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

Moon Miners' Manifesto

& The Moon Society Journal

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In FOCUS Who will be the next person to set foot on the Moon?

Every once in a while, someone suggests that what we need is another "Moon Race." The consequences of winning a race conducted only for the bragging rights of winning, a clear from what happened after Apollo. Yes, NASA did it's best to design our six visits to the lunar surface to maximize this unparalleled opportunity to do major science on location, with all the benefits that manned presence has over merely robotic and teleoperated science experiments and sampling.

But the media got bored first, and a bored media quickly puts the public to sleep, along with our policy-makers. "We will do this because it is hard," said Kennedy. That was surely a valid partial reason. But once it was done and we had proved we could do it, the reasons for remaining on the Moon were lost to most, even perhaps to NASA. In fact, it was only after we started experimenting with Moon rocks that we learned that we could make building materials from them with which to expand, and that the surface layers had sponged up a most valuable resource from the incessant solar wind: helium-3, the ideal fuel for fusion reactors if ever we could figure out how to build them. Soon we developed two other scenarios by which the Moon could help solve two intractable and intertwined problems facing us right down here on Earth: solar power satellites built of lunar materials and/or solar arrays on the Moon itself could beam to Earth virtually limitless clean energy, thereby removing the number one environmental threat: energy generation from fossil fuels.

That race was driven by the humilation we felt when the Russians launched Sputnik 1 well before we could follow suit. They soon embarrassed us further with the launch into orbit of Yuri Gagarin well before we could put Alan Shepherd into a mere suborbital hop.

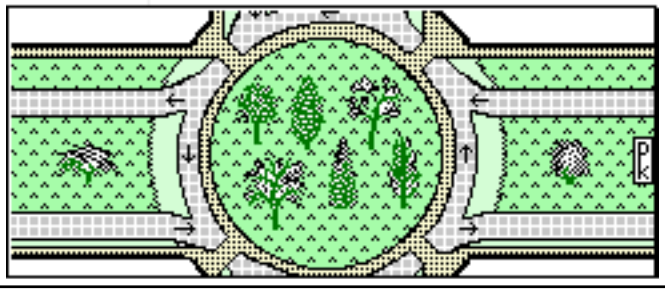
These days, the public, fooled badly about the need to invade Iraq, will not support an appeal to save the country's honor by spending more money to guarantee that we return to the Moon before anyone else can land on the Moon *for their first time.* This climate opens the door for other nations to do a simple self-contained Apollo style mission (land, walk around a bit, collect a few samples, take a few readings and then depart) before NASA can return to set up an outpost core module and get it ready for the first astronaut inhabitants.

We need to keep in mind that other nations do not have to go through all the hoops we did. They can skip some steps, and use already proven technology and equipment. And in contrast to the situation in a demoralized America, *their pride* is reason enough for the to spend as much as it takes.

China has a head start on India, but it is not insurmountable. Meanwhile, the Russians already have the technology and much experience. They lack only money, and that motivates them highly to take a fully commercialized route. Certainly, the Russians will be the first back to the "vicinity" of the Moon, looping it without landing, and with a paying tourist. This could happen before the end of this decade. [⇒ p. 2, col. 2]

The "Modular" Biosphere

It makes no sense at all to look for centralized solutions to the need to grow and sustain a mini-biosphere that can in turn sustain lunar and/or Martian pioneers. All human communities either grow or petrify. By designing each structural module, be it residential, office, commercial, school, industrial or agricultural space should contribute its share to the biomass. In this issue, pp. 6-7, we look at the "Middoor" contribution.



Moon Miners' Manifesto
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• **Moon Miners' Manifesto CLASSICS:** The non-time-sensitive articles and editorials of MMM's first fifteen years have been re-edited, reillustrated, and republished in 15 PDF format volumes, for free downloading from either of two locations:

www.lunar-reclamation.org/mmm_classics/
www.moonsociety.org/publications/mmm_classics/

• **MMM's VISION:** "expanding the human economy through off-planet resources"; the early era of heavy reliance on Lunar materials; early use of Mars system and asteroidal resources; and establishment of permanent settlements supporting this 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 additional 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 nonprofit 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 50 chapters, dedicated to the creation of a spacefaring civilization.

National Space Society, 1620 I Street NW, Suite 615, Washington, DC 2006; Ph: (202) 429-1600
FAX: (202)463-8497; nss@nss.org - www.nss.org

•• **The Moon Society** is "dedicated to overcoming the business, financial, and technological challenges to the establishment of a permanent, self-sustaining human presence on the Moon." — Contact information p. 9.

• **NSS chapter**s 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.

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• **Submissions**

√ EMAIL to KokhMMM@aol.com (***preferred***)
√ Mac compatible CD / typed hard copy to:
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⇒ IN FOCUS Editorial continued from p. 1.

Even little but quickly industrializing Malaysia wants to get in on the act. The history of the industrial revolution is replete with examples of feats that took monumental resources to accomplish the first time, but proportionately little to repeat, or copy.

That others may beat us back to the Moon, however, is neither here nor there - *unless they also beat us in deploying a lunar habitat.* To date, the Moon has hosted no more than science picnics. We came, laid out our blanket, dined in glory, then picked up and went home.

Many Americans, even perhaps most space enthusiasts, would be horrified and embarrassed if another nation set up shop first. But the embarrassment of NASA and the government Administrations and Congresses that had a part in the fiasco will be *encouragement to private enterprise.*

NASA's way of doing business makes everything much more expensive than it need be, and this is intimidating to those who would try to do the same thing without NASA's deep pockets. We all - Americans as much as others - stand to gain if the secret ever gets out that doing the Moon is not as pricey a proposition as we have been led to believe. **PK**

An Ode to MMM on its 20th Anniversary

by David A. Dunlop - December 9, 2006

The Moon in night's sky
Delights a wide eye,
Hanging in Space, yet showing
A cratered pocked face.
Her light is for lovers and makers of dreams, but
this blue-yellow orb is more than it seems.

From Apollo's few footprints and that harried race
We learned quite a lot from that rocky place.
Bathed in winds of Sun's fusion breath
Is a dry barren world and of water bereft.

Perhaps at the poles in an icy rock stew
We may manage to gulp an ice beverage or two.
From Aitken's deep basin To Malapert's height
We hope to find power in continuous light
Which mingles with dust at the Moon's terminator
and charges that dust as a great levitator.

Sun's Coronal ejections are fusion flung ways
Of cosmonaut cooking, plus
Hard gamma rays!

These brave lunar settler's at first will be few
But hope to find shelter in Moon's lava tubes.
The sinuous chambers in Mare's hard rock
are Bryce Walden's passion and knowledge- trade stock.

With KREEP enriched soils, and Titanium basalt,
Anorthosite highlands and deep lunar faults
We'll study and master the hard lunar ways
Of living on Moon land for 14 day days
And 14 day nights, as the lunar day goes.
This lunar progression makes horizon glows
and transient effects from hidden gas flows.

It's hard scrabble living from in situ stocks
Of lunar sourced treasures and lunar source rocks

But Moon Miner living is coming to stay,
From 20 years' thinking from the Great Peter K!

Thanks, Dave, but I do it because I love doing it. - PK

by Peter Kokh

There are three principal human space expansion pathways advocated by persons preoccupied with three principal imperatives. Each of them sees space as key to the ultimate challenge facing humanity: *survival.*

1. **Planetary Defense of our homeworld from potential impactors (Near Earth Asteroids)**
2. **Establishment of a viable exclave of human civilization on another world (Mars)** to guarantee human survival should civilization on Earth fall victim to an impacting object, or implode through overpopulation and human-caused environmental degradation
3. **Using space resources to halt and ultimately reverse environmental degradation on Earth** through overuse of fossil fuels, and to make possible a more equitable global economy **(The Moon)**

First, let's go into a bit more detail on each of these rationales for human expansion into space. Then, I want to suggest why the Moon Society should, rather than concentrate solely on the third, be deeply concerned and involved in all three.

What follows is a first draft of a talk planned for MarsCon 2007 in Minneapolis-St. Paul on March 3rd. My intention is to develop it into a position paper to propose for adoption by the Moon Society Board of Directors as a guide to the Society's future.

Let's look at the three more closely.

1) Planetary Defense:

We need to mitigate the very real threat that a large population of near Earth objects, many as yet to be detected or tracked, could in some time from today into the far future, cause significant destruction on Earth by impacts that could conceivably wipe out whole cites, devastate a continent, even cause mass extinctions on a global scale. There is no way of knowing whether one of these potential varmints might strike Earth in our lifetimes, or within the next millennium, or within the next 100,000 years. The point is, the danger is finite, and since it is conceivable that we could intervene successfully to ward off individual threats, we ought to prepare ourselves to do so. That said, it is necessary to pick or battles, choosing the most bang for the least bucks. That starts with detection, orbit tracking, and cataloging object masses and compositions. But to put the risk in perspective, weighting proximate danger more heavily, the risk of making much of Earth uninhabitable within this century by our own thoughtless habits is more real, more urgent.

Back to NEOs. Compositions are important when it comes to choosing methods of orbit correction and threat removal. Some of these objects may be solid; how they would behave in various schemes to alter their orbits will be easier to predict. Others are deeply fractured or fragmented, or even just loose aggregations of previous impact debris - literally, giant beanbags in space. Altering their orbits will be quite a challenge. Others may be dead comets, with icy snowball cores covered with dust and hydrocarbon fallback gunk deep enough to choke any further cometary outgassing.

How can the Moon fit into Planetary Defense initiatives? I propose first of all, that we attempt to identify any advantages to placing automated, teleoperated telescopes on the Moon dedicated exclusively to the detection, tracking, and classification of the near Earth object populations. In the process, we are sure to identify asteroids with resources needed for the expansion of the lunar economy, and in orbits that are relatively easy to reach. It will be in the interests of the young lunar frontier to support development of those NEO resources.

When and if a suite of possible NEO orbit modification schemes are developed, some of them may involve forward facilities on the Moon. Some of these plans may involve manned missions more economically staged from the Moon rather than from Earth.

If in modifying NEO orbits, it is feasible to shepherd some of them into stable Earth-Sun or even Earth-Moon Lagrange areas, those rich in elements in which the Moon is deficient would become less expensive sources for such elements than upshipments from Earth itself.

Thus strategic participation in a comprehensive Planetary Defense plan could have major positive implications for the viability and industrial diversification and strength of the Lunar economy. Further, it will be a long, long time, before a lunar frontier economy could survive if contact with Earth were totally interrupted. Earth is the principal market for the Lunar economy. Protecting Earth is very much in the interests of any future Lunar Settlement Frontier

Concerned organizations are: **The Planetary Society**
www.planetary.org/programs/projects/asteroid_alert/
www.planetary.org/programs/projects/apophis_competition/
The Space-Frontier Foundation
www.space-frontier.org/Projects/Moon/PressReleases/20020712planetarydefense.html

http://www.planetarydefense.info/
http://en.wikipedia.org/wiki/Planetary_defense

I propose that we open the door to collaboration with these organizations in the development of a thorough Planetary Defense knowledge base and systems.

2) Long term Survival of the human race:

Establishment of a self-sufficient exclave of human civilization on Mars in the event that human civilization on Earth implodes from the combined pressures of overpopulation and environmental degradation, and possible killer impacts is a priority goal shared by many. Their number should include us, not just Mars advocates.

Mars does have *more* indigenous resources than the Moon to support a substantial frontier population. "More" is an understatement. Yet Mars' present climate is not very attractive and it beats me how people who have made life style decisions to move to warm sunny climates can say with internal honesty that they would be willing to help pioneer a world where the temperature range is more akin to that of Antarctica. They talk the talk but can they walk the walk?

But that is neither here nor there. Mars is the best place in our Solar System to host an autonomous human civilization that can survive whatever may happen to Earth either by way of natural disaster or via prolonged human stupidity, very much in evidence.

Why is it in the interest of the Moon Society to support the opening of a human frontier on Mars? One word: ***Trade.***

The Moon lacks some of the resources needed for total self-sufficiency. This does not mean that the Moon cannot support a viable economy. Look at Japan! Japan lacked the two major wellsprings of the Industrial Revolution: coal and iron. But it had something more precious: a population that was ingenious and resourceful and determined. This island nation developed economies beyond its shores all along the western Pacific Rim in areas where resources it lacked were abundant. These areas became its core trading partners, and Japan rose to become the second greatest economy on Earth. That it used tactics we would not tolerate today is not the point.

The Moon, hopefully with an ingenious, resourceful, enterprising population, has three other major assets that more than balance those it lacks: *location, location, location.* The Moon in fact is poised to become the Japan of Space. To realize that destiny, the lunar frontier must tap resources in shallower gravity wells than Earth's: Near Earth Objects *plus Mars, and Mars' two moonlets, Phobos and Deimos.* It is thus in the lunar frontier's most vital interest to support the opening of the Martian frontier. And, even though "Mars only" fans may be too defensive to see it, it is very much in the Martian frontier's vital interest to see parallel development on the Moon. Earth has little need for whatever Mars can produce. The Moon will emerge as Mars' main trading partner. The Moon in turn can trade with Earth and Earth orbiting markets.

The Moon Society can support this long range goal by prioritizing development of technologies useful on both worlds:

- □ modular architectures including modular biospheric systems;
- □ life support technologies
- □ space suit development
- □ mining, processing, and construction technologies
- □ small pocket hospitals
- □ agricultural and food production systems.

This is just the start of a potentially very long list. Of course some technologies needed on the Moon will not apply to Mars and vice versa. But considering what is to be gained by working together, that world-unique sector is trivial.

What if the Mars enthusiast community does not reply in kind? We must still support this goal. What's in it for us trumps all essentially petty considerations. If the Mars community does not respond in kind, we still stand to gain.

Nor should we fear budgetary competition! At this stage of the game, only a consortium of governments can open Mars. Meanwhile, government outposts on the Moon serve to discourage rather than encourage commercial development there, no matter what NASA may say to the contrary. NASA culture and private enterprise culture are like oil and water, SBIRs and other gestures notwithstanding. The upshot is that the Lunar Frontier and the Martian Frontier are not competing for the same financial resources I admit that there is a pro-Moon constituency still has faith in a government pioneered route and they will be fearful of getting less than their fair share of a limited budget pie. If necessary, we have to be prepared to leave those supporters behind.

The bottom line is that to be viable long term, the Moon needs Mars as a trading partner. We should, I would suggest, proclaim our support of the opening of the Mars Frontier as a goal of the Moon Society, along the lines suggested above. That does not mean that we should be preoccupied with it. It must be a *secondary* focus as should be planetary defense.

3) Keeping our irreplaceable homeworld blue, green, *and white*

To halt and eventually reverse environmental degradation or our homeworld, and underwrite economic well-being on a global basis, etc., through the use of l**unar resources to provide ample clean energy on Earth on a sustainable basis** is the third great driver for human expansion into space.

There are those who say we should tap asteroidal resources for this exclusively, on the grounds that the delta V needed to reach some of these objects is less than that needed to land on the Moon. That's find for cargo. For human missions that dynamic reverses big time. Humans need life support: air, water, food. And missions to asteroids will involve much greater travel time than missions to the Moon, where in due time, there will be established biospheres from which these consumables

can be replenished. The Moon trumps with the triple advantage of "location, location, location."

For building solar power satellites, asteroid materials can be accessed more cheaply but only on an irregular "target of opportunity" basis as launch windows to objects with low delta V access are the farther apart in time the lower the delta V. This is **the catch-22 of orbital mechanics.** *The closer the orbital period of two bodies (Earth and a NEO) are, the less frequent the launch windows between them.*

The Moon offers the option of direct hosting of lunar solar power arrays, adjacent to, or on the very regolith covered terrain from which the building materials to construct these arrays are to be found.

The Moon also boasts immense easily recovered reserves of Helium-3, the ideal radiation-free fuel for fusion reactors, should we ever succeed in engineering them. Note that the Bush Administration killed all further research in this direction. Hopefully that will change soon.

While asteroid resources can provide some haphazard irregular sourcing of materials for solar power satellites, the Moon can supply these on a continuous conveyor belt schedule, as well as alone support the other two clean energy options identified.

Lunar development is humanity's last great hope to save Earth as the beautiful livable world we have always known it to be. It will do little good to prevent asteroid impact if we have let the Earth go to hell in a man-made basket in the meanwhile.

The upshot is that there is a logical human expansion "triway to space," and that all three portions of this triway must be pursued.

1. We must defend the planet against catastrophic impacts.
2. In the meantime, we must guarantee the survival of our species no matter what by creating a viable self-sufficient colony on Mars.
3. And we must work to halt and then reverse human-caused degradation of our homeworld environment, as can best be done by taping lunar resources for bountiful clean energy.

If the Moon Society adopts this comprehensive strategy, more space enthusiasts will find us relevant, and a dynamic society deserving their support. This strategy will also be one with which we can attempt a rapprochement with the environmental community. For if they are honest, they must support it also.

Moon Miners' Manifesto has long put out one Mars Theme special issue a year, at first on no special schedule, but for some time now, always the March issue. We have has asteroid issues, but they have been fewer, and farther in between. We'll try to correct this.

As for the Moon Society, this strategy should guide us in forging new affiliations and working agreements with other organizations and efforts. But our prime focus, both of the newsletter and of the society, will remain on the Lunar Frontier, and its mission to help reverse the environmental collapse of our beautiful and irreplaceable home planet.

Space - what's in it for the average Joe? Everything! Survival of our planet, restoration of our biosphere, a contingency exclave should disaster strike Earth despite our best efforts. ***To Earth !***

Finding Collaborators

One of the most frequently heard criticisms of space enthusiasts is that "they cannot agree on goals." I believe that the Triway to Space is a Roadmap that can earn majority support. But it won't come easy.

The Space Frontier Foundation and the National Space Society will be the most open to this suggestion. While the Mars Society might seem a logical partner, there is one thing about the way government space programs are currently structured that makes the Moon appear a rival rather than a partner. The best use of hard to come by financial support is to apply government financing to the NEO project and to the exploration of Mars and the opening of the Mars Frontier. And ... to the further *robotic* exploration of the Moon. But government plans to field a permanent lunar outpost are the fly in the ointment. Budget cutbacks rooted in the enormous financial commitment to the war in Iraq make it almost certain that if a NASA outpost is fielded, it will be stillborn in terms of capacity to do anything useful, much less grow.

As long as a sizable fraction of lunar advocates are cheering on the NASA program for the Moon, the Mars people will see the Moon as a rival, not a collaborator. Mars Society spokesmen will continue to rip apart the NASA lunar program, and to deprecate the usefulness of the Moon to solving otherwise intractable environmental and energy plans on Earth.

Should the next administration be forced by inherited budget pressures to cancel the Lunar initiative, the Mars Society may find it easier to partner with the Moon Society, *if the Society officially endorses the commercial route to Lunar Settlement,* which, given its roots in the Artemis Project™ would certainly seem logical. It would then be much easier to bring the Mars Society into the Triway alliance.

I am not saying, mind you, that I agree with the Mars Society's position. I don't. While the goal of setting up a second human homeworld has very high value, working to save the one we have should take precedence. What seems imperative is to find ways to do both. Separation of funding sources would seem to be the logical first step in this direction.

We should support the Planetary Society's modest efforts at detection of threatening NEOs and its project to design "tagging" systems to place transponders on especially dangerous asteroids so that we can follow them more easily. TPS, however, has no real use for manned space efforts, with the exception of manned exploration of Mars focused on the search for life. Now it is not at all clear that the Planetary Society membership feels that way. But the hard reality is that TPS has been run as a theocracy from the outset. Members who disagree have no option other than choosing not to renew. But insofar as TPS projects are all eminently a good use of small funds, they deserve support. The upshot is that TPS will go its own way on this score, for the time being.

"Tit for tat" is a bankrupt policy, however. I recommend we support TPS (I am a long time member) even thought they may remain aloof to our concerns.

Yet even a limited Moon Society-NSS-SFF "Triway Alliance" would command growing respect from the media, a respect that has a much better chance to turn recommendations into reality, winning us all many new members who sense *we have our act together*. **<MMM>**

MODULAR BIOSPHERICS

II. Middoor Public Spaces as ideal Opportunities for added vegetation and even "urban" wildlife.

"Middoors" MMM speak for pressurized common spaces such as pedestrian passages, streets, parks, and plazas where temperatures could be allowed to fluctuate between cool predawn lows and warm pre-sunset highs; as opposed to "indoor spaces" in private residences and in commercial, educational, office and other fully climate-controlled areas of activity.

In the December 2006 issue of MMM #201, we described Living Wall systems which take advantage of frequently unused or underutilized wall-hugging spaces for growing plants that will help cleanse indoor air of carbon dioxide and other airborne pollutants, boost fresh oxygen levels, and in the process create water features that could harbor fish. In this installment of our "Modular Biospherics" series, we take up the opportunities for additional vegetation in other common spaces within the outpost or settlement.

Public Squares, Plazas, Marketplaces, etc.

These will be enlarged nodes or pressurized intersections where three or more pedestrian passages and/or pressurized roads for bicycles and electric vehicles come together. At least some of these intersection nodes should be enlarged to provide extra ground space for plants of various kinds, walkways, park benches, water features, etc. They should offer two more perks: higher vaulted ceilings, and overillumination.

Higher ceilings will offer welcome eye relief. The human eye has evolved to take in the sky, not just a horizon-hugging layer of vertical space. Living inside the confined vertically challenged spaces of an extensive modular maze will leave much to be desired. Yet, on the Moon at least, this may be necessary. The nitrogen needed as a neutral oxygen buffering component of breathable air will be in short supply. There are two ways to conserve the amount of nitrogen needed, and we will need to make use of both of them!

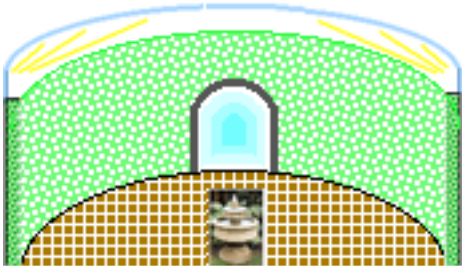
- using one half normal air pressure, with all the hit being taken by nitrogen. That means instead of a 79:21 nitrogen:oxygen mix, we may be using a 58:42 mix, with the actual partial pressure of oxygen unchanged. An important beneficial effect of using an 0.5 ATM pressure is that this will greatly reduce the propensity to spring leaks.
- keep ceiling heights, and thus total volume of air needed, on the low side. I wouldn't suggest lower than 9 feet. That may seem generous, but we would be allowing for the progeny of the first settler generation to grow taller than their parents, given the low gravity.

But here and there it will be advisable, for the sake of morale, to have more spacious places in which to congregate and relax. Outdoor full sunlight level lighting and notably higher ceilings, painted a matte sky blue and brightly uplit, will subconsciously lift spirits and supply a well-needed boost. People will enjoy being there!

We have ample experience creating little urban oases for people to relax and congregate. A hard-won lesson is that as great as has been the clamor for quiet spaces apart from the hustle and bustle of life, the experience has been that such places remain almost empty, favored only by a few. In contrast, urban oases in the midst of the hustle and bustle are always the more popular. Put simply, more people enjoy relaxing where they can see and be seen. We are, afterall, social animals.

Big or small, such openings in the otherwise space-stingy modular maze of settlement outposts, they can be much greener if the vertical surfaces around the perimeter nad vertical half-wall dividers within it, are given to wall-hugging narrow trees or shrubs, or better to living walls as described in our last issue. As dividers, living wall systems can easily be configured in 2-sided fashion. Using the "hanging gardens of Babylon" approach, more floor/ground space is available to paving tiles, seating, water features, and sculptures.

If the space, say a plaza in a prospering, growing settlement, is large enough, it may contain building structures playing supporting roles: changing space for performing artists, storage space for merchant kiosks, etc. These structures may also provide more vertical space to be given to living walls, and their roofs can be greenspace as well, so that the building in effect does not diminish overall ground space given to plantings. Roof top tea gardens would be popular, creating elevated spaces from which to watch passersby, and other activity on the main level.



Iillustration of a simple and small "greenhub" node. an intersection of 3 or 4 pedestrian passageways. It sports a higher vaulted ceiling, painted a matte sky blue, with cove uplighting using bright sunshine spectrum bulbs. Vertical surfaces are living walls. The floor is brick paver or cobblestone, with a scattering of benches, flower pots, and a central fountain. The lower vertical scale of connecting pedestrian walkways is seen.

Enter the polinators

It is amazing how many people do not realize that plants come in male and female also. Be that as it may, we do need to provide for plant pollination. Bees might be confined to agricultural areas, with only persons not allergic to their sting working in those areas.

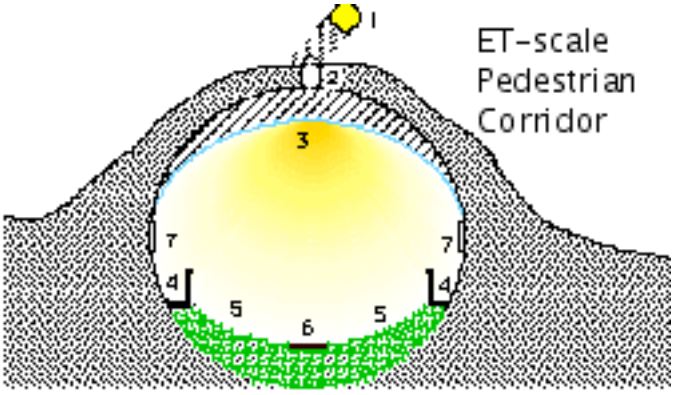
Hand pollination would be an unacceptable use of available manpower. Especially for agricultural areas, where similar plants are side by side, robotic hand-pollination equipment teleoperated from Earth where real labor costs are much lower, should be a priority area for research and development, with a lot of "spin-up" potential. In the meantime, we might concentrate on plant species that can be polinated by hummingbirds. The sight of these tiny and beautiful creatures fliting to and fro in search of pollen syrup would do much towards making such urban relaation spots all the more delightful. Might lunan hummingbirds slowly evolve larger subspecies? A humingbird whose linear dimensions are 1.817 times

Earth-normal for humingbirds would weight the same on the Moon, as an Earth-normal hummingbird does on Earth.

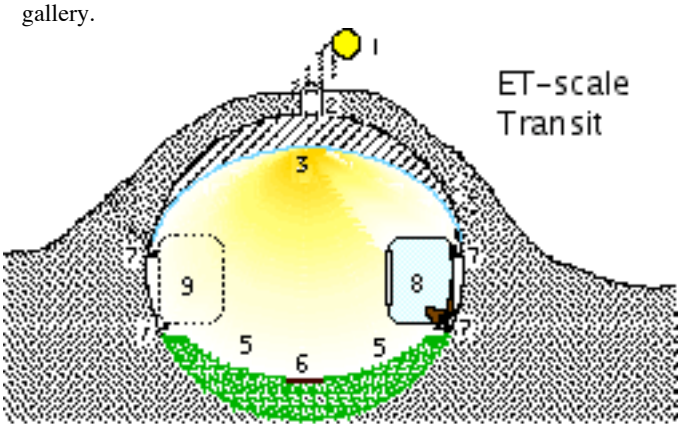
We might make room for additional wildlife. Fish, talapia, small tropical, goldfish, even stream trout should mix well. But without adding in a mix of flying insects at great risk to serve as food, we'd have to feed them manually, or by autmoated fishfood dispensers. Squirrels and chipmunks can do much damage, but they sure are delightful to watch. The same is true of rabbits and other sall mamals. If only neutered individuals were released into the settlement commons, and breeding stock kept striclty sequestered, runaway populations could be avoided. Humans evovled side by side with plants and animals. Sure, some individuals would sooner be without them. But how truly "human" are they? We need to go into space as the front wave for Earth life at large. We just have to be careful what species we bring along with us. But that's a whole new article.

If we are living, working, shoping, recreating, and traveling in pressurized spaces, there is no justification for any of these modules to be sterile, devoid of life. In our own cities, the boulevard is an icon for how presurized roadways can be designed to contribute both to overall biosphere biomass, and to bio-diversity. Given the controlled climate, vehicles operating solely in pressurized environments can be open, roofless, and even sideless. Of course, vehicles meant to operate at high speed would need wind-shielding.

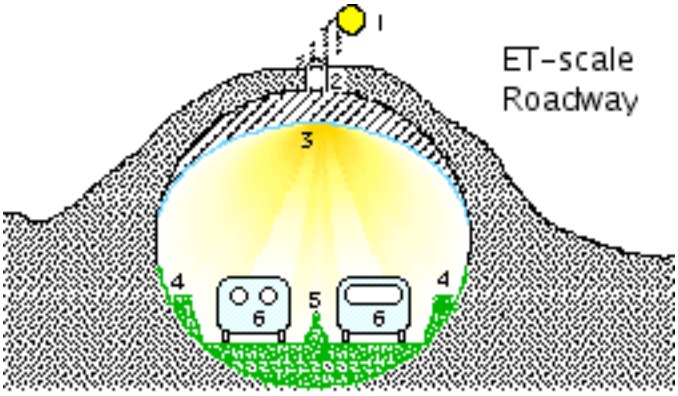
Various Larger Pressurized Passageway Options



KEY: (1) Sun, (2) fiber optic bundle sunpipe, (3) sky-blue sunlight diffuser (same air pressure either side), (4) pedestrian walkways, (5) terraced plant beds, (6) gardener's path, (7) art and poster gallery.

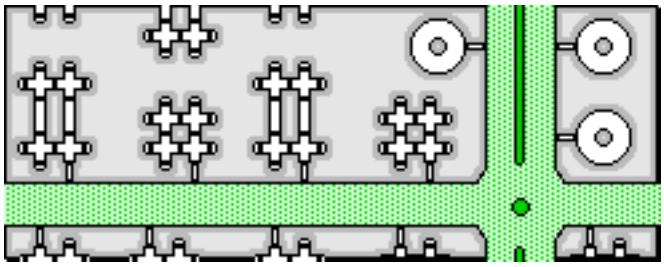


KEY: (1, 2, 3, 5, 6) as above. (7) wall-mount rail suspension system, (8, 9) bench seat transit car.

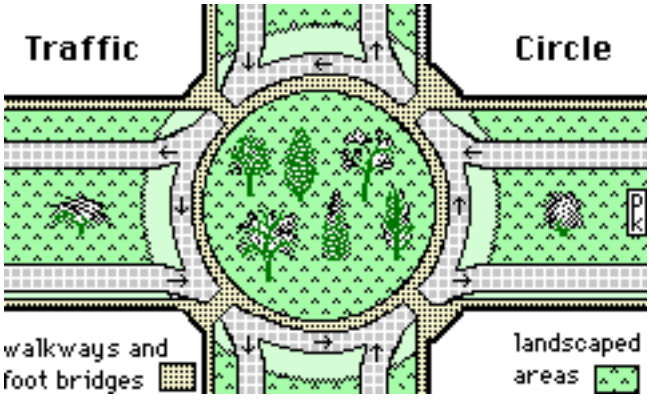


KEY: (1, 2, 3) as above. (4) living wall / hanging garden, (5) planter-topped divider, (6) vehicles.

In all of these connector examples, there is a place for vegetation, and the more place the better. It is more than a matter of morale, the comfort of mothering greenery against the stark sterile barrenness beyond the settlement airlocks. It is a matter of always paying heed to the overriding requirement to maintain a healthy and integrally functioning biosphere as a host to all other activities within the settlement hull complex.



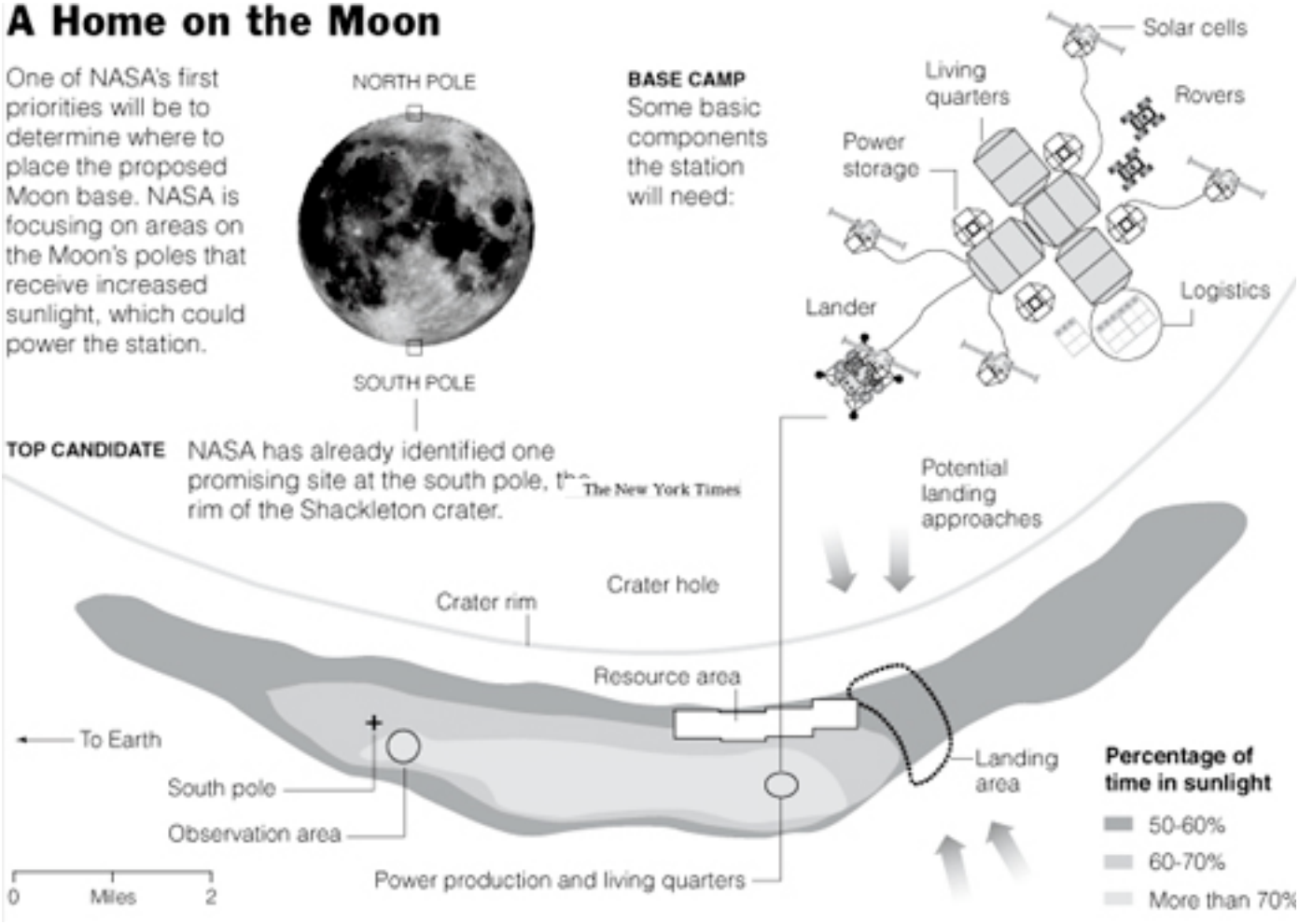
ABOVE: a sketch of how a residential settlement "block" grid could be laid out. The Green represents the pressurized road grid and its significant contribution to the total biomass of this modular settlement biosphere. One road is shown in "boulevard" fashion, with an expanded roundabout intersection centering on a tree & shrubbery inner circle. The gray represents the open-to-vacuum regolith covered surface. Shown in it, are various modular residences, individually regolith-shielded, all opening onto the pressurized road grid, allowing shirtsleeve travel throughout the settlement by pedestrians, bicycles, and electric vehicles.



More on the Settlement's pressurized road grid

There is considerable discussion of many aspects bearing on the topic of public places in the lengthy article "**Luna City Streets**" MMM #109, October 1997, pp. 3-11. This article has been republished in MMM Classics #11, pp. 61-69 - a free access **pdf** file download from :

www.moonsociety.org/publications/mmm_classics/



NASA Illustration from the New York Times

Editor's Comments

- 70% is not good enough. As we will need to develop power storage systems for the other 30% of the time, why not prepare for 50% sunlight conditions, enabling us to go anywhere on the Moon, including locations better situated to take advantage of *all* the resources we will need to develop an industrial lunar settlement?
- To realize 70% or better total sunshine time, solar arrays will have to be located at a number of sites in this elongated 1x5 mile area. The total mass of the involved equipment for such an extensive layout could be greater than that needed to store power for full nightspan operations at other non-polar locations.
- When the sun is above the horizon, it will be just barely above it, or only partially above it, creating very long ink black shadows that change vector from day to day making terrain recognition difficult, a potential safety problem. Radar and other non-visual guidance for vehicles and personnel on foot will be needed
- Until "ground truth" probes can investigate further, we cannot yet be sure that the adjoining Shackleton crater has economically mineable polar ice deposits using technologies that can be developed in the near term.
- The low thermal variation of polar sites is an illusion. *Surface* temperature variation may be low, but a standing figure will catch the sun broadside, much worse than at the equator at high noon.

NASA should keep sites at both poles on its short list, but also identify other resource-centered locations with access to both highland and mare suites of regolith as well as to KREEP-rich and ilmenite-rich areas. If we prepare to go anywhere, when the best location presents itself, we will be prepared to go there. Let us not choose favorites until we have developed all our systems and gotten "ground truth" confirmation of all the resources we will need for maximum local support of the station, best increasing the chances for successful growth into a settlement with a diversified industrial base.

NASA is also making a grave mistake in minimizing the lift capacity of its new transportation system, replacing "Apollo on Steroids" with "Apollo on Steroids *Light*" just barely adequate to boost size and weight constrained modules to the Moon, guaranteeing that we will get at best a sardine can station minimally capable of supporting extended operations.

By cutting Advanced Life Research, we will end up with a station that is not a model of what would be needed on Mars, nor a model of sustainability on the Moon. Replacement oxygen and water will have t o be shipped in from Earth on a regular basis as with ISS, almost certainly increasing the vulnerability of the Moonbase program for fatal cuts. This "foot-in-the-door" "toe-in-the-water" approach is simply asking for the door to be slammed shut.

Any future joint Moon Society/National Space Society Lunar Analog Research Station should model a much more capable and "pregnant" design. **<MMM>**

The Moon Society

J O U R N A L

http://www.moonsociety.org

http://www.moonsociety.org/blog/

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/

Moonbase Simulations - Lunarpedia wiki

Moon Society DUES with ***Moon Miners' Manifesto***

- **Electronic MMM** (pdf) **$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: the Moon in its natural beauty, empty and deceptively barren, waiting for human settlers to shelter and to mother as their adopted second human home world. We have work to do!

A New Year: The "Happy" is up to us!

from Peter Kokh, President

There are many things that appear to be working against Moon Society goals. The endless financial tsunami of the conflict in Iraq is putting enormous budgetary pressures on all other programs, especially those seen as frills. The Vision for Space Exploration is regarded by many in Congress *on both sides of the aisle*, as a target.

Potentially mortal cuts, chosen by Mike Griffin, have already been made in the return to the Moon program. We will have a transportation system which is marginal, not robust, and a just-in-time-resupply system for air and water instead of an advanced biological regenerative life support system. If production of oxygen is done on the Moon, it will only be for demonstration sake, and not used as fuel to reduce transportation costs. There is little left to be excited about, and that too is on the chopping block.

On the bright side, startup companies continue to make encouraging progress in search of profits from space enthusiasts who want to go into space themselves. And the robotic space exploration programs of other nations are taking up the slack.

The Moon Society is a small organization. While there are millions of people who support the Moon program, that has not translated into vigorous membership growth for the Society. We need to do a much better job of getting the word out that we exist, who we are, and what our exciting goals are.

My father, a pharmacist with his own drugstore, had a plaque above his desk which impressed its message indelibly on my young mind. "Opportunity never comes to those who wait for it." It's a simple lesson. We must take the initiative and *create opportunities* which we can then use to our advantage.

Currently, we are doing so on two announced fronts. We are working hard to define an ideal Lunar Analog Research Station program (LARS) so that we have a bite-size list of definite portions with which to lure prospective funders.

And encouragingly, our new Moon Wiki, modeled on the highly successful Wikipedia open-source online encyclopedia project, is beginning to flesh out. Already, the number of contributors to www.lunarpedia.org who are not members of the Society, is substantial. And this has led to an effort to market the Lunarpedia to other Moon-friendly space organizations and individuals. In turn, Lunarpedia will call attention to the Moon Society and to its other projects and programs.

We launched an effort to leverage our connections with other space groups back in August 2004 with the Mars Society. We are now actively partnering with the American Lunar Society who will be adding material to the Lunarpedia, the Calgary Space Workers Society, and other organizations. We continue to sound out other potential partners, including our own chapters and outposts.

We will have a great opportunity to reach out at the upcoming International Space Development Conference in Dallas this May, and are working to make sure that we have a robust presence. We encourage members to attend! And we have much more up our sleeve.

2007 can be a great year for us, but only if we energetically create ever more opportunities. **<PK>**

Two Notes on "Mining the Moon"

From Peter Kokh

A Return to Sudbury

Two years ago, June 6-9, 2005, I attended the Planetary & Terrestrial Mining Sciences Symposium [PTMSS] in Sudbury, Ontario. Unfortunately, I could not stay for the whole event. Sudbury sits on the edge of a 2 billion year old impact crater whose rim includes the some of the richest intrusions of nickel and copper rich ores in the world. This has led to Sudbury becoming a world hub of advanced mining technologies involving robotics, teleoperation, and automated mining systems. The symposium is run by NORCAT, the Northern Centre for Advanced Technologies at Cambrian College in Sudbury has become a hotbed for brainstorming how to mine the Moon. These guys know their stuff and are itching to try their tricks on our companion world.

Now I will have a chance to go back. The Calgary Space Workers Society has invited me to join them in Sudbury, June 10-13, and to present on their behalf. They are bringing along their Airstream travel trailer, converted into a command center for the mobile modular lunar analog station they intend to deploy in Alberta.

This conference is not well known in the States, but deserves to be near the head of the list of must-attend events [**www.ptmss.com**] I vividly recall an article in the Engineering & Mining Journal (E&MJ) [www.e-mj.com] some years ago that ridiculed the idea of mining "poor lunar ores." Well these people in Sudbury are out to prove them wrong. The development of successful technologies for mining the Moon's somewhat homogenized and unconcentrated ores will have great impact on Earth. No, we won't be shipping metals and other materials to Earth. But the technologies themselves will transform the economic geography of Earth, by allowing nations previously considered to be poorly endowed with natural resources to tap their own "poor ores" so as to economically provide for their own needs. The divide between resource-rich and resource-poor nations will begin to dissolve, bringing with it widespread economic equity and political stability.

The conference is not cheap, but I recommend it.

The Future of Mining

Once again, thanks goes to our neighbors to the north, this time in the Province of Manitoba. Well worth a visit is their page on the future of mining at:

http://www.digistar.mb.ca/minsci/future/futurem.htm

There is quite a bit to explore here as is evident in the menu links: *Ocean Mining, Deep Sea Nodules,* ***Biological Leaching****,* ***Asteroid Mining****,* ***Helium-3 Mining****,* *Nuclear Blasting,* ***Moon Mining****,* ***Oxygen Mining****,* *Methane Hydrates, UNDERGROUND Methods, SURFACE Methods,* ***Law of the Sea Treaty****, Short History of Law of the Sea,* ***Space Law****, Ocean Deposits*

On the Moon, mining techniques will differ greatly. For one thing, most of what we want is to be found in the 2-10 meter/yard thick pre-pulverized blanket of rock powder: the "regolith." That means Moon mining will be much less intrusive and defacing than what we have seen on Earth. *Recommended Reading!*

A visit to Portland & the Oregon L5 Team

by Peter Kokh

My combined birthday (December 11th) and Christmas gift this year from my sister and brother who live in Port Angeles, Washington at the top of the Olympic Peninsula, a 20 mile ferry ride south from Victoria, BC, was a frequent flyer round trip ticket from Milwaukee to Seattle, for a week-long visit. We arranged the dates so that on my return, I could take the Greyhound down the 175 miles to Portland, Oregon to take in the scheduled January 20th meeting of the Oregon L5 Society.

I have known many of the prime movers and shakers in this hotbed of Moon/Mars enthusiasm for many years. In a previous visit back in 1992, Bryce Walden and Cheryl York gave me a personal guided tour of the Youngs Cave complex outside Bend, Oregon, site of the famed Oregon Moonbase simulation activities in the late 1980s and early 90s.

Bob McGown, who over the years has contributed ten articles to MMM, volunteered to put me up for Friday and Saturday nights and proposed a dinner party after the meeting. Bob met me at the Greyhound terminal and proceded to show me Portland's assets at night: a number of great book stores, including one devoted totally to science; the campus of Portland State University; OMSI, the Oregon Museum of Science & Industry which was open late that night; the Linus Pauling house, where I assisted Bob in changing out all the circuit breakers.

The meeting was great. Others I had known in person or by email that were present included Tom Billings, Allen Taylor, Dick Steffens, and Kevin Albright, along with Bob's partner Dareth Murray. Bryce, Cheryl, and Tom updated everyone on the Lavatube simulation project the group has been doing on their Second Life (secondlife.com) virtual reality plot, alongside NASA and the Museum of Space Flight. This is something new, vastly superior to the ASI-MOO as a simulation environment, that some of our members may want to engage in also, and I'll be talking more about that next month as well as on artemis-list.

I gave an updated presentation on our preliminary lunar analog station planning. Afterwards five of us went out for Chinese cuisine, each picking a different dish to pass around the table, apparently a tradition!.

On Sunday, it was back to Seattle. My bus was met by longtime friend Dave Stuart, formerly of the Twin Cities, who helped kickstart the Milwaukee chapter (LRS) back in August 23, 1986. We joined Chris Vancil of Puget Sound NSS after some Indian cuisine, for more talk, sharing of ideas, etc. Then Dave drove me to SeaTac for my flight home. It was a very productive weekend among great company.

Without Moon Society funds to help with travel expenses, or any funds of our own, this was a great opportunity to 'piggyback' a Society business/social visit on a separate pre-paid trip at little extra cost ($50). We're always on the lookout for opportunities to visit chapters, affiliates, and potential collaborators. This "Op" came via the generoisity of siblings.

Thanks, Mary! **<PK>**

Antarctic South Pole Station's Food Growth Chamber

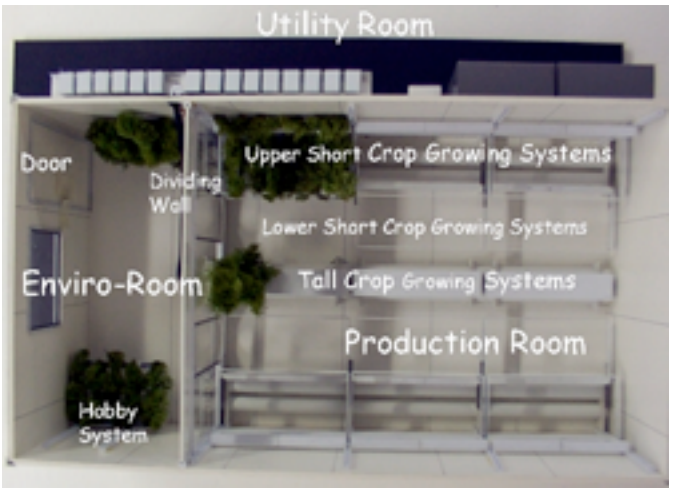
It came out of the blue, as the silver lining of an ominous cloud: NASA's cancellation of all further research on advanced life support systems using plants rather than chemicals to maintain air and water quality both in the ISS and for the proposed lunar outpost. University of Arizona personnel working with private industry had come up with a working practical system. Demonstrated at the U.S. South Pole station, a rather modest 3 by 8.5 meter (10x28 ft.) facility, teleoperated at that, produces two salads a day for the post's 75 person crew. Meanwhile, it refreshes the air and water supplies.

Here are some photos and links to follow for more information.

prototype for a lunar analog station greenhouse
http://www.theepochtimes.com/ news/6-1-11/36815.html

While the facility is largely teleoperated, outpost personnel are on hand to intervene where necessary. The great thing about the system is its low demand on crew time, which is precious. That makes this system ideal for lunar and Martian outposts as well, and for ISS also. Yet no NASA money or supervision has been involved. "KISS" "Keep It Simple, Stupid" triumphs over pricey elaboration.

http://ag.arizona.edu/ceac/CEACresearch/International/004f.htm



http://ag.arizona.edu/ceac/CEACresearch/International/004f.htm

The sketch above shows that only part of the Food Growth Chamber is used for growing salad stuffs for the crew. An antechamber shown at left allows personnel to visit and enjoy the sight of lush vegetation. They can eat a meal here, and there is provision in this small space for crew members so inclined to grow their own herbs, spices, flowers, ornamental plants – *whatever.*

While the Food Growth Facility would have been successful without this antechamber, the latter has added to its popularity with the crew, boosting moral even further by enabling hobbytime activities.

Costs and an Encore

This successful project, in operation for over two years, cost about $500,000 to set up – "half a Mil" – very modest by NASA standards. Its designers now want to create a second one, designed to fit inside a module that could be carried into space by a shuttle or in an equivalent payload bay or faring space. They have the Moon and Mars in mind!

In this setup, the Food Growth Chamber itself is separated from the rest of the post by an airlock. Inside the air is carbon dioxide enriched: plants thrive on this mixture. More, the light levels inside the chamber are high: not just reading level, but midsummer cloudless day sunlight level. This over-illumination contributes to the frequency base personnel pay a visit. Over-illumination is known to boost spirits and morale. Northerners used to cloudy winters can attest to the ill affects of overly long spells without the salutary brilliance of sunshine.

We are approaching the people involved in design and setup of this system in the hopes that one of them can make a presentation at ISDC 2007 in Dallas, May 23-28, Memorial Day Weekend. We'd also like to talk to them about how we could set up something similar, should we be able to setup our own Lunar Analog Research Station. One problem, which has thwarted Mars Society efforts to upgrade their modest MDRS GreenHab facility, is that personnel are on hand only part of the year. We'd have to involve local personnel during the off-season. But that the facility can be largely teleoperated would seem to reduce the need for on-hand involvement to a level it may be possible to arrange. Learning about this South Pole Food Growth Chamber certainly made my day. **<PK>**

Four Additions to the Board of Advisors

At the January 17th Leadership Council & Board of Directors meeting, the following four persons were confirmed as Advisors to the Moon Society. They had each accepted invitations from Society President Peter Kokh. They will join 20 others appointed earlier. The complete list is to be found at:
http://www.moonsociety.org/about/advisors.html
The four new Advisors are, in alphabetical order:

Michael Bakk, "Captain" of the Calgary Space Workers Society in Calgary, Alberta, Canada, with whom the Moon Society is partnering in exploration of a mobile-modular architecture for a lunar analog research station.

Larry J. Friesen, Houston, TX. Larry has contributed a several articles to Moon Miners' Manifesto over the years, and has been of invaluable assistance to the editor on technical issues. With a PhD from Rice U. in Space Physics and Astronomy, he has years of experience in the aero-space world working for contractors at JSC.

Tom Greenwalt, Minneapolis, MN, created our blog site and maintains it. He is a member of our new partner NSS chapter, Minnesota Space Frontier Society.

Jesus Raygoza, originally of Guadalajara, Jalisco, Mexico where he founded the NSS chapter. Currently working in Colorado, Raygoza is spearheading the drive to develop the new Mexican Space Agency, has founded the Mexican Space Society. Jesuis is the architect of the MexLunarHab plan for an lunar analog research station.

The Lunarpedia: encouraging progress

www.lunapedia.org - from Peter Kokh

Our new wiki has a long way to go, but it has already attracted a number of contributors, some from our own membership, others quite notable. Moon Society Advisor Geoffrey A. Landis of NASA Glenn, with a line of credits too long to present here, is one of them.

We will be inviting all Moon Society Advisors as well as members of affiliated organizations to join in the fun (and work) of fleshing out our open-source online encyclopedia of "all things 'Moon.'" Someone has volunteered, with my full cooperation and permission to place many articles from MMM on Lunarpedia.

Lunarpedia will have much information about the Moon itself as well as about robotic and manned lunar exploration, development, and settlement. There will be articles about hardware needed to reach the Moon, life support systems, in situ resource development, life in lunar settlements, the Moon in human history and culture. In short anything and everything that has a lunar connection is suitable content.

This is, of course, an all volunteer effort. We invite readers to check out what's online already, and to check back often. Please do consider how you can help. One does not need to be a Moon Society member to be part of the team. Lunarpedia is on a separate server and logins are created for anyone who wants to help.

This is, of course, a Moon Society sponsored project, and the Society stands to benefit from its progress. **<PK>**

Bay Area Moon Society

http://www.moonsociety.org/chapters/bams/
Meeting **4th** Thurs. montlhly at Henry Cates' in San Jose

Contact: Henry Cates <hcate2@pacbell.net>

At the November 30th meeting, Andrew, David and I had more Pizza than we could eat. We talked a bit about David's proposals to use UAV [Unmanned Aerial Vehicles] to sample the Antarctic volcanos where normal means are limited because of fear of contamination of some unique ecologies.

We wound up with a discussion of how to balance robotic missions and manned exploration of the Moon. Robots are getting more capable and can do a lot to gather data to select an adequate site for an outpost. Manned expeditions need to be able to stay for a long time to justify the cost of the trip. Tools to set up a habitat, start using local resources, can make a big difference in the success of long term occupation and exploration of the Moon.

We touched on Space Exploration, Bigelow inflatables, and Jon Goff's selenianboondocks.blogspot.com

Moon Society St. Louis

http://www.moonsociety.org/chapters/stlouis/
Meeting the **2nd** Wed. monthly at Buder Branch Library
4401 S. Hampton, in the basement conference room

Contact: Keith Wetzel <kawetzel@swbell.net>
or Bob Perry <surfer_bob@sbcglobal.net>

We celebrated Moon Madness Night Friday, Jan. 5, 2007 at the Center for Creative Learning - Intermediate Campus, 265 Old State Road, Ellisville. This was the 10th annual event, which Moon Society St. Louis has supported annually the past four years, supplying exhbits, literature, and speakers. Member Chris Nobbe is the principal organizer of the event. A nice writeup in Suburban Journals:
http://suburbanjournals.stltoday.com/articles/2007/01/10/news/sj2tn20070109-0109prj_rockmoon.ii1.txt

Next is Show-Me-Con, April 20 - 22, Marriott West County. St. Louis. www.showmecon.com/news.php

Moon Society Phoenix Outpost Blog

http://www.moonsocphx.blogspot.com/

Moon Society Milwaukee Outpost

http://www.moonsociety.org/chapters/milwaukee/
Contact: Petr Kokh <kokhmmm@aol.com>

The Milwaukee Outpost finally has 3 members, the minimum required for chapter status: Peter Kokh, David Dunlop, and Ken Paul. However Ken's hours are very irregular, and Dave (Moon Society Director of Project Development) lives in Green Bay. 120 miles to the north. but stops in when buisiness takes him to Chicago. So it is almost impossible for us to meet as a threesome. We are working with the Lunar Reclamation Society to organize outreach events in the Metro area to recruit more bodies.

GREAT BROWSING !

NASA offers a $250,000 prize for a better glove:
http://www.courant.com/technology/hc-space0425.artapr25,0,666931.story?track=rss

Bigelow Aerospace Solitaire
http://www.bigelowaerospace.com/galaxy_games/flash/BASolitaire.php

Servicing clustered observatories at Sun-Earth L2
http://www.thespacereview.com/article/759/1

International Agency for the Development of Mars
http://www.thespacereview.com/article/763/1

X-Ray Pulsar Navigation: the "GPS" of Space
http://www.thespacereview.com/article/762/1

Detecting Asteroid Impacts in Other Solar Systems
http://www.thespacereview.com/article/761/1

Review: Lunar Prospector: Against All Odds
http://www.thespacereview.com/article/751/1

Revisiting "Limits to Growth as driver for Space
http://www.thespacereview.com/article/775/1

"Humans for humans' sake" ***MUST READING***
http://www.thespacereview.com/article/772/1

Will Mars challenge the "prime directive"?
http://www.thespacereview.com/article/771/1

Post your resumé here for a Space Career Job
http://click.heyamigo.net/ct/ac760464

The long term prospects for ISS
http://www.thespacereview.com/article/769/1

The rise of India as a Space Power
http://www.thespacereview.com/article/768/1

13 issues of Cosmic Search (1979-80) now online
http://www.bigear.org/CSMO/HTML/CSIntro.htm

$50K Apophis "Tagging" Design Competition
http://planetary.org/programs/projects/apophis_competition/

The "Space Settlement" Nexus - 8,000 pages online
http://www.nss.org/settlement/

FAA sets Guidelines for Space Travel
www.space.com/businesstechnology/061221_faa_fin.html

Future Mining Methods: fr. Ocean floor to the Moon
http://www.digistar.mb.ca/minsci/future/futurem.htm

Send a wish or message to the Moon
http://www.jaxa.jp/pr/event/selene/index_e.html

Dowload this 100 mg Photographic Moon Atlas
http://artsnova.com/blog/2007/01/19/22/

NASA Guide to the International Space Station
www.spaceref.com/news/viewsr.html?pid=23098

MAIL TO MMM

Bob Wilcox: <ramgwilcox@verizon.net> 9/14/06
Re: Mobile Lunar Analog Research Stations

What a great idea! (MMM 197, 8/06)
The following is so obvious that it already should be on your brainstorm list, but I'd like to verufy that :

A commercial semi-truck & trailer, with the trailer shell replaced by a Bigelow inflatabule module. Better/bigger yet, the "core" built onto the trailer bed, with a sausage (or central bagel) baloon to be inflated out either side. For the latter, fold-down sides would make a handy support platform.

I wonder if this would be marketable to the RV trade -- sort of a really extra big expando unit.

I saw my first soft-sided (canvas) cargo lorries while visiting Britain. Those are all I saw on road-trains in Australia. Only now am I beginning to see them on semi-truck rigs in the US. They have hard roofs, but the relatively easily removable sides might be useful for the balloon expansion(s). Bob Wilcox, *Los Angeles*

Bob Wilcox: <ramgwilcox@verizon.net> 8/04/06
Re: Projected Earth-view, illustrations

To add completeness to Rick Brown's notes on outside viewing (MMM 6/06 mail), we should include "camera obscura" -- projecting the image onto an opposite wall. I have in mind a 10-foot diameter image of the Earth, probably giving enough light for ordinary room activities. (I watch NASA TV and have spent hours watching the Earth views there.) This would incidentally also impose something of an Earthly day-night cycle for those who need it. Bob Wilcox, *Los Angeles*

[**Editor:**] Bob, thanks for your suggestion. But, I don't get the drift of this last sentence. What Lunans will see, indirectly or directly, is Earth whose phase shifts from new to full to new again over the same 29.5 day period as for us, the Moon goes from full to new, back to full again.

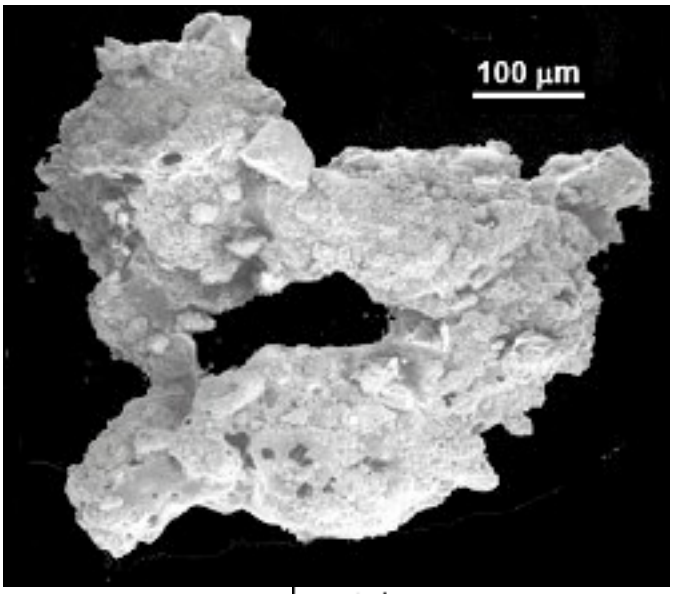
The portion of the Earth's Moon-facing hemisphere that is lit will change only slightly from day to day just as the phase of the Moon changes only slightly in phase for us. So the Earth Projection would not help simulate a 24-hour day/night rhythm. However, you are right in so far as Full Earth will always occur during local nightspan, producing the brightest image when it is most needed. What does change on a 24 hour basis is which continents are facing the Moon at the moment.

One design challenge involved in your suggestion is that the Earth is only approximately in the same location in the lunar sky for any given place on the Moon, Owing to the effects of libration, the Earth would seem to wander up/down and side to side by about 7 degrees off its mean position. See this illustration as an example:
http://www.asi.org/images/asi199700004.gif
For an explanation of libration processes, check out:
http://en.wikipedia.org/wiki/Libration

This 1.1 mb animaiton shows how center nearside is only approximately facing Earth. http://upload.wikimedia.org/wikipedia/en/e/e6/Libration-noshad2b.gif

Any device focused on Earth must be programmed to follow this wandering. This is doable, but makes the process a bit more complicated than it might seem. **PK**

MMM PHOTO GALLERY



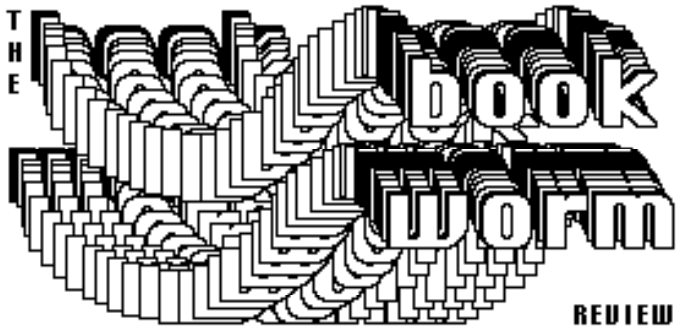
Above: A speck of Moon dirt. The strange shape tells a tale of violence: It results from the welding of rock, mineral and glass by the heat of micrometeoroid impacts. Image credit: David S. McKay, NASA/JSC. Source:
http://science.nasa.gov/headlines/y2006/28dec_truefake.htm

http://public.**blueorigin**.com/img/2006_11_13_launch.wmv

On November 13, 2006, Jeff Bezos' (amazon.com) Blue Origin company launched and landed "Goddard" – a first development vehicle in the New Shepard program. On the first flight, it reached 285 feet, then landed pefectly. Many Blue Origins engineers were previously involved in the Delta Clipper (DCX) project. You can watch the video at the link above.

Some of those present at the founding of NSS-Milwaukee (Lunar Reclamation Society) attend 20th Anniversary Gala on Dec. 9th. L>R: Ben Huset (MN SFS), Myles Mullikin and Peter Kokh (LRS), Scot Shjefte (MN SFS), Dave Riedel (LRS) and Larry Ahearn (Chicago SFS) – It was MMM's 20th also. More: www.lunar-reclamation.org/page12htm#20years

The **Food Growth Chamber** at Antarctica's South Pole Station: a model for what we can do on the Moon and Mars, *and,* at a Lunar Analog Research Station. The Chamber uses CO2-enriched atmosphere and over-illumination, with teleoperated hydroponic systems. In operation for two years, it produces two salads a day for each of the stations 75 person crew. Its designers are working on a similar chamber designed to fit in a cylindrical habitat module for Moon and/or Mars.



MoonQuake

by Dr. Alan Binder

2006 C.G. Publishing – ISBN 1-807-350-00-7
Paperback 312 pages – *Review by Peter Kokh*

The author, best known as the Principal Investigator for the ***Lunar Prospector*** mission in 1998-99, has had a long career in space science. During that career, especially while shepherding the Lunar Prospector mission to completion once NASA decided to fund it as a Discovery mission opportunity, has clearly developed strong negative feelings about NASA. His nonfiction work, *Lunar Prospector: Against All Odds*, is ample testimony.

Binder is also a Lunar scientist, and had earlier warned that the original indications that the Moon was seismically quiet were wrong, that major long-lasting moonquakes could and did occur and are responsible for a number of "young" scarps in various locations on the Moon. NASA had shut down the Apollo seismic network early, "to save money," when it could have been accumulating valuable data.

In the novel, NASA is ready to deploy its first Moonbase by 2014. I liked the fact that in the novel, NASA had picked an equatorial site, in the Fra Mauro area visited by Apollo 14, over a polar site, on the valid grounds that Fra Mauro was much better situated to access all the various mineral resources necessary for an industrial settlement, whereas a Polar site is not.

In the wake of a 3rd shuttle disaster, this one with Atlantis, NASA was still cutting corners, corners which could have safety implications. The various modules of the outpost were put together and shielded by teleoperation from Earth in advance of crew arrival, something I find eminently sensible, but which Binder evidently does not.

By sheer coincidence, the kind of Moonquake which might occur every 100,000 years or so, happens not only a few weeks after the first crew arrives to occupy the outpost, but its epicenter is only a few miles away. I find blasting NASA for this coincidence a little stretched. After all, the slumbering supervolcano below Yellowstone could in fact erupt at any time, devastating most of the Western United States, but we can't put life on hold just because in theory this could happen, andy more than we can put life on hold because a killer asteroid might strike in the immediate future as opposed to hundreds of millennia into the future.

It is another question whether or not we could come up with "seismic building codes" for the Moon which would address the peculiar long-duration quakes that could ever so rarely occur. I was surprised that Binder did not suggest any such measures (that NASA could have taken) but only faults NASA for tele-assembling the base. I would have liked to have seen more "constructive" criticism.

Binder does suggests that we should at earliest opportunity set up a thorough and capable lunar seismic station network. Indeed, this is in the works, not by NASA, but if I remember right, by the Japanese and the Russians. But how long would such a system have to operate before we had even the beginnings of a map of seismic danger zones for the Moon, including probability of occurrence over stated time periods? We are still learning about the seismic state of our home planet after studying it thoroughly for many, many decades.

Can we put placement of a first moonbase on hold until we have a "confident" picture of seismic risks? Given how often seismic events are likely to occur in any one area, I would emphatically say no. We have lived with risks of many kinds on Earth since time immemorial. We will never be without risks. If the cost-benefit ratio is high enough, we might justify short delays. But many thousands of Americans tour Yellowstone every year even though the supervolcano *might* come to life while they are there. And millions live on top of one active fault zone or another in California, even though "the big one" just *might* happen while they were there.

So in short, I don't think Binder justifies his indictment of NASA in this case. I am not known for cozying up to NASA myself, however. But I am usually careful to put the blame where it really belongs, with fickle Congressional oversight, and the total irrationality of the political process. Many dedicated people in NASA have had to compromise their best judgment to suit political mischief.

Now all this said, the book is a fast read! Once you get to the part where the quake occurs, you cannot put the book down. Binder's characters are real and colorful, and their personalities drive the story line. There is tragedy, conflict, suffering, heroism, and redemption. The book, if you can look past the NASA-bashing to the real culprits, is a good read.

Settling the Moon will not be a picnic. The frontier is not for those who want life easy. When America was opening its west, those who needed the latest, the best, the most comfortable, the most convenient did not go west. They stayed in Boston and Baltimore (no offense to those of you who still live in these great cities!)

The frontier is for those for whom the most compelling thing is the chance to start over, to start fresh, to get in on the ground floor, to help really shape the future – as opposed to just getting along and going with the flow.

Opening the Moon will exact its price in heroism and suffering and personal tragedies. But if we are going to do it, we have to believe that it will all be worth it. It is only that spirit that got us from the savannas of our real mother world, East Africa, to the neighboring planets of Asia, Europe, and eventually the Americas and Australia. It is only that spirit which will let us traverse the new wider, deeper seas of space to the even more challenging shores beyond.

Moonquake is more than a political statement, or a scientific one. It is a story about people. Go buy the book! *Peter Kokh*

[Review of **MoonQuake**, continued]
For *the story behind the story*, read Alan Binder's post: www.apogeespacebooks.com/forum/viewtopic.php?t=12

Binder's reply, a conversation, and further notes

The review above was posted on Apogee Books "Forum."

http://www.apogeespacebooks.com/forum/

where Alan Binder saw it right away and replied, full text:

www.apogeespacebooks.com/forum/viewtopic.php?p=45#45

In short

Dr. Binder feels that while Congress definitely gets a big share of the blame for things, NASA/Contractor mismanagement abounds and deserves blame for both Challenger and Columbia and other failures.

Binder agrees that we should not wait until all the seismic evidence is in before designing and deploying a moonbase, but does insist that we should build it to take a good "shaking." This means making every module and hallway sealable, to limit and localize decompression accidents. In response to my suggestion that I thought "teleoperated construction" was a good thing, greatly reducing the risks of extensive EVA in accident-prone construction situations, he replied that he agreed to that, but thought that there should be personnel on location to monitor the teleoperated construction process, double checking alignments and other critical parameters. This suggestion does seem to offer the best of both worlds.

[**Editor:**] Designing flexible seals will be quite a challenge. Most flexible materials, if not all, have very inflexible thermal limits. Flexibility turns to brittleness at specific colder temperatures, and may simply fail altogether at specific higher temperatures. Isolating seals from thermal extremes will be important, but simply shielding them with regolith may do the job. Silicone sealants in general perform well through a significantly larger thermal range than do hydrocarbon sealants. Glass fiber can help limit the spread of cracks, but can hardly be expected to eliminate them.

Previous Quake-proofing suggestions

Heinlein made suggestions to "quakeproof" lunar habitats in "Gentlemen, Be Seated," by Robert Heinlein, published by Argosy in 1948

www.technovelgy.com/ct/content.asp?Bnum=1010

Part of Heinlein's solution involve "Tag-alongs," balloons with sticky inner surfaces that are drawn to and sucked in by any emergent cracks in the pressure hull.

www.technovelgy.com/ct/content.asp?Bnum=1009

A Conversation

As it happened, I was online when Alan sent me his reply to my review and I answered that reply right away, which was then followed by a phone call from him.

We seem to be on the same page on a number of things: location of a moonbase where it can access *all* of the major elements needed for a diversified lunar settlement industry (i.e. *not* at the poles), on location oversight of teleoperated construction processes, that only private enterprise can bring costs down and prioritize things in a way that makes sense (as opposed to satisfying design-by-committee demands). We both look forward to private enterprise seizing the initiative in the Return to the Moon, and strongly believe that a NASA directed effort will not produce anything lasting. **<PK>**

QUOTABLE / NOTABLE

Science vs. Engineering, Robots vs. Humans, and *Human* Goals

"Essentially, **science is about looking at the universe and nature as it is**, figuring out how it all works, and contri-buting to the knowledge of humankind.

"**Engineering is about changing the universe to suit us**, inventing and building things to benefit humankind. The two are related, but they are different. And the universe is big enough for the both of them.

"The reason that our ancestors colonized the Earth was to have human beings all over the planet. The reason to continue human spaceflight is to have human beings through-out the solar system—humans for humans' sake."

Michael Huang (fhprize@gmail.com) in "Humans for humans' sake" www.thespacereview.com/article/772/1

NASA Re cycles

2 Successful Probes get 3 Follow-on Missions

www.astronomy.com/asy/default.aspx?c=a&id=4646"

"NASA selected three missions of opportunity that would utilize two spacecraft that have already already completed their primary objectives.

"The **Deep Impact eXtended Investigation of Comets** (**DIXI)** mission would use the Deep Impact space--craft for an extended fly by mission to Comet Boethin. The probe would take pictures of its nucleus to increase our understanding of the diversity of comets. Michael A'Hearn of the University of Maryland is DIXI's principal investigator.

"The **Extrasolar Planet Observations and Characterization** (**EPOCh**) also will utilize Deep Impact. EPOCH will use the probe's high-resolution camera to search for the first Earth-sized planets. L. Drake Deming of Goddard is EPOCh's principal investigator.

"The **Stardust NExT** mission would use the Stardust spacecraft to fly by Comet Tempel 1 and observe changes since Deep Impact visited it in 2005. Joseph Veverka of Cornell Univ. is NexT's principal investigator.

"These missions will receive $250,000 each to further develop the concepts. Selected projects must be completed for less than $35 million. ###

Planetary Society's

Apophis Mission Design Challenge

How do we keep accurate track of asteroids in orbits which could someday impact Earth? The most accurate way to track and determine the orbit of a potentially dangerous asteroid is to send a space probe there and "tag" it. But that is something that, right now, no one knows exactly how to do. For more, go to:

www.planetary.org/programs/projects/apophis_competition/

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

(*LRS Board Members for 2007)

LRS Upcoming Events – February, March, April

Saturday, February 10th, 1-4 pm

LRS Meeting, Mayfair Mall, Garden Suites Room G110
AGENDA: www. lunar-reclamation.org/page4.htm
Reports on Peter's visit to the Oregon L5 Society; upcoming outreach opportunities: Earth Day March 20th, Yuri's Night April 12th, Astronomy Day April 21st. How can we take advantage of these opportunities, and which one or two should we concentrate on?

Discussion of a possible group field trip to the new lakefront aquarium with its mock-up walk-through sea bed station, and/or to see IMAX' "Roving Mars"
http://www.mpm.edu/imax/movies/mars/index.php

Saturdays, March 10th, April 14th, 1-4 pm

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

MMM 7 NSS Chapters Strong

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

Chicago Space Frontier L5

610 West 47th Place, Chicago, IL 60609

INFORMATION: Larry Ahearn: 773/373-0349

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

Feb 17 – Mar 17 – Apr 21

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

Pix from the LRS/MMM 20th anniversary 12-09-07
http://www.freemars.org/mnfan/LRS-MMM/

MN SFS Year in Review – 24 linked pages
http://freemars.org/mnfan/MNSFS/2006-Review/

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@charter.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 7-9pm

FEB 15th: The Stoelting House, **Kiel**
MAR 15th UW-Sheboygan, Room 6101, **Sheboygan**
APR 21st: The Stoelting House, **Kiel**

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/]

[http://www.phillypasa.blogspot.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 .

Next Meetings: Feb 17 - Mar 17 - Apr 21

December Meeting Notes: We need pictures of our group events for our website as well as those space related events we have been part of as individuals. This is the first item we talked of after our re installation of officers. I had hoped we could ask someone to fill the post of educational outreach coordinator. I was thinking of Michael Steward, who is involved in the field, for the post. We will discuss this at our next meeting on January 20.

Hank Smith reported on various science fiction events he will attend, including *Lunacon*, the third weekend in March at the Hilton Hotel in Ryetown, NY.

We also talked of the possibility of conflicts between events: it is possible that *Worldcon*, the World Science Fiction Convention, and The 10th Annual Mars Society Conference may occur at the same time. And in the future: Worldcon in Australia (2010).

Dotty brought material about NASA research on air purifying plants in The Edwardian Garden which is part of Duke Gardens in New Jersey. She mentioned that they sell books at the Gardens on the usage of plants for this application. This report turned out to be particularly timely as the December *Moon Miners* had an extensive article on this, and other, uses for plants and more for Moon bases both analog and, in a decade or so, real.

Larry the Webmaster brought pictures! We now have a few on our site and should have more' We have been invited to both the George Washington Carver Science Fair and Super Science Weekend in the March and May time frames respectively. We will make an effort to get shots from those events and see if other events with photo opportunities are possible. Can someone get us pictures from Philcon? We had a guest there with a film camera and maybe we can get scans? Larry also asked about our events calendar and when things like The NASTAR Center Open House was happening. We could then post it for our members. (No word at this time).

Mitch brought material about contacts for Super Science Weekend,May 19 and 20 this year. No conflict with *Balticon* again (Memorial Day weekend) Super Science is a great way to promote the science and engineering education the public will need for the future we seek to be possible. Mitch also reported on reaching out to the people at *Philcon* who signed up for information.

We also talked of "Space Exploration Day: July 20 or U.N. Space Exploration Day in October?" Some of the major aerospace firms have promoted July 20 (also called Landing Day) while internationalists, and those wanting to bring in college students with an event during the school year, want October. We have no venue currently for July and so we can't do both. Maybe at a new aerospace company location? Go Mitch!

There was material from *The Futurist Magazine*, for November and December, on the future of Space Cruises with flights beginning as early as 2014 with eighty to one hundred passengers. And much more. And last but not least from Mitch was the material he brought about Space Camp for 2007. This will be hand outs for our spring events.

Michelle, our Treasurer, gave us the financial report and asked, once again, for member renewals. We do tend to carry former members for some time but must hear from you.

Earl brought material from *Analog Science Fiction and Fact* which included a technical article on material science: "Toward Not-Just-a-Diamond Age" where materials other than carbon nano tubes and Bucky Balls will play very important functions (like fireproofing the Beanstalk maybe? Earl) as components of fuel cells and batteries and many other possibilities based on silicate structures and "tungsten bronzes" . Stephen L. Gillett wrote the fact article. The Alternate View piece on "Extra Solar Planets and Occult Astronomy". This is, of course, about tools used to block a primary's emissions to view potential stellar companions directly. A very interesting explanation of the technique and obstacles, beyond the emission of the primary. that must be taken into account. The author, John G. Cramer, points out that the Hubble, and the forthcoming Webb, could image Earth sized planets at 23 Light Years if the right tools are available. This was from the March issue of the magazine The January issue of Nuts and Volts has been with a number of good articles therein including the Near Space column by L Paul Verhage. He has a number of clever experiments and describes some analog to digital interfaces he built to connect to his flight computer. More on this and other material at the next meeting.

Event Notes: We will need volunteers for our part in the George Washington Carver Science Fair in late February and early March. We need at least two judges for our Special Awards in honor of our late members James Chestek and Oscar H. Harris . Contact Earl at 215-633-0878 to volunteer. - Submitted by Earl Bennett

January 20th Meeting Notes: Our first report was from Michelle Baker, our treasurer, said that our quarterly payment for Moon Miners had been paid and that we where solvent. She also asked for (and later received) our activities for our annual report to The National Space Society. They are our foundation organization and the chapters activity report is part of there requirements. Thanks to our helpful members, we are active!

Larry, our Webmaster, brought up several points: our blog is at http://phillypas.blogspot.com. I listed it incorrectly previously. He also informed us that Hank

Smith, our Science Fiction Outreach Coordinator, has signed on as an author for blogsite postings. The utilities are courtesy of NSS in the for of calendars for posting of events. There are two locations, one for everyone to post chapter activities, and the other for the local organization We are posting our meeting dates and event schedules there. And our website is showing increased visitations. Thank you Larry and NSS!

Dorothy reports that The Franklin Institute is featuring "The Search for Life: Are We Alone" with Harrison Ford as the narrator.

Hank Smith reported on P.S.F.S. activities and the reelection of Michael McConnell as its President. Hank had run for the office as well. He will be at Lunacon (now) and Balticon in May. See you there Hank!

Mitch Gordon brought a number of publications and a new "toy set". This consisted of a "Massaging Penn" and laser pointer set for our talks, The laser has a set of optical "caps" that allow arrows and symbols to be projected. He reprised a talk he gave in 2005 0n space tourism. This was a lead-in for the January/ February *The Futurist* Magazine with projections by Nick Diamontis on Space Tourism in the near term: 2007 to 2014. Some of this looks like it will happen with Mr. Diamontis and family playing a significant part as well as other entrepreneurs like Richard Branson and Bill Richardson. Here we have chickens and eggs being codeveloped! Mitch also brought up the need to send NSS its report and the May 19 and 20 Super Science event. More later.

Janice brought up her interest in a possible asteroid impact by *Apophis* in about 2029 or, because of its current orbit, in 2035. If it has a near encounter the path could be changed enough to throw it away from future close approaches entirely (optimistically), or into collision. She will post her inquiry , and the response she is receiving from NASA and whoever else she is talking to on this grim possibility. One of the replies she has, from a Nasa Q and A link. Since the response to the question was somewhat simplistic she is going forward with further research on the problem. As mentioned above, if the asteroid just misses us, this will be a very close approach. It will come as close as geosynchronous orbit (but at an angle to miss the Clarke Belt) this time. If deflected it could come back and might hit the Earth or Moon or miss entirely. On another topic: we had a rather long talk about the environment and Man's affect on it. More below.

Earl brought several publications including the April 2007 *Analog* Magazine from which the conversation on climate change by Man was expanded. The piece. "The Ice Age That Wasn't" by Richard A. Lovett concerned the possibility that our agricultural and animal husbandry activities has altered the climate enough, over the last 10,000 years, to have prevented at least one Ice Age and moderated much of the effects of coinciding weather cycles. The author quotes a source with an interesting hypothesis: the major decreases in human activity caused by massive die offs (plagues) allowed some of the cool offs we had after these disasters. Satellite data and geologic exploration gathered the evidence.

Speaking of satellites: The Amsat Journal had a number of interesting reports and discussions with a novel RADAR transponder going up on RAFT1 CubeSat by Anthony Monterio (AA2TX) and Robert Bruninga (WB4APR). There is an article on the P3E Satellite and a new financing scheme: A picture of the craft is broken down into pixels, and these are auctioned off. The really cool part of this is that you can get a block of pixels that can have information you would like to display. You should go to p3e-satellite.org for details and participation rules. The buyer who purchases the most pixel blocks wins a trip to the Launch. Additional trips will be raffled off.

And there is another contest for those who want to be involved but aren't in the ham community!. Very nice, at ticket-to-Mars.org. Page 24&25. And The Orbital Classroom of course. November/December journal. And finally *Nuts & Volts* for January 2007 had the Near Space Column" by Paul Verhage" Balloon Sats, Pongsats, And the Idaho Cluster Bomb" with a number of neat experiments and devices described. He describes interfacing to the HOBO Data Logger mentioned previously. The "Pongsat" is a clever idea for encapsulating a tiny sensor system in a ping pong ball. I,ll have to try that for Super Science Weekend in May. The last item is actually about exploding (or not!) bags of potato chips. The details of how the author set about gathering his data for this experiment using a low cost digital camcorder (some are down to ~$70.). It Is Rocket Science! Or can turn out to be.

Reminders: At the beginning of March we will judge and present awards at The George Washington Carver Science Fair, and, May 19 and 20, we will be at Super Science Weekend. The date may have been noted as April previously. - Submitted by Earl Bennett.

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.
● Feb 17 - Mar 17 - Apr 21
Information: OASIS Hotline, 310/364-2290; website.

Upcoming Events

- **Sat. Feb. 17th, 1:00 pm** - OASIS Monthly Business Meeting at the home of Steve Bartlett/Tina Beychok. 7108 E. Peabody Street, Long Beach, CA 90808.
- **Sat March 17 th, 3:00 pm** - Meeting, location TBD.
- **Thurs/Friday March 22/23, 7 pm** - "The Dream Mission to the Asteroid Belt" by Dr. Marc Raymann, Proj. Systems Engineer, Dawn Mission (Vesta, Ceres)
- **Friday March 23, 10 am** - Beckman Auditorium, Caltech Film: "The Astronomer's Dream.: $5/person. For grades 5-12. One hour schoold day performance. Call Mary Herrera 626-395-6059 mhh@caltech.edu.

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○ **$45 National Space Society dues** include *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 MMM** (pdf) **$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* <=
○ **$12 USA** MMM Subscriptions; ○ US**$22** Canada;
○ US**$50** Surface Mail Outside North America
Payable to "LRS", PO Box 2102, Milwaukee WI 53201

CHICAGO SPACE FRONTIER L5
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○ $12 low "one rate"

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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