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

Moon Miners' Manifesto

& Moon Society Journal

169 – October 2003

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 individuals world-=wide. EDITOR: Peter Kokh, c/o LRS, PO Box 2102, Milwaukee WI 53201. Ph: 414-342-0705. **Submissions:** "MMM", 1630 N. 32nd Str., Milwaukee, WI 53208; Email: kokhmmm@aol.com

In FOCUS: On the Road to Sudbury and Lunar Prospector 2

September 23, 2003, SUDBURY, Ontario, Canada. I find myself tonight, in an RV park just south of Sudbury, on a trip with a friend to the Canadian Maritime Provinces (Nova Scotia, etc.) and New England. I'd first been through this very special town decades ago, long before I knew that it was special. Founded first as a Canadian Pacific railroad hub, it soon became a lumbering center. But underneath lay relics of an ancient visitor, shattered shards that would thrust upon this town, a quite different importance. Nearly two billion years ago, an iron-nickel-copper-rich asteroid 35 cubic miles (146 cu km) in size plowed into what would someday be North America at this location, at mach 100, creating the second largest impact basin on Earth (the much younger 65 million year old dinosaur-killing Chicxulub crater in Yucatan being third largest.) In the intervening 1,850,000,000 years, nearby mountain building activity, a smaller impact creating the Wanapitei Lake basin along Sudbury's NE edge, and constant eroision have deformed the basin to the point that it can only be recognized from space - but from that perspective, it is quite clear.

Much of our current geological theory results from the examination of this site. Indeed, the Sudbury site and the craters of the Moon have shed light on one another.

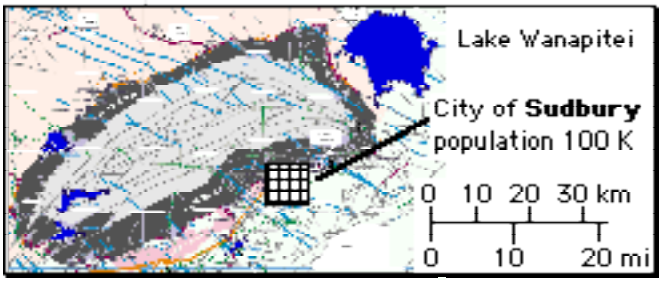
The nature of the 9 km (5.5 mi.) wide impacting asteroid that must have erased all life for hundreds of miles around, is the critical point: The Ni-Cu-Co-Pt-Pd-Au (**nickel, copper, cobalt, platinum, palladium, gold**) deposits in the Sudbury footwall are among Earth's most valuable. In 1995, an average 508 tons of nickel and 481 tons of copper were mined per day. A gift from the sky indeed!

The point

The elements listed above, all strategic to modern industry and technology, are precisely those in which the Moon seems to be most deficient. Apollo and Lunakhod rock samples show them to be present only in parts per million (or billion!) concentrations. This fact threatens to hamper the rise of a diversified industrial economy on the Moon, unless .... Unless the same sort of event has happened there! Now it may not have. The Sudbury impactor was an uncommon one. Most impactors are stony or stony-iron bodies that have left no such endowment. And while the Moon appears to us as the more heavily cratered, Earth, with its much more powerful gravity well, attracts eight times as many passing bodies into its maw. [➪ p. 2, col. 2]

Searching for a special "Star Wound" (astrobleme)

At right is a map of the central ore-rich crater at Sudbury, Ontario. We've found Helium-3 on the Moon. We have found Water-Ice at its poles. We are certain there are intact lavatubes there, but have yet to map them. Now we need to find a lunar equivalent to the strategic-metal-rich Sudbury "astrobleme." All this would complete a "1-2-3-4 punch" for a return to the Moon. Read pages 1-2.



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 organizations can be labeled by indirect mutual association is unwarranted.

• For the current space news and near-term developments, read *Ad Astra*, the magazine of the **National Space Society**, in which we recommend and encourage membership.

• **The Lunar Reclamation Society** is an independently incorporated non-profit membership organization engaged in public outreach, freely associated with the National Space Society, insofar as LRS goals include those in NSS vision statement. LRS serves as NSS' Milwaukee chapter
=> www.lunar-reclamation.org

• **The National Space Society** is a grassroots pro-space membership organization, with 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.

Our point is that it may have happened. How deficient the Moon is in these critical elements is unimportant *if,* and that's a big "if," a Sudbury-like event occurred somewhere, *anywhere* on the Moon. We simply have not yet examined the Moon's surface from orbit with instruments *designed to detect* any subtle, telltale signs that any crater was formed by such a metal-rich asteroid.

Question: what instruments could detect this bounty from orbit? We do not presume to know. Remote sensing experts could examine current orbital thematic imaging maps to see if the Sudbury structure shows any anomalous features that trace to the elemental makeup of the impactor. If no such clues show up, that is a sign that no instruments used to date are up to the task.

Then it becomes a problem of brainstorming the instruments designed to detect one or more elements in the Ni-Cu-Co-Pt-Pd-Au group, and putting such an instrument in Earth orbit to verify how well (or if at all) it picks up the Sudbury impact basin, identifying it as rich in these elements. If we succeed in this, the next agenda item is to put a duplicate instrument on board a follow-up Lunar Prospector probe and fly a thorough mapping mission of the Moon. Again, we may pick up nothing. But the stakes are high. If we do find a lunar Sudbury, even one much smaller in size, the import for the future of the Lunar Economy will be immense.

Discovery of a lunar "Sudbury" would guarantee that site as a candidate for a major industrial settlement. Even if it was a secondary one, in a remote area of the Moon, it would be vital to the lunar economy. If the Moon has to import all the nickel, copper, cobalt, platinum, palladium, and gold needed for its industries, this will have a negative effect on the lunar settlements' ability to achieve a positive trade balance, it's ability to earn enough from exports to pay for needed imports. A positive find would create a wave of optimism about the Moon's future, and enable the frontier to attract much more investment.

Discovery of a Ni-Cu-Co-Pt-Pd-Au-rich "Mother Lode" would be the third post Apollo "find" leading to a major rethinking of the Moon's potential economic import. First was the mid-70s discovery of the fusion fuel Helium-3 in solar wind gases trapped in the regolith powder. Second was the '98 discovery of major hydrogen deposits (water-ice being the simplest, most logical source) in permanently shadowed craters in the Moon's north and south polar regions. With each of these discoveries, the Moon has become much more than the barren rubble pile explored by the Apollo astronauts. Behind door # 1: Helium-3. Behind door #2: water-ice. Behind doors # 3 and #4 Ni-Cu-Co-Pt-Pd-Au and Lavatube mapping. These last two doors have yet to be opened. Our task is to do the orbital Earth-search first, then push for a Lunar Prospector 2. - PK.

Producing OZONE on the Moon for use in Water Purification and as a Rocket Thruster Fuel

by Dave Dietzler < Dietz37@msn.com >

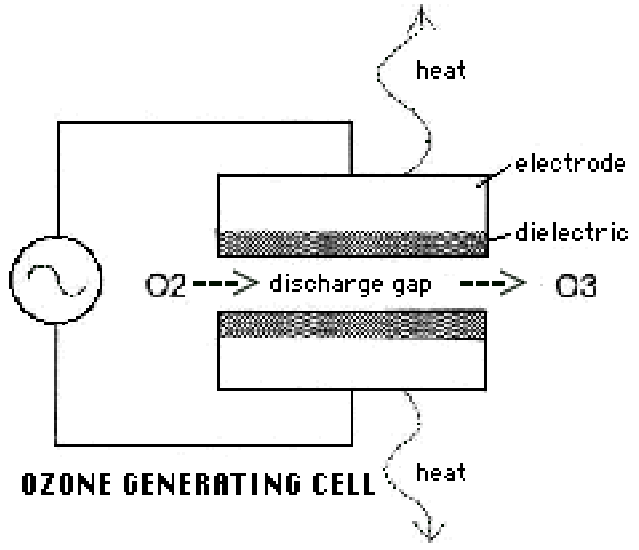
Ozone: O**3**, a triatomic form or Oxygen (normally diatomic, O**2**), a bluish irritating gas of pungent odor

There isn't much Chlorine on the Moon, but there is plenty of oxygen in the rocks and regolith. Oxygen can easily be converted to ozone with electrically powered ozone generators. Ozone can be used to safely sterilize water supplies more effectively than chlorine does and it is a powerful bleaching agent.

Some thinkers have suggested running water through glass tubes [1] on the lunar surface and letting solar UV rays sterilize water, but this won't work for 14 out of 28 days at most lunar locations. Also, do we really want to risk pumping our precious water through glass tubes that could be shattered by micrometer impacts? Or crack due to thermal stress? Or be easily destroyed by a terrorist with merely a sledgehammer? I feel much better about ozone.

Liquid Ozone is a more powerful oxidizer for rockets than is liquid Oxygen. Unfortunately, liquid Ozone is sensitive to mechanical shock and vibration and can decompose disastrously. Compressed gaseous Ozone won't do this, therefore it could be used for thrusters that burn silane. The use of silane (SiH**4**, a silicon analog of methane, CH**4**) and gaseous Ozone for thrusters could extend our precious Hydrogen supplies.

See illustration below.



[1] The editor [PK] has frequently suggested using quartz covered tanks for solar ultraviolet purification of waste water. Quartz lets solar UV through unimpeded, whereas glass partially filters UV. An easily changeable sacrificial outer pane of quartz could protect the quartz-lid from the vast bulk of micro-meteorite strikes.

Smelting Moondust : a PostScript

from Dave Dietzler < pioneer137@yahoo.com >

In my article in last month's issue [MMM #168] I went out on a limb and getseem to have been saved by serendipity. I've been fretting about the proportions of lime and SiO2 (silica, sand, same thing) in the stuff after H2SO4 treatment of moondust. It's about 80% SiO2 and 20% CaO after you break down the CaSO4 with heat and or carbon+heat. Cement is 65% CaO, 20% SiO2 and some other stuff. But concrete is made with a 1:2:3 mix of cement: sand: rocks 100 lbs. of cement(contains 60 lbs. CaO)+200 lbs. sand=300 lbs. That makes a 20% CaO and 80% sand mixture. I knew the CaO % was too low for cement but I figgered that when you mixed it up for concrete, it would work out and it does.

So what we do on the Moon is take the stuff that we filter out after H2SO4 leach of 'de-ironed' regolith, heat it (calcine) at 1400 C. or reduce with carbon to decompose CaSO4 to CaO (lime), then mix it with an equal amount of rocks (coarse aggregate) and we have concrete. We have to throw in a dash of CaSO4 also.

After extensive searching, I found out what happens when you mix molten silica with molten CaSO4. The CaSO4 breaks down to lime and SOx bubbles to the surface. They do this to refine glass, but these days they use Na2SO4 instead of gypsum. So molten unmixing which seemed so simple won't work. But it doesn't matter, because we can just make concrete! We can get the comparatively small amounts of CaSO4 just by washing in a 'percolator' or stopping the calcining before all of it breaks down into lime. How do we get the rocks (coarse aggregate)? We seive all the moondust to catch the rocks because we want the fine dust that will react better in the acid, and get more rocks by chipping away at boulders or blasting. Now if that doesn't work, nothing will.

Summing up with Pictures

Here's help to picture the smelting operation. This page has seven illustrations worth a thousand words each.

www.moonminer.com/Regolith_refining.html

For a follow up summary, also read:
http://groups.msn.com/DaveDietzler/followup.msnw

For a flow chart of the whole regolith smelting operation, go to:
http://groups.msn.com/DaveDietzler/moonmining.msnw?action=ShowPhoto&PhotoID=330

I'm just an amateur theoretical chemist in need of a laboratory, some witnesses and a video camera to prove my claims, and a US patent. :-) **< DD >**

For more of Dave's Brainstorming, explore:
www.moonminer.com

Early Frontier Highways on the Moon

by Peter Kokh

The Moon has a regolith blanketed surface of impact-pulverized rock rubble and powder of variegated graytones. There has been no weathering by wind or water and the pristine impact powder on the Moon remains angular and gritty. There are no rivers, not even dry ones (wadis or arroyos) to cross, no need to provide drainage.

On the other hand, the fact that the momentum of a moving vehicle remains "Earth-normal," its traction is greatly reduced in the Moon's light 1/6th normal gravity, means that extra attention must be paid to banking on curves and/or providing surfaces with enhanced "grip."

The earliest frontier roads; marked trails

Getting down to the nitty gritty bare bones essentials, a road or trail is essentially a route that someone has pioneered and which is visibly evident to anyone who would follow or retrace it. On the Moon, footprints and wheel tracks in the soft, easily compacted moondust, will remain visible for centuries or more.

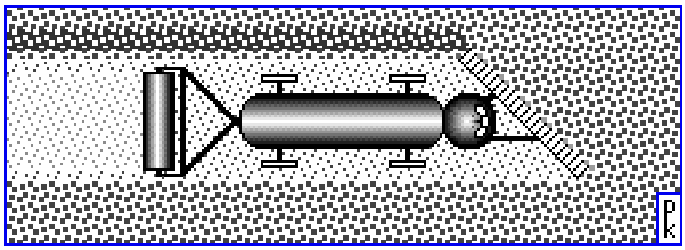
The amount of effort to be made in "construc-ting" a "road" depends on the amount of "traffic" that we anticipate. Clearly, that will change with time. In our own experience, ungraded dirt roads give way to graded ones, then gravel, and finally paved byways.

The first outpost may have a number of frequently visited out-stations: out-vac tank farms of fuel and other volatiles; warehouses; remote nuclear power station; a launch pad in early stages of becoming a spaceport; a scenic overlook or two; areas of enriched raw materials for early industry, etc. And there will be exploration and prospecting sorties to areas further afield, possibly scouting sites for additional outposts or "industrial parks.".

To aid in route surveying and "highroute" corridor designation, we will need more accurate, higher resolution lunar global altimetry maps than those now available. Based on the maps yielded by such a *TopoSat,* potential corridors and routes of varying breadth, both main and tributary branch routes, can be identified prior to decisions on where to site new outposts. Proximity to such routes linking poten-tial sites to the early population centers will be a primary, if not over-riding consideration in final site selections. This map of potential traffic routes, color-coded for sections needing special improvement, identifying and quantifying clear-grade and cut-fill hurdles according to difficulty and expensed options will provide one part of a Global Lunar Development Map.

Given the Moon's low gravity, grades steep by our own terrestrial standards, may present no big problem, at least not for wide-track vehicles with low center of gravity. But we'll want to pick paths with gradual changes in grade, and relatively free of large boulders - routes that promise to be relatively easy to negotiate - and which do not lead to dead-ends, e.g. into a box canyon, toward a cliff or escarpment, or into jumbled, chaotic terrain.

The simple passage of other vehicles following a first trail, will compact the moondust, making the route more clearly visible and easier to follow. But without minimal improvements, average speeds may be rather low. In general, routes will be picked that steer clear of boulders of any size, say a foot (30 cm) or so high. These smaller ones can be handled by the vehicle's suspension but wheeling over them will make for slow going. It will make sense to provide vehicles with a forward, canted rake that will "plow" them to one side. A second parallel pass would widen the "smoothway" to two "lanes." If the "plowing" vehicle has a trailing weighted roller, then smaller rocks of a couple inches (5 cm) or less will be compacted along with the moondust, making a rut-free smoothway that can be driven at modest speeds. With no additions of extraneous material, the road's color will be that of the host terrain, blending in perfectly. It will show up, from close up or far away, mainly by its clearly "processed texture." The earliest "roadmaking," then, will be a matter of "Rake & Roll."



Trail Smoother rakes/plows small rocks and boulders to one side, leaving pebble size rocks behind, to be packed into soft regolith by the weighted trailing roller. A row of boulders is left to one side. A return pass by the Smoother on the far side of the boulder row, will thicken that row and create a median strip. Boulders in the median strip can be removed where needed to allow left turns onto junction roads. Additional reverse-direction passes to either side of the median would widen the smoothway, and create smaller boulder rows marking the two shoulders. How wide and high would the boulder rows be? That would depend on the amount of boulders in the area smoothed. The boulder rows may be discontinuous, but would still effectively mark the way.

[For a way to trailblaze pioneer roads at no public expense, see Luna City Yellow Pages, this issue, page 8, # Trail Blazers, LLC.]

"Fixing" the roadway: dust-control

Away from settled areas, dust control, while always helpful (reducing and simplifying vehicle maintenance) will be less important. Depending upon traffic volume, the simple clearing of boulders and modest "smoothing" may

suffice over carefully surveyed routes. But regularly used traffic ways need be more than rut-resistan. They should also be dust-free or dust-stabilized.

Surfaces can be self-paved by fusing or sintering the top layers to a sufficient depth to support expected wheel weights, using microwave beams in a stereo array or focused solar beams in a controlled pattern to produce a hard but not glassy surface, textured to improve traction of spring-tired vehicles. Just how to do this is a matter that will require some amount of determined experimentation, first Earthside with analog materials, then with in-field/on-site confirmation tests with actual lunar produced materials under real travel conditions. Determining cheap and easy pavement options should be a priority "homework" item for the initial outpost-base.

One challenge will be the high surface temperature range of +400° F, +200° C., over the month-long dayspan-nightspan cycle. This will constrain the way and extent to which potential dust-fixers like sulfur are used. "Pavement" strengtheners such as locally produced fiberglass mats may be part of the solution.

As to lunar concrete bear, in mind that this is a sixth-weight environment and the "pavement" need not be as strong as that needed to bear up under heavy terrestrial traffic. At the same time, on the early frontier, we can expect a large percent of the traffic to be that of heavy "lith-moving, construction and mining equipment. On Earth, a six to one mix of raw on site soil with cement is enough to produce a serviceable walkway. But will such a low ratio mix sustain construction equipment traffic as well as lighter road traffic? Tests are needed!

Right of Ways and Road/Lane Widths

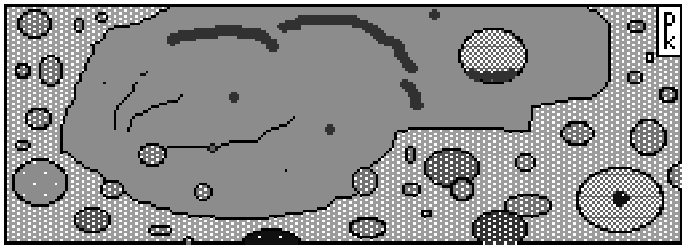
How wide should a rural highway be? This may seem a strange question. But on the wide open owned-by-nobody Moon, there would seem no reason to arbitrarily limit the width of vehicles, and determine lane widths accordingly. There are no potentially productive lands being eaten up by wider highway rights-of-way. With no air or atmosphere, there is no need for streamlining either. ("dustlining" is another question!) There are as yet no bridges or underpasses or tunnels of set size to influence width and height restrictions. On the other hand, there is low gravity - which brings with it proportionately low traction - along with unreduced full-normal momentum. Together, these conditions make wider than normal track and lower than normal center of gravity, wise design goals. We predict that lunar highways may be generously wide, lane for lane, by our standards.

But roads can always be widened, if the right of way set-aside is appropriately generous. At the very outset, where the traveler does not expect to meet oncoming traffic, one ample lane should be enough. Two ample lanes with a rock median strip, as described above, should do for quite some time. Eventually populations in various centers, and the trade and passenger traffic between them, may make wider, and even "limited-access" roads advisable.

Graded trails

The simple roadway preparation above, may work well enough for relatively flat mare [pronounce "MAH-ray'] plains of the Moon, the so called seas (actually seas of great lava sheets now long congealed), their upper surfaces reduced to powder and rubble by billions of years of meteorite bombardment and micro meteorite rain - the patchy areas of the Moon that look dark gray to the naked eye. And it is our guess that the first major lunar settlement will be built near a mare/highland coast, probably on the mare itself, for the significant industrial advantage of having access to both aluminum-calcium rich highland soils, and iron-titanium rich mare soils.

But even the maria (plural of mare, Latin for sea, pronounce MAH-ree-ah) are not totally smooth. Successive lava flows have left terminal slopes. Here and there, lavatubes too close to the surface, have collapsed into valleys called rilles, hundreds of meters wide and deep, many kilometers long. Here and there also, more recent major asteroid impacts have cratered the mare surfaces. And in some major impact basins, Mare Smythii being a good example, the subsequent lava floods have been too shallow to bury the older heavily cratered impact basin. The rims of ghost craters poke through the mare surface like so many coral atoll reefs.



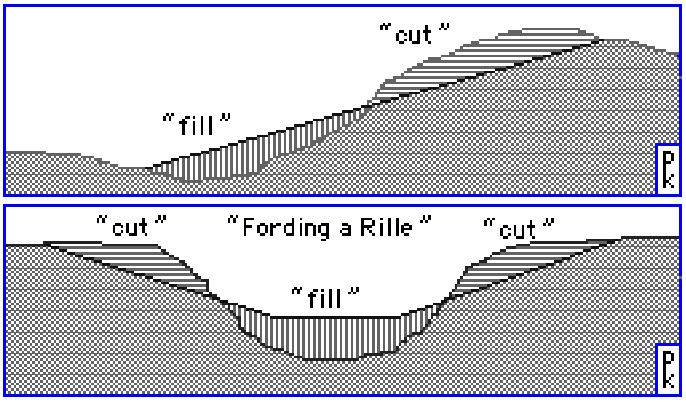
Lighter, crater-pocked highlands surround darker and flatter lava flood plains called maria. The mare, in turn, has several deep rille valleys (left) and flow front escarpments (top) as well as a few younger craters.

And in the highlands, even where reasonably negotiable routes can be found through "inter-crater plains," road making may require more than boulder plow-raking and "smoothing." Aggressive grading may be needed to fashion lanes free enough of small scale dips and mounds to permit acceptable travel speeds. What our Trail Smoother begins, or cannot even touch, will be the job of bulldozers, graders, and other earthmoving equipment.

It will be some time before roads outside the peripheries of the settlements are used regularly enough to constitute what we would call "traffic." Only when they do, will substantial grading, paving, and routing improvements to allow higher speeds and shorter trip times become financially justifiable budget priorities.

Forging shortcuts: cut & fill, causeways, bridges , tunnels

These early paths-of-least-resistance routes will do well enough for a start. But as global lunar population and intersettlement traffic grows, 'shortcuts' demanding extensive "cut and fill" work, perhaps even bridges and tunnels, will become justifiable expenditures. Looking at the sketch above, it is clear that without such engineering, we may have no choice but round-about routes, sometimes a hundred miles or more longer than a direct route. That means more hours spent in transit.



It may be some time before bridges and tunnels are built. "Cut & Fill" is easier, less expensive, low-tech: ideal for a small population with limited industry. The lunar surface is bulldozable down to a depth of 2-5 meters, 6-16 feet. Below that lies fractured bedrock. So major "cuts" will need the assistance of dynamite or other explosives.

Scenic Highroutes

On Earth, "scenic" roads often hug terrain features such as valleys, shorelines, ridges and mountain crests. On the Moon, it will be no different. Routes chosen for the views they afford will wind along rille tops or bottoms, crater rims, and mare coastal ramparts, lava flow fronts etc. As they may well be more expensive to build, such roads will come later, multiplying step by step as the domestic and *foreign* (terrestrial) tourist traffic increases.

Automated Self-Serve Roadside Service Pods

For travel off the beaten path, we must use self-contained vehicles that need no resupply other than what is obtainable from the surroundings. Range will be limited. But along improved roads open to routine travel, wherever the distances between settlements and outposts are substantial, safety and convenience will be promoted by the placement of automated solar-powered service stations.

At such "pit-stops," vehicles can pull up and hook up to refuel or recharge. The station's solar power units will recharge exhausted batteries, electrolyze water from fuel cell operation to make hydrogen and oxygen for refueling other fuel cells. And there will be on site solar power storage for limited nightspan operation.

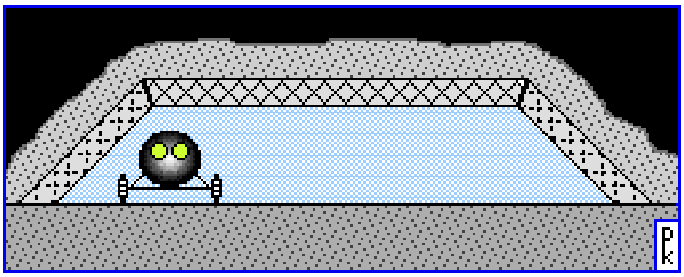
First aid supplies may complement emergency food rations. An antenna for high gain communications is likely to be available.

There may be a locked storeroom stocked with commonly needed parts and tools, accessible by credit card. Use a tool and don't return it, and you get charged not only the purchase cost of the item, but the cost of restocking it to the location at which it was "checked out."

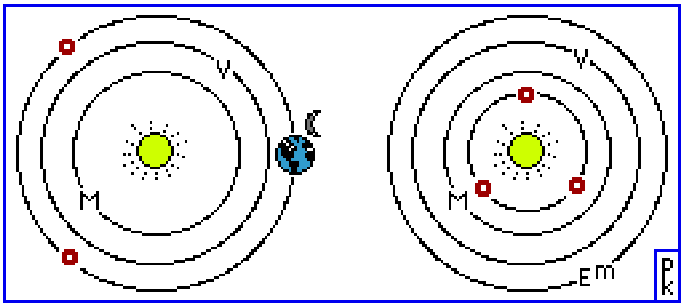
A computer in the main town could keep track of vended inventories and the quantities of water, hydrogen, oxygen, stored power reserves etc. This will allow scheduled just-in-time resupply and equipment maintenance.

Such Stations can be designed as compact units with modular pull-out/plug-in changeable components. They would be trucked to the site, following road-blazing crews, or in advance by all-terrain scout vehicles.

Next in priority will be "flare sheds," covered hangers where vehicles can find shelter from the occasional solar flare. Those readers who had the luck to see the made-for-TV Disney-ABC science fiction film "Plymouth" (shown only twice, Memorial Day Weekend in 1991 and '92) will appreciate the importance of such sanctuaries from the powerful radiation of solar flares.



As advance warning time for solar flares is rather minimal, these havens need to be placed at "reachable" intervals along regularly traveled routes. It will be a high priorty for the safety of lunar pioneers to agitate for early placement of flare-warning stations in orbit around the Sun. A minimum of two 120 ° ahead and behind the Earth-Moon system in the Earth's orbit around the Sun will do. Three, at 120° intervals in a close-in, within the orbit of Mercury, might be better. These orbiting satellites will be able to see around the flanks of the Sun to spot troublesome sunspots before they are carried by the Sun's rotation to the field of view visible from Earth or the Moon.



LEFT: A two satellite system in Earth orbit covers parts of Sun out-of-view of Earth & Moon to give complete advance warning. RIGHT: three satellites cover the solar globe at higher resolution, from an orbit inside Mercury.

A complete network would monitor developing storms anywhere on the Sun's surface. With such advanced warning, flare sheds could be placed at greater intervals.

Such sheds can be designed and erected in modular fashion, to grow in shelter capacity as road traffic warrants. In time, some of these refuges may become the nuclei of staffed service centers, including restaurants, lodging, and even recreational facilities.

Motoring on the Moon will be a very different experience for those accustomed to road travel on Earth. Here, even in remote areas from from the roadside spam of non-point-of-interest billboards, even in the most arid of desert and mountain areas free of vegetation, we enjoy conditions not to be found on the Moon. Without water-vapor laden air, lunar skies will be black, even when the glare of sunlit moonscapes is intense. A passing truck will be scarcely noticed, with no telltale "suction" effect as it passes. Vehicles will have to be fully pressurized and more dependable, with backup systems. Without air and wind, awnings against the solar glare will cause no drag.

Properly routed, with scenic overlooks and opportunistically placed waysides (replete with sculpture gardens) lunar highways need not be boring. Yet, to the same people who on Earth feel that "when you've seen one mountain (river/waterfall/lake/cliff/valley) you've seen them all" the Moon will be especially boring. To those of us capable of sensing and appreciating the differences and who marvel and are awestruck by the endless variety, there will be no shortage ofscenes full of wonder.

Early highway passenger vehicles will be more akin to our "coaches" or "greyhounds", not in shape or size, but in function. Personal and private vehicles will be available on pressurized in-settlement streets, long before they become affordable or common out on the surface., When they are built, they may be mainly rental vehicles. Few pioneers will need personal transportation between settlements until the population grows substantially, and the economy has diversified considerably. **<MMM>**

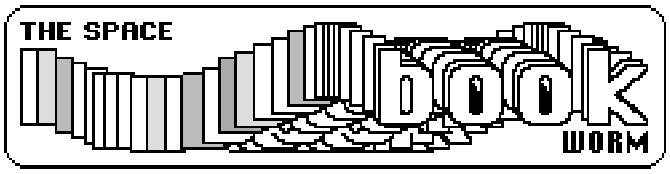
Relavent articles from these past issues of MMM

37 JUL '90, "Flare Sheds" pp. 4-5

79 October 1994
p 13. Lunar Roads
p 16. Lunar Vehicle Design Cconstraints

81 December 1994
p 3 Rural Luna: Surface Vehicles & Transportation
p 4. Over the Road Long Distance Trucking Rigs
p 5. Toadmobile Conversions
p 6. Beyond the Beaten Path: Skimmers
p 7. Spider (vehicles); Camping Under the Stars

82 February 1995 p 7. Rural Luna: The Beaten Path
85 May '95 p 7. Waysides; Farms; p 8. Mines
86 June '95, p 7. Science outposts; Recluse outposts



Home on the Moon:
Living on a Space Frontier
by Marianne J.Dyson

Former NASA Mission Controller and Winner of the 1999 Golden Kite Award for best Science Book for Children

Published 2003 by National Geographic, Washington DC
ISBN 0-7922-7193-9. 64 pages, for ages 8-12, $18.95 retail.
For more information, contact: mjdyson@swbell.com

Reviewed by Peter Kokh [more, page 10, col. 2]

This is not the first chidren's book about the Moon. I have bought others, and been disappointed. The writer always got the "facts" right. But "just the facts," without the possibilities, become "half truths" giving distorted impressions. Yes, the Moon is airless. So? Yes the Moon has no liquid water. So? When you know all the facts, including the real possibilities, these bits of trivia become irrelevant.

Dyson clearly shows the young reader how, with the help of technology, human resourcefulness, and the Moon's own resources, we can live full and exciting lives on this frontier world. Written in large print and plain English to be easily understood by today's middle schoolers ("ages 8-12"), Home on the Moon takes the reader back to the first Apollo/Saturn V Moon mission, then to the letdown years since. With technology developed in the interim, the price tag for lunar outposts now seems much lower. Living on the Moon seems much less dangerous. We now know the Moon has water-ice. We know how to recyle precious elements in agricultural and human wastes, how to provide a radiation-proof blanket of moondust over our habitats, how to make useful metal alloys, and other practical building materials out of the elements common in the soil. The author talks about the Moon's origin and how it got to be the way it is; about its resources, and where they are to be found.

The illustrations are clear, well chosen, and easy to understand for the young reader. "Activity experiments" are included (e.g. demonstrating how a crater is formed; making simulated moon rock from edible ingredients.) The reader learns how pioneers will produce metals, air, water.

Dyson explains how transportation costs will come down, how the early outposts may be built, and how pioneers will get from here to there. She also shows how pioneers will have fun doing things impossible in our heavy gravity, like human-powered flight. The book includes a glossary.

If you hae kids, grandkids, or neices and nephews in, or soon to be in this age bracket, get the book. If you do not, get it anyway and donate it to a school or library. We need to get the word out about the liveable Moon! Hats off to Marianne Dyson for an excellent contribution. **<PK>**

Luna City Yellow Pages

Moon Rock Suppliers

Frigoris Road Rocks, Inc.

A Subsidiary of Frigoris Road Construction Co.

We sell rocks of all sizes collected in road construction. Breccias, whole or cut and polished per your request. See our catalog for specialty carved rock items. We also produce rock-face wall-clading.

Prices per item | per metric tonne | per cubic meter

We have a fine selection of moonscape photographs taken by our road crews. These can be purchased as is, or overprinted per your specifications.

Also moving moonscape pans and sequences for use in computer edited movies.

Purchase online at www.frigorisroadrocks.com.lu

or visit our showrooms in North Junction at
29 Amundsen Road - Ph: *3-**377-6247**
in Luna City at 213 Heinlein Trail - Ph: *1-377-6247

Excursions, Off-Trail

Trail Blazers, LLC.

Virgin Territory Excursion Opportunities

We are under contract to the Lunar Frontier Republic, Frigoris Province, to conduct pioneering trailblazing traverses of routes identified as negotiable from orbital high resolution data.

Some of these routes will become future highways.

On each Trail Blazer Excursion, we have room fo
a supplemental crew of 15 persons.

Expertise that will prove useful:

- photographic skills (photographic album of traverse)
- geology & prospecting;
- economic geography (frontage characterization) etc.
- mechanics license - LandRover ™ FerOx™ engines
- doctor, nurse, paramedic, cook

State your talents and hobbies in your resume.

If we are interested, you will be called for an interview.

Opportunities occur frequently.

To learn more, or purchase videos of past Trail Blazer Excursions,Visit us Online at:

www.trailblazer.com.lu

Visit our Trail Blazer Museum
31 Amundsen Road in North Junction

For hours or group tour appointments, call
*3-825-2937

Magazines & Periodicals

Lunar Frontier Highways ®

The magazine that takes you
"everywhere on Luna within reach of a road"

Available Online in PDF format and with accompanying archived discussion list (moderated)

www.lunarfrontierhighways.com.lu

Also see our monthly hour-long Cable TV show (see your local TV-Cable Guide for date, channel, time)

Attention photographers and writers!
We are always interested in free lance submissions, but please query us first.

query@lunarfrontierhighways.com.lu

editorial office: 401 Crisium Parkway, Luna City
Phone: *1-**344-6267**

Highway Travel Outfitters

RoadMaster Outfitters

Let us Optimize your Travel Experience

Custom fit your vehicle to suit your travel needs with our leased, rented, or purchased packages

- **Extended sortie packages**
  - Reserve power (fuel cells)
  - Emergency food rations
  - CELSS packages
  - Portable EZ-shield-on-site™ shelters
  - EVA suits
  - EVA hobby tools (prospecting, rock collecting, photography, more)
- **Nightspan sortie packages**
  - Night vision vehicle package
  - EVA Nightvision packages
  - Supplemental heating
- "**Com-Tainment**" **packages**
  - High gain antennas - pick up Earthside radio stations and TV channels

Visit our two showrooms

33 Amundsen Road, North Junction *3-762-7837
225 Heinlein Trail, Luna City *1-762-7837

Visit and shop Online
Www.roadmasteroutfitters.com.lu

Our first goal is your safety and convenience
Our second goal is repeat customers

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 cooperation with other like-focused organizations and groups.

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

Join/Renew Online at
www.moonsociety.org/register/

- $35 USA/Canada + MMM hardcopy
- $60 elsewhere + MMM hardcopy
- $35 anywhere + MMM electronic PDF file
- $20 Student/Senior + 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

Artemis Society vs. Moon Society

Many people are still confused on the relationship of the Moon Society to Artemis Society International. Some think it is just a name change, one replacing the other. That's not at all true. Both organizations continue to exist, each pursuing its proper goals with less distraction.

Moon Society President Gregory R. Bennett puts it this way:

"Artemis Society International is a Research Foundation. The Moon Society is a Membership Organization."

"The key reason for forming the Moon Society was to get ASI out of the membership services business and back into research." Thus Artemis Society International continues to work on the technical aspects of the Artemis Moonbase Project, ever improving the reference mission. Meanwhile, membership services, including chapters and the newsletter are now handled by the Moon Society. The Moon Society also seeks working relationships with other Moon-focused organizations.

India's Moon Mission is Reaffirmed

India hopes to put its **Chandrayan-1** spacecraft in a 100 km high polar orbit around the Moon no later than 2008, according to Prime Minister Atal Behari Vajpayee, speaking to the nation on India's Independence Day, Aug.ust 15th. His remarks ended doubts about the project. The Indian Space Research Organisation (ISRO) will spend about $100 M on the project. [Compare with $69 M cost of **Lunar Prospector**.] The 525 kg satellite, with 60 kg available for science payloads, will make the ride on one of India's own Polar Satellite Launch Vehicle (PSLV).

Over a two year period, Chandrayan-1 will gather data for a global chemical map of the Moon's surface. High-resolution remote sensing in the visible, near infrared, low and high-energy X-ray regions will provide date for the creation of A 3-dimensional atlas of "regions of interest" - the north and south polar regions and the enigmatic SPA (South Pole - Aitken) basin, an immense, deep, and ancient impact basin never flooded by subsequent lava flows.

Instruments being considered: terrain mapping camera; low energy X-ray spectrometer covering 0-10 keV region; hard X-g-ray spectrometer covering 15-200 keV region; laser ranging instrument; 32 channel hyperspectral spectral image at 80 m resolution that can distinguish anorthosite (highland), basalt (mare) and some minerals expected to be present at some depth within the moon.

Observations at a 5 m (16 ft) ground resolution in the X-ray spectrum and with stereo-graphic coverage of most of the Moon's surface is designed to provide new insight in understanding the processes that have fashioned the lunar surface.

Moon Society Elections 2003 Results

From Gregory R. Bennett, Moon Society President

Uncontested Positions: Elected to a 2nd Term were:

- Vice-President: David Wetnight
- Secretary: Amy McGovern

3 Contested Directors Directors Positions: The election for Moon Society Directors resulted in a tie for one of the open positions. We will plan how to resolve the election and report the resolution in next month's issue.

Time to Think Ahead: Elections 2004

by Peter Kokh

At the October 1st Leadership Council meeting, Moon Society President Gregory R. Bennett suggested we look into adopting Term Limits. His proposal is to limit any officer to two terms, before stepping aside. The retiring officer *would be eligible* to run for another (a different) position) and, two years later, if he or she so chose, to run again for the original position. The two plusses are:

- it gives new persons the chance to advance, and to contribute their talents and insights to the Society
- it gives retiring persons the chance to refresh their sources of inspiration, rethink positions, and recharge

Those participating in the October 1st Leadership Meeting (held electronically on ASI-MOO) seemed to be generally in favor of such a change in the election rules. The matter is under investigation as to the legal process needed to make the change. Meanwhile, the proposal is open to amendments and suggestions from any/all members.

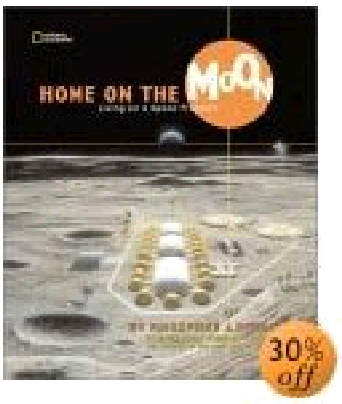
-- comments sent to kokhmmm@aol.com will be passed on.

Personal reflections: While the idea seems reasonable and proper on the face of it, there is some real risk. The Moon Society membership is small in comparison with other space organizations, and, as a consequence, the number of potential qualified volunteers for office is proportionately limited. *If we adopt rules that guarantee* the (at least temporary) retirement of the current President and Treasurer of the Society next year, can we be guaranteed that qualified persons will step to the fore and either nominate themselves for these positions or accept their names being placed in nomination by others?

I think we must take that risk, but a risk it is. Both President and Treasurer are jobs that require dedication of considerable time and effort. If we cannot find new persons to step forward, perhaps we don't need to continue in existence. If you have leadership skills and the motivation and insights require, *consider now* putting your name in the ring *next summer*, when we go through this whole process anew. **‹ PK ›**

Moon Society Member Publishes New Children's Book "Home on the Moon"

See the Review of Marianne J. Dyson's latest book on page 7, column 2, this issue.
Do buy it!.



Amazon.com has it for $13.27 new and from $7.94 used.

A great price for a gift to your local library or middle school.

Announcing "Moon-Discuss"

From the Moon Society LeadershipCouncil

Since the Artemis Project was started, there has been a public mailing list (artemis-list@asi.org). This list has served as a forum for many kinds of technical questions and debates about ideas on returning to the Moon. It is an open list, and non-members can participate.

Now that the Moon Society has been established, and our back room operations have improved over the last year, the Leadership Council has put in place a new General Discussion Forum. This will serve as a place for members (only) to continue to debate and discuss the return to the Moon, future moon missions, and other Society issues, such as outreach, conferences, and projects, that have long needed a place separate from the Artemis Project.

It is the council's goal that the new list continue the fine traditions of the Artemis Project list. The Artemis list is still active and no changes are in the works.

"Exploring the Moon" on Planetary Radio

Two Radio Shows You can listen to on the web.

http://www.planetarysociety.org/audio/pr-archivesubject.html#moon

You need either the Real Player or Windows Media Player. Either can be downloaded from sites above

The Moon, Ion Engines, and Helium 3 ..What More Could You Want? – Airdate: October 6, 2003
http://www.planetarysociety.org/audio/pr20031006.html
Guest: Bernard Foing, Project Scientist for SMART-1

SMART-1 Goes to the Moon - *Airdate: August 11, 2003*
http://www.planetarysociety.org/audio/pr20030811.html
Guest: Bernard Foing, Project Scientist for SMART-1

Mail for MSJ

Are there any Satellites in Lunar Orbit? Does Anything Orbit Around the Moon?

Question Recently Asked on Artemis-List
Response from Arthur P. Smith < apsmith@aps.org >

There are apparently 4 man-made satellites still (believed to be) in lunar orbit, the oldest being Luna 10, launched in 1966. I couldn't find orbital parameters on 3 of them, but the Japanese Hagoromo orbiter had an elliptical orbit with closest approach 7400 km, furthest 20,000 km, so in the range I indicated was reasonable stable (on a scale of decades at least). Unfortunately, all these orbiters have ceased functioning many years ago. (Hagoromo never worked at all, other than to insert itself into a lunar orbit). See : www.habitablezone.com/space/messages/293593.html

Artemis Magazine – issue # 8 is on its way

from Ian Randall Strock, Editor, < irs@panix.com >

Artemis Magazine is on its way to the printer. Issue #8 should be available soon, and with our newest distribution deal, far more copies will be available in book stores than any of the previous issues. Issue # 8 has work by Spider Robinson, Jerry Oltion, Bud Sparhawk, Edward M. Lerner, John C. Bunnell, our own Arthur Smith, and the latest columns of Allen M. Steele and Daniel M. Kimmel.

We need more customers. A few new subscriptions would really help the magazine's cash flow right now. The first issue of a new subscription can either be the last one put out, available right today, or issue # 8, available just as soon as copies arrive from the printer. Subscription renewals and gift subscriptions are equally valuable to us.

The average life of a start-up magazine is 0.8 issues -- many magazines that are announced don't ever publish a first issue. Of those that do, the average life is 3 issues. So we're way ahead of the curve. This year, Artemis Magazine came in 7th on the Hugo nominations list in our category; we'll be putting about 3,000 copies on the newsstands of issue # 8; and the future ilooks bright. It's now just a problem of getting from here to there.

So, thank you, all, for any help you can give us. Subscriptions make good gifts, and gift subscriptions to libraries can also help us publicize the whole Project.

They're available for **$15 for 4 issues**, or **$24 for 8** (in the US, $20/$32 in Canada; $30/$45 elsewhere), to:

LRC Publications
1380 E 17 St, Ste 201
Brooklyn, NY 11230-6011 USA

India's "The Planetary Society of Youth" Seeks Collaboration with Moon Society

To: Peter Kokh
Moon Society Chapters Coordinator

I thank you for sending me information about the Moon Society. And I am very grateful to the Moon Society for supporting our Society's effort to run Moon related events in India.

The TPSY [The Planetary Society of Youth] is going to launch a Contest for School Students. The theme of the contest is "Design a Mission to Moon". And I invite the Moon Society to be involved in this Contest. By this your society will gain publicity in INDIA. And to be sure, you will be able to get more members from India.

Yes, we wish to have sort of association with Moon Society. So please let me know more about it.

And we would like to receive some materials from Moon Society to pass them during our events:

- An Artemis Project poster
- A set of postcards showing the phases of the Artemis Project first mission
- A bumper sticker
- Moon Society brochures
- T-shirts, etc

I hope you will be able to send the above items to our society. On Jan 11 and 12th, 2004, Our society will hold an International Space Expo. And on that ocassion, I will be able to showcase your society in the Expo. And our Society is very eager to start Moon related events in India with Moon Society. So please help us.

The Planetary Society of Youth
Amrut Yalagi
21 Main Road, Vijay Nagar,
Near Engg. College,
Bagalkot - 587 102
Karnataka - INDIA

Current TPSY organization membership breakdown:

1. Student Members: - 500
2. Ordinary Members: - 1,000
3. Life Memebrs:- 1,000
4. Donors: - 10

Upcoming TPSY Events : [underlined of interest to TMS]

- Lunar Eclipse on November 8, 2003
- Rocketry Workshop on December 18, 2003
- Conference on Moon Mission on December 20th, 2003 with Indian Space Research Organisation (ISRO)
- Frontier Science and Cutting Edge Technology; International Space Expo - January 11-12, 2004
- Design a Mission to Moon Contest, Yet to be announced
- Transit of Venus on June 8, 2004 **<TPSY>**

Moon Society Chapters & Outposts — The Outpost Frontier Report

Brigham Young University Student Outpost

from Jonathan Goff < jag42@et.byu.edu >

A pre-kickoff meeting for the newly renamed "**BYU Space Development Club**" was held Thursday evening, Sept. 18th at 5-6 pm in 250 CTB. The meeting was to be mostly an information meeting, as well as a little logistics planning for an upcoming activity the following week

Over the summer we submitted some bylaws and an application to the College of Engineering and Technology, and we just received news this week that the Club has been okayed. It will be organized under the College, instead of through BYUSA, so it should be a little easier to organize.

An account for the club has been set up, and we have permission now to schedule rooms for meetings on a more permanent basis.

As to our new name, we decided to broaden the scope a bit (so as to encourage people interested in Mars, the NEOs, or Space Access to join as well). However, we will still act as the Student Outpost for the Moon Society (and maybe the Mars Society). Kinda like the Lunar Reclamation Society does. Anyway, we'll see where this goes, but I'm optimistic.

September 18th Meeting Report: We had a brief presentation by me about the importance of commercial space ventures, and the purpose of the Space Development Club. We discussed logistical items needed in the coming week. We also discussed a little about potential projects (the catalytic torch igniter, and Len Cormier's TPS system).

On Oct. 9th, the College is sponsoring an event for all the clubs and societies in the college. All of them are invited to put up tables from 12-3pm with stuff about their club, and have registration sheets for anyone who wants to join. Refreshments will be provided by the college, and they'll have terminals setup inside the Clyde building so people can sign up for societies with online registration (such as AIAA, The Moon Society, and The Mars Society). We have several things we need to get done before then, and we divided up the following action item responsibilities:

- Prepare membership registration form
- Arrange for webspace & setup preliminary website (done) http://www.et.byu.edu/groups/sdc/
- Prepare Poster

I also spoke with Dr Eastman about the igniter idea, and he said that it is something we could work on. I suggested doing it in conjunction with Unity IV (since they need a good reliable igniter), and he said that there is probably enough money to try and develop the system, but that should probably be brought up in the rocket class. I've got a few sketches in my lab book back home, and I can rough up a CATIA model for anyone interested. **<JAG>**

Chapter & Outpost Resources Online

The Moon Society Chapters Coordinator keeps a log (with active links) to resources appropriate for use by Moon Society Chapters and Outposts on the Space Chapters Hub website. This log is online at:

www.moonsociety.org/chapters/milwaukee/msmo_output.htm

Moon Society St. Louis

www.moonsociety.org/chapters/stlouis/

from Keith Wetzel < kawetzel@swbell.net >

We have just rolled out an updated version of our chapter website, URL above, so take a look. It still needs a little tweaking and some more information added, but it is servicable enough.

Check out the member bio info links; I knew we had a couple of talented folk, but when I read their bios it blew me away! One sad note, we may have lost a member, our original webmistress, who set up all pages/layout has disappeared, maybe she got side tracked by school and/or her job, but after several email attempts, she hasn't surfaced yet.

Archon 27, the big local Sci-Fi Con in St Louis is the weekend of Oct. 2-5th. MSSL is going to have a Club/Info table in the main convention center on Sat Oct 4th.

Moon Society San Diego

www.moonsociety.org/chapters/sandiego/

from David Shrunck < DOC SCILAW@aol.com >

We have just redone our new chapter's website and invite everyone to take a look!

Calling all Joint Moon Society / NSS members Introducing a new "Liaison Chapter" – Maybe

from Peter Kokh < kokhmmm@aol.com >

Some Moon Society Members, who also happen to be members of the National Space Society, are exploring the idea of starting a Moon Projects Special Interest Group or "at large" chapter in NSS. The idea promises these advantages:

- access to a much larger pool of Moon-interested persons
- access to a larger talent pool
- access to greater financial resources

Hopefully, the new chapter would be able to take on projects of interest to both Societies and have a much better chance of pulling them off.

As of print time, four Moon Society members have expressed interest. We need more! If you are a joint TMS/NSS member and are interested, please contact me.

Vulcan, No. "Vulcanoids", Maybe

From Louis Friedman, Exec. Dir., the Planetary Society

Vulcan: a hypothetical planet proposed by the 19th C astronomer Le Verrier, the codiscoverer of Neptune, calculated to revolve about the Sun within the orbit of Mercury. No such planet was never found. -- Ed.

Vulcanoids: a hypothetical swarm of asteroids in the same orbital area as the never-found Vulcan. -- Ed.

As a result of repeated discoveries of other swarms of asteroids in our solar system -- each one first predicted by astronomers long before observatories could see them -- scientific interest in vulcanoids has been re-awakened. The near-Earth asteroids, the Centaurs orbiting the Jupiter/Saturn region, the Kuiper Belt past Neptune, all have been found once astronomers predicted them in so-called "dynamically stable" niches of the solar system.

Now it's the vulcanoids' turn. ... Some theories do keep showing that they should be there. And if they do exist, they could provide insights into our solar system's history unlike anything else. Here's why:

All of the inner planets - Earth, Mercury, Venus, and Mars - have been drastically altered since their formation. They've been bombarded, melted, fractured, weathered, mixed up, re-melted - a process that 'has made life possible here ... but has also made it virtually impossible to really know what these planets looked like in the beginning -- these large bodies are all "differentiated," heavy elements like iron, have sunk to their cores.

The vulcanoid asteroids, if they exist, are small and scattered, and would have retained most of their basic qualities over billions of years. They'd very likely be ... a pristine "snapshot" of the early inner solar system. Finding them would ... rewrite the astronomy textbooks.

A one-time opportunity - NASA is retiring the 40 year old **Black Brant** suboribital planetary science mission program. Just three of these rocket flights remain on the schedule at White Sands Missile Test Range. The Planetary Society has the chance to have a "piggyback" experiment aboard.

Vulcanoids would be very small and orbit so close to the sun, that Earth-based observers cannot see them in the Sun's glare. Our only chance to observe them is just before sunrise or just after sunset from high above the thickest part of the atmosphere. Alan Stern and Steven Durda of the Southwest Research Institute in Boulder, CO, have created a sensitive camera specifically designed for the task. A flight on a F/A-18 Hornet fighter jet to 49,000 ft was not high enough. On a Black Brant flight they should be able to find any vulcanoids a few kilometers across.

The Planetary Society is seeking donations to help meet this sudden opportunity. Send to "The Planetary Society," 65 North Catalina, Ave., Pasadena, CA 91106-2301. or give online: https://planetary.org/donations.html

New Europa Study Looks at Mysterious Ice Domes, Search For Evidence Of Life

www.colorado.edu/news/releases/2003/340.html

U. of Colorado at Boulder News Release Sept. 2, 2003

A new U. of Colorado - Boulder study of Jupiter's moon Europa may help explain the origin of the giant ice domes peppering its surface and the implications for discovering evidence of past or present life forms there.

Asst. Prof. Robert Pappalardo and PhD student Amy Barr previously believed the mysterious domes may be formed by blobs of ice from the interior of the frozen shell (likely about 13 miles thick) that were being pushed upward by thermal upwelling from warmer ice underneath. Europa is believed to have an ocean under its icy surface.

They now think that dome creation also requires small amounts of impurities, such as sodium chloride or sulfuric acid. These compounds melt ice at low temperatures, allowing warmer, more pristine blobs of ice to force the icy surface up in places, creating the domes.

A paper co-authored by Pappalardo and Barr was presented at the annual Division of Planetary Sciences Meeting held September 2nd-6th in Monterey, CA. DPS is an arm of the American Astronomical Society.

Europa experiences major tides as it elliptically orbits Jupiter - strong enough "to squeeze the moon" and heat its interior Warm ice blobs rise upward through the ice shell toward the colder surface, melting out saltier regions in their path. The less dense blobs can continue rising all the way to the surface to create the domes.

The domes - some more than four miles wide and 300 feet high - and are found in clusters on the surface. Said Barr, "it is possible that any present or past life or even just the chemistry of the ocean may be lifted to the surface, forming these domes." The idea that either small amounts of salt or sulfuric acid might help to create the domes was Pappalardo's, who knew about similar domes on Earth that form in clumps in arid regions. On Earth, it is salt that is buoyant enough to move up through cracks and fissures in rock formations to form dome clusters at the surface. Infrared and color images taken of Europa by NASA's Galileo spacecraft seem to indicate some of the ice on the surface of these domes is contaminated. Impurities seen at the surface are clues to the internal salty ice composition of the Jovian moon.

Europa's surface is constantly being blasted by radiation from Jupiter. This likely precludes any life on the moon's surface, but a spacecraft might be able to detect signs of microbes just under the surface. A National Research Council panel called for an Europa Orbiter to be launched iwithin the decade. Its objectives would include confirming the presence of an ocean, remotely measuring the composition of the surface and scouting out potential landing sites for a follow-on lander mission. **</MMM>**

GREAT BROWSING !

Planetary Radio

www.planetary.org/audio/planetaryradio.html

The Pluto & Europa Campaigns

www.planetary.org/html/
UPDATES/Pluto/pluto_europa_action.html

Astronomy Workshop Tools

http://janus.astro.umd.edu/awtools.html

Space Music

www.prometheus-music.com/space.html

The Moon in Science Fiction

www.biblioinfo.com/moon/sf_moon.html

Earth-size Worlds around other Suns

http://SkyandTelescope.com/news/article_1041_1.asp

International Space Exploration and Colonization Co.
Closed Ecological Life Support System Research
http://isseco.org

Life Support

lots here for techno-nerds who like diagrams:
http://flightprojects.msfc.nasa.gov/book/chap5.html

Europe's Smart I Mission Homepage

The Smart I craft will make an x-ray map of the Moon. When it arrives there after a 15-month voyage, it will begin searching for water-ice in pshaded polar craters and determine the abundance of surface minerals. In the process, it will look for landing sites for future lunar exploration such as a sample return mission planned by the US space agency (NASA) for 2009.

http://www.esa.int/export/esaMI/SMART-1/

Earth-Moon System in Far Future

Earth and Moon will not always be the same distance apart as they are now. The length of the month, and the length of the day will converge, and then ....

http://www.earthsky.com/2000/esmi001009.html

Open Directory Project: Space Colonization

http://directory.google.com/Top/Science/
Technology/Space/Space_Colonization/?tc=1

Habitation 2004

Conference on Space Habitation Research and Technology Development

January 4-7, 2004

Rozen Plaza Hotel, Orlando, Florida

http://habitation2004.org/

Principal Sponsors:

- ***Habitation****, *Internationall Journal for Human Support Research* *fka ***Life Support and Biosphere Science**, *International Journal of Earth and Space.*
- National Aeronautics & Space Administration (NASA)
- American Inst. of Aeronautics & Astronautics (AIAA)

"Habitation 2004" will bring together scientists and engineers engaged in research and technology development that enables long duration missions for human exploration of space. This conference will be an open forum that provides an opportunity to present research results and share data and other information.

"Habitation 2004" is open to all interested participants from any nation and all organizations, including academic, government, not-for-profit, and industry.

Registration Fee: $350 before September 1st 2003, or $395 afterwards. Student registration fee is $150

Hotel Rooms: $135 single / double, $155 triple, plus tax

Focus Areas: include the following:

Monitoring & Control- advanced air/ water monitoring, microbial detection & control, environmental monitoring; integrated testing and advanced habitats, including ISS

Human Life Support- self sufficiency and reliability in life support; hybrid bioregenerative life support; human-rated closed environmental life support ground test beds; biologcal and physical-chemical methods for air and water purification; food production/processing; food processing and nutrition; genetic engineering of plants and microbes for life support systems; physical/ chemical life support; bioregenerative life support systems; thermal control; systems analysis and modeling; extravehicular activity

Human Factors & Ergonomics- h.f. engineering; h.f. simulators; individual/group effects of long-duration isolation; interface design for teleoperation and control of semi-automatic equipment; physical, informational and opera-tional models of human performance in artificial habitats; crew training procedures; selection, training, assignment for long-duration missions; just-in-time training, job aids & procedure design for long-duration missions; design of habitat, medical, equipment maintenance tasks; time/activity management; human reliability in long-duration mission design; communications; habitability measurement/design.

Mail For MMM

"Sealing a Lavatube"

9/17/03, pioneer137@yahoo.com (David Dietzler) writes:

"Whenever I think about lava tubes I imagine spacesuited workers on scaffolding slapping plaster or cement on the walls. My own stupidity amazes me at times. After sealing the opening, we should just send a wheeled robot in there that sprays the cement or plaster all over the porous walls, if the walls are very porous to begin with. Then all we have to do is condense the water vapor if it doesn't freeze out in there. A few robots the size of pickup trucks is all we'd need. Then we just pressurize the tube, go inside and start stacking bricks, pouring concrete, wiring, plumbing, etc. and build the Lunar Hilton.

All we have to do is find a nice lava tube."

Editor's response: As I understand it, the rock around the lavatube is likely to be fractured. Cement or plaster may help, but would probably freeze before it could bond.

I wonder if spraying with steam or water vapor wouldn't be the only thing we'd need to do. The water vapor would find its way into the cracks and freeze, sealing them in the process. Tube temperature is likely to be no more than 80 Kelvins, pretty cold. To me, sealing and pressurizing a lavatube is an advanced, farther future, endeavor.

Yet spraying the dark tube walls with concrete or a lime whitewash would definitely brighten the tube and make it possible for less lighting to do more. Near term I would:

Phase I

1) grade the entrance for ease of entry and exit
2) knock down any loose debris, preemptively
3) grade a roadway through any rubble on the floor
4) erect space frame platforms above the rough areas
5) deck same
6) deploy insulated inflatable structures and pressurized passageways between them. The advantage would protection from both cosmic radiation and micrometeorite impacts without having to cover the structures, directly or indirectly, with enough loose regolith soil to provide such protection. Plus plenty of room to expand.

Phase II

7) drill holes through the ceiling to run optic fiber bundles through, and using surface sunlight reflectors, condense sunlight about 36:1 to dump through the fiber optics to a diffuser just below the ceiling. LOTS of these. Someday maybe light blue glass diffuser panels suspended below the ceiling fiber optic inlets to create the illusion of a backlit light blue sky. A hard trick to pull off right away.
8) After testing, attach rows of rock bolts to the ceiling for suspended lighting tracks, platforms, overhead crane.
9) make an opening large enough for a freight elevator (passenger too while we are at it)

Challenges

÷ achieving a thermal balance. Activity generates heat, but without lot's of insulation, we may need supplemental heating. Habitat heat leaks will slowly raise the internal temperature. Not sure where the balance point will be.
÷ achieving comfort and ambiance. Sky blue ceiling & sunlight will help. The tube will have a slight downward gradient. So a central pressurized passageway could support a recirculating stream, intermittent waterfalls and fountains, fish, water plants, etc.

At this stage of the game, until we do a lot more (none yet!!) exploring of actual tubes and engineering tests on site, schemes of pressurizing lavatubes are where terra-forming schemes stillnare: "garbage in, garbage out." I.e., nice to think about, no small stunt to pull off, no grounds for can-do confidence that we understand how to go about it, what will work, or won't, what will help, or hurt, etc.

Nifty topic, however. Great subject for artists.

NASA cuts Research into Ultra Fast Space Travel

Source: story by Ian Brown: www.sundayherald.com/36686

Cancellation of the small NASA Breakthrough Physics Propulsion (BPP) project, begun in 1996 at NASA-Glenn in Cleveland, Ohio, could return manned interstellar flight to the realm of pipedreams, for the foreseeable future.

The project was set up as a clearing house for research aimed ad breaking out of the envelope of current physics and explore ideas on how to to push spacecraft beyond our tiny insular solar system into interstellar space beyond.

Over seven years, the project cost only $15.5 M, but in the aftermath of the Columbia fiasco, this dream is getting the axe. In congressional budget circles, "defferal" tends to become indefinite. This defferal is for two years. But BPP head Marc Millis admits that no firm commitment has been made to continue the project in 2005.

In the light of *current* 'conventional' physics, practical 'star flight' is impossible. Only through some yet undefined breakthroughs in propulsion physics could that assessment be reversed. Three key breakthroughs have been identifiede: propellent-free propulsion; propulsion that can reach he maximum speeds physically possible; and production of the enormous energy needed to power any such engines.

Says Millis, "To send even a small starship to Proxima Centauri, a rocket powered by nuclear fusion would need 1000 supertanker-size propellant tanks just to get there in 900 years -- and that's not including the propellant needed for braking."

Propellant-free light sails "pushed" by powerful laser beams in Earth orbit and ships that inhale the thin gases in space for use as fuel are among two of the more conventional possibilities that have been under study. But the BPP was aiming higher. To reach other stars within the lifetime of a human crew, a craft would have to attain faster-than-light velocities. And this is the hitherto science-fictional realm into which the project has been delving: "warp drives", "wormholes", "gravity control" and "inertial modification" may sound fantastic, but, according to Millis, lie within the scope of the BPP project. Pragmatically, Millis has concentrated in inding the increments of credible and affordable research that can take us beyond our present limits.

Millis admits that such breakthroughs might simply not exist to be discovered, but that more stands to be gained by trying than by giving up, perhaps prematurely.

MMM Comment: That there may be no solutions to the challenges & dreams of starflight, make BPP a tempting target for cost-cutters. The goals are far off, and we may have to be much more advanced in physics to understand the ways, if any, to cheat the apparent barriers..

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 Contact Information

LRS PRESIDENT, MMM/MMR Editor - Peter Kokh*
< kokhmmm@aol.com > 414-342-0705
VICE-PRES/TREAS../LRS/MMM Business & Database Manager - Robert Bialecki*..... 414-372-9613
SECRETARY. - Charlotte DuPree
< cmdupree@netwurx.net > 262-675-0941
NEWSLETTER ASSEMBLY - Charlotte DuPree and Carol Nelson 414-466-2081
(* Board Members, & Ken Paul < kenpaul@cape-mac.org >

LRS NEWS

• **September 13th Meeting Report:** With Peter Kokh at a class reunion in Chicago, Bob Bialecki led the meeting. There was discussion of the Columbia Accident Inquiry Board's findings and report, and on several other topics.

LRS OCTOBER & NOVEMBER Events

Saturday, OCT. 11 th, NOV. 8 th1–4 pm

LRS Meeting, Mayfair Mall, Garden Suites **Room G110**, which is located on the lower level "Garden Suites East" near the mall entrance below the cinema complex.

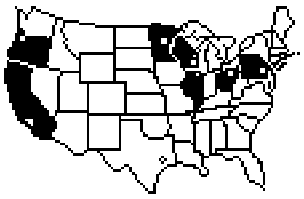
Updates on AGENDA, MINUTES:
www.lunar-reclamation.org/page4.htm

Collaborating Milwaukee Area Space Groups

Moon Society Milwaukee Outpost
c/o Peter Kokh 414-342-0705 - kokhmmm@aol.com
http://www.moonsociety.org/chapters/milwaukee/
MSMO currently meets jointly with LRS

Wisconsin Mars Society c/o Matthew Giovanelli
7133 West Wells Street, Milwaukee, WI 53213
414-774-8952 - marsmatt@wi.rr.com
http://chapters.marssociety.org/usa/wi/
WMS usually meets at address above on 3rd Sat. 1pm

U.S. CHAPTERS



NSS Chapter Events MMM 8 Chapters Strong

Space Chapters HUB Website:
[http://nsschapters.org/hub/]

MINNESOTA

Minnesota Space Frontier Society

c/o Dave Buth 433 South 7th St. #1808
Minneapolis, MN 55415

Tom Greenwalt (w) 763-784-6244 (h) 763-442-6015
David Buth (w) (612) 333-1872, (h) (763) 536-1237
Email: tomg@mnsfs.org

[www.mnsfs.org/]

• **September 16th Meeting Report:** The joint MNSFS/SEDS public meeting was a smashing success. Professor Candler gave a great presentation on space craft reentry and there was plenty of socializing after the talk.

• **October 14th**, 7:00 PM, we have another public meeting at the UofM Coffman Union Room 324. Ben Huset will talk about Dragon Space: the Chinese Space Program. Sometime very soon (this Fall in all likely hood) China is planning to have their first manned launch and has the potential to be the future leader in space exploration and development.

• **November 11th**: our public meeting talk will be on Mars Exploration: Past, Present and Future. With Europe's Mars Express due to arrive at Mars shortly after Christmas, and the American and Japanese missions arriving in January of 2004, it's going to be a busy time on Mars. At this meeting we will elect the MNSFS Board for 2004. All positions are open; if you are interested in serving on the Board or want to nominate anyone, contact anyone on the current Board.

Sept MN SFS / SEDS Meeting pics | Starquest 2003 pics
http://www.FreeMars.org/mnfan/mnsfs/2003-Sept/
http://www.FreeMars.org/mnfan/starquest03/

Solar System Ambassadors

PASA - Princeton, NJ/Philadelphia, PA
Michelle Baker - chaos@cybernet.net

CSFS - Chicago,IL
Bill Higgins - higgins@fnal.gov

SSS - Sheboygan, WI
Harald Schenk - hschenk@excel.net

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://www.oasis-nss.org/]

Odyssey Newsletter Online
http://www.oasis-nss.org/articles.html

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

Microcosm, 401 Coral Circle, El Segundo.
Information: OASIS Hotline, 310/364-2290; website.

- **Oct 18, 3:00 p.m.** -- OASIS Monthly Business Meeting, location TBD. Info.: the OASIS Hotline, 310/364-2290

Looking Ahead

- **January 2-4, 2004** -- Planetfest 2004! Pasadena, California. Info: www.planetary.org/planetfest04

Recurring Events

- **Fridays, 7 pm** "Night Sky Show." -- **8 pm** Guest lectures. Santa Monica College John Drescher Planetarium, 2nd Flr Technology Bldg, 1900 Pico Blvd. $4 /show; $7/both. 310/452-9223 www.smc.edu/events/weeklyeven.
- **Fridays -** "Mike Hodel's Hour 25" webcast. The world of science fact/fiction: interviews, news, Radio dramas, artists, writers, stories, reviews. www.hour25online.com/

OREGON

Oregon L5 Society, Inc.

P.O. Box 86, Oregon City, OR 97045
voice mail / (503) 655-6189 -- FAX (503)-251-9901

[http://www.OregonL5.org/]

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

Bryce Walden <moonbase@attbi.com>
(LBRT - Oregon Moonbase) moonbase@attbi.com

☞ Meetings **3rd Sat.** each month at **2 p.m.**
Bourne Plaza, 1441 SE 122nd, Portland, **downstairs**

NEXT MEETINGS: **OCT 18th, NOV 15th, DEC 20th**

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

[http://www.tcei.com/sss/]

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

OCTOBER 21: Stoelting House, Kiel
NOVEMBER 18: Sheboygan , location to be announced
DECEMBER 16: Stoelting House, Kiel

PENNSYLVANIA

Philadelphia Area Space Alliance

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

[http://pasa01.triipod.com/]

• **PASA regular** business luncheon/formal meeting, **1-3 pm**, the **3rd Saturday**, every month, at the New and Improved **Liberty One** food court on the second level, 16th and S. Market. Go toward the windows on the 17th street side and turn right as you enter the area near the windows. Look for table sign. Parking at Liberty One on 17th St.

Meeting Dates: OCT 18th, NOV 15th, DEC 20th.
Call Earl or Mitch 215-625-0670 to verify all meetings

• Meeting Notes submitted by Earl Bennett: We found our way to the newly opened area of the court with Dottie and Larry being first to arrive with most of the rest of us finding our way. Alas, at least one of our people, Simon missed the location due to the poor signage and obstacles.

Mitch Gordon: gave a mixed report with a reprise of some of the material from last month due, in part, to the infrequent publication of **Ad Astra** and **The Futurist** . There are several good articles in these publications and I believe both can be found at better news outlets. He also reported on an event that he is largely responsible for achieving: there will be a book signing at the 18th and Walnut street Barnes and Noble. The author is Robert Zimmerman and the title is "Leaving Earth". A number of us will be there Oct. 16th at 7 p.m. Mitch also brought a copy of our latest brochure and logo. He will continue to develop it and hand it off to Gary Fisher for check out and duplication. Simon Koumjian also worked on the revision.

The next report from Gary Fisher from The Independence Chapter of the Mars Society was on his and son Ben's trip to Hanksville, Utah, where the new section of the Greenhab System, built by Gary and family, was partly assembled by them and the Mars Desert Research Station crew and, due to fortuitous circumstance, the previously mentioned Simon and Louise, his wife. They where looking at a future home site (note near Hanksville!) and pitched in. We have pictures! Due to the unusual weather conditions in the area , including flash flooding in an area that normally gets five inches of rain a year, the parts for the Greenhab had to first be cleaned and then, after some where blown off the partly assembled module, checked and cleaned again. Oh yes and the unit also had to be rolled back in place. Very high winds. Other people working on the prep crew (the research crew will come in November) where Dr David Alred, Bruce, the Peripatetic, Mackenzie, Doug and his girlfriend (probably Mars explorer candidates). Gary's' son Ben will have great "How I spent My Summer Vacation" material. He is in several pictures resting in a utility box (with an apparent stake in his heart) which is understandable -- ivery dry (15% humidity) hot working conditions.

Gary also talked about the Mars Society Conference which he both attended and presented at. His presentations were on the Greenhab Project and on The Mars Mutual Society Fund that could promote the development of needed technology in a way similar to the X-Prize efforts. His idea is that a group of donors would invest ~$1000 each and that 1000 donors could make this money an award for the achievement of some significant goal. No achievement, no award given. The group would determine the conditions of distribution and how long the award program should run. The participant donors could give incrementally to the level they had pledged. There where more details on this including a currently running D.A.R.P.A program wherein the contestants must achieve an impressive goal: to build an autonomous vehicle that would travel a long distance (hundreds of miles?) across variable terrain, to a goal location. If no one completes the task, no award given. All risk is to the contestants, but, so also is the results of the effort. Other examples exist.

Mars viewing was possible at the event, thanks to someone hauling in a good sized telescope, which was set up near the performance stage. The Extremeophiles were the entertainment. Rock(s?) and Roll! We also discussed the upcoming Mars landings of our Rovers and what we could do to promote exploration and colonization through this opportunity. We are looking into the Franklin Institute as a possible venue as well as our January activities at The New Jersey State Museum. This will be very good for outreach: an interested audience and well prepared speakers.

Larry, our Webmaster brought material in on the

website and its hit frequency (low) and need for material and labels for images which I am supplying, for the New York trip (finally). He also told us of Eye in the Sky linking to us (to be explored). Material from an October 11th World Future Society event and other activities is requested.

Dottie Kurtz reported on the couples trip to another semi frontier location: Prince Edward Island which while abounding in red clayey soil, was an enjoyable place to visit. She also requested someone contact an English correspondent who would like to hear more about space habitation from our perspective. I can give the address to a member who would write this individual (not on the Net.)

Hank Smith brought us word on his continuing efforts to recruit people to science fiction conventions, his other fiction convention activities (which include helping other groups plan and implement their activities, and his recent trip to the World Con. He wasn't able to set up a Hospitality Suite this time due to finance and circumstance, but enjoyed the stimulation the event provided. ~4,000 attended and there was a large Hard Science Tract.

Hank also brought in a list of panel or presentation topic ideas to think about. We have several excellent presenters as members and group associates. Among these: The Future of Communication, Space Debris, Terraforming the Moon, Organic vs Non Organic foods, various tragedy related discussions, and nanotechnology in our future. Deadline: late October. He also noted an International Space Symposium in Washington D.C. Oct. 28-30th: [spacesymposium.org] ph: 1-800-691-4000. Cost not known.

Earl Bennett gave a brief set of presentations as well as passing material around from several sources. These included the announcement for Nanotech 2003 to be held in Boston from October 23rd and 24th. Lots of interesting material including a talk on Nanotechnology in Space by Dan Powell titled "Oriented Nanocomposite Extrusion" that describes work on material development for the Titan Orbiter Aerorover Mission (TOAM). (on the 23rd at 2 p.m.)

Also from the same publication, **NASA Tech Briefs**, work done at Caltech by Marco Quadrelli entitled "Swarms of Micron Sized Sensors" in a paper talking about large quantities of small units (called "carriers" in this presentation) that would have various types of sensing equipment on board. The author says this is generally called "Granule controllable Matter" (although I have not seen this before) and reports that these constructs could be used to explore remote planets and interplanetary space. As readers of science fiction of the hard type and followers of Eric Drexler and the late Robert Forward may remember, much of this type of application of nanotechnology has already ben outlined (much of this starting in the late 70s). The difference is that now we can begin to build some of the bigger parts. Further information is available on the techbriefs.com/tsp under "Physical Sciences." These and other great articles are from the September issue.

In the September issue of **Laser Focus World** is "Microreflectors permit passive free space link" showing how a very small set of mirrors (and the drive electronics) can be built in a very small space using micromechanical techniques. In operation the tiny mirror assemblies are arranged in "corner cube reflector" arrangements. Modulated or continuos light (laser or?) strikes this object and it can be reflected in various ways including back toward the source without changing it or, by changing a part of the cube's mirror alignment, sending the beam away from the emitter's accompanying detector. By varying this shifting a signal can be imposed on the beam. Floating in space, or in a space habitat of some kind, these systems could be the environmental sensing system that would make a very wide ranging and robust system for various jobs possible. Again science fiction comes to mind with a Vernor Vinge story describing a world where commercial production of tiny, interrelating, devices could be used, in that application, to sense a low vision environment and translate the image up to the visible spectrum for people. A practical aspect of the current devices in the short paper from UCLA-Berkley's Sensor and Actuator Center is that the microreflector communication subsystem could transfer information at a much lower energy cost per bit than a current R.F. system, "Blue Tooth" (~50:1). It also has a longer range according to the article starting on page 15 this issue. Much other great material including quantum entanglement and more.

In the Aug. 21 **Machine Design** (machinedesign.com) were two reports: one on the tracking of reentering Shuttles and the signature of Columbia in comparison to others, including its own, and what was found. The other, more extensive article is on the X-Prize contenders, with neat illustrations including the efforts of one who has visited us, Pat Bahn, and his company: T.G.V. They and the other competitors and there craft are well featured. Check the magazine site at machinedesign.com

The July/August **Amsat Journal** has several reports on aspects of three satellites and their development: Echo, Eagle, and P3E, one of the "Phase Three" orbiters with lots of capability on a number of frequencies. A sub topic, the P-5 Mars Mission Project (cool!) Article starts on page 19.

And last but not least: I have had two interesting correspondents recently: Penny, who teaches children on the Main Line, told me of an event at Villanova University for sky viewing that the public could attend. Our talks began with her interest in Mars related events, which lead to Gary and us and onward. I will mention our meeting to her. We also had a contact for a local astronomy club from Sherlene in Chestnut Hill who wanted a convenient group. After some research I found the lady who runs The Delaware Valley Amateur Astronomy Society (dvaa.org) that normally meet in a nature center in Philadelphia. They are having several Mars viewing events in the area so check the website. She (Sherlene) thanked us for the effort.

NAME _____

STREET_____

CITY/ST/ZIP_____

PHONE #S_____.

❍ **$38 NATIONAL SPACE SOC.** dues includes *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**
- **Students/Seniors** Electonic (pdf) **MMM** on website: **$20**

INDEX to # 169 OCTOBER 2003

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

❍ $25 for all members

O.A.S.I.S. L5 (Los Angeles)

❍ $25 regular dues with MMM

PHILADELPHIA AREA SPACE ALLIANCE

❍ Annual dues for all with MMM $20, due in March or $5 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 Reclamation Society 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