

Moon Miners' Manifesto

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fi IN FOCUS Editorial continued from p. 1.

their findings, another series of workshops can begin to look at commonalities and where problem areas impinge on one another. Finally the time may be ripe for an International Conference on Space Debris charged with writing the language for a proposed **International Treaty of Spacecraft Design and Launch Standards** aimed at drastically curtailing the current rate of debris production.

What could come out of such a study? We have some ideas but they may well be naive. We leave it to the engineers and spacecraft designers. As to the bean counters, it is hard to see how they can be part of the solution, since it is the bean counting practice of dismissing life-cycle costs that is at the heart of the problem. Could this be an opportunity for redemption?

It may take ten years for such a process to run its course, *if people begin to take it seriously now*. Sadly, it may take a killer blow for people to become concerned enough to be willing to accept design inconveniences and upfront costs necessary in the long run to keep the Space Age an open-ended Age. Even if we were to start today, there's no guarantee we could finish such a process in time.

Our attitude towards space debris is like that towards icebergs and sharks. Sure, there out there. So is lightning. So what?

Our advice is for the minority who do care to start the process quietly on their own. Rather than look for ways to cleanup what's out there, we should concentrate on slowing the generation of new debris by spacecraft yet to be launched. Once we've plugged the leaks in the damn, *then* we can turn our attention to mopping up. - PK

If you get MMM as a membership benefit

Attention members of the Moon Society and of NSS Chapters who get Moon Miners' Manifesto as a benefit of membership.

- When you move, it is imperative that you notify your organization about your change of address.
- MMM arrives in your mailbox by bulk mail, which is *not* forwarded, even if you leave forwarding instructions (they apply only to first class mail.)
- If you notify the Lunar Reclamation Society, we will try to change your label, but the change will not be permanent. What's more, the flood of such requests is one of the reasons MMM has been so late getting in the mail. *We would prefer that all change of address notices come to us from the organization in which you are a member.* That will help everything work more smoothly..

L1 Gateway a Budgetary Pipe Dream?

At the World Space Congress recently held in Houston TX, NASA's Exploration Team (NEXT) presented its bold blueprint for setting up an inflatable orbital habitat at the L1 point between the Earth and the Moon to house astronauts while they prepare for exploring the Moon or Mars and servicing telescopes in space. Next envisions this habitat as a spinning structure that would create gravity for crews in space. NEXT has been working at the plan behind-the-scenes for three years.

While the consensus of the Space Community is that NASA is indulging in pipe dreams given budgetary realities, *we think it is worthwhile exploring the options, not for NASA, but for a Business/Industry "take it one step at a time" opening of the Lunar Frontier.*

Constructing an L1 Gateway on a "Just-in-Time" Schedule (the way Business & Industry would do it)

"If the Moon had a moon, what could we do with it?"

by Peter Kokh

Asking the Right Questions

In this essay, we want to approach the idea of an L1 Gateway with a clean slate drawing board, putting out-of-sight, out-of-mind, the recent elaborate mega-proposal from NEXT, NASA's Exploration Team. Instead, we would like to answer two simple questions:

1. If the Moon had a moon, what could we do with it?
2. How could you phase in an L1 Gateway in a logical step-by-step "just-in-time" fashion while you are establishing and developing a first lunar outpost?

If the Moon had a moon ...

To be fair, we should add "a moon always parked above," for essentially, that is the great logistical asset of the L1 position. Anything parked in that gravitational "mountain pass" is always "overhead" from any outpost or vehicle on the surface on the Moon's nearside. As opposed to any satellite or craft in a low lunar orbit which would be in access range only part of the time, this parking lot in the nearside sky suggests some interesting possibilities:

- an ideal place for relaying messages and teleoperation instructions between one spot on the Moon's nearside and any other
- an ideal spot to cache supplies, equipment, tools, etc. for the use of travelers between Earth and Moon
- the only ideal place to put a solar power array for beaming energy to anywhere on nearside during the long nightspan period

These service opportunities could be provided one at a time, and ramped up on a "just-in-time" basis as the costs involved become justified in relation to the amount of use and savings they provide. In other words, we suspect that the L1 gateway could, and should, be grown, and phased in, just as the lunar outpost is grown, and phased in, on the surface. There is no reason under the sun to "complete" either all at once *before* operations at either can begin.

Armed with that conviction, we would urge outright rejection of the NASA-NEXT plan *even if the money were there*. It is simple common sense that the only logical way to develop something complex is in an orderly step-by-step co-evolution with whatever other developments are co-dependent upon it. But in point of fact, NASA would, if it could, develop L1 completely as a manned gateway before deciding to establish lunar surface operations (as opposed to using the gateway mainly as a Mars jump off point.)

This NASA approach may look like political cowardice, but it is a tack NASA is forced to take given the decades long lack of direction from Congress and the Administration. However this approach would only repeat the costly mistake of developing the International Space Station without reference to its logical depot functions

Both a lunar outpost and an L1 gateway facility are best left to industry and enterprise. Only they have the mindset to do either logically. "Just-in-time" development would lead to a symbiotic pair of installations. "Symbiotic growth" would accelerate, rather than delay the pace at which we could advance from deployment of the first permanent habit structure on the Moon's surface to a first permanently inhabited local resource using frontier town.

Many space activists are impatient. Some would advance the date of the first manned mission to Mars even if it chanced that any opening of the Mars frontier to settlement might be delayed decades as a result. Others would skip L1 Gateway development to make an earlier start on a first moonbase even if it meant that the evolution of that first humble outpost into a settlement were retarded. It is a basic cosmic law that impatience always backfires. So let's make the case for doing things right. *Impatience is an itch that we cannot afford to scratch!*

Upper and Lower Moonbase

It is our thesis that we should be thinking in terms of a pair of moonbases, one on the surface, one parked above the surface in space, and that:

- a. we should develop both symbiotically in co-dependence
- b. doing so will advance rather than retard the pace at which surface operations expand at the original settlement site
- c. doing so will advance rather than retard the pace at which surface operations spread to other sites on the Moon's nearside

“Early,” “Transitional,” “Fully Operational” phases

Lets attempt a first trail balloon sketch of the phases by which L1 Gateway “Upper Moonbase Services” to a Surface Moonbase could be realized. This crude “reference mission plan” will be revised as others have input.

Early Phase: virtual (teleoperated) staffing - this is a list of services that could be provided without any on hand staff, with all control from the ground, preferably from the surface Moonbase rather than from an Earthside mission control, as the time delay would be much shorter, 0.4 seconds vs. 2.6 seconds., significantly closer to “real time.”

- Communications Relay connecting Nearside outposts & vehicles in transit, and allowing Moonbase personnel to teleoperate robotic rovers thousands of miles away.
- Search and Rescue capabilities anywhere on nearside (faster, with superior resolution, than from Earth)
- Tie in with outrigger relays at L4 and L5 to reach 2/3rds of farside as well
- Fuel Depot - drone tanker ferries teleoperable from the surface would attach LOX tanks to a rack, and other lunar-produced fuels and oxidizers as they become available. This would create a “gas station” to refuel craft bound for the Moon - or for Mars.
- Solar Power Array for gateway operations (1) and for nightspan operations of the surface base and other surface installations. This array could be built and expanded in modular fashion as demand dictates. Thus the L1 gateway becomes a part of the solution of the “Nightspan Problem.” The costs and versatility of such a power system will have to stand comparison with those of nuclear and non-nuclear *surface options* for providing or storing power for nightspan operations.

Transitional Phase: crews on duty when needed - If we add a habitat module complex that can accommodate visiting crews, we can do even more:

- Warehousing contingency resupply items for much more timely response to emergency needs anywhere on the nearside surface from this nearby cache accessible 24/7/365. A fresh Moonbound crew from Earth could pick up supplies even if the request came after their departure from Earth.
- A self-help Tool Crib | garage | docking port - where craft plying between Earth and Moon (and Mars) can be serviced, repaired, or assembled by the crews passing through - no permanent staff necessary
- A Mars Sample Return Quarantine Lab could be docked with the facility and staffed when samples arrive. Here isolation and quarantine from Earth’s biosphere are assured and the chances of accidental contamination in either direction enormously minimized.

Fully Operational Phase: permanently staffed - As the scope of surface operations expands and the number of people on the surface grows, permanent staffing of the L1 Gateway would be in order. A permanent staff would do these things:

- Maintain the complex and oversee its continual growth.
- Handle a steady stream of Earth-bound, Moon-bound, and Mars-bound traffic, providing a more complete list of services to spacecraft, crews, passengers, and immigrants. This would eventually include hotel operations.. While passengers bound for the Moon would probably be on location only for brief visits, those en route to Mars might be there for some time awaiting a window to open, or awaiting craft assembly.
- Include a Medical Facility for first treatment of crews and passengers transferring at the gateway. This could include a Zero-G infirmary for patients from the Moon for cases where such treatment is prescribed.
- A variable *G* facility in which persons who have lived on the Moon for a long period can recondition themselves gradually for a visit or permanent return to Earth.
- Miantain a growing Solar Power beaming operation that supplies not only nightspan base power to permanent surface operations, but full time power to surface vehicles in transit with dedicated slaved beams with power loads on demand from the engaged vehicles controlled by feedback loops. This would greatly assist remote and mobile mining operations as well as freight and passenger transporta-tion between surface destinations dayspan and nightspan alike.

One step at a time – Easy does it!

You can see from the above, that there is no need to plunge into the full scale development of an L1 gateway facility. Following the sequence of the Artemis Project mission plan, the first payload to be dropped off at L1 would come after the first surface crew deployed the initial permanent habitat structure and auxiliary equipment but in time for the delivery of the first rover and the arrival of the first overnighing crew.

The first L1 Gateway payload would consist of a relay satellite with station-keeping ability and a host expansion rack for the addition of add-on equipment. Would a first modular power generation and beaming array come next? This is a whole new area of logistics not previously considered by Moon mission planners. We invite all interested parties to get involved in the brainstorming. What comes when? What size and capacity when? How do we best synchronize development of this “Upper Moonbase” with the surface “Lower Moonbase?”

We will announce a discussion list address (most likely hosted on the asi.org domain) as soon as one has been set up.

<MMM>

Names for an L1 Gateway

An Exercise in Idle Musing

"L1" (Ell One) is a convenient enough designation and it could be that people will always call it by that name. But in general, it is inevitable that spacecraft and space facilities are given proper names. Here we could always follow the precedent of the International Space Station and avoid naming the complex as a whole and simply name individual modules. That may well be what happens if the L1 Gateway is built as an international multi-govenmental facility. If L1 is developed as part of a business-industry effort to open the Moon, however, bowing to international sensitivities could be less of a consideration.

A gateway facility could be named after some prominent scientist, astronaut, or politician, or bureaucrat. That certainly leaves us with a large pool of names of persons associated with the Moon: Armstrong, Lovell, Borman, Von Braun, Schumacher, and on and on. It would be a pointless exercise to pick a favorite here.

Or, as has often been done before, we could turn to the pool of names from ancient mythologies. Let's see where that takes us. We find:

- **Hecate** would be good for L3 on the opposite side of the Moon's orbit, with Earth in between and "hiding" the Moon. Ancients called the Moon "Hecate" when it was below the horizon, before rising or after setting.
- **Endymion** (m) was the mortal beloved by Selene (f) (Greek Luna) (but not an actual lover.) He was placed in eternal sleep to be the eternal lover of Selene
- **Pan** (m) was a god to whom Selene submitted -- "pan" is also Grek for "all" (= Roman "omni"). Pangate would be doubly fitting i.e. serving all destinations (Moon, Mars, asteroids, etc.) as this is the function that currently endears it to the NASA Exploration Team.

So **Pan** or **Pangate** is our pick for best mythologically appropriate name choice to compete against the most popular choice from the list of mortals associated with the Moon, four of them mentioned above.

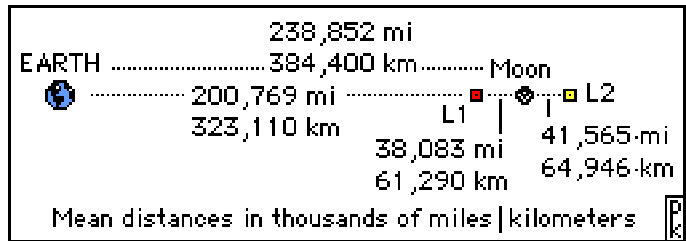
L1 in Eclipse

If the Moon's orbit around the Earth lay in the same plane as Earth's orbit around the Sun, there would be a total lunar eclipse every month at the time of full moon. But as the Moon's orbit is significantly inclined, there are only two or three times a year that the Moon passes through the Earth's shadow cone. L1 would share that orbit inclination and eclipse frequency. At such time, it could be without solar power for as much as four hours, so backup power generation, power storage, or sleep mode operations would be necessary.

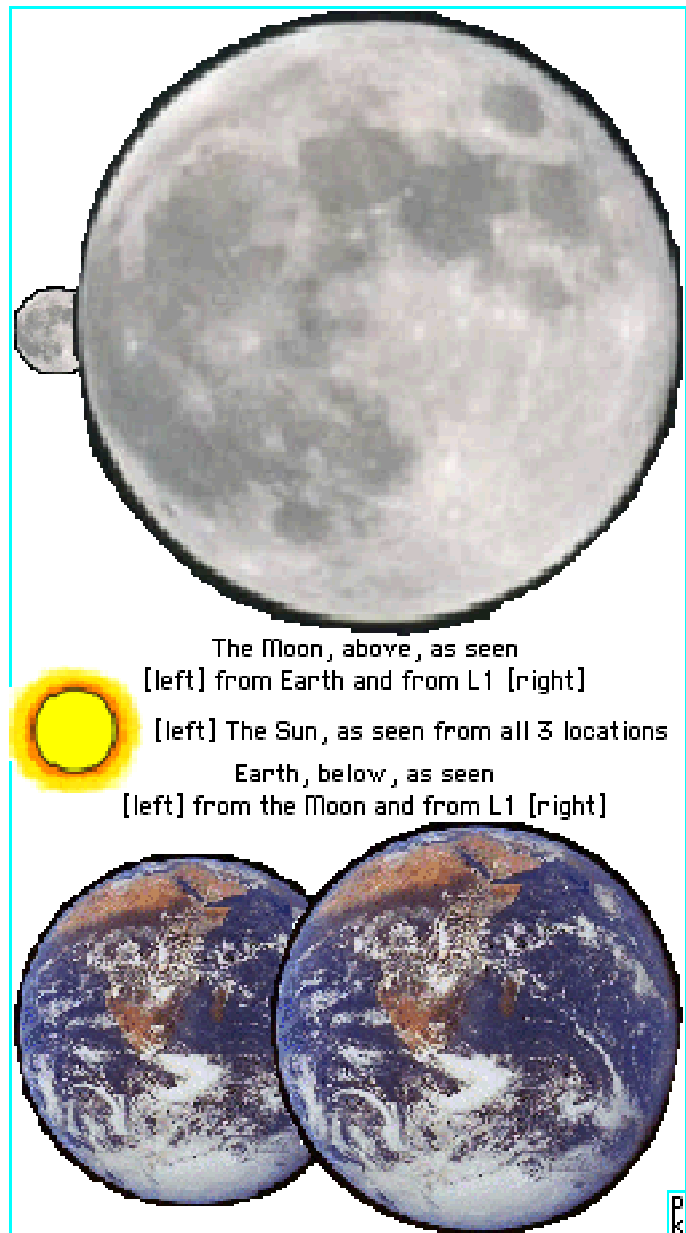
The View From L1 Gateway

by Peter Kokh

L1 is 84 % of the way from Earth to the Moon:



- 0°31' apparent size of the Moon from Earth
- 3°14' apparent size of the Moon from L1 Gateway
- 1°54' apparent size of Earth from the Moon
- 2°15' apparent size of Earth from L1 Gateway



The Moon, above, as seen
[left] from Earth and from L1 [right]

[left] The Sun, as seen from all 3 locations

Earth, below, as seen
[left] from the Moon and from L1 [right]

Clearly, anyone stationed at (or passing through) the L1 Gateway, will "have the best of both worlds!" <MMM>

Making Glass on the Moon

by Dave Dietzler <Dietz37@msn.com>

The Trend in Building Materials on Earth

In a future time when clean electricity from solar power satellites and helium 3 fusion powers the world's machines including home furnaces and automobiles, it will be possible to make structural plastics from remaining petro-leum reserves and abundant coal. Burning oil is such a waste. There will be plastic two by fours, sheets, planks and trim that are as easy to drive a nail through as wood. We already have vinyl siding. Houses will also be made of steel frames and brick with fiberglass insulation. Plastic won't rot or suffer from the effects of water damage and houses made from it will last for centuries. We will no longer have to chop the world's forests down for lumber. Plastic will make it possible to save the Earth.

Lunar pioneers must rely on other options

On the Moon, we won't have the luxury of cheap plastic, paper or wood, perhaps not even after polar ice deposits that include some nitrogen oxide and carbon oxide ices are tapped. These materials, so cheap on Earth will be the precious ingredients that sustain our mini biospheres and pretty much reserved for life cycle uses. Iron and other metal alloys, cast basalt, ceramics, concrete, and glass will be our chief manufacturing materials on Luna.

When it comes to glass, fused raw regolith will make an inexpensive, plentiful, but dark product, suitable for tableware and vases and giftware. By varying the mix of mare regolith and highland regolith, for example, a beautiful glass of variegated gray and black shades should be easy to make and popular. "Settlement Glass," it will likely be called. I can just see the dark bottles of Oceanus Procellarum Beer, brewed on the Moon. But to get beyond this stage we will have to choose the ingredients for our glassmaking recipes with care.

Soda-lime glass is typically 70-74% SiO₂, 1-2.5% Al₂O₃, 12-16% Na₂O and 8-14% CaO by weight. Sometimes a little MgO is included. Oxygen, silicon, aluminum, calcium and magnesium are plentiful on the Moon, but sodium is a little less common. Sodium is present in regolith at about 3.3 parts per thousand. From a million tons of regolith, or a square pit about a quarter of a mile on a side ten feet deep, we could get 3300 tons of sodium for 4450 tons of Na₂O. If our soda-lime glass is 14% Na₂O, we could make almost 32,000 tons of conventional glass. That would be plenty (to a ridiculous extent?) for "indoor" or "middoor" windows, bottles, tableware and more for a colony of several thousand people.

All soda-lime glass items will be recycled. Returnable soda bottles with a ten cent deposit will be resurrected on the Moon. Billions of tons of maria regolith will be processed by mobile mining vehicles to get helium 3, but

this only involves roasting out the volatiles. Processing regolith for oxygen, silicon and metals will be more complex and use more time and energy, so we will only go through a few million tons of dirt for Oxygen, Silicon and metals a year. Recycling of glass to conserve less abundant elements like sodium will be essential.

There is very little boron for making Pyrex glass on the Moon. If regolith is treated with hot fluorine gas to extract silicon, some boron trifluoride gas that can be separated through fractional liquefaction will also result. From a million tons of regolith we could get a couple of tons of boron. That isn't much. We might want to import some boron. We could also use pure fused silica glass for laboratory ware, outer windows exposed to high temperatures and thermal shock and cookware. Although fused silica consisting of 100% SiO₂ is hard to make and work with because of its high melt point (1700-1800 C.) it will be worth it for these special purposes.

Glass for a myriad of consumer needs

What about supplying the demand for glass by millions of Lunans and Space Oases dwellers? What if we want lots of glass fibers, glass pipes, glass walls, glass doors, woven glass fiber fabrics, and many other glass items for a growing population in space? We aren't going to make it all out of fused silica and we don't have that much sodium.

The answer is aluminosilicate glass as described by Geoffrey Landis in his article "Glassmaking on the Moon" [Artemis Data Book (<http://www.asi.org/adb/fulloutline.html>) <http://www.asi.org/adb/02/13/01/glass-production.html>] A boron-free formulation of aluminosilicate glass would be approximately 60% SiO₂, 20% Al₂O₃, 12% MgO, 5% CaO, 1% Na₂O, 1% traces.

With this formulation, over 400,000 tons of glass could be made with the sodium in a million tons of regolith. There's enough silica to make this much glass in a million tons of regolith, but some extra alumina and magnesia will be needed. Aluminosilicate glass will soften at a higher temperature than soda-lime glass, but it will be much more workable than fused silica.

Optically Clear Glass

Transparent glass must be iron free. Fortunately, we will use electromagnets to remove iron from regolith and produce iron free feed-stock for glassmaking. In some cases, we will actually want to add iron to our glass. Amber colored glass can be made by adding iron sulfide. Blue-green glass can be made by adding iron chromite. Yellow-green glass can be made by adding chromic oxide and blue glass can be made with cobalt oxide. Red glass can be made with cadmium sulfide or cadmium selenide. A few hundred kilos of selenium and a few kilos of cadmium exist in a million tons of regolith. Although we should be able to get that cadmium and selenium when distilling regolith for zinc, there won't be much glass tinted red on the Moon. [The

only inorganic true reds are compounds of mercury or lead and both elements are very scarce on the Moon. - Ed.]

Cobalt Blue Glass (from www.glass.co.nz/encyclopedia/)

Small amounts of cobalt (c. 1 oz/ton of glass) are used to neutralize the yellow tint of iron in glass such as window glass. To produce a blue color in glass, you only need to add five ounces to a ton of glass. Deeper blues are obtained by adding up to ten pounds of cobalt oxide to a ton of glass. This deep blue glass can then be ground up into a powder called "SMALT" which is used as a coloring agent for enamel, for glazes on pottery, and for making more blue glass.

So, if we get 25 tons of cobalt from the magic million tons of regolith, we could color over 5000 tons of glass deep blue and 175,000 tons light blue. That's a lot of paperweights and dinner ware.

Glass Brings Color to a Gray World

A combination of colored glass (though it may be mostly amber or blue-green), sodium silicate based paints, flowers, green plants, aquariums with bright tropical fish or gold fish, terrariums and bird cages will make our mostly gray metal, concrete and black stone subsurface dwellings more pleasing to the eye. Combine this with some live and piped in music, fountains, waterfalls and imported or Moon-grown potpourri and we will have some real nice places to call home on the Moon. Light will come from heliostats with UV filters by day and sulfur lamps by night that closely mimic natural sunlight to bring out the colors.

Market Sink for Recycled Glass

With all this aluminosilicate glass available we will be able to extrude fibers from trashed glass and add it to cement for a stronger concrete as described by Peter Kokh in the Sept., '02 MMM #158. I can see the older generation from the days of tight glass recycling being appalled by the younger set getting drunk and smashing disposable bottles and wine glasses. "So what, pop? It's all going in the concrete! Come on, it's not like we're tossing plastic or paper in the trash!" Aluminum beer and soda cans will end up in the concrete too, so young Lunans and old will have the joy of just throwing stuff away without guilt. Call it consumer culture! [See our remarks below. - Ed.]

BIBLIOGRAPHY: Data in this article was derived from:

- Van Nostrand's Scientific Encyclopedia, 8th edition, 1995.
- McGraw-Hill Encyclopedia of Science and Technology, 8th edition, Volume 2, NY: McGraw-Hill.
- Geoffrey A. Landis, "Glassmaking on the Moon." ADB. Artemis Society International: 2000. <http://www.asi.org/adb/02/13/01/glass-production.html>
- Peter Kokh, "Concrete: A Versatile Lunar Material of Choice." MMM # 158. Sept. 2002 <DD>

Recycling Glass and Other Materials in Lunar Settlements

by Peter Kokh

Many thanks to Dave Dietzler of the Moon Society St. Louis Outpost for another great article.

Dave is correct to point out that as mentioned in my previous article on Concrete, which he cites, glass shards can be used as decorative aggregate in concrete. He is also correct in saying that aluminum and other post consumer "trash" can end up in that sink.

That said, we beg to differ on a wisdom of general tolerance for such kinds of disposal. There is more to consider than that. Those materials that incorporate a lot of energy in their production should preferably be recycled in a way that captures as much as possible of that energy.

The best way to recycle glass is in the production of more glass. The best way to recycle aluminum is in the production of more aluminum. There are plenty of rocks and aggregate rubble on the Moon to serve as filler for concrete at little energy expense. If we toss aluminum scrap into the concrete batch, that means more electricity must be generated to replace that aluminum than would be the case if we simply recycled it properly.

Glass recycling, as most of us who try to do it know, can be tricky. You have to keep the colors separate, and some kinds of glass can not yet be economically recycled at all - the mongrel glass in the so-called "disposable bottles."

There may be incentives for business to find uses for various orphan categories of post consumer waste. And there may well be an effort to design consumer products for designated afterlife usages. In the 70s there was an attempt to design a "world bottle" with a shape that would let it serve adequately as a building brick when empty. It would be a good idea to take another look at this challenge. Today, an increasing number of businesses are seeing the economic sense of reuse design.

I think that young Lunans will grow up learning the Four "R"s - "Reading, wRiting, 'Rithmatic, and Recycling." On the Moon we will always be behind the proverbial Eight Ball in fighting the odds in a never ending struggle to survive in a decent and satisfying fashion. The better we attend to our Ps and Qs, the better our chances of a good life. The more sloppy and careless we allow ourselves to become, the more quickly the curtain will fall on an a self-aborted effort to settle a new world.

Young people can be given the yeoman chores of recycling, and do their universal service in all the utility systems upon which survival on this unforgiving world is possible. That should instill in most of them a second nature habit of care and concern. Plainly put, it will take a bit more to make a good Lunan citizen than what sadly passes for a good American citizen. <PK>

Will Settlement Change The Moon's Appearance?

by Arthur P. Smith and Peter Kokh

Thoughts on a Controversy & Artists to the Rescue

Arthur P. Smith <apsmith@aps.org> 10-27-02

A couple of thoughts I had:

(1) we've had this slight bit of controversy the last six months or so [in the Moon Society discussion lists] about "development" of the Moon, and how that could spoil it for all the Moon lovers down here on Earth. I think some images showing the potential for transformations of the face of the Moon in future might gain us a lot of good will. The Heinlein cover with split Earth/Moon that Ian [Ian Randal Strock, Editor] ran on **Artemis** magazine recently is an example of the idea - would the Moon not be more beautiful if it was endowed with the colors of life, rather than its current grayscale desolation?

You could start from a full-Moon image as it is now, focus in on, say, Mare Anguis and a lava-tube development, making at first almost no perceptible change in lunar appearance. What change in fact would it make? The shimmer of solar panels? Radiators hidden from the sun? A variety of mining vehicles, and a landing/launch facility on the surface... Would any trace of the inner life seep through a "skylight"?

Then fast-forward a few decades - the shimmer and skylight effects spread, new structures rise above the surface; a "mass driver" or two are installed for transport of lunar materials elsewhere; lunar solar power stations covered with solar panels and dotted with radio telescope-like transmission antennas appear. But all of these would be close to invisible from Earth - what would such changes in relatively tiny patches of the Moon (less than 1% of area, more on the edges than in the center) look like from that enormous distance?

Development then spreads further - craters are enclosed, some locations become highly desirable, others less so. Clusters of blue-green-brown appear amid the grey. What would our moon look like, with tiny fleks of color, concentrated here, sparser there?

(2) Sublunar life. At first a lot of what is done will be underground, for radiation protection and thermal stability. How will agriculture and industry mix beneath the surface? Lighting and temperature in an ambient -20 C environment. Lots of mushrooms growing in the dark? Chickens, rabbits, pigs on a farm? Giant sulfur lamps lighting acres of growing wheat and corn? Algae growth pools and drying facilities. Workshops where bulk lunar metal is forged, and united with electronics and light machinery imported from Earth. Sports arenas. Homes that are some cross between a cave and a modern cottage. And

some airlocks, barriers, and other safety devices to guard against loss of atmosphere.

There's lots of things an artist could work on, fleshing out the vision we have of lunar development. I'd love to see it happen!

Changing the Moon's Appearance: & Reality Checks

Peter Kokh <kokhmmm@aol.com>

Near term, I doubt that we could do much that was noticeable. If we did widespread harvesting for surface volatiles, that "gardening" operation would tend to raise the albedo a bit for the areas covered, making them brighter.

Surface Night lights from the settlements might be noticeable in telescopes, but a settlement would have to be pretty humongous for its surface lights to be noticeable from Earth. Most of the activities that are supported by outdoor lighting on Earth would take place indoors or middoors on the Moon. Surface roads would be fewer in number than the sub-surface ones at least in urban areas.

That said, I'm all in favor of a lighthouse beacon on the Moon at the intended settlement site before the first Moonbase module is landed. Green light is supposedly the most visible, and also the least disconcerting. Green signifies "life," "okay," "go."

Most changes would be so gradual, that no one would really notice. In stark contrast, the changes we have wrought on Planet Earth as visible from the Moon over the past century must be startling! The bright light clusters from urban areas and gasfield burnoffs are something new in the past century for prospective observers on the Moon. but I think most would see that a beauty, not pollution.

There are concerns, but I think less about mining activities and other physical alterations that might change the appearance of the Moon to lovers on Earth. I worry about something else, something more difficult to fight, something much more insidious.

If our habitats were leaky and there were enough of them, there might be some slow faint rusty gray patches around settlement areas as some of the free iron fines were oxidized by traces of humid air. As more and more volatiles are pumped into the vacuum from rocket exhaust and leaky airlocks and seals, the longer it will take to dissipate into space. In time the extremely tenuous lunar atmosphere would be come progressively less tenuous. There would be more and more rusting, and someday, even occasional dust clouds.

We have written about dock-locks, snuglocks, barometric airlocks, turtle back suits, iron fine burning rockets, and other contraptions that might help conserve air, slow leakage losses, and slow vacuum degradation. The lunar vacuum is a priceless scientific-industrial resource. We shrug our shoulders at its slow contamination to our ultimate irrevocable loss.

<PK>

The Moon Society



JOURNAL

<http://www.moonsociety.org>

Please make NEWS submissions to
David Wetnight at newsmonger@asi.org
Other submissions: KokhMMM@aol.com

The Moon Society was formed in July, 2000 as a broad-based membership organization with local chapters, to spearhead a drive for further 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®**

Join/Renew Online at

www.moonsociety.org/register/

- \$35 USA/Canada + MMM hardcopy
- \$60 elsewhere + MMM hardcopy
- \$35 anywhere + MMM electronic PDF file

Questions? email: membership@asi.org

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

- Artemis Reference Mission
- Artemis Data Book

Project LETO™

<http://www.projectleto.org/>

Please send all mail related to Memberships to:

The Moon Society Membership Services
PO Box 940825, Plano, TX 75094-0825, USA

How to fix MMM Subscription Errors:

www.asi.org/adb/06/09/04/1999/09/news-19990915.html

"My Moon Society Page" is Here

Per email discussion October 24, 2002

Newly elected Moon Society Board member Arthur P. Smith has come up with a great idea and posed this question.

"Can we set up WSD with dynamic pages for users after they login, sort of a "My Moon Society" page? This would have their name, address and contact info (with links to update this), membership number, expiration date, a big "Renew" button, maybe a "Donate" button, and links to MMM and sections of the ADB that are members only. Also any team memberships. Right now all the "personal" stuff seems to be spread over a lot of different web pages, and it would be very nice if we could consolidate that."

Randall Severy, of CyberTeams, Inc., whose **Team Website Director** software powers both the moonsociety.org and asi.org websites, replies:

"I think this is a *great* idea! It also ties into some things I'm trying to do with Team Director and Help Director. For this to work right, the Moon Society and ASI Team Director databases need to be fully synchronized, an effort that has been underway for some time and should be finished in the near future. Team Director already supports an API call to retrieve membership information, so constructing a "My Moon Society" page that shows selected membership information (probably built in PHP) should be fairly straightforward. I am working on getting a prototype put together so that we can hash out the best design for such a page.

Cheers, Randall

Join (renew/rejoin) the Moon Society today!

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

Society Website to get Dynamic Makeover

From the Web Team

Given a mandate from the Moon Society Board, the Web Team is pondering a long list of suggestions to provide not just a new look, but more information, easier navigation, and other items that will make moonsociety.org work better for both members and visitors alike.

Included in the discussions, are coordination of the Moon Society and Artemis Society websites, regular updating of key pages (notably the chapters and local contacts list) and possibly a new logo (we haven't had an old one!) and masthead.

A lot is happening in the Moon Society, but very little of it has been apparent to website visitors. We have to make this tool work for us!

[The following letter arrived in handwritten form. I could not resolve with confidence words unfamiliar to me. What is printed here is an edited version. - Editor.]

Personal Reflections on a Visit to Kennedy Space Center

from E. Philpott, UK

On August 22nd, I had the pleasure of my first visit to Kennedy Space Center in Florida.

On the coach, the first thing I see is the huge VAB. *Wow! I'm here! This is the place where humankind shall reach for the stars!* (at least I once thought that)

We pass by Space Camp on the way in. The mockup Shuttle missing parts of its wing leading edge. No one has bothered to repair it. The kids will be upset.

We pass through the gates and climb off the coach and wait in sticky heat to go in. Once past that we are herded on to NASA coaches to see the pads from the look out platform. On the way, a close up look at the VAB and crawlers. The crawlers look forlorn, rusty, and it seems awaiting to be scrapped.

Once at the platform, hot dogs, soft drinks and potato chips seem to be number one thing on people's minds. I climb to the top of the platform as the queue grows longer down below. At the top, I look at the old 1960's pads. Battleship gray and rust colors cook under the Florida sun. Obsolete monuments whose birth was thought to be the start of America's thrust into space and beyond before the budget axe fell on such dreams.

Munch on hot dog and a drink, back onto the coach to see the Saturn V exhibit. Huge TV screens give history and mechanical countdown of the huge vehicle but for me the atmosphere is spoiled by loud music played throughout. Then it ends and the exhibit doors slide open. Laying on its side like a felled redwood, is the Saturn V. I'm so awed at the size and power of this thing of incredible metal, that I can't tell if it is a test rig or a flight model. As I look around this monolith I notice in the hall itself, a fast food bar of all things!?! Beneath a mock up LM you can stuff your face with fries and burgers. To me this amounts to setting up a burger bar in a cathedral!

Back on the coach to the main visitors center. I watch the IMAX film on the International Space Station. The "T-word" - Tourism - is never mentioned, but supposed "hi-tech" breakthroughs in ISS research are hyped for all they are worth!

I walk back out into Florida's hot sun to see the rocket garden. There is a general air of neglect around the place. I note that the astronaut memorial lists no Russians. I come away thinking that the KSC is in danger of sinking back into the swamps on which it was built.

What can we, the Moon Society, do?

1. Put away the idea that we can do the whole Artemis mission on our own.
2. Pour all our energy into developing our "Lunar Habitat Module" (LHM)
3. Make this LHM on the "TransHab" (inflatable) model.
4. Make the LHM compatible with several non-NASA launch vehicles to leave our options wide open
5. Seek out fellow space enthusiasts in Japan as the TransHab could make a great space station for their proposed SST to dock with.

E. Philpott lives in South Wirral County, England.

Editor's reflections:


The way we experience new things depends a lot upon our expectations. If they were unreal-istic, we are bound to see them dashed. The sad fact is that the dream of mankind moving out into space is shared by only a fraction of Americans, and among this constituency, only a much smaller fraction is willing to see that happen on through tax-payer dollars.

Maintenance at KSC is not what it should be, again because of budget compromises. NASA needs to keep as much of its available budget to develop ISS, and understandably puts tourist facility maintenance and preservation of historic structures and equipment on hold. Yet it would be tragic to see historic equipment go under the scrapman's torch. There is always the hope that a private foundation will take custody, as has, in fact happened on a smaller scale with some equipment, especially items adopted by local space museums.

TransHab vs. SpaceHab for the Artemis Moonbase core

The idea of designing a TransHab type lunar base is an interesting one, and we pioneered that idea before there was a TransHab in our 1991 Lunar Hostels paper. We should not, however, abandon the SpaceHab design. It would be a better idea to have teams working both design tracks in order to keep our launch and delivery options open.

We have rusted on our laurels for the past seven years since switching to the SpaceHab design. We have put off action items that need addressing in transforming the flat-side up SpaceHab Logistics Double Module into our flat-side out Moonbase Triple Module (list what needs to be inside, layout and outfitting design.) Sure, in the end this has to be done by the contractor, but there is no reason why we can not and should not do some helpful footwork!

Then let's also take the TransHab R&D, which got respectably far along before Congress killed it in 1999, and rethink it for a surface application. The inflatable walls could be thinner, the enclosed volume greater, IF we took care to give it a moondust blanket promptly. - PK. 

Artemis Society of Oregon Schedules Talk

<http://chapters.asi.org/oregon/>

The Oregon chapter continues to show strong signs of revival. **Charles Radley** will be giving a talk on Thursday evening, February 20th at the Linus Pauling Complex, 3945 S.E. Hawthorne St., Portland at 7:00 p.m. The event will be cosponsored by the chapter and the Rose City [Portland] Astronomers [<http://www.rca-oms.org/>].

While we haven't gotten together as a Moon Society chapter for nearly 2 years, most of the members are active locally with Oregon L5 Society, a chapter of The National Space Society. [<http://www.OregonL5.org/>]

• **October 19th Meeting Report:** After the Oregon L5 meeting we held an informal meeting of the Oregon Artemis Society members present, which included Tom Billings, Bob McGown, Norm Robinson, and Dick Steffens. We agreed that we should continue developing Oregon Artemis Society, and should call a meeting to discuss things we can do, and to elect officers. We also agreed to communicate by e-mail with each other for the purpose of setting the agenda, time, date, and place for that meeting,

Dick Steffens < rsteff@attbi.com >

Moon Society St. Louis Ag-Experiments

Dave Dietzler has been conducting lunar agriculture experiments, picking up where the LRS-sponsored LUNAX experiments program of the early 1990s left off [www.lunar-reclamation.org/page10.htm]. The object of his experiments is to determine data points on the question of the best strategies to nurse Moonbase and outpost crops through the two week nightspan periods when live sunshine is not available. Save has been trying various regimes of refrigeration and artificial lighting. You can contact Dave at < Dietz37@msn.com > or Peter at < kokhmmm@aol.com > if you have any questions after visiting the LUNAX page at the address above.

"Our next Outpost meeting is Nov. 13th. We have made email contact with a potential fifth member (making the magic number 5 for official recognition and a charter) but have not met her in person yet." - DD

Bay Area Moon Society

posts page on "Ideas for what a chapter can do"

<http://chapters.moonsociety.org/bams/ideas.html>

Contact: Tim Cadell < tcadell@savageresearch.com >

The Bay Area Moon Society (California) serves the San Francisco-Oakland-San Jose area

Moon Society Milwaukee Outpost Project to develop exhibit plans for use by Moon Society Chapters & Outposts

from Peter Kokh < kokhmmm@aol.com >

On October 22nd, we finished working up instructions for putting together a chapter/outpost exhibit about Resources on the Moon. Image links and concise bulletized text for the display have been uploaded to the Space Chapter Hub website at the following address:

http://nsschapters.org/hub/stybd_moon_resources.htm

We have begun working up additional "story board exhibit" plans for Moon Society Chapters and Outposts, in order of front to rear burner priority indicated below:

1. The Artemis Moonbase™ Project
2. Lavatubes on the Moon (and Mars)
3. Lunar resources-based Space Power options

Moon Society Pittsburgh Outpost

Neil Durst < asi_durst@yahoo.com >

Neil reports (9/26/02) the following:

"I am happy to continue to serve as the Moon Society's local contact for Pittsburgh / western PA.

"I like the "Gravity Jugs" exhibit idea! I'm going to have my (youngest) daughter put a set together and see if I can get her Junior High School science teacher interested in a Moon day or event. This idea is physics, space science, and fun put together."

[<http://nsschapters.org/hub/gravityjugs.htm>]

Other Active Moon Society Outposts

• New York City Outpost

Contact: Ian Randall Stock < irs@panix.com >

• Suffolk County Outpost (Long Island)

Contact: Arthur P. Smith < apsmith@aps.org >

• Mid-Atlantic Outpost (DC-Maryland-Virginia area)

Contact: Margo Duesterhaus < duester@pop.erols.com >

• Durham Outpost (North Carolina)

Contact: David Wetnight < davew@intrex.net >

• Dallas Outpost

Contact: Scotty Gamenthaller < scottygamm@topher.net >

• San Antonio Outpost

Contact: Robert Lancaster < fixerbob@worldnet.att.net >

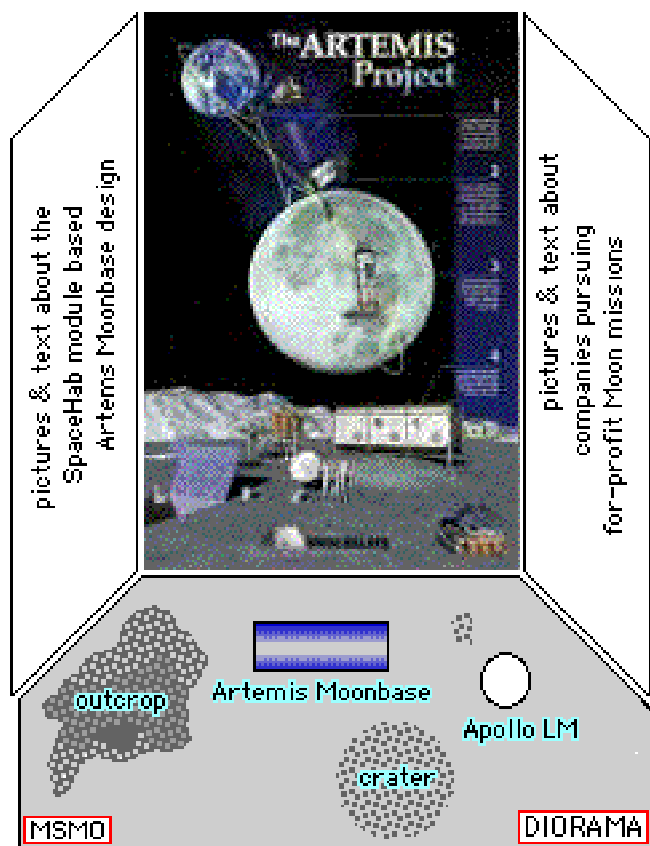
Volunteer to be a Moon Society Local Contact

Send an email giving your complete preferred contact information to:

- Peter Kokh, Chapters Coordinator < kokhmmm@aol.com >
- or < chapters-coordinator@moonsociety.org >

Moon Society Chapters – The Outpost Frontier Report

Easy to Make Artemis Project Display Plans now available Online to Moon Society Chapters & Outposts



http://nsschapters.org/hub/storyboards/sb_artemismoonbase.htm

For the price of a color 24" x36" Artemis Project Poster available for \$9.95 plus shipping & handling from LunarTraders.com, a 36" x 48" piece of 1/4" foam core (or 2 24" X 36" pieces, and some spray adhesive, you can make an attractive table top display for your outreach event. The display has the mounted poster in between two wing panels on which complementary information is presented in a combination of pictures, graphics and large type text for easy reading by the casual passerby.

Everything that goes on each side panel is ready for you to download and print from two pdf files. Each side uses four 8.5x11" pages in landscape orientation. There is an empty box at top right on the right panel printout in which to put your chapter or outpost name.

Moon Society Milwaukee Outpost originated the display and has put the instructions and pdf files on the web. MSMO is now working on a diorama to sit at its base, with a low-detail Artemis Moonbase and an Apollo era LM to the same scale for the sake of comparison. Complete instructions and a photo will be posted when done.

Exhibit Go-withs

You will want to complement this exhibit with some additional items:

- flyers: see last months issue - or look for appropriate flyers listed at: <http://nsschapters.org/hub/flyers.htm>
- sign-up sheets to get on your "mailing list"
- If your chapter/outpost has a regular meeting place and time (e.g. xth weekday of the month, hours), or you want to offers speakers to other groups, you can put this on a vertical flyer holder - helpful hints at: <http://nsschapters.org/hub/exhibits.htm>
- eventually, some 3-D items:
 - a set of Earth-Moon gravity bricks (free to any chapter or outpost - while supplies last - email kokhmmm@aol.com) or
 - gravity jugs (make yourself, less than \$5 in less 1 hour) - <http://nsschapters.org/gravityjugs.htm>
 - a model of the Artemis Moonbase (can be low detail, as its sole purpose will be to catch the eye of the passerby and direct it to the exhibit itself) or of
 - the proposed Space Motorcycle ascent vehicle

The idea is not to create all of this at once, but to provide an agenda for exhibit improvements. so that at each opportunity, your exhibit will become more and more effective in attracting visitors that you may be able to engage in a fruitful conversation.

Identifying Outreach Opportunities

Now this is by far the harder part. Ten-fifteen years ago, it was a fairly easy task to find Outreach Ops. Many malls welcomed non-profit groups and their information tables. The very few that still do now typically require that you show proof of a million dollars liability insurance coverage. If someone picks up your flyer and then drops it on the mall floor, and someone else slips on it, the Mall wants your pocket to take the hit for the injury claim.

Other options: Air shows and other airport events, science fiction conventions (though most fans are not into real space), astronomy events (most amateurs don't see planets as "destinations" or future homeworlds), museum events. Check out <http://nsschapters.org/hub/events.htm>

Piggybacking on an established traffic-generating event is certainly easier and usually more productive than starting your own event from scratch. But there are ways to create your own event and generate traffic. One such way is to create a mobile "sidewalk astronomy" setup and set up on "good Moon nights" in cinema parking lots, etc. The Milwaukee Outpost is looking into this.

Meandering through the Universe

A Column on the Cooperative Movement on the Space

Frontier © 2002 by Richard Richardson

A "Gravity Shield" Device?

You may have heard the recent hubbub surrounding the claims of discovery of an antigravity effect (and the means to produce) it having been discovered in 1992 by the Finnish scientist, Eugene Podkletnov. The claim is that the effect (called a "shielding" effect because it seems to be shielding the test object from Earth's gravity field) reached 1.9-2.1% at maximum.

These claims have stimulated a great deal of interest, debate and controversy in scientific circles. Both Boeing and NASA have been looking into it. In fact, NASA's Marshall Space Flight Center initiated a joint research project with the University of Alabama in 1996 to try to replicate Podkletnov's findings. However, the project eventually disintegrated, leaving some bad feelings between NASA and the academicians. Professor of physics, Larry Smalley, is reported as saying that NASA's team of scientists did not give the project a serious chance. He goes on to say that he felt like the NASA team "wasted time, a lot of money and a really golden opportunity to do something." Ning Li, who led the university team, seems to share professor Smalley's opinion of NASA's involvement in the project and has left the university to pursue further research in this area with a company she founded for that purpose. Meanwhile, it's reported that NASA has awarded a \$600,000 contract to Superconductive Components Inc. in Columbus, Ohio to build a gravity shield device. The company reports that it is on or ahead of schedule.

There have been several reports about the current state of antigravity research as well as the history of research in that field on public radio in the last few weeks (Sept. 2002) since the release of an article in *Jane's Defense Weekly* — and a book — by one of the writers for that periodical. In one or more of the public radio discussions it was mentioned that Boeing has contracted with someone (I believe it was Mr. Podkletnov, the "original" investigator himself) to see what they can come up with.

Doubts and Alternative Explanations

If the Boeing Co. really has started spending money on antigravity, it probably is a strong indication that there really is something to the reports about the current state of research. On the other hand, back in 1995, M. Bull and M. De Podesta have shown "that the phenomena tentatively ascribed by Podkletnov and Nieminen to gravi-tational screening may be easily understood in terms of a buoyancy correction to the authors' weighing procedure." Likewise, two out of three scientists on *Scientific American's* "Ask The Experts" web page agree that since they don't believe it, it ain't true. The third expert scientist seems to think that the jury is still out. We'll see, I guess.

Meanwhile, back to the Moon & Growth Potential

Here's a little quiz for you: Do goldfish which remain confined to a one gallon fish bowl grow up to be meter long carp? Do the people once known as pygmies grow up to be meter and three quarters tall adults? Did the variety of woolly mammoths that lived on Wrangell Island (in what is now Alaska, only dying out some 700 years ago) grow to be three meters or more in height at their haunches? How tall will adult humans grow to be on Earth's moon?

Think about these questions for a minute. Apparently the answers are quite counterintuitive. Have you thought about them? Okay, are you ready for the answers?

Given the proper background information, it is obvious that the answers to the first three questions are all, NO. No, the goldfish will remain small. No, the pygmy people rarely grew to be more than about a meter and a quarter, as I understand it. No, the Wrangell Island woolly mammoths never exceeded about a meter and a half at the haunches.

All these questions are about growth, and more specifically, about growth potential. What do carp, genetically small humans, and the last to die out of the arctic elephants have to do with humans on the Moon? Good question.

Have you ever heard it suggested that in low gravity environments humans will become much taller? I've heard it over and over again everywhere from the pages of fantasy to the speculations of fairly level headed scientific types. I object and suggest, rather, that the truth of the matter is plainly that we just do not know how a low gravity environment will affect human shape and size.

The question is important for more than mere entertainment. If a person or organization wants to make a reasonable design for a space settlement they should take in to account the size and shape of residents 20 years down the road. If the first native generation will be two and a half meters tall then there had better be head room for them. It's going to be extremely expensive to remodel in space.

Likewise, it's going to be not only extremely expensive but also political suicide to either send away or kill anyone who grows up to be too tall for their community. Even if native generations only have to regularly suffer bumping their heads all the time, the consequences will be extremely serious and negative. The same sort of problems will occur if the space environment results in people who are too short to reach things or are too thick to pass between door frames and the like. Just because the predictors haven't predicted shapes and sizes other than tall and thin doesn't mean that low gravity definitely won't affect native born children in one or more of these ways.

Asking the Right Question

This is a relevant and important question. Yet, like so many other questions, we don't know the answer. In fact, there are three separate questions here which usually seem to be confused.

1. What will be the effect on adults raised on Earth who then live for decades in a low gravity environment?
2. What will be the result of low gravity on people with the current genome who are raised in it?
3. How will the genome evolve over a long period of time and what will be the result of that?

All of the animals and plants here on Earth live in an extremely limited range of gravity varying by something like one part per many million, or thereabouts, yet there is a great variety of sizes and shapes not only between species, but within species, and even within immediate family groups. In other words, there are many other factors besides gravity which have significant effects on the ultimate size and shape of individual organisms.

What are some of these factors? Animals, including humans have adapted in size and shape to take advantage of local conditions affecting acquisition of food, sources of shelter, security, and reproduction considerations, among other things. It truly would be a miracle if all of these factors suddenly no longer applied simply because we are now living in space.

Whether in space or on the home planet, some specific instances of some of these factors help select for shorter people, for instance. It seems more like a crap shoot than an educated guess to predict (without extensive research) that people will suddenly be much taller because they grew up in space. Still, with the proper research it might become possible to make a very good educated guess. If that research comes *before* a great deal of investment is made in space infrastructure intended for human use and occupation it might spare us huge amounts of money, uncountable inconvenient small injuries and many serious injuries. If space colonies are going to be rich and have an exceedingly easy time prospering then we can afford to ignore this issue. But if there will only be a thin margin between making it and ghost town, we had better do the research, do it right and apply the results carefully and intelligently to our colony designs from the very start.
<RRR>

[**Editor:** this question will be vital as we approach having the capacity to manufacture shelter modules on the Moon from locally processed building materials. Richardson's point is well taken and one more reason that we must allow personnel reproductive freedom. We cannot afford to delay knowing how the first native born Lunans mature and what if any health problems they have result from their gestation and development in the Moon's low gravity. - PK]

New Company Taking Orders for Non-recoverable Suborbital Payloads

[10-27-2002 MMM Public Service Annoucemnt]

The Lunar Rocket & Rover Co., Inc. has a secondary payload space available for a launch to suborbital space on its maiden Shadow I small launch vehicle. The payload space available has the dimensions of approximately 3.5 cm in Diameter by 29 cm in length.

Launch is planned to be from Cape Canaveral in the 2nd Quarter of 2003 or sooner if at all possible. The altitude reached will be approximately to 200,000 feet with a non-recoverable payload and burn-up in the atmosphere.

The Lunar Rocket & Rover Co., Inc. will have a number of the above sized payloads available for launches in the future and larger payloads approximately 13.5 - 17.5-inch diameter may be available in the future as well.

For details please contact:

Robert P. Kleinberger
Lunar Rocket & Rover Co., Inc.
11771 Harrisburg Road
Los Alamitos, CA 90720
Tel: (562) 596 - 7847
Cell: (562) 307 - 0234
Fax: (562) 596 - 2950
E-mail: robert.kleinberger@lrocket.com

Press Enthusiastic about Oregon Mousetronauts

from Bryce Walden <moonbase@attbi.com>

Oregon L5's Gus Frederick, who also wears hats for the Mars Society Oregon Chapter and the Oregon Public Education Network (OPEN), conducted an experiment with two mice in his Controlled Ecological Mouse Support System (CEMSS) at Skylight Cave in Oregon's High Cascades, September 27-29. Members of Oregon L5 Society, the Oregon chapter of the Moon Society, and surveyors from Pacific Survey Supply also participated.

Gus is preparing a website. Meanwhile, a photographer and reporters showed up, and here are a couple of the press articles:

CBSNEWS.com:

www.cbsnews.com/stories/2002/09/25/tech/main523274.shtml

Bend Bulletin Today:

www.bendbulletin.com/news/story.cfm?story_no=7906

Gus, chair of ORL5's Mars Instrument and Science Team (MIST), can be reached at MIST@OregonL5.org

Congratulations, Gus!

Mars Express seeks to pick up Life Search Where Limited Viking Probes Left Off

ESA Science News - <http://sci.esa.int> - 03 Sep 2002 /MMM

The Situation: Stuck on hold:

Of all missions sent to Mars only one, the **Viking 26** years ago, has dared to search for life. Its only conclusive result was that finding proof of extraterrestrial life proved to be much harder than expected. Second attempts never followed. Until now. ESA's **Mars Express**, the next mission to the Red Planet and the first European one, has an ambitious goal. To be launched in 2003, Mars Express will be the first spacecraft after Viking to search for direct and indirect evidence for past or present life on Mars. This time, scientists are equipped with more knowledge and insight in how to detect Martian life. The chances of success look very good.

Changing Expectations

The expectations regarding life on Mars have changed substantially since the Viking missions. Today's scientists are considering several alternatives:

1. Martian life exists, but the lifeforms are so small you can barely see them and they probably live underground
2. Martian life is not only small but also dead and extinct by now, so the search is for fossils, not living organisms
3. there is no life on Mars now and there never has been.

Each of the two Viking landers, launched in 1976, carried three biological experiments. All of them searched for microbes or microorganisms, or their 'signature', in soil samples. All three experiments, based on different concepts, quickly produced positive results. The thrill died down as scientists soon realised that a non-biological process could easily explain most of the results. Surprisingly, the non-biological process that had tricked scientists had not been anticipated by anyone prior to the launch.

This is all about to change

In December 2003 ESA's Mars Express will arrive at Mars and will follow a strategy quite different from that of the Viking. It consists of an orbiter plus a lander, called **Beagle 2**, "as an homage to the ship on which Charles Darwin found the inspiration to write his theory of evolution," says Agustin Chicarro, ESA Project Scientist for Mars Express, also pointing out that "indeed this mission could be as revolutionary as Darwin's ideas because it is the first one after the Viking to search for life."

A key difference between Mars Express and the Vikings is that now scientists are aware that they should also look for past, fossilised life. A few biological experiments are not enough. Mars Express's scientists will combine many different types of test findings, for example, to help discard contradictory results.

Key Instruments on the Orbiter

Some of the evidence will be indirect, mostly focused on the search for water. The Mars Express orbiter will have seven instruments on-board, apart from those on the lander Beagle 2.

1. One of these instruments will image the entire planet in full color, in 3D, at a resolution of about 10 metres.
2. Another will map the mineral composition of the surface with great accuracy. "These data will be key to determine how much water there was in the past, and from that you can estimate how much water there is left," says Chicarro.
3. A third instrument on-board the Mars Express orbiter will search for water below the surface, to measure the thickness of the layer of ice or permafrost, that is, a thick subsurface layer of soil that has a temperature below 0 C all year round.
4. Other studies will determine the amount of water in the atmosphere and the water cycle: how the water is deposited in the poles and how it evaporates depending on the seasons.

Beagle 2 to search on and under the surface:

The search for direct evidence of past or present biological activity will be the task of the lander, Beagle 2. Once deployed, in an area that was probably flooded in the past, Beagle 2 will unfold its robotic arm where most of the instruments are located. Beagle 2 carries several instruments, among them a gas analysis package that will determine whether carbonate minerals on Mars, if they exist, have been involved in biological processes. If there are certain gases on Mars, such as methane, that scientists believe can only be produced by organisms living either on the surface or below it, Beagle's 'nose' will detect them.

The feeble Martian atmosphere cannot prevent ultraviolet radiation from the Sun killing potential life. So it is important to get samples from below the surface, under large boulders, and within the interiors of rocks. Beagle 2 will collect samples with a mole able to crawl short distances across the surface, about 1 centimetre every six seconds, and to dig down to 1.5 metres deep. If the digging proves to be hard, a grinder will help access the rocks' protected interior. With all these available tools, Mars Express will be the best mission ever to discover life on Mars. There can be no place for life to hide from it.

LINKS

- Mars Express - <http://sci.esa.int/marsexpress>
- Launch Vehicle - http://spdext.estec.esa.nl/content/doc/83/2179_htm
- Lander, Landing site - http://spdext.estec.esa.nl/content/doc/8f/27791_htm
- Chances of life are linked to water - http://spdext.estec.esa.nl/content/doc/90/30352_htm

India's Updated Moon Mission Plans

MMM Special Report

based on several Internet source, including:
www.cnn.com/2002/TECH/space/08/13/india.moon/
and Reports from the recent World Space Congress

A Quick Rewind

We first heard of India's plans to launch a mission to the Moon in July, 2001. Shortly after that, the Indian Government sought to deflate runaway enthusiasm by pointing out that the government had yet to determine that the proposed mission was in India's overall best interests. But apparently, the Indian Space Research Organization (ISRO) is still serious about the proposal and "about 100 scientists from various disciplines have been working on the mission plan. [The Times of India / New Delhi - July 7 2001]

Focus of India's Space Program to date:

The prime objective of the Indian Space Research Organization (ISRO) has been to develop space technology and its applications to various national tasks. Since 1969, ISRO has launched the INSAT for telecommunication, television broadcasting and meteorological services, and the Indian Remote Sensing Satellites (IRS) for resources monitoring and management. ISRO has also developed the satellite launch vehicles PSLV (Polar Satellite Launch Vehicle) and GSLV (Geosynch. Satellite Launch Vehicle) to place satellites in required orbits. - <http://www.isro.org/>

ISRO continues to contemplate a big step forward.

The Task Force on an Indian Lunar Mission set up by ISRO has submitted its report to ISRO and the report has been sent to the Indian Space Commission and the government of India for approval and clearance. It is also under review among the scientific community. Professor Narendra Bhandari of Physical Research Laboratory gave a presentation on the program at the recent World Space Congress in Houston.

ISRO could launch India's first lunar mission in the 2006-7 time frame.

The Moon Mission Launch Vehicle:

India's reliable PSLV (Polar Satellite Launch Vehicle) can be used to launch a satellite into circumlunar polar orbit at an altitude of 600 km, to eventually, 100 km for the 450 kg orbiter payload contemplated.

Science Goals of the Moon Mission:

The small spacecraft would spend several years studying the moon with reflectometers, spectrometers and cameras concentrating on:

- photogeology and geochemical mapping of selected regions of the Moon
- stratigraphic correlation of various surface units in selected areas of the Moon

Strategic and National Prestige Goals

According to Dr. K. Kasturirangan, chairman of ISRO, the Moon Mission has these additional ulterior goals:

- provide a big boost to the cutting edge technology
- push India into an elite group, which would help India acquire a greater say in the exploration of lunar resources in the long run.

The Bottom Line

The projected cost of the Moon Mission is estimated to be around \$82.5 million. This compares with the \$69 prelaunch cost calculation for the Lunar Prospector Mission, launched by NASA in 1998. That mission returned many times the science data promised and has revolutionized our outlook on the Moon. With the right choice of instruments and good targeting, India's Moon Mission could accomplish much, and downplaying it as a stunt in advance should be recognized as a cheap shot.

IRS Data Applications

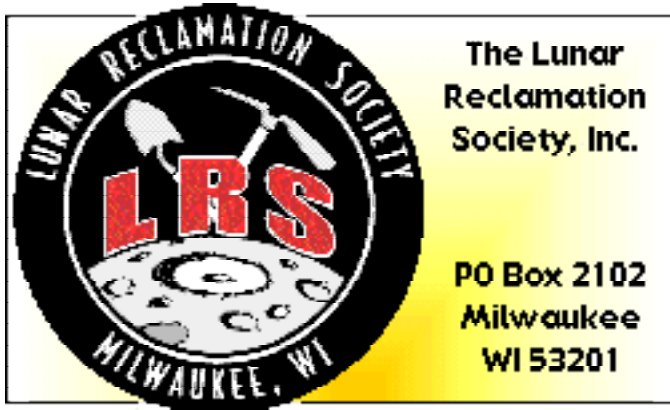
India's Remote Sensing Program is extensive and commands respect. Data from the Indian Remote Sensing Satellite is used for various applications of resources survey and management under NNRMS, National Natural Resources Management System.

- Preharvest crop acreage and major crop production estimates
- Drought monitoring and assessment based on vegetation condition.
- Flood risk zone mapping and flood damage assessment.
- Hydro-geomorphological maps for locating underground water resources for drilling well.
- Irrigation command area status monitoring
- Snow-melt run-off estimates for planning water use in down stream projects
- Land use and land cover mapping
- Urban planning
- Forest survey
- Wetland mapping
- Coastal studies
- Environmental impact analysis
- Mineral Prospecting
- Integrated Mission for Sustainable Development for generating locale-specific prescriptions for integrated land and water resources development in 174 districts.

Centers of India's Space Program Activities:

http://WWW.ISRO.ORG/isro_centers.htm -- India's Dept. of Space (DOS) has established a network of some 19 space activity centers throughout India, to bring its Economy and Industrial Complex into the Space Age; Among these are:

- Bangalore, Karnataka - ISRO Satellite Center.
- Ahmedabad, Gujarat - Space Applications Center
- Thiruvananthapuram - Space Physics Laboratory
- Lucknow, U.P. - Telemetry, Tracking & Command
- Dehradun, U.P. - Indian Institute of Remote Sensing
- Hyderabad, A.P. - National Remote Sensing Agency
- Shar Sriharikota - Main Launch Center </MMM>



The Lunar
Reclamation
Society, Inc.

PO Box 2102
Milwaukee
WI 53201

www.lunar-reclamation.org

Ad Astra per Ardua Nostra

To the Stars through our own hard work!

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(* LRS Board Members, plus Ken Paul 426-0432)

LRS NEWS

• **LRS Reworganization & self reinvention efforts continue:**
Recently, Ken Paul has joined the LRS Board which now consists of three active members: Paul, Robert Bialecki, and Peter Kokh. Attention is being given to membership retention, membership recruitment, MMM, and development of lively Meeting Agendas.

LRS DECEMBER Events

 **Saturday, DEC 14th, 1-4 pm**

LRS Chapter Meeting, Mayfair Mall, Garden Suites Room G110 (lower level, NE part of Mall) near the ground-level entrance below Cinema complex.

Annual pre-Holiday Pot-Luck & classic Science Fiction Film:

(DVD) **Forbidden Planet:** Walter Pigeon, Leslie Nielsen

- Joint event of LRS, Wisconsin Mars Society (WMS), and Moon Society Milwaukee Outpost (MSMO)
- New MSMO & WMS Space Exhibits will be on Display
- Spare MMM Back Issue Copies available for the taking
- Unannounced Goodies & Door Prizes

LRS JANUARY Events

 **Saturday, JAN 11th, 1-4 pm**

LRS Chapter Meeting, Mayfair Mall, Garden Suites Room G110 (lower level, NE part of Mall) near the ground-level entrance below AMC Cinemas. JANUARY AGENDA to be announced

U.S. CHAPTERS



NSS
Chapter Events
MMM
8 Chapters Strong

Space Chapters HUB Website:

<http://nsschapters.org/hub/>

OREGON




**Oregon L5
Society, Inc.**

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

<http://www.OregonL5.org/>

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

 Meetings 3rd Sat. each month at 2 p.m.

Bourne Plaza, 1441 SE 122nd, Portland, downstairs
NEXT MEETINGS: **NOV 16, DEC 21, JAN .18**

Article on Gus Frederick's Cotrolled Ecological Mouse Support Systems experiments on page 14, this issue.

WISCONSIN



**Sheboygan
Space Society**

728 Center St., Kiel WI 54042-1034

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

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

<http://www.tcei.com/sss>

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

NOV 18th Foerster Academy of Dance, Sheboygan

DEC 16th MEETING at the Stoelting House in Kiel

JAN 20th Foerster Academy of Dance, Sheboygan

• On Thursday, October 24th, we had **Nagin Cox** give a presentation at UW-Sheboygan. Nagin is an engineer at JPL. Her talk centered around her experience with the Galileo mission at Jupiter. She is currently working on the Mars 2003 Rover mission. Nagin showed us a short video on the plans for Mars also.

MINNESOTA



Minnesota Space Frontier Society

c/o Dave Buth, 5120 Ewing Avenue North,
Brooklyn Center, MN 55429

Dave Buth (w) (612) 333-1872, (h) (763) 536-1237
612-375-1539 (Jeff Root)

Email: mnsfs@freemars.org

www.FreeMars.org/L5/index.html

• **Saturday, November 16, L-5MN/MnSFS's 23rd Annual Election** after a pot luck dinner beginning at 6 PM in the party room. Some Martian videos! Offices open & their current nominees are:

- **Executive Director:** David Buth (incumbent)
- **Assistant Director:** Rich Brown (incumbent)
- **Secretary:** George Anderson (incumbent)
- **Treasurer:** Kevin Wilson (incumbent)
- **State Councilor 1:** Scott Shjefte (incumbent)

Event Location: Centre Village Party Room, 433 So. 7th St., Minneapolis (612) 333-1872

CALIFORNIA



OASIS: Organization for the Advancement of Space Industrialization and Settlement

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

Events Hotline/Answering Machine: (310) 364-2290

Odyssey Ed: Craig Ward - cew@acm.org

E-mail: oasis-leaders@netcom.com

<http://chapters.nss.org/oasis>

Odyssey Newsletter Online

<http://www.geocities.com/CapeCanaveral/Lab/4005/articles.html>

Regular Meeting 3 pm 3rd Sat. each month

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

DEC 14th -- Business Meeting at location TBD - note: this is the **2nd Saturday**. Christmas Party follows.

JAN 18th -- Business Meeting at location TBD

Recurring Events

- **The Griffith Observatory** is undergoing renovations and upgrades to reopen in 2003.
- **Fridays, 7 pm "Night Sky Show."** -- **8 pm** Guest lectures. Santa Monica College John Drescher Planetarium, 2nd Floor Technology Bldg, 1900 Pico Blvd. \$4 per show or \$7 for both. 310/452-9223

www.smc.edu/events/weeklyeven.

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

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>

Note : PASA is now on the tripod.com system

- **PASA regular business luncheon/formal meeting** from 1-3 pm, the **3rd Saturday** of every month (except 2nd Saturday this March), 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.

NEXT MEETINGS: NOV 16th, DEC 13th (2nd Sat.) for brunch at the Marriott Center City during Philcon
#Special Meeting Location: The Franklin Institute#

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

From Earl Bennett <EarlBennett@erols.com>

- **October 19th Meeting Report:** *Gary Fisher*, peripatetic President of the Independence Chapter of the Mars Soc. reported on the forthcoming Nov. 3rd visit of Robert Zubrin to our vicinity (SE PA) in the Lehigh Valley. More information at: www.lvaas.org/activities/banquete.html. He reported on continuing work on the Mars Desert Research Station's Greenhab Unit and on the people doing it: a Professor Kangas and a student traveled from Maryland to work on the project. When you're "out there" you have to cover everything, unlike here, where one group member could go back many a mile to town for needed materials for the Green Hab and, when someone became ill, go back to Civilization if necessary. The work continues with bioprospecting being considered, looking for ways to close the loop on waste water and matter treatment. Duck grass was being used as part of the process with the water being used for toilet flushing initially. This was not the envisioned use nor was flush toilets returned to after quite some effort to use The Insinulet, incinerating toilet (power hog), and The Biolet composting toilet which caused odor problems. This last would not be funny in space. Think: smells = long term toxin. Water assay kits are being brought out to the site to

see if the purification is up to at least wash water quality. Canadian participants would like stay for a month as researchers starting late October. Gary also reported that several analog rovers were progressing toward completion. Much discussion and comment with this report.

Mitch Gordon reported on The Future of Medicine talk of the World Future Society with professors from The University of Pennsylvania and Thomas Jefferson Hospital as speakers on November 20th. He also reported on efforts to create a meeting space for us and other groups, having us send representatives to a local television show (WYBE, channel 35) to do public outreach. The group thought that Mitch should at least be one of the people, if not primarily, at least as a member of the "on camera" team. We all need members and shows like "Philly Live" can give us that extra memory boost for a potential advocate.

Hank Smith reported on the move of P.S.F.S, the Philadelphia Science Fiction Society, to a new location at The Franklin Inn Club in center city at 13th and Camac. This will commence in January 2003. We also discussed the upcoming Philcon Convention in December and our peoples' participation and the need for biographical information to be given Hank. He also told us that Phil Casey will head P.S.F.S in 2003, that more event info. is at www.philcon.org

Rich Bowers, founder of our parent organization in 1976, came to the meeting as did Janet (guest) and much lively discussion happened with contributions from the aforementioned as well as past President Michelle Baker and other members from a seed in Ad Astra on space commercialization. The Space Commercialization Act (in force) and the Space Exploration Act (proposal) where both brought up and in particular claims to an area on the Moon by a resident, not just an explorer or flag planter, for 600K square miles with regular resupply drew added talk. Gary Fisher pointed to his talk at the Mars Society 2001 Conference (Toronto) on self governance for Mars which anticipated some of the current proposal for the Moon. Who owns what on other celestial bodies is important as no truly major projects will be financed without clear answers.

Earl Bennett gave brief reports on articles in Analog Science Fiction & Fact by Ben Bova on The New Outlook for Astrobiology which includes how Ames Research Center became the lab primarily responsible for this work. December 2002 issue. NASA Tech Briefs for October had an article with the title "Robotics Plays a Key Role in Manufacturing Productivity" which actually has some good material on cooperation by LEGO and National Instruments (an industrial and scientific instrumentation/software supplier) who worked together on the Mindstorms robotics systems. The N.A.S.A Robonaut was also featured. The last tech item mentioned is the ongoing dialog in The Industrial Physicist on "Solar Power Via the Moon" which originally appeared in the April/May issue. The Oct./Nov. issue had a number of letters and responses, from author

David Criswell on why the idea that many of our older members are quite familiar with would work and be profitable. Even people in specialized area like microwave power transmission, signal propagation and radar systems can have questions that need clarification for this application and Dr. Criswell (dcriswell@houston.rr.com) gives well reasoned answers to them. Interested parties should read the background material at www.tipmagazine.com, www.worldenergy.org/wec-geis searching for Criswell or lunar solar power or.....

Last but not least: Space Station the new OmniMax movie was the reason we convened at The Franklin Institute in Philadelphia. Our theater has a large curved screen so you are "in" the scene much more than most films. Excellent presentation. Individuals will also go to the opening of Space Command at the planetarium, which has been refurbished, of the Institute in the near future.

OHIO



Cuyahoga Valley Space Society

3433 North Ave. Parma, OH 44134-1252

c/o George F. Cooper III, Phone 216-749-0017

E-Mail: geocooper3@aol.com

Monthly Meetings, the 4th Thursday each month

7-9:15 pm, Parma Regional Library

NEXT MEETING DATES: Wed. NOV 20th, DEC ??

September 25th Meeting Report: We met at the Parma Regional Library. We had a NASA speaker. Ruben Ramos spoke about the early history of rocketry. After the meeting, we adjourned to Wendy's. We held the CVSS picnic on September 29th at Annette and Jim Wood's home in North Ridgeville. We thank Annette and Jim for the use of their home and outdoor grill. We sat around the Woods' picnic table enjoying the sunny day, talking. We heard the tale of the angry woodpecker as evidenced by the back wall of Annette's house. Again, thank you Annette.

We were set to meet on October 30th, the last Wednesday of the month, the day before Halloween, at the Parma Regional Library: discussion topics: (1) the Space Age began with Sputnik 40 years ago on the 4th. What do you remember of the major events of the Space Age? (2) What books most influenced your interest in Space? (3) What video do you have that relates space and Halloween?

We meet during the third week of November, on Wednesday the 20th at the Cleveland Museum of Natural History in basement meeting room B, and will have a chance to see the planetarium show.

Membership fees for 2003 are due in December. Come January, Moon Miners' Manifesto will no longer be a membership benefit. Members can subscribe individually.

NAME _____
 STREET _____
 CITY/ST/ZIP _____
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\$38 NATIONAL SPACE SOC. dues includes *Ad Astra*
 \$20 NSS dues if under 22 / over 64. *State age* ____
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Moon Miners' MANIFESTO

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