt tiles made in Czechoslovakia and marketed in the US out of West Virginia. We could also start out with interior walls constructed not of 2"x4" wood studs and drywall (as is the case at MDRS and FMARS), but of steel studs and *duroc* cement board. Not only would that be closer to what we might end up doing on the Moon, it would be a fireproof solution.

As we demonstrate new materials technologies, we could then replace more and more of the original materials, furniture and furnishings used in the station with those analogous to what we might be able to produce on the Moon. In this manner, the quality of the "simulation" would keep increasing - proof that we are learning things worthwhile!

A Lunar Analog Station as a Part of a larger Project

A Lunar Analog Research Station is but one part of a grander dream of the Moon Society, called Project LETO {Lunar Exploration and Tourist Organization} which would

involve a major tourist and educational center. It is my opinion that the research facility should not be included in such a complex but located separately in an appropriate isolated landscape. However, a twin facility at the tourist center, evolving (expanding and upgrading) in step, would be available for regular tours. It would have monitors at each location to show web cam views of what is currently going on in the real research station.

The Mars Society relies on publicity for its analog stations to increase public support and funding. But a sister complex open to tours with a peep hole into the actual one, if located in a high tourist traffic area such as Las Vegas or Orlando, would greatly increase public exposure, public enthusiasm, and, equally if not as important, a steady flow of donations and new members.

What's Next for the Moon Society–NSS collaboration? Another Crew at MDRS? Moving somewhere else?

We can do *some* of these things suggested above at the Mars Desert Research Station in the 2007 Field Season - for example, a first modeling of operations through a complete lunar dayspan/nightspan cycle.

However, the demonstration of a modular biospherics expansion architecture, as it involves the facilities themselves, would necessitate an independent operation on a separate site. It would be foolish to make major capital investments in a facility not our own, and from which we planned to move. Further, there is no reason to believe that the Mars Society would approve any such expansion plans. If we want to do these things, we must find another site and deploy a fresh habitat complex of a friendlier design.

As for a new site for our new modular complex, locating it in a "lava sheet, lava tube area" would be optimum for silane and/or fuel cell based utilities, cast basalt operations and other materials processing and manufacturing operations we want to demonstrate. It will take some time both to identify a new site and acquire access and use.

It would take more time, and money, to deploy our desired complex. However, we could start with a mockup complex of rented or purchased used old camping trailers, replacing them one at a time with new construction. This is a plan that would involve the minimum interruption in annual simulation exercises, a plan that would maintain momentum.

- ☐ 2006 -plan a 2nd crew to MDRS in the 2007 field season
- ☐ 2006-2007 locate and acquire access to a new site in a geologically more appropriate area
- ☐ 2007 - 2nd exercise at MDRS
- ☐ 2008 - 1st exercise at new Lunar Station with temporary camper modules or RVs
- ☐ 2009 - replace first camper with permanent module, etc.

We can do this! But not without donations! We are still \$1250 shy of full funding for this year's effort! *To find out how to donate, write kokhmm@aol.com or write us at the MMM submission address, on page 1.* <MMM>

The Mars Analog Research Station Program is Missing Key Critical Opportunities.

Central to the Mission Plan of "Mars Direct" is the thesis that we can make fuel for the return to Earth leg of a Mars exploration mission on Mars itself. By not having to lug along return fuel to Mars, an outbound Mission can be significantly lighter, which translates to significant savings. A "Mars Direct" mission would cost only a fraction of a traditional mission architecture.

The return fuel, to be derived from Mars atmosphere, is methane, CH₄, which would be burned with oxygen, also extracted from the atmosphere. The idea is brilliant and elegant. A natural solution.

Why then are we operating the generators at FMARS on Devon Island and at MDRS in Utah on diesel fuel? Why are we operating the furnace, the range, and the refrigerator with propane? Granted, these are the kinds of equipment available now for powering a station on Earth "off the grid." What we do not understand is why there is no engineering competition to develop methane fueled generators, furnaces, ranges, and refrigerators. Wouldn't such a demonstration go a long way to show the world that the "Mars Direct" plan will work? Wouldn't that show skeptics that an outpost on Mars is feasible?

How difficult would it be to develop methane-fueled vehicles, appliances and generators?

It shouldn't be that difficult considering that there are already more than a million vehicles worldwide, mostly buses, fueled by natural gas. And natural gas appliances are commonplace. After all, natural gas is 90% methane. We simply need to try using a 100% methane fuel.

An alternative would be to demonstrate the production of propane C₂H₆, a proven fuel, from the Martian atmosphere, taking methane CH₄ production one step further.

Perhaps there is indeed a long range plan to do this, but if not, it is time for the Mars Society to up the ante, go to the next step, and demonstrate these critical technologies.

While they are at it, at least one rover at one of the analog stations should be methane- or propane-fueled. As it may be impractical to convert ATVs that the Society is only renting, this demonstration vehicle could be a "pressureized rover". - perhaps the vehicle that brings in (and takes back) crew and supplies from staging points in Salt Lake City or Grand Junction, CO..

We can think of more things that could be done at FMARS and MDRS - (the 3 minute response delay should be varied within a 6-40 minute range to be realistic) - but we'll leave it like this for now. <MMM>

The Moon Society



JOURNAL

<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 Nominations & Elections 2006

from the Society President

Once again it is that time of year to begin the annual election process for Society Officers and Board Members. Two year terms are staggered so that roughly half the officers and directors are elected in alternating years. The 2-year terms of the following Officers and Directors end this year, nominally on August 1st.

Officers (2):

President: Peter Kokh

Secretary: Gary Gray (retiring)

Board Positions (4 directors):

Gregory R. Bennett

Bill Clawson

Mike Delaney (retiring)

Charles Radley (retiring)

Current position holders may each choose to nominate themselves, or accept nomination by others for another term. But any member who has been a *continuous* member in good standing for a minimum of two years as of August 1, '06 is eligible to run for any open officer or director position in this election, and may nominate themselves or accept nomination by others. The two year minimum requirement is met this time by members with a member # of 1336 or lower.

The board may choose to waive this 2-year requirement for persons who have already been contributing substantially to the efforts of the society in volunteer positions.

Nominations (for yourself or for another) may be sent by July 1, by email to elections@moonsociety.org or by mail to the Plano, TX PO Box (in column A, to the left)

Please keep in mind that we need people who are ready and able to commit time to the governance and direction of the Society. Nominees should be able to attend online Leadership Council meetings on the ASI-MOO (chat room) the first and third Wednesday evenings of the month, 9-11 pm ET, 8-10 pm CT, 7-9 pm MT, 6-8 pm PT, 2-3 am UT

Attendance at every meeting is not required, but if you suspect that you will regularly not *be able to attend*, then you should not run. While contribution to decision making at the two monthly meetings is the principal duty, except for officers, time and energy and willingness to take care of occasional action items is much appreciated. We are an all volunteer society, and the more of us willing to roll up our sleeves, the more we can accomplish together. For duties and other information, confer Sections V (Board of Directors) and VI (Officers) of the Moon Society ByLaws: www.moonsociety.org/organizing-documents/bylaws.html

If you do not want to run for an office or director slot, and/or do not meet the 2-year requirement, but would like to take part in deliberations, you are still welcome to join the leadership council in a nonvoting capacity. Email president@moonsociety.org about your willingness to help out. We are an open participation organization. <TMS>

Should the Society begin holding its own Conference every other year?

From Moon Society President, Peter Kokh

After the founding convention in Las Vegas, Nevada, July 20-27, 2000, Greg Bennett, founder and first President, asked for bids on a Moon Society conference for 2001. His expectations were high. After all, the Mars Society which had been born just two years earlier, was drawing several hundred enthusiasts every year.

On the other hand, our membership, inherited from Artemis Society International (which still exists as a foundation) was between 300 and 400, a small pool from which it was reasonable to expect some few dozen might attend. Two years earlier, when I was chair of NSS' 1998 International Space Development Conference in Milwaukee, I had given the Artemis Society its own room, capacity 90, and own track for all three days, in effect, an ASI conference held simultaneously with the NSS ISDC. We did manage to come up with programming for all those slots, and did draw an audience, but less than two dozen of our own members were present. On that basis, I put forward a proposal for a 2001 conference to be held either in Milwaukee or Chicago, sized for 50-125 persons. This was rejected as too small.

Since then, no other conference proposals have been put forward. As to the Mars Society, the situation is different. Mars is a sexier world: bigger, some atmosphere, ice and probably water, a day and seasons not unlike our own. As a new frontier it appealed to youth as well as many others. Robert Zubrin was, and remains, a charismatic leader. It was expected that they would outdraw us.

We applaud their success and look for ways to collaborate with them in areas where our plans and needs coincide. But we have to look at our own situation. The Moon Society remains the smaller organization. But that does not mean that we cannot have a conference as well.

How big in terms of attendance?

Given the past record and present circumstances, I think it is realistic to expect a small turnout, even if we manage to get some decent publicity, and high-draw speakers. The most important item is a hotel contract that will allow us to at least break even if the attendance is low, but will provide space should attendance be more than we had dared hope. A range of 30-100 would be ideal. If you plan for 500 and get 30, you may lose thousands of dollars to the conference hotel. That's a gamble we cannot take.

How big in terms of program?

Right now, a multitrack conference would be dead-on-arrival. We'd need a big team to find speakers and all. Multiple tracks also means more function space and a deeper commitment to the hotel. Until we are assured of larger attendances, we need to stick to a one track program.

How often should we hold a conference?

In the larger Mars Society, and much larger National Space Society, it is difficult to find local chapters or teams of committed individuals to put on a conference year after year. With far fewer chapters, we could expect a yearly commitment impossible to keep.

Keeping a conference down to one track will be a less formidable task for small chapters to take on. It will also be less draining. In the past, several vigorous NSS chapters have taken on big conferences only to burn out in the process, sometimes even disappearing afterwards. That is not a desirable outcome.

If we keep the conference to one track, I believe we might be able to pull this off every other year. Currently, we have cores of energized individuals in St. Louis, Portland, Milwaukee, Minneapolis-St. Paul, Washington DC-Baltimore, and Dallas areas that might be able to handle a rotating small attendance one-track conference, say in odd numbered years, beginning in 2007, with more than a decade between repeats. Hopefully in time we will have additional chapters that could step up to the plate. For 2007, Milwaukee and Baltimore seem ready.

Why not piggyback on an established conference?

Actually, we did that with our founding conference which was piggybacked on the Space Frontier Foundation's 2000 Return to the Moon Conference. By holding ours immediately afterwards, we gained some SFF people in our attendance, and probably drew more of our own, by the attraction of the prior SFF conference. But financially, it was a disaster as the proceeds sharing agreement was not kept, or differently understood by the two parties.

Who might put on a conference?

That aside, piggybacking sequentially, one conference after the other at the same hotel, can work against higher attendance by discouraging those who can only spare a day or two from attending. To take in both means more than a weekend. It implies a mini-vacation!

But why not just have an piggyback Moon Society program - same days, same hotel? Well, we did that also in Milwaukee in 1998. The problem is that for many of our own people, the competition of speakers and topics will prove distracting, and some good percentage of them will be taking in other presentations. The very attractiveness of a larger conference to a potential piggybacking one, is then self-defeating. I think we need to go it alone.

The conference program

Most conferences are all about "speakers." People go to hear them, find out what's new, and what's on the horizon. Very few people go to a conference *to help get something started, or to help maintain momentum in an ongoing project.* That, however, is precisely *what we need to be doing.*

Sample Draft Conference Program

- Friday Night Reception: Attendees arriving early have a chance to meet one another, and to meet society leaders.
- Saturday morning welcome talk
- Project Workshop: Project discussed and teams breakout to work on various aspects
- Lunch, with short speech
- Workshop breakouts continue
- All reconvene to hear reports from breakout chairs
- Action items spoken for
- Before dinner, all welcome in the display area, for drinks
- Dinner speaker
- After dinner, a few awards, committee reports
- Socializer
- Sunday breakfast and departures of energized people.

In such a plan, we are all convened to work on one and the same project. If attendance growth warrants, we can do two projects at once. We can grow the program as results warrant. Yes, there is a lot to work on. The point is that it is better to have a critical mass of talent assembled in one place to work on one project, than one or two to work on each of several projects.

The point is not to attempt something that will be dead-on-arrival. We all think that there must be millions of people out there interested in a return to the Moon to Stay. There are! But they want to watch, not participate. Even among our own membership, we have that distinction. Many would love to participate, but simply do not have the discretionary time, money, or other resources to do more than read, follow, cheer the movement on and help by their dues. We need them too.

Feedback please!

We think the above proposal for small, one-track conferences in odd number years, off by ourselves without the distractions of a larger conference, is a logical way to start and could be sustainable over the long haul. As our membership and member-involvement grows, these conferences could grow apace.

But we need to know before we take the plunge. If you think that an every other year one-track conference aimed not at informing attendees, but at having them work on advancing a project that is focused on the goals of the society is a good way to start, tell us so.

Please email us at president@moonsociety.org or mail us at the Milwaukee PO Box listed on page 9, column 1.

Tell us what you think about:

- the conference size
- the one track, roll-up-the-sleeves workshop program idea
- whether you would be attracted to attend
- if you would consider being on a conference team
- what times of the year are best for you. <PK/MSJ>

Ideas for Brainstorming Workshops that could advance the Society's goals

In our discussion of the possibility of biennial society conferences, just above, we suggested that they not be passive affairs, where most come to hear others speak, but roll-up-the-sleeves events, at which we tackle projects, topics, and issues that are essential to the achievement of our goal of furthering the creation of resource-using civilian communities on the Moon.

Workshops, with subtopic breakout sessions, are one way to organize such an event. The product of a workshop could be anything from a position paper, to the design of a college level engineering design competitions, to the scheduling of steps to grow and evolve our desired Lunar Analog Research Station, to the design of an aggressive public outreach campaign.

If you read our article on pages 5-8 above, "What a Lunar Analog Research Station Should Try to Demonstrate" you will have noticed quite a list of things that might further advance through well-designed workshop programs.

But Society-organized workshops need not be restricted to the suggested odd-year membership conferences. We could also organize invitational workshops with experts working in various related areas to tackle the design of some project, or to sketch out ways to further their common research by working together. Topics for expert workshops which would serve our goals might include:

- design of a human waste treatment facility using plants and that might involve soil improvement for food production at an Analog Research Station
- design of a Modular Architecture with a minimum number of different elements yet allowing a wide variety of combinations, easy to assemble with a minimum of labor, and which represent modules that could be produced out of building materials processed from lunar regolith. The goal would be to produce an architecture that we could use to build or expand an analog moonbase station.
- design an orderly program of teleoperation demonstrations with an increasing order of difficulty/complexity. Such a workshop could be part of a wider effort to expand research into human-robot synergies.
- design a prototype lunar dayspan power storage system to provide adequate minimal nightspan power needs, the prototype to be demonstrated at an analog station
- tackle the largely neglected topic of lunar-surface-based deceleration systems for incoming craft to reduce the amount of fuel they must carry to land on the Moon.
- The possibilities go on and on.

A Lunar Analog Research Station, A Project LETO Visitors Center, biennial membership Conferences, Expert Workshops - they are all tools to craft our dream. <PK/MSJ>

Design a Banner for our Website and win a Free Membership or Renewal

May 3, 2006 - The Moon Society Leadership Council has given its support to a "design competition" that could produce a Banner for the Moon Society Website.

Contest Limitations:

- The Moon Society is *not* obliged to pick or declare a winner, if no entries meet with our enthused approval.
- If we pick a submitted banner design for our front page, the prize will be a new one year membership or a one year renewal, as applicable.
- If other designs are also well received, we may accept them for use on other pages, awarding (a) runner up prize(s) of one half year membership or renewal

Contest Details:

- **Graphic Content:** The ideal banner should convey "the journey from where we are now, a membership society on Earth," to "where we want to end up, a civilian pioneer society on the Moon." How to suggest this is entirely up to the artist.
- **Included wording:** The words "The Moon Society" need not appear as they will be prominent elsewhere on the page. You may wish, however, to include the rally cry "*To the Moon to Stay!*"
- **Animation?** - short answer, "no." But if you incorporate the rally cry above, you could have two frames, the first with "To the Moon" and then, when all the rest of the page has finished loading, a highlighted "to Stay!" could pop up (and remain). Feel free, however to come up with other ideas, so long as once the page is loaded, the banner will remain static, in its final phase.
- **Low Banner Size in kilobytes** will be a judging/decision factor. The banner should load in no more time than does the full moon logo which is 160 KB.
- **Deadline July 1st**, with (a) winner(s), if any, to be announced on August 1st, to coincide with announcement of society officer and director election winners.

Entering the Contest:

- **Email your entry** to president@moonsociety.org with the banner as an attachment, and with the words "Banner Entry" in the subject line.
- Your submission may be in any standard image form (.gif, .jpg, .tff, .psd, .pict, etc. or as a paint file.) or in pdf file format, but attached by itself, with any explanatory remarks about the image to be put in the email message body text.

Chapters & Outposts

Bay Area Moon Society

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

From: Henry Cate <hcate2@offshore.ai>

Jonathan Goff and Henry Cate took in the Space Access Society Conference in Phoenix, April 20-22nd. BAMS was scheduled to meet, Thursday, April 27th at Henry's..

We are discussing ways to observe the anniversary of the first Apollo Moon landing, July 20th.

Moon Society St. Louis

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

From: Keith Wetzel <kawetzel@swbell.net>

Meeting the 2nd Wednesday of the month, 7:30 pm at the Buder Branch Public Library, 4401 S. Hampton, in the basement conference room

ShowMeCon Report: We are digesting our first experience with this Con (April 21-23) with a view to improving our displays and presentations for next years event, but also for our scheduled participation at Archon next October 5-8.

The Proposed Biennial Conference and Society Chapters & Outposts

We already mentioned that there are a few chapter clusters within the Society that might be able to host a small one-track conference which was workshop-based, not speaker based. We included the three NSS chapters that partner with the Moon Society in that assessment.

But we also think that a lone individual, with some long distance assistance (not all conference planning tasks need to be done locally) could pull it off. And with good local advertising the conference might raw enough local enthusiasts to transform a one-person outpost into a full chapter.

So bidding on a conference such as we have described on pages 10-11 should be open to lone individual contacts, "outposts," as well as to established chapters.

Something to chew on! If there were enough takers, the conference could become an annual one, and be a force both to grow chapters and membership at large, as well as to advance the Society's goals.

The conferences would also be a good way to identify new leadership talent within the Society.

Artemis Moonbase Sim 1 gets Good Press

There is a 3 page Writeup in the current summer 2006 issue of Ad Astra, the glossy quarterly (15,000 circulation) of the National Space Society, pp. 16-18, "Moon Flag Flies over Mars Desert Outpost."

GREAT BROWSING !

The League of New Worlds

<http://quantumeditions.com/league/>

What went wrong with a commercial approach by the government to procuring launch services.

<http://www.thespacereview.com/article/598/1>

A novel that examines what happens when an accident strands a space tourist alone in orbit.

<http://www.thespacereview.com/article/595/1>

Does investing in transportation to Earth orbit make sense?

<http://www.thespacereview.com/article/587/1>

Battle of the new spaceports

<http://www.thespacereview.com/article/605/1>

Human orbital spaceflight: the ultralight approach

How small can a spacecraft be and still safely carry a human into orbit and back? Richard Speck sees potential in "ultralight" spacecraft that weigh little more than their occupant as a low-cost means of ferrying tourists to and from space stations.

<http://www.thespacereview.com/article/603/1>

NASA may not be technologically ready for manned missions to Mars for some decades

<http://www.thespacereview.com/article/602/1>

SMART-1 image of portion of Mare Humorum / highland boundary

http://esamultimedia.esa.int/images/smart_1/orbit_1777_humorum_comp_new.jpg

NASA offers a \$250,000 prize for a better glove:

<http://www.courant.com/technology/hc-space0425.artapr25,0,666931.story?track=rss>

Milky Way has Millions of Unseen Objects

http://www.nasa.gov/vision/universe/starsgalaxies/milkyway_map.html

A Space Station-based Lunar Return Scenario

<http://www.thespacereview.com/article/615/1>

Is Ceres really a Mini-Planet?

<http://hubblesite.org/newscenter/newsdesk/archive/releases/2005/27/>

NASA: Making \$\$\$ on the Moon Key to Exploration

http://news.yahoo.com/s/nm/20060428/sc_nm/space_exploration_dc_3

Space Walks for Future Tourists?

<http://www.thespacereview.com/article/617/1>

Burt Rutan on the Space Industry

<http://www.thespacereview.com/article/618/1>

NASA Tests Prototype Spaceflight Software

Release: 06-27AR - Software that astronauts could use during spaceflight and in future moon habitats is being tested by NASA in a Utah desert April 23 to May 7, 2006.

The research is taking place in the SE Utah desert, at the Mars Society's **Mars Desert Research Station** near Hanksville, where scientists are field-testing a computer network to monitor space power systems that uses the same kind of intelligent software that may assist astronauts to conduct planetary exploration with robotic systems.

"We will experiment with sensors and software that will help us manage a generator and batteries that provide power to a habitat, while we are living and working inside," said Bill Clancey of NASA Ames Research Center, Moffett Field, Calif., the project's principal investigator.

Nine scientists and engineers from NASA Ames are taking part in the experiments with the software and hardware systems. The Mars Desert Research Station will simulate a spaceship in flight or a habitat on Mars or the Moon.

During exercise, the researchers' objective is to test software 'agents' that assist astronauts by monitoring an electrical power system and sounding alarms that indicate problems. The agents also will provide procedural advice when problems occur. The system could keep track of astronaut locations, timelines and important tasks. Researchers will trigger some simulated problems to learn how the computer systems help or hinder the crew's response.

"By using the systems we are developing here, we are both testing our ideas and validating our assumptions about what kinds of tools people really need," Clancey said. "A total systems perspective - developing our software in a setting analogous to where it will be used - provides direct experience and new insights as to how people and automated systems can be designed to fit together," Clancey added.

Team members will use prototype tools, including a wireless computer network, and voice-commanded mission control communication services that partly automate the role of capsule communicator personnel, who monitor and advise astronauts like they did during the Apollo missions to the moon in the late 1960s and early 1970s.

Scientists are making audio and video recordings of the activities using the Crew-Activity Analyzer system developed under a Small Business Innovation Research Program grant to Foster-Miller, Inc., Waltham, Mass. It will synchronize audio and video recordings with records of the crewmembers' locations in the habitat. From analysis of the recordings and other data, investigators can evaluate the prototype power system monitoring software and develop requirements for computer systems to interact with people.

"Human-systems interaction is one focus of exploration research," said David Korskmeier, NASA Ames Intelligent Systems Division chief. "We participate in space autonomy, health management and advanced software projects to increase future exploration spacecraft capabilities." #

"Lunar Geology" vs. "Selenology"

<http://lunar.arc.nasa.gov/science/geovsel.htm>

"Use of the prefix "geo-" for lunar and planetary studies has been criticized, but it is justified by:

- applicability to all other solid bodies of the geologic principles developed for the Earth;
- elimination of the need for new terms for every new world observed at geologically useful scales, whose number now exceeds 20;
- the Greek etymology, which includes the meanings "land" or "ground"
- three decades of usage (Shoemaker, 1962a, p 117; Ronca, 1965; Mutch, 1970; Wilhelms, 1970b).

"The prefix "seleno-" is no longer used by professional lunar scientists except in some terms referring to coordinates, control points, or the global figure (selenographic, selenodetic). Although "astrogeology" was chosen as a convenient and appropriate name (Milton, 1969) for the U.S Geological Survey's branch devoted to Lunar and Planetary studies, "lunar (planetary) geology" is more commonly used. "Planetology" is a broader term that includes such nongeologic sciences as atmospheric and planetary astronomy." - Text: The Geologic History of the Moon, Wilhelms, Don E., USGS professional paper 1348.

Editor's Comment: A new breed of persons interested in the Moon summarily has shoved aside three centuries of precedent. This decision is a sign of indifference on the part of planetary scientists in and out of NASA to the cosmic scope of where we may be headed in Space..

Following suite, planetary scientists have degraded the meaning of "Terra" from a proper name for the Planet Earth, to a common name for land areas or masses on Venus and other bodies. Thus they have undercut the use of both Terra and Gaia/Ge/Gea as proper names for our home planet. The only unsullied Greco-Roman name for our world left is "Tellus", the name of a Roman Earth goddess.

Erring as well in the other direction, they have taken a generic term, "sol", which should mean the period from noon to noon on *any body* orbiting the sun, and applied it exclusively to that time period on Mars.

There is no one, no organization, to hold planetary scientists accountable, or to say, "now look here, this is bad practice!" But perhaps we space visionaries should. <PK>

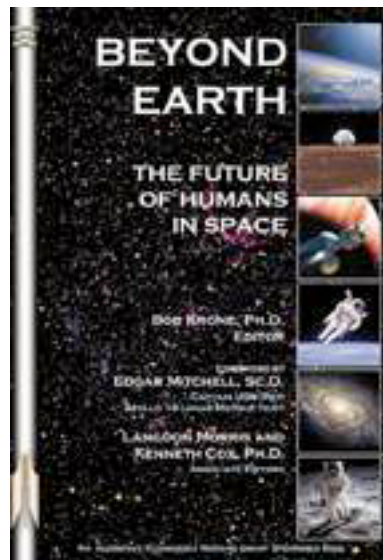
COUNTRY MUSIC TELEVISION

exposes "Small Town Secrets:
Missiles, Mustangs, and Martians"

Saturday June 24, 2006

Check your local cable/satellite TV listings

The "Martians" episode involves a CMT crew visit to the Mars Desert Research Station outside Hanksville, Utah.



BEYOND EARTH: The Future of Humans in Space

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£18.95 UK

[Publisher's Review]

This is a critical time for the space program and for all of us. Even the significant steps that we have taken since the dawn of the space age in 1957, including getting into orbit, going to the Moon, and building space stations, will in retrospect seem to be tiny steps compared to what lies ahead. Migrating into space will task us beyond anything we have previously accomplished. We are destined to face challenges both fantastically breathtaking and supremely dangerous. **BEYOND EARTH** provides a foundation for space planners and anyone interested in humankind's next great adventure - the human settlement of the Solar System. World-class scholars, scientists, engineers, managers, astronauts, artists, authors, and university professors capture the questions that plague our unique circumstance: Why does space matter to us? What can we use it for? How can we get there efficiently? What will ordinary life be like in space? What will our homes be like on the Moon? On Mars? In orbit? Will we play? Will we love?

BEYOND EARTH does not stop with questions. It goes beyond the dramatic, the superficial, and the overly technical to the prescriptive, literally laying the brick and mortar for our future space faring civilization. Contributing authors come from both hard and soft sciences; include education and the arts; and ask kids, who will be the future space dwellers, for their visions. They document needed research. An enclosed CD provides detailed information for some of the more complex issues covered conceptually.

Three underlying assumptions drive this book: First, that the human urge for flight, exploration and survival, plus its curiosity about the universe, are deeply embedded in our genes and in our minds; Second, that even if these urges were ignored, the continual improvement of the quality of life for the human race on Earth, and perhaps even its ultimate survival, hinge on the successes of human exploration and habitation of space; and, Third: our generation can use the opportunity presented by outwards expansion to design a rewarding and exciting future of collaboration to capitalize on the lessons learned from human history on Earth

Resolving Long Standing Solar Cycle Mystery

Solar Storms can be hazardous to unprotected Astronauts

Release 06-087: Goddard Space Flight Center, Greenbelt, MD

Scientists predict the next solar activity cycle will be 30 to 50% stronger than the previous one and up to a year late. Accurately predicting the Sun's cycles will help plan for the effects of solar storms. The storms can disrupt satellite orbits and electronics; interfere with radio communication; damage power systems; and can be hazardous to unprotected astronauts.

The breakthrough "solar climate" forecast by Mausumi Dikpati and colleagues at the National Center for Atmospheric Research in Boulder, CO was made with a combination of computer simulation and groundbreaking observations of the solar interior from space using NASA's Solar and Heliospheric Observatory (SOHO). NASA's Living With a Star program and the National Science Foundation funded the research.

The Sun goes through a roughly 11-year cycle of activity, from stormy to quiet and back again. Solar storms begin with tangled magnetic fields generated by the Sun's churning electrically charged gas (plasma). Like a rubber band twisted too far, solar magnetic fields can suddenly snap to a new shape, releasing tremendous energy as a flare or a coronal mass ejection (CME). This violent solar activity often occurs near Sunspots, dark regions on the Sun caused by concentrated magnetic fields.

Understanding plasma flows in the Sun's interior is essential to predicting the solar activity cycle. Plasma currents within the Sun transport, concentrate, and help dissipate solar magnetic fields. "We understood these flows in a general way, but the details were unclear, so we could not use them to make predictions before," Dikpati said. Her paper about this research was published in the March 3 online edition of *Geophysical Research Letters*.

The new technique of "helioseismology" revealed these details by allowing researchers to see inside the Sun. Helioseismology traces sound waves reverberating inside the Sun to build up a picture of the interior, similar to the way ultrasound is used to create a picture of an unborn baby.

Two major plasma flows govern the cycle.

The first acts like a conveyor belt. Deep beneath the surface, plasma flows from the poles to the equator. At the equator, the plasma rises and flows back to the poles, where it sinks and repeats. The second flow acts like a taffy pull. The surface layer of the Sun rotates faster at the equator than it does near the poles. Since the large-scale solar magnetic field crosses the equator as it goes from pole to pole, it gets wrapped around the equator, over and over again, by the faster rotation there. This is what periodically concentrates the solar magnetic field, leading to peaks in solar storm activity.

"Precise helioseismic observations of the 'conveyor belt' flow speed by the Michelson Doppler Imager (MDI)

instrument on board SOHO gave us a breakthrough," Dikpati said. "We now know it takes two cycles to fill half the belt with magnetic field and another two cycles to fill the other half. Because of this, the next solar cycle depends on characteristics from as far back as 40 years previously - the Sun has a magnetic 'memory'."

The magnetic data input comes from the SOHO/MDI instrument and historical records. Computer analysis of the past eight years' magnetic data matched actual observations over the last 80 years. The team added magnetic data and ran the model ahead 10 years to get their prediction for the next cycle. The Sun is in the quiet period for the current cycle (cycle 23).

The team predicts the next cycle will begin with an increase in solar activity in late 2007 or early 2008, and there will be 30 to 50 percent more Sunspots, flares, and CMEs in cycle 24. This is about one year later than the prediction using previous methods, which rely on such statistics as the strength of the large-scale solar magnetic field and the number of Sunspots to make estimates for the next cycle. This work will be advanced by more detail observations from the Solar Dynamics Observatory, scheduled to launch in August 2008.

SOHO is a project of international collaboration between NASA and the European Space Agency. For images explaining the data on the Web, visit:

http://www.nasa.gov/vision/universe/solarsystem/solar_cycle_graphics.html

Accurate Solar Storm Forecasts Vital to Spacefaring

by Peter Kokh

Oh, "Sun Science!" *Boring!* Now wait just a minute! Accurate long term Solar Storm "seasonal" forecasts, and accurate short term "flare eruption" ones are of make or break importance to Mankind's ability to safely spread throughout the Solar System.

Long term forecasts: Just as, in the era of transAtlantic ship transport, immigrants from Europe to the Americas preferred calmer seas that follow seasonal patterns, once we get past the heroic age of exploration of Mars, pioneer immigrants would want to set sail in quiet Sun periods. If that holds true, such immigration will take place in waves. It takes several months to make the transit, and they will want accurate forecasts over the duration *with ample margin*. For those setting out for destinations even further out (Ceres, Europa, Titan, etc.), accurate long-range forecasts may be literally a matter of life or death.

Short term forecasts: Explorers, prospectors, and others working on the lunar surface will need accurate solar flare forecasts with as much advance warning as possible so that they can take cover. They may rely on a network of solar monitors within the orbit of Mercury to follow developing storms just over the Sun's morning limb. Solar weather will be of concern for more than just communications! <PK>

Mars Exploration Rover "Spirit" searches the night skies of Mars for Shooting Stars

SOURCE: December 5, 2005: RELEASE: 05-420:

"Nasa's Mars Rovers Continue to Explore & Amaze"

NASA's durable twin Mars rovers have successfully explored the surface of the mysterious red planet for a full Martian year (687 Earth days, 670 Martian Sols).

Opportunity starts its second Martian year Dec. 11; Spirit started a new year three weeks ago. The rovers' original mission was scheduled for only three months.

[snip]

Aided by a good power supply from Spirit's solar cells, researchers have been using the rover at night for astronomical observations.

One experiment watched the sky during a meteor shower as Mars passed through the debris trail left by a passage of Halley's comet. "We're taking advantage of a unique opportunity to do some bonus science we never anticipated we would be able to do," Said Cornell's Dr. Jim Bell, lead scientist for the rovers' panoramic cameras.

[snip]

Of What Interest are Meteor Showers on Mars?

by Peter Kokh

Way back in November 1989, MMM #30 carried an article by Harold Shenck: "Are There Meteor Showers on Mars?" It is natural to wonder, because Mars, like Earth and unlike the Moon, has an atmosphere. Debris from comet tails should burn up high in Mars atmosphere just as it does high in Earth's atmosphere. That, at the surface, Mars' atmosphere is much thinner than Earth's is of no relevance. The writer concluded that there must be meteor showers and shooting stars on Mars. That means that future Martians will get to enjoy the Leonids and other meteor showers just as we do on Earth. One more "Earth-like" aspect of Mars.

But this expectation brings up another question of very practical import. Above Mars as above Earth, these incinerating objects will create ionized plasma trails of brief duration. Before the era of satellite communications, some trucking companies used to rely on bouncing signals off of these trails to reach receivers well over the horizon. It turns out that while the well-known showers concentrate these events, debris is constantly hitting the atmosphere and creating these plasma trails. "Meteorburst Communications" usually can find a plasma trail within a second or two.

On Mars, we will want communications relay satellites. But if one or several fail, it may take longer to replace them than here on Earth. If we can get meteorburst communications to work on Mars, that will make the pioneering settlements just that much more viable and able to survive if resupply from Earth, always slow, is cut off altogether. We think its worth an on location experiment! <PK>

A Robotic Bloodhound as the Lunar Prospector's Best Friend

Thanks to Darrel Preble for the Heads up on this Story <http://www.fit.edu/newsroom/news/April2006.html#dart>

Florida Tech has acquired a sensitive instrument that can sniff chemicals in seconds. Produced by JEOL USA Inc., the DART (Direct Analysis in Real Time) enables direct detection of drugs, chemicals or explosives on surfaces, in liquids and in gases without the need for sample preparation. Featured in a recent CSI episode, it is being used to detect traces of illegal drugs, explosives, and other substances by law enforcement, homeland security, and forensic labs.

The DART allows sample analysis, by atmospheric pressure ionization, in the open air. It requires no radioactive components, solvent sprays or exposed high voltage to alter the sample state. "If a dog can smell it, the DART can detect it too," brags co-inventor Dr. Robert "Chip" Cody.

Astro-Hound Possibilities?

In sending me the link to this story, Darrel assumed that without adaptation, the system would not work on the airless Moon. "This nifty "DART" analyzer uses atmospheric pressure ionization (so wouldn't work on Moon), but I bet it could be adapted to use ionization such as from an appropriately "hot" radioisotope; perhaps cesium 137, a beta-emitter with a half-life of 30 years," writes Darrel. Whatever needs to be done to make DART work on the Moon may be worth the trouble and the expense. A lot is at stake.

Prospecting is a challenge on the Moon. Eons of major and minor bombardment by asteroids, astrochunks, and lesser objects has scattered originally local materials to the "four corners" of the lunar globe. In any one location, half of the surface material has arrived as ejecta from a bombardment elsewhere. The effect is that the Moon's surface is quasi-homogenized -- but not totally. There are subtle differences in the abundances of major and minor elements from place to place. Once you get beyond the seven major elements that compose the vast bulk of the Moon (Oxygen, Silicon, Aluminum, Magnesium, Titanium, Iron, Calcium) it becomes increasingly more difficult to find economically retrievable concentrations of other elements.

Searching for useful concentrations of trace elements will be like looking for a needle in a haystack, only much worse. Now if we had a robotic bloodhound nose, reporting its findings to a central computer, that would save enormously on somewhat risky and surely tiresome and boring work by a cadre of human prospectors.

Can we do this in a closed vacuum chamber to prevent dissipation of trace elements? Or will we have to do it in some sort of neutral atmosphere, oxygen being quite reactive? There is an abundance of helium from the solar wind loosely affixed to the moon dust. That may be a way.

Calling all space-enthusiast Inventors! </MMM>



Lunar Reclamation Society, Inc.

**P.O. Box 2102
Milwaukee
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www.lunar-reclamation.org

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

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LRS News

- **Peter gives pair of talks in Highland Park , IL:** On two successive Wednesday mornings, April 19th and 26th, we talked at the Highland Park Library on: (19th) "Practicing for Mars in the Utah Desert" and (26th) "The Moon, its Resources, and Earth's Future." Both were well received.
- **(Milwaukee) Lunar Reclamation Society turns 20!** It was on Saturday, September 15th, 1986, that members of the Chicago and Minnesota L5 Society chapters descended upon Milwaukee during the ongoing Triangulum 2 Science-Fiction Convention at the Red Carpet Hotel. Some 15 L5 Society members from Milwaukee and elsewhere in Wisconsin replied to an invitation to the meeting at which we successfully "colonized." Myles M. Mullikin took the lead in getting us started and by December, we were a fully functioning chapter. Anticipating the merger of L5 with the National Space Society, we were the first merged chapter!
- **MMM turns 20** with the upcoming December issue.

LRS Upcoming Events - June, Summer

 **Saturday, June 10th, 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. A look at the calendar ahead.

**No Scheduled Chapter Activities
During July & August.**

Our next Scheduled Meeting is set for **September 9th**

U.S. CHAPTERS



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Chapter Events
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**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. each month at 2 p.m.**

**Bourne Plaza, 1441 SE 122nd, Portland, downstairs
June 18 - July 16 - Aug. 20**

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

MN SF current space flight display is n public view at:

- Minneapolis Community and Technical College (MCTC)
Astronomy Dept., 1501 Hennepin Avenue, Minneapolis
- Radio City Inc., 2663 County Road I, Mounds View.

Yuri's Night Pics, April 12th

<http://freemars.org/mnfan/MNSFS/2006-04-YurisNight/>

OddCon Pics

<http://freemars.org/mnfan/Odd-Con/2006/>

MiniCon 41 pics

<http://freemars.org/mnfan/MiniCon/2006/>

Astronomy Day Pics

<http://freemars.org/mnfan/CVAS/2006-Astroday/>

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

MAY 19th: UW-Sheboygan, Room 6101, **Sheboygan**

JUN 16th The Stoelting House, **Kiel**

JULY 21st: UW-Sheboygan, Room 6101, **Sheboygan**

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: May 20, June 17

Events: we will participate at Super Science Weekend on the 29th and 30th in April. In May a number of us are going to Balticon in Maryland's Hunt Valley Inn, which is outside of the city of Baltimore. And in the summer a group will attend the Mars Society Convention which will be in Washington D.C, this August! We have offered to help as we did when Robert Zubrin spoke in Allentown several years ago.

March Meeting Notes: We had a Sunday meeting in March to bring in our Saturday working members. Although he could not come in our founder, Rich Bowers, gave a report in absentia on the idea of a Space Lottery. This, he points out, would be more democratic than the current system of multi-millionaires, national figures or Astronauts being the only

ones to go out. His model is the Spanish Lottery which is different from what we are use to. Our lotteries could be called Greek Lotteries in the sense of the ancient Olympics: the winner takes all. The Spanish Lottery has an upper limit with multiple winners. The overall fund has a goal, in that case the support of the blind, and does quite well for the people it is supposed to serve. I know about this because a company I worked with sent representatives to sell our high end products to the National Lottery organization. If it were done here, we could raise enough per year to send an individual(or more) to the ISS or as passengers on some of the forecasted "Tourist Opportunities". The Spanish Lotteries top prizes, \$300,000, is in the range of some of these flights. A grand prize to the ISS (\$ 20,000,000) would stimulate people to try for it, but sub orbital flights aren't too shabby for the runners up. If it happens business would have an income stream to work with as they go for loans etc. Great idea! Thank you Rich!

Speaking of money: Michelle Baker, our Treasurer, says we are solvent and reminds us that membership is up in March so renew today!. She also discussed the use of the Vonage phone system that works via the Internet and likes it. O.K. Michelle!

Larry our webmaster and business card designer, we have very few hits on the website. I am partly responsible for this as I haven't posted material myself. The latest net related possibility is to link to the First website. This is the organization that has robotic projects and competitions as there primary activity. The reason to link is obvious. On the card front: Larry is bringing several hundred (at least) of our cards that features a nebula that exploded to form an hourglass shape. It also bears the motto "Save the Earth, Develop Space". We will be using them for several events. Thank you Larry.

Mitch Gordon talked about the new private space port described in the new Ad Astra. It will be built by Richard Branson and Bill Richardson. The title is "Build it and They will Come" There is a large number of articles from the new Allen SETI Array to "Free Enterprise: NASA's' Next Mission?"

Hank Smith gave us an update on the future site of Philcon: The Franklin Wyndham will become a Sheraton. He wasn't happy with the P.S.F.S. meeting he had attended in that very little was accomplished in spite of much talk. Its o.k. though: we come and contribute what we can when they get it together. Hank will have gone to Lunacon by now and will report in April. If anyone has information on ConCussion please contact Hank at: 215-455-7108.. He is planning to attend Balticon. It will be at the Hunt Valley Inn which is a Marriott hotel. And last but not least: Hank will be our Planetary Report Outreach Coordinator and tell us of activities of the Planetary Society. Thanks Hank!

Earl Bennett reported on a number of things: We awarded Bansi Bhatt, a young lady with interests in plants


and the effect of magnetic fields on their growth, The James H. Chestek Award for her research in that area. It was fun to give the award and be the "TV personality" for our organization. Thanks to Gary Fisher for contributing substantially to the award, and Mike Fisher who, due to a convergence of events, was our only Judge! The Best Laid etc....

Earl also reported on a number of ideas presented in Analog, Science Fiction and Fact, both the April and May issues: April had The Shape of Wings to Come on the history and development of high flying gliders and sailplanes. They can reach 100,000 feet (sound familiar?) on Earth and cover great distances with no fuel. The piece is by Alexis Glynn Latner. Also in that issue: "Will We Return to the Moon?" by Jeffery D. Kooistra. More on "retro" technologies later. The May issue contains The Terrestrial Search for Extra Terrestrial Life by Cathrine H. Shaffer. This is a great exposition on what lives here on Earth and may show us that looking for life on other "extreme" spheres may be biospheres after all. Richard A. Lovett's biologi is on this Ph.D. in Biological Chemistry Science fiction writer. Also: in Nuts and Volts is a Near Space article on "A Martian Near Space Launch" about what it does take, and what it would take to explore Mars (and Titan!) via balloon, complete with some of the relevant equations. This is another fine article by L. Paul Verhage. There is also a piece on Space Ship One by Edward Driscoll Jr. It is entitled "Leaving the Cradle". See it for the links and entrepreneurial inspiration. This is all from the March 2006 issue. And more! I had no input on the projects we could use for Super Science Weekend at the meeting.

Added note: Earl Bennett, your correspondent, has found a book on dreams of yesteryear: Space Traveler's Handbook speaks about the bright future of exploration and habitation that was "foreseen" in 1979. The author, Michael Freeman, has lots of the images and drawings that inspired many people to want the hope filled future society we could have. For those who are too young to have seen this version of "our future life" (i.e.: those under~ 40) it may actually give paths to work already done: ideas presented as "futuristic" in the seventies might be realizable now due to the diffusion of some of the then "cutting", now called bleeding edge, technologies into more areas. Much of what we now take for granted in our lives has gone through several levels of cost reductions due to the perception of reliable financial or material returns to investors. I think the book might be worth reading with this point of view. I found it in a local library.

The April PASA Meeting report did not arrive in time to be published in this issue of MMM. We hope to have that for you in the upcoming June issue. - Editor

CALI FORNIA



OASIS: Organization for the Advancement of Space Industrialization and Settlement
Greater Los Angeles Chapter of NSS
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Odyssey Newsletter Online

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

 **Regular Meeting 3 pm 3rd Sat. each month**

Microcosm, 401 Coral Circle, El Segundo.

• **June 18th - July 16th - August 20th**

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

Upcoming Events

- **Sat. May 20th, 3:00 pm** – OASIS Monthly Business Meeting at the home of Bob and Paula Gounley, 1738 La Paz Rd. Altadena.
- **May 20-21, 9:00 a.m. to 5:00 p.m.** - Jet Propulsion Laboratory Open House 4800 Oak Grove Drive, Pasadena. Free admission and parking. 818/354-0112 or <http://www.jpl.nasa.gov/ps0/oh.cfm>

Recurring 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/>



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How do be an effective serendipitist

*Keep looking for something else!!!!
 and keep finding stuff!!!*

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 INDEX to #195 May 2006 	MINNESOTA SPACE FRONTIER SOCIETY <input type="radio"/> \$25 Regular Dues
p 1. In Focus: Worrysome Bumps on the Roadway Back to the Moon," Editorial, P. Kokh p 3 Solar Thermal Rocket Engines, Ben Smith p 5. Goals of a Lunar Analog Station Program, Kokh, Dunlop p.9. Moon Society Nominations & Elections 2006 p 10. Moon Society Conferences Every Other Year? p 11. Ideas for Brainstorming Workshops p 12. Create a Website Banner; Chapters & Outposts p 13. Browsing Links; Prototype Spaceflight Software p 14. "Lunar Geology" vs. "Selenology"; Book Review p 15. Spirit sees Shooting Stars; Astrodogs & Prospecting p 17. LRS News; MMM NSS Chapters News	OREGON L5 SOCIETY <input type="radio"/> \$25 for all members
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