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

Moon Miners' Manifesto

& The Moon Society Journal

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In FOCUS: Deep Impact Sequels and Planetary Defense Strategies

On July 4th, this year, "the" fireworks were many millions of miles away in space, as an 820 pound (364 kg) man-made "impactor" collided with the comet Temple 1 at 23,000 mph (37,000 kph) spewing many tons of comet stuff into space in a spectacularly visible plume, while carving out a "football stadium-sized" crater. It turns out that by using an impactor paired with a flyby mothercraft to analyze the chemical and physical composition of the splashout, is by far the cheapest and simplest way to do a "sample return." The idea is not new, and was proposed a while back as a way to "return" samples from Europa's icy crust.

Meanwhile, many people are concerned about the finite possibility of a killer asteroid or comet chunk hitting the Earth at any time from now into the indefinite future. A number of movies and novels have appeared in which the day is saved by sending out nuke-tipped missiles to blast the threatening body to smithereens. Many concerned individuals want to make "Planetary Defense" a high priority, maybe even the highest priority of the space program. But there is a twofold problem.

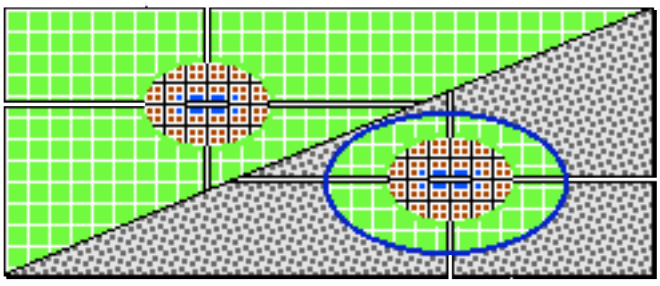
First, it is not possible or plausible to sufficiently alarm or motivate the public about such an indefinite threat. Consider: in the next 25,000 years, a "killer" impact could occur. It *could* happen tomorrow, in fact. *Or not for tens of millions of years.* And that is the hitch. Meanwhile, in the next 25,000 years it is all but absolutely certain that most of Canada, some bordering parts of the US, all of Scandinavia and some of Europe and Russia, will be literally wiped clean by glaciers in the next ice age. And guess what? No one is losing any sleep over it.

While the idea of mobilizing the public around this issue is patently absurd, the idea that we should prudently prepare for such a cosmic threat is not. Note the word "prudently." We have to approach the threat problem logically and in the right sequence. Right now, we have a GIGO situation in terms of what we know about the population of threatening near Earth objects: "garbage in, garbage out" - GIGO. To design methods of destroying or deflecting or rerouting threatening objects we have to know what they are made of, their physical structure and cohesiveness, and other things that will codetermine the effectiveness of any methods or "weapons" we deploy.

Deep Impact, while giving us lot's of data and new knowledge about this particular comet, and a step in the right direction, still leaves us wondering how we could deflect this body, put it on a safer orbit, if [⇒ p. 2, col. 2]

Cities (on Earth) vs. Xities (beyond)

In this issue, we explore the significant and definitive differences between human cities on Earth and the kind of human settlements that alone can survive beyond our biosphere. Settlements on the Space Frontier will not endure if they do not include within their limits what Earth cities can conveniently keep outside. There is a great difference between Outpost Mindset and Settlement Mindset. pp. 3-6



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

=> www.lunar-reclamation.org

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

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

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

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

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⇒ IN FOCUS Editorial continued from p. 1.

it were ever found to be a threat (which is not the case.)

Deep Impact did teach us that the expected "skin" of dust that overlays the cores of comets can be much deeper than we expected. Our impactor plowed into a blanket of talcum powder like dust fluff many tens of meters thick. Obviously, not an effective way to impart a deflective change of momentum to put it in a "safer" orbit.

But it's a start. Not just for "planetary defense," but for scientific knowledge, *such indirect "sample return" missions should be flown to all the various types of near Earth objects out there*, and there are several. Asteroids are not a homogeneous group. There are stony ones, metal-rich ones, some that have significant amounts of ice and other volatiles. Near term comets in close in orbits will also vary. Depending on how much time they have spent in the inner solar system, their dusty outer layers will be thinner (less time) or thicker (more time.) Deep Impact failed to reach the core of the comet, now realized to be significantly deeper below the surface than suspected. So we have as yet to "sample" real "comet core stuff."

Currently, our main effort is to identify "all" near Earth objects that could conceivably threaten Earth anytime in the future, and fully characterizing their orbits. This is relatively inexpensive, and simply good astronomy, teaching us about the Solar System of which we are a part.

But we have to go beyond this to really know what these objects are made of. Impact-Splashout-Characterization missions like Deep Impact, but an order of magnitude more massive are in order to at least one each of each "species" of asteroid and comet in question. Only with that knowledge, which tells us about the objects composition and physical structure and cohesive strength, can we possibly come up with effective means of rerouting any such objects should it become necessary. The proposal frequently put forward to stockpile ICBMs for Planetary Defense is just naive male testosterone. What we know now gives us no reason to be confident such devices would be effective.

The question of money is paramount. Governments do not want to spend money foolishly, and efforts to get governments to begin programs which are not yet scientifically grounded are counterproductive. What money we can shake up is best spent on knowledge. Not only do we need that knowledge to design an effective repertoire of deflection strategies, but it is something astronomers and planetary scientists want to know, and will back.

Yes, the "sky could fall" tomorrow, but so could a number of other conceivable catastrophes for which we can not imagine an effective countermeasure. That's life, or life and death. Nature. Natural.

So let's cut the killer asteroid hysteria which is not going anywhere and makes some organizations focused on it look ridiculous. Let's take this one step at a time. A program of impact-splashout missions is the place to start. PK

Cities *"Out There"*
Bringing Home the Difference

by Peter Kokh

In MMM's 6th year, issues #s 51-60, December 1991 - November 1992 [just reedited, reillustrated and republished in MMM Classics #6 available as a PDF file download from www.lunar-reclamation.org/mmm_classics/] one theme dominated the year: the vast and rather radical (root-deep) difference between cities as we know them, all within Earth's biosphere and taking that biosphere for granted, and cities out there -- anywhere out there (other than planets around other suns, if those planets have a breathable atmosphere.)

MMMC #6 begins: .... "**defining how different city life would be beyond Earth's cradling Biosphere. Cities out there, whether in free space as Gerald K. O'Neill envisioned, or on the surface of the Moon or other on worlds would be radically different. They would have to establish their own mini-biospheres, no longer something to be taken for granted, then learn to sustain them and live within them.** ***This will change everything!***

"So radical will be the way cities out there will be built and run, that we cannot appropriately use the same word for them as we do for our familiar cities on Earth: whether they be primitive prehistoric towns, third world megacities or the affluent cities in prosperous countries. *They all get to take the biosphere for granted.*

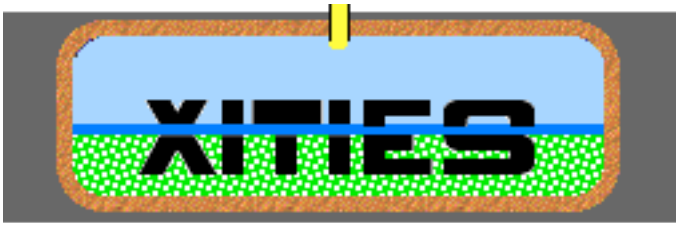
"Out there, our settlements will have to reprioritize everything. We need a different word for this different species of urban entity. **We call it the Xity:** X for "exo-terrestrial, not just beyond Earth, but beyond Biosphere I, Gaia.

"We pronounce it not EXity (it's not ex- anything) but KSity, city preceded by a hard K, for the hard hull/shell that contains the manmade biosphere that pioneers now must nourish and care for as if their lives depended on it. *for indeed, their lives will!"*

We encourage readers online to download this volume of the MMM Classics and read it. Those not online may be able to access it at to a local library.

In these articles we discussed a lot of things: new departments of xity government tasked with maintaining the integrity and livability of the manmade mini-biosphere and pressure hull complex; with short-cylce air and water recycling; with education to help citizens do their part: how xity-architecture and urban planning will play key roles . We discussed Xities on the Moon, then on Mars, on Europa and elsewhere in the Outer Solar System, even aerial (aerostat) Xities high in the clouds of Venus.

We tried to illustrate the difference between city and xity from many points of view. Having just reedited these 13-14 year old articles, however, new ideas for bringing home to the reader the crucial and definitive city/xity differences have occurred to us. *Read on!*



Xities beyond Earth's Biosphere will be be founded on a new contract between Man & Nature, a reintegration of urban and rural, of residential and agricultural, in which both humans and nature are much more immediately interdependent for survival. There is no more "downwind" and "downstream." There is no more "somebody else's backyard." There is no more putting problems off to future generations. In contrast, "Responsibility" and immediate "self interest" will be one, not two in conflict. Making it work will be everyone's job, not just the community fathers. There will be no room for "politics." Survival will always be problematic. Alert status: maximum.

by Peter Kokh

Here on Earth, we have since time immemorial taken the global atmosphere, hydrosphere, and biosphere for granted. While destructive weather and locally catastrophic geological burps are problems, by and large, earth is a human-friendly place to live with lot's of shoulder room, although through our rabbit-like reproductive instincts, this last feature is rapidly coming to a close.

When we invented agriculture and started domesticating edible plant species and animals, our farms and hamlets were close-coupled. In time cities arose populated by those engaged in other pursuits than agriculture. Farm and settlement entered a period of evolving disengagement, with many urban dwellers never experiencing farm life and food production activities. Cities became places where nature was present only as a landscaping token. Urban "parks" while helpful, are nonetheless still token. Citizens of denizens of cities grow up with a vastly distorted view of how much plant biomass is necessary to sustain fresh air, much less the food supply. Cities became places in which people kept houseplants.

Symbols of Disengagement:

chimneys  **&**  **smokestacks**

Earth's atmosphere is vast: global and seemingly topless. Before the scientific age, most people imagined (some still do) that the atmosphere pervades all of space. That it is a finite blanket in which only so much can be dumped is just starting to be taken seriously, by some. Whether we are just heating our homes, or using heat in manufacturing, the nasty residue can just conveniently be dumped "downwind." Curbs on this practice are recent.

In Xities that contain and maintain a very finite atmosphere, there is no downwind. Everyone lives downwind of themselves. If you use a chimney or other exhaust

device, what it pumps out you must inhale. Oops, we better do something drastically different. We can no longer count on the winds, the rain, the seas, and the forests to gradually cleanse our smoke and other dirty exhausts by the time the global winds bring it back around to us weeks later.

In xities, the long term recycling provided by nature on earth will not be available. We will have to use smoke-free, gas-free heating and manufacturing processes or find ways to scrub the exhaust before it leaves the confines of its generation. This will make xities out there radically different from cities down here.

Symbols of Disengagement:

gutters  **&**  **drains**

It was way back about 2,500 B.C. in the Indus River valley (now Pakistan) in the settlement we call Mohenjo-Daro that urban sewage systems were first built. That made an immense difference. People were not wallowing in their own body wastes. What we have today is but a more sophisticated elaboration of this ancient prototype, a means of transporting the undesirable to somewhere else. Now, of course, we are mandated by law to treat sewage before it is allowed to enter nature's waterways. But Earth's hydrosphere being so massive and vast, "clean enough" is still far from clean. We rely on nature to finish the job.

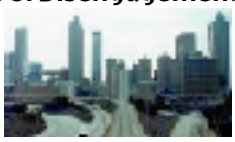
In settlements out there, settlements that contain mini-biospheres that they rely on totally, there is not enough biomass and water reserves to "finish the job" of sewage treatment. We must devise more comprehensive systems. The water we flush will be the water we drink, much sooner than we think. There no "downstream" out there. Unlike citizens, xitizens will live immediately downstream of themselves.

It seems to us that treatment must begin immediately, with in-home treatment of toilet wastes. The Wolverton graywater system, in which wastes are flushed into tanks inoculated with microbes to breakdown the pathogens as well as the solids, and which feed successive tanks and beds of first swamp plants, then marsh plants, bog plants and soil plants, continuously cleansing the water while the plants cleanse the air, is the way to go. Check out:

http://www.wolvertonenvironmental.com/

Every unit or module that has a toilet, be it residential, office, school, workplace, recreation area, etc. should be so equipped. That will greatly reduce the burden the xity waste treatment facilities must handle in order to produce water for agriculture, industry, hygiene, and drinking. It will also increase the amount of biomass able to keep the air fresh and sweet. Water in advanced stages or treatment can do double duty for landscaping, park streams and waterfalls, boating, etc.

Symbols of Disengagement:

city  **&**  **farm**

Not long after the dawn of agriculture, cooperative farming began. People lived in farming villages, surrounded by their farms. Village and farm were separate but fully integrated. As cities developed to support marketing and trade, their integration with agriculture was less direct. As manufacturing arose, including the manufacturing of farming implements, the separation intensified. Nowadays it is common for city people to have never spent time on a farm, to have only a foggy and distorted idea of what is involved in bringing food to their table.

Because on the space frontier, xities and their farms must share the same contained atmosphere and mini-biosphere -- it will be the farm areas that keep the xity's air fresh and sweet -- this separation will end. Unlike the aloof and separate city, the xity will be fully integrated with the farms that support it. We will have come full-circle, back to the days of farming villages surrounded by their village-owned farmlands.

Forests and other natural planted areas will also be part of the xity. The amount of vegetation mass needed to clean the xity's are naturally is great. We can opt for chemical means, but that puts us at the mercy of engineered systems prone to breakdown. No xity biosphere will ever have the guarnteed flywheel recycling system that Earth/Gaia enjoys, but the further we advance in that direction, the greater will be the Xity-Biosphere viability and security.

Symbols of Disengagement:

land  **&**  **sea**

City dwellers simply have no concept at all of how great the support ratio is of hydrosphere to vegetation mass to people mass is. Not only cannot we live with the help of a few potted plants, we cannot live without the analog of an ocean. In a hull-limited biosphere volume, we cannot, of course have anything like an ocean. On the other hand, the "ocean" of Biosphere II, while at the time a bold step in the right direction, was pitifully inadequate and symbolic.

Having ample water reserves will provide security, greatly ease water recycling system engineering, support recreation, and provide a thermal flywheel to help even out internal dayspan-nightspan temperature variations.

Rain which helps cleanse and sweeten the air as well as water vegetation and clean paved surfaces, is unlikely to occur naturally in a mini-biosphere. It may need to be provided by ceiling sprinklers, or at best coaxed out of air that has become to humid -- not a comfortable prospect. Fountains and mists may be a workable substitute.

Symbols of Disengagement:

city  &  world

The ultimate disengagement here on today's Earth is that between the city and the living world at large, aka the global biosphere, personified as Gaia. On the space frontier, xity and biosphere must be one and the same, united against the barren and inhospitable surroundings. Unlike citizens, xitizens have no global biosphere to take for granted. They must create, nourish, and sustain one inside their own urban space. World, as livable, as nourishing, as enabling and supporting must be one with the xity.

Consequences

We talk these days about "permanent outposts" on the Moon and Mars, about putting down roots and staying. No small outpost can have a sustainable biosphere. We will not be on the Moon, or Mars "to stay," all intentions, declarations and legislation to do so notwithstanding, until we build xities with a genetically diverse population of settlers, with a rich and diverse biota, with systems in place that will allow us to live immediately downwind and downstream of ourselves. That expertise will be a licensed export to Earth.

More simply said, humans can not settle the space frontier -- not alone, not without taking Earth-life along to reencradle themselves. In the process our civilization which now is a mess of disengagements of things that must naturally thrive together, will becomw whole again. Like a symbiote, we cannot live without our partner life system. Humanity and Gaia together will establish joint pockets beyond Earth. In contrast, "men bearing houseplants will go nowhere." except to lay the foundations of future ruins.

We will, of course, have outposts, rural boondocks towns supporting mines, tourism, and other "parts" of global economies on new worlds. But long term, those smaller exclaves of humanity will not survive without supporting xities within practical reach. The same goes for spaceships spending long times "at space" between ports. Their food growing areas will be token and fragile. Without ports of call with established biospheres, they can probably not ply the space lanes for long. It follows that for rural outposts and spaceships alike, the bigger the better, because needed plant life requires acreage and volume. Think grand! "Larger" will be much less expensive in the long run. But we can expect that to be a hard sell to budget-minded myopic officials and administrators.

Our goal must not be to establish a "permanent outpost" on the Moon, or Mars, or anywhere else. It must be to establish Xities, not exo-cities, but miniature encapsulated Earths, viable *populated biosphere systems*.

Our cry is "Ad Astra!" Well, Xities come first. So let's build Xities then. **<MMM>**

Outpost vs. XITY

Two Very Different Games and Mindsets
The Implications for Agriculture

by Peter Kokh

When the technologies needed for the Moon are discussed, it is almost always in the context of a starter outpost. After all, we do have to start somewhere, so it is only natural that everyone is focused on "the gambit game."

> A lot of the conventional wisdom about what we will need, and what we will do on the Moon turns out to hold only in this startup context. Once we begin to expand in determined fashion, *everything changes.*

In this brief article, I'd like to touch on a few of those things, to get the point across. For long term, we need to start looking at things from a totally opposite vantage point. Indeed, unless we can switch perspectives and gears, there will be no "long term."

Outpost Goals

Some may want to prioritize Science & Exploration as the principal goals of the Outpost. *Patience!* Far more sand much better science, and far more thorough exploration will get done, the sooner we transition from Outpost to Settlement. ***Preparing to lay the foundations for Settlement must be Outpost Job #1.*** If this is not the name of the game, then we are fooling everyone, including ourselves, and spending taxpayer money for trivial pursuits. In this light, here are the priorities, all in the form "test & prove":

- various methods of regolith shielding emplacement
- methods of excess dayspan power generation and storage for nightspan use
- methods for processing regolith for oxygen, iron, other metals and elements needed to for building materials
- modular architecture concepts using locally produced building materials

Notice that "test & prove" agriculture methods and concepts is not in this list. This is not an oversight. As we transition to settlement, the context of operations will change so radically, that little of what we learn in outpost agriculture exercises will continue to apply.

Out of the Sardine Can

The first lunar outpost will be constructed from modules and other elements manufactured on Earth: hard modules such as we have been using to date in space station construction, and inflatable and rigid-inflatable-hybrids. The inflatables will give us more elbow room per mass delivered to the Moon's surface and per number of flights. While this is a significant improvement on both counts over previous all rigid module outpost concepts, it will still put a premium on working and living space. We will always need more than we have. It will still be the Sardine Can, just the

larger size. Priority in pressurized space allocation must be given for processing, manufacturing, and fabrication experiments. Any other prioritization will lead to inevitable failure of the Outpost as to its main goal: not to keep a token presence on the Moon indefinitely, but to lead expiditiously to real permanent human presence in the form of the first settlement.

(The Settlement will be unsuccessful if it is not sited to have access to all the suites of materials it will need to produce the bulk of its needs locally. That's why this writer so strongly opposes a lunar polar outpost. It's in the wrong place for industry.)

In sharp and definitive contrast to the Outpost, the Settlement Xity-in-the-making will be built all but completely from modules manufactured locally from local materials. Suddenly the cost per cubic foot per person will drop so dramatically, that we can begin to be more generous in per person allotments. The Settlement will be the beginning of the end of Sardine Can living on the Moon.

Now as we expand human presence across the lunar globe, their will always be small starter outposts. However they too will be built of modules made on the Moon. The cost if not the per person space allotment will be much improved over the first government or commercial outpost.

Beyond Hydroponics

With significantly cheaper and more spacious units produced on location, agriculture will be one of the first beneficiaries. This new elbow room will allow us to move past hydroponics to a mixture of hydroponics and geoponics. Why? Two very simple and cogent reasons:

1. Some plants do better in soil than in nutrient solutions. For more variety on the table, we have to give up the silly adoration of hydroponics as "the" modern method.
2. Far more importantly, *all hydroponic nutrients must be imported.* That represents a cost target for reduction. The simple fact is that the greater mass by weight of the nutrients needed per mass of plant are found in the regolith. So it is simple economics that once pressurized "space" is not a bottleneck, we transition to systems that are more locally supportable. Regolith can be processed into good agricultural soil *in the process of moving it* from out on the surface into an agricultural module.

Beyond Agriculture

"Man does not live by bread alone!" or food alone. We also need fresh air, and frankly, just growing all our food will not provide the biomass needed to support a true biosphere, a biosphere which naturally cycles air and water. Now we will never get to the stage we enjoy here on Earth where nature takes care of itself. Our biosphere operates as a flywheel, always maintaining itself, *given sunshine*. Our mini-biospheres will need some mechanical assist, and at times, some chemical tweaking. But to the extent that we can get it to run "on automatic" the more truly viable and sustainable our presence on the Moon, or anywhere else, will be. For that we need more than food and fiber plants.

But before we elaborate on that, consider fiber. No man-made fabric is as comfortable as cotton, all claims to the contrary notwithstanding. Yet most writers insist that cotton will have no place on the space frontier because too great a percent of the plant is inedible and/or unusable for any other purpose. "We simply can not devote that much acreage for that little fiber output." This may be true in an Outpost situation. Once we see the Outpost as "a temporary construction shack for the Settlement," all those points go out the window. Indeed:

- The "waste" biomass can, in fact, be run through a biodigester (such as one manufactured by a biotech firm in Wisconsin) to produce a tofu like food with only 2% stubborn residue
- The "waste" biomass is helping produce oxygen from waste carbon dioxide, and thus supporting the biosphere
- The argument from "efficiency" is thus quite invalid

Other desirable crops which have been put on the embargoed list prematurely by the Outpost-mindset, can now likewise be reviewed for their bioshphere contribution value. Even more significant. given that no amount of plant biomass is too much, and that from a biosphere point of view that more is definitely better, those with a Settlement-mindset need to think beyond food, fiber, and pharmaceuticals, indeed, *beyond agriculture.*

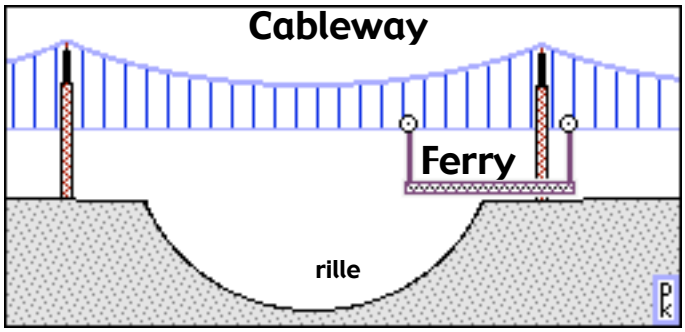
Think of a diversified flora, groves of trees and nature parks with ornamental and other species. Think of flower gardens, not just vegetable gardens. They all will help the biosphere engine run more smoothly on automatic.

Generous water to biomass to human mass ratios

Consider the enormous mass of Earth's hydrosphere (oceans, ice sheets, lakes, rivers, clouds) in comparison to the mass of living plants. The ratio is quite high. Consider the enormous mass of living plants (forests, grasslands, crops, etc.) to that of the Earth's human population. While not as great as it once was, that ratio is still quite high. The point is Earth's biosphere can only support certain minimum ratios if its going to continue to be self-maintaining.

We may never reach such a state in our minibiospheres beyond Earth, perhaps not even on a terraformed Mars. But the more generous a ratio of water to plant life to human population, the better. This means abandoning the Outpost mindset which thinks in terms of *just enough* water just in time, *just enough* food just in time. Any "monkey wrench" at all in such a fragile setup will lead to crises.

We have to have generous water reserves, and extensive vegetation. The Outpost can think house plants. The Settlement must think Nature. Again, we have to reintegrate human community with life at large. Our Xity must include what cities do not: the farms and the forests and prairies and seas. *They must be mini-Earths.* **<MMM>**



a way to "bridge" rille valley chasms *before traffic warrants building a bridge*

by Peter Kokh

While the Moon has no water-filled rivers, it does have river-like valleys and chasms that present potential obstacles to road builders wanting to take the most direct route. Someday, we may find ourselves building bridges on the Moon, and Mars too, for the same reasons and in very similar situations.

While the maria are lava plains, much more easily traversed than crater-saturated highlands, they frequently incorporate lavatubes as part of the process by which the lava sheets spread across the basin. And lavatubes not sufficiently deep below the surface will have ceilings thin enough to have failed and collapsed resulting in a chain of pits or even continuous rille valleys. These valleys could lay astride otherwise logical transportation routes, presenting an obstacle. Detouring around the shortest section of the tube might detour involve extra drives from tens of miles to a few hundred, all out of the way: a lot of time and fuel would be wasted. At first there will be little choice. But as "traffic" develops, the incentive for some way to "bridge" or "ford" the gap will gain enough priority to trigger action.

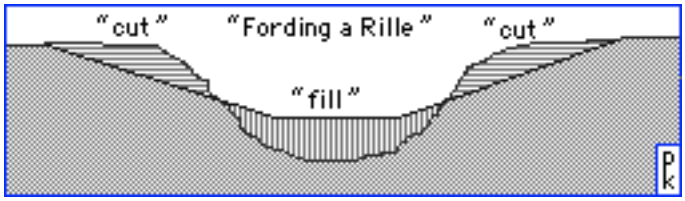
[MMM #169, October 2003, "Early Frontier Highways on the Moon" pp. 4-7] "Lighter, crater-pocked highlands surround darker and flatter lava flood plains, the 'maria'. But a mare may have several deep rille valleys (left) and flow front escarpments (top) and a few younger craters.

Road building solutions

Switchback roads, carefully zigzagging down one valley wall to the bottom, then carefully winding its way back the other side might seem the simplest solution, involving not much more than one heck of a lot of grading. But in soil that is poorly consolidated, and prone to slides, this would be dangerous work for human-crewed road building equipment. Teleoperating such equipment would be safer for the pioneers, but involve no risk reduction for expensive equipment. It is not an ideal solution, the more so the steeper the valley slopes.

Of course, on the Moon where rights of way are of little concern, one could engineer a single long **ramp** down one side and another single ramp up the other, avoiding switchbacks which are accidents waiting to happen.

"**Cut & fill**" is a more ambitious and elegant solution is to do a procedure to build a direct and straight road across the gap by moderating the slope changes.



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

Lighter Touch Solutions

It may well be much more expensive and require more materials and man-hours of labor to build a bridge than to cut & fill a landfill causeway. Yet there may be reasons why we want to, *or decide to,* tread with a lighter foot on the lunar landscapes, preserving them as integrally as we can in their natural state.

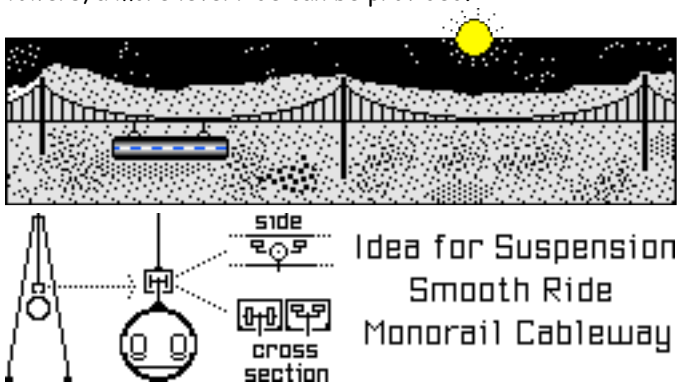
The problem is the cost. Does the foreseen growth in traffic warrant that expense? That a bridge is more convenient is not the point. Where the valley is deep and the slopes steep and treacherous, making traditional road-building approaches more difficult and dangerous, the bridge will loom more attractive.

Yet the expense of building a bridge could be a lot for the young frontier government to handle. We'd like to suggest a step-at-a-time bridge building approach by which key elements are built first, other elements phased in as the growth of traffic warrants.

The Proto Bridge

There are a growing number of types of bridge architectures. While the earliest bridgings may have been fallen logs over small streams and brooks, or carefully placed steppig stones in a shallow river bed, the early true bridges were supported from below by a masonry arch, or if needed, by a series of arches: this method was elaborated further to build aqueducts and their close cousin, the elevated canalways of Britain. The wooden trestle bridges of the early railroading days also are supported from below. But this is as much an incursion on the valleyscape as a cut & fill causeway, even if more appealing to the eye.

The **suspension bridge** and its more recent take-off, the cable-stay bridge, are products of the industrial revolution with the heavy use of iron and steel. We think that the suspension approach is ideally suited for the Moon. Once the towers are in place and the cables strung, traffic can hover above the otherwise undisturbed moonscapes allowing them to remain more natural and rustic. We have already talked about using cableways for tourists in especially scenic areas, along valley shoulders, crater rims, and mountain ridges. By having the cable car ride a second cable -- *or a box beam* -- below the support cable sagging between towers, a more level ride can be provided.



A "Ferry Crossing"

While we may well see cableways continue over rille valleys, the idea here is to build a "ferry crossing" using elements of the above-described suspension cableway system. Two towers and two anchor points are needed, one of each on each rille valley shoulder. A single suspension cable is slung from anchor to tower top to tower top to anchor. From it is suspended a box beam in which a pair of trolley boogies can ride, holding up a flatbed car, built to carry land vehicles from side to side.

The ferry parks on one side, the destination side of its most recent traverse, waiting for customer traffic. It is fully automated, so that it does not matter if the wait is minutes, hours, or days. If a vehicle approaches from the side on which the ferry waits, it drives on and uses the appropriate radio frequency to activate the controls. Once on the other side, the vehicle driver tells the flatbed ferry to wait in park mode, and drives off the other end to continue its journey. If a vehicle approaches from the side opposite to that on which the flatbed ferry is parked, the driver signals the ferry to cross so that it can be boarded.

From single to double suspension ferry to full bridge

Such a system postpones the erection of a second twin cable and suspended box beam as well as of a roadway supported between them. As traffic becomes more frequent the second suspension cable/box beam pair can be built so that two flatbed ferries can cross in the same or opposite directions at the same time. Now the stage is set for building a true bridge roadbed when traffic becomes so frequent as to warrant it.

If traffic never grows beyond the capacity of the first phase, nothing is wasted. And that is the beauty of the Suspension Ferry system. It is self-sufficient, but can be the start of a full-fledged roadway bridge.

The role of Bridges in the history of civilizations on Earth

Many major cities have grown up around the junctions of roads and rivers. Bridges were built were rivers were narrowest and most easily spanned. Bridges have united communities that had sprung up on both sides (Buda + Pest => Budapest being but one example) and have allowed other cities to expand to the "other side."

... and on the Moon (and Mars)

More importantly, bridges are logical pinch points for transportation. Traffic funnels from various angles on both sides to the Bridge crossing, and thus into and through the city built around the bridge. This is true even where, in advance of a bridge being built, a regular service ferry crossing is established. River cities have become major gateways to virgin lands beyond (e.g. St. Louis) The pinch point inevitably becomes a major regional center of trade, commerce, culture, and recreation.

Cities grow up around other seeds, of course, such as where river meets shore or at entrances to mountain passes. We discussed how the lay of the land and transportation routes would determine where thriving settlements would spring up on the Moon in MMM #140 November 2000.

Suspension Ferry Crossings that provide shortcuts across mare rilles and similar obstacles will attract convenience travel centers, and possibly settlements. Thus, erection of a cable suspension ferry crossing will appeal to entrepreneurs who want to get in on the ground floor of a potential successful new settlement and market center. It could well be an enterprise that builds the first such system rather than a frontier government. Of course, a frontier government led by forward thinking leaders might well start the ball rolling by seeking suitable enterprise partners. After all, what's good for business is good for taxes!

Not all river crossing, river-spanning cities have names that reflect that fact. But some do: Harper's Ferry, Bridgeport, Rockford, Sioux Falls, Grand Rapids, etc. It is possible that some future lunar towns will be named in part for there valley spanning function.

The Moon is more than a gray,monotonous rubble pile

The more one gets familiar with the lunar globe and maps, the more the nuances which make *this* gray rubble spot different from *that* one begin to suggest a world of possibilities - indeed, a human world of possibilities! The idea of suspension ferry crossings that span rille valleys is just one example. The more really familiar with the Moon you become., the more concrete the potential of settlement will loom. Take the first step through the Lunar Study and Observation Certificate Program cosponsored by the Moon Society at www.moonsociety.org/certificate/. **<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 August 1994 as a forum for supporters and participants in the **Artemis Project™** quest to establish a commercial Moon base as a first step to a permanent, self-supporting lunar community. **ASI** does not engage in any form of commercial business directly, but seeks to build a Project support business team. Registered trademarks of the **Artemis Project™** belong to **The Lunar Resources Company®**

PROJECTS: www.moonsociety.org/projects/

The Artemis Project™ – Project LETO™ – Rent–MDRS

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 – www.moonsociety.org/register/

Mail Box Destinations:

□ **Checks, money orders, membership questions**
Moon Society Membership Services:
PO Box 940825, Plano, TX 75094-0825, USA **:**

□ **Projects, chapters, volunteers, information, etc.**
Moon Society Program Services
PO Box 080395, Milwaukee, WI 53208, USA

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

Moon Society Election Results

from Peter Kokh and Gary Gray, Election Committee Chair

This year two Officer Positions were open. The following have been elected, both without opposition:

Vice President: Randall Severy #115
Treasurer: Dana Carson #10

Our congratulations to them! Both Dana and Randall have been central figures in both the Artemis Society and the Moon Society from the outset. Randall replaces retiring Vice President David Wetnight, who is now elected to the Board of Directors (see below.) Dana replaces retiring Treasurer R. Scotty Gammenthaller, who is now also elected to the Board of Directors. Scotty has been treasurer from day one when the Moon Society formed in July 2000, and has done a splendid job of putting the Society on a sound financial basis. We are happy that he will be continuing to contribute his wisdom in his new position.

The drama and suspense in this year's election, of course was the **Board of Directors** election with five candidates vying for three open positions. The weighted preferential voting was very close. But after all the math was done and checked, the winners are. *in alphabetical order:*

Scotty Gammenthaller #394
Randall Severy #125
David Wetnight #627

Candidate Dana Carson will still serve the Society os our new treasurer, and we are most grateful to him for volunteering to run for this position. Candidate John R. Schrock, who was running for reelection, has been a work horse for the past three years, taking on the job of building a new front page for our website. We hope that he will continue to provide his valuable insights and input as a member of the Leadership Council.

For more on Leadership Council opportunities, see the invitation just below on page 10.

We mentioned above the difficult math demanded by the present system. Some of us would like to change the voting procedures now in place to something simpler. The current bylaws, specifically Article IX, Section 2, only state that "If there are more eligible nominees for Board positions than there are open positions, those eligible nominees receiving the most votes, up to the number required to fill the available positions, shall be elected." So the origin of the current practice, and our obligation to follow it is unclear.

In next yea's election, the offices of President and Secretary and four board of directors positions will be open. Current position holders may run for reelection but new candidates are always welcome and a sign of vigor. Do consider these opportunities. As to how to prepare for such a possibility, read the article that follows.

Consider Joining the Leadership Council

It's the ideal first step toward running for a Moon Society Office or Board Position

from Peter Kokh

If you have abilities (and some free time) to put at the disposal of the Society, you might want to consider a possible nomination to the Board for the next time around. The best way to test the waters is to join the Leadership Council as a non-voting member. This will allow you to participate in the discussions and deliberations that lead to Moon Society decisions. The Leadership Council meets in the Moon-Leaders room on the ASI-MOO (an advanced private chat room) twice a month on the 1st and 3rd Wednesdays at 9-11 pm ET, 8-10 pm CT, 7-9 pm MT, 6-8 pm PT.

http://www.asi.org/adb/09/08/04/moo.html

We are open to members who want to work with others to find practical ways we can advance our goals. If you have some free time and are willing to volunteer for small action items, and do some footwork on suggested initiatives, you will be a big asset to us. In fact quite a few issues are settled by consensus among the leaders without having to put the matter to the Board of Directors. So even without being elected, or before being elected, you have an opportunity to make a difference.

In contrast, it is very difficult to get enthused about candidates for the board who seem to come from nowhere, with no history of involvement. The Leadership Council is the ideal place to establish yourself as well as to know what you might be getting yourself into should you decide to run for office.

Without that experience, you run the risk of having unrealistic ideas about what we can accomplish as a team. Yes we have to be ambitious, industriously so, but it is also important to know what assets and resources we have to call on in pursuing bold dreams. We always want to aim higher, but "abracadabra" wave a magic wand approaches don't work too well.

To join the Leadership Council, send an email to president@moonsociety.org, and tell me a bit about your self and I'll respond and get you set up with the necessary access and permissions, and send you all the instructions on how to get into the online meeting room.

We have a great bunch of talented volunteers now, but if we are going to do more great things, we have to grow the pool of involved persons. You just might make a great addition.

Recent Website Problems & Improvements

from Peter Kokh

On May 15th, I made some changes to the front page of the Moon Society website. Normally any maintenance on this page is done by some of our very skilled volunteers on the web team. This time, however, no one on the team had the necessary free time, and as it now seems, impatiently, I made the requested changes myself. I should have waited, as the result was to freeze the page. No one noticed for some time. I first noticed that the Moon's phase was off, then that the space news, which should update hourly, was stuck on May 15th.

Board member Dana Carson (and candidate for treasurer) came to the rescue and fixed the problem. From now on, I know better. Patience is the best policy.

The Web Team needs more Expert Volunteers

But this mishap brings to light a problem: we are in real need of people with real http experience and some disposable free time, to join the web team! Our present team is stretched too thin.

ASI Website

The vaccum is especially felt in maintaining the Artemis Society International website. Many pages are outdated. Many links are broken. We do not have paid staff to fix these problems.

If you have the expertise and the time, please consider helping us out. We can bring you up to speed on the Web Site Director software that is used to maintain this extensive site.

Contact MikeDelany <mdelaneyis@eircom.net>

Further Website Improvements?

Adding new material, more reports, projects, and features to the website has been a top priority. Many positive changes have been made in the past several months. We are now struggling to add a program that will automatically change the featured picture or illustration each time one refreshes the entry page. We will be adding more pictures. The hitch so far has been available volunteer free time, not the technology or software.

If you have suggestions to make the Moon Society's website more user friendly and/or more attractive, please let us know. Just write president@moonsociety.org, or by mail, use the 2nd PO Box (Milwaukee) listed on page 9 above. Please bear in mind, that it is easier to imagine a new feature than to effect it, and most of all, keep in mind that we have no paid staff, only volunteers who have day job, families, and other demands on their limited time.

Recently, we have added a lot more useful information that you can find in the right hand destinations menu by clicking Moon Info and Things Lunar.

Critical Path Tasks *that We can do*

from Moon Society President, Peter Kokh

While many research and development projects needed to put us on the Moon to stay do require considerable expenditures and resource access, that is not the whole story. There are "critical path tasks" that do not require megabucks research or cutting edge expertise to *advance.* Yet these tasks are *ophans.* Nobody has spoken for them. They are all potentially within our capacity. Let's pursue the Moon *as if we mean it.* We do not have to wait and watch.

- Using existing topographical and photographic data to determine logical transportation coridor routes
- Simulate robotic and teleoperable shielding emplacement options
- Identify best outfitting options for the triiple double SpaceHab Artemis Moonbase reference design
- Identify all needed and desirable auxiliary modules and equipment
- Simulate overnighting, testing various energy management strategies to find most practical near term options
- Develop a dependency/prerequisite technology based flow chart of how lunar industrialisation and development could best be pursued, identifying enabled domestic manufacturing and export options at each stage.
- Test hydroponic and geoponic options for different crop species, weighing the intangibles of greenhouse morale, fresh food, fresh air, menu variety, and lessened dependence on Earth, and progress towards a biospheric life support flywheel
- Determine valuable skills needed and develop a new member recruiting plan with the above tasks in mind.
- Develop projects to pursue all of the above, ranked on the basis of manpower, expense, and talent in tow vs. talent needing to be recruited.

"One thing is for sure; time doesn't do things. People do things. Nothing happens if we don't make it happen."

Gregory R. Bennett
Moon Society Founder and President Emeritus

Where do small enterprises fit in this scheme?

1. Small "space" enterprises - for example the kinds of companies ASI/Moon Society members are forming
2. Small "space spin-up" terrestrial enterprises -for example, the kinds of companies out to make a buck out of down to Earth applications of technologies that will be needed, or helpful, once we return to the Moon.

Do you fit in this picture somewhere? T*hat's up to you!*

Email president@moonsociety.org listing your talents, experience, expertise, and intersts for some suggestions.

Renew Your Membership Now
& get an Historic Moon Map

from Gregory R. Bennett, President Emeritus

While our limited supply lasts, renewing members will receive a rare collectable piece of history -- Rand McNally's "Official Map of the Moon" published *just before* the historic first landing of Apollo 11!

This full-color one-sheet map has a map of the Moon with several of the proposed Apollo landing sites identified and a sidebar with summaries of Apollo flights 8, 9, 10, and the plans for Apollo 11.

Sent folded in a business-size envelope.

You need not wait until your current membership is about to expire. Renew early to get in on this limited time, first come first served offer: your current membership will be extended a full twelve months. Limited to the first 150 to respond!

Earn an $8 Credit towards your next renewal

In April, the Moon Society unveiled our new Lunar Study and Observer Certificate Program. Designed by the American Lunar Society, an organization of amateur astronomers fascinated by the Moon, the Moon Society now cosponsors this program. The Board of Directors approved giving full credit for the $8 fee that must be included with the completed Observation Forms to ALS. That credit will not be rebated, but it can be deducted from your next renewal, once we have been notified by ALS that your forms are in order and that you have earned the certificate. The certificate will be signed by both societies and be sent to you about four weeks after your application arrives.

We are doing this to encourage our members to become more familiar with the Moon's nearside, the side forever turned towards Earth, since the Moon turns on its own axis in the same period that it revolves around Earth.

First Moon Society Member Completes Program

We are happy to announce that we have been notified that one of our recent new members has completed the Lunar Study and Observing Program and has sent in the forms and check to apply for the certificate.

We'll publish his name as soon as we receive confirmation from American Lunar Society. Meanwhile both Societies are continuing to explore various options and opportunities for further collaboration and some form of formal mutual association. Our futures certainly overlap!

Proposing a Project:

Fully "Homeworked" Proposals are more welcome!

We have received many suggestions for Projects the Moon Society could undertake in order to further its goals. They come from Board Members, other leaders, members at large, visitors to our website, and even from friendly leaders of other organizations.

If the person making the suggestion sees no evidence that his or her suggestion is being pursued, discouragement or even rejection of the Society may follow. *This is unfortunate.* Such situations arise when the proposer has unrealistic ideas of what it will take to undertake the project suggested, and/or very unrealistic ideas about the financial, manpower, and other resources of the Society.

Coming up with an idea is one thing. Making it happen is quite another. Let's start from the top. You have a simple, great project idea. You should consider this:

- The Society has no paid staff, only members, a few of whom volunteering some of their limited free time.
- The Society's principal source of income is member dues

If someone proposes a project "idea", that means that *someone else* must examine it, identify all the steps it will take to undertake the project and estimate how many man-hours will be involved, how much money and other resources it will take, and identify concrete sponsors who may be willing to underwrite all or a portion of the expenses as a sponsor or cosponsor. Just to get this far means that a current volunteer who is probably already too busy, must volunteer to devote a lot of time to completing this homework. *The Board cannot consider or vote on a Project Proposal until all this homework and footwork is done.*

Now the one proposing the Project idea, can fast forward to the next step, Board consideration, by doing this homework and footwork by him/herself. This we call, baking the potato. Sending in a Project Proposal without doing this preliminary work is a lot like sending us a half-baked potato. *We do appreciate your enthusiasm.* But if the project means something to you, you might want to invest some time in this preliminary work -- and/or find some associate(s) who can team up with you to put together a "mature" proposal. *[MMM will be happy to run an ad for you to find assistance!]*

A mature project proposal is far more likely to get Board attention, than one that is not, however potentially great it may be. Doing this homework first means that you are taking ownership of the idea. In other words, when you put up your hand to say, "I have a great idea," consider how much more it would enthuse your audience if you could add, "and I have done a lot of footwork in examining it, identifying all the steps and phases, all the manpower and other resources needed, where we can get funding and sponsors, etc." *Then you will have our attention!*

Chapters & Outposts

Bay Area Moon Society

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

Contact: Bill Clawson <billclawson@yahoo.com>

Contact: Jonathan Goff <jongoff@myrealbox.com>

Regular monthly meeting the **Fourth Thursday**.

Next Meeting Dates: Aug 26 – Sep 22 – Oct 27

Moon Society St. Louis

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

Contact: Keith Wetzel <kawetzel@swbell.net>

Regularly scheduled monthly meeting the **Second Wednesday** of the month 7:30 PM - Buder Branch Public Library 4401 S. Hampton, in the basement conference room

Next Meeting Dates: Aug 10 – Sep 14 – Oct 12

Attention Moon Society Members

Keeping your Membership Information Current

This is a quarterly reminder for those of you who are online. You can check, and update if necessary, your personal contact information that the Society keeps on file, most importantly, your mailing address and your preferred email address if you have one.

The procedure may seem complicated, but once you try it, you will find it easy enough

Go to: **http://www.moonsociety.org/mymoon/**

If any of the information in the box Member Information needs updating, click on the link Edit Member Info

If you don't yet have a Team Director account, you won't be able to log in to My Moon Society, but you will get the login form where you can request a login account.

If you have a hardcopy subscription to the newsletter, your copy of MMM will not reach you unless we have your correct current address on file.

And without your correct current email address on file, you will miss periodic email reports to members on the Society's progress in pursuing the realization of its Vision and Mission.

If you prefer, you can always simply send your corrected contact information to us, and we'll make the changes for you. However, if you are up to doing it yourself, that will save us time for other tasks.

Email: president@moonsociety.org

GREAT BROWSING!

The Cosmos I Solar Sail Launch Failure:
Lou Friedman: "We will try again!"
www.planetary.org/solarsail/update_20050625.html

Spacehab "Apex" Multi-purpose spacecraft
http://www.spacehab.com/news/2005/05_07_12.htm

Smalltug: the *low fuel cargo route* to the Moon's L1 gateway
http://www.andrews-space.com/en/corporate/Smalltug(200411).htm

The New Mexico Space Alliance
http://www.NewMexicoSpaceAlliance.com

Apollo 11 - 17 Mission - Fullscreen QTVR photo
http://www.panoramas.dk/fullscreen3/f29.html

Solar System Tourism Opportunity Development.
http://www.thespacereview.com/article/400/1

Build a space station with a few launches of large components *or* many launches of smaller ones?
http://www.thespacereview.com/article/398/1

Google: Moon: Apollo Landing Sites - *Zoom in!*
http://moon.google.com/?fc=1

NASA - Abandoned Spaceships & Moon Buggies
http://science.nasa.gov/headlines/y2005/11jul_lroc.htm?list25823

Lunar Breccia Meteorites homepage
http://groups.msn.com/moonmeteorites/homepage

Mars Cold, Bitter Planet for a Long, Long Time
http://www.space.com/scienceastronomy/050721_mars_cold.html

Russian Report on Failed Solar Sail Launch
http://www.space.com/missionlaunches/sfn_050721_cosmos_solarsail.htm

The First Woman on the Moon - *When?*
http://www.thespacereview.com/article/415/1

How the Mars Foundation is Imagineering the Settlement of Mars - Illustation Galleries
http://www.marshome.org/images2/

Welcome to Jamestown on the Moon
http://www.jamestownonthemoon.org/

Got $100 M? Take a trip around the Moon!
http://en.rian.ru/russia/20050726/40976276.html

Branson/Rutan Form "The Spaceship Company"
www.space.com/news/050727_branson_rutan.html

MMM Classics

http://www.lunar-reclamation.org/mmm_classics/
Now available in pdf format for free download

Beginning with the July 2004 publishing slot, we began republishing the classic articles from the first ten years, December 1986 to November 1996, two volumes at a time, twice a year, each volume covering one year - in PDF format (Adobe Portable Document File). We are proud to have now completed the first six volumes:

MMM Classics - Year 1 **mmmc1_Jul2004.pdf**
Dec. '86 - Nov. '87 - *#s* 1-10 - 31 pp - 1.3 mb

MMM Classics - Year 2 **mmmc2_Jul2004.pdf**
Dec. '87 - Nov. '88 - *#s* 11-20 - 54 pp - 2.0 mb

MMM Classics - Year 3 **mmmc3_Jan2005.pdf**
Dec. '88 - Nov. '89 - *#s* 21-30 - 58 pp - 2.9 mb

MMM Classics - Year 4 **mmmc4_Jan2005.pdf**
Dec. '89 - Nov. '90 - *#s* 31-40 - 70 pp - 2.2 mb

MMM Classics - Year 5 **mmmc5_Jul2005.pdf**
Dec. '90 - Nov. '91 - *#s* 41-50 - 56 pp - 2.8 mb

MMM Classics - Year 6 **mmmc6_Jul2005.pdf**
Dec. '91 - Nov. '92 - *#s* 51-60 - 64 pp - 2.5 mb

Look for the next two volumes, #7 & 8,
covering issues *#s* 61-80 in January, 2006

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Saving Voyager & Hubble:

A Call for Action from the Planetary Society

From Louis Friedman, Exec Dir. The Planetary Society

July 15, 2005 - Letter Excerpts

Two of humankind's greatest space achievements -- two of the greatest scientific endeavors of all time, the twin Voyager deep space probes and the Hubble Space Telescope -- are under attack. In an incredibly misguided decision, Voyager is facing imminent shutdown, while Hubble is being prematurely threatened with destruction.

With swift action, we can save these treasures ... but to do it, we need help from you ...

Consider the Voyager probes

After three long decades of travel, passing Jupiter, Saturn, Uranus and Neptune, Voyager 1 has just now reached the heliosheath [or "heliopause"] -- the very outer edge of our solar system -- with Voyager 2 close behind. Shutting the program down at this moment is pure folly, the worst kind of false economy: it will save a pittance ... but irretrievably lose us the opportunity of a lifetime.

Launched in 1977, the Voyager 1 spacecraft is now more distant than any other human artifact, ... twice as far away from the Sun as Pluto, just crossing the boundary to interstellar space. We will not get another chance to explore so far from home for, literally, generations.

Now the probes are watching as the solar wind encounters the interstellar medium, sensing this unknown substance for the first time. True to form, they are reliably broadcasting their findings to us ... and will continue doing so until some time around 2020, when their nuclear power sources finally die.

Despite all of this, NASA Administration accountants have imposed the death penalty on Voyager ... all to save a little -- literally, just a little -- money from NASA's multi-billion dollar budget.

As for Hubble

For most people, the argument for keeping it in operation is obvious: no space mission has produced such spectacular and publicly accessible findings. In reality, the issue is a complex one. Hubble's benefits have been enormous ... but the costs of a service mission will be enormous, too, and there are legitimate concerns about the risk. The problem is, no one seems to have even considered Hubble's benefits when they decided to toss it into oblivion. In fact, NASA failed to even consult the scientific community before the decision was announced.

It was a cavalier and dismissive decision ... one that was made despite the fact that Hubble has been described as "the most successful scientific instrument ever built" and the most scientifically productive space mission in history.

To be sure, our ability to service Hubble in time is far from certain. To do so will require a costly shuttle flight which, by current measure, is considered unsafe. But -- again! -- the decision did not have to be made now! Hubble can continue in operation for two more years, maybe longer, without service. Two years from now, such a service mission might be considered safe (even prudent); if not, then is when a sad decision should be made to terminate Hubble...but not now.

The truth is that Hubble and the Voyager probes really are among humanity's greatest assets. They are beloved by the public and the scientific community -- worldwide -- alike. They each continue giving us a rich flow of new knowledge...they continue to earn their keep each and every day!

The U.S. Congress needs to know this. Congress needs to know how you and I, and millions of people around the world, feel about these missions. And, these leaders need to know that we ARE watching. Because right now, too many of them think that space is a "minor" public interest. Even NASA sometimes forgets that these ventures are part of a PUBLIC program.

There are deep and legitimate questions about the cost and safety -- even the feasibility -- of how to mount a necessary service trip. Nonetheless, there is no reason to give up yet: the observatory should work for another two years or more before it must be serviced ... so no decision needs to be made yet! As with Voyager, so too here, this "rush to judgment" is purely false economy, one that will close our options off prematurely.

Fortunately, these decisions can still be reversed. But -- with the U.S. Congress preparing its final action on next year's budget right now -- our window of opportunity will close soon. Voyager and Hubble are world assets, so this is a global effort. That's why we need Society Members from all over the world to take action -- now -- to convince those responsible to preserve these crucial projects.

Specifically, I'm urging you to take two vital steps to join the battle [to save both Voyager & Hubble] and make a difference:

1. Sign our petition:
   http://planetary.org/voyager_hubble
2. Make a generous contribution to the Society today
   https://planetary.org/donations.html

   The Planetary Society
   65 NorthCatalina Avenue
   Padadena, CA 91106-2301

DISCLAIMER: In reprinting this letter, MMM is merely calling to your attention an opportunity for action in which you may or may not wish to involve yourself. We are neither encouraging or discouraging donations to this effort. We should all actively support our dreams for a human future in space, but which efforts we choose to actively support and which we choose to just monitor, are personal decisions.

Official Mars Homestead Project Press Release 07-25-2005

Mars Foundation Completes Groundbreaking Mars Settlement Study

www.marshome.org/news/20050725-pressrelease2.html

Reading, MA - The Mars Foundation™ has completed a comprehensive, 8-month, pre-design study of the first human settlement on the planet Mars, an effort called the Mars Homestead™ Project. This study verifies that a permanent settlement can be established early in the course of human Mars exploration by using near-term technologies and local mars resources. The unprecedented, unified Mars settlement design and vision places the Mars Foundation at the forefront of understanding in this field.

The Mars Foundation's global team of 21 scientists and engineers has examined the needs of the proposed settlement, developed technical concepts for Mars-based life support and resource utilization, and identified core technologies. Detailed concepts have been generated for many technical disciplines including agriculture, architecture, electrical distribution, bulk gas, HVAC, instrumentation and controls, information technology, medicine, psychology, nuclear power, waste recycling, polymer manufacturing, and metals manufacturing systems.

The Mars Homestead team will present results of this study in various peer-reviewed publications and conferences, beginning with the July SAE-ICES (International Conference on Environmental Systems) in Rome. At this conference, Georgi Petrov, team architect and recent graduate of the MIT School of Architecture, presented a paper that describes the Homestead's architectural design. In August, at the Mars Society Convention in Boulder, CO, the team will deliver a track of eight presentations covering multiple technical areas. Additional presentations of study results and technical concepts will be given at the Meridiani Base Workshop in August, and at the ASCE Earth & Space, AIAA Habitation, NSS International Space Development, and MIT Mars-Week conferences in the coming year.

The Mars Foundation's scientific and technical team continues to refine and expand upon these concepts. They have created a settlement technology roadmap, and are establishing a series of special task forces that are making more detailed investigations of specific technical areas not covered in the initial study, including space suit design, Earth-Mars transport, robotic automation and surface vehicle design. These efforts are being pursued with the assistance of student groups at MIT, U. of Illinois, U. of Central Florida, and U. of Michigan.

"Mars Foundation", "Mars Homestead", "Mars Homestead Project" are trademarks of the Mars Foundation. More information about The Mars Foundation is available at www.MarsHome.org Media Contact: Joseph Palaia 508-532-0617, Info@MarsHome.org **<MF>**

MF Image Gallery: http://www.marshome.org/images2/

Russia offers $100 Million Moon Flyby Tour

http://en.rian.ru/russia/20050726/40976276.html

MOSCOW, July 26,2005 (RIA Novosti) - The Russian space-shuttle maker Energia has submitted a proposal for would-be space tourists to the Federal Space Agency Roskosmos to charter a flight to the moon, the daily newspaper ***Izvestia*** reported.

Spacecraft have already been selected, a flight route worked out and a business plan compiled. All that is left to do is find someone wanting to take a 2-week trip to the Moon for $100 million.

The game tourist will spend the first seven days aboard the International Space Station (ISS). After that, a Soyuz TMA spacecraft will carry a mission commander and the tourist for a flyby of the Moon, subsequently returning to the Earth. It will take 18 months or two years to manufacture all the required equipment and to implement the project as soon as the money is received.

Roskosmos Director Anatoly Perminov has already negotiated with Energia President Nikolai Sevastyanov, who was recently elected amidst workers' protests of what they called his poor aptitude as an engineer. Consequently, Sevastyanov is now forced to look for sensational projects that will win him acclaim and provide Energia with money.

Cosmonaut Alexei Leonov, the first man to walk in space and who was to have commanded the aborted Soviet mission around the Moon, is quite pessimistic about the project because Russia does not have any dependable space technology for this purpose.

Colonel Yury Shargin, who worked seven days aboard the ISS in 2004 as the first Russian Space Force cosmonaut, volunteered for the project, playing the part of a tourist.

However, Russia has only managed to attract two space tourists to date for the ISS flight. And the question of where Energia plans to find someone willing to drop $100 million on a two-week vacation also comes into play.

[Editor's comment:Who would pay $100 M? Looping the Moon is way beyond a trip to ISS. My guess is that they would have more takers for a lunar flyby at 5 times the ISS cost that they have had for ISS. Including *moi.* I'd drop a cool billion if I had it!]

For a fictional account of such a trip, read "Lunar Overflight Tours" in MMM #21, December 1988. This article is online: www.asi.org/adb/06/09/03/02/021/lunar_overflight.html

You can also read it in reedited and reillustrated form in MMM Classic #3 which you can download as a pdf file from: http://www.lunar-reclamation.org/mmm_classics

Giving the keynote speach at ISDC '88 in Denver, then deputy NASA Administrator J. R. Thompson said it was his personal dream to refuel the shuttle in orbit and send it around the Moon in an orbit like that of Apollo 10 (and 13.)

Mail For MMM

Space Murals for Children

I was reading your Space Chapter Hub Merchandise Page,

http://www.nsschapters.org/hub/merchandise.htm#murals

I own and operate a web base business designing , and manufacturing wall sticker mural sets, and magnetic vinyl sheets that provide interactive murals for children.(note the magnetic murals are still in the design stage and not offered at this time.)

http://www.prestochangodecor.com/spwastmu.html

Your article addressed the need to educate as well as to inspire young minds to the excitement of space. One of the ways was to find space mural, calander and such.

This inspired me and my wife Tracy to design an Outer Space wall sticker set, and we just wanted to introduce ourselves. If you have any further idea's of future products we could design to help educate and inspire our youth please contact us anytime.

Steve and Tracy Jones
Presto Chango Decor Inc.
727 515 4282

NOTE:Readers with suggestions for Steve and Tracy may email them at tjones23@tampabay.rr.com

SPACE CAREER JOB OPENINGS

[MMM does not usually look for this kind of information. But recently we have had a flury of requests to do so, as a service to our readers. We will only post such information, however, when we have page space available for it.]

[1] Jobs in Europe

"We have recently started a EU-project in the area of spacecraft dynamics simulation and post-mission data analysis called "First Look - Fast Initial In-Orbit Identification of Scientific Satellites". For this project we can offer two PostDoc positions and a short term grant for a senior researcher (see attached pdf-files).

[Please] ... "spread this informa-tion to your colleagues and partner institutions in order to give more people the opportunity to consider these open positions."

Dr. Stephan Theil Email: theil@zarm.uni-bremen.de
ZARM / University of Bremen Phone: +49-421-218-3551
Hochschulring / Am Fallturm Fax: +49-421-218-4356
D 28359 Bremen, Germany
http://spacetec.zarm.uni-bremen.de

[2] More Jobs in Europe

European industry needs high-level specialists in space exploration. To respond to this requirement, three European universities have joined together to offer an MSc with a difference: a new international post graduate course in space exploration and development systems called SEEDS. More at:
http://www.esa.int/esaCP/SEMQRB808BE_index_0.html

[3] Opening s at International Space University

New positions are now available on ISU website:
HE-Space is seeking for:
- Organisational Support to Human Spaceflight
- Information Support to Human Spaceflight
- Engineering Support for Human Spaceflight

For more info: http://www.isunet.edu/FR/72

Space Applications Services is seeking A Software Engineer. For more info: http://www.isunet.edu/FR/75

Caroline Ritter
(ISU) External Relations and Development

[4] Opening in North Carolina

Visiting Scientist Position in Space Science
North Carolina Agricultural and Technical State University (http://hoth.ncat.edu/)

Applications are invited for a one-year visiting scientist position in Space Science and related fields. The Department of Physics is developing its space science education and research programs through funding from NASA. The successful candidate is expected to teach one space science related course, conduct research, advise graduate and undergraduate students. While applicants with PhD in Physics will be considered, preference will be given to candidates with teaching and research experience in space physics, astrophysics, planetary science and atmospheres, computational space science and space weather.

The position is expected to be renewed for one or two more years. Review of applications begins immediately and the position will be open until it is filled. A completed application includes curriculum vitae, undergraduate and graduate transcripts; a statement of research expertise, interests and research plan; and abstracts of completed research and publications, names and addresses of three individuals in your profession who will testify about your qualifications. Please send these documents to: Dr. Abebe Kebede, Director of Space Science Programs, Departments of Physics, 101 Marteena Hall, North Carolina A&T State University, 1601 East Market St. Greensboro, NC 27411. Incomplete applications will not be considered. All questions should be addressed to Dr. Kebede, by email:

gutaye@ncat.edu or telephone (336) 256 2039.

North Carolina A&T State University is an Equal Opportunity/Affirmative Action Employer. Women & under-represented minorities are strongly encouraged to apply.

Abebe Kebede, Associate Professor of Physics
NC A&T State University
http://hoth.ncat.edu/~michael/
Tel: 336-256-2039 Fax: 336-256-0815

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

• **Peter plans to take in Mars Convention:** This year the annual Convention of the Mars Society returns to its home turf, the U. of Colorado in Boulder, CO, **August 12-14th**.

LRS Upcoming Events – September, October

Saturday, September 10th, 1-4 pm

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

Reports on Summer events, Updates on space and space mission news, conferences etc. A look at the calendar ahead.

SOLAR SYSTEM AMBASSADORS
www.jpl.nasa.gov/ambassador/

Michelle Baker
Princeton/Philadelphia
chaos@cybernet.net

Bill Higgins
Chicago, IL
higgins@fnal.gov

Bill Hensley
Kenosha, WI
hensley@acronet.net

Harold Schenk
Sheboygan, WI
hschenk@excel.net

Attn: MNSFS, Oregon L5, OASIS: If a member of your chapter is a JPL Solar Syestem Ambassador and you would like him or her to be listed above, please email MMM c/o kokhmmm@aol.com

U.S. CHAPTERS

NSS
Chapter Events
MMM
6 Chapters Strong

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

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@comcast.net>
(LBRT - Oregon Moonbase) moonbase@comcast.net

Meetings 3rd Sat. each month at **2 p.m.**
Bourne Plaza, 1441 SE 122nd, Portland, **downstairs**
July 16th – Aug. 20th – Sep. 17th

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/]

MN SFS News & Pictures

• **Convergence Sci-Fi Con July 1-3, Sheraton South**
Ben's Convergence Pics
http://www.freemars.org/mnfan/convergence/2005/
Convergence Science Room only pics
www.freemars.org/mnfan/convergence/2005/sci-rm.html

• **Ben reaches upper level in SETI@home data scrunching**

Ben has now been credited with processing 6114 units of SETI search data, representing 7,437 years of CPU time. That puts him ahead of 99.03% of other participants in this program which makes use of idle capacity of a program participant's computer to fetch and process incoming SETI search data. Without such involvement, it would be impossible to process the enormous amount of data. Way to go, Ben!.

WISCONSIN

Sheboygan Space Society

728 Center St., Kiel WI 54042-1034

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

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

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

JULY 21st: UW-Sheboygan, Room 6101, **Sheboygan**
AUG 18th The Stoelting House, **Kiel**
SEP 15th: UW-Sheboygan, Room 6101, **Sheboygan**

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

Next Meetings: July 17th (Sun) , August 20, September 17

Meeting Notes: We had a number of discussion points including the fun of attending an **ISDC** from Gary Fisher, who thought the speech by **Burt Rutan** (of Spaceship One fame) was the highlight of the event. Gary also mentioned the **Mars Homestead Project** presentation he did and some details on the way that organization works: We, in PASA as well as a number of other organizations in the space exploration community, are basically supporters and observers of other peoples actions in the field. This is not so for some organizations, especially in there beginnings. Some of us are members of these participatory groups that invite you to do something as a member beyond talking about them. I am a member of several such groups and The Mars Homestead Project is one that Gary helped found to do the requisite background work for after they have got to Mars. This is in keeping with Gary's' other work with **The Mars Society** where he has been one of "Them That's Doin" as the old Mother Earth News saying goes. If you are interested and think you can contribute some skills to them; check our link to there website (marshome.org)

On the **Mars Desert Research Station** front: Gary mentioned a family visit in which the researcher brought her children to for a team called "The Flame" to work together on Mars living needs. Extended homesteader family soon?

Mitch Gordon found the concepts of **Bigelow Aerospace** and **Bob Branson** exciting in that they might put a space hotel up in less than ten years. This engendered a wide ranging discussion from the **Popular Science** article to **Nasa Tech Briefs** (on laminated structures and why to use this technique) and the possibilities for planetary exploration and habitation. One of the applications that was being examined in the past was for an aeronautical vehicle for exploration of **Titan.** This talk of possible structures for exploring other planets brought us to another explorer, **Mars Express,** has the *Marsis* instrument which will explore for (from orbit via ground penetrating radar), the presence of a large body of frozen water covered by dust in the equatorial regions of Mars.

Mitch also brought in the latest ***Ad Astra*** from **The National Space Society.** It has a lot of interesting, and a bit discouraging, material on various aspects of several ideas and projects. One is called "Deconstructing JIMO." This is the once and now future (maybe) mission to explore the moon **Europa,** primarily, along with Callisto and Ganymede. These are Jupiter's Icy Moons and the JIMO probe would go exploring with a real deep space power plant: a 100 Kilowatt nuclear powered electric generator. The probe has undergone a fair amount of redesign both to cut its rather major program cost (~ $10 Billion Dollars) and to alter its travel time; reduced time equals improved reliability. For a change the spacecraft's destination and the need for shielding from the power plant work together: Europa is in a very harsh radiation environment to begin with, the levels being many times "man lethal" rates per hour. Heavy shielding is thus required at any event. But, after the head of NASA's' nuclear program, Craig Steidle, was given a tour of nuclear technology at *The Office of Naval Reactors,* he concluded that we are not ready to build the plant. Things have been put into rethink mode. Not cancel, but rethink. See the article in *Ad Astra* for Summer 2005. This issue also has positive articles including an opinion piece by Burt Rutan titled "Risky Business" which I interpret as on intelligent risk taking. Read the paper, maybe join NSS. to get it!

Earl Bennett brought a number of technical pieces but reduced there number in the interest of time and desire

to promote an interesting book: Paul Gilsters' **Centauri Dreams** on the technologies that will make Intra and Inter Stellar flight possible. Although it has many great ideas there is very little of the mathematical analysis that underpins most of the possibilities given. This is a book on the big dreams and has a number of dreamers to match: Robert Forward, Geoffrey Landis, and Drs. Matloff and Mallove (The Starflight Handbook) and quite a few others who are not familiar names. I will buy it when I can for the notes in the back:: you see that in this field the dreams are based in science as we know it. Someday we may have space warps and short cuts, but we don't absolutely need them. A very interesting book.

Earl also mentioned an article from the June 2005 **Nasa Tech Briefs** that bears on the power plant issue: "Nanowire Thermoelectric Devices", by Alexander Borshchevsky et al., is on the fabrication of very high length to diameter ratio columns that can be formed in holes in a template. These long thin elements can then be connected with metallizations that allow many of these devices to be connected for higher current and higher voltage than one set of elements can supply. The physical effect being used here is the Seebeck Effect and the authors from **Caltech** believe they are on track for making a mass produceable (compared to current methods) unit with high conversion efficiency. The individual elements are only10 nanometers in diameter but 40 microns long. Much other great material.

And last but not least we have **Dorothy Kurtz's'** impressions of the 2005 ISDC, which are seen in Dotty's Dimensions. The first day was great, starting with **Burt Rutan** and ending with **Robert Zubrin** as speakers. This was Thursday the 19th. Almost everything at the event was of a high quality science track nature, for those familiar with this format, and Dorothy enjoyed most of the presentations she attended. She and Larry stayed till Sunday and she reported on meeting a number of our national friends and associates.

Other highlights included: *Women in Aerospace*, The Moon, Mars and Beyond, a panel appraisal of The new NASA administrator and talks with him. There where also displays which included a scale model of the International Space Station and a full size mockup **of The Crew Return Vehicle**. Oh, and also attending and participating where both NASA's Chief Scientist and the Deputy Chief Scientist.

I begin to feel jealous about missing these grand events. And the next week Dorothy and Larry attended **Balticon!** Submitted by Earl Bennett.

One thing is for sure; time doesn't do things. People do things. Nothing happens if we don't make it happen."

Gregory R. Bennett

Moon Society Founder and President Emeritus

CALI FORNIA

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
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[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.
- **July 16th – August 20th –September 17th**

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

Upcoming Events

- **Sat. August 20th, 3:00 pm –** at the home of Bob and Paula Gounley, 1738 La Paz Road, Altadena. Planned extras for the meeting include viewing of a video of the winning X Prize flight of SpaceShipOne. Call the OASIS Hotline, 310/364-2290, for more information.
- **Sat. September 17, 3:00 p.m.** -- OASIS Monthly Business Meeting, location TBD. Call the OASIS Hotline, 310/364-2290, for more information.
- **Sat. Oct 15, 1:00 p.m.** -- OASIS Monthly Business Meeting, location TBD. Call the OASIS Hotline, 310/364-2290, for more information.
- **Sat. Oct 15, 4:00 p.m.** -- OASIS Lecture Series, tentatively scheduled Orbital Machanics for Real People, presented by Seth Potter. Call the OASIS Hotline, 310/364-2290, for more information.

Recuring Events

- **Fridays** -- Mike Hodel's Hour 25 webcast. The world of science fact and fiction with interviews, news, radio dramas, artists, writers, stories, reviews, and much more. Information: http://www.hour25online.com/.

Upcoming Events

- **Check our Calendar Page!**

  http://www.oasis-nss.org/calendar.html

  Here you will find a long list of space-interest events coming up in the Greater Los Angeles area that you might want to consider taking in!

NAME _____

STREET _____

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❍ **$45 National Space Society** dues includes **Ad Astra**
❍ **$20** NSS dues if under 22 / over 64. *State age* ___
600 Pennsylvania Ave SE #201, Washington DC 20003

Moon Society dues include **Moon Miners'Manifesto**

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

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

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Send proper dues to address in chapter news section

=>for those outside participating chapter areas <=

❍ $15 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)
❍ $15 reg. ❍ $20 family ❍ $12 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 $25, due in March or $6 times each quarter before the next March

SHEBOYGAN SPACE SOCIETY (WI)
❍ $15 regular, ❍ $10 student,
❍ $1/extra family member

"SSS" c/o B. P. Knier, 22608 County Line Rd, Elkhart Lake WI 53020

Moon Miners' MANIFESTO

Lunar Reclamation Society Inc.
PO Box 2102, Milwaukee WI 53201-2102.

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