"Expanding the Human Economy through Off-Planet Resources"

Moon Miners' Manifesto

& Moon Society Journal

#152 February 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 ISS "non-severable, integral part of NASA's capacity" - O'Keefe

[Source: Media Briefing by NASA Administrator Sean O'Keefe, at Dryden Flight Research Center, 1/31/'02 - *via Jim Spellman - NSS Western Spaceport Chapter*]

O'Keefe began with the announcement of the nomination as NASA Deputy Administrator of Major General Charles Bolden, US Marine Corps, a veteran astronaut of five missions, commander of two, including first mission onto Mir. This is an indicator of the central importance the Bush Administration places on the Manned Spaceflight Program.

In response to a question about NASA budget overruns on the International Space Station and ISS's future:

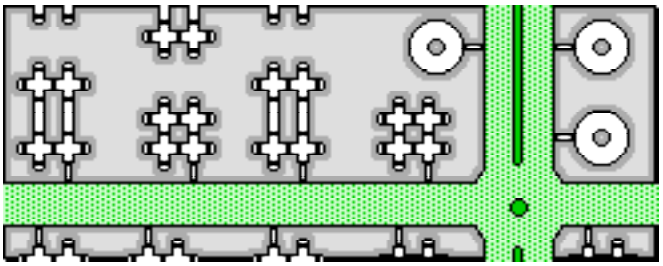
> "The most, poignant ... observation is [that] this [ISS] isn't a severable program, ... It is inextricably linked to a lot of things we do, throughout this entire agency. [But] it is, ... nothing more than a means to an end. It's a capacity, a capabi-lity to do things that we couldn't do in this ... atmosphere [on] Earth. ... So, ... in my mind it [ISS] is not ... a program that lays off to the side for which we all must figure out how to deal with it -- [The Space Station] is inextricably linked to all kinds of other things that we do ...
>
> "And frankly, ... there [are] certainly some challenges ahead, and there are going to be trade-offs we require, and we're going to have some tough choices to make, in terms of how we pursue this program, ... and this capability in a way that is most responsible, I'm driven by two factors: first one is we have an obligation to three people that are in orbit right now ... I think that's our first obligation. The second one, I think is to make sure that we utilize that capacity in a way that is most responsible and most synergistic with all the other things we do throughout NASA. ... and in doing that, it isn't about a tradeoff, it then becomes a case of making choices about ... how we utilize that capability."

These words will give little comfort to those circling vultures who have been salivating with glee in the belief that NASA's ISS Program cost overruns might finally spell the end of a program that they find spurious to NASA's mission which they see as robotic planetary exploration - only. Clearly, the Bush Administration does not share their view.

The new Administrator sent a clear signal that he is not on the job to slash and burn, but to justify and proceed accordingly. [=> p. 2, col. 2]

The "Middoors" as key Biosphere Component

In a modular settlement, allowed to grow as need be (not a fixed size megastructure based on someone's guesstimate of future needs), modular habitats and other structures are connected to pressurized residential/commercial "streets." These "commons" will contain the bulk of the settlement's biomass and biosphere. See "Being able to go Outside" 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.

O'Keefe on ISS Core & Crew Size:

Then Jim Spellman, KGET-TV17 News (& Pres. NSS/Western Spaceport) asked this key question:

> "As a followup to that, are you actually prepared at this time to commit to completion of ISS -- as per our International agreements with our other foreign ... partners -- which means a crew compliment beyond the three right now as far as Core Completion?"

O'Keefe:

> "Well, certainly we are committed to Core Complete ... which is the essence of what we have in place right now ... and to be improved upon here in the time ahead. We're about, oh, 90-95% complete on the Core Complete initiatives. The hard part's coming, which is the integration of all the modules.
>
> "the International agreements ... require ... and what we've signed up to, is a collaboration among 16 nations. And folks who are ... driven also by the science and technology, in general.
>
> "So the first thing I thing we need to do to [determine] what the size or capacity needs to be, is to make sure we're selective and prioritized about the size and technology in general; to be sure that what we send them up there to do *isn't just driven by some artificial number of folks who we want to accommodate, or that we want to have be there for some symbolic purpose.* So instead for what you need to have your expertise employed for those objectives.
>
> So, part of what I think our responsibility to be able to do is to minimize the amount of effort that astronauts have to put through on a range of different experiments and so forth, so that they can tend to the important mission that requires a human in spaceflight, as opposed to monitoring a lab rats, okay? And to minimize those kind of cases, because what we can get out of that may not need their, their direct uh, touch to it. So, I think that's something that will evolve, and *if there is a need to expand, that capability, it's something that we'll pursue once we get the Core Complete and the fundamentals right. ...*"

In our opinion, this seems to be a reasonable decision to rethink the whole ISS crewing rationale. What we stand to gain is not a crippled, truncated operation, but a more efficient use of precious and expensive manpower and, in the end, more science and research for the bucks. *Indeed, it could well be decided that we need a crew of more than seven!*

This kind of "mission definition" rethinking is on the same track as the mission rethinking that has lead to more than a tenfold cost reduction in the expected cost of a manned landing on Mars. If we go *efficiently,* we will go farther! - PK

Homes "at home" on the Moon:
Thermally Self-Regulating Lunar Habitats with Backup Off-Grid Power Systems

by Peter Kokh

Impossible? We will feel more "at home" on the Moon if our homesteads are designed to *play the lunar thermal cycles* so as not to depend totally on any outside heating or cooling inputs. A power grid may be essential, but power grids fail. On Earth this is a matter of inconvenience: bundling up if it's cold, meat spoilage if it's hot. On the Moon a temporary power plant outage could be a death sentence for many, if not all, if there are no back up systems. And building a modular back-up capacity into each unit will certainly provide the best security of all.

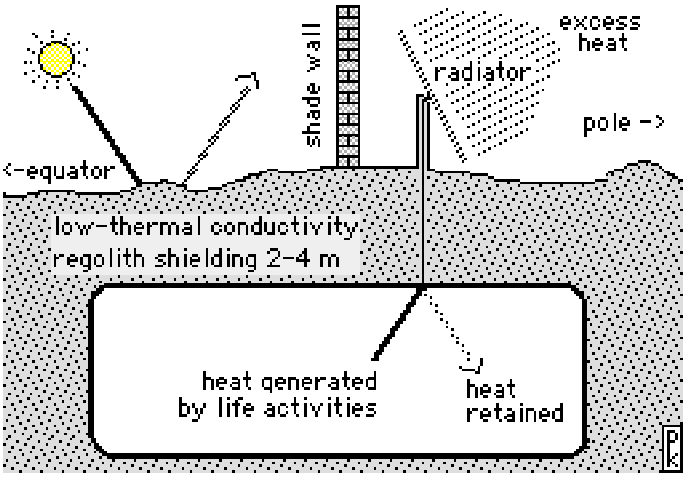
We are talking about thermal equilibrium as well as electric power generating capacity. This goal is not something new. There are a small but growing number of homes in theis country whose architecture and construction materials attempt to achieve an analogous "environmentally tuned" balance, first as to thermal management, second with respect to off-grid power generation capacity. On the Moon, this may well be a goal that will not be achieved without a an even greater amount of trial and error experimentation. The time to begin brainstorming is now, however, as our security and survivability will be tenuous and fragile from the gitgo -- until we can start building in this fashion as a matter of habit. The reward will not only be safer settlements but the feasibility of small isolated rural outposts wherever they are needed -- *and they will be needed!*

Thermal Storage Systems

Paper studies of possible thermal storage systems can help to get a first read on the merits of competing approaches, the comparative difficulty of installation and the engineering and technical challenges of each. On Earth, architects and builders have come up with a variety of passive and active systems. Some of these *may* suggest analogus solutions that will prove workable on the Moon. Other solutions will prove to be uniquely terrestrial. But we should not limit our brainstorming to the exploration of the adaptability of schemes we have tried here. It would be rather surprising if we did not find some uniquely lunar solutions.

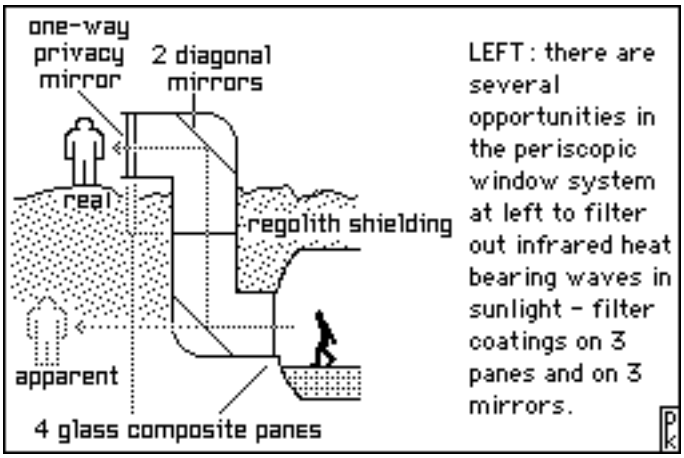
But to prime the reader's imagination, here are *some* of the more common thermal management techniques tried on Earth:

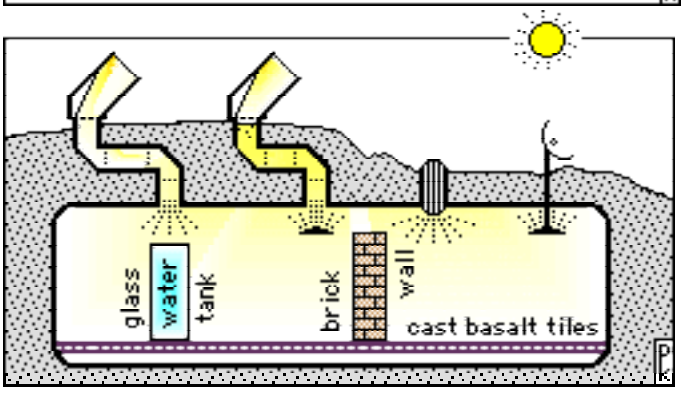
- **super-insulation** to keep out both excess cold and excess heat. On the Moon, that may not be enough, even if the stress of more extreme dayspan heat and nightspan cold is met. Daily living activities may produce a net heat excess that must be radiated to space to prevent steady heat build-up. Super-insulation *with radiators* are one approach



ABOVE: regolith shielding acts both to keep solar heat out of the habitat, and to keep heat generated by life activities within, Excess heat buildup is handled by shaded radiators shedding heat to the black cold sky.

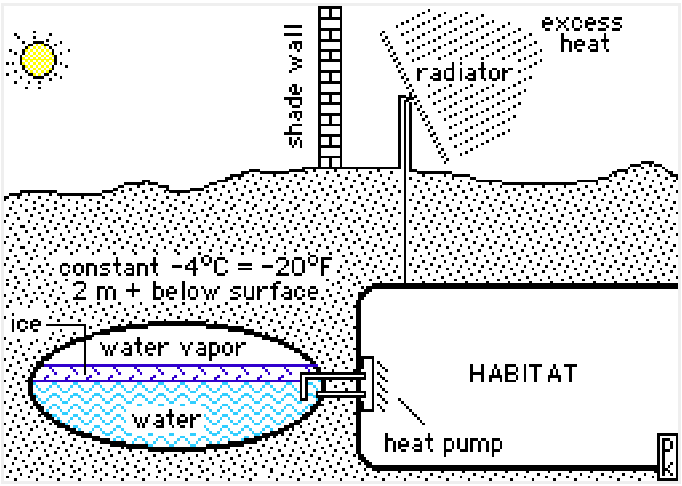
- **passive solar** - allowing some solar heat to enter during the dayspan through periscopic windows and sunpipes that filter out most infrared wavelenthts. This heat could be stored in massive reservoirs (cast basalt floor tiles, concrete hull, massive interior walls, water reservoirs etc.) for use during nightspan. A radiator system would still be needed to handle any net excess.





SHOWN: Controlled Passive Solar Inputs (heliostats and sunpipes with two types of light diffusers) and Thermal Storage Systems to radiate stored excess heat back into the habitat space in nightspan (massive floors, massive walls, and water reservoirs).

- **active systems using water reservoirs** to store cold as ice. Water is an ideal heat storage medium in itself, the more so because we will need to have an ample amount of it for biospheric stability. A water reservoir, connected to the homestead but exterior to it and insulated from the sun by two meters of more of soil, may be part of the solution. To shed excess heat, radiators may be needed. Want more of a challenge? Integrate semi-autonomous point source pre-treatment of waste waters.



- **active systems: magma-based.** If nightspan heating proves to be a greater problem than heat build-up, one system that could provide nightspan heat and power too, would use excess solar power capacity to melt regolith during dayspan, store it in a refractive alumina-lined cavity underground, and tap its heat (steam-powered generator) during nightspan. David Dunlop came up with this idea, and it may be more realistic for a neighborhood-scale habitat-cluster impletmentation.

Translating systems that work on Earth to something that will work on the Moon

We have but a layman's knowledge of thermal management engineering issues. Our purpose is to encourage those *with the expertise and terrestrial thermal management experience* to brainstorm how we might engineer stand-alone self-regulating lunar habitat spaces attune to the lunar dayspan/nightspan rhythm that will function autonomously and worry-free off-grid, should there be a power interruption.

Not all of the great variety ofschemes that have been tried on Earth with some success will successfully translate to unique lunar situations. But they are a starting point for brainstorming and we offer these ideas not to close discussion and experimentation but rather to begin it.

Electric Power Generation: Cluster or Neighborhood Solutions:

In search of safety and security, we should look not only at individual pressurized structures but at the structure of the utility grids themselves. Centralization concentrates risk. A decentralized "cellular" grid structure with a "neighborhood by neighborhood" approach has advantagess. By decentralizing power generation, building modular power generation plants so that each serves a cluster of pressurized structures or neighborhood, we provide a great deal of redundancy and resiliency. The fruit will be greatly increased "at home" peace of mind.

Whatever tricks we can master to maintain thermal equilibrium ought to include power generation survival systems that can operate off-grid for an appreciable amount of time, if not indefinitely. There are plenty of risks to pioneering the Moon. We need to minimize them, not increase them by over-dependence on centralized utilities that should be used to go beyond the minimum, not to provide it.

Off-Grid Electric Power Generation

If and when architects and structural systems engineers come up with plans that works to minimize the need for grid power to maintain a livable interior temperature range, we'll still need to address the question of providing autonomous off grid power systems for lunar homesteads for back-up insurance and safety for other electric uses besides heating and cooling -- communications, refrigeration, food preparation, etc. Every pioneer home should be able to operate *as if it were a small isolated rural outpost.*

Each habitat or pressurized space should have solar power panels of some type. These could be sized to provide a more than minimum power needed during dayspan -- enough extra to electrolyze waste water (thus recycling it at the same time) to run fuel cells for nighttime power *and fresh water*. This equipment should be a standard part of any habitat electrical system and a requisite for grid hook-up.

Minimizing the problem: Dayspan and Nightspan in the home

Even while the settlement power plants and grid are operating normally, pioneers may get in the habit of living at a different pace in the alternating two week long stretches of abundant sunshine and unbroken night. Even with a nuclear power plant, there will still be more energy available in dayspan when solar panels and concentrators are also at work. Production operations will concentrate on power-intensive tasks during dayspan, leaving manpower-intensive tasks for night, when and where feasible.

Within their homes, on their own time, it will make sense for Lunans to organize their household chores in like fashion, again where feasible. These go-with-the-flow practices and habits will provide extra resiliency in case of a grid power emergency, putting less strain on domestic backup systems.

The Reward -- In preparation and resiliency lies security, *and a sense of being "at home".* **<MMM>**

Reading from MMM Back Issues

#7 JUL '87, "POWERCO"
#43 MAR '91, pp. 5-6 "SUNTH Dayspan, Nightspan"

Being "at Home" is Completed by Being able to go "Outside"

by Peter Kokh

No matter how cozy the home, if you are a virtual prisoner inside, your sense of being "at home" will be most uncomfortably limited. But "outside" on the Moon means out on the vacuum-soaked, radiation-washed surface -- or does it?

The Concept of the "Middoors"

[A synopsis from past MMM articles. See list at end.]

Thanks to the appearance in recent decades of enclosed climate-controlled shopping malls, the idea of something in-between the indoors and outdoors (a distinciton as old as man) is now familiar to most of us. The "middoors" [i.e. between the doors of homes, offices, shops and the doors to the natural outdoors] is also prefigured in the landscaped, sunlit atriums in new hotels, office buildings and even cruise ships.

The beachhead science outpost will be simply a pressurized indoors up against the out-locks vacuum, the "out-vac". Whether in a government outpost or in an early company mining town, the construction of the first spacious atrium solarium garden will introduce a new kind of space - a space external to individual quarters, lab modules, and other work- and function-dedicated pressurized places, yet still keeping out the life-quenching vacuum beyond the air-locks and the docking ports. What we have called the "midoors" will be born.

From this humble beginning, airy, spacious, verdant middoor spaces will grow to eventually host the greater part of the settlement's atmosphere and biomass. And with it, the hoped for "biospheric flywheel" will become much more of a reality.

It is within such spaces that longer, wider sight lines will appear, offering postcard views and vistas, to dull the edge of early day claustrophobia. The settlement will begin to take on the trappings of a little "world", a continuum of varying horizons. The effects on settler morale will be considerable.

In Lunar cities, except to enter and exit those industrial facilities which for safety's sake must keep their air unmixed with that of the city at large, it will be possible to go most anywhere without donning a space suit. Homes, schools, offices, farms, factories, and stores will exit, not to the airless, radiation-swept surface, but to a pressurized, soil-shielded, indirectly sunlit grid of residential and commercial streets, avenues, and parkways; parks, squares, and playgrounds; and pedestrian walkways.

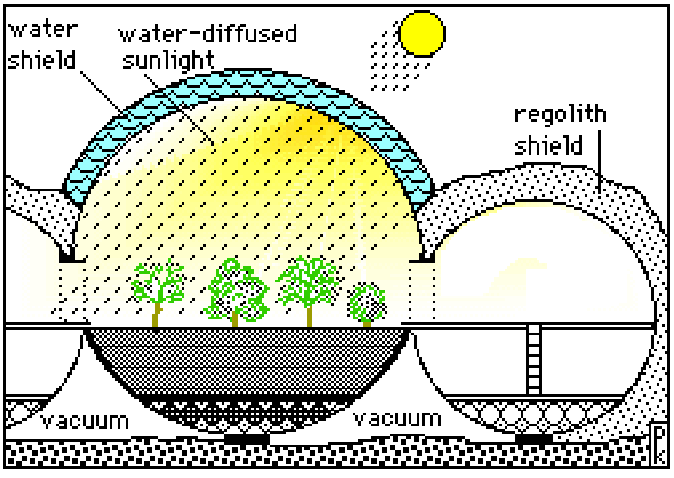
While the temperature of "indoor" spaces could easily be maintained at "room comfort" levels, that of the interconnecting middoors of the city could be allowed, through proper design, to register enough solar gain during the course of the long Lunar day-span and enough radiative loss during the long night-span to fluctuate 15 °F on either side, for example from 55-85 °F during the course of the lunar sunth.

Middoor spaces could be landscaped with plants thriving on this predictable variation. This would be invigorating and healthy for people, plants, and animals alike, providing a psychologically beneficial monthly rhythm of tempered mini-seasons. Of course, the middoors could be designed to keep a steady temperature. Oh how boring that would be!

For perhaps the greater part of the population, the creation of generously-sized pressurized commons, nature and picnic parks and playing fields and parkways will satisy everyday needs for the "outdoors." Sheltered from the cosmic elements, such spaces may nonetheless have an airy, supportively verdant feel to them. Such public common spazes form a matrix within which the indoor spaces of homes, offices, shops, schools, and factories can literally "breathe".

The more generous and more high-ceilinged spaces of the Lunan middoors can be realized by several architectural devices. Pressurized cylinders carrying vehicular traffic can have a radius generous enough to support green strips with hanging gardens, trees, walking and jogging paths, even meandering trout and canoe streams. Spherical or ovoid or torus structures can serve as more self-compact nonlinear park and nature space. Farming and food production areas can host public footpaths and picnic oases.

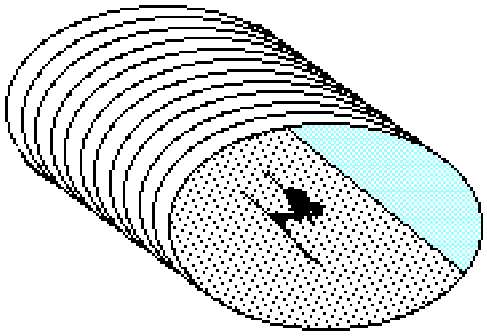
Sunshine ingress can be provided by bent path heliostat "sundows", by optic fiber shielded "sunwells", or more radically, as Marshall Savage suggests, by water-jacketed double domes.



Well-designed middoor spaces in a generous acre per citizen ratio can probably substitute for the openair greenspaces of Earth for a large cross-section of the settlers. Others will need to come to personal

terms with the out-vac. Still others will never be able to leave behind the green hills, the ocher deserts, the blue skies, the thick forests, the horizon to horizon expanses of ocean deep of the home world.

We will be able to walk, hike, bike, skate, row and trout-fish in lunar middoor spaces. Cherished outdoor activities that are more challenging to replicate but seem eventually doable include skiing and tobaganing in pressurized tubes positioned on the slopes of craters (see "Skiing the Moon" MMM #115 MAY '98).



Also doable is man-powered flight. Out of the question, at least in the early days of settlement are activities like powered flight and soaring, sky-diving, motorboating, sailing, ocean cruising and hunting for example.We'll be able to go caving or spelunking in lavatubes, but in pressure suits.

Each person pondering signing up for the lunar frontier must weigh his or her attachments to cherished activities that may not be supported in lunar settlement biospheres any time soon, if ever at all. Those taking the plunge will owe it to themselves to be politically and civically active in guaranteeing that the settlement middoors is as generous and diverse and user-friendly as economically possible. Nothing less than the morale and mental health and long-term survivability of the settlement is at stake.

While tightly climate controlled "indoor" spaces may vary but slightly from comfortable "room temperature" and humidity levels, the middoors may be designed to swing freely from a late pre-sunset dayspan temperature that is tolerably warm and humid, to a late predawn nightspan temperature just enough above freezing not to harm the various plantforms within. "Sunthly" "weather" patterns will add welcome variety and spice to day-in, day-out life.

That favorite conversation-making unpredictablity of terrestrial weather, however, may be hard to program in. If temperate food plants are desired, perhaps an annual hard frost might be arranged one nightspan a year, as part of a partial cleansing freeze out of accumulating atmospheric pollutants and impurities. It's a thought. And depending on ceiling heights of the street vaults, any gradual increase of humidity levels beyond a certain point might trigger mist-making condensations, say sometime after local sunset. At any rate, such middoor "weather changes" will help keep the populace healthfully invigorated, as well as supplied something innocuous to complain about. A fringe benefit will be a whole new cottage industry to create fashionable "outerwear".

Conclusion

The Middoors is an essential concept with a critical function in the design of lunar settlement mini-biospheres. Middoor spaces will include parks and parkways as well as agricultural areas, and thus host the lion's share of the settlement's biomass. Air circulation in the middoor maze of interconnected pressurized public spaces, markets, parks, walkways and streets will be an essential part of the air recycling system. Reserve waters as well as largely pretreated waste waters will also circulate through the middoors as part of the water purification system, providing fountains, waterfalls, trout streams, duck lagoons, and more.

Meanwhile, the middoors, even in modular settlements built unit by unit as needed (as opposed to vulnerable fixed-size megastructures so common on science-fiction rag covers) will go a long way to prevent the build up of cabin fever malaise. In contrast to habitat modules, the larger diameter cylinders for roadways, bike paths, public transit, and roadside plantings, and even larger spherical, ovoid, or toroidal plazas, squares and parks will boast higher ceilings and longer sight lines for welcome eye relief.

There will be those "hard core" outdoor types for whom this will not be enough. And that is great. Their enthusiasm and relentless search for ways to make themselves "at home" in "Out-Vac" sport and field activities out under open black skies will end in pushing the envelope even further. That will be good. The wider the cross-section of normal personality types that can enjoy satisfying lives in lunar environments reclaimed from wasteland, the more truly viable will lunar settlement become longterm .

Meanwhile, lunar settlement Middoors spaces will allow Lunan pioneers to feel "at home" outside their homes as well as inside them. **<MMM>**

Relevant Readings from Back Issues of MMM

5 MAY '87 "M is for Middoors"
8 SEP '87 "Parkway"
37 JUL '90 p 3, "Ramadas"
55 MAR '92 pp 4-6 "Xity Plans" - *illustrated*
74 APR '94 p 7 "Sun Moods" - *illustrated*
89 OCT '95 pp 3-4 "SHELTER on the Moon"
94 APR '96 p. 4 "Vac, Out-Vac, Lee Space, Midoors"
96 JUN '96 p. 6 "Spacesuit Aversion"

Homo Lunensis

"We must develop the habit of dealing with anything and everything lunar in such a way that the Moon becomes a place where we will have learned to become truly native."

Security Comfort Levels:

We won't be "at home" on the Moon until the Know-how to Maintain our Presence is Widespread among the Pioneer Population.

by Peter Kokh

In every culture throughout time, there have always been elders or an elite with special critical knowledge vital to the survival of the community. At the same time, other skills and know-how are often commonly widespread in the population.

In our own society there are the nuclear scientists and brain surgeons and other experts f esoteric domains - a relatively small group of highly trained individuals. But there is still a considerable body of vernacular know-how: auto repair, home repair and construction skills, day in - day out ability to use computers for a whole list of purposes, farming skills, and many more "trades" too numerous to mention.. And then there are specializations, even of things once commonly known, simply because life is so complex no one can know even the basics about "everything" -- how to make soap for example.

We have become ever more dependent on higher and higher technology. Yet that dependence extends only to quality of life. Without it, we'd be knocked down a few pegs to a cruder, simpler time. But our survival would not be at issue. On the Moon and Mars, however, the stakes will be radically higher. We will be dependent on high technology for our continued existence at every moment:

- maintenance of pressurization and seals
- constraints on lunar architecture / construction
- maintenance of ever more heavily biologically-assisted life support systems
- plumbing and ducting systems that assist in the refreshening of the air and the water
- biomass recycling and recovery
- last but hardly least, maintaining a positive import-export equation.

Our thesis in this article is that our security on future adopted worlds will depend on such kinds of essential know-how becoming, and remaining, widespread among the settler population; and that virtually everyone needs to understand the basics. Why? Because without citizen cooperation, the efforts to maintain these vital systems will be at real risk eventual failure. For example, the best engineering possible of water, air, and waste recycling will be defeated without strong public cooperation.

On Earth, these are important issues. But system failure is not a matter of life and death that threatens near term. Our planet gives us a generous biosphere. On the frontier, we have to provide this and maintain it ourselves. We cannot risk a settlement population becoming a misguided rabble.

The role of the settlement schools

Broad knowledge of the system of special expertise, systems, and engineering that make life in the lunar or Martian settlement possible can be guaranteed, by a simple plan, rigorously pursued.

Starting in the earliest years, children can be introduced to the basic ideas behind human-created and maintained mini-biospheres and the systems that make them work: abundant plant life, the food production system, water and air treatment, etc. The concept of the pressure hull and threats to its integrity. Simple lessons and explanations at first, but as the children grow older, each subject should be revisited in ever greater detail. What starts as a lesson, in time becomes a whole course. Periodic field trips to the settlement's utility facilities will help, with revisits as the child is older and can comprehend in greater depth.

Meanwhile, at home, children can take turns with housekeeping chores that help make the system work. Older kids can help sort recyclables, repair salvageable items, even disassemble products whose components need to be recycled separately.

After secondary school, young people could do a stint of universal service in any one of several vital areas: hull pressurization patrol and maintenance corps; yeoman duty with architectural and construction firms; agriculture & biomass recycling; the water works; recycling utility, etc. The result of such mandatory service (for a length of time to be determined by the settlement) would result in very widespread appreciation of what it takes to maintain human presence on the Moon or Mars. And therein lies security.

At the technical school and university level, individuals who feel the call to be at the forefront of one of these vital fields, can pursue studies further. , Settlement Systems 101 as an in depth introduction to all these vital systems would be a prerequisite to advanced courses and majors in any one of them.

The risk of ill-fated political decisions with unsuspected consequences that threaten the state of any of the settlement's essential systems, will be much less if the populace as a whole have a high degree of appreciation for what is at stake. On Earth we take the long term existence of our cultures and their towns and cities for granted. To be sure, we have our ghost towns, places where something stopped working (generally the economy). On the space frontier our presence will always be tentative. our future a presumption. There can, of course, be no guarantees. But if the population at large is engaged in what it takes to continue to win against the odds, the chances of continued success will be that much greater. Without this broad widespread appreciation, the chances of an end to human presence on the Moon, a string of ghost towns in our wake, is high. Do it right, and we will be, and feel, "at home." **<MMM/>**

Lighthouse Network for Travelers

by Peter Kokh

In MMM # 1251 DEC '01, pp. 3-6 "Engaging the Surface with Moonsuits instead of Spacesuits" we suggested that Lunar GPS units be standard equipment. Yet, the Moon being the *unforgiving* environment that it is, redundancy is the wisest policy.

So we pose the question: how would "lost" or location / direction-confused travelers, explorers, prospectors, and other people in the field find their way to their destination, or back home, if for some reason their GPS unit was not working, or the system was down (satellite failure)?

An updated and Moon-adapted analog of the time-revered lighthouse network along the coastlines of Earth's oceans and Great Lakes might be useful, particularly in analogous "coastal" areas of the Moon. The Moon's "seas" -- plains of congealed lava that fill great impact basins -- are bordered by impact basin ramparts and highlands with intermittent highpoints or headlands. Travelers taking coast-hugging routes could benefit from a chain of well-placed lighthouses. In time, a network of such beacons could be placed on high points along cross-highland routes as well.

By "Lighthouse" we mean:

Before we go any further in this seemingly romantic reverie, let's make clear what we do and do not mean by a lunar "lighthouse." These would not be manned, nor would they be eternally "lit" as are our terrestrial analogs. Nor need they be as large.

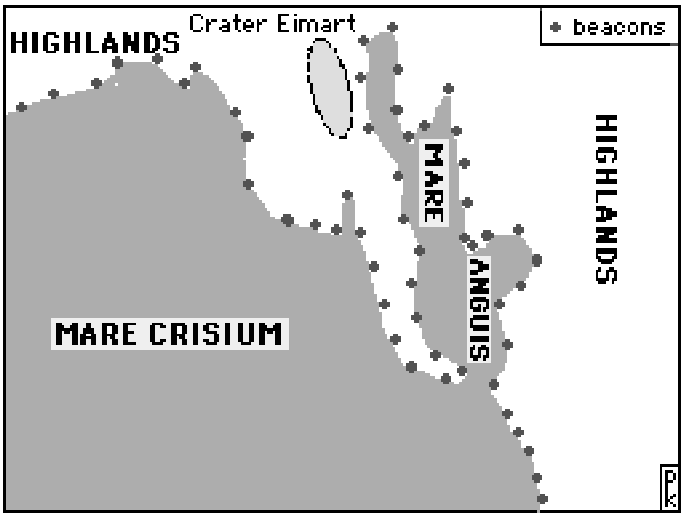
The lunar "lighthouse" we envision normally sits passive, "on call" when needed. An omni-directional radio signal from a confused traveler would awaken any lighthouses in line-of sight. Each would then send out a directional homing beacon signal that would contain a "signature" identifying it to the traveler to help in determining his/her location. A visible light pulse could also be emitted when the lighthouse was in darkness or shadow.

These units would have solar panels to keep batteries charged, with enough of a charge to work when needed during the long nightspan stretches. Once in place, they would operate "on call" indefinitely without tending, and without grid connections.

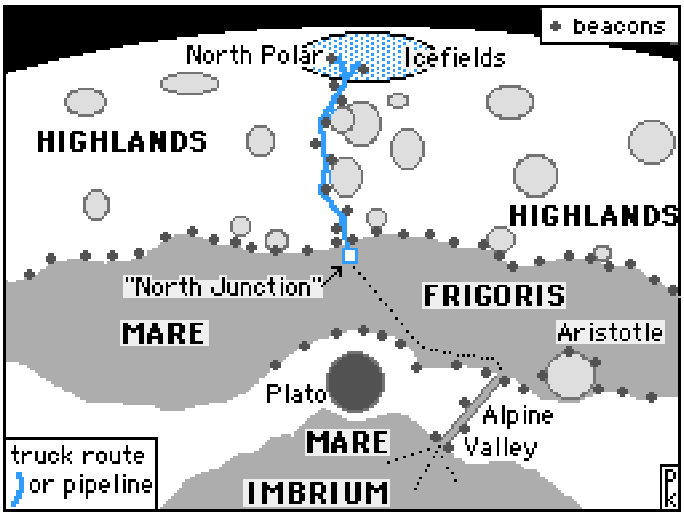
Samples of placement:

We have made line sketches of two areas where such networks might be useful in the earliest frontier period -- proposed areas of early settlement.

1. the coastlines of "Angus Bay" (Mare Anguis or the Sea of Serpents) and the adjoining NE coast of Mare Crisium (Sea of Crises)
2. the northern coastline of Mare Frigoris (Sea of Cold), a prime settlement location ("North Junction") -- and high points along one possible cross-highland route to the North Polar Icefields and the "white gold" they contain.



Beacons along the Crisium & Anguis "coasts"



Beacons along the Frigoris "coast" & Alpine Valley

Such automated "lighthouse" beacons could be small and relatively lightweight which would help in deployment. The first explorers to blaze any trail through "virgin" terrain would set them at surveyed high points so that the network would grow steadily with the expansion of "explored" terrain.

Could we package such beacons in inflatable tetrahedrons (we don't want them to roll back downhill much less down the opposite slope) so that we could hurl them precisely to their intended perches without having to scale hills ourselves? Within such an envelope, the equipment package would be self-upright itself, then deflate the cushioning envelope.

Along level terrain routes with no real high points, beacons can be hoisted up telescoping pylons -- after all, on the Moon the horizons are much closer than on the larger Earth. On this windless low-G world, such pylons could be very lightweight.

Such a system could be the prime carrier of communications and data *in, from, and to* the deep Farside where we will want to maintain high radio quiet for Radio Telescopes. It's all part of making the Moon *a friendlier place to call "home."* **<MMM/>**

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

Moon Society Election Results

from Gregory R. Bennett, Moon Society President

I'm pleased announce the results of the Moon Society Elections:

- Vice President David Wetnight
- Secretary Amy McGovern
- Board Member Dana Carson
- Board Member Ian Randal Strock

The elections for the board were incredibly close, with Vik Olliver and Michael Mealling polling just 1 or 2 votes behind Ian and Dana throughout the counting. I wish we could have had an electronic tally board; it would have been exciting to watch on line.

After going through many, many rounds of counting on the preferential ballot, it became obvious that it would be a Really Good Idea to expand the board by 2 members (from 5 to 7) and put those board positions up for voting in this year's elections. There was a very wide spread in the voting, with all candidates polling strongly.

So, we'll figure out what we need to do to propose a change in the Bylaws. I think that would be a board of directors action. However, I'd like to hear everyone's feelings about expanding the board.

Thanks to everyone who voted in this election!

Greg

Join the Moon Society today!
http://www.moonsociety.org/register/

The Capital Conundrum

Gregory R. Bennett

The real question for space tourism is how long it will take to get to the point that the average individual will be able to afford to travel in space. There are no technical barriers;

the technology exists today to build hotels on the Moon and in Earth orbit.

There are, however, business and political barriers to overcome. The primary difficulty to bringing enough capital together is to get it started.

Right now, transportation costs are too high to make space tourism financially viable. The amount of capital needed to develop a commercial passenger rocket (somewhere between $25 and $50 billion) is too far outside our current experience. Enough people want to travel in space that it certainly would possible to gather sufficient capital to do this, but new corporate ventures are severely constrained by securities exchange regulations and a venture capital culture that strongly reinforces mediocrity and the status quo to the detriment of major advances and innovation.

The political barriers stem from the growth of space development as an emblem of national pride and international diplomacy. We see the beginning of a change in that culture, notably within NASA now that the previous administrator has retired. The new office of commercialization within NASA has shifted its focus from trying to turn NASA into a commercial entity toward keep NASA within the bounds of a government agency while enabling commercial enterprise.

The Artemis Project™ Game Plan

Perhaps my role in the Artemis Project is even more important to this topic than my day job [at Bigelow Aerospace]. Enabling commercial space development, especially on Luna, is the key method proposed by the Artemis Project. Our goal is to create a market environment which in turn creates a demand for development of low-cost commercial passenger launchers as well as widespread pool of capital to enable their development.

The Artemis Project's lunar exploration ventures lead directly toward space tourism, where adventure travel to the Moon becomes available at least to those who can command a middle-class income. Initial sorties will be relatively expensive expedition-class trips, similar to the expeditions people take today into wild regions and up tall mountains. As more resources are developed at the destination -- similar to the development of base camps for mountain-climbing expeditions today -- the cost of the trip comes down. Transportation systems develop that can carry more passengers to and from the destination at a lower cost.

So it's not a question of whether it will work, but rather how long it will take.

It is important to realize, however, that nothing happens until someone makes it happen. There's an old adage, "When it's time to steam, you steam!", that implies that cultural advancements happen when the necessary resources are available regardless of the actions of individuals. That adage could not be more wrong.

History is filled with examples of opportunities for technological advancements that might have occurred if a small group of individuals had been inspired to do something; it is not unreasonable to project that technological development at the time of Alexander the Great could have lead to people traveling in space more than 2000 years ago. Most of the developments of the industrial revolution were delayed more than 1000 years by the Dark Ages, until a few brave individuals initiated events which changed the entire world.

With that though in mind, we are doing what we can to bring about the necessary changes so that space tourism can be accomplished within our lifetimes.

The Role of Bigelow Aerospace

The activities of the company I currently work forare a part of the solu-tion to this problem. The company attracted a lot of attention a couple of years ago because of study of commercial tourist facilities that included a trans-lunar cruise ship. That might have been a bit unfor-tunate because discussing the possibilities lead to some news stories that gave the impression we would be able to accomplish such a program in just a few years.

I used that study both to train the company's team and to explore the commercial viability of the concepts. It was very successful in achieving both of those goals. We identified all of the technical and financial parameters that affect such a program of translunar commercial space travel from the time you decided to buy a ticket to the point where you are getting a close-up view of the mountains of the Moon.

However, the company's current, real business focus is considerably more practical than giant spinning spaceships. We need to make a lot of baby steps before we will be able to fly people to the Moon. The first step is to get any kind of commercial manned facility flying in space and paying for itself, so we are developing a space station module that should prove to be commercially viable when it is ready to fly.

Because of today's cost of transportation to and from space, the first customer for these modules is more likely to be in the manufacturing industry than in the tourist industry; but this does get things going, increasing demand for launchers, which in turn leads to market competition and seeking lower-cost ways to accomplish the function.

We are still several years away from launch of the first module, but it's quite a bit more than just the pipe dreams we've heard in the past. We are in a unique financial situation because we have been able to step outside the business capital culture of enforced mediocrity -- the company is entirely financed by one entrepreneur who has the resources to do this.

For the larger scope, though, this is a unique situation. Very few people command sufficient wealth to finance a project like this, and among them I know of only one with the vision and courage to put his money where his dreams are. Even this project is not sufficient to enable the entire market of space tourism within our lifetimes. It plants the seed, but whether it will be us or our multi-great grandchildren who are taking vacation trips to Luna still depends on how much time it takes to focus a very large amount of capital on the problem.

Project Items to Work On

From Richard Perry <rperry@dial.pipex.com>

It seems that the **Artemis Project™ Reference Mission** and ADB (**Artemis Data Book**) status are not enough for some appetites, so here is a little list of things we need looked at before we can execute the Reference Mission, or anything like it.

If this reads like some little role playing game scenario, then it is. Only its for real. These are some of the paths back to the Moon, and no-one is stopping you but yourselves.

A. Commercial

1. An economic model for the moonbase. After some years, this is probably impossible to create in advance of the real thing, so look at economic models for the steps along the way
2. Economic model for trans-lunar tourism. Can you make it pay to fly a tourist (or more) to the Moon. We know the price for LEO, and it's already falling, so there are some real world figures to play with now. Do you need to do a lunar orbit insertion to make the trip attractive enough?
3. Business case for a manned landing. This is to put down the construction shack to support further missions. Don't necessarily look at trying to get everything into LEO using shuttle. Don't necessarily stick with SpaceHab's if you can find something similar (and equally proven). If you need to flight test something, build that into the cost.
4. Business cases for mineral exploration. This includes polar ice. How would you pursuade an exploration company to fund you plans? Would they be manned or unmanned, and would they help to build the permanent base. Hint, it's always a good idea to make use of existing infrastructure.
5. Business case for landing tourists. Again, they don't have to stay, they don't have to weave baskets in the hab to sell and make money. They just have to provide a revenue stream that is positive, and allows the facility to be expanded. There are all kinds of tourist, from extreme-adventure class to premier Class. You need to decide which you can cater for.

B. Technical

1. A really capable rover for lava tube research. Must be able to throw itself inside lava tube entraces, garner quality data and return it to Earth or an orbiting relay. Yes, you are allowed to use cables, IR transmittersm, radio or whatever to get the sensor data out from the lava tube. We made need lots of these robots, so cheap price and simple design are advantageous. They will probably be put to work on many lava tubes, before a good candidate is singled out for extensive examination. Hint - this means that the early explorer robots may not have to be that smart at all.
2. Inflatable habitats. These will be required for LEO (low Earth orbit) as well as elsewhere (trans-lunar, lunar orbit, lunar surface, lunar sub-surface, resale to Mars explorers). The technology exists, what is required to get it into use? Who owns the technology, what are the costs, what are the engineering constraints?
3. Lunar environs navigation. It will be very convenient to have a lunar GPS (global positioning system) in place, as well as landing guidance beacons, etc. What is required to put all this in place? Hint - how much available hardware is already in LEO, awaiting salvage or aquisition? What are the minimum requirements to drastically reduce reliance upon Earth-based tracking systems, and to greatly improve the ease of Lunar approach and landing? When the technical options are identified, go away and build the business cases for each. Who will the customers for these services be?
4. Lunar astronomy facilities. What can be put in place at what cost in terms of time/money/design effort? Can these facilities be unmanned cash-cows to support later manned missions? Turn previous thinking on its head to try to make this work before manned landings occur. Try to identify a branch of astronomical research that is a ready market for a soft-landed facility on the farside. Then work out how to preserve the radio specturm when returning your data and commanding your facility. Hint - go polar and site in a permanently shaded crater, using a local line-of sight comms link to the nearside.
5. LEO transfer station. Since the Reference Mission, LEO tourism has emerged. The Artemis Project requires some sort of staging post in LEO, and this could easily become a tourist destination. How big, how much, how quickly can it be created? The market is there, but how technically difficult is it? Hint - for LEO tourists, _volume_ and _privacy_ are probably the two most saleable commodities compared to all other presently available facilities. Design your facility to the specific requirements of the users (tourists and Artemis Project folks). Any one of the above topics is probably a years worth of work to get to a good level of detail (good enough to be useful). Each will help us get back to the Moon by some route.

Postscript (Richard Perry to MMM Editor)

Instead of making the list bigger, I have in my back pocket half a dozen specific technical solution ideas to work into full articles, and will do so real soon. Articles on ground breaking economic ideas will unfortunately have to be kept commercial confidential if they are ever to be realised. However, some ideas on possible future commercial scenarios may be publishable, perhaps in something titled 'Future Frontier Status', to try to highligh what could happen if the right folks got together.

Sneak preview of future topics:

1. Ice/steam carnot engine power generator (requires sunlight)
2. Moonbase 3 design, and the use of inertia wheels to store energy for the lunar night
3. Scenarios for expansion of space tourism with non-ISS facilities
4. Technicalities of a Transhab-like food farm structure
5. Continuous solar cell production using lunar materials (I need to go do some research to get my facts correct for this one)

I should make this my new hobby - picking out all the unsolved issues surrounding the moonbase design / the scenarios and providing some starter solutions.

What I'd reall like is half a dozen folks to pick up one idea from the original list and work solidly on it. This is what I think we ASI folks should be aiming to self-organise themselves into doing.

Have Fun
Richard

http://www.asi.org/seti/asi-setiathome.html
top 200 Seti@Home Clubs 11/26/01
http://setiathome.ssl.berkeley.edu/stats/team/team_type_4.html

ASI Team Seti ranks # 89. Our 114 members have logged 159,643 results and totalled 261 yrs CPU time

Inspiration for Moon Society Chapters

Memo from the Editor

It is a fair bet that many of our readers who belong to the Moon Society and the Artemis Society, never browse through the NSS chapters section at the rear of MMM. Perhaps you should start doing so.

One of the NSS / MMM chapters, P.A.S.A. - Philadelphia Area Space Alliance, has not only found a unique way to attract dynamic members, but month after month is engaged in the planning and execution of considerable outreach activities.

We would not know about these except for the faithful reporting of PASA activities issue after issue for some years now in MMM. Perhaps PASA is on to something, and other chapters, Moon Society and NSS alike only stand to gain by taking notice and seeking inspiration. *We owe that to ourselves.*

Those of you motivated to take heed, can start with this issue's PASA report on pages 18-19 and then start looking through whatever past issues of MMM and MMR you have on hand.

As to the first point, PASA's unique formula for attracting dynamic members, PASA is not just a National Space Society chapter. It is an alliance for action of active area members of several groups. Per its website [http://pasa01.tripod.com]:

- American Institute of Architects (AIA)
- Mars Society
- National Space Society (NSS)
- Philadelphia Science Fiction Society (PSFS)
- Planetary Society
- ProSpace
- Space Frontier Foundation
- Space Studies Institute (SSI)
- World Future Society (WFS)

Now mindful that a Moon Society chapter is much more tightly focused, on the Moon rather than on space in general, it might seem that such an alliance might not work for us. But if the alliance we wish to forge is of individual energized local members of various organizations rather than among organizations themselves, the idea seems much more realistic and practical. Indeed some space activist organizations do not have local chapters at all: The Planetary Society, Prospace, Space Frontier Foundation, Space Studies Institute among them. That leaves local members of these organizations, who yearn to get their fingernails dirty with local outreach, all alone, ripe for collaboration. And as to the Moon, it has a place of honor in the visions of both the Space Frontier Foundation and the Space Studies Institute.

Finding local members of other such groups is the harder chore. But if you can do it, you may find yourself with a "can do, let's do" team.

Meandering Through The Universe

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

Beliefs Affect Action: an Example from Launch Vehicle Construction

Last month I stated ... "that our views about what is possible and what is impossible, first, may not be accurate and, second, are the source of much of our inability to overcome the obstacles holding us back from the realization our goals." I noted that our beliefs guide and inform (or misinform) our efforts and often even dispose us to inaction because we believe that there is nothing productive (in terms of progress toward our desired goals) that we can do.

Although negative morale is sometimes accurate, I don't believe that it is in the case of space development and settlement. I have often tried to stir the readers of this column to reevaluate what it is that they personally have to offer to the advancement of our shared hopes of the human expansion into space. Over the three years that I have been writing this column I have occasionally given examples of actions that a person or group could take, which were intended as much as an invitation and encouragement to the readers to brainstorm along with me, as serious proposals.

This month I want to discuss a specific example from the arena of infrastructure technology — specifically, launch vehicle construction.

Minimum Cost Design - MCD

Mark Goll, of Texas Spacelines, Inc. (of which I am a shareholder — so consider yourself duly informed of any possible conflicts of interest to which I may or may not be subject) ... Anyway, Mark wrote an article last autumn on something he calls Minimum Cost Design (MCD) — a concept that he has been working on in recent months. The idea is that, besides meeting all *reasonable* performance criteria (including safety and profitability), a design implementation or plan implementation should be such that it incurs in the lowest cost possible — with any unavoidable tradeoffs between short term and long term costs duly balanced.

This is NOT something new to business philosophy, and yet, it is nonetheless frequently misapplied or overlooked — even by well trained, highly experienced business professionals. And it becomes ever more crucial to the success of an endeavor as the overall expense of the particular endeavor in question increases. That is to say, if one wishes to succeed in some task (whether the goal is to make a profit or to get some other result — say, satisfy a craving for ice cream or settle space), one must pay for it. If the outcome desired costs little more than pocket change then Minimum Cost Design saves pennies at best. But at the other end of the spectrum where the cost is terrifically great — as in space settlement — we need to be clever not just in regard to physics and engineering but also in regard to economics before we have any hope of success at all. When Minimum Cost Design is applied to physical infrastructure it deals with the interaction of economics with engineering. There is no honest economic competency without a very thorough intimacy between cost evaluation and engineering, and cost evaluation and plan development.

So, how might Minimum Cost Design (MCD) apply to our goal of permanent, thriving human space settlement? Mark is primarily concerned with launch vehicles for Earth to space missions and therefore his examples are concerned with such vehicles. Bear in mind that the same considers apply equally well to all of the other components of a space access infrastructure. Let's look at the examples he uses.

Four Areas of Launch Vehicle Design

In his essay on the subject Mark focuses on four areas of launch vehicle design: construction materials, fuels, staging ratio, and thrust profile. We will start with construction materials (specifically the factor of mass) to which the following formula applies:

Equation 1: $delta V = Isp * ln(MR) * g$, where

- *delta*V is change of velocity: meters per second (m/s) or feet per second (ft/s),
- I*sp* is "specific impulse" — a measure of thrust,
- *ln*(MR) is the natural log of the "mass ratio" — the mass of the vehicle and its cargo, including fuel, before the engines start, divided by the mass when the engines turn off (M0/M1),
- g is the force of gravity, which at sea level here on Earth is 9.8 m/s or 32ft/s.

Equation 1 is saying that the acceleration of a rocket depends on three things: the thrust of the engine(s), the mass of the rocket and everything it is carrying — including the fuel that powers it, and the pull of gravity. The frictional resistance of the atmosphere can be ignored for this discussion if the vehicle is reasonably aerodynamically sleek. Acceleration — that is, change in velocity (aka *delta*V) is the primary purpose of the rocket. To put the cargo (payload) in orbit, the rocket must accelerate the payload to a velocity where the rate of its fall toward the center of the Earth is precisely balanced by its forward motion over the curvature of the Earth's surface so that the payload never reaches the ground.

Although it is possible to shoot an object into orbit with a big gun, doing so requires that all of its velocity has to be imparted in a very short time, meaning huge accelerations which would crush almost anything but the toughest solid — a solid block of concrete, for instance. Since we don't want to crush people, or even electronic gadgets, we use rockets instead. The consequence, however, is that we have to

take the rocket along, too, for all or part of the journey. That means that the mass of the rocket itself must be lifted along with the mass of the payload.

The Point of Minimum Cost Design

And that brings us to the point of Minimum Cost Design. We will ignore the payload for this discussion, but remember that its design, too, should be looked at with MCD in mind in any real system. What we will consider is the construction of the structural components and covering of the rocket. Rather than the deep mysteries of physics or the elegant beauties of esoteric technologies, our primary concern in the development process *must* be with discovering the strategies, designs, and mind sets which are most likely to result in our success under the most favorable conditions. With regards to launch systems, this concern is expressed as:

*delta*V / $, that is, *(change in m/s) per (dollar)*

All that means is "the cost to get our desired payloads to space." What we need to do is find the least expensive way of getting there which still meets all of our safety and ease-of-use concerns.

There are many fundamental requirements for a launch system which cannot be avoided (a minimum strength of materials to maintain structural integrity, for example) and which therefore dictate the range of design choices. However, it is sometimes the case that design choices are based more on false assumptions, personal taste or personal interests than on pure and simple facts. Most scientist, engineers, and the rest of us technology geeks simply adore the brightest, shiniest, most complicated, highest tech way of doing things. That's fine for Rube Goldberg and it's okay for a personal hobby but it just doesn't cut it when applied to serious work like trying to open space for settlement because, in the end, the cost is just too high and the usability and reliability is just too low.

It is this kind of thinking which has led to a

total concentration on maximizing thrust and minimizing system mass *at all costs.*

It's the "at all costs" part which has done so much to defeat our aspirations. Instead the goal ought to be to maximize the economic efficiency of the total working infrastructure. That requires an economic overview of the whole infrastructure and an economic analysis of each detailed component and step along the way. That's not the way we have done things in the past.

Next Month ... More

Next time we'll compare the costs of building our rocket out of aluminum with the cost of building it out of ... Well, that's next month. **<RRR>**

Richard's homepage:

http://richardpatricia.homestead.com

A Mission to Ceres & Vesta 2006-15

MMM Special Report -- January 3, 2002
SOURCE -- www.spacer.com/news/dawn-02a.html

The Dawn mission, selected by NASA on December 21st, as the next project in its Discovery program of lower-cost interplanetary probes, is scheduled for launch in 2006 on a nine- year voyage to orbit the solar system's two largest asteroids, Ceres and Vesta. Orbital Sciences Corp has been selected to develop and build the spacecraft for a total cost of $80 M excluding launch vehicle costs.

Orbital is the industry partner on the Dawn mission team, led by Dr. Christopher T. Russell of UCLA and managed by JPL. This will be the first planetary spacecraft for Orbital and will make use of the Earth-orbiting satellite technologies the firm has used on over 75 spacecraft in the past decaded.

The design weight of the craft is 2,750 lbs (1,245 kg) at launch and will generate approximately 8 kilowatts of solar power at Earth's distance from the Sun. The spacecraft's core will be sine 6 ft (2 m) high, with solar arrays spanning 70 feet (21 meters).

After a mid-2006 launch by a Boeing Delta rocket, Dawn will embark on a nine-year journey into the main asteroid belt reaching ***Vesta*** in 2010 and ***Ceres*** in 2014, orbiting each in turn from a range of 60-500 mi (100-800 km) above their surfaces.

Dawn will use a high-performance ion rocket engine to get to the asteroid belt, using technology pioneered by JPL on NASA's Deep Space 1 mission.

Ceres, the first asteroid discovered (1801), is the largest known and estimated to contain more than 1/3 the total mass of all the asteroids combined. New Hubble measurements indicate that Ceres is slightly flattened, from 930-970 km (578-603 mi) in diameter*. [The Moon has a diameter of 3476 km = 2160 mi.] This flattening is greater than expected and may indicate that the inner structure is not as homogeneous as thought. Dawn will provide definitive observations with better resolution, following Ceres through its 9.08 hour rotation period to track surface features. The product would be a 'movie' that would allow us to map the surface of Ceres.

* Correlatea to a surface area of about 2.9 million km2 or 1.1 million mi2 -- about the size of the U.S. east of the Mississipi.
* Gravity 19% Moon's, 8.3% Mars', 3% Earth's
* Ceres orbits the Sun at 2.55-2.99 times Earth's mean distance, taking 4.6 years per orbit.
* Synchronous orbit would be about 800 km or 500 mi. above the surface -- elevator, anyone?

Vesta is also flattened, 531-564 km (330-350 mi) in diameter, and may have lava-filled basins. With a short 5.34 hr day, it is also closer to the Sun and orbits in 3.63 years. It *may be* the largest body in the Solar System with a cool *reachable* core, where a "negative zero-G" Physics lab could be built! - PK

Mail For MMM

On Dan Goldin's Legacy

I have a rather different opinion about Dan Goldin's effect on NASA than you expressed in your In Focus editorial in MMM #150. I think when he first took office as Administrator, he did the agency some good. Its culture needed to be shaken up, and to some extent, still does. But I think he pushed the "better, faster, cheaper" concept well beyond its workable limits. Once upon a time in my aerospace career, I worked for a supervisor who had above his desk a piece of paper with the words: "You can have it Good... Fast... Cheap... Pick two."

Because of NASA's previous culture, building huge spacecraft and massive missions, and the tendency to try to pile every instrument in the book on every interplanetary vehicle, there was at first a lot of room for give, for reductions in all three areas. But then you reached the point where you could only reduce one of the three factors by increasing one or both of the other two. I think the overemphasis on "better, faster, cheaper", plus Goldin's unwillingness to hear criticism are at the roots of the failures of missions such as the Mars Polar Lander. Goldin had created a climate where people were afraid to tell headquarters things like: "We really need more money for testing before we fly," or "Something about this mission doesn't seem to be going right".

I had a recent conversation with James Oberg, whom you may know, at least by reputation. He gave a direct quote from a conversation someone had had with Goldin: "I'm not NASA's representative to the Administration, I'm the Administration's representative at NASA." In other words, he did not see his role as being an advocate for NASA or the space program, but to go along with whatever the current Administration asked for, even if it didn't make sense. I asked Jim if other NASA Administrators had not also seen their role as being the Adminisration's representative at NASA, and he said: Somewhat. ..but they saw themselves in two worlds. They saw their role as both carrying out the instructions of the President and Congress, but at the same time carrying back to the administration and Congress the comments and recommendations of NASA's engineers, center heads, etc.

[EDITOR'S COMMENTS: I fear that Sean O'Keefe must see his mission somewhat as Goldin did his. This is only to be expected if the Administrator is chosen from outside NASA. Yet there are equal hazards in appointing an Administrator from within. Admiral Richard Truly, a former astronaut, was a staunch supporter of the manned space program. But one senses that he had a blind eye when it came to planetary science and other areas of NASA's mission. - PK]

Correcting a Misleading Phrase

In MMM #151 DEC 2001 pp 3-6, "Engaging the Surface with Moonsuits instead of Spacesuits" I spoke about equipping suits with a 'GPS' receiver so that the wearer would be sure of his/her location and find the way back to the outpost.

At least one reader assumed I was talking about an extended use of the present geo-centric Global Positioning System, and correctly pointed out that this would not work.

I was remiss in not making it clear that I was talking about a *Lunar* GPS, based on satellites either in lunar orbit or at the Lagrange points.

Peter Kokh, Editor

On "Moonsuits"

1/24/'02 A couple of points with respect to your moonsuit article [MMM #151]. *I haven't seen data on it, mostly I am working from my experience in nuclear applications, where I worked in an environment composed mostly of highly penetrating radiation (like 3MeV gammas).*

I suspect that the largest radiation dose would be to the person's feet. I think the incoming radiation on the surface is very "hard", and its the bremstrahlung from interactions with the surface which produces a big x-ray flux which would be the source of the exposure. In which case, having graded shielding (uranium/lead/tungsten, copper/steel, aluminum, polymer) in the sole would probably be fairly efficient.

I don't think we want to power our tools from our suit's power. Perhaps the power conduits from the tools battery pack run along our suit exterior for us to plug into, but we don't want the use of power tools to cut into our reserves for EVA. Say we walk out until we are at slightly less than 50% reserves, and on the way back we see something interesting. If the power tool's power comes from a non-suit source, we can calculate our linger time quite easily. But, if the power tool steals power from our suit, we run the risk of not being able to get home.

I don't think we need to leave "Reeses pieces" laying around to navigate home. GPS (especially DGPS) does a much better job. You can even take a more line of site route home, over terrain not traveled on the way out. Having passive transmitter in our tools would be handy. We could leave a tool at an interesting location, and find it later by waving a power beam around and listening for the signal coming from our tool. Mind you, if we have lunar GPS, we can probably navigate back to the spot just using that.

Gordon Haverland, B.Sc. M.Eng.
President Matter Realisations
http://www.materialisations.com/
Edmonton, Alberta, Canada
ghaverla @ freenet.edmonton.ab.ca

♂ Mars Society Updates ♂

Mars Desert Research Station in Utah Gets a Greenhouse - "GreenHab"

One of the disadvantages of the first Mars Analog Station site on Canada's far north Devon Island was that a Greenhouse, something we'll want to have at our first real outpost, on Mars itself, is not possible. The field season there is only 6-8 weeks long, and the rules of the host Nunavut Territory government do not allow leaving organic materials behind between field seasons. That means that at M.A.R.S. we cannot extend the simulation to include biologically-*assisted* life support.

At the Hanksville, Utah site, we can at last take our simulations to this next important level. The Mars Analog GreenHouse was built by the GreenHab group of the Mars Society. The prototype is at the University of Maryland:

http://chapters.MarsSociety.org/ttf/b_0.2.4.htm

Photos of the assembly of the GreenHab at theMars analog site in Utah:

http://chapters.MarsSociety.org/ttf/b_0.2.2.htm

Additional photos, diagrams and renderings:

http://chapters.marssociety.org/ttf/b_0.0.0.htm
http://chapters.MarsSociety.org/ttf/b_0.2.0.htm
http://chapters.MarsSociety.org/ttf/b_0.2.1.htm
http://chapters.MarsSociety.org/ttf/b_0.2.5.htm

Send suggestions for this web site or additional material should be sent to "Dean Calahan" <dean@baloney.com> & Gary <GCFisheris@aol.com>

This entire effort is the fruit of a member-organized effort, rising out of constructive criticism of the Mars Arctic Research Station as originally conceived and as constrained by the short Field season and Nunavut regulations cited above. It is indeed hard to conceive of an activity that will be a major part of operations on Mars that it is more important to simulate up front before we leave than that of a food production system tied into the waste recycling system. This system is critical as were we to have to bring along all the food needed for a 2-3 year Mars mission, total mission weight would be discouragingly high. Further, the first food-producing Mars Greenhouse will be an important and significant first step towards a permanent outpost, and ultimately settlement. (Those readers who have seen the recent film *Mission to Mars* will recall the vital role such a facility played in keeping the sole survivor of the first mission alive until he could be rescued some two years later.)

Dean Callahan, Gary Fisher (Philadelphia), and others on the team are to be commended for their hard work and persistence in putting together this first pilot testbed. Hopefully we will learn much from it with improved versions to follow.

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

• **Peter Kokh is MAS guest speaker:** On Friday, Jan. 18th, Peter gave a talk to the Milwaukee Astronomical Society at their monthly meeting in the UWM Physics Building. Topics included possible observatories on the Moon (at first automated, then tended, eventually staffed); economic incentives for private enterprise to develop the Moon; how early settlements might be built and expanded; and how future amateur astronomers living on the Moon might scratch their itch. The talk was well received.

• **Aviation Day at Mitchell Field:** Coming up on the last Thursday evening and Friday morning of April is Aviation Day at Mitchell International. Peter has put in a bid for a table with the theme: "We can fly on Mars." Covered will be designs for the first robotic planes, serious design studies, and the role of aviation in opening up Mars on a global basis.

At last year's event, we helped Dennis Love of Chicago with his table full of rocket models, bringing our Earth-Moon-Mars set of "gravity bricks".

LRS FEBRUARY / MARCH Events

Saturday, FEC 9th & MAR 9th, 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. FEB AGENDA: shuffling officers' duties; 2002 events.

U.S. CHAPTERS

NSS Chapter Events MMM 8 Chapters Strong

Space Chapters HUB Website:

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

MMM Award of Continued Excellence in Reporting Chapter Activities goes to PASA - Philadelphia Area Space Alliance.

We encourage members of other NSS chapters who receive MMM, as well as members of Moon Society chapters, to read PASA's monthly report atentively every month. *Read & Learn!* A continuous outstanding effort by a continuously active chapter! *Kudos!*

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**

FEB 19th MEETING at the Stoelting House in **Kiel**

MAR 19th UW-Sheboygan, **Sheboygan**
Matt Giovenelli, Pres. Wisconsin Mars Society, will be our guest speaker for this event.

MINNESOTA

Minnesota Space Frontier Society

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

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

www.FreeMars.org/l5/index.html

Agenda of Jan 26th MSSFSMeeting: We met at Rich Brown's, 1258 Van Buren Ave., St Paul to consider these topics:

- Marscon Preparations
- MOA Event with MAS
- MNSFS Web Site
- Mars Soc. Convention
- Rover Cam II
- Astronomy Day
- E-mail list
- Yuri Night

ILLINOIS

Chicago Space Frontier L5

610 West 47th Place, Chicago, IL 60609

Larry Ahearn: 773/373-0349
Call Larry for MEETING INFORMATION

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: **FEB 28, MARCH 28**

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.

FEB 16th -- Business Meeting at location TBD
MAR 16th -- 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/.

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: **JAN 19, FEB 16**

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 (*except the 2nd Saturday this February and March*), 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.

NEXT MEETINGS: **FEB 9th, MAR 9th**

Call Earl Bennett or Mitch Gordon 215-625-0670 to verify all meetings

• **Scheduled PASA activities:** February meeting as noted, Grorge Washington Carver Science Fair activities and award being determined, March meeting; the 16th. In July, members are to appear as speakers at the World Future Society Annual Convention details later.

by PASA Secretary Jay Haines <hainesjb@netaxs.com>

• **January 19th Meeting Report:** We held a meeting and due to snow, almost nobody came. However, thanks to circumstances, we had a good meeting. The circumstance I refer to was the appearance of *Roger Patrick Bahn*, Candidate for the Board of Directors of The National Space Society. He was in the area as part of a buisness trip/members contact. *Mitch Gordon* and I had a long talk with Patrick on his space and work background which currently coincide as he is C.E.O. of T.G.V Rockets Inc. We had a wide ranging discussion including Pat's work on projects in the field that include the **D C X** program and his view of the paradigm that he would like to bring to N.S.S.

As children of the Computer Revolution most of us know how most of the big guys missed the significance of the electronic version of smaller, faster, cheaper and so lost to commodity oriented people who gave us Microsoft, Apple, Oracle and others who recognized where they where at but also what the rate of technologic change could bring. The "secret" as envisioned by Mr Bahn is modularization just as has worked (and all of you reading this are benificiaries of this) in the electronics and information fields. I believe he would be a good adition to the board based on our talk. Email him at Bahn@tgv-rockets.com .

Other Activities: We are currently looking for members to act as judges for our annual award at The George Washington Carver Science Fair as noted before. Contact me on this, or Mitch or the people at the fair (and explain to them why). Our award will now be named for *Oscar H. Harris* at this event as Oscar was very involved in this event and helped get our award for Space Related Science and technology into the event. Our *James H. Chestak Award* will be given at another venue to bedetermined soon. Judging will happen late in February or early March, so if you read *Moon Miners* you may still be able to particapate.

Super Science Weekend at The New Jersey State Museum in Trenton -PASA Special Report Jan. '02

P.A.S.A (Philadelphia Area Space Alliance) was a participant at the annual event held for families at the Museum and an adjacent site in Trenton, New Jersey on January 12th and 13th. We had an excellent location directly across from the cafeteria. The event ran 9-5 and 11-5 respectively.

The display items brought for public education ,and to attract people, included a computer connected microscope ,which *Michelle Baker* used to show children a variety of slides and anything the children found interesting. They loved it! The microscope is the *Intel Play QX3* which I found at *Shop-Rite* stores for $40. We also had another hands on display of *Peter Kokh's* [Earth-Moon-Mars] "Gravity Bricks" were shown by *Hank Smith* of our group on Saturday and by *Mitch Gordon* on Sunday. Lots of use but we'll have to add more planets!

As Technical Director, I (*Earl Bennett*) tend to bring a number of demonstrations and display table talking point items. This time the demonstrations included several types of aerobraking maneuvers, using this, parachutes and air bags for *No Rockets Necessary* landing and explaining that the

Mars Rover landed (and bounced and landed) this way. This demo was performed from a step stool at the start with a bouncing lander on the ground at the finale.

Since we are discussing space transport, I also put a magnetic levitation display together that kids could try to balance. The nose cone could be seen to float when positioned right.

My attempt at a single coil accelerator was also shown as an adjunct to the *Space Studies Institute* material given out. The use of the *Mass Driver* as a launcher and engine was explained, and occasionally the *Slingatron* continuously pumped (for example) launch device.

The other major area was sensing and how things electronic worked better when cooled. This "hands on" was more a "finger on" a device called a *Cold Finger*. For best sensitivity and to suppress background noise from the sensor this special limited area cooler is used. Mine used Dry Ice as the coolant. The application of the technique to enabling detection of constituents in protostars and,with the telescope itself cooled, compounds in dust clouds was explained. Additionally, analyzing materials through their effect on light was explained and the uses of fiber optic light guide shown..

We had a great time and really enjoyed this event, as did our neighbor *Gary Fisher* who had *The Independence Chapter of the Mars Society* display next to us. *Michelle* helped on Sunday. The people who came really appreciate this form of learning for there children and quit a few also wanted to get in touch later.

A lesson for other chapters

If you can, put together a public outreach. This event, and the preparation for it, can renew the spark in the group as well as putting the organization in the public mind.

Submitted by Earl Bennett, President, PASA

Addendum by Gary Fisher

PASA and The Mars Society Independence Chapter had adjacent tables on the first floor of the New Jersey State Museum in Trenton, NJ for Super Science Weekend (January 12-13). This was a great improvement over our location last year and received significantly more traffic; no doubt because we were across from the entrance to the cafe!

Besides the table with two tri-fold boards with information about The Mars Society, and the NASA Design Reference mission, we also had a topographic Mars Globe on display. The big draw, however, was the 8 foot square simulated Mars terrain we set up next to the table. We had four chairs arranged next to the terrain and 4 radio controlled Rokenbok robots on the terrain that children (and a few adults!) could drive using the four controllers.

The children were tasked with "saving the astronauts" - toy astronauts that were distributed around the terrain. One of the robots had a scoop on the front, the other three had controllable pincers. The children would collect the astronauts and return them to the lander located in a corner of the terrain. A large cardboard standee of the old Lost in Space robot, B9, advertised the event with a sign. We gave each "crew" about 5 minutes to save as many astronauts as they could. We almost always had a line waiting to try and so I would guess we had about 500 children operate the robots over the course of the two days. While the children operated the robots, the person staffing the table could discuss Mars with their parents. We also gave away around 500 Mars Society pencils and a couple hundred brochures.

My sincere thanks to Mars Society Chapter members Richard Mallon-Day, Robert Meigs, Mitch Gordon, and Michelle Baker for helping to staff the table and assist the children running the robots. This was perhaps our chapter's most successful outreach effort yet. --- Gary Fisher

Congratulations, Gary, on your new Mars Society Steering Committee post!

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

Get Your "Gravity Brick" Sets Now!

Demonstrating the difference in gravity between Earth, the Moon, and Mars, these unique outreach tools are still available. Built of varying proportions of brick and styrofoam of the same apparent size, 16 sets have been produced to date for NSS, Mars Society, and Moon Society chapters around the country. One set was supposed to have been taken to the Mars Arctic station by Pascal Lee.

See www.lunar-reclamation.org/bricks_2.gif

Peter Kokh, who makes the sets, has enough materials left to make about 7 additional sets. You can order one for your chapter by check or money order for $15 made out to Peter, at 1630 N. 32nd St., Milwaukee WI, 53208. Allow 2 weeks, and on receipt, remit the cost of shipment as well.

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 #152 FEB. 2002

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

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

CHICAGO SPACE FRONTIER L5
○ $15 annual dues

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

MINNESOTA SPACE FRONTIER SOCIETY
○ $20 Regular Dues

OREGON L5 SOCIETY
○ $23 for all members

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

PHILADELPHIA AREA SPACE ALLIANCE
○ Annual dues for all with MMM $16, due in March or $4 times each quarter before the next March

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

Moon Miners' MANIFESTO

Lunar **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