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

Moon Miners' Manifesto

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In FOCUS: X-Prize Saga Continues:

We were all excited to see the X-Prize won, and handily so, in a flight that soared well above the 100 km, 62 mile altitude goal, passing it by over 12 km, almost 8 miles. The feat, the second qualifying flight coming within a week with more than a week to spare, left no doubt. Commercially produced rockets can take tourists to the edge of space!

When he founded the X-Prize Corp. in the mid-nineties, Peter Diamandis (earlier, the co-founder of The International Space University) hoped to jump start the age of space tourism and cheaper space access. Evidently he has succeeded, witness the quickly announced plans of Zero-G Corp., Virgin Galactic "Spacelines" and Bigelow Aerospace.

Diamandis' Zero-G Corp. (www.nogravity.com) has already commenced taking passengers up for airborne roller coaster rides and a half minute of free fall in a specially modified 727 for $3,000 apiece. NASA seems bent on undercutting this enterprise by expanding its "free" offerings in its "Vomit Comet." But as the number of thrill seekers rises, Zero-G should get ample business.

Meanwhile, Richard Branson of Virgin Atlantic has contracted with Burt Rutan's Scaled Composites Corp. to build a SpaceShipTwo plane with a capacity for seven passengers, for suborbital flights on Virgin Galactic.

Can it take us to the Moon?

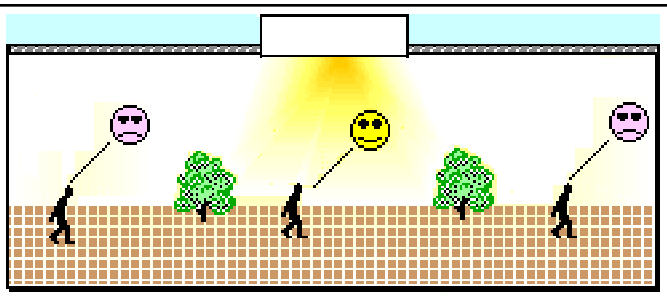
How popular suborbital flights become depends on the price tag. Currently, the round-the-world ocean cruise market, at $50,000 to $100,000 apiece is, however out of reach of most of us, a "sustainable market." There are enough world-cruise-setters with the money and the time to keep a number of ships in that service fully booked. Space promises to be more exciting, and could well prompt some to remortgage the old homestead for a chance to go "where few have gone before." Even at the edge of space, 60 miles or 100 kilometers up, too low for orbiting, the sky is black, the stars are brilliantly out, and the curvature of the blue, white, tan, and green globe below is very obvious. Short suborbital hops could be for many, the thrill of a lifetime.

At the same time as these announcements were forthcoming, Robert Bigelow announced a new higher $50 million dollar prize, half of it put up by himself, for the first privately built spaceplane that can take seven passengers to orbit, whether to ISS, or to his own planned Space Hotels. (He is busy building real inflatable habitats, building on the abandoned NASA-TransHab program.)

How long it will take for someone to win this prize does not matter. It took almost a decade for the X-Prize to be won, but now momentum and excitement [⇒ p. 2, col. 2]

Skylight Highs for Future Lunans?

Perhaps long-time residents of "sunbelt" areas will not have experienced it, but for those of us in the "cloud belt," sunny days are especially relished. Even indoors in a shopping mall equipped, as many are, with skylights to increase ambient lighting levels, a patch of bright sunlit sky infuses those passing below with a fleeting rush of euphoria. Are lunar pioneers just out of luck? see page 8.



Moon Miners' Manifesto

Moon Miners' MANIFESTO/ Moon Soc. Journal is published every month except in January and July.

• **Moon Miners' Manifesto CLASSICS :** Beginning with 'July 2004, we have begun an effort to re-edit, reformat, re-illustrate and republish the timeless articles of MMM's first ten years, with the intention of publishing two issues, each covering one year, in PDF format only, for free downloading, each January and July.

• **MMM's VISION:** "expanding the human economy through off-planet resources"; the early era of heavy reliance on Lunar materials; earliest use of Mars system and asteroidal resources; and the establishment of the permanent settlements necessary to support such an economy.

• **MMM's MISSION:** to encourage "spin-up" entrepreneurial development of the novel technologies needed and promote the economic-environmental rationale of space and lunar settlement.

• **MMM retains its editorial independence.** MMM serves several groups each with its own philosophy, agenda, and programs. Participation in this newsletter, while it suggests overall satisfaction with themes and treatment, requires no other litmus test. Any presumption that participating organizations can be labeled by indirect mutual association is unwarranted.

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

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

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• **The National Space Society** is a grassroots pro-space membership organization, with 10,000 members and 40 chapters, dedicated to the creation of a spacefaring civilization.

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

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• **The Moon Society** is "dedicated to overcoming the business, financial, and technological challenges necessary to establish a permanent, self-sustaining human presence on the Moon." — See contact information on page 9.

• **NSS chapters** and **Other Societies** with a compatible focus are welcome to join the MMM family. For special chapter/group rates, write the Editor, or call (414)-342-0705.

• **Publication Deadline:** Final draft is prepared ASAP after the 20th of each month. Articles needing to be keyed in or edited are due on the **15th**, Sooner is better! - No compensation is paid.

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⇒ **IN FOCUS** Editorial continued from p. 1.

are there to telescope the time before each succeeding achievement milestone is met and surpassed.

But can this momentum reach a crescendo that has tourists visiting the Moon? Robert Bigelow seems to think so. While his first goal is to get visitors and residents for the Inflatable Habitats he intends on building in space, he wants to offer them something extra, a chance to go beyond Earth orbit, to the Moon. He has been designing Earth-Moon cruise ships to take tourists there, no less.

Distance and time constraints make the Moon the ultimate tourist Mecca. The Moon has the three essential assets: location, location, location. But how do we make the seemingly tremendous leap from low Eartth orbit a couple hundred miles up all the way to the Moon and back? The fuel/energy needed for that boost is no more than it took to get you off Earth's surface into orbit.

It is a simple fact that a vehicle that can take people to Earth orbit, need only be refueled and stocked with provisions to last seven days, to rocket out from Earth orbit around a round-trip, loop-the-Moon cruise, in which passengers would get to skim close over the farside craters, without landing, before a double bounce off Earth's atmosphere deposits them safely in low Earth orbit again.

Now as you might expect, it's *not quite* that simple. Humans are not inert cargo. A short less-than-an-hour ride to orbit is one thing, but seven days strapped in a seat for a ride around the Moon? No way. They'll need berths, one for every two persons "hot-racking" on shifts, food, toilet facilities, some space to move around, and recreation. So that "same craft that brought them up from Earth" may in reality need to dock with a "Cruise Logistics Module" to provide minimum creature comforts. Bigelow will build it.

Landing Excursions to the Moon's surface are a good way in the future, with excursions to sites with ground facilities beyond that. But the point is that lunar overflight tours are a lot closer than most people dare imagine. Such a trip would take little more than a week of one's life, compared to a 3-4 year round-trip to Mars. Once prices fall, and they will, demand will be high, and steady.

And that will whet the appetite for the next step: self-contained Moon-landers that will take tourists to the Moon's surface for a quick sortie. Which in turn will lead to the building of tourist facilities on the Moon.

And to expand those lunar surface facilities at less expense, contractors will begin processing moondust into building materials and habitat modules. With or without a NASA return to the Moon, lunar beachheads with real resource-using development are in the future - *our future!*

And in the meantime, the first tourists may loop the Moon before the first astronauts return to its surface. If either the upcoming election or Congress kills the current Moon to Mars Space Initiative, we will still get there.

Keep the faith! - - **PK**

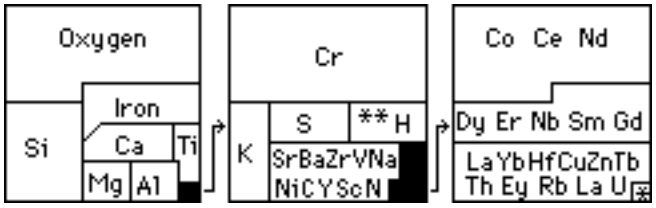
[Laying the Foundations for Lunar Industry]

Extracting Valuable Trace Elements With the Help of Micro-organisms Bioleaching: a Proven Tool for Moon Mining

by Dave Dietzler <Dietz37@msn.com>

Editor's Forward:

Seven elements make up the bulk of the 2-10 meter thick impact-pulverized blanket of dust and rock fragments that we call the regolith: oxygen, silicon, aluminum, calcium, iron, magnesium, and titanium. Chromium, potassium and sulfur are abundant in parts per ten thousand. But many of the elements vital to modern industry were found by the six Apollo and two Luna sample return missions to be present only in micro- and nano-traces. How do we extract these?



2nd Box: ** The moondust regolith contains significant gas reserves from the Solar Wind: H, C, N and He4, Ne, Ar, Kr, Ze, He3. Note that solar wind Hydrogen is the 11th most abundant element, more common than all the elements listed below it in the 2nd and 3rd Boxes above.

3rd Box: *(ppb): Ir Re Au Sb Ge Se Te Ag In Cd Bi Tl Br

Basics of Lunar Geology

It is believed that the Moon was once covered by a magma ocean several hundred kilometers deep. Heavier minerals like pyroxenes, olivine and chromite sank while lighter anorthositic (aluminosilicate suite) material floated to form the upper crust. Volcanism and massive asteroid impacts shattered the crust and molten lava flowed to the surface to fill in the mare basins.

Meanwhile iron sank to the core, chalcophile (copper-loving) elements like copper and PGEs (Platinum Group Elements) sank to the mantle (below the crust and above the core). Central crater peaks and masscons (mass concentrations where surface gravity is above normal) may represent denser mantle or deep crustal up-thrusts or rebounds from these impacts. [Ed.: We have no sample returns from these areas, and a robotic mission to a promising crater central peak should be a high priority.]

G. J. Taylor and Linda Martel believe that chromium, platinum group metals, nickel and titanium may be found in central peaks and crater rims[1]. They also think that silver, Platinum-group, zinc, mercury, lead and copper could be found in pyroclastic (volcanic origin) deposits near volcanic vents in the maria. It is fairly certain that orange and green glass micro spheres discovered by Apollo missions were spewed out from volcanic vents, now long extinct, so deep lavas from the lower crust and upper mantle, bearing valuable metals, may have reached the surface or subsurface beneath the homogenized regolith. Even so, "ores" of silver, platinum and copper are likely to be very low grade, and novel extraction methods will be needed to recover these metals, often called LDEs or lunar deficient elements.

Bioleaching

Bioleaching involves the use of micro-organisms to extract metals from low grade ores and has been performed successfully on Earth to obtain gold, copper and uranium[2]. About 20% of the world's copper is produced by bioleaching. This type of process has been used to extract uranium from the Elliott Lake district in northern Ontario, Canada[3].

Bioleaching of nickel, zinc and cobalt can be done with thermophyllic bacteria but has not proven economical; however, on the Moon where resources are sparse and imports comparatively expensive, this approach may be worthwhile. Nickel and cobalt are used to alloy steel and zinc is used to alloy magnesium.

Thiobacillus ferrooxidans, Leptospirillum ferrooxidans, Thiobacillus thiooxidans, Sulfolobus species and others have been used for bioleaching. Acidiphilium, Sulfobacillus, Ferroplasma, Sulfolobus, Metallosphaera, and Acidianus have also been used. These bacteria tolerate acids and metabolize sulfur. Weak solutions of acids are dripped through the ore and a bacterial liquor forms that is then electrolytically or chemically processed [4].

Sometimes this requires water and an organic substrate like potato peels as well as solvents to extract the metals from the bacterial mass. Chaff from crops may be used for bioleaching rather than livestock feed. Precious water will be recycled. If bioleaching becomes a major industrial activity on the Moon we will be pressed to conserve our vital water and hydrogen resources for this instead of wasting them in the form of rocket fuel.

As the bacteria feed on sulfur, only ores containing sulfur can be bioleached. Bioleaching does not require lots of energy but it is slow. High temperature roasting and smelting is not needed -- decided benefits in addition to the fact that bioleaching can get metals from low grade ores.

References:

1) Prospecting for Lunar & Martian Resources. G. Jeffrey Taylor and Linda Martel (Hawaii Institute of Geophysics and Planetology, University of Hawaii, www.mines.edu/research/srr/2001abstracts/Taylor.PDF

2) Mining and Mineral Fact Sheets http://www.fact-index.com/b/bi/bioleaching.html

3,4) Bioengineering-Microbial Mining www.bioteach.ubc.ca/Bioengineering/microbialmining/

More Information:

www.imm.org.uk/gilbertsonpaper.htm
www.nrcan-rncan.gc.ca/biotechnology/english/m_bioleach.html
http://en.wikipedia.org/wiki/Bioleaching **<DD>**

In Search of the Moon's Missing Resources

by Peter Kokh with Dave Dietzler

While the moondust samples returned by the six Apollo Moon-landing missions and the two unmanned Soviet sample return missions did differ from location to location, it was largely a difference of percentages. The highland areas such as the Descartes region visited by Apollo 16 (the Orion) are richer in aluminum, calcium, and magnesium, and the mare areas visited by other missions, are richer in iron and titanium. But the impact-pulverized surface of the Moon has matured to a point where in any given location, half of the material found has been ejected there from somewhere else. The Moon is somewhat "homogenized."

It is of concern that no place sampled has what we would consider to be an economically mine able concentration of some elements that are critical to modern industry: copper, zinc, silver, gold, to name a few. Nor will we find ore veins of these elements. Ores are deposited through eons of geological processing in the presence of water. No water to speak of, not now, not in the past.

Dave and I have been brainstorming back and forth the possibility of finding a Sudbury-type astrobleme (relic crater) on the Moon. In the vicinity of Sudbury, north of Lake Huron in Ontario, Canada, lies half the world's supply of nickel, and much of its copper - a gift from an especially rich asteroid. Common myth has it that ore-rich asteroids are commonplace. But the lie in that is clear from the impact evidence on Earth. Now the more massive Earth attracts eight times the number of impactors as does the Moon. But three quarters of those land in the ocean. So the odds for ore-rich impacts on Earth's land surface would seem to be only twice that on the Moon. If we knew how to look, we might just get lucky. And that would significantly improve the odds for a positive lunar settlement trade balance.

Lunar Prospector's gamma ray spectrometer was not fine-tuned for copper or nickel. Even if it had been, its poor 100-mile resolution might not have picked up o deposit even as large as that at Sudbury. But apparently the Sudbury ores all involve Sulfur as well. Could we build a gamma ray spectrometer with vastly higher resolution and fine-tuned to pick up unusual concentrations of sulfur?

We do not have all the answers, or even some of them to our satisfaction. A query has been sent to the Canadian Journal of Remote Sensing to determine whether or not the special character of the Sudbury impact area shows up in any existing remote sensing surveys. That it is a crater is obvious. That is not the point. Has any instrument detected its copper and nickel rich character? We need to know. In September 2003, I passed through Sudbury, not free to stop. A revisit, stopping at its new Earth sciences museum may be in order. Ultimately, a workshop to design a Sudbury-capable Lunar Prospector II?

We'll keep you informed. **<MMM@work>**

Trash >> Treasure = Trashure
Waste >> Resource = Wasource

Trashure Creativity & Wasourcefulnes: Two Critical Talents on the Space Frontier

by Peter Kokh

A shining example

There are many people who make their living, and many more who supplement what they can buy from day job wages or salaries by rescuing things others have thrown out as trash. They/we (for I am surely one of the later) reuse some things as they are, refinish other things, and find wholly new uses or adaptations for still other items. The practice of turning Trash into Treasure ("One man's **trash** is another man's treas**ure**" has so long been a part of our culture that the hybrid word "**trashure**" is now well established as a search engine exercise will demonstrate.

Yet it is certainly the case that most people are not up to speed on this -- perhaps they lack the spirit of creative adventure involved in "dumpster diving" and the thrill of acquiring, for little effort or money, something to treasure in their homes, or perhaps they can't be bothered to make the effort, or perhaps they disdain anything with a "history" or perhaps they have the cash to buy "new" (read unsullied.) Yet trashure is well-enough established to have become a respectable, even admired hobby.

On the Lunar and Martian frontiers, as on Earth, pioneer artists and craftsmen will find used materials and items their least expensive and most readily available option. It will pay for settlement citizens, individual and corporate, to presort discarded items and send them to a Stuffs or Trashure Market where, hopefully, a good and growing percentage of it will be adopted for reuse, rehabilitation, or transformation into new utilitarian and/or decorative items. "Dumpster Diving," "alley scrounging," and "moving day curbside scavenging" will come out of the closet.

Creative and enterprising volunteers will turn this windfall into unique furniture and furnishings items, works of art (sculptures, for example), musical instruments, toys, and even personal adornment jewelry items -- for personal use and for sale. The trashure industry will grow as the amount and variety of discard items increases, becoming a significant complimentary sector in the overall economy.

Everyone will benefit, as this activity will significantly expand the variety of locally produced items. Visiting trashstuff markets, flea markets, arts & crafts fairs, and specialty shops filled with born-again items on consignment will add weekend pleasures to spare time menu options.

Front End Trash Reduction Measures

Not all pioneers will have the creative talent and urge to make use of the flow of trash. If the volume of discarded items and materials is not to swamp them, up

front measures will be needed to reduce the sheer amount of stuff finding its way to the general pile. Here are some simple measures that will help (that some of our spoiled manufacturers may be temporarily inconvenienced by having to switch philosophies and gears should not dissuade settlement fathers from insisting on these protocols.)

- Using KD (easy "knockdown" or disassembly-friendly) methods of assembly, especially when dissimilar materials best recycled separately are involved. We are used to dissimilar items being permanently "bonded" by adhesives, and thus mutually contaminating one another as far as economical recycling options are concerned.
- a tax break on items so manufactured, calculated by special rates for kind of material and strategic value.
- a turn-in credit reward for consumers and manufacturers (who may discard *unworkable* seconds) discarding items in a properly sorted and disassembled state
- University involvement through a department of Industrial Engineering, in searching for designs that make secondary adaptive reuse relatively simple. Containers that can be reused as canisters, as stackable dresser drawers, as planters, etc.: [The "world bottle" was an inconclusive project in the 1970s to design a beverage bottle that could be used as a building brick.] If there are sufficient incentives, manufacturers will be motivated by profit to create items, normally for one-time use, that can become "pop" stuffs for all sorts of uses. We'll revisit this idea in a future article.

The same strictures should apply to the construction industry. Methods that make separation of materials that need to be recycled separately (i.e. metals and organics) all but impossible such as adhesives (yes, Liquid Nails) and staples, should be taxed sufficiently to provide the money (and labor) necessary to undo these difficult bonds, especially when organic or synthetic materials that embody elements scarce on the Moon (hydrogen, carbon, nitrogen, but also some metals such as copper, brass, zinc, lead, gold, silver, platinum.) KD! KD! KD! The tax should be sufficiently onerous to make KD assembly methods more attractive. Think of those who follow, if what you build or put together is not meant to work or perform forever!

Extending the paradigm: packaging waste

In MMM #4, April 1987, "Paper Chase II" (online at www.asi.org/adb/06/09/03/02/004/paperchase2.html),we speculated about ways settlers could do without paper. Paper as an agricultural byproduct should be reserved for quick-turnaround uses: art du jour or temporary children's art, for example, where it can easily and routinely be recycled back into the biosphere-biomass cycle. On Mars, where the stuffs of organic compounds (hydrogen, carbon, and nitrogen) are comparatively abundant, such stringent restrictions may not be necessary (but still wise!)

Paper and cardboard and other packaging materials constitute one third of the total volume of trash and rubbish in modern America. On the Moon, packaging will preferably be made of inorganic materials (e.g. wire mesh bags and baskets, foil, "tin" containers, etc.) or will be formulated and/or designed for easy craft reuse, especially as media for developing artistic talents in children.

There are many other suggestions in the article mentioned. The packaging nightmare has been greatly exacerbated in recent times by having to resort to shrink-wrap cardboard packaging for small items previously held in open bins, as a shoplifting counter-measure. Hopefully, the settlers will come up with other means of discouraging shoplifting in order to do away with this wasteful use of paper and plastic based materials -- but something short of the medieval custom of chopping off the hand of a thief!

Plastics

Most of our plastics are coal- or petroleum-derived. But there has been considerable effort in the past few decades since the first Oil Crisis, to derive suitable organic feedstocks from "oliferous" plants. Those who would pioneer the Martian Frontier are looking for even more direct routes, synthesizing basic plastics feedstocks like ethylene and propylene directly from the carbon, oxygen, nitrogen, and hydrogen in the Martian atmosphere. Their success will be of use to Lunan pioneers as well, though without such an atmospheric reservoir of needed key elements.

Import shipment "dunnage," the "co-imported" shipping container stuffs such as barrels, crates, skids, separators, dividers, and cushioning materials, will be a primary source of simpler plastics such as polyethylene and polypropylene that can be reformed and reused over and over again, *if separately recycled.* Current plastics recycling is mostly limited to those containers marked 1 or 2 (inside the recycling triangle symbol). Other containers may be marked properly, but the market for their reuse is not strong enough to support active recycling. On the frontier, it will be the best strategy to allow in (by import) only those plastics the settlement is prepared to recycle. Sub-varieties, color-coded both for proper sortation and for use in creating KD children's toys, could help expand options.

We have written previously about Plastics in MMM #26 June 1989, "Toy Chest" and "Thermoplastics" pp 5-6. These articles will be republished in MMM Classics 3, as a free access pdf file, in January, 2005. Also relevant is the article "Stowaway Imports" in MMM #65, May 1993.

Mining Wastes & Byproducts

Mining wastes include tailings, piles of gravel and other solids leftover after the extraction of the sought for element or ore out of the host soil or rock material. Also a problem is unrecycled reagents or acidic leachings dumped into ground water or drainage basins. On Earth, we can try to handle such problems by fines, but a far more effective

way is to promote the identification, with University assistance, of profitable products that can be made of such unwanted materials and wastes, and/or profitable markets for sale of such byproducts as is. It can be more profitable to sell byproducts than to discard them. But product and market development must be aggressively pursued.

This kind of thinking and these kinds of processes need to be incorporated in the drawing board stage of development of lunar industries and their diversification. New products from what would otherwise be wasted will mean a more diversified supply of products for domestic use on the Moon, but also a more diversified portfolio of products for export to other in-space markets. Making use of tailings, used reagents and leachings is best seen as a great opportunity for Lunar enterprise, rather than a burden that erodes their profit margins. Those without the right attitude should be discouraged from getting involved.

Tailings will be the host regolith minus the extracted element or suite of extracted elements. The flip side of the coin is that tailings are now "enriched" in all the elements not extracted! That makes tailings a potential feedstock for other materials.

Tailings that are of no further economic use, can perhaps be reused as aggregate for lunar concrete, paving material for lunar roads, and sintered into building materials for unpressurized vacuum exposed structures such as shade walls and radiation-shielding canopies or ramadas for storage purposes.

The tightest possible recovery and recycling of organic reagents and acid and heavy metal leachings will be a cornerstone of lunar industrialization. Given the tight supply of hydrogen, carbon, and nitrogen, and the need to reserve as much of that as possible to support the maintenance and browth of lunar settlement biospheres, no other policy makes sense, either environmentally or economically.

Manufacturing Wastes & Byproducts

Manufacturers will operate under the same environmental and economic sommon sense constraints. Material left over from exuding, casting, or machining parts will have to be recycled back into the source bin. Material contaminated by machine oils can be cleaned in house or shipped out to a service provider. Shipping containers that cannot be reused, will either be turned into sideline products or sold on a web-based byproducts and waste materials market. Most of these materials will be reused domestically on the Moon. But some may find viable export markets, further improving the Moon's import-export equation and overall economic viability.

Consultants will suggest new uses for manufacturing byproducts and waste materials will become a key player in making the lunar industrial system work well. Some of them may even take over a customer-approved plan as prime contractors. Bigger manufacturers may have in-house research departments doing this, spinning off subsidiary enterprises in the process. Waste reduction and recycling will be good business.

Agricultural "Wastes"

Once I was told by an expert in space agriculture that cotton was not a candidate plant for lunar agriculture. Despite the fact that no other fabric is as versatile, comfortable and recyclable, there is too much waste biomass involved. Fully 86% of the plant by weight is of no use. The statement, expert source or not, is absurd. One has only to look at the example of the African-American agricultural pioneer, George Washington Carver, with well over a hundred patents to his name on products that could be produced from the peanut plant. What Carver did in Tuskegee, Alabama should be a challenge to would be lunar farmers and farm product processors. That example could inspire a considerable diversification of lunar agriculture-based industries and enterprises. But even should future Lunan processors have less luck with cotton, it remains true that biodigesters have been demonstrated that can take any and all waste biomass and reduce it to an edible tofu like product, with only 2% stubborn waste.

Liquid and Liquefied Wastes: A Plumber's point of view

As a jack of all home-improvement trades, plumbing among them, I believe a lot of problems and challenges can be minimized by proper plumbing. In MMM #40 NOV '90, "Cloacal vs. Tritreme Plumbing" I described our present municipal plumbing systems, descended without substantial improvement from that of the ancient Indus Valley town of Mohenjo-Daro c. 2,500 B.C., as "cloacal." A cloaca is the discharge system used by monotremes (one hole), primitive mammals such as the duck billed platypus, in which the anus doubles as ureter. "One hole serves all." "One drain serves all." Nowadays some cities are belatedly trying to separate storm sewers from sanitary sewers. Too little, too late.

On the Moon, where we have a unique opportunity to design our infrastructure from scratch on a clean drawing board, we can institute polytreme, multi-hole multi-drain systems to minimize the treatment and recycling challenge. Agricultural runnoff, shower and sink runnoff, toiled wastes, manufacturing waste water - these can all be plumbed separately, minimizing the problem instead of compounding it. If we start off on the right foot right away, this way of doing "business" will not be seen as a burden, but as the only civilized way of doing things, implying derision of primitive terrestrials for the four and a half thousand year old system they insist on proliferating.

Primary Point–Source Treatment

Rigorously separated polytreme drain and sewer plumbing systems will make the job of finding market-worthy products derived from properly separated wastes that much easier. And even this challenge will be minimized by primary Point-Source Treatment. Biological gray water

treatment of human wastes, more on the model of the 20 year plus field-tested Wolverton Graywater System (http://www.wolvertonenvironmental.com/ww.htm) which provides the home, office, restaurant or other toilet-hosting modules or structures with fresh sweet air (regenerating oxygen from carbon dioxide), abundant greenery, and sunlight than on the workable but laboratory-like GreenHab system installed at the Mars Desert Research Station in Utah. Such systems will enable synchronized modular growth of settlement biospheres because every new toilet-equipped unit, resi-dence, office, commercial, industrial, or other, will be equipped to execute a 95% pretreatment of human wastes before the gray water enters the settlement municipal sanitary drain system. The central burden for both water and air recycling will be enormously minimized. Waste waters from other sources can also receive primary treat-ment at the point source, again enabling the modular growth of the biosphere, with farming and industrial areas each contributing their share.

Where does this put us?

Trash and rubbish are one thing. liquid wastes and sludges are something else, carrying the connotation of unclean and unsanitary, of polluted or even toxic. My point? If on Earth *we can afford not to* extend the same rehabilitation effort to liquified waste as we do, with growing frequency, to trash, that will not be the case on the Moon. On Mars, the pioneers could probably get away with indulging the same bad habits we have on Earth. The difference can be summed up in one word: volatiles. Most wastes, especially liquid ones (with or without solids) are composed of organics; volatile elements abundant on Earth, and accessible on Mars. On the Moon, these elements must be scavenged from solar wind gases trapped in the upper regolith layer or refined from comet-derived polar permashade ice depositsl. What on Earth is useless and without value will be priceless on the Moon.

Toilet systems that use human wastes to feed plants are now demonstrated. Entrepreneurs have learned to use drained motor oil as fuel for heating. But most organic wastes are just "wasted." The Lunan pioneers will need a whole new attitude towards all kinds of organic wastes from human wastes, to food production and preparation wastes to chemical plant wastes. They will need to do *the mental flip flop that equates waste with potential resource*. Waste not, want not! It's not just for the dinner table anymore. This kind of frugality is an investment in the future

To promote the idea, first among potential Lunan pioneers, then among our terrestrial brothers and sisters, we offer the *trashure*-parallel coinage: **wa**ste + re**source** = **wasource** pronounced "WAYsource".

Wasources must be integrated into the Lunar Resources pantry. Wasourcefulness must become part of their frontier culture, an aspect of settler resourcefulness.

The frontier government can offer incentives to entrepreneurs and established companies alike to develop nontrivial uses for various types of waste. An Internet-based waste metainventory database and exchange program could be inaugurated. A frontier university should be very much involved both in maintaining the system, in expanding the categories as needed, in research and development of new processes and product lines, and in waysource-based enterprise creation and assistance.

Wasources represent invested hydrocarbons and other organic and synthetic enabling elements. Chemical feedstocks for plastics, lubricants, even pharmaceuticals are among the rewards. The volatiles involved will either have been brought from Earth as food stuffs, agricultural nutrients and fertilizers, medications, chemical reagents. Some will come from routine gas scavenging of the solar wind gases in the regolith. Much of this will find their way through the human digestive track. Some of it will be waste byproduct of various food and regolith processing and manufacturing orations. The salient point is that any volatiles embodied in wastes (of whatever kind) should be treated as an investment, an endowment that should continue to produce income - not be flushed into some never-never land out-of-sight-out-of mind from which retrieval may be difficult and unprofitable.

Storing wasources

In designing a complete and efficiently organized storage system, thought must be given to storing waste liquid and sludges, carefully segregated according to source and gross chemical makeup. At least that should be a goal for priority implementation.

Before we get too far along in developing our initial beachhead outpost into an infant settlement, we will either be already recycling human wastes, hopefully near their individual point sources as in the Wolverton toilet=plant bed system, or we will have chosen by default for the settlement to fail. But early on, before such systems are in place, we will want to store these wastes in durable containers from which they can be retrieved when we are ready for them. To do that, all we need is to put them in permanently shaded areas (under a shed will do) where their chemical wealth can stay frozen and inert. To do otherwise would be seen in retrospect as an act of treason against the future human frontier, much as the currently accepted practice of scuttling the shuttle external tank just short of orbit is likely to be so judged, if only for its seven tons of copper, each, of almost astronomical value on the copper deficient Moon.

Pioneering the Moon will take a whole new set of attitudes, if we are going to make it work to enhance the viability of human outposts on a hostile world.. Wasourcefulness is one of them. Fortunately, there is a subculture paradigm for inspiration: that of "trashure." **< MMM >**

The Black Sky "Blues"

Part III: Faux Skylights & Clerestories

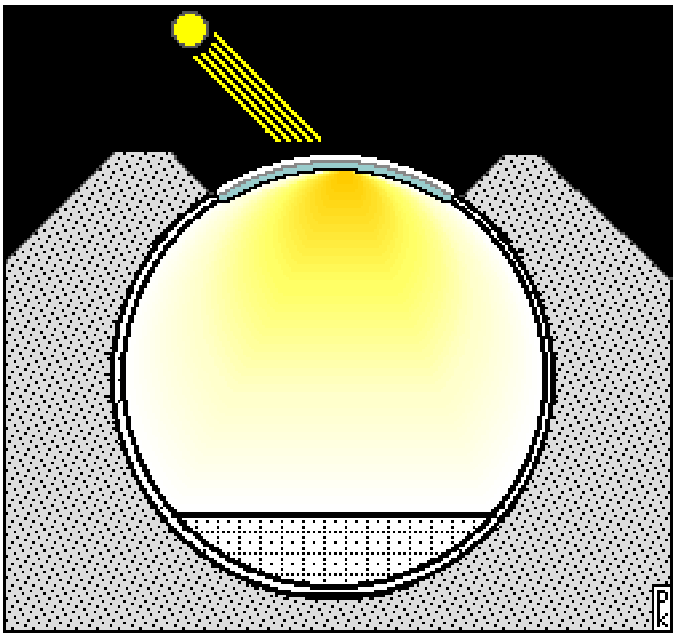
by Peter Kokh

MMM #138 SEP 2000, p 4. The Black Sky "Blues"
MMM #176 JUN 2004, p 7. "Black Sky Blues" Revisited

The skies of Luna will always be black and the uncomfortable glaring contrast with the overly bright sunlit surface will always be harsh. On Earth, water vapor in the atmosphere scatters the suns rays so that light seems to come uniformly from all directions. Our atmosphere is a natural "diffuser" with a bluish cast. In the first article cited above, I floated this suggestion:

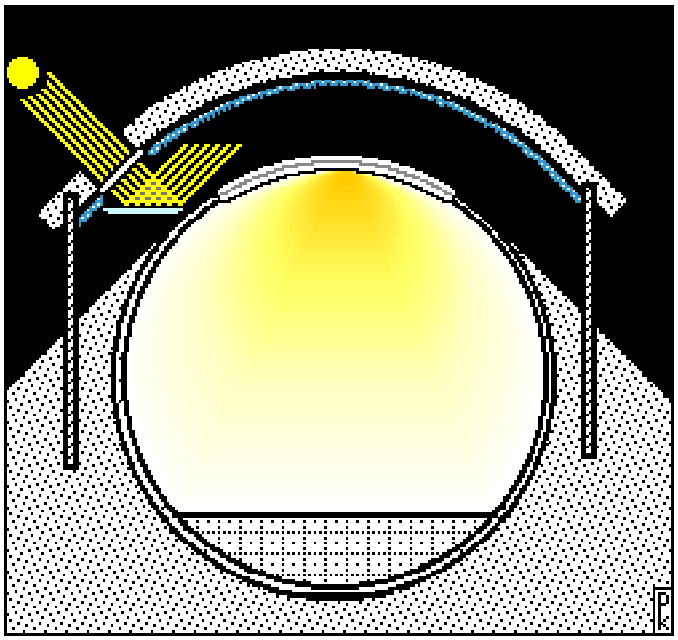
> "For those windows meant to bring in light but not necessarily the views, could we produce some sort of frosted and translucent, but not transparent, glass pane that will not only let in sunlight but appear itself to be bright, giving the illusion of a bright sky beyond? Again we but throw out the challenge. One might experiment by holding up various kinds of existing glass and diffusers to a streetlight against the dark nighttime sky."

The simple set of experiments is still worth making. It might require dual panes set some distance apart. But even if this worked, it would introduce the problem of breaching the shielding blanket.



This breach creates an intolerable situation. This type of skylight could be permitted only in locations rarely visited, such as honeymoon hotel suites. Proper shielding should be preserved in all regularly occupied structures.

But there are other ways to fool the eye with the desired uplifting effect. A shielded vault section could be suspended over a transparent glass skylight, its underside painted a bright matte blue. Sunlight would be funneled by mirrors to reflect on the underside of this outer "sky vault", creating the illusion of a bright blue sky within the habitat. These are admittedly very crude illustrations (in the absence of the services of a good illustrator, services MMM has lacked from the outset.) The engineering would differ from location to location depending on the latitude above or below the equator and the path of the sun across the sky.



In this illustration, a vault shaped to cover (and shield) all possible vision angles through the skylight. Mirrors would have to be shaped to scatter the sunlight as evenly as possible against the matte blue underside of the vault, probably through the use of a fresnel lens.

The skylight, as shown, follows the cylindrical or spherical shape of the module it is in. But in practice, the curvature should be inward, towards the pressurized interior as glass is much stronger under compression than under tension. During nightspan, an exterior sulfur lamp could take the place of the absent sun, using the same pathway. The skylight could also be shuttered as desired.

A properly done matte blue finish would seem to put the faux blue sky at an indefinite distance, increasing the illusion. Only reflected sunlight would entire the habitat area through the skylight. It is common practice on Earth to place skylights in north facing roof slopes (in the northern hemisphere) so as to feature the bright sky, not direct sunlight. So this arrangement would follow that practice.

Faux sky vault facing skylights could be installed in high end homesteads over a library, family room, or garden area. They might be more common in lunar settlement hotel atriums, in restaurants, and in corporate office foyers.

Future Lunan Pioneers will not give up access to sunlight and outside views. Neither, do we predict, will they long choose to do without bright blue skies. There is more than one way to skin this cat. **<MMM>**

The Moon Society

J O U R N A L

http://www.moonsociety.org

Please make NEWS submissions to KokhMMM@aol.com

The Moon Society was formed in July, 2000 as a broad-based membership organization with local chapters, to spearhead a drive for further exploration and utilization of the Moon in cooperation with other like-focused organizations and groups.

Artemis Society International was formed in Aug. 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 commer-cial business directly, but seeks to build a Project support business team. Registered trademarks of the **Artemis Project™** belong to **The Lunar Resources Company®**

PROJECTS:

The Artemis Project™ http://www.asi.org/

- Artemis Reference Mission
- Artemis Data Book

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

Moon Society DUES include **Moon Miners'Manifesto**

- **Electronic** (pdf) **MMM $35** **Students/Seniors**: **$20**
- **Hardcopy MMM**: U.S. & Canada **$35** Elsewhere: **$60**

Join/Renew Online at

www.moonsociety.org/register/

Or mail check or money order to:

PO Box 940825, Plano, TX 75094-0825, USA

Please send all mail related to Memberships to:

Moon Society Membership Services, address above.

OUR LOGO above, shows the Moon in its natural beauty, empty, deceptively barren, waiting for human settlers to shelter and mother. We have work to do!

Lunar Photo of the Day

http://www.lpod.org/

Space and the Moon: We have Options!

President's Message

I personally have not gotten deeply involved in supporting the Bush Administration's current Space Exploration Initiative, commonly dubbed "Moon to Mars." First, it was not clear that the President would be elected. And if he were, it was not clear that Congress, even dominated by members of his own party, would give wholehearted support.

Over the decades, Congress has jealously guarded its self-asserted prerogative to micromanage every NASA budget put before it. Long term planning has become an exercise in wishful thinking and futility. Programs are routinely downsized and scaled back until they are a shell of what was first proposed. Then, "to save money," projects are routinely "stretched out" over a longer period of time, in effect actually costing much more money in the end.

Then too, there is a question of the depth of Bush's own commitment. He cut manning of the Space Station from 7 to 3, meaning that little more than maintenance could be done as opposed to *significant* science. If a Moon base was indeed built, it would be long after his (second?) watch. But if the President at the time had only Bush's level of demonstrated commitment, that Moonbase would end up underbuilt, and undermanned, only a token of little use.

So unlike many Moon Society members, my reaction to the initiative has been ho hum, *yawn!* Put it this way:

"Government Space: *Been there, done that!"*

Don't get me wrong. I'd be delighted if my jaded cynicism were proven dead wrong. But only time will tell, and during that time, ***we*** *have to get busy and keep busy.*

What can we do as a group much smaller than we'd like to be? A lot. Getting us to the Moon is the job of the rocket scientists. Keeping us there requires a lot of other expertise and R&D that has been barely touched. There are, unbelievably, many areas of needed research where groundwork by layman can pave the way.

Legislation, not per se in support of NASA, but rather to encourage private sector activity is important. One idea is to require NASA to identify all the technologies *not now "on the shelf"* that would be needed to support permanent human presence on the Moon. Others outside NASA can take that list and brainstorm it item by item for possible profitable terrestrial applications. The second part of our legislative effort would be to have NASA or the Dept. of Commerce set prize incentives for pre-developing these technologies for just such terrestrial applications. The payoff? These technologies get put "on the shelf."

We can also host workshops, inviting the needed experts, to develop plans for a Lunar Prospector follow on resource locating mission, and other missions that would pave the way for more successful human beachheads.

Often enough, it is the humble first steps which make the difference. That's our cue. - *PK*

Renting the Mars Desert Research Station for Moon Outpost Simulation Exercises

by Peter Kokh

Moon Society Project Status:

This project is in the initial brainstorming stages. It is something that could be both exciting and fruitful, if done right. But that will require a lot of preparation.

Project Background:

The Mars Desert Research Station in Hanksville, south central Utah, has proved very productive. M.D.R.S. is the second Mars Society Analog Research Station, the Flashline Mars Arctic Research Station, F.M.A.R.S., on Devon Island in Canada's arctic north being the first. While the latter is located in terrain more analogous to what we expect on Mars, its operable season is only six weeks long. The Utah location allows several months of operation.

Because of those limitations, time is much more precious at the Arctic outpost, and talent and expertise requirements more exacting. It is now the practice to accept no application for crew assignments in the Arctic unless the applicant has already served a stint in Utah.

M.D.R.S. for Rent?

The available season at M.D.R.S. is longer than needed for Mars Society use. Thus they are soliciting proposals to rent out the Utah Outpost to other interested groups for two-week long stints. The suggested price is $7,000 for a 6 person crew for 2 weeks, no food or transportation included.

For us, the salient facts are these:

- The Moon Society can not afford at this time to design, build and deploy its own analog station, though that is our long term goal. (Project LETO)
- The Moon Society does not want to pay for a two-week stint at M.D.R.S. out of its General Operating Reserves.
- If we design a well-thought out plan to use M.D.R.S. in a way that will provide useful experience and knowledge, we should be able to raise this amount of funding from any number of interested sponsors.

The First Step – Designing a Program

The terrain surrounding the Utah facility is very suggestive of Mars in coloration. But colors can be ignored, or forgiven. We need to design an outpost simulation program that would concentrate on operations that will be unique or special to outposts on the Moon. What would that include that does not also apply to Mars? That is important to determine, because we can let our presently better funded friends in the Mars Society take care of simulating those operations that are valid for both worlds. After all, why reinvent the wheel, unless we determine that some of their conclusions need independent validation.

Some "top-of-the-head "Suggestions

• **Testing Outpost Habitat Ergonomics** - The crew should note what inside operations could benefit from more elbow room, or need less than provided. What activities could be better placed together or better separated. It may be that all F.M.A.R.S. and M.D.R.S. crews to date have worked on the same shift.

Some of the operation simulations we may want to conduct would work better during local nighttime, requiring nighttime sorties. We could try a two shift operation and make notes on whether sound insulation needs to be improved in the crew quarters, which operations of on duty crews are disturbing to off-duty crews, etc.

• **Simulating the lunar time cycle and its effect on crews and operations** - The Mars day is some 39 minutes longer than our own. This seems close enough to our own that there has been no effort to simulate the Martian day/night cycle to determine it's effect on crews. Actually, this could be done elsewhere, in a windowless closed environment, for example.

By such means as covering the windows for a 14 day period, and then in a second two-week stretch shining a flood light into them (and on the surrounding terrain) during the local nights, we could get some of the feel for the lunar cycle. Lighting up the terrain, but not the sky, at night would simulate the high glare surface and pitch dark skies of the lunar dayspan. Would that be worth the effort? At stake: practicing nightspan acclimatization (and dayspan); around the clock 2- or 3-shift operations during the dayspan stressing where possible energy intensive tasks, practicing dayspan power storage for nightspan usage, and lighter schedule, manpower intensive, energy light tasks during the ensuing nightspan.

To do this would require a pair of back to back two week crew rotations, i.e. at double expense.

• **Simulating Polar Lighting Conditions** - At the poles, sunlight will be coming in at or near the horizon, at no more than a degree and a half elevation. That means the slightest depressions will be inky black, and the appearance of the terrain will change radically from 24 hour day to day, the sun shifting clockwise (at the north pole) or counter-clockwise (at the south pole) about 12.5 degrees a day.

By using a strong search light beacon parallel to the ground on moon-less or totally overcast nights, we could simulate those conditions. And by sending out "sorties" in the same terrain on successive nights, the searchlight having been shifted appropriately, we can simulate lighting at the poles and see how easy or difficult it is to cope with. On the airless Moon, with almost no scattered light, the shallowest of shadowed depressions will appear as deep as a bottomless pit. How dangerous are such conditions?

How much or how little does it help to have rover headlights of spacesuit helmet lights? How easy is it to lose one's bearings? Could this be a reason to consider the poles an extreme operating environment? Note that using Night Vision Goggles would give misleading results. On the Moon, black is black, the amount of reflected light illuminating shadows being quite minimal.

• **Shielding Emplacement & Teleoperations** - The Mars crews have not gotten into shielding emplacement or teleoperations of any kind. We could do that by teleoperating (with or without a 3-second time delay) test robotic equipment to pile soil on an inexpensive dummy inflated structure or other type of mock up structure. Shielding is not an issue being addressed in the Mars Society. While it may not be necessary for short term stays, we want to pave the way for transition to settlement.

We could run a prior automated/teleoperated shielding emplacement design competition for most efficient way to cover a pre-landed outpost habitat with a moondust blanket before to the arrival of the first crew. How long it takes is less important than minimizing the mass of the required equipment and maximizing its hardiness and reliability and simplicity of repair. The winning designs could be selected for realistic trials at M.D.R.S. Moon Society expeditions.

Please do send us your suggestions of Moonbase operations we could reasonably simulate in the Utah desert.!

Possible Moon Society Outfitting Improvements on MDRS that would enable better simulation exercises for both Moon and Mars Outpost Simulations. These are things that may be too ambitious for a first expedition but may be good ideas for follow-on yearly M.D.R.S. rental sessions.

The ideas below are listed in order of simplest and least expensive to more complex and expensive, by a quick first estimate of what would be involved. We could brainstorm the simplest designs to be fabricated by a small local team that would work for simulation purposes and then cost these out. Possibly such donated improvements to the facility would defray some or all of the "rent." These improvements could be installed off-season.

• **Improving Airlock simulations** - While currently, crews in the Arctic and Utah must don mockup space suits and helmets to go outdoors, they do not "cycle" through an "airlock." By the simple means of adding a canvas-covered frame vestibule, the quality of this simulation could be improved. We could leave it behind as a contribution. Designing it would be a sub-project. The airlock could be spacious enough for spacesuit storage, thus effectively increasing the volume of the habitat for other uses.

• **Testing designs for shielded, non-pressurized ramadas, canopies, or hangers** that provide "lee" space protection from the cosmic elements of cosmic rays, solar flares, ultraviolet rays, micrometeorite rain, and thermal extremes. Attached lean-to structures will allow explorers to do routine outdoor activities in lightweight "unhardened" space suits. Simply attaching a semi-peripheral canopy (in real application it would be covered with some shielding but exposed to the lunar vacuum or thin Martian atmosphere) would allow ongoing simulation operations to determine which activities ought to be carried on in hab-hugging protected space and how ample a shielded space should be provided for. It might also suggest where similar sheltered unpressurized storage might be best for other kinds of items such as those infrequently needed, but prone to weather damage.

A prior design competition would identify options that would require the least imported mass, and could be made of locally processed building materials, and erected with no or minimal human EVA, automatically or by teleoperation. Competition winners could be field tested at M.D.R.S.

• **Verifying designs of add-on units that allow solar and visual access for shielded habitats.** In a real outpost situation on the Moon or Mars with radiation protection provided by 2 meters or more of a moondust blanket, such a units would provide visual access to the surroundings and be able to import sunshine inside. Nothing helps fine tune design better than actual real-situation usage. Either option would require a prior visit to M.D.R.S. to make the suitable measurements to insure a good fit. We would not need to do both simulations at the same time The one that required the more elaborate apparatus, probably the solar access unit, could be left for a return visit to Utah in another year.

1) A periscopic window unit could be temporarily affixed to the outside of one M.D.R.S. habitat window.

2) A heliostat-sunpipe system to follow the sun across the sky and reflect it via outside and inside window attachments into a ceiling mounted sun pipe sunlight distribution grid. Some of the sun-pipe components should be available commercially and would require customized assembly but not customized fabrication. If light concentrating fiber optics where used to channel heliostat gathered sunlight into the habitat, only a small portion of one of the existing windows need be taken over by this system, leaving most of the window for direct visual access to the countryside. The effects of such a system on the moods of the crew would be observed. During cloudy periods, an outside sunlamp could provide the "sunshine" input into the system.

3) A vegetation-assisted waste water primary treatment facility - The experience of our crew(s) and other crews could help perfect this "Modular Biospherics Friendly" technology. This would be an ambitious follow-on project for

a 2nd year effort. Designing such a system to be retro-fitted in the cramped volume of the main M.D.R.S. structure would be a major challenge. It might be easier to place it in a separate but adjacent structure. It could eventually be integrated with the GreenHab structure/system already in place. There is a home in Houston where such a system, designed by a retired NASA environmental engineer, had been working reliably for over twenty-five years.

for illustrations of all the above ideas, please check out:
http://www.moonsociety.org/projects/luna_mdrs_proj.htm

The suggestions above may be too demanding for an early program. We need to look at one possibility after the other to produce a list of doable simulation exercises that
(a) are uniquely relevant to Lunar Outposts; or
(b) relevant to both Lunar and Martian outposts but have not been addressed by F.M.A.R.S. or M.D.R.S. crews; and
(c) are prioritized according to reverse order of difficulty to set up and expected costs. Any of the above "advanced simulation" activities that we enable by providing the needed equipment or systems will help us get a handle on technologies that need further development.

The Bottom Line - It is not worth executing a poorly thought out program for which we would have difficulty finding sponsors. We stand to gain useful knowledge, and to identify technologies that need further development, concentrating on those where potentially profitable terrestrial applications could pay for the needed R&D.

If we can design a good program, for 2 weeks (one crew rotation) or 4 weeks (2 crew rotations) it is a good bet that we can secure funding. If we can pull it off, we will have advanced the opening of the lunar frontier by that much. Attendant "good" publicity will gain us new support: new members, new funding, new connections. If we can come up with good follow on programs to run each year, or every other year, that would exciting and productive.

So we have nothing to lose and everything to gain by taking the first step: designing a good and appropriate lunar operations simulation program. Not a penny need be spent until we have completed that homework.

How to Join Expedition Zero

To get aboard the team that will endeavor to come up with a Moonbase Simulation Program with real merit, you must be a current Moon Society member. Then go to: http://www.moonsociety.org/teams/ and scroll down the list until you find the Team: **Renting Mars Desert Outpost for Lunar Outpost Simulation Exercises** and click "Join Team." You will need to have selected a user name and password at www.moonsociety.org/wsd/ Then you will receive and be able to send messages to **rent-mdrs@moonsociety.org**

"To the Moon, by way of Utah!"

Mid-Atlantic Chapter goes on an Outing

http://www.moonsociety.org/chapter/mid-atlantic
From Margo Duesterhaus <duesterhaus1@comcast.net>

We had so much fun at our July outing to the **Air & Space Museum** in Virginia, that we want to plan another outing. If you have any idea for fun space-related places to go in the Mid-Atlantic area, send them to the list.

Thanks!
Margo

Moon Society St. Louis Fields Info Table at Archon 2004

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

Guest Peter Kokh, new Moon Society President and continuing Chapters Coordinator, coming from Milwaukee, had brought along the last of the two dozen plus gravity bricks sets he had made and which he had been holding in reserve for us since our chapter was chartered a week and a half ago. We also had recreated the Artemis Moonbase display from instructions on the Space Chapter Hub, plus a Moon Globe and enough other exhibits to fill two tables.

In the afternoon, at 4 pm, we had a well-attended (25-30 people) panel discussion: "Moon to Mars: Vision for Space Exploration or Why we must go back to stay" Saturday, 4 pm. Our panelists:

- Dave Heck, Boeing, Structures Design Engineer
- Dave Dietzler, Science Writer, contributing editor, Moon Miners Manifesto
- Peter Kokh, President, the Moon Society; editor, MMM

The panel discussion went very well with a lively question and answer period. Chapter president Keith Wetzel guarded the table during the panel session.

We folded up for the day at 5:30 pm and drove to Schlaffley's micro-brewery & restaurant in the western 'burbs where we were joined by members Chris Noble, a school teacher and her husband, a 3rd Dave (prospective new member) and Burton L. (Burt) Sharpe, former NASA Scientist ALSEP (Apollo Lunar Surface Experiment Packages), Project Management staff of the Viking (Mars Orbiter-Lander) Program. Co Author "The Moon Resources, Future Development, and Colonization."

In other MSStL news, Dave Heck has started the Boeing-St. Louis Space Society and has about a dozen fellow employees interested in concrete Moon-related engineering projects. We look forward to hearing about the "mischief" they get into.

Hey, Moon Society St. Louis is lonely out there. We need a lot more Moon Society chapters to form and share the excitement and the fun!

How large is the Moon compared to Earth?

Parameter:	Earth	Moon
Mean diameter	12,742 km	3,476 km
Volume	1.08321 x 1012 km	32.199 x 1010 km3
Mass	5.9736 x 1024 kg	7.349 x 1022 kg
Mean density	5.515	3.342
Surface gravity	9.78 m/s	21.62 m/s2
Escape velocity	11.2 km/s	2.38 km/s
Visual albedo	0.367	0.12
Visual magnitude	3.86+0.21	

The surface area of the Moon is just 7.44% that of Earth or 14,657,415 sq. mi. vs. Earth's 196,961,284 sq. mi. (The formula is $4\pi r^2$) However, that is still considerable. Imagine Canada and the U.S. on the nearside hemisphere, China and Brazil on the farside, and you about have it. Or North and South America less Mexico and Central America.

From the Moon, Earth appears 3.67 times as wide, and takes up 13.4 times as much area of sky. Thanks to the polar ice and all the clouds, Earth reflects much more light than the relatively dark Moon, and the full Earth appears 60 times as bright from the Moon as the full Moon we see.

Thanks to its smaller yet significant size and lower density, the Moon enjoys just 1/6th our gravity. Only Ganymede, Titan, Callisto, and Io are larger satellites, and only Io is more dense and has slightly more gravity. **MMM**

GREAT BROWSING !

Whatever happened to Solar Power Satellites?
http://www.thespacereview.com/article/214/1

"There will not be a financial reason to start creating a solar power system in space unless we reach a decision to include the hidden environmental costs of our current non-renewable sources of energy into the equation."

Expedition Mars
Mars Expedition Research Council
Mars Society Australia & Mars Society Canada
http://expedition-mars.org/

Earth & Moon to Scale
http://www.freemars.org/jeff/planets/Luna/Luna.htm

Lunar Page
http://www.aboutwater.com/lunar.htm

The X-Prize Success Cascade Begins

What Happens Next?: Jeff Foust: Space Review
http://www.thespacereview.com/article/241/1

Zero-G flights for $3 Gs have begun
for Individual & Group Bookings
www.space.com/missionlaunches/zero_g_040914.html
http://www.nogravity.com/

"Look, ma, no pilot!"
Should Unpiloted Tourist Flights be Allowed?
http://www.thespacereview.com/article/211/1
It's all about lowering the Ticket Price

Bigelow Aerospace offers $50 million Prize
for first Commercial Orbital Tourist Flights
http://www.space.com/missionlaunches
/bigelow_spaceprize_040927.html

Virgin Galactic - The 1st Tourist Spaceline?
http://www.virgingalactic.com/

Bigelow Aerospace to build Inflatable Habitats
http://www.space.com/news/businessmonday_040524.html

Bigelow Aerospace Plans Lunar Cruise Ship
http://www.space.com/sciencefiction/bigelow_tourism.html

Dealing with the Risks of Space Tourism
http://www.thespacereview.com/article/239/1

Non-technological Barriers to Lower Launch Costs
http://www.thespacereview.com/article/233/1

Lunar Tourism pages
www.moonminer.com/lunar_tourism_index.html

Mail For MMM

Comparing the Difficulty of Deep Space Missions

I appreciated Jeffrey Liss's guest editorial ("How to Make the Moon-Mars initiative Work") in the June MMM, issue # 176. I would like to make a comment on one minor point in the editorial.

On the first page of his editorial, Mr. Liss says that the Moon is closer in distance and time than Mars, and that that means (among other things) more payload. If Mr. Liss meant to say that payloads to the Moon will be greater than those to Mars for the same propellant (i.e. that the delta-V to the Moon is less) because the distance and trip time are closer, I beg to differ.

For Earthbound transportation, distance, trip time, and energy costs for travel and transport tend to be roughly proportional. However, the intuitions we have developed from Earth based experience don't always apply to space travel. We need to develop new intuitions.

For example, the planet Mercury, at closest approach, is further from Earth than either Venus or Mars at their closest approaches. However, the trip time for a Hohmann ellipse (the minimum energy trajectory) is much shorter in time than the minimum energy trajectories to either Venus or Mars. Yet while the trip time is shorter, the delta-V for a mission to Mercury is much larger. So large, in fact, that we are only now sending the second space probe to Mercury, Mercury Messenger. And even that requires us to use gravity assists from planetary flybys to get there with a reasonable payload.

So for spaceflight, distance between start point and destination, flight time, and mission delta-V are not necessarily correlated. One cannot automatically predict one parameter from another. It so happens that the Moon is closer than Mars in distance, closer in flight time, and has a smaller mission delta-V, all three. But it is not the case that one guarantees either of the others.

In fact, I have thought that a good measure of the difficulty of a space mission, especially one with a human crew, would be some combination of delta-V and flight time. Mission delta-V tells you how much propellant you require. Flight time tells you how large a consumables budget you need, and what the life support requirements will be. Perhaps the product of delta-V and flight time, or some weighted sum, would be a good measure.

Larry J. Friesen

EDITOR's Comment: A very good suggestion, which if followed, would quickly dispel a lot of the decades-long nonsense about near Earth asteroids being more accessible than the Moon (for crewed missions.) The consumables for such long duration missions would be very large. PK

Earth's Mushrooming Power Appetite (addressed to Dave Dietzler, cc: MMM)

Regarding your article "Earth's Mushrooming Power Appetite" [MMM # 177, August 2004, p. 3, article by Dave Dietzler], you might want to read the article at:

http://www.wired.com/wired/archive/12.09/china.html?pg=1&topic=(none)&topic_set=(none)

It's about China's preparation to mass produce inexpensive nuclear pebble reactors. These would be cheap enough that the idea of putting SPS up is even less appealing economically, which underscores the points in your article.

Tom Greenwalt < tomg@trancer.com >

Mars Drill to Seek Knowledge & Resources

Drilling for information first, then for resources, oil is not likely to be among exploration targets.

NASA Headquarters, WashingtonD.C. Sept.r 29, 2004
RELEASE: 04-318

The futuristic drilling rig, under development at Johnson Space Center, Houston, is designed for use on the Moon or on Mars. It is being tested, in conditions in some ways similar to Mars, through Oct. 3, at the Eureka Weather Station on Ellesmere Island in Canada's Artic Nunayut province about 690 miles from the North Pole.

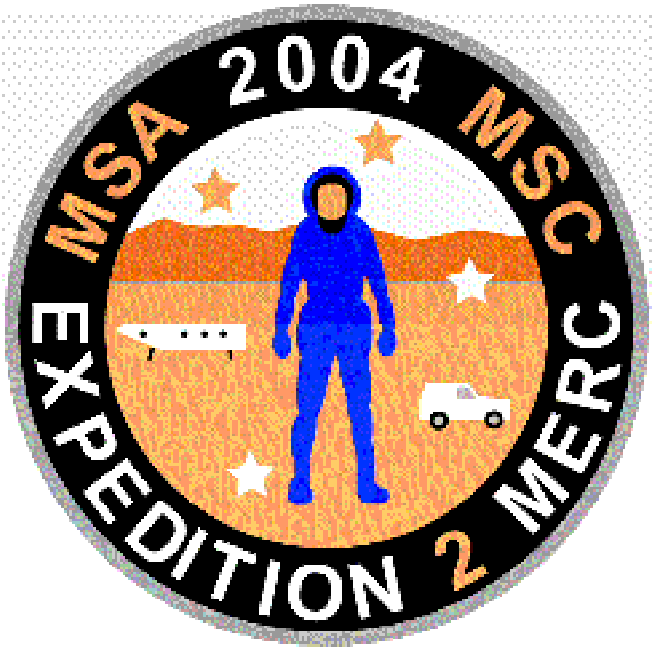
The Canadian tests are being done in cooperation with NASA's Ames Research Center (ARC), Calif., and with faculty members from two Canadian institutions, McGill U., Montreal and the U. of Toronto. Baker Hughes Inc. of Houston, with a rich oil field history, is participating in the project under a Space Act Agreement with NASA.

Setup exercises with the drill were held recently at JSC. Because it is designed for use on other planetary bodies, the drill has weight, size and power consumption limits. Power consumption is about 100 watts. Drill components are designed for minimum weight and size.

Because of weight and volume constraints, it cannot, like traditional drilling rigs, use drill pipe or drilling mud. The apparatus consists of a power source, a control box and the drill itself. The drill looks like a vertical pipe mounted on a support in the bottom of half a suitcase. A laptop is attached to the control box to record data. The base is anchored to the surface and an electrically powered bit rotates beneath it. The pipe-like drill module follows the bit down. The drill is periodically pulled to the surface by its tether to remove the core and cuttings.

This is the second generation of the drill. Initially the drill will be used to secure core samples for scientific study. Later versions eventually would drill for resources, like, possibly, subsurface water on Mars. The third or fourth generation will be ready for the moon or Marsand able to drill to depths of several hundred meters.

http://www.jsc.nasa.gov/news/marsdrill.html



Mars Society Australia – Mars Society Canada Joint Expedition 2 Concludes in South Australia

August 29, 2004 - Adelaide, Australia

The final members of the crew of Expedition Two returned safely home today after an adventurous time in the outback in Arkaroola, South Australia. Among the successful accomplishments of the ExTwo crew were:

- testingthe **MarsSkin 3** Mechanical-Counter-Pressure suit
- site selection for the **MARS-OZ** analog research station s
- testing Mars Society Canada EVA-datalogger prototypes
- completion of a multi-facet geology & biology program
- completion of the social-psychology program
- completion of another stage in the long term field operations program with the Scouting Exploration Methodology Study (SEMS)
- outreach with students from the International Space University, and the University of Technology Sydney
- interviews with newspapers, television and radio media
- acquisition of sponsorship from sources such as the Canadian Space Agency, Land Rover, Australian National University, Australian Geographic, and Arkaroola Wilderness Resort and Sanctuary, among others

Expedition Two involved a wide range of research projects within an approximately 200 km (125 mi.) radius of Arkaroola in the northern Flinders Ranges of the Australian Outback. It was the second in a series of 15 expeditions to Mars-like or 'analogue' locations here on Earth. The goal of the expeditions is to develop strategies and technologies that will support a successful future human Mars mission.

There were four main themes to the expedition: collecting baseline environmental data on the field area, carrying out Mars-mission related engineering analogue research, human factors studies, and publicity with respect to the human exploration of Mars.

Expedition Two culminated in the selection of the precise site in the Arkaroola area for the construction of MARS-OZ, one of the four Mars Analogue Research Stations planned worldwide. It will also lay the groundwork for future expeditions and research by Mars Society Australia in the Arkaroola region.

Previous expeditions run by Mars Society Australia in the Red Centre (Jarntimarra-1) and Utah (Expedition One) in conjunction with the Mars Society of Canada and the Mars Society in the United States led to extensive media coverage and a heightened profile for the organizations involved, individual expeditioners, and sponsors. It is therefore hoped that Expedition Two will provide an excellent platform for public education and outreach, as well as meeting the rigorous science and engineering goals of the Society. **<MSA – MSC>**

http://www.marssociety.org.au

You can Help Plan Moon Society Expeditions to the Mars Desert Research Station in Utah

See Pages 10-12 this issue of MMM

To get aboard the team that will endeavor to come up with a Moonbase Simulation Program with real merit, you must be a current Moon Society member. If you are not, go to http://www.moonsociety.org/rgister/

Then go to: http://www.moonsociety.org/teams/ and scroll down the list until you find the Team: **Renting Mars Desert Outpost for Lunar Outpost Simulation Exercises** and click "Join Team." You will need to select a user name and password at: www.moonsociety.org/wsd/

Then you will receive and be able to send messages to **rent-mdrs@moonsociety.org**

Information about the Mars Arctic & Mars Desert Research Stations in Canada & Utah

Flashline Mars ARCTIC Resarch Station, Devon I., Canada
'04 Reports: http://www.marssociety.org/arctic/index.asp
'01-'03 Archives:
http://www.marssociety.org/arctic/fmarchive.asp

Mars DESERT Research Station in Hanksville, Utah:
http://www.marssociety.org/mdrs/index.asp
MDRS 2003-04 Daily Field Reports
http://www.marssociety.org/MDRS/fs03/
MDRS Operations Manual
http://www.marssociety.org/MDRS/crews/opsman.asp
MDRS Floor Plan
http://www.marssociety.org/MDRS/crews/opsman01.asp
MDRS Topgraphical Map
http://www.marssociety.org/MDRS/crews/opsman02.asp
MDRS Mission Rules
http://www.marssociety.org/MDRS/crews/mrules.asp

October 27th Total Lunar Eclipse

www.space.com/spacewatch/041001_lunar_eclipse.html

Below is a timeline, for Eastern Daylight Time. In the Central Time Zone, subtract one hour from these times; in the Mountain Time Zone, subtract two hours, and for the Pacific Time Zone, subtract three hours.

* 9:14 pm: Moon enters Earth's dark umbral shadow
* 10:23 pm: Totality begins
* 11:04 pm: Mid-eclipse
* 11:45 pm: Totality ends
* 12:54 am (Oct. 28): Moon leaves the umbra

Students for the Exploration & Development of Space
National Conf. MIT – Nov. 11–14, 2004

http://www.seds.org/spacevision2004.html

This past year has marked a major rejuvenation in the SEDS-USA organization. To celebrate, SEDS is reinstating the SEDS-USA national conference after an eight-year hiatus. This is an annual gathering of students to organize the future activities of SEDS-USA and to develop a stronger community of young space enthusiasts.

This year's theme is "SpaceVision2004" and is being hosted by MITSEDS and the MIT Mars Society chapter. You do not have to be a SEDS member or even a student to attend, just bring your interest in space and a desire to meet and network with other students and professionals.

MMM–Derived Papers Online

http://www.lunar-reclamation.org/papers/

- "Spinning-up" Glass-Glass Composites Technology 1987
- MUS/cle Strategy for Lunar Industrial Diversification 1988
- Prinzton: a Rille-Bottom Settlement for Three Thousand Pioneers 1989
- The Lunar Hostel: An Alternate Concept for First Beachead and Secondary Outposts 1991
- The "Frontier Builder": an Earth-Moon Hotel Cruise Ship: Definition & Design Exercise 1992
- SSI Research Goals Proposal 1993
- Railroads on the Moon 1993
- The Prehistory of Lunar Prospector 1995
- The Use of Lunar Lavatubes 1995
- Reinventing Space Oases 1996
- Rehabilitating Venus as a Human Destination '92, '98, '00
- Living "Off the Ice" on Europa 1997, 1998, 2001
- What do Lavatubes Look Like? 1999
- TransHab and the Prehistory of its Architecture. 1999
- Steps to Civilian Lunar Home Rule Authority 1999
- The "MarsPulse" Calendar 1999, 2004
- "Improving" the Moon and The Developer's Role 2000
- Illustrated Discussion of Moon / Mars Habitat Options 2002

SpaceDev Begins Work on Dream Chaser™ Space Vehicle

Goal: Lower Cost Routine Human Access to Orbit

MOU Signed with NASA Ames Research Center

September 29, 2004: SpaceDev has begun designing a reuseable, piloted, sub-orbital space ship that could be scaled up to safely and economically transport passengers to and from low earth orbit, including the International Space Station. The name of the vehicle is the "SpaceDev Dream Chaser™."

SpaceDev's founding chairman and CEO, Jim Benson, recently signed a Space Act Memorandum of Understanding (MOU) with NASA Ames Research Center director, Dr. Scott Hubbard. This non-binding MOU confirms the intention of the two parties to explore novel, hybrid propulsion based hypersonic test beds for routine human space access. The parties will explore collaborative partnerships to investigate the potential of using SpaceDev's proven hybrid propulsion and other technologies, and a low cost, private space program development approach, to establish and design new piloted small launch vehicles and flight test platforms to enable near-term, low-cost routine space access for NASA and the United States. One possibility for collaboration is the SpaceDev Dream Chaser™ project, which is currently being discussed with NASA Ames.

Vertical Take–off

Unlike the more complex SpaceShipOne, for which SpaceDev provides critical proprietary hybrid rocket motor propulsion technologies, the SpaceDev Dream Chaser™ would be piloted and take-off vertically, like most launch vehicles, and is designed to glide back for a normal horizontal runway landing.

The sub-orbital SpaceDev Dream Chaser™ is derived from an existing X-Plane concept, will have an altitude goal of approximately 160 km (about 100 miles) and will be powered by a single, high performance hybrid rocket motor, under parallel development by SpaceDev for the SpaceDev Streaker™, a family of small, expendable launch vehicles, designed to affordably deliver small satellites to low earth orbit. The SpaceDev Dream Chaser™ will use motor technology being developed for the SpaceDev Streaker™ booster stage, the most powerful motor in the Streaker family. The SpaceDev Dream Chaser™ motor will produce approximately 100,000 pounds of thrust, about six times the thrust of the SpaceShipOne motor, but less than one-half that of the 250,000 pound thrust hybrid rocket motors developed several years ago by the American Rocket Company (AMROC). **</MMM>**

Great Reading from MMM's Past

http://www.lunar-reclamation.org/mmm_classics/

The Lunar Reclamation Society, Inc.

P.O. Box 2102
Milwaukee
WI 53201

www.lunar-reclamation.org

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

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Newsletter Mailing - Carol Nelson 414-466-2081
(* Board Members, & Ken Paul < kenpaul@cape-mac.org >

LRS NEWS

• **October 9th Meeting:** Peter reported on his trip to St. Louis to help the Moon Society chapter there at the Archon Sci-Fi Convention. Space News: X-Prize Momentum; Mars Rovers' continuing mission. We discussed what's happening inside NSS and the Moon Society; Improvements to Moon Miners' Manifesto and the campaign to beef up circulation.

The question of rights to MMM: should we sign a Contingency Agreement with the Moon Society? And what to do with our many exhibits gathering dust. An NSS member is starting a new space museum in Chicago.

We continued planning the December Holiday Special meeting on 12/11/04

LRS NOVEMBER Events

Saturday, NOV. 13 th, 1–4 pm

LRS Meeting, Mayfair Mall, Garden Suites Room G110
AGENDA: www. lunar-reclamation.org/page4.htm

U.S. CHAPTERS

NSS Chapter Events MMM

6 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 14, 7-9 pm Dr. Calvin Alexander from the U. Minn. Geology & Geophysics Dept. spoke on "The Geology of Mars: What We've Learned from Spirit and Opportunity"

• **pics of the mars scarecrow**
www.freemars.org/mnfan/MN-State-Fair/2004/

• **Lunar Eclipse Event** - On October 27th, we'll be iat the Eisenhower Observatory, 1001 West Hwy 7, Hopkins, that Wednesday, to witness a total lunar eclipse. We'll be there from 8pm to 11pm. Join us if you like or watch it from your own backyard. **Eclipse Times:** Partial Eclipse Begins: 8:14 pm

Total Eclipse Begins: 9:23pm; Ends: 10:45 pm
Partial Eclipse Ends: 11:54 pm

OREGON

Oregon L5 Society

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

voice mail / (503) 655-6189 -- FAX (503)-251-9901

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

Allen G. Taylor <allen.taylor@ieee.org>
Bryce Walden <moonbase@attbi.com>
(LBRT - Oregon Moonbase) moonbase@attbi.com

Meetings 3rd Sat. each month at **2 p.m.**
Bourne Plaza, 1441 SE 122nd, Portland, **downstairs**
Oct 16 - Celestial Navigation Work Shop, by Bob McGown
Nov 20 – TBA

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/]

The **3rd Thursday** of the month at **7–9pm**
OCT. 21st: Kiel – **NOV. 18th:** UW-Sheboygan, Room TBA

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.tripod.com/]

PASA regular business luncheon/formal meeting from **1–3 pm**, the **3rd Saturday** of every month at the **Liberty One** food court on the second level, 16th and S. Market. Go toward the windows on the 17th street side and go *left*. Look for table sign. Parking at Liberty One on 17th St.

Meeting Dates: Oct. 9th, Nov. 20 th. Call Earl or Mitch 215-625-0670 to verify all meetings. Meeting location and time as last month: The October meeting has been moved to the 9th. We moved the meeting because a number of directors are going to a convention called "Capclave" the next weekend. This will appear in *Moon Miners'* after our meeting but in the electronic format in time to consider attending. I am also late at sending this but will have more time to get the October Report in assuming that doing sales (an added, needed, job) for the company I work with doesn't affect me as much as it did in September.

•September Meeting Notes: Our first presenter was Hank Smith one of a number of our group who attended World Con in Boston. Although he enjoyed many of the exhibits and presentations at this event I think the behind the scenes problems he talked on at some length (convenience of the site, poorly structured internet area (hall way)). Other members who attended also complained of problems that distracted from the experience of visiting this event in the great city of Boston.

Hank and the others are both committed convention goers but also volunteers at the events they attend. They would be a great help for what attendees would like beyond the presentations(which they liked) and the exhibits that drew many favorable comments.In particular the E.E. (Doc.) Smith display. If you don't know who this is, go find out. He wrote stories back when we first had proof that galaxies existed thus titling one of his series "Galactic Patrol" when this was a new idea in the public mind.This is "The Lensemen" series starting with Triplanetary. Good teen age reading!

On other topics from Hank:besides the "gripe session" that happens after cons there was also talk of a World Con in Japan in 2007 and a discussion of our local Philcon and what we can contribute to this as speakers and/or panel members. We may contribute to "Space Mega Structures", "The Future of Medicine (or Education?) or Robots in the Military" or.... . Contact Hank for possibilities and to volunteer (hank@hotmail.com).

Dorothy Kurtz brought the latest Planetary Report with several good articles including "Planetary Protection; Don't Leave Home Without It" by Margaret Race on what is needed to do space travel without being killed or harmed by various hazards when leaving Earth. Also noted, from the same source,"Cassini/ Huygens New Home: First Days in Saturn's Orbit" by Emily Stewart Lahdawalla. There are lots of pictures of this grand return.

Mitch Gordon reported on the book signing on a non space book (where waiting on that one) and the need to contact The Franklin Institute for the events the organization will have. I hope that we can rebuild the contacts we developed in the past with this organization. For events: franklininstitute.edu .

Ad Astra has arrived! The latest issue includes material on "The Space Bird" as they call Space Ship One. The report is on the problems initially experi-enced during the first launch and what might happen in the future. We now have a glimpse of that future: As I write this Space Ship One has made its second "fast turn around" flight reaching for the Ansarii X- Prize. This issue contained many good articles including: Moon Base Designs, Heavy Lift Vehicles a thought piece: "One Way to Mars" and a report on the Space Blitz last spring; we,ll have to see if the Bush initiative of that time or Kerry's' backers will move private and public space activities forward. On the book front: Robbin Pinnel a publicist for authors we are trying to bring here, will contact Barnes and Noble to arrange an authors tour through our area this Fall. Mitch has been busy!

Earl Bennett gave a short report on material in the Autumn 2004 Searchlites, the publication of The Seti League. Among other things, the switch of the publication to an all electronic format is announced and that our executive director Dr.H. Paul Shuch will become part time due to job responsibilities.There is an article on a topic I have mentioned before: Harry Kimball's Seti station: A 96 Khz Project Argus Station. He reprises his work to upgrade the data bandwidth he can process and some of the details on analyzing what to keep and also discard. He is N0TOU in ham lingo, and his research station is EM29je.

There was also a guest editorial Moon Yes, Mars No! by Ron Sirull of Del Ray Beach, Florida. It comments on the "Moon, Mars and Beyond" program and includes some of the well known arguments we have discussed about staying on the Moon which in fact where talked of at our meetings lately One of the goals that this and other discussion has repeated is the desire for a Lunar Farside Observatory. Mr. Sirull asks "Why have the microbe hunters have so much

influence on the direction and funding of the research?" He asks members of our group (Seti League in this case) to speak up on applying resources to going to the Moon for many of the reasons we all see as advantages: Easy Access, Short Radio Transient Time, Fast Rescue. And of course a great place for robotically constructed observatories. For this and other material, including a memorium to radio astronomy pioneer Dr. John D. Kraus,W8jk, by H. Paul Shuch: see the publication.Website: setileague .org .

We also had an added discussion with material brought by Janice on one of her areas of interest: Global warming and the interactions that might be responsible for it. The first group of material was Global Satellite Imaging showing the retreat of the ice caps and glaciers from 1979 to 2002. The loss is about 20%. There was also material from "Wired" magazine of 8/11/2000 on using selective dumping of iron containing refuse to promote plankton growth.According to the article we are loosing plankton which produces much of the air (oxygen) in the atmosphere.

Submitted by *Earl Bennett.*

SOLAR SYSTEM AMBASSADORS

www.jpl.nasa.gov/ ambassador/

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We aren't finished
when we fail,
We're finished
when we quit !
So let's not !

"The best way to predict the future is to create it yourself."

- Dr. Peter H. Diamandis, Chairman & Founder of the X PRIZE Foundation

CALIFORNIA

OASIS

OASIS: Organization for the **A**dvancement of **S**pace **I**ndustrialization and **S**ettlement
Greater Los Angeles Chapter of NSS

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

Events Hotline/Answering Machine: (310) 364-2290
Odyssey Ed: Kat Tanaka - odyssey_editor@yahoo.com

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

oasis@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 15, 7:00 p.m.** -- "Mars Reconnaissance Orbiter: An Unprecedented Look at Mars," by Dr. Jim Graf, JPL, Mars Reconnaissance Orbiter Project Manager. Vosloh Forum at Pasadena City College, 1570 E Colorado Blvd. Admission is free. 818/354-0112 or http://www.jpl.nasa.gov/events/lectures/oct04.cfm
- **Oct. 16 th, 3:00 p.m.** --OASIS Monthly Business Meeting at Microcosm, 401 Coral Circle, El Segundo
- **Oct 21, 7:30 p.m.** -- "Apollo: The Golden Age of Space-flight," by Walter Cunningham, lunar module pilot for Apollo 7. San Diego Aerospace Museum, 2001 Pan American Plaza, San Diego. $10 for San Diego Aerospace Museum members or $15 non-members. 619/234-8291 or www.aerospacemuseum.org/upcoming/lectureseries.html
- **Oct 21** -- Orionids meteor shower peak. The duration of this meteor shower covers the period of October 15 to 29. The radiant rises around 10:30 p.m. At about 3:00 a.m. the radiant is about 50 degrees above the southern horizon. To best observe the Orionids, wear appropriate clothing for the weather and lie outside in a reclining lawn chair with your feet pointing toward the south and look straight up. The maximum rate typically reaches 20/hr.
- **Oct 23, sunset to 10 p.m.** -- Los Angeles Sidewalk Astronomers Star Party. Autry Museum of Western Heritage, 4700 Western Heritage Way (park in the Los Angeles Zoo parking lot). 323/664-1191 or www.sidewalkastronomers.com/chapters/laevents.html.
- **Dec. 4 th, 4:00 p.m.** -- "Mars Exploration: From the Vikings to the 21st Century", a lecture by Dr. John Callas, Mars Exploration Rover Science Manager, Long Beach Public Library, 101 Pacific Avenue, Long Beach.

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❍ **$45 National Space Society** dues includes **Ad Astra**
❍ **$20** NSS dues if under 22 / over 64. *State age* ___
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Moon Society dues include **Moon Miners'Manifesto**
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- **Hardcopy MMM**: U.S. & Canada **$35** Elsewhere: **$60**

P.O. Box 940825, Plano, TX 75094-0825, USA

INDEX to # 179 OCTOBER 2004

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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

CHICAGO SPACE FRONTIER L5
❍ $15 annual dues

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

MINNESOTA SPACE FRONTIER SOCIETY
❍ $25 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

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