

# Moon Miners' Manifesto

& Moon Society Journal

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## In Focus Thinking Outside the Box & Lessons from September 11th, 2001

The successes achieved by the September 11th terrorists caught most everyone by surprise. The public can be forgiven for this surprise, but not our security forces. We have all heard that "a chain is only as strong as its weakest link." The terrorist's job is to look for that weakest link. Security forces should be looking for it too. That they failed to see that a fully fueled commercial plane could be used as a missile demonstrates their failure to habitually "think outside the box." They failed to think "like terrorists" and in this, by their complacency, they let us all down. They settled for "quick fixes," for a "false sense of security." And they may do so again.

All Tools are indifferent. Any tool can be used for good or evil, constructively or destructively. It is the user alone who determines the morality of the work done by tools. Down deep, we all know this. Technophobes, of course, miss the point, much to the discredit of their own intelligence. Thinking outside the box is a "force" with "a dark side" too. And as with all tools, it is easier to put this to destructive use than to constructive results. Those impatient for results, find quicker gratification in destruction.

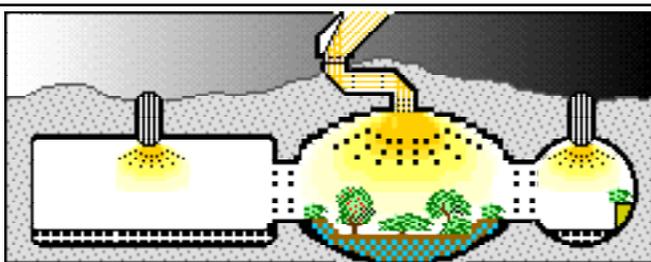
Thinking outside the box is a mental discipline that aims at identifying ways to "break out" of

the constrictive set of expectations and assumptions imposed by the "conventional wisdom" *in any area*. Ways to open the Space Frontier are no exception.

Few people ever think outside the box of conventional wisdom - this is not a discipline that comes easily. Not surprisingly, people interested in space are no exception. Both terrorism and space are frontiers, however radically different, where conventional mental exercises can be expected to produce only marginal and trivial results. Conventional Wisdom is a millstone around the neck of anyone who aims to open or help open a frontier. The smugness of conventional thinking must bear much of the blame for the painfully slow and trivial progress made in opening the space frontier over the past few decades.

Conventional Wisdom, when it is accepted without reservation, is *the true enemy inside*. It straitjackets our minds, preventing us from seeing, testing, and developing alternative strategies.

NASA is not, and never has been the enemy. The agency itself has used "thinking outside the box" to make many breakthroughs. But in anyone or in any organization, successes "settle in" and create a new complacent expertise. Thinking outside the box is something that *must* be practiced [=> p. 2, col. 2]



### The Heart of a Lunar Home: An "Earthpatch"

On Earth, if there is a feature that is considered the "heart of the home" it is the "hearth." Real fireplaces are a highly unlikely feature for Lunar homesteads. But pioneer homes will have a "heart" nonetheless, the interior Garden, a veritable "Patch of Old Earth." The "Earthpatch" will be important for much more than strong morale! See pp. 3-7.





And in fact, there is at least one more good reason. The homestead garden promises to be an especially prolific incubator of frontier “cottage industries”. More about that in the follow-on article.

### How do we provide for home interior gardens?

To have a garden in a habitat pressurized against the exterior vacuum and thermal extremes, we need to provide water and light. *For the sake of argument*, we accept the statements that hydroponics are much more efficient than soil-based geponic systems, and that blue and red LEDs are much more efficient than sunlight. That may indeed prove to be the way to go in the community agricultural units, at least for some crops which do especially well in hydroponic growing conditions. (We are unconvinced that *all or most* crops do better with hydroponics.)

Soil-based horticulture on the Moon is quite feasible. In the process of handling the raw regolith, there is opportunity to sift out the powdery fines that could clog drainage systems, and to transform many of the regolith minerals into zeolites by baking. *All this experimentation has been done and is well documented.* Plus the regolith has many of the nutrients that would be needed, without resort to wholesale importation from Earth. Desired organic content can come from in home pretreatment of human wastes and composting of kitchen scraps.

Sunlight delivers too much heat, yes, but that can be filtered out easily enough. Or sunlight can be used to generate electricity to run full-spectrum lamps that are designed to produce reduced heat.

The biggest argument of all is esthetics. If any reader has heard of a garden show that attracted throngs of people by its beauty, in which all the plants were grown hydroponically and shown under banks of LEDs, my conviction might be shaken a bit. We have thousands of years of conditioning of our sense of beauty by soil-based gardens.

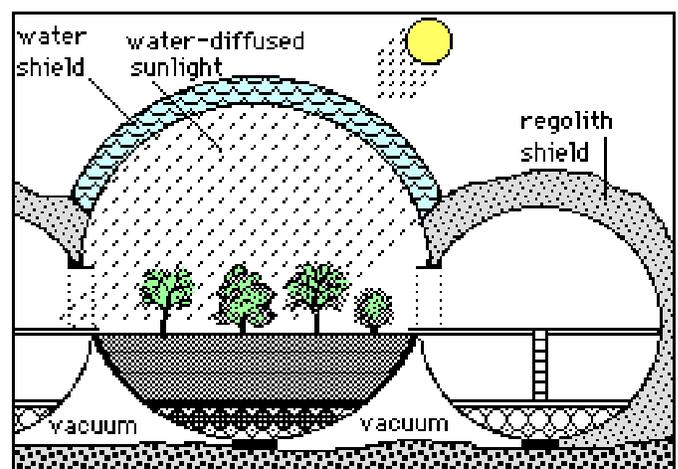
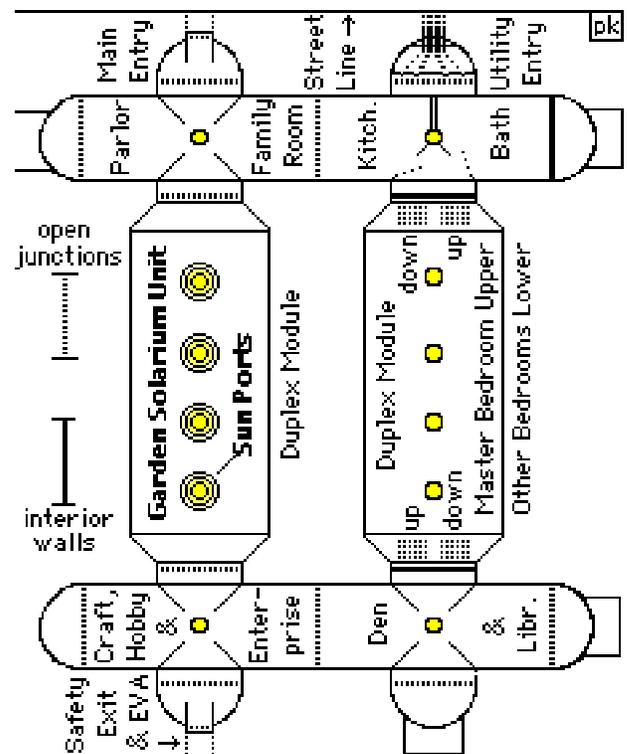
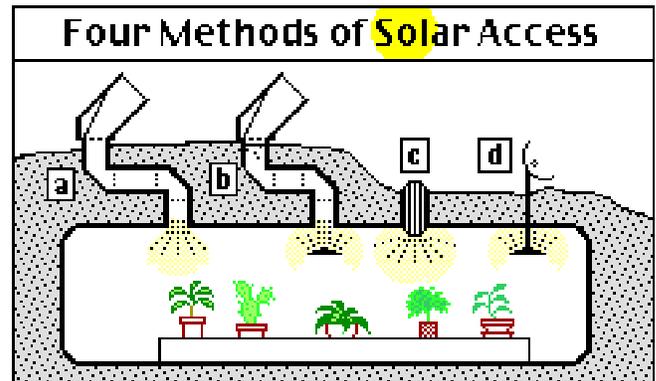
If soil-based horticulture is somewhat less efficient, that is immaterial. It has already been granted for the sake of argument that all the required nutritional needs for full dietary balance will be provided by the settlement farms. That means that home gardens are relied on *only for surplus and to provide treats* not planted in the settlement farms. The exchange of some degree of efficiency for much more beauty and satisfaction is a fair trade.

### Architectural Provisions

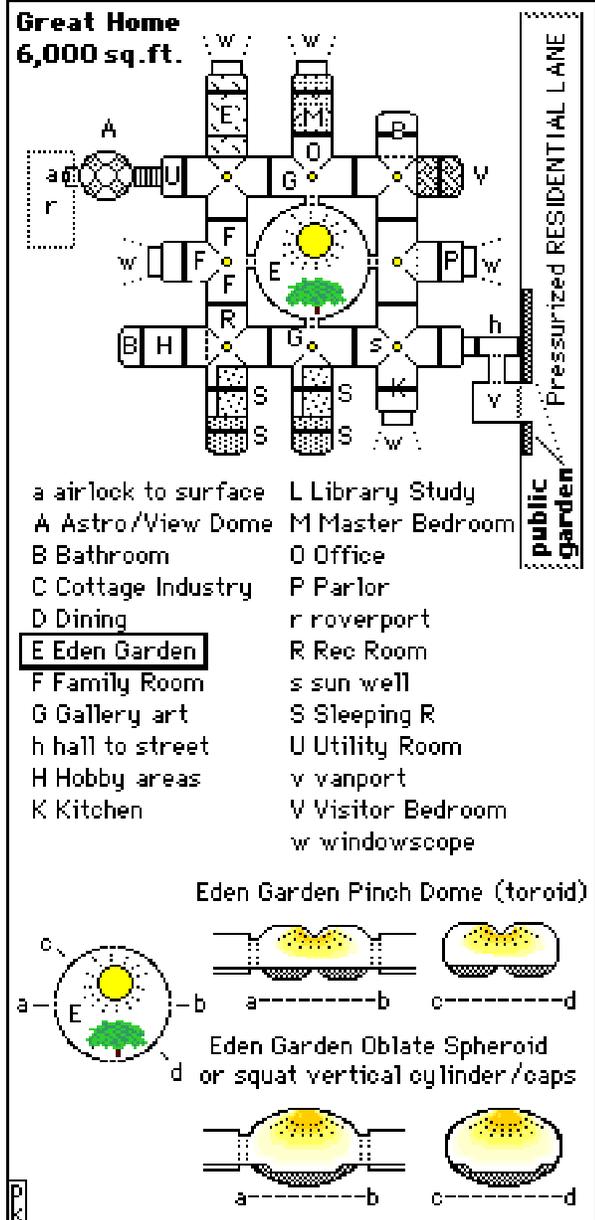
How can the frontier architect, working with pressurized structures and locally produced building materials, design in sunlit garden spaces? Once one is convinced of all that is to be gained by having “Earthpatches” and how much is to be lost by not designing for them, this will not seem like a design burden, but rather a design delight. It will be a chance for the frontier architect to be creative, much as they are with churches. While form follows func-

tion, that is not a 1:1 determination. Architects will find many ways, some better, some cheaper, some more satisfying. Variety is the spice of life.

We have suggested a number of ideas in past issues for modular homestead layouts in which sunlit garden spaces were a key element. Below are a few.



## Early Plan for a "table-top" model



The plan of the actual table top model of our modular "Moon Manor" introduced at ISDC '98 can be seen at [www.lunar-reclamation.org/page11mm.htm](http://www.lunar-reclamation.org/page11mm.htm)

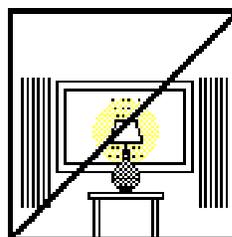
There are many architectural solutions for this concept and it is not our purpose to pick any one but simply to help the reader visualize some of the possibilities.

One interesting architectural allusion to some familiar terrestrial homes would be a frontier homestead built on the atrium garden courtyard plan with the living areas surrounding and opening onto a central garden area. Realizing that concept with modular construction methods in locally produced building materials is the challenge we put to would-be lunar architects. There is too much to be gained from realization of this idea to let initial difficulties stand in the way. *It will be done sooner or later.*

## Extending Garden Spots throughout the Home

Solar access can be arranged not just for the central garden area, but throughout the homestead, delivered from central access ports through light tubes to areas above planters as well as areas needing accent or task lighting. Thus there could be islets of greenery wherever one wanted to have them.

We might want planters, not lamps, in front of "windows" - be they "periscopic" units or live video screens - to act as reassuring living "filters" through which to view the magnificent but chillingly barren planetscapes beyond. Light pipe ports could funnel in sunlight.



out with  
one cliché  
in with  
another



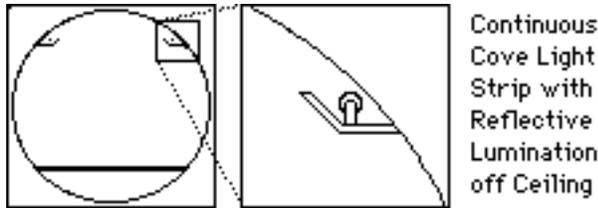
Using light pipe layouts to channel sunlight during the long dayspan and light from central sulfur bulb megalamps during the two week long nightspan, we can place planters, brimming with foliage and flowers, wherever we want them: along sidewalls, in the middle of large rooms, in sweeping curves or simple straight lines. Thus sunlit planters would be an especially great way to divide large spaces into cozy room settings. The pools of light would tend to visually obscure what lays behind them, making a virtual visual "wall" between areas with different functions.

How flexible would such a biological room divider system be? In other words, would the light pipe system and its ports be "rearrangeable?" After all, there are those homemaker types who quickly get bored with any given furniture arrangement, no matter how well it is tailored to the the living space shell (walls, doors, windows, fireplaces and other immovable particulars.)

Given that light pipe systems would likely be installed only with customer involvement in placement of runs and location of ports (light fixtures), it is most likely that they will be consist of modular components. If so, it is probable that they can be rearranged. At the most, it might involve ordering a few more modular connectors etc. However, pointable "spots" from a center ceiling-mounted pipe run should do the trick of channelling the dayspan sunshine (or nightspan substitute) wherever desired.

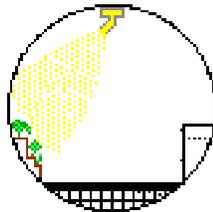
However, to the extent that some light access components are likely to be built into the various habitat modules, those would be more or less fixed. "Use them or lose them." These features would include the sunlight point of entry "sundows" of vrious designs. [See the illustration "Four Methods of Solar Access" at the top of page 4, Col. B]

Another built-in lighting fixture is likely to be coves to hide ceiling washer lights -- of little use to a plant lighting system anyway.



From MMM #75: "Lunar Appropriate Modular Architecture"

Another idea would be to make use of the lower part of some of the curved module walls for terraced plantings without taking up floor space that can be used for walking. Many kinds of plants are suitable for terracing, including hanging ivy, cactus collections, and even bonsai "forests." These terraces need not be geometrically regular. Freeform ones would be more nature-like and could even include mini-waterfalls. The illustration above shows a such garden side-wall terraces on the left, opposite built-in cabinets on the right, neither infringing on walkings space.



### Streetside Gardening Opportunities

Our homes are usually set on lots with front, rear and side "yards" covered with grass, shrubery, flowers etc. On the Moon or Mars "lots" are barren and lifeless and without access to water or useful air. The "front yard" and "garden" has to be interiorized, located in the "reclaimed" space within the pressure hull complex. This "reclamation" process allows us to create "Earthpatches" in these unlikely settings.

Homesteads will not exist in mutual isolation but be interconnected in a larger biospheric maze, each opening via a securable pressure door onto a pressurized "street" on the analogy of our terrestrial residential blocks. If these streets are sunlit at intervals, then these frontages are also opportunities for gardening - in public view.

### Connecting Indoors and "Outdoors"

On Earth, a few older homes and many new ones, are specially designed "to bring the outdoors inside." This is done with generous windows and window walls and patio doors. Outdoor plants seem visually connected to indoor ones. Using the same floor material on an outdoor patio as in the inside room opening onto the patio strengthens the illusion.

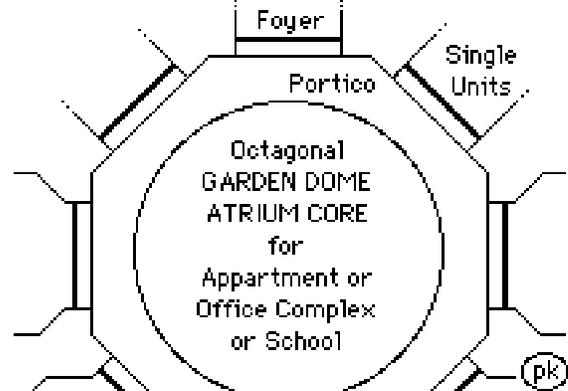
On the Moon where the "outdoors" strictly speaking is barren, lifeless vacuum -- the "Out-Vac" -- such a scheme is not possible. There is no vegetation outside the window and windows cannot be anywhere near as ample to keep depressurization risk at bay. But we can still establish a "connection." Japanese style sand and rock plantless "gardens" are a model. Lunan homesteaders can place areas of bare

regolith and lunar breccia rock, artfully arranged, in front of window areas, and fringe them with plants. This would "safely" invite the "Out-Vac" inside.

NOTE: not only would the regolith to be brought inside first be sifted to remove the ultrafine and troublesome "powder" but the remaining regolith "sand" would also need to be magnet-purged of as much of the free iron fines content as practical. These fines have kept their "virginity" as far as contact with moisture is concerned, intact for eons. Once in a pressurized and humid environment, they would rust. The graytones of the regolith would start to take on rusty hues. And that would destroy any illusion of an "indoors-outdoors" connection.

### Options for Lunar Apartment Living

Homestead Gardens will have their counterpart in multi-unit housing commons, with resident associations taking care of maintenance and upkeep.



### Water for the Gardens and Planters

Gardens require water, but not necessarily "extra" water. There is no reason why the water to be used in the gardens and planters, even in fountains and waterfalls, can't be waste water in some stage of treatment. Indeed, some interior plant beds can be integral to systems that provide primary treatment for human wastes, both liquid and solid. Bill Wolverton, a retired NASA environmental engineer has had such a system running trouble-free in his Houston home for decades. Not only is it surprisingly odor free and pathogen-free, but the air within his home is always fresh and sweet. We've written about his system before in MMM #116 July '98, "A Modular Approach to Biospherics" and incorporated a representation of it in our table top Moonbase. [See the link on page 5 col. A.] Read about Wolverton's work at: <http://www.wolvertonenvironmental.com/dww.htm>. His just-published book, "Growing Clean Water", joins his previous work, "How to Grow Fresh Air."

On Earth, every pound of living human flesh depends upon hundreds of pounds (or tons) of plant matter, every pound of which is supported by many tons of water -- consider the oceans! On the Moon it would be foolhardy to depend on marginal quantities of water. Even with conservative practices in both industry and agriculture and domestic use, we are





## The Moon Society



## JOURNAL

<http://www.moonsociety.org>

Please make NEWS submissions to  
David Wetnight at [news monger@asi.org](mailto:news monger@asi.org)  
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**The Moon Society** was formed in July, 2000 as a broad-based membership organization with local chapters, to spearhead a drive for the 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 Moonbase 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®

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## Getting K-12 Kids to think about What it will be like to live on the Moon

### The Moon Society's Moon Flag Contest

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

by Gregory R. Bennett, Moon Society President

The director of the National Space Grant Foundation will present the plan to the directors of the state space grant consortia in a meeting in Alaska this month. If all goes well, the Moon Flag Contest idea will be presented in every K-12 school in the country, and overseas as well. I'm hoping lots of kids will participate.

Meanwhile, I'm working on some materials that can be downloaded as PDF files and handed out in the classroom. I wish we could afford to send paper, but we can't; so I think a PDF that will look nice on a laser printer is our next best thing.

This idea was born on artemis-list, and the space grant folks really liked it. Designing a flag is the best way I've thought of so far to invite kids to think about what it would be like to live in the Moon because it requires them to try to think from the perspective of someone living on the Moon, imagine what is important to them and what is unique about them. I hope this will lead to some far-ranging discussions with quite a depth of learning.

**Local chapters** could also participate in this activity. Folks could contact the schools in their area, and maybe even visit classes to help lead discussions about living in the Moon.

Those how have the resources might also help with scanning images of the kids' artwork and getting essays submitted. (Note that the whole thing is electronic, again to save costs. We just can't afford the labor to handle paper. On the other hand, you can do artwork in Kidpix that would work nicely as a flag)

The existing web site outlines the basic plan. I am hoping we can offer additional prizes but will have to see how the budget works out. At the request of the space grants, we will ask the judges to select a best flag winner from each state as well as a grand prize winner. We also intend to have the grand prize winner's flag made into a real flag, to be presented at the Moon Society conference next year. 

NOTE: Entries may include an essay of not more than 2000 words explaining the design of the flag and its symbolism. This is not required, but is strongly encouraged and will be considered part of the entry for judging purposes if it accompanies the submitted image. A contestant may submit multiple entries.

NOTE: "*Greening the Gray*," an anthem for Lunar Pioneers by MMM Editor Peter Kokh (© 1990) points out many of the things that will make settlers proud.

<http://www.uwm.edu/~schamber/MSFS/MSFire/Vol2No5-6/greening.html>

## Lowering Project LETO's High Threshold

For Phase I, let's design, fabricate, and deploy a "doable" M.A.R.S. -like L.U.N.A.\* Analog Station

by Peter Kokh

[\* L.U.N.A. Lunar Utilization & Necessities Analog]

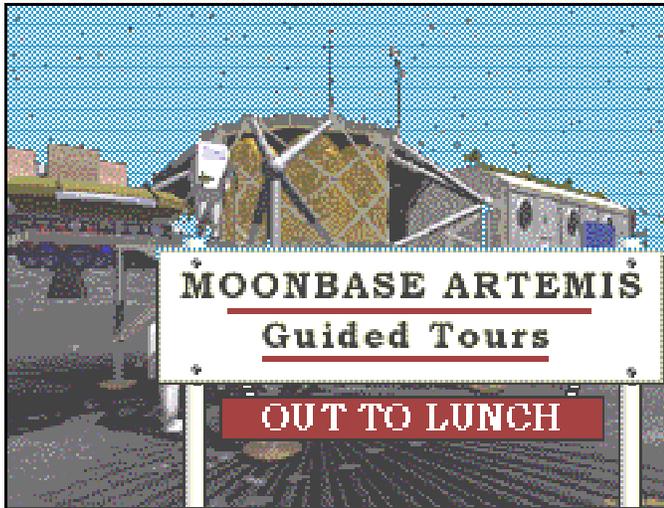


Image ©1998 Vik Olliver

In fact, the tour guides have been out for lunch for three years. The Moon Society has its Project LETO plans. There seems to be little agreement on how to start on what would be a very elaborate education-tourism-research facility. *But without a "doable" Phase I*, LETO is "at risk" of never being built.

## Design, Fabricate, Deploy - a serviceable Artemis Moonbase Analog Earth Station

The design for a first Artemis Moonbase™ that is currently worked into the Artemis Project™ Reference Mission is a complex that consists of three duplex SpaceHab modules ganged together side by side along with an airlock, sitting on the framework that was used to lower it off the lander stack to a horizontal position.



You can see this deployment scheme at:

<http://www.asi.org/images/asi199500026.mov>

The great advantage of using duplex SpaceHab modules, especially in comparison with the MarsHab design favored by the Mars Society, is that these modules exist. They are an off-the-shelf item, the only existing ready-to-buy and space-tested habitat

space, and available at a relatively cheap price.

While the Mars Society has been able to have two versions of its design fabricated at a reasonable price, the real thing does not exist except on drawing boards, and will not become real except through a very costly government development program. "A bird in the hand ..."

So in large measure, the design process comes down to decisions on interior outfitting. SpaceHab modules are built for use in zero G not on the Moon. So we need to determine a vertical orientation and floor system, and passageways between the connected duplex modules, plus an airlock. We don't have to go into details, just come up with a design that will work for operations simulation purposes.

The next step would be to put out a request for proposals from various potential fabricators of our serviceable mockup "analog station." AND put out a plea for major sponsors as well as individual donations. The Mars Society did not finance its two analog stations, one in the arctic, the other to be deployed in the American Southwest, from general funds. The whole concept of a reasonable analog station where people can practice operations on Mars' (or the Moon's) surface is evidently exciting to a large cross-section of the public. "Build it, and they will come!" Only here, by build it, we mean build the design and have cost estimates from real fabricators. What "will come" is the money.

It is extremely hard to sell such a concept to leaders who have had to struggle with perennially limited budgets - the idea that you can do something exciting without touching the group's treasury. It has proved impossible to convince the National Space Society of this, and that very frustration absolutely necessitated creation of a new "have gutzpah, will do it" society, the Mars Society, whose growth has been phenomenal. People can see that here is *one* outfit that will not rest with talk-talk, but it determined to "just do it." These are bitter words for others who cannot make the paradigm shift, and dismiss the Mars effort as so much grandstanding. Rather, it is those who only talk, and dare not do, that grandstand.

The Moon Society, and the associated Artemis Society in which there is joint membership, has remained small to date. The concept of the Artemis Project™ is great. Predictably, it does not win over those addicted to government socialized space. But to grow, we don't have to win Apollo Program junkies, we simply have to build our Field of Dreams. We regret any perceived stepping on toes that such a suggestion involves, but it needs to be done.

## Where should L.U.N.A. 1 be deployed?

Note that we do not have to determine the deployment location of our L.U.N.A. station in order

to design it, call for RFPs from a variety of potential fabricators, and make funding appeals. There is time for site selection. But it *is* important to begin determining how much space we will need to allow for adding such things as an agricultural unit, fabrication shop, sun-shade ramada, solar power arrays, etc.). We should allow 2 or 3 times as much growth space as we now think we might need -- at least.

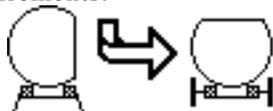
Next we should look at how much space we might want for a tourist visitors center slash forward base camp. This space should be nearby (e.g. within a mile or two) but need not be contiguous. There are such things as busses, ... er shuttle craft! Public parking access at the L.U.N.A. is unnecessary.

Experimentation and fabrication shops can be at either location. Those that would be on Earth in a real scenario can be at the Tourist Center. Those that need to be on the Moon would be at the L.U.N.A. site.

Space for the analog outpost itself can either be purchased or leased by agreement, say with the National Park service. The idea here is to have the actual analog outpost not on just any old piece of vacant desert rock and sand, but in a barren moonlike terrain with minimal vegetation and some geological analogies to features we will find on the Moon. There must be many sites worth considering besides the Nevada desert -- Death Valley National Monument, Oregon lavatube country, Craters of the Moon National Monument, etc. to name those that come easily to mind. I'm sure that there are others.

## Redeployability

The chosen inline complex of airlock / three ganged SpaceHab modules on a truss platform makes it eminently trailerable. This is a distinct advantage over the redeployable Mars Desert Research Station. The M.D.R.S. has to be taken apart, moved, and then reassembled. The L.U.N.A. complex only needs to be disconnected from on site utilities, and then towed. Actually, we will need to rotate the 13.5' high SpaceHab complex on its back (or tummy, in order to be within standard 14.5' bridge clearance requirements.



**SpaceHab  
Cross Section**

This clearance requirement will pose some constraints on how the airlock is sized and shaped and how the structure is tied to its truss frame as well as wheel placement. But none of these considerations would seem to be a lurking a showstopper.

As is to be done with the redeployable Mars Desert station, the L.U.N.A. station could have both its research seasons and an off-season in which it goes on tour to various space centers around North America. Moon Society membership will swell.

## Advantages of having a L.U.N.A.

The upside of such a project is considerable:

- We will be able to greatly improve the first lunar return mission plan by our operational simulations, finding the need for out-buildings and for equipment that we had not considered
- We may find design flaws that need correction if the facility is to provide maximum support for lunar surface operations, etc.
- We will have a chance to try various schemes for emplacement of regolith shielding over the base
- We can test the merits of the various competing biologically assisted waste recycling systems, some of them combined with food production
- “Overnighting” exercises are at the top of the list in overall importance. *Until we can safely “overnight” on the Moon, we won’t be back to stay!* -- We will be able to simulate abundant power operations during simulated dayspans as well as test various ways to remain productive while using much less energy during simulated nightspans. For the former, we can use powerful floodlights at night to simulate continuous dayspan periods. For the latter, we can have a large frame for a light-blocking tarp - or more simply, just shutter the portholes of the outpost. Helmets could have dark glass or filters that turn blue sky to black
- We can try sunshades over the entry porch area and dust-cleaning surfaces on airlock stoops.
- We can test various schemes for storing abundant dayspan solar power for use during nightspan, looking for the advantages and disadvantages.
- We could field test different interior outfittings from season to season to test ergonomics and effect on operations productivity, crew morale and satisfaction. We could hold an interior layout design competition with given set specifications for equipment and functions to be accommodated and crew size. Competition entries will give us an early idea of the kind of generic attachment points we may want to build into the structure.

Some of the lessons to be learned have already been clarified by operations simulations at the Mars Arctic Research Station on Devon Island. It won't hurt us to validate them, however. But that brings us to the topic of differences between the Moon and Mars that will affect how astronaut pioneers operate in the two different environments. We have already touched on simulating the 29.5 day long lunar dayspan / nightspan cycle. The M.A.R.S. and M.D.R.S. stations impose a ten minute built in time delay in two-way radio communications with “mission control.” Our L.U.N.A. station needs only a 3 second time delay.



# Meandering Through The Universe

A Column on the Cooperative Movement  
on the Space Frontier © 2001 by Richard Richardson

## Concrete: Space Frontier Construction Material

Concrete: The stuff dreams are made of ... (if you happen to be a heavy sleeper, anyway) ...

There is plenty of reason to believe that cement mortar and concrete will be among the most commonly used construction materials on the final frontier. Metals, glass, and perhaps even things like high tech ceramics will have their uses, but good old concrete will almost certainly play a primary role in space infrastructure.

Concrete components exposed to extreme heat don't burn, melt, warp, or sag. And if they have been engineered correctly, made correctly, and are fully cured they also will not usually chip or crack. Of course, like all stone, even concrete has a melting temperature. But it is well above the range of temperatures encountered in most common calamities — far above the melting temperatures of metals.

On the other hand, concrete components are relatively heavy, have limited tensile strength, and limited flexibility. It isn't a perfect material in every way, but it comes about as close as is possible for many construction applications, especially when integrated with steel rods (as is common here on Earth) or (as might be more advantageous in space) other materials or additives.

Here on Earth we have an abundance of other building materials easily available (such as lumber, straw, bricks made of organic materials, tars, old automobile tires, etc.). We also have a thick, breathable atmosphere which removes the need for pressure tightness and introduces significant thermal gains and losses via convection. So it is often convenient to use other materials which, under the circumstances are less expensive, easier to work with, and/or just more appealing for any real or arbitrary reason.

But nearly all of the alternative materials are composed of large percentages of complex organic chemicals, are only produced over long periods of time, require large amounts of energy in their manufacturing and/or finishing process(es), are formed by natural processes of Earth (and are not economically created via any other known process), or some combination of these. Consequently, most of these other materials would have to be shipped from Earth in a partially processed or finished condition or would require extremely large and expensive infrastructure development.

Concrete is different. Concrete is a combination of cement, sand, and gravel. According to Dr. T. D. Lin, cement is calcium silicates with high activation energies. Although usually described as a mixture of limestone and clay, it is irrelevant where the calcium and silicon come from or what their state

as raw materials. The important thing is that, by whatever process, calcium and silicon are combined to yield high activation energy calcium silicates. Silicon and calcium are available in dust, sand, and rocks in space. With research it might be possible to identify other chemical combinations which work as well or better (mechanically and/or economically) for the raw cement powder.

The other ingredient in cement is sand, and for concrete: gravel. Water is necessary to activate the chemical process involved, but most of it can be reclaimed at the end of the process or just released to the surroundings. Larger stones, while not necessary, are quite useful as filler to reduce the quantity of concrete required. Stones can also be used effectively to provide aesthetic interest.

Sand is just sub-millimeter diameter rock larger than about 10 micro-meters in diameter (i.e., larger than dust). Gravel is rock with diameters between one and five centimeters, more or less. Most of the other solid surface planets and moons in our solar system (especially in the inner solar system) offer quantities of sand and gravel. In most cases, sifting would be the only processing necessary to separate usable material from the remaining regolith.

Water may be so valuable early on as to be difficult to afford, but it (and the hydrogen and oxygen from which it is created) are fairly plentiful throughout the solar system. Besides, since water is critical for life support it is fairly certain that the means of mining water directly or of producing it from its elemental parts will quickly be developed and implemented. The larger stones are, like sand and gravel, widely available on the surfaces of the inner planets and their satellites.

And then there is the problem of curing the concrete. Curing is the dynamic set of chemical reactions which change the mixture from a viscous fluid to a solid. Because of our lack of experience with using cement in space we don't know all of the implications or the range of workarounds relevant to trying to cure concrete in settings with very low or zero surface pressures (unlike conditions in an "atmosphere" or body of water).

Curing concrete wouldn't necessarily be a problem inside a pressurized habitable volume in space ... at least for the concrete. However, it might seem that there would be potentially serious affects with regard to life support. By our experience, concrete that is in the process of curing (a process that can go on for years at an ever decreasing rate) soaks up a lot of oxygen and releases a lot of carbon dioxide — as the Biosphere II people found out the hard way. If significant masses of concrete were curing inside of an inhabited volume the life support system's oxygen output and carbon dioxide scrubbing capacities might have to be far more productive and responsive than would otherwise be the case. Since it

is certainly reasonable to think that construction inside of a habitat volume could continue even after the volume is sealed and even after it is inhabited it would seem reasonable to apply research to finding solutions to this problem.

The solution may be easier than it might seem, however. The O<sub>2</sub> sponge/CO<sub>2</sub> outgassing effect may be purely an artifact of curing concrete that has a good deal of organic impurities in it, either from uncalcined calcium carbonate, or from the "clay" used as a source of aluminosilicates. Pure cement concrete ingredients processed on the Moon would be virtually carbon free, and hence would "inhale" very little oxygen, "exhale" very little carbon dioxide, and cure relatively quickly.

There currently remain some problems with using concrete in space and there certainly will be situations for which other materials will be more appropriate. But once large scale development begins it is likely that concrete will easily beat out most of the other alternatives for most construction applications. Concrete comes out ahead of those materials that require importing a lot of ingredients from Earth, require huge investments in infrastructure to be produced, are much more energy intensive in their production, or any combination of these drawbacks.

### **New High-Tech "Concrete"**

And then there are "advanced" formulations of cement and concrete. *Popular Science* reports that the Lafarge company of Lyon, France has developed a concrete product it calls *Ductal*. Ductal is concrete but is able to bend without cracking or breaking (apparently more or less in the same range as wood). It is also far stronger than ordinary concrete.

Ductal products might include such things as thin, high pressure concrete pipe and smaller, lighter, non-brittle beams that require considerably less reinforcement. Lafarge claims that Ductal beams of similar size, strength, and weight to steel I-beams will cost less than the steel beams and can be made at or near the construction site. The company also has a concrete product which fills and compacts significantly better than traditional concrete.

A product with these characteristics could prove very valuable in a low gravity environment. The catch, of course, is that these products require a small percentage of additives to give the concrete these useful characteristics. I don't know what the additives consist of but it seems likely that they would have to be shipped from Earth, at least until patents expired or Lafarge developed a plant off Earth. Even so, for such valuable structural characteristics, it might be worth the expense. <RRR>

[Editor: other recent developments include *glass fiber reinforced* concrete, something easily made on the Moon. Concrete used to make pressure hulls has to be highly reinforced, as concrete is normally much weaker under tension than compression. -- PK.]

## **Two New Cassini Program Slide Sets**

"A Trip to Saturn" chronicles the assembly, launch, and journey of Cassini-Huygens to the Saturn System.

"The Saturn System" is a compilation of images of Saturn, its moons, rings, and magnetospheres as seen through Voyager and the Hubble Space Telescope.

To view new slide sets, go to:

- <http://www.jpl.nasa.gov/cassini/>
- Click-on Cassini-Huygens website
- Click-on Gallery

## **SpaceDev Progress Report**

from Jim Benson <Jim@SpaceDev.com> 8/14/01  
Space Dev Founder, Chairman, CEO

MTV: SpaceDev test fired its revolutionary miniature orbital Maneuvering and Transfer Vehicle (MTV). The 25 kg MTV is the smallest of the family of three, and is designed to move payloads from GTO to LEO or GEO with up to 1600 m/s of delta-v. The MTV is optionally designed to perform on-orbit rendezvous, with a universal payload interface. Customer payloads can perform inspection, repair, refueling, robotic manipulation, science, Earth observation, or operations on other orbiting satellites. More:

[http://www.spacedev.com/media/recent\\_news.htm](http://www.spacedev.com/media/recent_news.htm)

CHIPSat: We are now assembling and testing the "flatsat" version of CHIPSat, the 70 kg microsat for Berkeley. Launch May 15 - June 2, 2002. More:

<http://spacedev.com/products/earthorbit.html>

SURVEY: SpaceDev & Sea Launch are working to provide inexpensive secondary Domestic launches for government and commercial users on a regular basis. We are currently performing a market survey of all those who need / might need smallsat launches.

MARS MSR: SpaceDev is part of an effort to define a wide variety of possible Mars Sample Return Missions. Details:

<http://spacedev.com/media/pressrelease/23apr01.html>

MARS MAV: We are part of a team exploring concepts for The Mars Sample Return Ascent Vehicle. SpaceDev is analyzing propulsion possibilities for JPL for the possible use of our unique, advanced hybrid rocket motors for Mars return samples. More:

[http://www.spacedev.com/media/recent\\_news.htm](http://www.spacedev.com/media/recent_news.htm)

HYBRIDS: A long string of successes in Space Dev's development and test firing of hybrid rocket motor-based products has made us a leader in the developing safe rocket motors for suborbital human space flight, and orbital maneuvering vehicles. More:

[http://spacedev.com/products/Hybrid\\_Propulsion\\_RLV.htm](http://spacedev.com/products/Hybrid_Propulsion_RLV.htm)

# EARTH-SPACE

Saturday, October 13th, 2001

## Mars Migration & Earth Regeneration Workshop

Lothlorien Nature Sanctuary,  
Bedford, Indiana

A multi-media-driven discussion circle and think tank focusing on frontier science, future settlements on Mars and tools & technology for the greening of Spaceship Earth

Two sessions: 10 AM - noon and 1 PM-4 PM  
Admission \$10 (includes both sessions and lunch)

Galaxy Dance & Sky Watch Party 8 PM until 1 AM

Gaze through the telescopes - wish on the stars or cosmoically converse around the campfire then step inside the solar electrified hall to emerge yourself in light and sound spin around - dance the round costumes are AOK

Admission to the Galaxy Dance and Sky Party: \$5 (refreshments are available)

EVERYONE WELCOME - BRING THE FAMILY

Camp-over passes: \$5/person (BYO camping gear) limited indoor space for sleeping bags available

Full package, including camping: \$20

No advance registration necessary

Sponsored by:

- ▣ the Green CELSS Task Force
- ▣ the Indiana Chapter of the Mars Society
- ▣ Starlight Technology
- ▣ the Elf Lore Family, Inc.

Dare to explore the final frontier!

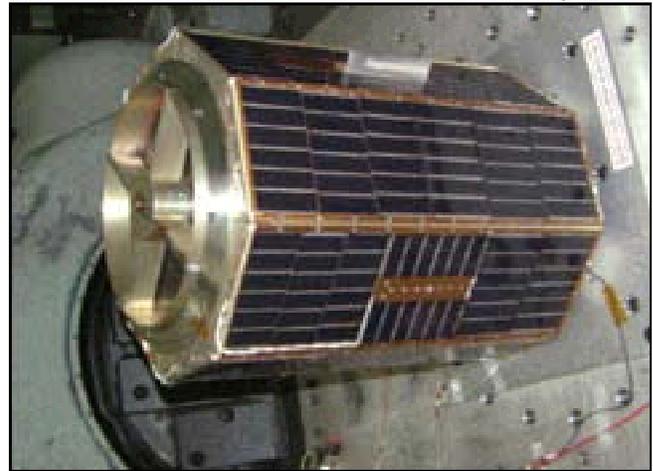
Online map to Lothlorien at:

<http://www.elflore.org/rdmap.html>

## \$200,000 SimpleSat Launched by Shuttle 1st Orbiting Amateur Telescope

<http://www.cnn.com/2001/TECH/space/08/20/discovery.undock/index.html>

(NASA)



SimpleSat was launched on August 10, 2001 on the Orbiter Discovery for mission STS-105. Last on the mission's task list was the deployment of SimpleSat in its HitchHiker protective cannister.

SimpleSat is about 2' long, 18" in diameter. Its success could demonstrate that off-the-shelf commercial technology can be used to build inexpensive satellites. Dave Skillman built the 52 kg craft with some volunteer help, for only \$200,000. He serves as the project's principal investigator.

SimpleSat Homepage

<http://ltpwww.gsfc.nasa.gov/simplesat/>

**SimpleSat** is an inexpensive 3-axis stabilized spacecraft with a 12" telescope - or in NASA speak, "optical science gathering capability". It has a GPS receiver to determine its orientation, information that will be used to control the telescope aim.

SimpleSat will orbit Earth for 5 months or so before its orbit decays. During that time Skillman, working at Goddard Space Flight Center, will attempt to communicate with SimpleSat by ham radio.

SimpleSat is sponsored by The Laser Remote Sensing Branch of the Laboratory for Terrestrial Physics at NASA's Goddard Space Flight Center & the Goddard Director's Discretionary Fund.

### Objectives

- Design a low-cost satellite with modest capabilities
- Construct satellite and pass all STS safety reviews
- Launch / Operate to evaluate on-orbit performance
- Accomplish all the above without infrastructure
- Design, construct, operate using DDF funding levels
- Demonstration flight for :

- College/university constructed spacecraft
- Aircraft/sounding rocket alternative
- Potential RTOP/Incubator "missions"

## SOLAR SYSTEM AMBASSADORS



**Michelle Baker**  
Princeton/Philadelphia  
[chaos@cybernet.net](mailto:chaos@cybernet.net)

**Bill Higgins**  
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**Herald Schenk**  
Sheboygan, WI  
[hschenk@excel.net](mailto:hschenk@excel.net)

[www.jpl.nasa.gov/ambassador](http://www.jpl.nasa.gov/ambassador)

## 70 day Jupiter Movie sees Patterns in Chaos

- <http://www.jpl.nasa.gov/videos/jupiter>
- <http://ciclops.lpl.arizona.edu>

## Readers, We have a Problem!

From the MMM Editor

Every year, MMM takes a plunge into the light side, putting together a collection of "News Reports" from the "AFD News Agency" in the April issue. "Tell people what they want to believe, and no matter how fictitious, they will believe it" - at least for a few moments. We have always expected that the reader will quickly realize that we are having a little fun "pulling legs." And I believe we have taken due measures to ensure that this will be the case.

Apparently we have given readers too much credit. This year, according to several sources, our report about "**Swansong**", a tiny faint brown dwarf star discovered only 8 light months out and coming our way, was taken seriously by a good number of readers, none of whom will I embarrass by mentioning by name.

*Always read the fine print!* On the bottom of each annual report from the "AFD News Agency", we have *always* posted the following disclaimer.

MMM's 15th annual Happy April Fools Day News

Is having to turn one's newsletter upside down to read the fine print too much to ask? *If* we have crossed the line, we apologize. We have been reluctant to otherwise tip our hand by admitting what we are up to. After all, this spoils our fun for next year, and perhaps every year afterwards. But when we were contacted by an astronomer from Yerkes Observatory recently about our sources for this story, we felt it was necessary to come clean.

Yes, *all annual issues numbers ending in 4*, fifteen of them in all starting in 1987, contain collections of such fictitious reports. Our only regret is that the game is up. *Or is it?*

Putting together MMM for the past fifteen years has been a lot of work, much of it, but not all, enjoyable. We think your tireless editor is entitled to a little mischief! -- PK

## Air Force Puts Nail in X-33, X-34 Coffins

Report & Editorial Commentary

The U.S. Air Force has made a brief statement that it has decided not to pick up the X-33, X-34, or any other projects canceled by NASA.

That does not mean all is lost. It is possible that especially sound and promising technologies involved will become part of future, better designed X-programs, either in the U.S. or elsewhere. In our opinion, the X-33 tried to do way too much all in one program, abandoning the time-tested X-vehicle philosophy of testing and proving one new technology at a time. And there lingers the offensive smell of a program whose primary purpose seems to have been to make work for Lockheed Martin. -- PK

## Trouble in the Mars Society?

Report & Editorial Commentary

In early September, several members of the Mars Society Steering Committee resigned: Kim Stanley Robinson, Eric Tilenius, and Marc Bouchet among them. All except the latter did so on a provisional basis until insurance could be provided that would guarantee that they would not individually be sued in any hypothetical suits filed against the Society. Such coverage is now being arranged and these members are likely to be back aboard.

However, Mr. Bouchet of Canada, who has been a tireless contributor to the Society, creating its website and helping guide operations on Devon Island, was also motivated by deep dissatisfaction over recent Steering Committee decisions due to some misunderstandings of its rules, and has tried to paint these resignations as a "general" revolt from an "unprofessionally" run Society.

The accomplishments of the Society to date are considerable. We hope the Mars Society can weather this storm, correct anything that needs to be corrected, and move on to more good work. -- PK.

## Mars Society Launches Translife Project

[www.marssociety.org/bulletins/08.28.01.translife.html](http://www.marssociety.org/bulletins/08.28.01.translife.html)

At its Stanford convention, the Mars Society resolved to commit its resources to initiate the Translife Mission as its first spaceflight mission project. It will consist of a Mars-level (0.38 g) artificial gravity spacecraft carrying a crew of mice (and possibly other animals and plants) in low Earth orbit for a period of some two months, during which the mice will be allowed to reproduce and the young will develop into adults. The craft will then be recovered, and both original crew and progeny will be examined.

The mission will:

1. Validate the miniature artificial-gravity craft and life support system for further missions.
2. Establish whether Mars-level artificial gravity can serve as an effective countermeasure for mammals against the physiological deterioration of long-duration spaceflight in zero-g, essential for planning human expeditions to Mars.
3. Establish whether mammals from Earth can be born and develop into proper adults in Mars gravity conditions. The answer is key to establishing whether humans and other Earth life can ultimately settle Mars, and other planets with gravity substantially less than that of Earth.

Follow-on missions could include flights into deep space as far as the orbit of Mars. Individuals or organizations willing to volunteer talent, hardware, or cash in support of the Translife mission should write the Translife Project, Mars Society, Box 273, Indian Hills, CO 80454. Donations tax deductible.



U.S. CHAPTERS



**NSS**  
Chapter Events  
**MMM**  
9 Chapters Strong

Space Chapters HUB Website:

<http://www.nss.ac/hub/>

WISCONSIN



**Sheboygan  
Space Society**

728 Center St., Kiel WI 54042-1034

c/o Will Foerster 920-894-2376 (h) <willf@tcei.com>  
SSS Sec. Harald Schenk <hschenk@excel.net>  
>>> **DUES:** "SSS" c/o B. P. Knier  
22608 County Line Rd, Elkhart Lake WI 53020

☞ We meet the 3rd Tuesday of the month at 7-9pm

**OCT 16th** MEETING at the Stoelting House in Kiel  
**NOV 20th** at Foerster Academy of Dance, Sheboygan

MINNESOTA



**Minnesota Space  
Frontier Society**

c/o Dave Buth, 3331 Cedar Ave. S. #2  
Minneapolis, MN 55407

612-721-4772 (Dave Buth) 612-375-1539 (Jeff Root)  
Email: mnsfs@freemars.org

<http://www.FreeMars.org/15/index.html>

Next meeting **Saturday, September 22th at 1 pm** at  
Radio City Inc., 2663 County Road I, Mounds View,  
Mn. 55122 -- (763) 786-4475 --Back meeting room.

It's north of I-694 just off of County 10,  
between Long Lake and Silver Lake Road, not Hwy 10  
which is close by. Hwy 10 runs along I-35W. You  
have to be on *County 10*. If you need more directions  
or want to add to the Agenda call: (612) 333-1872.  
We will be discussing the website reworking and  
many other topics. Hope to see you there!

MICHIGAN



**Ann Arbor  
Space Society**

P.O. Box 130118, Ann Arbor MI 48113-0118

John Wolter (734) 665-1263 johnswolter@provide.net

☞ 2nd Wednesday (**Oct 10th, NOV 14th**) 7 pm,  
MEETINGS at members' homes. Contact above

OHIO



**Guyahoga Valley  
Space Society**

3433 North Ave. Parma, OH 44134-1252

c/o George F. Cooper III, Phone 216-749-0017  
E-Mail: geocooper3@aol.com [new]

☞ Monthly Meetings, the 4th Thursday 7-9:15 pm,  
rm 106, Wilker Hall, Baldwin Wallace College, Berea  
NEXT DATE: **SEP 27th, OCT 25th**

CALIFORNIA



**OASIS: Organization for the Advancement  
of Space Industrialization and Settlement**

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

Events Hotline/Answering Machine: (310) 364-2290  
Odyssey Ed: Craig Ward - cew@acm.org

E-mail: oasis-leaders@netcom.com

<http://chapters.nss.org/oasis>

**Odyssey Newsletter Online**

[http://www.geocities.com/CapeCanaveral/  
Lab/4005/articles.html](http://www.geocities.com/CapeCanaveral/Lab/4005/articles.html)

☞ **Regular Meeting 3 pm 3rd Saturday of each month.**  
Information: OASIS Hotline, 310/364-2290; website.

- **SEP 15th** -- OASIS Monthly Meeting, at the home of Craig and Karin Ward, 1914 Condon Avenue, Redondo Beach.
- **OCT 20th** -- OASIS Monthly Meeting
- **NOV 17th** -- OASIS Monthly Meeting

• **Recurring Events**

- **Daily** (call observatory 323/664-1191 for times) "Oceans of Mars," live, multi-media planetarium show. Griffith Observatory, 2800 East Observatory Rd, Los Angeles. \$4 adults, \$2 children, \$3 seniors. <http://www.griffithobs.org/>.
- **Fridays, 7 pm** "Night Sky Show." -- **8 pm** Guest lectures. Santa Monica College John Drescher Planetarium, 2nd Floor Technology Building, 1900 Pico Blvd. \$4 per show or \$7 for both. Info: 310/452-9223 [www.smc.edu/events/weeklyeven](http://www.smc.edu/events/weeklyeven).
- **Fridays** -- "Mike Hodel's Hour 25" webcast. The world of science fact and fiction with interviews, news, radio dramas, artists, writers, stories, reviews, and more. Info: [www.hour25online.com/](http://www.hour25online.com/).



**Oregon L5  
Society, Inc.**

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

voice mail / FAX (503) 655-6189

<http://www.OregonL5.org/>

Allen G. Taylor <allen.taylor@ieee.org>

Bryce Walden <BWalden@aol.com>

(LBRT - Oregon Moonbase) moonbase@home.com

☞ Meetings the **3rd Saturday** of each month at **2:00 p.m.**

**Bourne Plaza, 1441 SE 122nd, Portland, downstairs**

**NEXT MEETING DATES: OCT 20th, NOV 17th**



**610 West 47th Place, Chicago, IL 60609**

Larry Ahearn: 773/373-0349

Call Larry for MEETING INFORMATION



**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)

**NEW URL** <http://pasa01.tripod.com>

*Note* : PASA is now on the tripod.com system

☞ **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 17 th street side and go **left**. Look for table sign. Parking at Liberty One on 17th St. Verify meetings with Earl.

**NEXT MEETINGS: OCT 20th, NOV 17th**

• **Scheduled PASA activities:** Monthly meeting schedule for the first six months of 2001: 3rd Sat. of every month, exc. Sun.. June 10th, location TBA. Call Earl to verify.

Report by PASA President Earl Bennett

• **August Meeting Report:** A meeting report had not been received by Press Time.

## Plan Now for ISDC 2002

### SETTLING THE SOLAR SYSTEM

The National Space Society's 21st Annual International Space Development Conference and Exhibition

Memorial Day Weekend -- **May 23-27, 2002**

**Denver Tech Center Marriott Hotel**

1901 University Blvd NE

Greenwood Village, CO (**Denver**)

Hotel Reservations (303) 779-1100

1-800-445-8667 ("ISDC 2002" or "NSS")

\$85 + tax per night, single-quadruple occupancy.

<http://www.isdc2002.org>

Conference Registration Rates:

\$60 thru 09/30/01

Fri. Professional Day +\$25

\$75 until 12/31/01

Senior/Teacher/Student 50%

\$90 until 05/01/02

Children in Tow -- Free

\$100 at the Door

#### Call for Papers

#### *"To Create a Spacefaring Civilization"*

The mission of the National Space Society formally describes our member's motivation for belonging to the Society:

*we want to live and work in Outer Space.*

Every year for the last 20 years, we have gathered at our annual International Space Development Conference to listen to professional speakers, develop strategies for furthering our goals, and to enjoy the company of others who attend the conference. In 2002 the Society will hold its 21st conference, one mile high, in Denver, Colorado.

The theme chosen for the conference is **"Settling the Solar System"**. In keeping with the theme of the conference, we are inviting prospective speakers to submit abstracts on the following topics:

- **Space Mining**
- **Space Construction**
- **Space Solar Power**
- **Development and Settlement of the Moon**
- **Development and Settlement of Mars**
- **Space Medicine**
- **Space Law**
- **Space Business**
- **Military Space.**

These topics will be addressed in a one-day professional symposium **Friday, May 24, 2002.**

We hope you will consider joining us in Denver and submit an abstract for consideration.

NAME \_\_\_\_\_ ÷  
 STREET \_\_\_\_\_ ÷  
 CITY/ST/ZIP \_\_\_\_\_ ÷  
 PHONE #S \_\_\_\_\_ ÷

\$35 **NATIONAL SPACE SOC.** dues w. **Ad Astra**  
 \$20 NSS dues if under 22 or over 64. *Must state age* \_\_\_\_  
 NSS, 600 Pennsylvania Ave SE #201, Washington DC 20003  
 (Make payable to local chapter for 1st year **free local dues**)  
 (Offer not honored by Oregon L5 Society)

\$35 **MOON Society** dues with MMM  
 \$25 **Moon Society** dues for those already getting MMM  
 Moon Soc. Membership, PO Box 940825, Plano, TX 75094

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**Member Dues -- MMM/MMR Subscriptions:**  
 Send proper amount to address listed in chapter news sections.  
 ==>for those outside participating chapter areas <=  
 \$15 **Individual Subscriptions to MMM/MMR: Outside  
 North America**  \$45 Surface Mail -- Make payable to  
 "LRS", P.O. Box 2102, Milwaukee WI 53201

**ANN ARBOR SPACE SOCIETY**

\$10 regular dues

**CUYAHOGA VALLEY SPACE SOCIETY**

\$10 presently; Raise to \$15 under consideration

**CHICAGO SPACE FRONTIER L5**

\$15 annual dues

**LUNAR RECLAMATION SOCIETY, INC.**

\$15 regular,  \$20 family,  \$12 student / senior cit.

**MINNESOTA SPACE FRONTIER SOCIETY**

\$20 Regular Dues

**OREGON L5 SOCIETY**

NOTE DUES RAISE:  \$23 for all members

**O.A.S.I.S. L5**

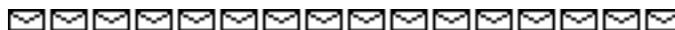
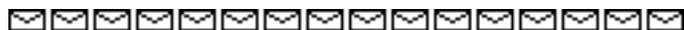
\$18 regular dues

**PHILADELPHIA AREA SPACE ALLIANCE**

Annual dues for all with MMM \$16, due in March  
 or \$4 times each quarter before the next March

**SHEBOYGAN SPACE SOCIETY**

\$15 regular,  \$10 student,  \$1 / extra family memb  
 "SSS" c/o B. P. Knier, 22608 County Line Rd,  
 Elkhart Lake WI 53020



**Moon Miners' MANIFESTO**  
 Lunar Reclamation Society Inc.  
 PO Box 2102, Milwaukee WI 53201-2102.

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