

Moon Miners’ Manifesto



& The Moon Society Journal

www.MoonMinersManifesto.com

205

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In FOCUS India’s Space Vision goes far beyond U.S. “VSE”

Dr. A. P. J. Abdul Kalam, President of India Speaks to the Symposium on “The Future of Space Exploration: Solutions to Earthly Problems” to mark the occasion of the 50th Anniversary of the dawn of Space Age, Boston University, Boston, MA, April 12, 2007.

<http://www.presidentofindia.nic.in/scripts/eventslatest1.jsp?id=1494s>

“Since the dawn of space era in 1957, space science and technology has enhanced man’s knowledge of earth, atmosphere and outer space. It has improved the quality of life of human race. Our space vision to the next fifty years has to consolidate these benefits and expand them further to address crucial issues faced by humanity in energy, envi-ronment, water and minerals. Above all, we have to keep upper most in our mind the need for an alternate habitat for the human race in our solar system. The crucial mission for the global space community is to realize a dramatic reduction in the cost of access to space.”

Excerpt Highlights

“Today, India has the capability to build any type of satellite launch vehicle to place remote sensing, communication and meteorology satellites in different orbits and space application has become part of our daily life. [...and have demonstrated space capsule recovery.]



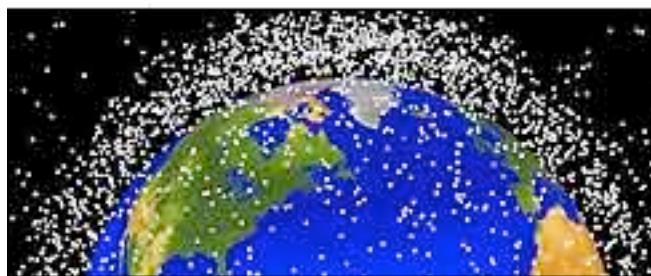
“India is now working on its second space vision which will include space missions to the Moon and Mars *founded on space industrialization.*

“Space Research has been a Technology Generator, consistently aiming at the *impossible* and the *incredible*. It is almost a “Green Technology. ... The world population is projected to be 9+ billion by 2050. Critical issues arising from this growth are shortage of energy, shortage of water and increasing damage to the natural environment and ecology. ... What better vision can there be for the future of space exploration, than a global mission for perennial supply of renewable energy from space?”

Water for future generations – “There is a four-fold method towards providing safe and fresh drinking water for large population. The first is to re-distribute water supply; the second is to save and reduce demand for water; the third is to recycle used water supplies and the fourth is to find new sources of fresh water. Desalination is an energy intensive process. Hence, the use of renewable energy through space solar satellites can bring down the cost of fresh water substantially. Space based solar power stations have six to fifteen times greater capital utilization than equivalent sized ground solar stations. Linking Space solar power to reverse osmosis technology for large-scale drinking water supplies could be yet another major contribution of Space. [=> p. 2, col. 2]

Space Debris Threatens to Close Space Access

While some people have been sounding the alarm for decades with increasing stridency, it is clear that most observers and space enthusiasts have a cavalier attitude towards the growing threat to space transportation to and through low Earth orbit posed by space debris. This one problem could trump all other concerns by confining us to a terrestrial prison for millennia. See: www.wired.com/wired/archive/15.05/st_houston.html



Moon Miners' Manifesto

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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.

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• **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.

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

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

• Submissions

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⇒ IN FOCUS Editorial continued from p. 1.

Potentially Dangerous Asteroids – "Space community has to keep monitoring the dynamics of all potentially dangerous asteroids. Asteroid 1950DA's rendezvous with Earth is predicted to be on Mar 16, 2880. The impact probability calculations initially indicated a serious condition of 1 in 300 which has to be continuously monitored. In such a crucial condition, we should aim to deflect or destroy this asteroid with the technology available.

Space Missions (2050) – "Geosynchronous Equatorial Orbit (GEO) is a well utilized resource. The spacecraft orbiting in GEO are very high value resources. However, the life of these spacecraft are determined by component failure, capacity of fuel, internal energy systems and space environment. While new design practices and technologies are constantly increasing the life of satellite, there is a requirement for extending the life of satellite through in-orbit maintenance such as diagnosis, replacement, recharging, powering, refueling or de-boosting after use. This calls for creation of Space Satellite Service Stations for all the spacecraft in the GEO as a permanent international facility. Future satellites and payloads have also to be designed with self healing capability and mid-life maintenance.

Space Industrial Revolution – "Mankind's 21st. Century thrust into space ... means is the creation of architectural and revolutionary changes leading to new space markets, systems and technologies on a planetary scale. Such a Space Industrial Revolution will be triggered by the following missions that can address all segments of global space community. What are the possible drivers for such a Space Industrial Revolution?

"The first major factor will be man's quest for perennial sources of clean energy such as solar and other renewable energies and thermonuclear fusion. Helium 3 from Moon is seen as a valuable fuel for thermonuclear reactors.

"The Moon's sky is clear to waves of all frequencies. With interplanetary communication systems located on the farside, the Moon would also shield these communication stations from the continuous radio emissions from the Earth. Hence *the Moon has potential to become a "Telecommunications Hub" for interplanetary communications* also.

"The Moon also has other advantages as a source of construction materials for near Earth orbit. Its weak surface gravity is only one-sixth as strong as Earth's. As a result, in combination with its small diameter, it takes less than five percent as much energy to boost materials from the lunar surface into orbit compared with the launch energy needed from Earth's surface into orbit. *Electromagnetic mass drivers powered by solar energy could provide low-cost transportation of lunar materials to space construction sites.*

Habitat on MARS – "As my friend Prof UR Rao, former Chairman of ISRO says, space scientists are habituated to protecting systems against single point failures; so, in the longer term, *creation of extra terrestrial habitat on MARS should be studied as fail safe mechanism for our problems on Earth.* How would we create livable conditions on Mars?

continued, next page

Moon-Based Solar Power Stations – “The non-availability of low cost, fully reusable space transportation has denied mankind the benefit of space solar power stations in geo-stationary and other orbits.

“The Moon is the ideal environment for large-area solar converters. The solar flux to the lunar surface is predicable and dependable. There is no air or water to degrade large-area thin film devices. The Moon is extremely quiet mechanically. It is devoid of weather, significant seismic activity, and biological processes that degrade terrestrial equipment. Solar collectors can be made that are unaffected by decades of exposure to solar cosmic rays and the solar wind. Sensitive circuitry and wiring can be buried under a few- to tens- of centimeters of lunar soil and completely protected against solar radiation, temperature extremes, and micrometeorites. Studies have also shown that it is technically and economically feasible to provide about 100,000 GWe of solar electric energy from facilities on the Moon.

One Major Problem – “How are we going to make the cost of access to space affordable?. The question hinges on creating space markets and developing cutting edge technologies to make low cost of access to space a reality. The future of the space industrial revolution created by a space exploration initiative would hinge greatly on new means of safe, affordable access to near earth space, as the platform for deep space exploration.

Cost of access to Space – The present level of markets for communication, are getting saturated. ... The current cost of access to space for information missions such as telecommunication, remote sensing and navigation varies from US \$ 10000 to US \$ 20000 per kg in low earth orbit.

Hence “the future of space exploration requires that space industry moves out of the present era of information collection missions, into an era of mass missions. There is a need to reduce the cost of access by two to three orders of magnitude. It is only by such reduction in cost of access to space that mankind can hope to harvest the benefits of space exploration by 2050.

Affordable, Low Cost Space Transportation

“The payload fraction of current generation expendable launch vehicles in the world does not exceed 1 or 2% of the launch weight. Such gigantic rocket based space transportation systems, with marginal payload fractions, *are wholly uneconomical* for carrying out mass missions and to carry freight and men to and from the Moon.

“Studies in India have shown that the greatest economy through the highest payload fractions are obtained when fully reusable space transportation systems are designed which carry no oxidizer at launch, but gather liquid oxygen while the spacecraft ascends directly from earth to orbit in a single stage. These studies in India suggest that a “aerobic” space transportation vehicle can indeed have a 15% payload fraction for a launch weight of 270 tonnes. This type of space plane has the potential to increase the payload fraction to 30% for higher take off weight. For such heavy lift space planes, with 10 times the payload fraction and 100 times reuse, the cost of payload in orbit can be reduced dramatically by several orders of magnitude lower than the cost of access to space with expendable launch vehicles.

“The real value of space exploration for human advancement will occur only when mankind builds fully reusable space transportation systems with very high payload efficiencies. This will become available when the technology of oxygen liquefaction in high-speed flight in earth’s atmosphere is mastered.

Maintaining Peace in Space – There is a need for an International Space Force made up of all nations wishing to participate and contribute to protect world space assets in a manner which will enable peaceful exploitation of space on a global cooperative basis.

Challenges before the Space Research Community

“The scientists of today must come up with a steady fountain of ideas that would attract the students. This is a great challenge. I would be happy if the great minds gathered here, articulate to the young, the space vision for the next fifty years and challenges presented and discussed in the Symposium. Space does not have geographic borders and why should those who pursue space research have any borders?

Space Missions 2050 – “I would like to suggest the following space missions for the consideration by the space community assembled here to be fully accomplished before the year 2050.

1. Evolving a **Global Strategic Plan** for space industrialization so as to create large scale markets and advanced space systems and technologies, **for clean energy, drinking water, tele-education, tele-medicine, communications, resource management and science; and for undertaking planetary exploration mission.**
2. Implementing a **Global Partnership Mission in advanced space transportation, charged with the goal of reducing the cost of access to space by two orders of magnitude to US \$ 200 per kg. using identified core competencies, responsibilities and equitable funding by partners, encouraging innovation and new concepts through two parallel international teams**
3. **Developing and deploying in-orbit Space Satellite Service Stations for enhancing the life of spacecraft in GEO as a permanent international facility.**

“Interplanetary exploration is a necessity. Living people of the planet Earth have to pave the way for alternate abode for human beings.” – Abdul Kaman

[Editorial Comment: If you read carefully, you will have noticed several points that blow the Bush-Griffin Vision literally out of the water. ✓ Kalam presents a well-thought out plan for achieving drastic cuts in space transportation. In the VSE, all that is foreseen is deployment of a token, “visitable” Moon station which could be done with the minimally improved transportation hardware on NASA’s drawing boards. But Kalam sees wholesale industrialization of the Moon to provide clean energy to Earth and reverse environmental degradation. This is not going to happen without very large reductions in space transportation costs. Further evidence that we need NASA out of the Space Transportation business. ✓ He sees the need to open up the Martian Frontier so that all of humanity’s “eggs are not in one basket.” – **Kudos!**

We need to adopt this Vision! -- PK]

Mercury

Mercury Frontier Speculations for the fun of it !

by Peter Kokh

Climate Zones – dayspan temperature swings

Notice the cooler area surrounding the poles hugs the pole more closely on the side of Mercury that faces the Sun at perihelion, than the aphelion facing side. The idea of creating this climate zone graphic is to show in which areas it would be relatively easier or relatively harder to set up a manned presence.

Shade, Thermal Shielding, and Burrowing Down

Shade is one thing. Shade protects you from *further heating from the Sun above*. It does not protect you from the heat already accumulated in the ground below. To find lower temperatures, we'll have to do what we do on Earth, dig down. On Earth, and we think on the Moon, the temperature a couple of yards or meters down stays fairly even year around. That temperature level is higher the closer you are to the equator, and colder, the closer you are to the pole. Tap water is wonderfully cold in the northern states and Canada, but almost luke warm in the southern states.

As Mercury is much closer to the Sun, it receives an average of nearly seven times the solar influx per square meter as does Earth or the Moon. The subsurface ground temperature will vary with the climate zones we sketched at right. But the subsurface temperatures are likely to be quite high by our standards.

Obviously the light colored (graphic at right) polar zone would be the coolest area for a settlement. But, I, for one, am not confident that the subsurface temperatures will be low enough for even there. We need ground probes that can drill 10–20 meters (31–62 feet) down to be sure of that.

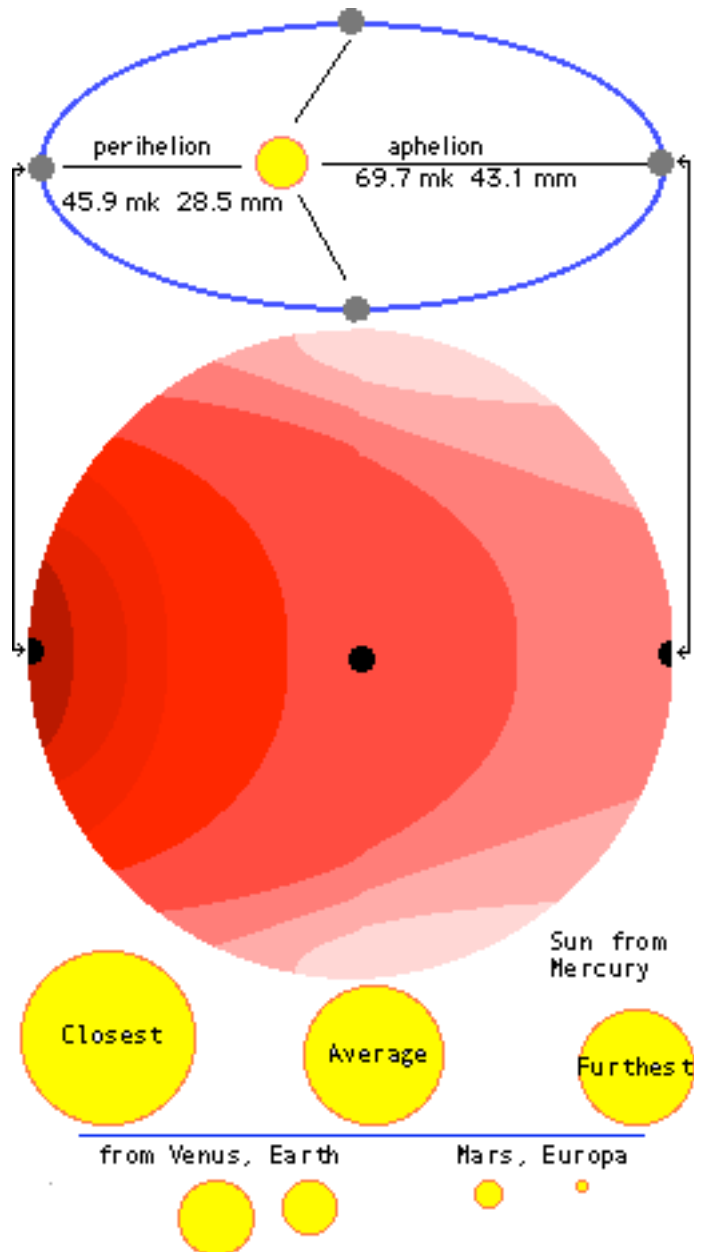
According to Bryce Johnson's research (see last month's article on Mercury), we'll have to burrow that far down (or tuck ourselves under a blanket of regolith that thick) to protect ourselves from Mercury's much greater solar flare flux than we are used to in Earth–Moon space. As to Cosmic Rays, their intensity will be the same everywhere we go within, *and without*, our solar system.

Obviously, the discovery of intact lavatubes will be of even greater significance for shelter than for the Moon or Mars. While the one side of Mercury that we have mapped on a quick swingby, shows no abundance of maria like features, there do appear to be some lava flows, and wherever there are lava sheets, there are likely to be lavatubes. If we find areas in which there have been more than one episode of lava flooding, there may be lavatubes intact in each layer. And the lower we go down the more protection we will find.

But there is a possible Catch-22. Here on Earth, in deep mine shafts, we find that the lower we go the hotter it gets and that the cool temperatures between 6 and a thousand feet down or so, are all the buffer zone we get. Below that zone, we start to feel the heat of the Earth below. That heat comes from billions of years of radioactive decay. Will we find a similar situation on Mercury. Maybe, maybe not. Read on, *page 4*

Mercury is not evenly hot all over

Mercury's rotation is sun-locked -- sort of. It does not always keep the same face to the Sun at all times, but in its very eccentric orbit, it revolves at a pace that allows it to present the same face towards the Sun when Mercury is closest to the Sun (Perihelion) and the opposite face is always turned towards the Sun when the planet is furthest from away in its orbit (aphelion.) The diagram sketches both Mercury's orbit and the resulting climate zones, hottest to coolest. Those of you who get MMM as Black & White hardcopy only, will not be able to see the climate zones. So we put this diagram online at: www.lunar-reclamation.org/images/mercury_zones.gif



Above you will see how much larger the Sun looks from Mercury at its closest approach to the Sun in comparison to its furthest recession. From Earth, the Sun looks much smaller, yet quite a bit larger than it does from Mars. By the time you get out to the great moons of Jupiter, The Sun still looks round, but now very much smaller. From Neptune and Pluto, it looks more like Venus looks in our sky, only, much, much brighter.

Mercury's Internal Heat

Compared to Earth, the first planet has a very large iron core, and an overall density similar to Earth's.

This core may not be molten or have a molten mantle above it. But it is bound to be hot, both from the residual heat of its contraction and formation and from radioactive decay.

The question is what is the temperature of the subsurface layer in which both solar heat and internal heat bottom out? Will there be a sweet cool layer that is thermally friendly?

It matters not how well endowed the planet is with resources that could support an industrial civilization if there is nowhere on the planet's surface or not too far below it, that we will find cool enough? What is cool enough? Human activity, especially in our current state of energy use, produces surplus heat. We will need a heat sink. We'd like to find a subsurface area that is well below freezing. Therein, just the heat of daily living will keep us as warm as we want to be.

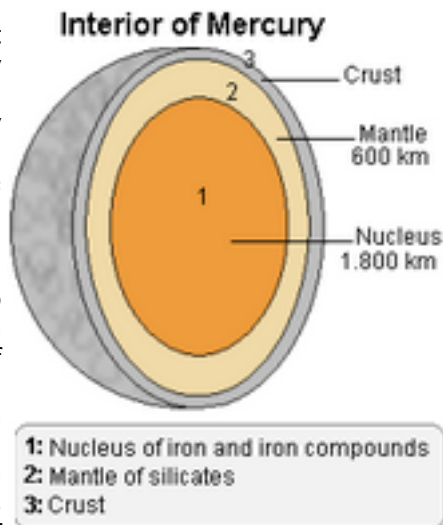
We can do our best to come up with an educated guess, but there is nothing so reassuring as actual readings, *meaning, we have to go there, and find out*, if not in person, then via our robots.

The Polar areas

If we confirm the existence of frozen water-rich volatiles in permashade craters near both the Moon's poles, we are likelier to find plenty in similar coldtraps on Mercury. Mercury, even though it is closer to the Sun, and therefore both warmer, and possibly a less frequent target of impacting comets, has an edge in that there is only a small fraction of a degree, ~ one arc minute, of tilt in Mercury's axis to the plane of its orbit. The Moon's tilt is about 1.5° - thus on the Moon, there are crater areas that are shaded most, but not all of the time.

The Goldstone 70-meter antenna transmitting and 26 antennas of the Very Large Array receiving, has provided evidence for the presence of polar ice in craters around the north pole of Mercury, in 1991, seven years before Lunar Prospector found evidence of polar ice deposits on the Moon. Some, confusing the usually poor odds of good luck, with nature's laws want to find any other explanation. But hydrogen is the most common element in the Universe, with oxygen third. No molecule is more likely to be abundant than water, H₂O. If Ockham's Razor is worth considering, water is easily the most elegant, the most simple, and the most natural explanation.

Evidently, Mercury's polar subsurface temperatures are cold enough, any internal planetary heat notwithstanding. That is good news! It means that if we dig down elsewhere, it will likely be cold enough there also.



Mercury's Lavatubes

On Earth, we find lavatubes wherever runny, not-so-viscous lava has flowed. We find them in shield volcanoes, with gentle profiles unlike Mt. Fuji or other classical cone volcanoes. Thus the Island of Hawaii, which in its entirety consists of that portion of the flanks of the twin volcanoes, Mauna Loa and Mauna Kea, above sea level, is honeycombed with lava tubes. Now we find shield volcanoes of gargantuan proportions on Mars, but none on the Moon that we have yet identified as such.

However, we find them on Earth and on the Moon in lava sheet flows. The first evidence was the many sinuous or winding rille valleys, which are now universally believed to be collapsed lavatubes of vast proportions. That lunar tubes are so much larger in scale than terrestrial ones, both in length and in cross section, suggests that in this case, size is in an inverse relationship with the host planet's gravity. The gravity on Mercury and Mars is two plus something times greater than that on the Moon and about three eighths that of Earth. So we might expect lavatubes on Mercury to be comparable to those on Mars, and somewhere in between in size, but still eminently usable as ready made shelter from the hazards of cosmic weather and thermal extremes.

Bryce Johnson reports several sinuous rilles in mare-like areas on Mercury. The total volume of uncollapsed lavatubes on Mercury is likely to be much smaller than that on Mars were such flows were immense, or on the Moon, both because lunar tubes are likely to be much larger in scale and because on the one hemisphere of Mercury that we have photographed, the extent of lava sheet flooding has been comparatively minor.

Any intact lavatubes on Mercury, could support settlements, industrial parks, warehousing, you name it. Those nearest the poles in the more thermally less extreme climate zones would have the edge. Unfortunately, the areas where conditions were right for lava sheet floods and the formation of lavatubes may not conveniently coincide with those sections on Mercury that have relatively cooler climates.

Around and around -- Keeping up with the terminator

That Mercury's dayspan-nightspace cycle is so long, 176 days or 6 months long, provides an advantage. On Earth, the terminator advances at over a thousand miles an hour at the equator and about 750 miles an hour at mid latitudes (mid 40's, north or south). On Mercury, at the equator, the sunrise and sunset terminators advance some 87 km = 54 mi *per day*, or just 3.6 kph = 2.2 mph. One can almost walk that fast, though probably not in a space suit. As you go further away from the equator towards either pole, that slow walk becomes a crawl.

Put it another way, the sun marches across the sky at just 2° a day, compared to 360° here on Earth.

The area just behind the sunrise terminator will likely be much more pleasant than the area just ahead of the sunset terminator. Ten days after sunrise, the Sun will be only 10° above the horizon at best, less, away from the equator. One could linger in an area for a week or more before moving on.

Imagine, if you will, a circumpolar railroad, that hugs the pole on the side of the planet facing the sun at perihelion, and dropping to lower latitudes on the side facing the Sun at aphelion, say along the interface between the coolest two zones in the graphic on pa. 3.

Now imagine six settlements along the track. One could move to the next settlement every 29.3 days, or if there were just five settlements, every 5 weeks.

The permanent part of each settlement would be living space, with the highly functional spaces on railway cars, along with the expensive mining and processing equipment. It would be a different way of life, but one more settled than that of terrestrial nomads. Consider how many persons now have two homes, one for winter months, another for summer months.

Each trackside settlement would have to be dug in, of course, just to be safe from radiation hazards. If actual time spent traveling from one location to the next was relatively trivial, say a day or two at most, the railroad track could be simply covered with a shielded shed all along its route.

Sound like too much of an adjustment? Consider the adjustment northern peoples have made since leaving Africa. Humans are amazingly adaptable, and quickly adjust to new surroundings and conditions, learning to be at home there, learning to love their new life style. In time, humans will spread wherever they can find away to support themselves long term.

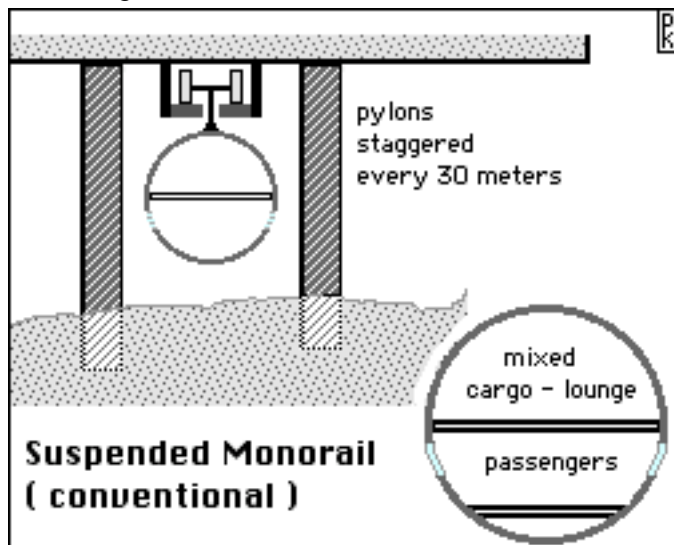
On the Moon, Mars, and Mercury, there is no real need to stick with narrow gauge tracks. Right of way is not a problem. We just need to make wider bridges, cuts, and tunnels. An average rail car could be two floors and double the width we are accustomed to having.

ON Mercury, solar power at nearly seven times the intensity at which sunlight is available on Earth, could power rail systems. Overhead monorails would fit in nicely with overhead shielded shed structures.

Of course, if we can find sufficiently abundant materials with which to make a circumpolar superconducting maglev line, that would work too.

All we have to do is survey the route, and if the terrain does not lend itself, make the necessary alterations. Now a monorail system under a shield shed all along the way, would simply adjust pylon length rather than smooth out the host right-of-way terrain.

North circumpolar or south? The overall ease of the terrain and the comparative wealth of resources along each route would be factors to consider. Just were the north and south magnetic poles are located might also be something to consider.



Mercury Trivia

- **The surface area of Mercury** is about one seventh that of Earth: ~28,000,000 sq. mi, ~73,000,000 sq km, or put in more familiar terms, about as large as North and South America and Africa together, and twice as extensive as the surface area of the Moon.
- **No intra-Mercurial planet** or asteroid has ever been found, false reports of one hastily christened Vulcan, notwithstanding.
- **Mercury's orbital eccentricity and inclination** of its orbit to the main plane of the Solar System (which should be that of Jupiter's orbit, not Earth's) are both much greater than for the other inner planets. Is this the relic of some major impact earlier in its history? The Caloris Basin, is the largest impact site we are aware of on Mercury, but we have only photographed one hemisphere.

Mercury Messenger Trivia

- This is a Discovery class mission
- To become the first spacecraft to orbit Mercury, Messenger must follow a path through the inner solar system, including one flyby of Earth, two flybys of Venus, and three flybys of Mercury
- Due to arrive in orbit about Mercury four years from now, March 18, 2011, Messenger is the first craft to orbit around the quicksilver planet
- These seven instruments are on board: Mercury Dual Imaging System (MDIS), Gamma-Ray and Neutron Spectrometer (GRNS), X-Ray Spectrometer (XRS), Magnetometer (MAG), Mercury Laser Altimeter (MLA), Mercury Atmospheric and Surface Composition Spectrometer (MASCs), Energetic Particle and Plasma Spectrometer (EPPS)
- Mercury Messenger is designed to answer six broad scientific questions:
 - Why is Mercury so dense?
 - What is Mercury's geologic history?
 - What is the structure and state of Mercury's core?
 - What is the nature of Mercury's magnetic field?
 - What unusual materials lie at Mercury's poles?
 - What volatiles are important at Mercury?
- official site: <http://messenger.jhuapl.edu/>

Brainstorming for fun and profit

Well, I don't know about profit, but the fun of this exercise is in looking for ways to extend a human presence on Mercury *beyond the poles*. We learned that not all of Mercury is uniformly hot, that there may be natural shelters in convenient places, in the form of lava tubes. We realized that the slow march of the Sun across the Mercurial sky opens up plausible semi-nomadic life-style options. By the time we get to go, we'll probably have found many more choices than these.

The "Manifesto" of "Moon Miners" is the brash assertion that *we can make ourselves at home* on other, seemingly alien worlds, *and end up thriving*. <MMM>

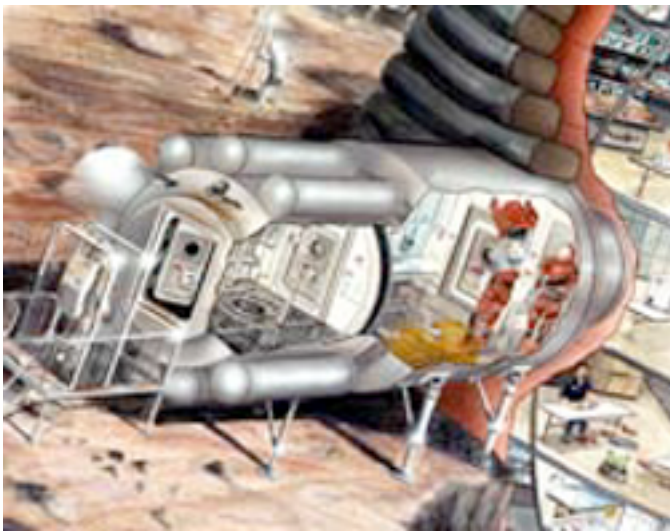
Who's Afraid of "Big Bad Moondust?"

by Peter Kokh

I've seen a good number of articles in the past year or so, to the effect that "the moondust problem" is so intractable that perhaps we should rethink our plans to return to the Moon. So what's new? There have always been people like that looking for excuses why others should not do what they are not interested in. And guess what, those of us who have wanted to something, supposedly too against the grain, have always, always found a way. So much for the Power Of Negative Thinking?

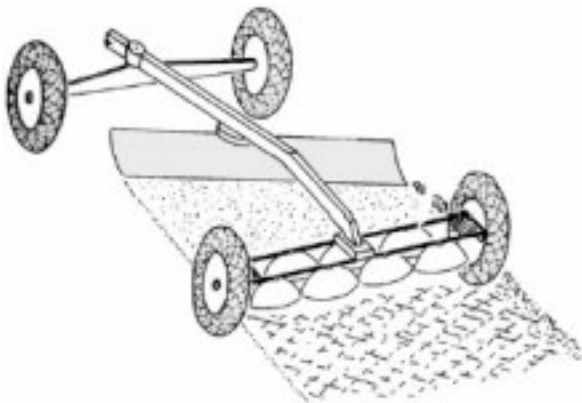
Of course the moondust has some troublesome qualities! But all the evidence from tens of millennia of human history shouts, "*so what?*" Yes, the dust tends to get in everywhere, potentially fouling engines, gears, bearings, and even human lungs. *Potentially!* But that will be so only if we don't rise to the occasion with customary ingenuity and Wasourcefulness. And, *of course*, that is just what has been happening.

NASA, of course, has thought much about this problem as well, and decades ago (yes, it's been that long since December, 1972) proposed a car-wash type space-suit cleaning antechamber to the conventional airlock. If we had to have one of these ultra-expensive modules for every airlock, that certainly would have put a serious damper on our future on the Moon. *We need toi look for a suite of simpler, less expensive, ore elegant solutions!*



The Lunar Moondust "Lawn Mower"

www.moondaily.com/reports/Lunar_Lawn_Mower.html



Larry Taylor, Distinguished Professor of Planetary Sciences at the University of Tennessee has an idea: Don't try to get rid of troublesome moondust -- *melt it into something useful!* The achilles heel of moondust as an opponent challenging our hopes to make a second home on the Moon is that a significant fraction of its powdery fines contain iron: making moondust amenable to control by magnetism. Taylor once put a small pile of lunar soil brought back by the Apollo astronauts into a microwave oven. And he found that it melted "lickety-split," he said, within 30 seconds at only 250 watts.

Taylor foresees application of this moondust taming technology for sintered rocket landing pads, roads, bricks for habitats, radiation shielding, even Arecibo-like mirrors in small craters -- useful moondust-fused products and dust abatement, all at once.

Moral of this story

A lesson I learned from my mother in my early teens is that *if you see something as a disadvantage and as an obstacle or even a show-stopper, evidently you are looking at it from the wrong perspective!* The key is not to ignore that negative aspect but to embrace it and turn it into the cornerstone of your plan. Reverse the tables!

There are many space advocates who are unfortunately easily discouraged by reports of obstacles: radiation from solar flares and cosmic rays and the mischievous behavior of fine moondust particles being two of the most frequently cited such "downers." We must tackle these head on, and, rather than ignoring or dismissing these facts and conditions, embrace them and keep looking at them from new angles until we see them as the anchors of a plan to succeed in our efforts to make ourselves truly at home on the Moon and in space.

Attitude is everything, and temperament can either be the real problem, or the real solution.

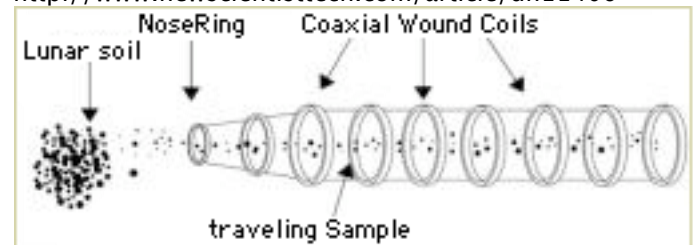
Relevant Online Articles

Magnets Might Foil Moondust – Apr 07, 2006

www.moondaily.com/reports/Magnets_Might_Foil_Moondust.html

Magnetic 'elephant trunk' sucks up lunar soil

<http://www.newscientisttech.com/article/dn11406>



The humor Dept: *If you can't beat 'em, join 'em*

Texans know what to do with a dusty car window!



<MMM>

[Call for Papers]

Machine Learning in Space: Extending Our Reach

Special Issue of the *Machine Learning Journal*

Amy McGovern* and Kiri L. Wagstaff, guest editors
<http://www.wkiri.com/ml4space>

Submission deadline: July 1, 2007

Remote space environments simultaneously present significant challenges to the machine learning community and enormous opportunities for advancement. Enhancing spacecraft autonomy with machine learning has the potential to permit new discoveries that pre-scripted activities would preclude.

On-board machine learning could enable intelligent filtering or prioritizing of data as it is collected to make the best use of the available bandwidth. Rovers with learning capabilities could more thoroughly and more quickly explore new environments, relating them to previously observed areas and highlighting novel or unexpected observations.

While some initial tests have been made in this direction, the increasing computational power now available on spacecraft has broadened the field of what could feasibly be done on-board. Ultimately, machine learning can help these spacecraft graduate from their current status as "science prosthetics" into "science assistants"

The purpose of this special issue is to collect recent advances in machine learning for remote space or planetary environments and to identify novel space applications where machine learning could significantly increase capabilities, robustness, and/or efficiency.

Key topics of interest include:

- How to perform machine learning in a high-risk, remote environment
- Learning with resource constraints (memory, computation, etc.)
- Multi-instrument machine learning
- Multi-mission machine learning
- Novel applications and uses of machine learning in space
- How to evaluate and validate machine learning methods prior to deployment on-board a spacecraft
- Methods for safe real-time learning
- Methods that trade off exploration and exploitation, given mission science goals and safety/reliability requirements
- Methods for reducing risk and increasing acceptance of machine learning in space flight missions
- A survey of space-borne machine learning accomplishments

We encourage all prospective authors to email us with a brief summary of the paper concept for feedback, especially for survey papers or papers focused on applications

Submissions are expected to represent high-quality, significant contributions in the area of machine learning algorithms and/or applications. Authors should follow standard formatting guidelines for Machine Learning manuscripts

Administrative notes:

- Authors retain the copyrights to their papers. (See publication agreement on the MLJ website: <http://pages.stern.nyu.edu/~fprovost/MLJ/>.)
- Submissions and reviewing will be handled electronically using standard procedures for Machine Learning (<http://mach.edmgr.com>)
- Authors must register with the system before they can submit their manuscripts
- Authors must select the appropriate Article Type -- Machine Learning in Space -- when submitting their manuscripts
- Accepted papers will be published electronically and citable immediately (before the print version appears)

Schedule

- Submission Deadline: July 1, 2007
- Send Papers to Reviewers July 15, 2007
- Reviews Due Back to Editors: September 1, 2007
- Decisions Announced: September 15, 2007
- Camera-Ready Due: October 31, 2007
- Print Publication: Early 2008

* **Dr. Amy McGovern** is a long time member of Artemis Society International and of the Moon Society. She is currently Assistant Professor, School of Computer Science, and Adjunct Assistant Professor, School of Meteorology, and Director of the Idea Lab at the University of Oklahoma. <http://www.cs.ou.edu/~amy/>

Domestic Bulk Mail,
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or The Lunar Reclamation Society)
IF your copy of MMM is late,

Please wait a week before hitting the panic button. Bulk Mail is not handled like first class, but is delivered on a schedule at your carrier's discretion.

"When you are inspired by some great purpose, some extraordinary project, all your thoughts break their bounds. Your mind transcends limitations, your consciousness expands in every direction, and you find yourself in a new, great and wonderful world. Dormant forces, faculties and talents come alive, and you discover yourself to be a greater person by far than you ever dreamt yourself to be."

Maharishi Patanjali, India, c. 500 BC

The Moon Society



JOURNAL

<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!

The Moon Society's big Gamble: Going to Dallas with Enthusiasm

from President Peter Kokh

Going for broke

Not since the 1998 ISDC in Milwaukee when, as chair, I gave the Artemis Society a whole track – its own room to do with as it liked, have we (Moon Society members began as Artemis Society members prior to August, 2,000) had a bigger presence than the one we are preparing for Dallas. I had been asked to chair the Cislunar & Moon Track, with our Director of Project Management, Dave Dunlop, assisting.

Moon Society Speakers

Presentations by Moon Society speakers include myself (2), Dave Dunlop (1) plus (1) that we will present together, Ken Murphy (1), Jonathan Goff (1), and Michael Bakk (1) (total 7) plus a couple of panel sessions.

Our Exhibit table will highlight:

- ✓ our lunar analog activity
- ✓ our spin off websites:
www.Lunarpedia.org
www.Exodictionary.org
and more
- ✓ Moon Miners' Manifesto
- ✓ our new *Flagship Project*:

The University of Luna Project (following pp.)

Our hospitality Suite

At hours to be advertised daily, this room will be open to the members, friends and the curious. We will have refreshments, posters, flyers, and Moon Society people on hand to answer questions, brainstorm together, etc.

We had hoped to have a Moon Society Town Meeting, but a) there is no space available that we know of (unless there is a canceled track item) and no ideal time. So we will just have to do that kind of activity in our suite on an open schedule.

ISDC Registration Packets

This will be put together at the hotel by an advance local crew, the Sunday before the conference. So we are hustling to make things available on time. We hope to email pdf files of several flyers to the MMM printer in Florida who will then ship them directly to the hotel, c/o ISDC.

There are a couple of other things up our sleeve but that is a closely guarded secret, and no one will know about it, except me until they happen. Yes, conspiracy is fun, but not spoiling the surprise is the real motivation.

We hope to see as many members as possible there. Do come to our suite. Dave and I will be easy to pick out as will any Moon Society officers and directors, for whom we will have special badges ready. Just walk up to any of us and introduce yourselves. We all put on our pants one leg at a time!

Why this year?

Well, to tell the truth, it was a no brainer. One of our members, Ken Murphy, is co-chair. Dallas is an easy place to get to by air. And the time is ripe. We very much need to grow our numbers. We are introducing a suite of very ambitious new projects and we need member support for them. It is easier to piggyback on ISDC than host our own event. Finally, and I trust you will agree, it's about high time we did something special like this!<MSJ>

Grand Unveiling at ISDC 2007



www.U-LunaProject.org

The Story Behind the Story

More than a year ago, my long time friend, and companion in mischief-making brainstorming, David A. Dunlop of Green Bay, Wisconsin, came to me and said, "Peter, I am retired now. What can I do for you to help you with the Moon Society that will use my organizing and managerial skills, and for which you simply do not have time? Wow! Many people live their lifetimes without an offer like that.

Dave and I met on July 25, 1989 at a Planetarium in Neenah, Wisconsin, which happened to be the only place in reach of either of us that was prepared for a live feed from JPL of the data coming in as Voyager II first made its closest approach to Neptune, then a few hours later, in the wee hours of the local morning, as it passed by Triton, Neptune's largest moon, size wise, a twin of Pluto. I had brought along several exhibits of a Milwaukee chapter brainstorming project, designing a lunar settlement for from 1-5,000 people, and Dave was hooked.

Green Bay is 130 miles north of Milwaukee, but we found many occasions to work together. It was on the way home from the 1993 ISDC in Huntsville. AL that we brainstormed the plan for an ISDC in Milwaukee.

Dave was the brains behind the LUNAX effort, LUNar National Agricultural eXperiment Corporation to interest high school science teachers in having their students do basic agricultural experiments aimed at finding optimum schedules for plant lighting during the 2 week long lunar nightspan. He also put together the Rockets for Schools program in Sheboygan, now in its 11th year.

Well, yes, I did need help. First I asked Dave to help me with the Moon Track at Dallas. Then I showed him all that I had written about The University of Luna Project, starting way back in 1991. I had the idea, but not the ability to pull it off, to make it real. I had even chaired a workshop on the topic at ISDC 1998. About two dozen people came, but none of them prepared to help me make it real. So there it languished, a good idea, with no one capable of getting it beyond that idea stage.

Dave set out in February on a long 7,000 mile road trip visiting key institutions and key personnel all involved with the return to the Moon effort. He was encouraged by what he saw, especially all the activity going on in the academic and private industry areas. And, in running our project idea past potential colleagues, found a great interest: our project seemed to be the right idea at just the right time. In this process, Dave made the project truly his own and greatly developed and fleshed out my seminal concepts of how this project would work, and what all it might involve.

So just what is The University of Luna Project?

Introduction

There will be no Earth-Moon Economy, no Lunar Frontier, and no University of Luna on the Moon someday, if we do not learn more about the Moon now, its resources, potential and challenges, *and predevelop now* the key technologies to progress from an outpost to enterprise-based frontier.

To address these needs, we have created The University of Luna Project.

✓ Our **Vision**: Growth and development of an Earth/Moon economy with genuine civilian lunar settlements

✓ Our **Mission**: Encourage the research and development of technologies needed to create an Earth Moon Economy that uses lunar and space based resources to address the critical energy and environmental problems of the Earth.

The University of Luna Project is designed as a many-faceted "engine" that will help keep all our various efforts on track towards achievement of our vision

The ULP will help guide efforts already begun such as:

- **www.Lunarpedia.org** online open-source encyclopedia of knowledge about the Moon and its potential
- **Lunar Analog Research** activities
- **Any other projects** and spin-off endeavors launched by the Moon Society and/or Moon Society members
- **The ULP is thus a master plan** and guideline that will energize and keep on track all other Society efforts

How will it work?

We begin with these tools in our toolbox:

- **Lunarpedia.org** – An open-source online Moon-focused Encyclopedia launched in January 2007
- **Data Mining Project** – gaining fresh knowledge about the moon from data of lunar missions already flown, whether by analyzing data not yet processed or by application of new software tools of data analysis
- **"Spin-up" Enterprises** – doing the R&D *now* for technologies needed on the Moon, *for the sake of profitable terrestrial applications*, thus putting these technologies "on the shelf," with the R&D bill paid for by consumers (rather than a much later crash program bill paid for by taxpayers.) – engaging entrepreneurs
- **Listing Masters & Doctoral Theses Topics** picked to address specific research holes – *engage students*
- **Targeted College Engineering & Design Contests & Competitions** – *engage students*
- **Research-focused Curricula** – *engage students*
- **Envelope Pushing Workshops**
- **Involving Universities, Corporations, Enterprise**
- **Lunar Analog Research Station Activities** – such facilities can serve as testing grounds for the various technologies under development, thus becoming integrally involved in the University of Luna Project.



University of Luna Project Partners

While this project has been developed by leaders of the Moon Society, specifically by President Peter Kokh and Director of Project Development David A. Dunlop, for it to become real, we need to bring aboard the widest possible family of cosponsors and research partners.

The ULP begins as a Moon Society Initiative, *but*

- It will be separately incorporated
- It will function with full autonomy, with its own Board of Directors, Officers, and Advisors
- It will have its own budget and financing
- It will invite all space advocacy organizations to cosponsor its efforts – *NSS is already aboard*
- It will seek academic, corporate, and entrepreneurial sponsors
- It will operate on an international level from the outset

Co-Sponsors:

The Executive Committee of the **National Space Society** has already reviewed our project proposal and will announce its cosponsorship at the upcoming International Space Development Conference in Dallas, TX, May 24–28, 2007. We will be approaching the leaders of other space advocacy organizations as well. We see this as an effort that will advance the goals of all of us, however they differ in particular focus.

Corporate Sponsors:

Research & Development of the very wide set of technologies that we foresee as needed will involve many corporations, industries, and enterprises. We expect to be able to list many of them as supporters and sponsors.

Academic Sponsors:

A primary thrust of The University of Luna Project is to engage students, who will be the future leaders of humanity's push into space. Much of this research will be done in universities scattered across the globe. We hope to be able to list many universities and university departments as supporters of the Project.

National/International Space Agencies:

The output of The University of Luna Project will help advance the Moon & Cislunar-focused efforts of many national Space Agencies around the globe. We hope to find support and collaboration with NASA (USA), ESA (Europe), JAXA (Japan), ISRO (India) and other national space agencies. Our work is an effort to assist both Private Enterprise and National Space Agency lunar initiatives. *The University of Luna Project will be an international one.*

We are planning to involve organizations, institutions, universities, students, corporations and entrepreneurs in Canada, Mexico, India, Europe, and Japan for starters, and eventually wherever we can find support.

Dirty Energy Generation and Global Environmental Degradation are Life-as-we-have-known-it threatening problems – without borders.

Developing an Earth-Moon Economy is hence an equally global priority.

The University of Luna Project will be a Global Effort

Universities have Departments

The University of Luna Project is not a University. It is a project of university-scope. And someday, our hope is that its efforts and achievements will lead to the creation of a real University in some future Luna City.

Nonetheless, it might help to list some of the research initiatives we foresee according to “departments.” After all, much of this research will be done in specific university departments (as well as in industry laboratories, etc.) So here is a “tip of the iceberg” outline of some of the research areas that need addressing.

SELENOLOGY DEPT

- “Economic Geography” of Lunar Resources
- Identification of logical Transportation Corridors
- Ground Truth landers & rovers
- Data Mining Projects (missions already flown)
- Feature and Place Name Registry
- Areas of Geological, Scenic, Historical value

ENERGY DEPT

- Helium 3 extraction, handling, shipping
- Lunar Solar Power Systems
- Power Storage System
- Dayspan/Nightspace Operations
- Recycling of embodied energy
- Energy efficiency research
- Industrial parks organized into thermal cascades
- Lunar sourceable fuels for generators, vehicles
- Mass driver systems for bulk exports
- Mass catcher systems for bulk imports

ASTRONOMY DEPT

- Farside radio astronomy
- Optical astronomy installations
- Amateur Telescopes for Lunan pioneers

LUNAR TECHNOLOGY DEPT

- Mining & Processing Technologies
- Lunar-deficient elements – alternative sources
- Lunar Satellite systems
- Water-conserving Manufacturing
- Dust control systems
- Lunar-Appropriate Industrial Design
- Disassembly-friendly assembly to enable proper recycling

MATERIALS RESEARCH DEPT

- Concrete, ceramics, cast basalt
- Glass, glass fiber, glass composites
- Ceramics options
- Metal alloys

ARCHITECTURE

- Modular architecture system
- Surface structure architecture
- Shielding systems and Flare sheds
- Warehouse systems
- Construction systems that minimize EVA
- Low gravity Stair / ladder design

BIOSPHERE & AGRICULTURE

Lunar Biospherics Research

- Modular biospherics to enable in step growth
- Graywater and blackwater systems
- Environmental protection protocols

BIOSPHERE & AGRICULTURE cont.

Agriculture & Food Processing

- Development of new hybrids
- Biological Diversification project
- Wild Areas project
- Food processing
- Biomass waste recycling
- Fiber production
- Pharmaceutical production
- Climate options

ARTS DEPARTMENT

- Made-on-Luna art media
- Made-on-Luna musical instruments
- Lunar performing arts forms

TRANSPORTATION DEPT

- Vehicles for pressurized roadways
- Design surface highways and various vehicles
- Design self-help roadway service stations, etc.
- Lunar railway & cableway systems
- Human-powered cycles for 1/6th G
- Suborbital transports and runways

SPORTS & RECREATION DEPT

- Sports designed for lunar 1/6 th G
- Dance forms for 1/6 th G
- Exposed surface recreation and sporting activities

FRONTIER MEDICINE / HEALTH

- Compact full-function hospitals
- Frontier first aid kits and systems
- Research in LEO facilities with 1/6th for early cues to physiological & other health problems
- Nutritional diets for 1/6th gravity

HUMAN RESOURCES DEPT

- Production-support roles for seniors, youth, etc.
- Tasks to outsource to teleoperators on Earth to free others for export/domestic production needs.
- Tasks for the antisocial element

POLITICAL SCIENCE DEPT

- Determine criteria for phasing in home rule
- Earth Political, Economic, Cultural, Relations

As we indicated, this list will prove to be just the tip of the proverbial iceberg.

So much needs to be done, and it is most efficiently and inexpensively done in advance, motivated by profitable terrestrial applications now – as opposed to expensive government crash programs

A word about our website: www.U-LunaProject.org

As of this writing, going into ISDC 2007, this domain directs you to a temporary website, very much under construction. The temporary location is a Moon Society website directory /university/ i.e.

<http://www.moonsociety.org/university>

In the very near future, it will move to another server, and be run on Joomla software rather than WSD. We see the site growing enormously, with various sections maintained by those getting involved.

So stay tuned! The U-LunaProject.org address will remain valid. We deeply appreciate offers to help with the website as it grows!

More, next month: "The Friends of ULP" <ULP>

Introducing our new email newsletter



Moon Society Frontlines

Want to sign up? *Simply go to:*

<http://list-manage.com/subscribe.phtml?id=0006e65d5b>

Chapters & Outposts

Bay Area Moon Society

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

Meeting 4th Thurs. monthly at Henry Cates' in San Jose

Contact: Henry Cates <hcate2@pacbell.net>

Henry has put together a Carnival Blog about space for targeted at the growing number of homeschooled children who might not otherwise be exposed to space topics. Check this out at:

<http://whyhomeschool.blogspot.com/2007/04/announcing-carnival-of-space.html>

Moon Society St. Louis

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

Meeting the 3rd Wed. monthly at Buder Branch Library
4401 S. Hampton, in the basement conference room

Contact: Keith Wetzel <kawetzel@swbell.net>

ShowMeCon 5 (2007) – Saturday, April 21st, Keith Wetzel, Rufus Anderson, Dave Heck, and Bob Perry manned our "fan table" and conducted the "hard science" block of presentations and panels at this combined science fiction and anime convention.

MSStL Secretary **David Heck** is planning on going to the ISDC in Dallas, TX over the Memorial Day Weekend.

Visitors: Moon Society President Peter Kokh, and Director of Project Development, Dave Dunlop, will be in St. Louis, en route to the ISDC in Dallas, on the morning of May 23 and hope to meet with those MSStL members who are free, when they visit researchers at Washington University in St. Louis before continuing their journey. This will be Kokh's third visit to the St. Louis chapter since it formed.

Moon Society Phoenix Outpost Blog

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

Contact: Craig Porter <portercd@msn.com>

We invite everyone to attend SpaceFest 2007. August 17-19th in Greater Phoenix, at the Mesa Convention Center. For more information, check out:

<http://www.novaspace.com/Spacefest/>

GREAT BROWSING !

International skepticism about Asteroid Threat

<http://www.thespacereview.com/article/815/1>

Doubts about Energiya's bold plans

<http://www.thespacereview.com/article/824/1>

The Search for Life on Mars and Europa

<http://www.thespacereview.com/article/827/1>

The Space Debris Crisis Exacerbated by China

<http://www.thespacereview.com/article/825/1>

The Three "Ds" of Planetary Defense

<http://www.thespacereview.com/article/835/1>

Why the Moon? Ensuring Human Survival!

<http://www.thespacereview.com/article/832/1>

Soviet Plans for 1970 Manned Lunar Lander?

http://www.deepcold.com/deepcold/lk_main.html

"Software eyeglasses" nearly doubles resolution of Lunar Prospector Thorium maps

www.astronomy.com/asy/default.aspx?c=a&id=5357

NASA tests Inflatable Moon Habitat structures

<http://bcast1.imaginnov.com/t?r=2&ctl=D442:4A48D>

Update on the puzzling Pioneer Anomaly

http://planetary.org/programs/projects/pioneer_anomaly/update_20070328.html

Lunar & Planetary Conference News: Saturn, Mars

http://planetary.org/news/2007/0312_Reports_from_the_2007_Lunar_and.html

Human Space Exploration: Next 50 Years - M. Griffin

http://aviationweek.typepad.com/space/2007/03/human_space_exp.html

Business & Legal Issues Critical to Space Industry

<http://www.thespacereview.com/article/840/1>

Off-Earth Settlements: Utopias or Dystopias?

<http://www.thespacereview.com/article/839/1>

Orbital Mechanics: Few Asteroids easily reached

<http://www.thespacereview.com/article/838/1>

Lunar Lander Challenge Prize Competitors

<http://www.thespacereview.com/article/844/1>

Why do we want to go to the Moon?

Why spend money going to the Moon when there are urgent needs here on Earth?

What will a large-scale lunar settlement look like?

How much will it cost to visit the Moon?

www.space-frontier.org/Projects/Moon/faqs.html

Objective: To establish a large scale, economically viable, permanent human settlement on the Moon within the next 25 years

<http://www.space-frontier.org/Projects/Moon/>

The puzzle of Venus' turbulent atmosphere

www.astronomy.com/asy/default.aspx?c=a&id=5394

The mysterious double asteroid Antiope

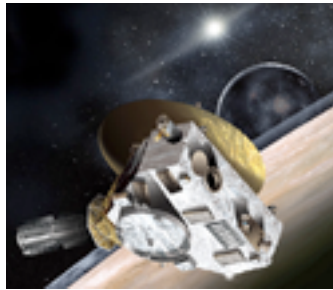
www.astronomy.com/asy/default.aspx?c=a&id=5375

One look at Lunar Colonization

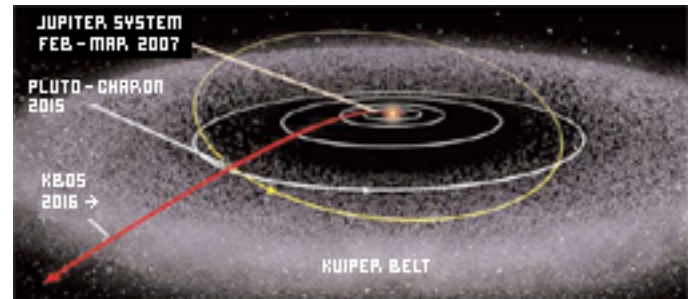
www.answers.com/topic/colonization-of-the-moon

New Horizons craft Photo-ops Europa enroute to Pluto

http://dsc.discovery.com/news/2007/02/27/plutoprobe_spa.html?category=space&guid=20070227103030n



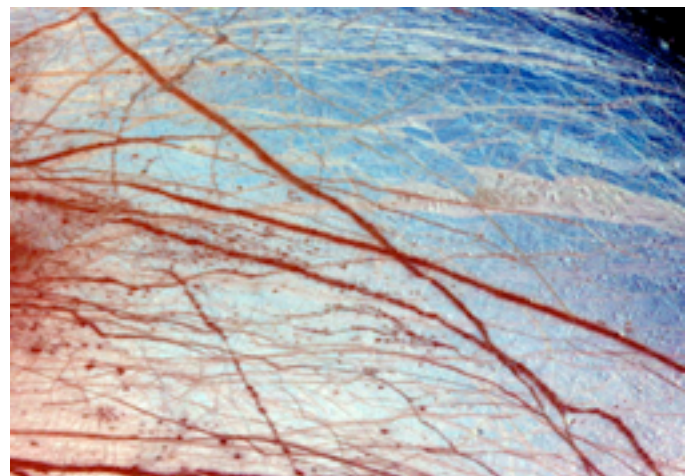
To get to Pluto as fast as possible, New Horizons had to make a close flyby of Jupiter in order to steal extra momentum. It is some 18 years after Pluto's closest approach to the Sun, and this mysterious world is quickly receding. Its atmosphere will soon freeze out as a mix of methane snow and other frozen hydrocarbon gases. Pluto, with its three moons Charon, Hydra and Nix won't be this close until well into the 23rd century.



Thanks to this urgency, then, we had the first chance since the Galileo mission to visit Jupiter and its moons, including the fascinating ice-crust ocean world, Europa. The New Horizons Jupiter encounter was thus an active "mission enroute to a mission" covering the dates February 24 to March 5th.

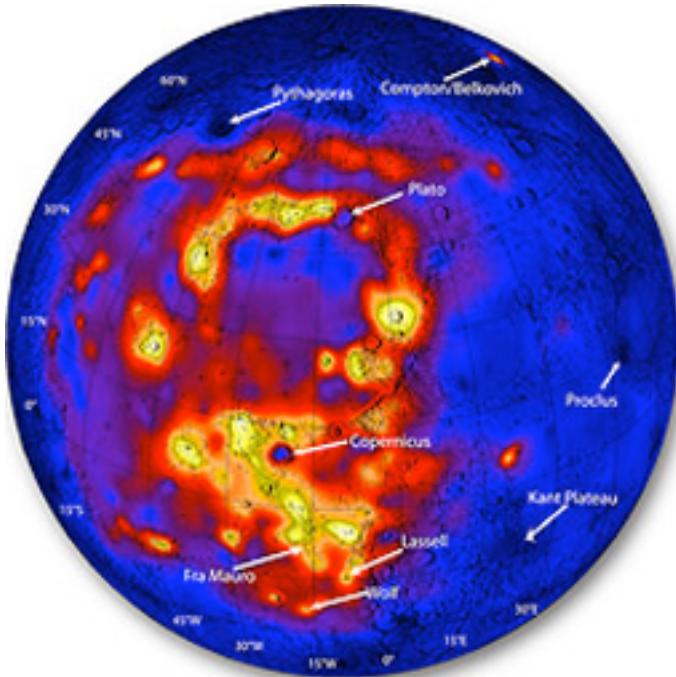
New Horizons' closest approach to Europa came on February 28th, at 2,967,838 km; 1,843,146 mi. The face of Europa presented to New Horizons was a 69.5° crescent. The ALICE Uv Spectrometer studied the tenuous European atmosphere, while the LEISA high resolution mapper snapped Europa's portrait at a resolution of 15 km per pixel, with Europa's disk presenting an image 210 pixels across at the time.

Below: *Not From New Horizons*, a NASA-AMES False Color Image of Minos Linea Region on Europa. "Triple bands, lineae and mottled terrains appear in brown and reddish hues, indicating the presence of contaminants in the ice."



MMM PHOTO GALLERY

Thorium Distribution on Moon's Nearside



New processing of Lunar Prospector data gives scientists a better look at the Moon's thorium, which exists almost exclusively on the Earth-facing side. Lighter colors = higher thorium levels. Thorium lows mark Copernicus and Pythagoras craters, which are punched into the Moon's feldspar-rich crust. Lawrence et al. 2007/GRL [URL page 13, Col. A.] Thorium can be processed into fissionable U-233, a future lunar nuclear fuels industry.

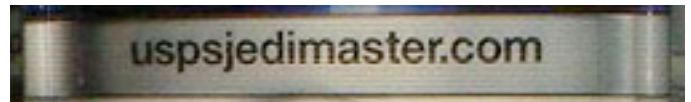


New-found methane/ethane lake (L) near Titan's north pole covers more area than our Lake Superior (R)



New US Postal Service "R2D2" mailboxes

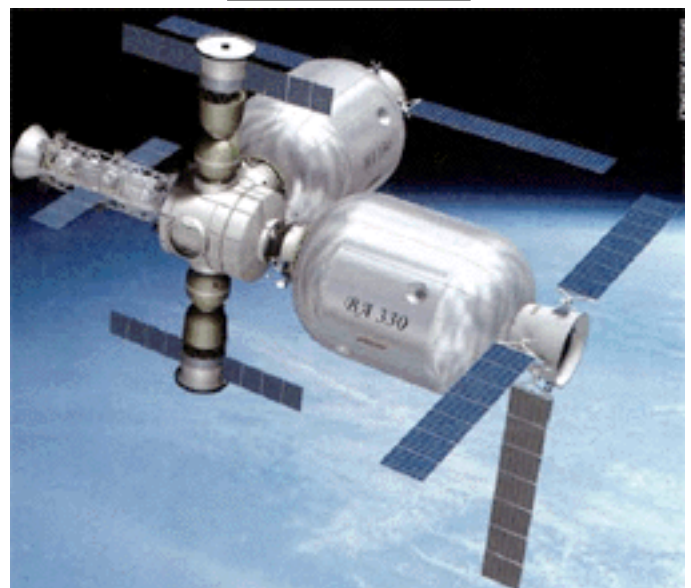
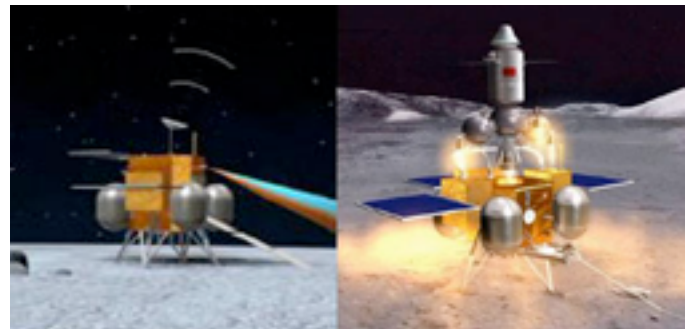
on the side of those R2D2 Mailboxes



NASA tests inflatable Moon Habitat



China's planned Lunar Sample Return Setup



Early Bigelow Aerospace Station serviced by Russian Soyuz or Chinese Shenzhou spacecraft

Is "Transpermia" Real?

Can microbes transfer from planet to planet? The Planetary Society wants to find out.

[from a Planetary Society e-letter, April 16, 2007]

Background: A possible mechanism for transfer of life between planets is via rocks ejected by major asteroid or comet impacts. The term "transpermia" was coined by Oliver Morton to describe the transfer of lifeforms by this method and to distinguish it from the more general concept of panspermia. -

<http://users.tpg.com.au/users/tps-seti/transpermia.html>

From Louis Friedman, TPS Executive Director [excerpts]

With the Planetary Society's preliminary approval to develop an experiment to "piggy-back" on the Russian 2009 sample return mission to Phobos, [**Phobos-Grunt**] we now have the perfect opportunity to conduct a transpermia experiment. This has never been done on an interplanetary flight before.

[<http://en.wikipedia.org/wiki/Phobos-Grunt>]

The Planetary Society needs help funding for:

- Develop the experiment design and science plan, including the selection of the microbes to be tested
- Build and test the container that will carry the microbes (simulating the meteoroid environment), including engineering models and flight hardware
- Develop a planetary protection strategy, to minimize the possibility of any kind of contamination
- Integrate our container into the Russian spacecraft with no interference to other mission objectives

Relevant Considerations

The LIFE experiment (Living Interplanetary Flight Experiment) will send ten different types of microorganisms and a natural soil colony from Earth on three year journey into deep space and back to Earth. The experiment will travel on board Phobos-Grunt - a Russian sample return mission to the Martian moon Phobos, scheduled to launch in 2009. The goal of the experiment is to test whether microbes can survive the harsh conditions of space for an extensive period of time.

The LIFE experiment will shed light on the transpermia hypothesis - the possibility that simple life forms are transported between worlds on board space rocks that are blasted from one planet and land on another. For the hypothesis to be credible some organisms must be hardy enough to survive in space long enough to make it from one planet to another. For example, could microbes survive the journey from Mars to Earth? We don't know. By sending microbes on a prolonged space Odyssey in what is, in effect a simulated space rock, the LIFE experiment is testing whether such a journey is possible - for some microorganisms at least.

Some scientists believe that transpermia played a crucial role in the emergence of life on Earth. By shedding light on transpermia and whether it is feasible, scientists will move one small step closer to understanding our own origins.

We are conducting the experiment in collaboration with the Space Research Institute and the Institute of Microbiology of the Russian Academy of Sciences. Currently, the experiment is under formal consideration by

NPO Lavochkin, the engineering organization building the spacecraft, for inclusion on the Russian Phobos-Grunt [Russian for Soil] sample return mission.

This is the only scheduled mission that will return to Earth from deep space, a rare opportunity for a return trip to interplanetary space for about 34 months. We are hoping to fly a similar experiment on other missions.

Earth's magnetosphere, the area of influence of its magnetic field, protects near-Earth spacecraft (and any life that would be flying upon them) from the harsh radiation of space. Sending biological samples through deep space is therefore a much better test of interplanetary survivability than sending the samples on a typical Earth-orbiting flight.

Apollo 16 and 17 carried with them into Lunar orbit European experiments named Biostak 1 and Biostak 2, containing living organisms. They flew well outside the Earth's magnetosphere, but only for short periods of 11 and 12 days. Numerous other experiments have sent microorganisms into Earth orbit for longer periods of time, but well within the Earth's magnetic field. LIFE is the first experiment to send microbes for a prolonged stay in space, well outside the Earth's protective magnetosphere.

In order to have as little impact upon the Phobos sample return mission as possible, and to fit within the sample return capsule, the outer envelope will be 56 mm in diameter with a maximum thickness of 18 mm. Mass will be 100 grams or less for the entire bio-module. The current design is a short cylinder, looking much like a hockey puck, but smaller.

The exact organisms to be included are still under analysis. However, they will include microbes that have been flown in near-Earth space on short missions, microbes that have been studied extensively, microbes that are resistant to environmental factors such as radiation, well-studied plant seeds, and a "natural" soil colony of microbes. None of the microbes will be dangerous to humans. We plan to fly representatives of all three domains of life: bacteria, eukaryota and archaea. We anticipate flying 10 individual organisms in 30 self-contained samples, i.e., each will be flown in triplicate for better science results. In addition, one or more natural native soil samples will be flown in their own self contained capsule.

Could this experiment contaminate Mars with life, confusing future searches for life on Mars? This is very unlikely, but we will fully comply with the COSPAR (Committee on Space Research, International Council for Science) planetary protection guidelines to prevent the contamination of Mars by introducing terrestrial life onto Mars' surface. Initial results of our analysis indicate that we will exceed COSPAR planetary protection standards by a wide margin. If at any point we find that contamination risks of the LIFE experiment exceed safety guidelines we will redesign the experiment until it is acceptable. <TPS>

Factinos:

- About 1 Martian meteorite is thought to hit Earth every month.
- About a billion tons of Martian rocks are thought to have landed on Earth since the solar system formed.
- About 30 Martian meteorites have been identified on Earth.

1000 Days at Sea “out of sight of land” The MARS OCEAN ODYSSEY

An effort to spend the same amount of time that a round trip to Mars would take, without setting touch on Terra Firma, staying at sea.

[from <http://www.1000days.net>]

Photo Index: <http://www.1000days.net/images/photos/>

On Saturday, April 21, 2007 at 3 PM, Captain Reid Stowe and mate Soanya Ahmad departed the mouth of the Hudson River at New York City on the 70 ft. Schooner Anne to sail the oceans of the world out of sight of land without re-supply for 1,000 days.



Imagine having everything two people could need to survive for three years packed into the space of a bedroom. They have it all onboard. Reid Stowe designed and built the Schooner Anne as the ultimate long distance sailboat and has proven her in Antarctica, around Cape Horn and on other voyages for hundreds of days at a time. Because of the similar length of time as a Mars mission and human factor issues, Reid has promoted the voyage as a space analogous expedition "Seafarers of today provide a role model for spacefarers of tomorrow." Should Reid and Soanya succeed, they will have departed the touch of the terra firma longer than any human has before.

You can follow their course, see photos and read other stories from the longest voyage in history on www.1000days.net, to be updated regularly. Website visitors can also support the effort with purchases of apparel and other items. ###

Europe's Venus Express



One year at Venus, and going strong

http://www.esa.int/esaSC/SEM26GLJC0F_index_0.html

Most of us planetary enthusiasts want to know more about the surface – we are surface-chauvinists after all, even those of us who want to live in fixed size fake zoo-type scenary space settlements.

Well If Venus Express finds anything to scratches our surface interests, it will be serendipitous. This cloned probe is designed to answer the many misteries of Venus' atmosphere. Nonetheless, we had best pay attention to its findings, because conditions at the surface are equally rooted in the atmosphere above and in the tectonic engine below.

A virtual twin of the highly successful Mars Express, the probes findings about a subject many may consider boring, are quite interesting.

[from the site referenced above]

Venus' stormy atmosphere

"Using state-of-the-art instrumentation, Venus Express is approaching the study of Venus on a global scale. The space probe is collecting information about Venus' noxious and restless atmosphere (including its clouds and high-speed winds, as seen from this video obtained with the VMC camera on board) and its interaction with the solar wind and the interplanetary environment. Last but not least, it is looking for signs of surface activity, such as active volcanism. [snip]

"The first ever, terrific global views of the double-eyed vortex at Venus' south pole, the first sets of 3D data about the structure and the dynamics of the sulphuric-acid clouds surrounding Venus in a thick curtain, temperature maps of the surface and the atmosphere at different altitudes, are only a few of the results obtained so far."

The night-glowing 'lantern' of Venus

"New infrared data is now available about Venus' oxygen airglow – a phenomenon detectable on the night-side that makes the planet glow like a 'space lantern'. [Editor: Would this effect provide steady light for navigation on the surface at night?]

"The oxygen airglow was first discovered thanks to ground observations, and also observed by other missions to Venus such as the Russian Venera spacecraft and the US Pioneer Venus orbiter," said Pierre Drossart, co-Principal Investigator on Venus Express' VIRTIS instrument. "However, the global and detailed view we are getting thanks to Venus Express is truly unprecedented."

"The fluorescence of the airglow is produced when oxygen atoms present in the atmosphere 'recombine' into molecular oxygen (or 'O2') emitting light. Where does the oxygen come from? [for more on this fascinating topic, see the webpage referenced above.]

</MMM>



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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(*Board Members & Ken Paul <kenpaul@cape-mac.org>)

LRS News

- **May 12th Meeting:** Peter was out of town for a family wedding near Lake Geneva. Members discussed possible dates for a summer field trip to the new Discovery World Museum and Aquarium on the Lakefront.
- **Spaceport Sheboygan** We have not been able to attend the annual Rockets for Schools event in recent years, but Dave Dunlop reports that the event, now in its 11th year, has ambitious plans for the future in connection with the spaceport project which continues to advance. We hope to have a report from Dave in the months ahead.

LRS Upcoming Events - June through September

 **Meeting Location, Time, Agenda**

**Mayfair Mall, Garden Suites Room G110,
2nd Saturday of the month (ex. July, Aug) 1-4 pm**
AGENDA: www.lunar-reclamation.org/page4.htm

June 9th Meeting

Agenda: ✓ Report on ISDC 2007. ✓ Possible plans for summer events, and a look ahead at the Fall Calendar

**No Meetings in July or August
Possible Field Trip**

September 8th Meeting

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

Chicago Space Frontier L5

610 West 47th Place, Chicago, IL 60609

INFORMATION: Larry Ahearn: 773/373-0349

MMM 7 NSS Chapters Strong



NSS Chapter Events


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



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
June 16 - July 21 - Aug. 18



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

MN Yuri's Night pics

<http://freemars.org/mnfan/MNSFS/2007-04-Yuri'sNight/>

Minicon Pics

<http://www.freemars.org/mnfan/MiniCon/2007/>

Minicon MAS / MN SFS tables

<http://www.freemars.org/mnfan/BESN/2007/>

Thanks to Monique R. Adams :Hands on Science Event Coordinator and Christine LaBounty for helping staff the MAS / MN SFS tables.

MAS AstroDay pics

<http://freemars.org/mnfan/MAS/2007-04-AstroDay/---/mnfan/MAS/2007-04-AstroDay/index-onan.html>

FMARS 4-month mission: Ben is following with great interest and some envy, and will report on the mission.

WISCONSIN



Sheboygan Space Society

728 Center St., Kiel WI 54042-1034

c/o Will Foerster 920-894-2376 (h) <willf@tcei.com>
SSS Sec. Harald Schenk <hschenk@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

May 17th: UW-Sheboygan, Room 6101, Sheboygan

June 21st The Stoelting House, Kiel

JULY 19th: UW-Sheboygan, Room 6101, Sheboygan

Sheboygan Space Society Annual Report 2006

This year our chapter did work with several projects. This years "Rockets for Schools" [RFS], was held on May 12-13 in Sheboygan at Blue Harbor, a resort on Sheboygan's waterfront, and the chapter's display was again this year a large Lego model built by chapter member Brian Hastings (seen below), complete assembly of the Shuttle Stack on the launch pad including tower.



For RFS 2006 the astronaut that spoke to the students was John M Grunsfeld. He also brought his son along and stayed both days so they could watch the rocket launches on Saturday. Later in 2006 we heard that he was assigned to the last Hubble repair mission. He explained how hard work in the Sciences and Math help him in his career in space. Our member Harald Schenk has again able to secure the Society a meeting place at the University of Wisconsin -Sheboygan (UW-S) so now we have a place to meet every other month. The months in between we meet in Kiel at the Stoelting House (KSH), (a community center). This is the third year we have been meeting on the third Thursday of the month. <SSS>

PENNSYLVANIA



Philadelphia Area Space Alliance

PO Box 1715, Philadelphia, PA 19105

c/o Earl Bennett, EarlBennett@erols.com
215/633-0878 (H), 610/640-2345(W)

[<http://pasa01.tripod.com/>]

[<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, 2nd level, 16th & S. Market. Go toward the windows on the 17th street side and go left. Look for table sign. Parking at Liberty One on 17th St. Call Earl or Mitch 215-625-0670 to verify all meetings.

Next Meetings: June 16, July 21, August 18

Meeting Times and Locations: in May we will be at The State of New Jersey's **Super Science Weekend, May 19-20:** regular location at Liberty One on **June 16,** and **July 21** at the Atlantic City shore. Mitch will pick a restaurant location. Note that this is after Moon Landing Day.

April 21 Meeting Notes: many members were away: however **Michelle**, our Treasurer, says we are solvent, **Dorothy** had a family function, and **Larry**, our Webmaster, was with her. And we tend to meet when Alex Howerton and several other members can,t make it due to family and work obligations. **Alex** works in aerospace and does travel for **The Nistar Center** and can be most anywhere. Many of our members have active lives and keep in touch through e-mail or phone, and read **Moon Miners** for our, and other, reports.

Hank Smith told us of the science fiction events he has, or will, attend and his place in the **Philadelphia Science Fiction Society** where he has helped with the Science Track for a number of years. Hank reported that **Margaret Trebeling** will be head of science programming. Hank will work with her and give us more on what we can do later. Hank went to **Lunacon** in Ryetown, New York and enjoyed it. His next event will be one a number of us are attending: **Balticon**, on Memorial Day weekend. The n WesterCon, July 4, in California, and finally, **NASFI** in late August in Collinsville, Illinois.

Mitch Gordon brought news from **The Futurist Magazine** for May/June with [Fusion Power for Space Propulsion](#) appearing on page 2. This is a proposed pulsed fusion system but for details see: uah.edu/news. There have been a number of papers in the past, but they have almost all turned out to research papers with little progress beyond this. To be fair: most ideas for fusion of any kind involve massive amounts of funding for even proof of concept system. More in a future article.

Mitch also brought the new **NSS brochure** for our critique and will have a number of them for Super Science

and general distribution. He will be talking to NSS on updating the "Why Space?" series of papers that were once published to explain why we should be going and the returns we are getting. To facilitate public outreach Mitch has modified a number of our business cards with website information. Go Mitch!

Janie brought in some unusual material on "Why We Should Go Into Space" from a source of assistive technology for famine plagued and war ravaged areas. These devices included solar cookers and water purifiers also driven by solar energy. As Earth Day was the next day, we had an extended discussion on this and other problems that solar, and "alternative" technology could help reduce. The starting point for much of the materials and engineering that makes these devices possible or economic is space and its exploration (with the military having also done this in the past). This is not space per se but could be considered an area of spin offs.

Earl brought material from *Analog Science Fiction and Fact* on the exploration of Saturn's moons from **Richard A. Lovett**, whose piece is titled: *Cyrovols, Swiss Cheese, and the Walnut Moon*. The article starts with Saturn's rings and the "herder" moons and bodies that may be aggregations rather than solid objects. A small moon ("moonlet"), **Pan**, is especially interesting in that it is described as the "master of the Enke Gap" which creates and destroys clumps of ring particles along its path. Then we go to **Enceladus** which turns out to be a very active body; but only in a limited area. The 504 kilometer body has a geyser, dubbed "Cold Faithful" by one of the researchers, with the high temperature being above -260 F. **Cassini** flew right over it and found water vapor in its path and the hot spot, on the moons south pole, below it. Also in this issue is **Richard A. Lovett's** science fiction: "The Sands of Titan" the other major investigation target among the moons.

And last but not least in this June issue is **Jeffery D. Kooistras'** reflections on the hundredth anniversary of **Robert Anson Heinlein's** birth. There will be a party in July. Go to: heinliencentennial.com. From the attendees mentioned I expect a lot of "Robert's Klds" will be there for the guests and the remembrance of this bright, down to Earth, man. I have by chance just read Mr. Heinlein's speech to a graduating class at the U.S. Naval Academy found in the June 1974 *Analog*. He is the guest editor in that publication and give a talk on writing, how he got into writing, and why he wrote science fiction. I think you, ll be enlightened and somewhat sobered by some of his reasoning. Good reading.

I also received *Nuts and Volts* for April with more on near space and specifically *Near Space Ventures*. The actual site is a dot com. The site is the result of the convergence of two groups with interest in this technology: Hams, and a Civil Air Patrol group called **CAPnSpace**. Good data and pictures. The site was founded by a couple, the Campbells, in 2004. Also received, the March /April *Amsat Journal* which I will report on next month.

Submitted by Earl Bennett

"Each country's success [in space] is the success of the whole world, and they build on each other."

- James Oberg

CALIFORNIA



**OASIS: Organization for the Advancement of Space Industrialization and Settlement
Greater Los Angeles Chapter of NSS**

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

Events Hotline/Answering Machine:(310) 364-2290
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[<http://www.oasis-nss.org/>]

oasis@oasis-nss.org

Odyssey Newsletter Online

<http://www.oasis-nss.org/articles.html>

Regular Meeting 3 pm 3rd Sat. each month

Microcosm, 401 Coral Circle, El Segundo.

• **June 16 - July 21 - Aug. 18**

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

Upcoming Events

- **Sat. May 19, 3:00 pm** - We are meeting at the home of Steve Bartlett and Tina Beychok, 7108 East Peabody Steet, Long Beach
- **Sat June 16th, 1:00 pm** - OASIS Monthly Business Meeting, Long Beach Public Library. Call the *OASIS Hotline*, 310/364-2290, for more information.

Looking Ahead

- **May 19-20, JPL Open House** -- The Jet Propulsion Laboratory will host its next Open House on Saturday and Sunday, May 19th and 20th, 2007 from 9am to 5pm both days. For more information, visit <http://www.jpl.nasa.gov/psd/oh.cfm>.
- **May 24-28, International Space Development Convergence** -- The 2007 ISDC, Dallas, Texas at the InterContinental Hotel. <http://isdc.nss.org/2007/>

Recurring Events

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

SOLAR SYSTEM AMBASSADORS

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\$45 National Space Society dues include *Ad Astra*
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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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\$25 Regular Dues

OREGON L5 SOCIETY

\$25 for all members

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

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Annual dues for all with MMM \$25, due in March or \$6 times each quarter before the next March

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"SSS" c/o B. P. Knier, 22608 County Line Rd,
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