"Expanding the Human Economy through Off-Planet Resouces"

Moon Miners' Manifesto

& Moon Society Journal

#157 August 2002

Published monthly except January and July., by the **Lunar Reclamation Society** (NSS-Milwaukee) for its members, members of **participating National Space Society chapters**, members of the **Moon Society**, and for individuals worldwide. EDITOR: Peter Kokh, c/o LRS, PO Box 2102, Milwaukee WI 53201. Ph: (414) 342-0705.

Submission address: "MMM", 1630 N. 32nd Street, Milwaukee, WI 53208-2040; **E-Mail**: kokhmmm@aol.com

In Focus Euro M.A.R.S. Hab Exhibit in Chicago Misses Golden Opportunity

The Chicago area Mars Society chapters have justly earned our admiration and respect for their successful efforts in erecting the new (3rd!) Mars Analog Research Station structure, destined for a permanent home in Iceland (story, pp. 16-7) on the grounds of Adler Planetarium on Chicago's lake-front, and for hustling up the many volunteers to staff it during visiting hours. That said, we must say that we were very disappointed in what we saw on our chapter (Lunar Reclamation Society) visit to the facility on Saturday, July 20th.

Inside the facility are many exhibits on Mars, some from the Adler collection, others from the Mars Society. But we think that it is a gross failure of the imagination on the part of the Mars Society leadership to treat this opportunity as just a chance to tell people about Mars. That's important, to be sure. But such exhibits could have been in a tent or other simple structure that visitors would pass through *first*.

The Mars Analog Research Station program is an exciting one, and a chance to really enthuse the public about the goals and early achievements of the first two stations on Devon Island and in south central Utah was missed. Yes, it would have taken more *planning*, more lead *time*, and more *expense*. But the station shell should have been outfitted with a mockup of what it will look like when it enters service in Iceland next spring; a preview, as well, of what the first manned station on Mars itself could be like some 10-20 years from now. That's what we hoped to see, why we came down from Milwaukee.

More planning, more time, more money. But the Mars Society doesn't have the resources! Perhaps, but that simply means that special additional fund raising is/was needed. Our point is a simple one.

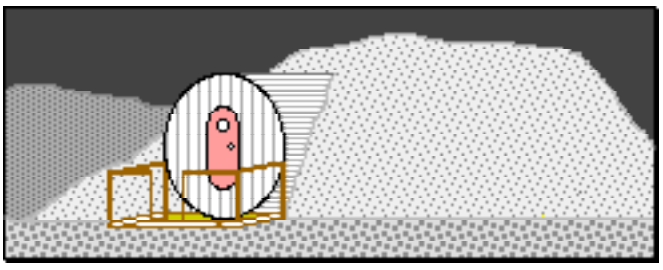
Anything worth doing is worth doing well!

That may seem to be a cheap shot. It is not. This maxim should be everyone's way of life, a guiding philosophy driving all our efforts in whatever we do in life, individually, or as part of a group.

We could excuse this dropping of the ball if it was a one time thing. But last summer, the Station destined for Utah was on display at Kennedy Space Center, and may have been similarly unimaginatively presented. We need to learn from each experience and then devise a plan to improve. We strongly support the Mars Analog Research Station program. The public is waiting to be turned on. We disappoint them at our own great risk. [=> p. 2, col. 2]

Porches on the Moon?

The very idea of a lunar habitat having a "porch" seems absurd at first thought. But on Earth, porches serve a number of useful functions, and we examine the question from this viewpoint -- how could we serve these functions for lunar pioneers? The whimsical sketch at right is not quite an illustration of the applications we foresee. ==> pp. 5-6



Moon Miners' Manifesto

Moon Miners' MANIFESTO/ Moon Soc. Journal is published every month except in January and July, by the Lunar Reclamation Society. In January and July, all members and subscribers recieve **Moon Miners' REVIEW** instead.

® **MMM** is being reedited for the World Wide Web by members of the Artemis Society International. => www.asi.org/mmm

® **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/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 societies and chapters can be labeled by this 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 over 25,000 members and 80 chapters, dedicated to the creation of a spacefaring civilization.

The National Space Society, 600 Pennsylvania Ave. SE, Suite 201, Washington, DC 20003; Ph: 202-543-1900; FAX: 202-546-4189; 202-543-1995 NSS Space Hotline; nss@nss.org => www.nss.org

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

openfrontier@delphi.com => www.space-frontier.org

® **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.

÷ **EMAIL** to KokhMMM@aol.com (*preferred*)

÷ **Mac diskette** or **typed hard copy** to:

Moon Miners' Manifesto, c/o Peter Kokh,
1630 N. 32nd Street, Milwaukee WI 53208-2040

fi IN FOCUS Editorial continued from p. 1.

It was great meeting some of the Chicago area Mars Society people and seeing again several Chicago area NSS members. The exhibits at Adler were great as usual. But what we wanted was to get vicarious gratification from pretending that we were selected to be a station crew, given a chance to simulate exploration of "take-you-there" Mars-like terrain, endure the awkwardness and "can't scratch an itch" discomforts of wearing "spacesuits, " of sending messages to "Earth" with speed of light time delays, of testing equipment and getting a chance to suggest useful modifications; ant to pretend, just for a moment, that we were on a real expedition to Mars.

We wanted to see the M.A.R.S.' workstations, the sleeping quarters, the wardroom, the "air-lock." We went to Chicago to get charged up. But we didn't get to see or experience anything not already available to us on the Internet or in magazines.

Hopefully, if their is a next time, (Mars Society Australia is building its own Analog Station, of a different design, and you'll have to go "down under" to see it,) the Mars Society will be better prepared. The Mars Desert Research Station in Utah was designed so that it could be disassembled and moved. Perhaps in some future off-season, it will be open to tourists, if not elsewhere, then in its present location. As crude a mockup of what we might actually send to Mars as it is, that would be worth a trip.

In the much smaller Moon Society, some of us have been brainstorming how to do a similar analog Moonbase project. Hopefully, we will learn a lesson from the Mars Society experience. People want to know about Mars and the Moon, yes. But above all, they want to be "transported" there, if just for a moment, to experience what it would be like. We have to give them that experience if we want their support.

These days, with government space initiatives pretty much on hold, and with potential entrepreneurs still searching for business plans that will deliver a worthwhile return on investment, the potential of the "tourist" in opening space is getting a lot of attention. Tourists have money and don't need to go through legislative and budget hoops, if travel products and tourist experiences are priced within their reach. Even the vast majority of us who are under no illusion about ever being able to afford such ventures, still want to pretend. You can recite the whole long litany of "benefits" of space exploration and development. But if you can't magically transport us to the frontier for a vicarious mind-expanding moment or too, you've lost us.

Consider that it is quite possible that the first tourist will "loop around the Moon" without landing before the first astronaut, government or private touches down again. But the idea of touring Mars is really *far off*. The Mars Society needs to understand the importance of "let's pretend." - PK

Lance Bass to get October Skies Ride

3rd "Space Tourist" is 1st from Young Generation

NSYNC's Lance Bass, 23-yr old Teen Idol

In this "New Space World Order" pioneered last year by Dennis Tito with the enabling assist of a cash-starved Russian Space Program, all it takes to get a seat to the International Space Station for a one week visit are three things: enough cash, health test hurdles, and training to be a non-interfering visitor.

For most of us space buffs and enthusiasts, nothing as been so disheartening than the widespread disinterest and cynical apathy of today's younger generation, just the ones we had all hoped would be most "into" our spacefaring future. Alas, "into" *Star Trek* and *Star Wars* does not translate into real world space exploration and development. The young crowd is into now, and gratification now, not into deferred rewards in a hard-won future. "Space the real thing" is not even on their radar screen.

Thus even those of us to whom NSYNC doesn't ring a bell have reason to be excited about the news that hurdles are being cleared by the Russians to make the Lance Bass trip to ISS this October happen. It is more than a question of tourist #3, it is a case of seizing the attention of the whole younger generation, those on whom the realization of our future in space will all to soon rest.

In a letter dated July 17th, Russian Space Agency Rosaviakosmos notified NASA of its intention to "nominate space flight participant Lance bass, for the October, 2002 Soyuz TMA mission. We ask for the cooperation of all the ISS partners in this endeavor as it will ensure RASA's ability to meet Soyuz production obligations in 2002 and allow us certain surplus for the coming year" -- reading between the lines it is clearly a matter of money. The Russians are ready to lower some training hoops to meet the October income opportunity window. [http://www.space.com/missionlaunches/bass_letter_020717.html]

The Russians go on to say that Bass will not need proficiency in Russian as both cosmonauts are fluent in English. Further the Soyuz TMA module has been modified so that "for the right seat occupant, the crew duties are far more simpler [sic] than for the older Soyuz TM vehicle, especially for launch and orbit insertion. This will greatly mitigate any training concerns for a right seat space flight participant in this vehicle." That certainly seems to be progress to support true tourism. **</MMM>**

Interplanetary Internet to Debut in 2003

Report by Peter Kokh based on an online story at http://abcnews.go.com/sections/scitech/DailyNews/cybershake020729.html and on an earlier article in MMM #118 SEPT '98 p 10, "Expanding the INTERNET to the Moon and Beyond"

From the Larry Jacobs ABC News piece

"Father of the Internet" Vint Cerf and a project team at the Jet Propulsion Laboratory are working on software and protocol standards that will could lead to an Interplanetary Internet, or IPN. Current Net schemes created in the 1970s could lead to a cheaper, more robust communications network to keep astronauts in touch with each other and Earth.

Email and other one-way-at-a-time activities such as uploading, downloading, , etc. do not depend upon the recipient's being online at the time of sending and are not inconvenienced by long response lag times. Thus email is a good place to start

"By standardizing all future space communications onto one established set of standards, the IPN could eventually be used to connect to the Earth-based Net. ... lead[ing] to all sorts of interesting uses, such as allowing students to explore a distant planet via an automated robot connected to the IPN." Such things may be decades off, but the project team is working to get key bits of the IPN off the ground now. They hope to complete this year some of the software and standards needed to test the space network to allow NASA to include the software on the next set of Mars-bound probes and robotic rovers in 2003.

From the MMM # 118 Article

The Moon being so close to Earth, there is only 2.5 seconds "speed of light" response lag time for "live" communications, not much more noticeable or annoying than that in current intercontinental-via-satellite communications. For Internet browsing and other purposes, there would essentially be one seamless Earth-Moon Internet, the Earth and Moon twin planet system functionally one "location."

Both email and web browsing should be available now, via the existing relay satellite system, to crew members on the International Space Station. We will see this activity automatically expand to include ships and missions venturing out to the Moon.

While the much greater (150-1,000 times as long) Earth><Mars response lag times will not impede email or other one-way-at-a-time communications, it will probably mean a separate, smaller echo Mars Internet, but with everything (from the Earth-Moon Internet) available via email request. The same situation will apply to other interplanetary destinations as well as interplanetary spaceships in transit.

The first bits of Interplanetary Internet activity on near future Mars probe missions will surely prove widely exciting, working to bring Mars within the event-horizon of public awareness. **###**

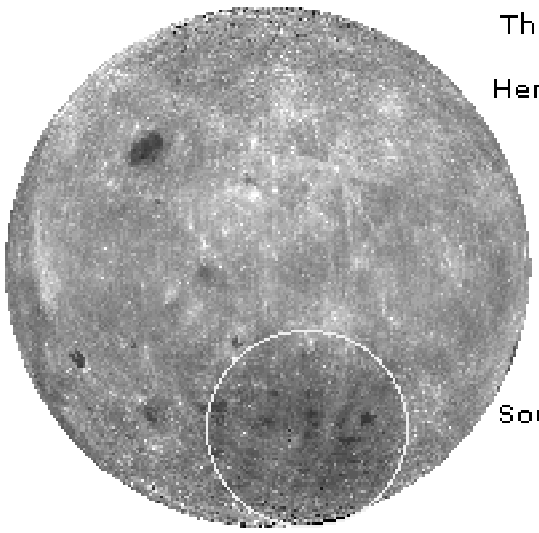
BULLETIN! - Planetary Scientists show born-again Curiosity about the Moon!

by Peter Kokh

When scientists looked at the first photos of the Moon's previously never seen Farside hemisphere they were surprised by an apparent major difference from the hemisphere always turned towards Earth. More than a third (38%) of the familiar side of the Moon is covered with dark lava plains called "seas" or "maria" (Latin: mare, maria = sea). But similar features seem to cover no more than 2% of the hemisphere forever turned away from Earth. Could it be that no large impact basins formed on the farside?

Actually, both topographic and altimetry evidence are that there are just as many large impact basins on the farside as on the nearside. The difference comes in what did and did not happen after the basins formed. On the nearside, where the crust is thinner, molten lava magma from the Moon's mantle eventually worked its way up through the fractured basin bottom crusts to flood the basins, turning them into the maria we are familiar with today. But on the farside, where the crust is thicker (100 km vs. 60 km) owing to a deformity in the Moon's shape caused by its tidal lock with Earth, the magma reached the surface in fewer places.

Indeed, the Moon's largest impact basin lies not below the Ocean of Storms (Oceanus Procellarum) but in lower farside. Known as the South Pole-Atken Basin, it is the largest and deepest on the Moon. But with no more than local patchy lava flooding, it is not called a "mare" but a "thalassoid" (Greek: qalassa thalassa = sea). The established name comes from its southernmost (south pole) and northernmost (Aitken crater) easily identifiable features.



The Moon's FARSIDE Hemisphere with South Pole-Aitken Basin Circled

SPA, as it is known in planetary science short hand, is unusual in more than its size (1,500 miles or 2,400 km in diameter - covering 90% of the span between the S. Pole and the equator!) and depth (12 km = 7.5 mi. = c. 40,000 ft) but in the as yet uncertain compostion of its floor. Impact theory, as we presently understand it, would demand that the floor of this immense basin consist largely of mantle material exposed when the crust above was blown away. But Clementine and Prospector data cannot confirm this. The uncertainty, festering since the Lunar Prospector results were released in 1999, has planetary scientists in a dither. Gone is the previous comfortable posture of most planetary scientists towards the Moon. "We've been there, done that, and we understand all we really wanted to know about the Moon." Gone too is their post Apollo-results exclusive preoccupation with Mars, Europa, and Pluto.

Unexpectedly the Moon is very much back on the must do agenda of Planetary Geology. A robotic mission to recover samples from the floor of the SPA Basin is suddenly vying for equal attention with strongly supported Europa Orbiter and Pluto Flyby missions. A National Research Council group has recommended prioritizing such a mission as a near term Discovery Mission. NASA seems to be listening.

Easier said than done

Yes, we have sent probes to the Moon before, and the Russians have done a few robotic lunar sample return missions. But there is some little fact that puts an SPA sample return mission well beyond that technology. Simply put, the target area is on the Moon's Farside, in the permanent radio shaddow, out of reach of teleoperators stationed on Earth. We see three ways to get around this obstacle.

1. Total robotic control using expert programs and what we have ready to go of AI, artifical intelligence. And we cross our fingers!
2. Operate in tandem with a lunar orbiter that can act as relay for teleoperation *when* the orbiter is above the surface probe's horizon.
3. Put a relay satellite in the L4 or L5 Lagrange areas of the Moon's orbit, 60° ahead or behind the Moon in its orbit respectively. The easternmost and westernmost protions of the SPA basin would be in sight of one or the other.

What's in it for us?

Hey we're glad to hear that NASA is changing its mind about returning to the Moon. And we share some of the planetary science curiosity. But what will any of this matter for those of us who want to see a permanent resource-using settlement on the Moon? Here are some reasons for *us* to get excited.

- This same robotic technology can be used to get samples of lunar polar ice deposits - a resource exceedingly important for lunar pioneering
- The SBA basin floor is the largest unsampled type of lunar terrain and just may contain unexpected resource concentrations
- This mission could be a precursor to the establishment of farside observatories on the Moon

So lets keep our fingers crossed and support this proposal. For more, go to: http://www.space.com/missionlaunches/robotic_moon_020801.html **<MMM>**

PORCHES on the Moon?

by Peter Kokh

The Inspiration for this essay was a recent 7-28-02 HGTV Cable TV special "Americans & their Porches"

Porch: 1. an exterior appendage to a residence, forming a covered approach to a doorway. 2. *U.S.* a veranda.

A brief ancient/modern history of porches

The porch or portico is an ancient amenity going back at least two thousand years.

Porches became a common feature of homes built in the 19th Century in America, offering a middle ground between the inner sanctum of the home itself and the outside world, specifically the neighborhood beyond. They have served several functions:

- greeting neighbors and passers-by without having to invite them inside, thus enjoying the pleasures of civility and neighborliness
- enjoying the weather within reach of shelter; sunrises and sunsets, approaching storms, breezes
- nature watching: sunrises and sunsets, trees and gardens, birds and other wildlife
- storing paraphernalia used outdoors
- shedding dust and mud before entering the home

Porches began to disappear from both new and old construction after World War II. New housing was needed at the lowest no-frills price possible. In old housing, porches were converted to extra indoor rooms (bedrooms, 3-season rooms) for growing families more cheaply than by building an addition from scratch. Television was new and proved to be an addictive lure away from porch-sitting (people in general seemed to become more self-involved.) Air conditioning made indoor relaxation more appealing.

Small town America was not immune to these changes, but seemed to hold on to porches longer. The pendulum is swinging back. Boredom with the TV/Cable boob tube passive wasteland, a purposeful re-emergence of neighborliness, a re-discovery of the pleasures of relaxation and real weather -- all these are luring more people to their own bit of outdoors. There is a growing "new urbanism" that is rediscovering the city (as opposed to the suburbs) and the greater opportunities afforded by higher density and diversity to enjoy the pleasures of more frequent contact with neighbors. Porches build community.

Functions of Porch Analogs on the Moon

The essence of a porch is an interface between "home/habitat" and "world." On the Moon. in pioneer settlements, the opportunity to establish such an interface occurs on three levels:

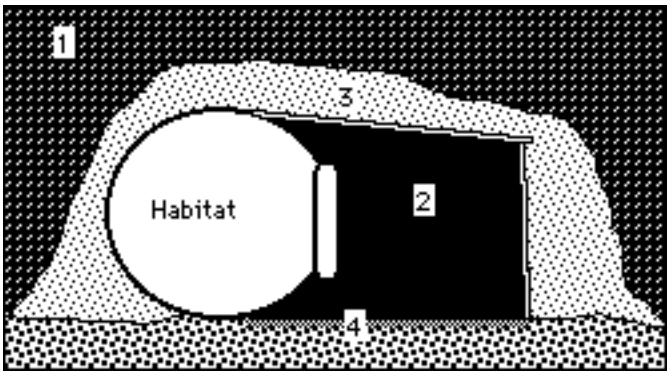
1. outside the airlock (if there is one)
2. outside a door opening onto a pressurized passage
3. inside adjacent to an indoor "yard" or solarium garden space or "Earthpatch"

Out-vac "Porches"

Our illustration on the front cover of this issue may seem whimsical. But when you think about it, an airlock-connected "porch" could be useful:

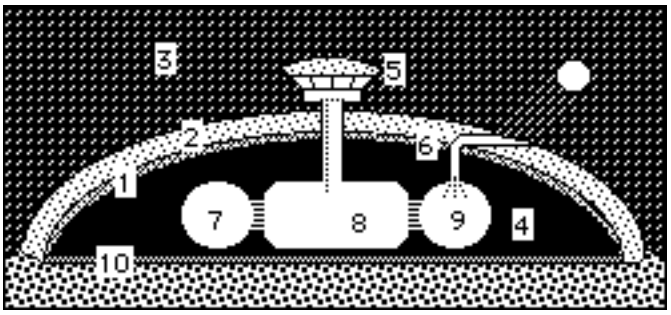
- provide a place and the means (a special "doormat") to *shed troublesome moondust* before entering - we talked about ways to do this in MMM #89 OCT '95, pp. 5-6 "Dust Control" (design of a special turtle-back suit and mated airlock)
- a place to *store equipment* used outside
- if roofed, shade from the glare of the sun
- *relief* (if the roof-canopy has a sufficient regolith blanket) from micrometeorite rain and cosmic ray exposure while doing routine outdoor chores like changing out fuel tanks - this is the concept of the "Ramada" which we talked about in MMM #37. JUL '90 pp. 3-4 and in MMM # 89, OCT '95 pp. 3-4 "Shelter on the Moon"
- an opportunity if so desired, to *customize* the out-vac entry to their personal family haven

Here is an illustration of the porch canopy concept from the MMM #89 "Shelter" article:



Directly Shielded Habitat with Carport/Service Area Shed: KEY: (1) Exposed Vacuum; (2) Sheltered Vacuum; (4) compacted and sintered floor of carport, part of dust-control strategy.

Another option for achieving the same sort of protection is to place habitat structures within or under a shielded hanger-like shed. Another illustration from the same article:



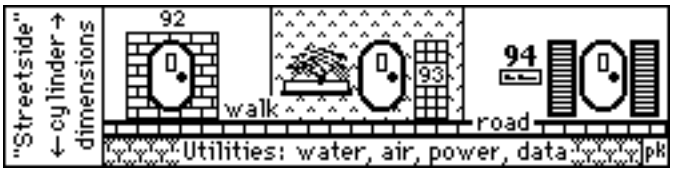
KEY: (1) Space Frame Arch, Fabric Cover; (2) 20 cm or more regolith dust shielding; (3) exposed vacuum, radiation, micro-meteorites, UV, solar flares; (4) protected lee vacuum service area; (5) observation cupola with ladder shaft to habitat space below (7, 8, 9); (6) broken-path solar access via heliostat and fresnel lens diffuser; (10) compacted, sintered hangar apron

Ways to customize one's out-vac surface entrance (color, texture, and design options) were discussed in MMM #55 MAY '92, p 7, "Moon Roofs.".

Middoor Porches

The concept of the "middoors" is simple. In lunar settlements, there will be pressurized climate-controlled shielded spaces "outside" individual habitats and work structures but "inside" as opposed to the vacuum and radiation-washed exterior surface "out-vac." Recently, we wrote about the role of these middoor spaces in supporting a large portion of the settlement biosphere: MMM #152 FEB '02, pp. 5-6.

In this concept of the modular settlement, growing naturally a module at a time, each residence unit has an air-lockable entrance on to a pressurized residential thoroughfare. The street frontage serves as the interface through which individual-private and shared-public worlds meet. Thus that entrance façade will probably be a more popular canvas for a distinctive statement. "I'm unique and proud of it." Here is an illustration of some possibilities from MMM # 109, OCT '97 pp. 3-11 "LUNA CITY STREETS." [This *major* article was sent to the ASI web team, but was never put online -- One of several reasons we're "on strike" in getting MMM articles on the web.]



Sidewall section of a residential street, suggesting how homedwellers might customize entrance façades. *Ibid.* p. 6

Now these "middoor" entrances provide an architectural opportunity to do more - to provide a "porch" enabling setback or easement on the residential street. These can be left empty or unstructured, but may eventually entice homedwellers to use them as semi-private, semi-public spaces where they can relax and enjoy opportunities to socialize with their neighbors and passersby. Such a "porch" will also allow them to enjoy the less controlled middoor climate -- in the middoors, temperatures might be allowed to swing in natural dayspan-nightspan (29.5 day) cycles as well as seasonal cycles fitting for the kinds of plants (and wildlife) desired. It will also provide "at home" relaxation space from which to enjoy any settlement "urban wildlife": birds, butterflies, squirrels, etc.

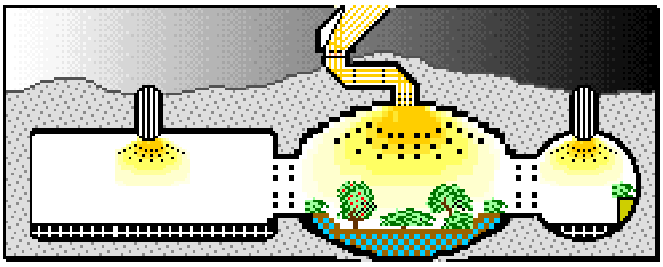
The Middoor porch would probably not have a roof or canopy, sharing the protection of the pressurized street itself. But railings, hanging pots and planters, swings and gliders and other seating and tables might become a common sight.

The pioneers will have other opportunities to socialize and bond, to be sure: at school, at work, and in voluntary group activities. But there is something special about the unprogrammed unstructured opportunities for "neighborliness" that a "curbside" porch brings. It is an easy place to be, within reach of one's inner sanctum on a moment's notice or whim. An "at home" place to enjoy living in a settlement.

It is not enough to build the settlement physically, nor enough to provide an ample and varied modular biosphere. It will be essential, if a human presence on the Moon is to truly endure and not be just another false start leading to history's most expensive "ghost town" to aim beyond those two goals. We have to do what it takes to build the settlement *as a community*. The "middoor porch" may have a strong supporting role to play in this effort.

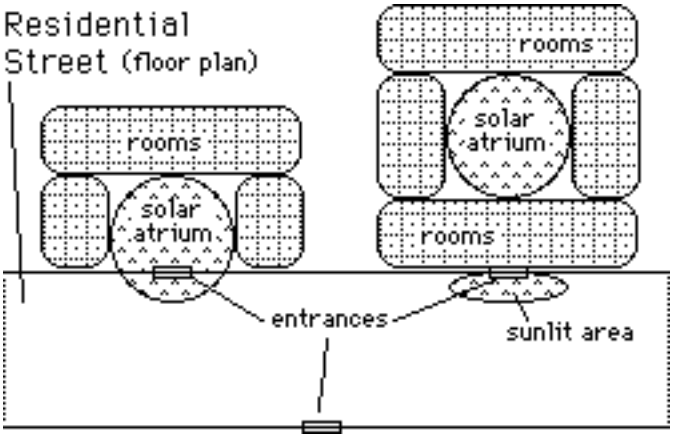
Solarium Garden Patios

One of the noted pleasures of porch-sitting, enjoying the surrounding trees, shrubs, and flowers, to be sure does not require street-facing placement. A backyard patio will do as well. On the Moon, homesteads are more likely to "interiorize" any private "yards," that is, to have gardenspace or "Earthpatch" atrium solaria in which they can garden away to their hearts' content. See MMM #148 OCT '01 pp. 3-6.



If you have such a pleasant space within your homestead, full of greenery, flowers, fresh air, fragrances, and sunlight, why not have a place along its perimeter to sit and relax and commune (or grok?)

It is not a matter of choosing to have a curbside porch and an interior atrium patio -- lunar homesteaders can have both. But depending on the architecture, they could have both in one. In other words, put the atrium solarium to the front of the house so it opens onto the streetscape as well. The illustration (from the MMM #89 article) shows the two options - combined at left, separate at right.



Strange as it sounds at first, the "porch" may become a commonplace of lunar pioneer life. **<MMM>**

Cobalt Blue & Other Substances From Lunar Regolith

by David A. Dietzler, St. Louis, Mo. 7/6/2002

Prospector Pete [Peter Kokh] has described the manufacture and use of paints made with metallic salts dissolved in sodium silicate. Only materials available on the Moon are used. Here is a process, which is by no means the last word, for getting necessary substances from lunar regolith.

1) Roast regolith to drive out H, N, CO, CO2 (carbon will react with oxides), S, He 3, He 4, Ne (and all other noble gases). Separate volatiles thru fractional liquification. There are also traces of fluorine (140 ppm), chlorine (14 ppm), bromine (0.1 ppm), and iodine (0.0006-1.4 ppm) in the regolith, but they are probably in the form of salts that could be leached out of the regolith with carefully recycled water. Calcium fluoride is not soluble in water and these halogens may be bound in silicates, so leaching with water may not be useful. Barium at 200 ppm is present in the regolith most probably in oxide form. Barium oxide is soluble in water, unlike most oxides. It reacts with water to for barium hydroxide. The simplicity of water leaching is appealing.

2) Use electromagnets to separate illmenite grains (FeTiO), iron, iron oxides, cobalt oxides (Co 25 ppm), nickel oxides (Ni 200 ppm), troilite (FeS) from roasted regolith. Reduce with heat and hydrogen to yield water and hydrogen sulphide gas. Electrolyze water to recover hydrogen and store oxygen. Hydrogen sulphide is either electrolzyed or pyrolized to recover hydrogen and get sulfur. Heat the metals with carbon monoxide to produce carbonyls of iron, cobalt and nickel that can be formed and decomposed at different temperatures to get the pure metals. This is called the Mond Process. Iron composes about 14% of the regolith and will form iron pentacarbonyl (Fe(CO)5). This boils at 103 C. and decomposes at 200 C. Nickel tetracarbonyl (Ni(CO)4) boils at 43 C. and explodes at 60 C. Caution will be required when decomposing small abounts of this substance at a time. Cobalt tetracarbonyl (Co2(CO)8) melts at 51 C. and decomposes above this temperature. If the mixture is heated high enough to distill the iron and nickel, the cobalt carbonyl will decompose. To separate the cobalt and titania residue that will be leftover, the mixture could be roasted with carbon monoxide again to reform cobalt tetracarbonyl. Since this is soluble in alcohol, ether and carbon disulphide, it will be easily washed out of the mixture then heated and decomposed to recover CO and obtain pure cobalt for our blue pigments. Titania will remain and this will be carbo-chlorinated and electrolzyed to get pure titanium and oxygen. Carbon for CO will be imported and traces of carbon extracted from regolith will be used to replenish losses due to leakage. Organic solvents will be handled in a similar manner. Now, all we need is some sodium and silicon oxides to get sodium silicate to make paint. Sodium hydroxide heated under pressure with silicon dioxide will produce sodium silicate. Sodium hydroxide is made by electrolyzing aqueous solutions of sodium chloride in chlor-alkali membrane cells. Hydrogen and chlorine will be imported, recycled and traces from the regolith used to replenish leakage losses. We will also need aluminum to make cobaltous aluminate (Co(AlO2)2) for our beautiful blue paint.

3) Take the roasted and magnetically beneficiated regolith and leach it with hydrofluoric acid. This will produce water and silicon tetrafluoride gas that will be boiled off (some UF6 also, perhaps). That water will be electrolyzed to recover hydrogen, the oxygen stored for many purposes and the SiF4 will be decomposed at high temperatures to get pure silicon which composes 20% of the regolith and recover fluorine. This will leave a pile of fluoride salts behind. These will be heated with silicon (silicothermic reduction) to make more SiF4 gas that will be decomposed for recycling. Since the SiF4 will evaporate from the mass, the reaction will be driven strongly to the right. Equilibrium won't stop us! 4XFl + Si = 4X + SiF4

4) Now we have a granulated (hopefully) mass of free metals that must be separated. Zinc is refined by distillation because of its low boiling point of 907 degrees Celsius. There's only about 15 ppm zinc in regolith, but we want to get it. Although most of our magnesium alloys will be made with aluminum, silicon, thorium and manganese; we might want some zinc for some magnesium alloys and other special purposes including plant nutrition. We will roast this mass of metals in a solar or electric furnace to boil off and distill sodium (3300 ppm), potassium, phosphorus, any remaining sulfur, cadmium, selenium, arsenic, rubidium, cesium, mercury and zinc. All of these boil at lower temperatures than zinc. Some are present only in traces. Mercury is almost non-existent at 0.0006-0.013 ppm, meaning we'll only get a few hundred grams to a few kilos from a million tons of regolith, but how much mercury will we need? We will acquire substantial quantities of sodium to make sodium silicate for paints. We will also have some potassium to make potassium silicate which might also be of use. We will have silicon for PV cells and roast it with oxygen to make pure silica for glass and making sodium silicate.

5) Now we need aluminum to make cobaltous aluminate. Various chemical processes will be used to separate the remaining metals: aluminum, magnesium, calcium, manganese, chromium and trace metals including copper (11 ppm). Sulfuric acid leaching, electrolysis, electrostatic separation similar to the

action of a mass spectrometer, and other methods will be applied. Much has been written about this by O'Niell and company. The CD-ROM in the 3rd edition of The High Frontier may be consulted.

It may also be possible to heat this mixture with carbon monoxide to produce chrominum hexacarbonyl (Cr(CO)6) and manganese carbonyl (Mn2(CO)10). Manganese carbonyl melts at 154 C. but begins to decompose at only 110 C. Fortunately it is soluble in most organic solvents. Chromium hexacarbonyl is not soluble in alcohol, ether or acetic acid; so one of these will be used to draw off the manganese carbonyl and leave the chromium carbonyl behind. The manganese bearing solution will be distilled, the organic solvent recycled and the carbonyl decomposed with heat to get manganese and recover CO. The chromium carbonyl melts at 150 C. and explodes at 210 C. This could be a problem. It is slightly soluble in iodoform and carbon tetrachloride. Multiple extractions with these solvents after the manganese carbonyl is removed will be performed to get the chromium out of the Al, Mg, Ca, and trace metals mixture. Organic solvents may be boiled off and distilled at lower temperatures by taking advantage of the free vacuum of space. Chromium carbonyl decomposes when solutions are exposed to light. Photochemical decomposition may be less violent than heat decomposition to get the chromium. Other transition metals like vanadium, niobium, tantalum, molybdenum, tungsten, rhenium, ruthenium, osmium, rhodium and iridium; traces of which some of these are found in lunar regolith, also form carbonyls that may be extracted.

The Al, Mg, Ca and trace element rich residue could be mixed into molten sodium hydroxide. Magnesium will float on top and be skimmed off. Aluminum will dissolve into the alkali which can be poured off and boiled down. Alumina rather than pure aluminum will probably remain due to reaction of aluminum with sodium hydroxide and this can be purified with the Alcoa process. Calcium and traces of other metals will remain to be purified by various processes. Cobalt, alumina and sodium silicate for azure blue paint will be produced along with many other subtances when this point is reached. **<DAD>**

REFERENCES: The regolith elemental composition data in this paper was obtained from The Lunar Rocks by Brian Mason and William G. Melson, Wiley-Interscience, New York: 1970.

Chemical data obtained from Hawley's Condensed Chemical Dictionary eleventh edition revised by N. Irving Sax and Richard J. Lewis, Sr. , Van Nostrand Reinhold Co., New York: 1987

The use of sodium hydroxide to extract magnesium and aluminum is described in the Artemis Data Book, "Sodium Hydroxide Method for Extracting Oxygen from Lunar Minerals" by Dr. Larry Friesen, 3/20/00, available http://www.asi.org/

"Stereochromie" & the Prehistory of "Lunar" Waterglass Paints

by Gerald J. Grott <jgrott@cci-29palms.com>

[Email to KokhMMM@aol.com, September 16, 2001]

Early applications of "Stereochromie"

The first recorded origin of painting with waterglass and inorganic pigments was about 1840. It was known as 'stereochromie' and most university libraries have one or more references under that name. Hundreds of buildings in middle Europe still sport external paintings in bright colors though they are over a century old. The shroud of Turin, scores of feet high, was painted on linen and hung in a German Cathedral until destroyed by Allied bombs in WWII.

I myself started with this about 50 years ago. My original purpose was to flame proof wood with bright colored paint that soaked in.. It worked very well as, on exposure to high heat, the wood would char but not burn.

In the 1970's we started a new business to commercialize the matching of the natural colors of rocks, particularily "Desert Patina", so that rock surfaces exposed by earth moving and blasting can be economically restored to a permanent matching surface coloration. We purchased the sodium silicate in numbers of 55 gallon drums. Unfortunately, our young manager died of cancer and none of us chose to leave our own businesses to run that one and we let the business die.

Methods & Tricks of the Trade

For painting pictures and illustrations, most any of the truly insoluble inorganic pigments are compatable with sodium silicate. However,you must be very careful not to have any contamination with soluble *carbonates* or *sulfates*. These are in detergents and soaps so you must rinse surfaces carefully before painting.

Also, avoid painting on cloths that have sizing in the fabric. Sizing in new cloth will almost always cause flaking or other decrepitation of the silicate. As history shows, unsized linen is a good base.

Magnesium oxide is a good material for reacting slowly with sodium silicate to form a 'permanent' rock like coating.

I have several full sized notebooks of R&D regarding the use of sodium silicate base nmaterials for sealing surfaces against moisture penetration and particularily for avoiding deterioration of marble objects or masonry of, or containing limestone or magnesite.

You are on a good course. I wish you good luck.

Jerry Grott

[Editor: I am grateful for Jerry's advice, but have yet to take time to try out his "tricks of the trade."- PK]

http://www.moonsociety.org

Please make NEWS submissions to
David Wetnight at newsmonger@asi.org
Other submissions: 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 explor-ation and utilization of the Moon in cooper-ation with other like-focused organizations and groups.

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

Join/Renew Online at
www.moonsociety.org/register/
- $35 USA/Canada + MMM hardcopy
- $60 elsewhere + MMM hardcopy
- $35 anywhere + MMM electronic PDF file

Questions? email: membership@asi.org

The Artemis Project™ http://www.asi.org/
- Artemis Reference Mission
- Artemis Data Book

Project LETO™
http://www.projectleto.org/

Please send all mail related to Memberships to:

The Moon Society Membership Services
PO Box 940825, Plano, TX 75094-0825, USA

How to fix MMM Subscription Errors:
www.asi.org/adb/06/09/04/1999/09/news-19990915.html

The Moon Society
PO BOX 940825, Plano, TX 75094-0825

August 15, 2002

Dear Moon Society member,

It is time for the annual election of officers and directors in the Moon Society. This election is being conducted by both email and paper mail ballots. You may vote either way. The Board of directors has set October 1, 2002 as the date by which ballots must be received by the Moon Society.

By action of the Board of directors, there will be five directors elected this year to bring the board to a total of seven. To even out elections in future years, a randomly chosen newly elected director will serve for only a one year term. Officers whose terms expire this year are President and Treasurer. All offices other than the randomly chosen board slot are for two year terms. A separate action of the board waived Article V.3.b of the bylaws to allow Arthur Smith to run for the Board.

Each candidate that gave us an electoral statement has this statement included at the end of the ballot. Please consult these statements for guidance in voting.

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

Please return your completed ballot to the Moon Society to either the elections email address: elections@moonsociety.org or to the paper mail address listed above by October 1, 2002. If you vote by email, remember to include your membership number. We will be sending an email ballot out to all current Moon Society members with valid email addresses.

Board of Directors Moon Society Incorporated

• **President** Only one nomination was received
[ ] Gregory Bennett #1 (incumbent)

• **Treasurer** Only one nomination was received
[ ] Scotty Gammenthaler #393 (incumbent)

• **Board** Vote 1 - 7 beside each name
[ ] Gregory Bennett #1 (incumbent)
[ ] Randall Severy #125 (incumb. board chair)
[ ] Peter Kokh #239
[ ] Richard Perry #340
[ ] Scotty Gammenthaler #393 (incumbent)
[ ] Michael Mealling #579
[ ] Arthur Smith (#1031)

_____ _____
Voter's Signature Membership Number

STATEMENTS:

• **Gregory Bennett**

President (incumbent)

Board of Directors (incumbent)

I have served on the board of directors of the Moon Society and of Artemis Society International since these organizations were founded. The board of directors is responsible for establishing the policies of the Moon Society, which are carried out by its officers. I believe that I have had considerable influence over the Society's policies since it was founded, and have demonstrated sound judgement which has kept the Society from being taken over by the personal interests and social causes which have spelled the doom of so many space organizations before us. If I continue on the board, I intend to continue to argue for policies that promote steady, solid growth of the Society, establishing the foundations as we build, and resisting the incursion of personal interests and social causes which would lead the Society away from achieving its goals.

As president of the Society, I will continue application of the board's policies with an emphasis on outreach and establishing programs which further the Society's central goal of development of human settlements on the moon and the scientific study of the moon. We are nearing a cusp in the development of the Society where we may soon be able to establish meaningful research programs and renew our outreach and fund-raising efforts. We have invested considerable effort in laying out the ground work for these programs with an emphasis on meaningful development rather than ephemeral publicity stunts, and I want to continue them into the next term.

I have been active in the development and direction of the Society since its inception. I have worked long hours in our projects to reach out beyond the community of space fans to the general public, which I see as the only way that any space organization will be able to focus sufficient resources on our goals to achieve even a part of the daunting space development tasks ahead of us. A key qualification for both officers and board members in the Moon Society is the ability and willingness to participate in the meetings for these bodies. I have been available almost continuously on the meeting server and have always placed highest priority on keeping my commitment to participate in the scheduled and special meetings. My loyalty is not distracted by vested interest in a single project or other personal agendas, and I strive to give credit to the organization which is accomplishing the great work of the Moon Society.

• **Randall Severy** (incumbent chair of BOD), Board of Directors

In several leadership roles in Artemis Society International since late 1995, I have worked hard to help build the society into an effective world-wide organization. When the Moon Society was founded, I joined the board of the new organization to continue that effort. I also founded CyberTeams, one of the early program participants in the Artemis Project. To help other program participants get started and develop, I formed the Artemis Project Business Team. If re-elected to the Moon Society Board of Directors, I will continue to devote my time to growing the organization and supporting projects launched by the Moon Society.

• **Peter Kokh**, Board of Directors

I have been a member of the Society since the Spring of 1995. I have been editor of, and a principal contributor to Moon Miners Manifesto since its first issue in December, 1986 (this publication becoming the official newsletter of Artemis Society International in September, 1995 and of the Moon Society in August, 2000.

I am happy to be running for the Board of Directors without running against anyone. Both Greg Bennett and Scotty Gamenthaller, if reelected as officers but not as directors, would remain ex officio members of the Board; and that is how it should be. Their input is vital but they do not need to be reelected, as directors, to continue to play a role in Board deliberations. Open Board seats should therefore preferably go to non-officers to expand the leadership base of the Society.

I am a strong chapter person, and would work to make it easier to organize chapters and easier for chapters to get the materials they need to do public outreach on the vision and mission of the Society, and to do recruitment. This means that developing flyers, brochures, and instructions for easy-to-make displays and models should be a priority. It also means that we should have a chapter webring and other ways in which we can encourage one another and learn from one another, sharing lessons learned and expertise gained.

I believe that projects are the life of the Society, and the life of chapters. The Moon Society is small in numbers. That we seem to lack a critical mass should not deter us from launching ambitious projects. We simply have to choose our projects carefully, designing them to fit the organizing and management talent and energies available, but with publicity impact that will attract new members to an apparently vigorous outfit. In the age old dilemma, which comes first, the chicken or the egg? we must confidently play rooster and get the ball rolling. Some ambitious projects will definitely have to wait until we have a larger membership. But if we don't

find ambitious projects that we can manage with the talent and energy pool we now have, the game is over. We will only grow if we earn the attention and spark the excitement of prospective new members. Indeed, our membership has been declining. We have not been doing enough to make new members feel that they are in an outfit that has a future.

• **Richard Perry**, Board of Directors

Having been with the Artemis Society (now part of The Moon Society) since 1996, I have seen that organisation and the whole field of space advocacy change out of all recognition since that time.

There are still barriers to be removed, but we now have real space tourism, a supportive general public, industry and astronauts on our side, and the first signs of interest from general commerce.

To return to the Moon, this kind of progress has been long in coming, but comparatively swift considering the starting point. Now we need to take the Society forward whilst keeping it focussed on the goal of real colonisation as soon as commercially viable.

A small but significant part of that is the society spinoff company Transorbital Inc, which I have been working with for some time now to get us physically closer to the Moon off the back of our own efforts, by proxy, if not yet in person.

I have also worked with many members of the media in the production of items that have featured the Artemis Project, and look forward to doing the same for The Moon Society.

As a Director of The Moon Society, I would seek to continue to act in an ambassadorial role for the society in the UK or where ever I happen to be enjoying the opportunity to communicate what we are trying to achieve.

• **Scotty Gammenthaler** (incumbent), Board of Directors, Treasurer

As Treasurer of the Moon Society for the past two years, I have been responsible for collecting and depositing funds, paying bills, and preparation of financial statements. I also led the effort to obtain 501(c)(3) non-profit recognition from the IRS, and I developed most of the on-line membership registration system.

• **Michael Mealling**, Board of Directors

In order for the Moon Society to fully realize its goals it must develop programs and relationships that leverage market forces for developing a sustainable market driven economy both on the moon and for lunar produced goods and services. My focus on business practices, market surveys, business plans and actual market execution should help bring credibility and investment money into Moon Society participants and programs.

I am currently "putting my money where my mouth is" by starting up at least two companies: ExoAerospace, Inc and an as yet unnamed real estate investment company. The lessons I learn while starting these companies will be used to help Artemis participants and affiliates develop their own businesses.

• **Arthur Smith**, Board of Directors

We are few in number, but in my short experience with the Moon Society, extremely dedicated to our cause: development and human settlement of the Moon. We have had an influence beyond our numbers, the remarkable diversity of spin-off companies is just one example. As a board member I want to focus on identifying opportunities to maximize the effectiveness of our efforts and bring in more of those who want to help but haven't yet found a niche.

I see current opportunities in four areas. First communications: we already do a lot of this, through our online media, books and periodicals. But I think we could be more effective in bringing our message to a broader audience. Online message boards, scientific reports, written letters of support for our agenda to NASA and political leadership are areas where a small number of informed people can make a big difference by speaking out.

The second area is in research, and outreach: our physical presence in our local communities, working with schools, meetings and conferences, networking with other societies and those interested in space development. And actual projects either on a science fair scale or bigger (such as project Leto).

Third: finances. We have the charitable tax recognition status, so if our actions are seen as effective, we should be able to raise more money. Whether or not the membership grows, we will not accomplish what we want without significant growth in financial resources.

Fourth: business. Our vision of the future of the Moon is one of thriving commerce; in my view that will involve both new and old businesses, small and large. There are several large corporations in Japan that seem to have a vision of lunar development. How can we bring others, around the world, on board, bring the time scale forward, and stimulate healthy competition? I don't have answers, but I believe there are significant opportunities here.

There's a lot that can be done, and the Moon Society board should be involved in coordination and recognition of these activities. You can find out more about my recent space activities online:

http://www.lispace.org/ASMITH/

Remember: *If you move,* you must inform the Moon Society, *not MMM,* of your change in address!

The Moon is Back on the Radar Screen!

by Peter Kokh

Apparently, NASA officials were surprised and somewhat dismayed to learn of the National Research Council's recommendation of a robotic lunar sample return mission (to the floor of the South Pole -Aitken Basin [SPA] - see. page 4 this issue). But the arguments of planetary scientists who have been leaving an ISS/Shuttle fixated NASA in their brain-storming wake are persuasive.

If those interested in an SPA mission are able to put together a good Discovery Class Mission team and proposal, there is every reason to believe that NASA will feel constrained to appease them with a budget item request. Then, of course, it is up to the Administration and the Congress.

The planetary scientists, led by Mike Duke, a space geologist at the School of Mines in Golden, CO [see his abstract at http://solarsystem.estec.esa.nl/Moon2000/abs04_duke.PDF] and others interested in the geological mysteries of the formation of the Moon's cratered terrain are not alone in professing a strong interest in getting back to the Moon. Their are at least three other contingencies at work.

First there are those who rightly see the Moon in general, and the deep farside in particular, as *the* best location for the second generation of space telescopes after *Hubble*. More on this in a future MMM.

Natural allies of the above, are those who see the need for special dedicated telescopes on the Moon, especially infrared scopes, that can hunt out Earth-skirting astrobits that might come *too* close. The Moon, says the *Alliance to Rescue Civilization* [ARC], is our last best hope of survival. ARC leader is William E. Burrows. More at: www.popsci.com/popsci/aviation/article/0,12543,216204-9,00.html

Then there are ourselves and kindred spirits around the globe passionately interested in the open-ended settlement of the Moon and utilization of its resources both for the benefit of Earth and for their own prosperity. Echoing the sentiment of the Earth Defense contingency, they point out that should we fail to stop an incoming civilization-busting asteroid humanity would have a chance to live on and perhaps repopulate the Earth from an established enclave on the Moon.

Additional Reading:

• *Scientists, Dreamers Continue Refining Ideas for Future Lunar Bases* - By Leonard David, July 18, '02 http://www.space.com/missionlaunches/moonbase_return_020718.html

• *George Abbey: 'Moon Is A Stepping Stone', But NASA Falling Behind Technologically* Leonard David, July 19, '02 http://www.space.com/missionlaunches/abbey_houston_020719.html

More on the Proposed SPA Sample Return Mission [see article, page 4 this issue.]

History of Robotic Sample-Return Missions

1. **Luna 16** performed the first robotic sampling of the Moon in **1970** . It spent some 26 hours on the lunar surface, rocketing back to Earth fragments of Moon stuff for later analysis.
2. **Luna 20** followed in **1972** , soft-landing in a mountainous area known as the Apollonius highlands. It plopped down roughly 75-miles (120 kilometers) from the Luna 16 site. The probe drilled into the lunar terrain and transferred bits and pieces of the Moon into a sealed capsule. Capsule and contents blasted off the Moon and parachuted into the Soviet Union a few days later.
3. **Luna 24** in **1976** was the last in this Soviet series of Moon robots. It set down in Mare Crisium, also returning to Earth a small, but treasured load of lunar turf.

- **Nb.** The U.S. /NASA has had no experience with robotic sample return missions.

New Tecgnologies Needed for SPA Mission

- **Autopilot Moon landing** - Automated descent, hazard avoidance and precision landing gear
- **Advanced on-the-spot sampling**, maybe even drilling, age dating, chemical sensing sensors.
- **Return sample probe** (new to NASA, Russian collaboration?) - sample transfer into an ascent vehicle and Earth-return hardware.
- **Farside teleoperation** command & control via a relay satellite in suitable lunar orbit
- **Pricetag** of these new technologies **$$$???**

"The planetary program is moving from an era of flybys and orbital reconnaissance to an advanced era of surface exploration and sample returns. It is not only scientifically valuable, but logical that NASA should start with the Moon, and it's in our backyard." -- Wesley Huntress, Jr., Director of the Geophysical Laboratory at the Carnegie Institution of Washington, Washington, D.C.

In other words, the planetary program is now evolving to a higher plane of investigation in which it can no longer be said, with respect to the Moon, "Been there, Done that." -- PK

Additional Reading:

www.sciencemag.org/cgi/content/full/297/5580/317a (must be a paid subscriber to Science to access file)

The Biggest Hole in the Solar System. G. Jeffrey Taylor http://www.psrd.hawaii.edu/July98/spa.html

Meandering *through the Universe*

A Column on the Cooperative Movement on the Space Frontier © 2002 by Richard Richardson

Space as a Frontier

The general consensus seems to be that space is a frontier in the same manner that the western hemisphere and especially the land which became the United States was a frontier. Let's think about that for a minute. Who will be living there? Pat answer: malcontents, misfits, adventurers, the oppressed. Under what conditions? Pat answer: hardship, depravation, challenge, struggle, opportunity. What social elements? Pat answer: Loners, fugitives, rough necks, singles, families. Well, looking at the answers to the questions it seems obvious that space *is* going to be a frontier. And by "frontier" it is clear that it will be a frontier for human expansion from the very start. In fact, the ever growing number of families (as well as drifters, and just plain folk who love a challenge) who currently have permanent residences on the space station just goes to prove that space is a settlement frontier ... always has been, always will be!

Ooops, sorry, that was a low blow. *Now* doesn't count. The last 40+ years don't count. Everybody's plans for the for the foreseeable future don't count.

Oh, sorry again. That was another low blow.

I have observed that (just like every other grouping of humans in every other realm of activity and imagination) the space enthusiast community has a tendency to condemn (or when we're feeling generous, ignore) anyone who questions our "*if we cross our fingers and wish hard enough, it will come true*" attitude. It is true that there is somewhat less wishing and more actual doing now than in the past. But there is still a great deal of wishy washy thinking. The fact is, the future will come, one way or another. And it will bring with it one set of circumstances or another. Also, any particular person or group of people has — and only has — a certain limited ability to shape that future. Yet, careful analysis, planning and execution (i.e. *work*) goes a long way toward making a desired outcome a reality.

As space enthusiasts we have a fair consensus that the future we would like to see is one of permanent, fairly democratic, human communities flourishing in space. That means, families, freedom and opportunity in addition to single folk and all the dangers and hardships waiting for us. Oh, if only we ask the right questions and give ourselves the right answers we can inherit our dream future without lifting a finger — just like when the Apollo program led naturally to the permanent space stations and moonbases which were constructed in the 1970s and continue to flourish today. Ooops, there's another of those nasty illustrations of what hopes, dreams, and reliance on others gets us.

I would like to convey the notion that futures that haven't been carefully planned and diligently (and intelligently) worked for, seldom come to pass. I am also trying to posit that the more challenging the frontier, the less likely it can be permanently occupied — and even less likely settled — without a detailed social structure in place first. Extremely expensive and complicated futures like we hope for are just not going to happen without diligent, directed, determined effort — and not just on the technology front.

Some people can talk about space communities being company towns with the workers being rotated out (and back to Earth) on a few month to couple year basis and in the next breath talk about the same communities as being some worker utopia where birds sing, families smile together for all their long and happy lives, and Jedi knights keep all harm at bay. Unfortunately, the two are mutually exclusive. The company town scenario could come to pass without much involvement by space enthusiasts. The other won't happen ... period. But just because the workers' paradise/social nirvana dream is not realistic *Does not mean* that the offshore oil derrick/outpost scenario is the only possible future for space.

The United States approaches being "the land of the free and the home of the brave", but *only* because its founders didn't go dazedly after lotus dreams and they didn't just accept the seriously flawed future that was coming of its own accord — that is to say, by the decisions and actions of others. Their land frontier was *not* the same as ours. So don't be distracted by the fact that both 18th century North America and 21st century inner solar system space are frontiers. There are as many differences as similarities. And the differences play a far greater role in the pre- and early stages of settlement than the similarities do.

And yet, the greatest challenge then was the same as we face now: identifying the *real* problems, identifying the resources available to address the real problems, and utilizing those resources effectively. The greatest challenge then, turned out to *not be* a frontier of place nearly as much as a frontier of social organization. The same is true for the space enthusiast community today.

The frontier which eventually became the United States would have been assimilated anyway. What happened, though, that not only greatly sped up the process of settlement, but also changed the future of all the rest of the world, was that the visionaries in New England had a common goal (of independence). They realized that with a frontier they had a chance to implement a new paradigm of social organization. They probably didn't fully realize what they had started. Most of them had very mixed motives, far less pure than we would like to believe. However, those things don't much matter. They took their common goal, carefully formulated a detailed plan

(which was completely idealistic and unworkable — just ask any of the naysayers of the time) and risk everything to buck the social order of their day "in order to form a more perfect union".

Sure, it wasn't as simple as it sounds when one tries to describe it, and sure, they had to make some fairly major midcourse corrections and oodles of little corrections And there has definitely been a whole lot of evil in the history of the U.S. But even with all those caveats, a rational mind can see the truly monumental good that has come to humankind because the big wigs of mid 18th century New England didn't just advocate the opening, development, and settlement of the "new" frontier. Instead, they broke away from the status quo even though doing so subjected them to being mocked, reviled, persecuted, and even killed. They challenged the social frontier so that they might use the place frontier as a blank slate upon which to write a whole new chapter of humanity. They didn't need a "new order" (if you will) to enable frontier settlement. But their "new order" greatly enhanced the rate at which the frontier was settled.

We have several advantages over the powdered wig crowd. Our frontier of place is still free of permanent human occupation. To some extent, it does not yet have an old world/old ways owner whose rules and other interests, must take priority — no matter how harsh, arbitrary, or senseless. But our frontier of place is a much more challenging and dangerous natural environment than theirs. Our frontier of place won't just be slow to be settled without a carefully crafted social system in place. More likely, it will be very very slow to be developed and only after long long delays -- if we don't have our social "technology" developed, debugged, and deployed beforehand.

Our modern equivalents of the old empire-and-provinces status quo are the government scientific/military outpost and the international corporation remote resource extraction outpost (ala the mega oil corporation off shore derrick model). Neither is what we want and neither leads to what we want. If we are serious in what we say we want then what we must do is thrash out as clear an expression as possible of how exactly we want society to run in space and exactly how we think we can best make that society, step by step, concept by concept. And then we've got to start the legal processes, the business processes, and the educational processes to try to make it all come true. The founders of what became the United States didn't first work out the technological and economic issues of forging a new nation from a frontier and then create the social structure. They did need technology and especially finances to break free from the bonds of the old world and make a new world their home. But they realized that they had to be offering something that individuals and families with the every day concerns of normal individuals and families would consider worth living and working for. We are not there yet. Most of us know that we are working for something which only takes resources away from meeting our individual and familial needs and comforts. That is fine for a hobby where we sacrifice so little that there is no real impact on our budgets. But if we want to open space anytime soon we need to address the issues of the social frontier facing us, face the challenge of designing a society which offers enough reward to individuals and families to be worth sacrificing for, and take the risk of implementing it here on Earth, at least in a preliminary form. **<RRR>**

Richard's homepage:
http://richardpatricia.homestead.com

On Breaking the Silence

Randomized Breezes will do more than gently rustle leaves in the settlement's open spaces. Given random breezes, the pioneers should also be able to enjoy he lilting of windchimes of various kinds of construction (glass, ceramic, metal alloy, etc.).

Tom Heidel, *Milwaukee*

Radio Free Mars

From Rocky Persaud <rocky.persaud@utoronto.ca>

July 4, 2002 -- Good morning!

On this day, the anniversary of the Viking and Pathfinder Mars landings, the blue world's first news, entertainment and educational audio-streaming radio station dedicated to the red planet is now live. The first transmission is a recording of the Orson Welles' "War of the Worlds" broadcast from the 1930s, about an invasion from Mars. The recording is 57 minutes long, so will repeat aabout every hour until new content is added for transmission.

Radio Free Mars is being hosted from a temporary site, until another, faster server is approved (by the time you read this). In the future RFM will be accessible from radio-free-mars.org

For now, access RFM from the link at the top of the Mars Society of Canada home page at:
http://marssociety.ca

To listen from a PC you will need Winamp (which is freely downloadable), or compatible Mac software.

We will transmit audio from the Australian Mars Exploration Confer-ence (July 12-14) after we receive their recordings.

Enjoy **<RP>**

Sending RATs to Mars

From: Ron Baalke (baalke@zagami.jpl.nasa.gov)
http://mars.jpl.nasa.gov/spotlight/rat01.html
Jet Propulsion LaboratoryApril 29, 2002
[Abridged slightly by MMM]
[Thanks to Ben Huset, MNSFS, for the “heads up”]

NASA and JPL are sending RATS to Mars to work as field geologists. Not quite our furry little friends, but rather a high-tech robot with diamond teeth, called a Rock Abrasion Tool (RAT). One RAT will ride on each of the two Mars Exploration Rovers, launching to Mars in summer 2003. These RATS will allow humans to remotely "crack open" rocks on Mars for the first time in the history of Mars exploration.

"... exciting, but ... a little intimidating ... no one has ever tried to get into a rock on Mars before," says Stephen Gorevan (chairman of Honeybee, the small robotics contractor for the Rock Abrasion Tool a mile away from ground zero in NYC.) Past Mars missions to the surface had different science and technology objectives. " The Viking landers in the 70's scooped up dirt on Mars and the Sojourner rover proved we could move around in ‘97." Digging into a rock is the next step for the maturing Marsprogram.

Bringing a rock back from Mars or sending a human geologist [is] prohibitive, so sending the RAT is the next best thing. The tool will enable scientists to peer inside a rock to analyze unweathered minerals and learn about the rock’s origins. Rick Paynter, deputy lead Quality Assurance on the Mars Exploration Rover project at JPL, explains that the RAT will help "peel off the orange rind" and reveal new information about the evolution of Mars. It’ll also help compare rocks on Mars to rocks on Earth.

The Exploration Rover will look for an interesting rock, nuzzle up to it, and maneuver its robotic arm to press the RAT up against the rock. The RAT, the size of a soda can, will shave away the top layers of the rock. That process may take anywhere from 30 minutes to three hours to remove a round hole about 45 mm (1.5 inches) in diameter and 5 mm (1/8th inch) deep, depending on the texture of the rock.

It's more like an electric shaver than a drill, says Steve Kondos, contract technical manager at JPL . "The difference is, the shaver heads move in and out rather than being stationary - this takes less power. Power, energy, and mass are precious on the rover, so in order to be efficient, we shave the rock rather than drill it, which is power intensive."

The RAT Brushes Its Teeth -- After the RAT shaves off part of a rock, it scurries aside via a Dr. Seuss-like arm device, which also holds a camera and chemical analysis tools to explore the newly exposed rock layers. Before it goes to grind another rock, it turns around and brushes its "teeth" against a RAT brush that acts like a shoe polisher as the RAT "teeth" spin against it to clear out leftover rock. The RAT is designed to grind away one rock, but could shave up to as many as 10 rocks.

The RAT With the Right Stuff -The RAT must prove it has the right stuff before it can launch. The Rock Abrasion Tool is the brainchild of Mars Exploration Rover Principal Investigator , Steve Squyres, Cornell U., Ithaca, NY, who thought of the need to expose a rock on Mars.

After winning the competitive instrument contract, the Honeybee team has had to follow strict size, mass, and pressure requirements dictated by the strength limitations of the robotic arm. The team had to use its ingenuity to come up with the optimum way to provide a mini crater in a martian rock. Gorevan says, "We cobbled and cogitated together to test ideas, and we're at about point W on the way to Z."

In April, Steve Kondos and Rick Paynter from JPL hand-delivered to Honeybee the motors that run the RATS. "We're conservative at JPL. The value of the instrument far exceeds the cost," says Paynter. "We split the motors and carried them in different pieces of luggage and took separate planes to NYC."

Now that JPL delivered the motors, "we have a clear path to finish our environmental tests and 'shake and bake' the RAT." "Shake and bake" is a process used by engineers to ensure that instruments can withstand the intense vibrations and heat of launch, the extraordinary impact of landing on Mars, and the strong radiation exposure during interplanetary cruise. Other challenges still remain. "One surprise has been to find how much dust is created by the RAT," explains Gorevan at Honeybee. As the robot grinds away at a rock, it generates dust plumes andleaves RAT "droppings" that can blow onto the solar arrays of the rovers or the cameras.

"Honeybee's claim to fame in NYC is a long way from its new role with Mars - they created the giant moving parts on the Coca-Cola sign in Time Square," says Rick Paynter from JPL. Steve Kondos from JPL calls the RAT people at Honeybee ingenious. "They are concerned with cost and schedule milestones, and best of all, they are fun to be with. Since we come from LA, the Honeybee team introduces us to little known spots, like a deli where the bread is so good that Frank Sinatra used to have loaves shipped from Manhattan to Hollywood every week."

New York, 9/11, and Mars

"After September 11 happened, the first thought was how the team at Honeybee was affected", explains Kondos. "We called immediately, but of course couldn't get in contact with them." Luckily, no one on the team was hurt.

NASA HQ just approved putting an American flag on the rock shield of the Rock Abrasion Tool. "It's not the equivalent of placing the American flag in the rubble pile, but it's something like that." Kondos adds, "We're not stopping our progress and hiding, we're rising to the stars." **<NASA/MMM>**

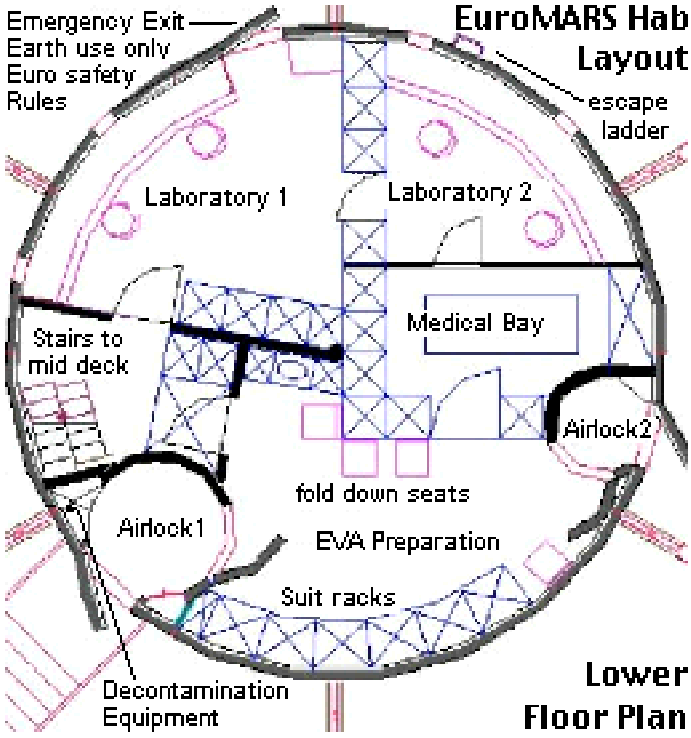
3rd Mars Analog Station, a tad Wider/Taller Gets "Attic-Loft" & Improved Layout

Euro-MARS Design [slightly abridged for MMM]

The Euro-MARS habitat unit is now in the design phase, a cross-European team working with the support of the United States to develop a habitat unit that will provide our science teams with an outstanding analogue station.

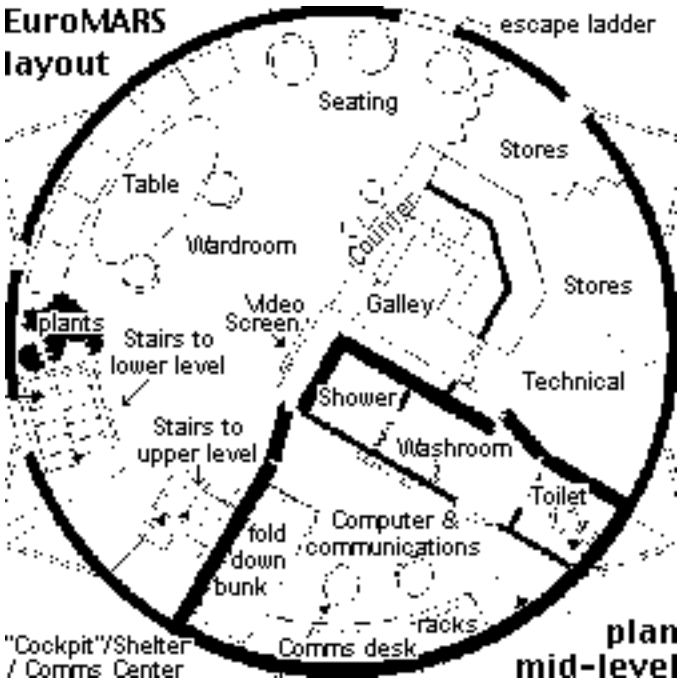
Following a design meeting held in Frankfurt in March 2002, a final 3-deck design for the Euro-MARS was agreed upon. The design will comprise:

a Lower deck: containing a large split-laboratory / work area for field science, plus the main EVA preparation / decontamination area that connects to the two airlocks. Both airlocks will be large enough to rotate teams of 2 or 3 at a time. This deck will also incorporate an emergency exit built in to one wall panel that will allow egress directly to the outside world to meet European safety standards in the event of an emergency. A yachting ladder will connect this deck to the mid-deck.



www.euromars.org/images/design/lower_current.jpg

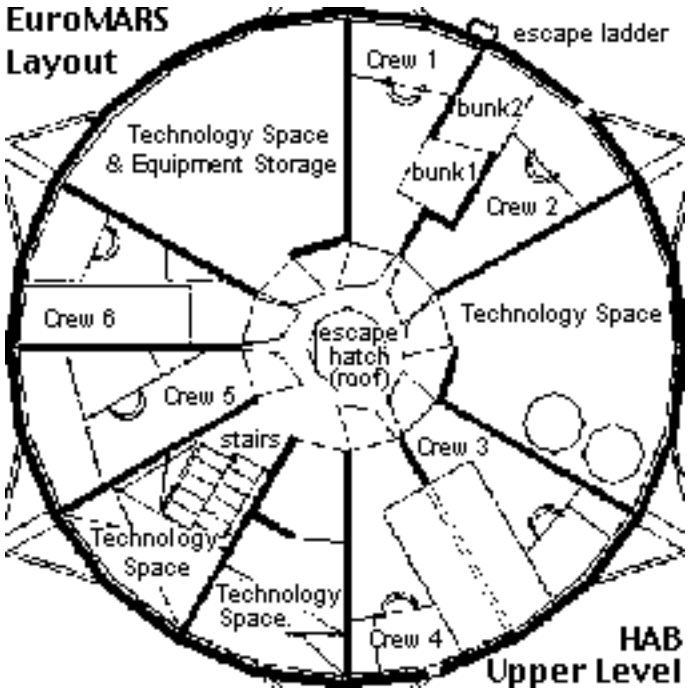
A Mid-deck: which will contain the main living / working environs. A large living / communal area will connect directly with a hygiene centre, galley and a "storm shelter / communications centre". Two large diameter (35-50cm) windows will provide natural light into the living area, supported by two smaller diameter windows. The "storm shelter" will house the primary communications systems, habitat computer systems and have enough room to providing seating for the crew during simulated solar flares. A second yachting ladder will connect this level with the upper deck.



www.euromars.org/images/design/mid_current.jpg

An Upper Deck will house crew sleeping quarters, in 3 paired groups of cabins, each with a different lay-out (position of bed, position of personal workspace, etc.), for greater human factors research into living / sleeping facilities. This deck will also include a 2nd toilet (safety/convenience), plus an emergency egress hatch to the roof, with a steel roll-up escape ladder bolted to it for escape purposes. This hatch will also provide access to any satellite communications antennae that may be located on the roof of the hab.

Work is underway to developed detailed plans for each of the major sections within the hab (EVA preparation room, science labs, living area, cockpit)



www.euromars.org/images/design/upper_current.jpg

EuroMARS Station headed for Iceland

http://www.euromars.org/location.htm

Its preview season on Chicago's Adler Planetarium Lake Michigan shore grounds ending Sept. 2nd, the EuroMAR.S structure will be disassembled and shipped to Iceland. There it will be put together again, this time fully outfitted, just in time for the Spring 2003 season at a location in the **Myvatn** area about 40 mi/60 km ESE of **Akuyeri**, Iceland's oldest (1,000 years) and second largest city (c. 15,000), a busy fishing port on a north coast fjord.

Learn a little about **ICELAND - Visit:**
http://www.icelandnaturally.com/index.shtml

MAP (showing Akuyeri and Myvatn)
http://www.lonelyplanet.com/
mapshells/europe/iceland/iceland.htm

Euro-MARS Site-Selection Criteria

- Represent a reasonable Mars analogue location – largely devoid of vegetation, relatively dry, physical features that resemble the surface of Mars
- Present the opportunities to carry out a range of sciences including:
  - Biology / the search for extremophile life forms
  - Geology and comparative Earth / Mars geological studies
  - Chemistry (soil, water, etc.)
  - Sub-surface studies
- Reasonably remote to give a sense of isolation as it might be felt on Mars, discouraging casual visitors
- Provide the opportunities for away-from-base EVAs and excursions.

The Krafla/Myvatn volcanic area of NE Iceland offers a very Mars-like terrain, together with geological features similar to those already seen on Mars. The area is also the home to a range of extremophile life of the kinds that may be encountered on Mars.

Besides its scientific relevance, the site is photogenic and particularly well suited to television reportage and other media coverage. ♂

The Lunar Reclamation Society, Inc.

PO Box 2102
Milwaukee
WI 53201

www.lunar-reclamation.org

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

LRS OFFICERS (area code 414) unless specified

LRS PRESIDENT, MMM/MMR Editor - Peter Kokh* <kokhmmm@aol.com> 342-0705
VICE-PRES/TREAS. - Robert Bialecki* .. 372-9613
SECRETARY. - Charlotte DuPree <cmdupree@netwurx.net> .... [262] 677-9149
MMM Database Manager - Joe Mackowski <jmackowski@execpc.com> 546-9520
LRS/MMM Business Manager - Mark Kaehny* <kaehny@execpc.com> ..... [262] 424-3073
(* LRS Board Members)

LRS NEWS

• **Our Field trip to "M.A.R.S." - in Chicago:** Five of us, Carol Nelson, Gene and Charlotte Dupree, Doug Armstrong, and Peter Kokh, made the field trip to Adler planetarium to see the "EuroMARS" analog habitat station on display, prior to its permanent placement in Iceland next year. Scott Davis of the Wisconsin Mars Society joined us for the trip. At the site we met Matt Lowry of the Chicago North Shore Mars Society chapter who gave us our guided tour. One of our "Gravity Bricks" sets was part of the display. Inside Adler we met Larry Ahearn, Jeffrey Liss, and Geri Haracz of the Chicago NSS chapter.

It was an enjoyable field trip, yet somewhat disappointing - see the page one editorial this issue.

LRS SEPTEMBER/OCTOBER Events

Saturday, SEP 14th & OCT 12th, 1-4 pm

LRS Chapter Meeting, Mayfair Mall, Garden Suites **Room G11** (lower level, NE part of Mall) near the ground-level entrance below General Cinemas.

SEPTEMBER AGENDA: • Review of improving chapter finances in the aftermath of rigorous accounting reforms and monthly reviews of the MMM mailing list. • Space News reports: Space Station, Shuttle, Moon, Mars, Asteroids, Space Tourism. • Discussion of possible outreach event opportunities on the horizon and of a "fresh blood" recruiting effort. • Show & Tell: recently redesigned "Gravity Bricks."

U.S. CHAPTERS

NSS
Chapter Events
MMM
7 Chapters Strong

Space Chapters HUB Website:

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

The National Space Society's vision is people living and working in thriving communities beyond Earth. NSS members promote change in social, technical, economic, and political conditions to advance the day when people will live and work in space.

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

NEW >>> http://www.tcei.com/sss

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

AUG 19th MEETING at the Stoelting House in **Kiel**
SEP 16th Foerster Hall of Dance, **Sheboygan**
OCT 21st MEETING at the Stoelting House in **Kiel**

MINNESOTA

Minnesota Space Frontier Society

c/o Dave Buth, 5120 Ewing Avenue North, Brooklyn Center, MN 55429

Dave Buth (w) (612) 333-1872, (h) (763) 536-1237
612-375-1539 (Jeff Root)

Email: mnsfs@freemars.org

www.FreeMars.org/l5/index.html

Next Meeting -- No info as of press time: **Radio City Inc. 2663 County Road I**, Mounds View, Mn. 55122 (763) 786-4475 -- back meeting room. It's north of I694 just off of County 10, between Long Lake and Silver Lake Road, not Hwy. 10, close by, which runs along I-35W. You must be on *County* 10. For more directions or to add to Agenda call: (612) 333-1872

CALIFORNIA

OASIS

OASIS: Organization for the **A**dvancement of **S**pace **I**ndustrialization and **S**ettlement

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

> Regular Meeting 3 pm 3rd Sat. each month

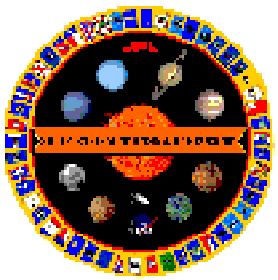
Information: OASIS Hotline, 310/364-2290; website.

SEP 16th -- Business Meeting at location TBD
OCT 20th -- Business Meeting at location TBD

Recurring Events

- **The Griffith Observatory** is undergoing renovations and upgrades to reopen in 2003.
- **Fridays, 7 pm** "Night Sky Show." -- **8 pm** Guest lectures. Santa Monica College John Drescher Planetarium, 2nd Floor Technology Bldg, 1900 Pico Blvd. $4 per show or $7 for both. 310/452-9223 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. Info: www.hour25online.com/.

SOLAR SYSTEM AMBASSADORS



Michelle Baker
Princeton/Philadelphia
chaos@cybernet.net

Bill Higgins
Chicago, IL
higgins@final.gov

Harold Schenk
Sheboygan, WI
hschenk@excel.net

Bill Hensley
Kenosha, WI
hensley@acronet.net

www.jpl.nasa.gov/ambassador

Moving? MMM is mailed by second class bulk mail and will not be forwarded. Notifying the Post Office is not enough. **You must notify** the society / chapter through which you have your subscription.

OREGON

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 **3rd Sat.** each month at **2 p.m.**
Bourne Plaza, 1441 SE 122nd, Portland,
downstairs NEXT MEETINGS: **SEP 16, OCT 20**

ORL5 Paper Accepted -- July 18, 2002 -- We are pleased to announce acceptance of our paper, "Mare Orientale Prime Meridian Lunar Coordinate System" (Walden, York, McGown, & Billings) by the World Space Congress held this October in Houston TX (see letter below). As a poster presentation, it will be on display for the run of the conference, and so, accessible to the maximum number of people.

I have also received an invitation, sent to me at the Oregon L5 address, to "join the National Space Society Governors and Directors for a by-invitation-only Leadership Symposium and Dinner" at the Houston Hyatt during WSC!

We also (finally!) received our copies of the omnibus "Proceedings" volume of Space 2002 and Robotics 2002, with our full five papers published. See the ASCE website for purchase information ($89 + $4 shipping /cough!/):
http://www.pubs.asce.org/BOOKdisplay.cgi?9991350

Our papers are also available on our website.

Click on the "Space exploration" keyword on the above page for prior-year Proceedings. We had one paper published in the Space 2000 Proceedings, "Lunar Lavatube Base Construction" by Billings, Walden & York ($105 + $4, does not include Robotics 2000, available separatly). These volumes and others in the series are available for research/reading at the Oregon L5 office. For reasons that should now be obvious, they are not permitted to leave the office! We have not yet received our office copy of the 2002 volume, but we expect it soon; contact myself, Cheryl York, or Tom Billings to see their personal copies.

It will be expensive to register for the World Space Conference and for food, travel, and housing, yet now we are expected to attend. Much leading-edge research will be discussed and potentially valuable contacts will be made. Tax-deductible donations are welcome, to "Oregon L5 Society - Oregon Moonbase Fund," and can be specifically earmarked to "Research conference and travel expenses" or left as a general donation to our work.

Bryce Walden

PENNSYLVANIA

Philadelphia Area Space Alliance

PO Box 1715, Philadelphia, PA 19105
c/o Earl Bennett, EarlBennett@erols.com
215/633-0878 (H), 610/640-2345(W)

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 17th street side and go *left*. Look for table sign. Parking at Liberty One on 17th St.
- **Scheduled PASA activities:** Regular monthly meetings ***Sunday*, August 18th** - *location TBD (see note below)*, and **Sat., Sept. 21st.** Call Earl Bennett or Mitch Gordon 215-625-0670 to verify all meetings from Earl Bennet <EarlBennett@erols.com>
- **There was no meeting in July**

OHIO

Cuyahoga 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 each month
7-9:15 pm, Parma Regional Library
NEXT MEETING DATES: **AUG 22, SEP 26, OCT 24**

June Meeting Report -- We met at the Madison branch of the Lakewood Public Library. George highlighted the Denver ISDC 2002 conference, a smaller event but with new faces. He also displayed the chapter's new National Space Society banner -- something professional looking to dress up future information tables.

Brian circulated several space articles from *Popular Mechanics*. Bob and Joe discussed the causes and resurrection of the *Iridium* project. Steven showed pictures of his telescope. Lou talked about astronomy, Ron Leeseburg's *Star Geezer What's Up?* email newsletter in particular. Charlie demonstrated the retrograde motion of Mars. We adjourned to the nearby space-theme restaurant *Capsule*.

NAME _____ ÷

STREET _____ ÷

CITY/ST/ZIP _____ ÷

PHONE #S _____ ÷

○ $35 **NATIONAL SPACE SOC.** dues + **Ad Astra**
○ $20 NSS dues if under 22 / over 64. *State age* ___
600 Pennsylvania Ave SE #201, Washington DC 20003

Join **The Moon Society** - dues address on page 9

- **For members residing in the U.S & Canada:**
  Printed **MMM** delivered by postal mail: **$35**
  Electronic (pdf) **MMM** available on website: **$35**
- **For members residing in other locations:**
  Printed **MMM** delivered by postal mail: **$60**
  Electronic (pdf) **MMM** available on website: **$35**

INDEX to # 157 AUG. 2002

p 1. IN FOCUS: Euro-M.A.R.S. Hab Exhibit in Chicago misses Golden Opportunity, Edit'l, P. Kokh
p 3. Lance Bass gets OK; Interplanetary Internet to Debut
p 4. Planetary Scientists' Renewed interest in Moon. Kokh
p 5. PORCHES ON THE MOON?, P. Kokh
p 7. Cobalt Blue & Other Substances from Lunar Regolith, Dave Dietzler
p 8. Stereochromie / Pre-History of Lunar Waterglass Paints
p 9. MOON SOCIETY JOURNAL™ Moon Soc. Election Ballot
p 10. TMS Candidate Statements
p 12. Moon Back on Radar Screen; More on SPA Mission
p 13. Meandering Through the Universe, R. Richardson
p 14. MMM Mail; Radio Free Mars p 15. RATs to Mars
p 16. EuroMARS' Improved Layout p. 17 Iceland Location
p 17. LRS. News p 18. News of NSS/MMM Chapters

Member Dues -- MMM/MMR Subscriptions:
Send proper dues to address in chapter news section

=>*for those outside participating chapter areas* <=
○ $18 **Individual Subscriptions to MMM/MMR:**
Outside North America ○ $50 Surface Mail --
Payable to "LRS", PO Box 2102, Milwaukee WI 53201

LUNAR RECLAMATION SOC. (NSS-Milwaukee)
○ $18 reg. ○ $24 family ○ $15 student/senior

CUYAHOGA VALLEY SPACE SOC. (Cleveland, OH)
○ $15

CHICAGO SPACE FRONTIER L5
○ $15 annual dues

MINNESOTA SPACE FRONTIER SOCIETY
○ $20 Regular Dues

OREGON L5 SOCIETY
○ $25 for all members

O.A.S.I.S. L5 (Los Angeles)
○ $18 regular dues

PHILADELPHIA AREA SPACE ALLIANCE
○ Annual dues for all with MMM $20, due in March or $ times each quarter before the next March

SHEBOYGAN SPACE SOCIETY (WI)
○ $15 reg., ○ $10 stdnt, ○ $1/extra family memb "SSS" c/o B. P. Knier, 22608 County Line Rd, Elkhart Lake WI 53020

Moon Miners' MANIFESTO

Lunar **R**eclamation **S**ociety Inc.
PO Box 2102, Milwaukee WI 53201-2102.

==> *Mail Carrier, Time Sensitive Material* <==

Non-Profit Org.
U.S. Postage Paid
Milwaukee, WI
Permit No. 3532