

# Moon Miners' Manifesto

& Moon Society Journal

[www.lunar-reclamation.org/mmm/](http://www.lunar-reclamation.org/mmm/)

# 175 – May 2004

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## In Focus: Space Exploration Alliance:

<http://www.nss.org/news/releases/pr20040508.html>

May 8, 2004    In an unprecedented show of unity, thirteen of the nation's premier space advocacy groups, industry associations and space policy organizations have teamed up to support the effort to refocus NASA's human space activities toward exploration, including a return to the Moon and moving on to Mars and beyond.

The organizations involved include: The Aerospace Industries Association, The Aerospace States Association, American Astronautical Society, American Institute of Aeronautics and Astronautics, California Space Authority, Florida Space Authority, The Mars Society, National Coalition of Spaceport States, National Space Society, The Planetary Society, ProSpace, Space Access Society and Space Frontier Foundation.

Collectively these groups can count almost one million Americans as members or as employees of member companies. Their first goal as a group is to work for broad Congressional support of the new national vision for space exploration outside of low earth orbit, which they refer to as Moon, Mars and Beyond. To begin they will work to secure first year funding for the initiative, which they view as a necessary first step for in-depth planning of the exploration

## “It's time for Moon, Mars, & Beyond”

program to commence in earnest.

In addition they intend to aggressively refute the false impression that Moon, Mars and Beyond is too expensive for this country to take on. They will demonstrate how modest but steady growth in our national expenditures on space can move the nation toward these important goals, and the benefits those expenditures will provide.

As space activity becomes increasingly integrated with every aspect of life here on earth, this new focus on exploration will provide myriad advances in science and technology, untold economic opportunity and serve as an inspiration to our nation's youth. Given those benefits and the many more that lie in store, this new program of human space exploration beyond low earth orbit is a vital link to the future of the United States and the world.

**Comment:** Amending an oversight, the Artemis Society and Moon Society have been invited to join. The importance of this joint declaration is to dispell any impression that the pro-space community is divided in its reaction to the Bush Administrations's new space initiative. While there are differences in emphasis, all of the above groups favor expanded space exploration leading to a permanent human presence in space with self-reliant communities.    PK

### House-scale Biospherics Testbed in Indiana

Terry Ryan Kok has been doing biospherics experiments in SW Central Indiana (Needmore/Bedford area) for more than a decade. At right is his door-top model for a “home scale total recycling for self-sufficient living” that he calls the **TerraVita – Ecoark Prototype**.

You can read more about it at

<http://www.magickmonkey.com/aeonecotechnics.html>



# Moon Miners' Manifesto

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- **MMM** is being reedited for the World Wide Web by members of Artemis Society International. => [www.asi.org/mmm](http://www.asi.org/mmm)
- **MMM's VISION:** "expanding the human economy through off-planet resources" -- the early era of heavy reliance on Lunar materials; earliest use of Mars system and asteroidal resources; and the establishment of the permanent settlements necessary to support such an economy.
- **MMM's MISSION:** to encourage "spin-up" entrepreneurial development of the novel technologies needed and promote the economic-environmental rationale of space/lunar settlement.
- **MMM retains its editorial independence.** MMM serves several groups each with its own philosophy, agenda, and programs. Participation in this newsletter, while it suggests overall satisfaction with themes and treatment, requires no other litmus test. Any presumption that participating organizations can be labeled by indirect mutual association is unwarranted.
- For the current space news and near-term developments, read **Ad Astra**, the magazine of the **National Space Society**, in which we recommend and encourage membership.
- **The Lunar Reclamation Society** is an independently incorporated non-profit membership organization engaged in public outreach, freely associated with the National Space Society, insofar as LRS goals include those in NSS vision statement. LRS serves as NSS' Milwaukee chapter  
=> [www.lunar-reclamation.org](http://www.lunar-reclamation.org)
- **The National Space Society** is a grassroots pro-space membership organization, with over 25,000 members and 80 chapters, dedicated to the creation of a spacefaring civilization.  
The National Space Society, 1620 I Street NW, Suite 615, Washington, DC 20006; Ph: (202) 429-1600 <= **NEW HQ**  
FAX: (202) 463-8497; [nss@nss.org](mailto:nss@nss.org) => [www.nss.org](http://www.nss.org)
- **MMM's desktop publication** has received ongoing support (computer hardware and software) from the **Space Frontier Foundation**, 16 First Ave., Nyack NY 10960; 800-78-SPACE - SFF seeks to open the space frontier to human exploration and settlement as rapidly as possible.  
[openfrontier@delphi.com](mailto:openfrontier@delphi.com) => [www.space-frontier.org](http://www.space-frontier.org)
- **The Moon Society** is "dedicated to overcoming the business, financial, and technological challenges necessary to establish a permanent, self-sustaining human presence on the Moon." — See contact information on page 9.
- **NSS chapters** and **Other Societies** with a compatible focus are welcome to join the MMM family. For special chapter/group rates, write the Editor, or call (414)-342-0705.
- **Publication Deadline:** Final draft is prepared ASAP after the 20th of each month. Articles needing to be keyed in or edited are due on the **15th**, *Sooner is better!* - No compensation is paid.

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\* *Handwritten submissions may be ignored.*

## NSS to Aldrige Commission: Explore to Create a Spacefaring Civilization

<http://www.nss.org/news/releases/pr20040505.html>  
May 5, 2004 WASHINGTON, DC - National Space Society Executive Director George Whitesides testified at the final hearing of the President's Commission on Moon, Mars and Beyond in New York City. Committing NSS to support the Exploration Vision, Whitesides urged the Commission to closely integrate public participation and private industry, while emphasizing that the goal of exploration must be space settlement.

"We must all evangelize an exploration society predicated on settlement," stated Whitesides. "This, ultimately, is the real cause for the exploration we seek: to create a spacefaring civilization - a civilization of vibrant communities living and working beyond Earth."

NSS has long advocated a roadmap for exploration that is reflected in the architecture of the new vision. Returning to the Moon and on to Mars is the right way to move forward, as long as it builds infrastructure and capacity of private industry along the way.

"The degree to which this initiative stimulates and establishes private enterprise throughout the solar system will be the central indicator of whether it will have a lasting impact on our society." Whitesides continued: "Settlement is the destination for exploration's efforts; without it, exploration is a dead end."

The National Space Society will be announcing a major campaign to support the Vision at its annual conference, the International Space Development Conference, May 27-31. This will include local, regional and national education campaigns to promote space exploration.

"Exploration is a truly noble goal. It is worthy of society's strong support, worthy indeed of weaving into the very fabric of our civilization. It expands the perspective of us all - at a moment in history when such perspective may be the key to solving our most intractable problems."

## NOTICE – NOTICE – NOTICE

from Peter Kokh, MMM Editor, [kokhmmm@aol.com](mailto:kokhmmm@aol.com)

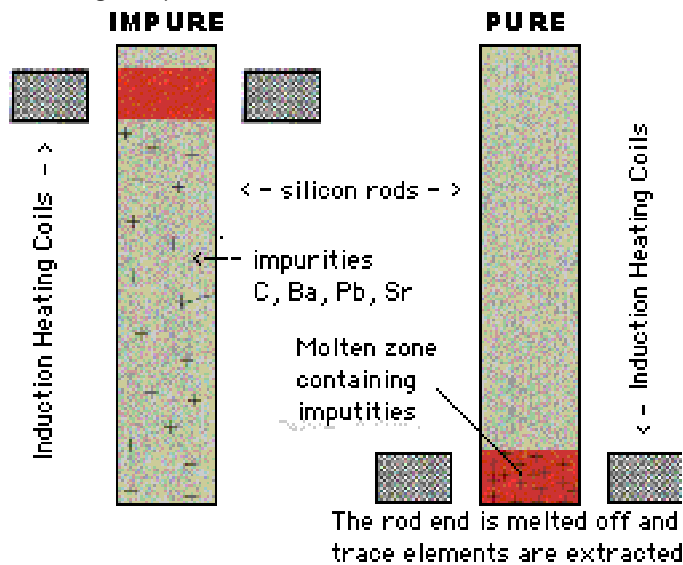
To avoid passing on new steep printing cost rises to our client chapters, to the Moon Society, and to our individual subscribers, it is necessary for us to make the following three adjustments:

- The 2 **Moon Miners' Review** issues (July and January) will be dropped - The 10 **Moon Miners' Manifesto** issues will be published as usual, with the following changes
- The slightly gray, heavier weight cover sheet with the pre-printed blue moonscape has been replaced by plain white paper with the moonscape in grayscale.
- The blue centerfold sheet has been replaced with white paper. Thank you for your continued support!

## Zone Refining in Space and on the Moon: Extracting pure metals and other elements from the Moon's pulverized surface blanket.

by Dave Dietzler <Dietz37@msn.com>

On Earth, ultra-pure silicon is obtained by zone refining. Basically, a silicon rod is lowered through an electric heating coil. As the red hot molten zone moves along the rod impurities that are more soluble in the molten zone are swept along. Surface tension holds the rod together. This must be done in an inert gas filled container or the red hot molten zone will start to oxidize. Only small four inch long rods are purified this way. Huge rods would fall apart in Earth's gravity.



Above:Left: induction coils start to move down along the rod  
Above Right: The coils have reached the bottom and all the impurities have traveled to the bottom in the melt zone.

### What about Zone Refining in Space, or on the Moon?

In space, such limitations do not exist. We could zone refine metal rods amassing tons and do it in the pure vacuum without the necessity of an inert gas filled container. It might even be possible to focus the Sun's rays on the rods instead of using electric heating coils. Any metal can be purified this way in space, including metals that would fall apart in Earth's gravity or catch fire easily.

Zone refining is also advantageous because it does not require any chemical reagents or water which is so precious on the Moon and it concentrates impurities in the molten end of the rod after refining is accomplished. It will be easier to extract trace elements that compose the impurities once they are concentrated.

To build Solar Power Satellites, we need lots of pure silicon. We could go with aluminum foil reflectors and turbo-generators, but those need more maintenance and a larger crew than thin film silicon panel powersats will. Silicon can be extracted directly from moon dust with fluorine gas. The silicon tetrafluoride gas that forms can be

decomposed with heat and the silicon can then be zone refined.

We can also produce silicon in other ways. If roasted and magnetically beneficiated moon dust that has had all the iron removed is leached in sulfuric acid (the most produced industrial chemical also called the "bread of chemistry") a solution of magnesium and aluminum sulfate with trace sulfates will result that can be filtered off and then refined to get magnesium, aluminum and other metals. Silica (SiO<sub>2</sub>), calcium sulfate and some calcium trisilicate slag will remain. These could be separated with washing and/or electrostatic separation (needs some investigation).

Since barium, lead and strontium, present only in traces in lunar soil, do not form soluble sulfate salts they will be present as impurities in the silica and CaSO<sub>4</sub>. There could also be some insoluble chromic sulfate salts in there. This won't make much difference for the CaSO<sub>4</sub> because that is going to be used for plaster or calcined to get lime, the active ingredient in cement and an ingredient in soda-lime glass.

The silica (silicon dioxide) can be reduced to silicon in a solar furnace with carbon at about 1700 deg. C. This avoids corrosive fluorine gas and is the conventional way to make lots of silicon. Now we have silicon contaminated with carbon and a little lead, strontium and barium. All we have to do is take our multi-ton rods of silicon and zone refine them until we get pure silicon in huge quantities to make giant powersats.

The carbon which is rare on the Moon must be recycled. Carbon monoxide generated during reduction will be shifted to methane and water which are more easily decomposed. Carbon in the rod ends, along with lead, strontium, barium and perhaps some chromium will be concentrated. [See illustration at left.] Some hydrofluoric acid and not very exotic chemistry could get all those separated. There is only about 3 ppm of lead in regolith, so we won't be rich with the stuff, but all we want it for is to tint glass red. After refining millions of tons of moon dust we could have a couple of tons of lead, and that should make plenty of red glass.

Magnesium and aluminum-silicon alloys obtained by solar silicothermic and carbothermic reduction of magnesia and alumina obtained from the sulfates obtained during sulfuric acid leaching could also be zone refined to get tonnages of pure metals on the Moon or in free space. Zone refining will concentrate trace elements and make them easier to extract.

As a rule, it is easier to extract more concentrated elements than it is to extract traces. Chromium and manganese, present in raw moon dust at about 2000 ppm each, will be present in the Al/Si alloy obtained by solar smelting. Vanadium, zirconium and yttrium, present at about 114 ppm, 311 ppm and 84 ppm respectively in raw regolith, will also be present. If these can be concentrated into the

rod ends and then extracted and separated, we will do well. Vanadium is used for titanium alloys, making tool steels and as a sulfuric acid making catalyst in the form of vanadium pentoxide. Zirconium is used in magnesium alloys and nuclear fuel cladding in fission reactors. Yttrium can strengthen magnesium and aluminum alloys, and that is of great importance on the Moon where copper, a major aluminum alloying ingredient, and zinc which is used to alloy magnesium, are rare. If we find lunar Sudbury type impacts this might not be such a problem. We keep our fingers crossed.

Zone refining in space needs to be investigated on the ISS. We must show the way to the future. We could also use a centrifuge on the ISS with white mice in it to see what happens to mammals in lunar 1/6th and Martian 3/8ths gravity fields for long periods of time also, because it looks like we are going to be working up there.

**Summary:** If my hunch is right, and we can zone refine in space and on the Moon in larger batches (using larger rods) then can get super pure materials with a simple process that doesn't require any reagents. In the process, we zone refine and melt off the end containing impurities. Then we zone refine in turn a rod made of those concentrated impurities. The end result -- a highly enriched concentrate of moodust trace elements.

Since zirconium and vanadium are trace elements at around 100-300 ppm, we might get some decent amounts of these. Zr can give magnesium higher temp. strength and resistance to combustion, although Zr itself is highly combustible. V can be used in tool steels and Ti alloys.

#### **Implications for providing badly needed color.**

It didn't dawn on me that we could concentrate lead by zone refining, until I started to write this piece. Lead is present in lunar regolith only in parts per billion, and so is not otherwise economically producible. Now we have some red glass to go with the cobalt blue glass and the white washes. This is one patriotic Moon city. Add all that polished metal, pyrite coated iron, rusty stone, shiny black basalt and what have you including some green plants and flowers and this place is becoming livable. Hell, we're living there already in our imaginations. Some people would think we was crazy. What do you think of prisms to cast rainbows of color around?? And birds of many colors. <DD>

**Editor's note:** Lead is also essential for high gloss ceramic glazes and without it, we will only be able to produce matte finishes. Lead would also be the "dopant of choice" in making low temperature glass matrix for glass-glass composites. But we can do almost as well with sodium and phosphorus.

Lead is an alloy ingredient of pewter, and has many industrial applications. The only other suggestion to provide lead in desirable abundance that seems viable (besides importation and zone refining) is biological processing, using microbial cultures with an affinity to lead to help concentrate it to the point where it can be economically isolated.

## **Coloring the Moon – anything but Gray!**

A February 16, 2004 email exchange between Dave Dietzler <Dietz37@msn.co> (Moon Society St. Louis) and MMM Editor, Peter Kokh <KokhMMM@aol.com>

**PK** To build of brick and mortar in lavatubes we'll need some sort of pressurized envelope. We've talked about self-sealing tubes via water vapor freezing in the cracks. Works as long as there is no freeze-thaw cycling going on. Could be tricky. I think we need to find a tube, secure the entrances, generate water vapor and then simulate the kind of fluctuating heat-flow that would come from expected human activities of all kinds, and do this for a couple of years as a test. What do you think?

**DD** Yes. If we are lucky, those lava tubes won't even be that porous. Also, the sub-selene temp. is a fairly constant minus four Fahrenheit. Might not have a freeze-thaw cycle. More investigation is called for. One more job for the early research base!

**PK** I also suggested use of colored lights and/or colored glass lamp diffusers for casting color shades on whitewash surfaces etc.

**DD** that's a good idea. One little piece of colored glass and many, many square meters of colored area, and you can change it as you like much easier than if it was painted. Have you ever been to a commercial cave where they use colored lights to decorate within? Meramec Caverns about 60 miles from here [St. Louis, MO] which was also Jesse James hideout is decorated that way. A purist might shudder, but I think they achieve beautiful effects with colored lights there. I haven't been there in years and I suppose they still use colored lights and have not become purists.....

**PK** Remember the early recycled plastics with swirls of variegated colors within a narrow range of shades? I think we could do naturally variegated gray tones with ceramics, raw glass, and cast basalt products.

**DD** I don't remember, but we can certainly do grays and black. They can make biodegradable plastic from corn these days. I think they can from soybean also. Don't know much about the colors.

**PK** Next easiest would be to steam the free iron content and make all sorts of ochre-hued regolith products. We could do this before we have the ability to separate out the elements needed to make metal oxide pigment powders.

**DD** Could we tint the lava tube walls that way???

**PK** Paints: have you noticed that some stores now sell special latex paints that are environment friendly i.e. low-volatiles? I wonder what is involved in that. If we are going to use paints indoors, with no fresh air exchange, volatile emissions are going to have to be tightly controlled. We may have to paint things in factory conditions and sell only cured painted objects, i.e. no paints for the do-it-yourselfer that are not near zero-emission of troublesome volatiles. <MMM>

## A Private Enterprise Teleoperation Potpourri could be an Overture to a Return to the Moon

by Peter Kokh

Those of us interested in establishing private/free enterprise on the Moon have realized for quite some time that grandiose "clean energy for Earth with lunar resources" schemes are not the place to start. With horrific amounts of up front capital needed and a decades-long wait for first "returns-on-investment," such plans are currently untouchable, however attractive.

No, we have to start small, terracing one humble quick-paying business plan on another. Indeed, there have been a number of start-up proposals, most involving "vanity products."

- ▣ sales of land - rather disreputable, because no one has title to land on the Moon, a prerequisite for selling any
- ▣ crash landing personal items on the Moon: from business cards to personal archives of text and photos
- ▣ crash landing of a "pinch" of one's personal "cremains"

Applied Space Resources was the first to explore the Archive idea. They concentrated on archive sales but had no vehicle to get the archive to the Moon except one on paper. Now TransOrbital, with an actual vehicle, Trailblazer 1, seems poised for launch. It would do orbital photographic surveys at unprecedented resolution, and at the end of its mission, crash into the Moon's surface bearing an impact-surviving canister of archival materials.

Popular interest in such archives, planned to survive for thousands of years, has been light. MMM's first article will be aboard the Trailblazer canister, however. It is time to ramp up to the next step, costing more money, but probably also guaranteed to spark more interest:

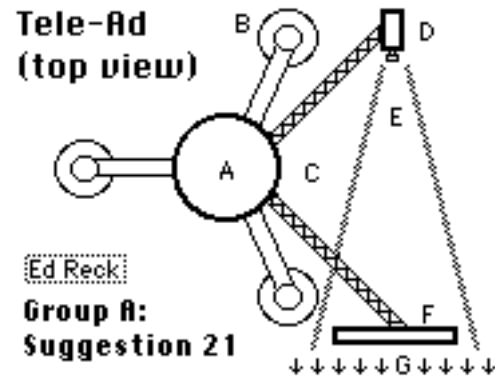
### Teleoperable Landers & Lander-Rovers Racers, Message Boards, and More

Applied Space Resources, Luna Corp, and Carnegie Mellon University have all had detailed blueprints for lunar landers. Alas, without viable business plans, none of these efforts are still alive. The dust-gathering plans are a place to start, however, for anyone who would take up the challenge anew. With 22 start-up companies in the race for the X-Prize, which may be won yet this year, interest in private enterprise space ventures is vigorous and growing.

So we dust off those plans, taking the best of each and put together a teleoperable lander or lander-rover. What ventures could be built on such a platform? Plenty!

Several Moon-soft-landed teleoperable for-profit ventures have already been suggested. In one scheme, two identical teleoperable rovers would be available for tele-driven races, with the Earthside drivers selected by lottery or highest bid. If the racing rovers survived the event, they could be raced repeatedly, as long as public interest was high enough to generate good money.

The 1995 First Contact Science/Science-Fiction Convention in Milwaukee featured a "Commercial Moonbase Brainstorming Workshop." [See MMM # 91 DEC '95, p 14. Commercial Moonbase Brainstorm Workshop] at which perhaps the most interesting suggestion was that of artist Ed Reck who proposed a lander with a power and communications package [illustration below]



Ed Reck

### Group A: Suggestion 21

- A. lander core; B. One of three landing pads
- C. retractable booms; D. videocam
- E. Videocam's field of view
- F. Electronic message board tele-changed from Earth
- G. Background scenery.

Ed's idea was simple. Earth-bound romantics could send greetings messages ("I love you, please marry me"; "Honey, please forgive me"; Happy Birthday, Happy Anniversary, Happy Valentines Day) or product/service advertisements to be displayed on the electronic message board against a real live moonscape background. This idea is simple and could be accomplished with highly miniaturized equipment, and thus a smaller power pack and landing vehicle.

As for investors, this enterprise would appeal to many: Hallmark, E-cards, AT&T, and new entrepreneurs. The message board would include Earth-time (Universal or in the time-zone of the sender or targeted recipient. It could include local Moon time (day of the sunth) and even an inset window onto a tag-along lunar sundial. Messages could be public, or private (costlier?) As to background moonscape, this could be static or panned. Of course, you would want your Lunar Messenger to land in a scenic location!

If the Message Board was high resolution, it could showcase photographs and pieces of art as well as simple messages. Advertisements could incorporate logos and pictures of products or service providers or customers.

Another idea would be to land a server or an Internet relay on the Moon, for "Moon-based Chat Rooms" and Moon-relayed email messages. This might not be an independently viable venture, but it seems to be one that could be piggybacked on the Lunar Messenger above, for added income. Indeed, any such business plan should brainstorm a wide variety of piggyback-worthy ventures that could be supported on the Messenger Lander without adding significantly to its weight or power demands.

## Tele-Crafted Art Objects

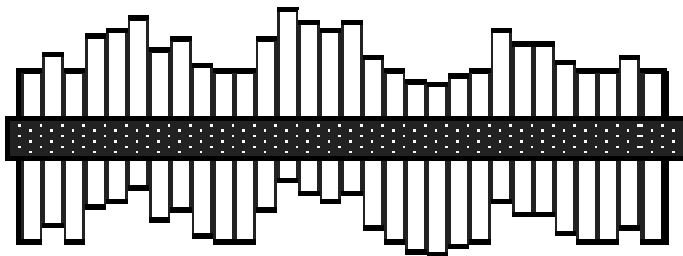
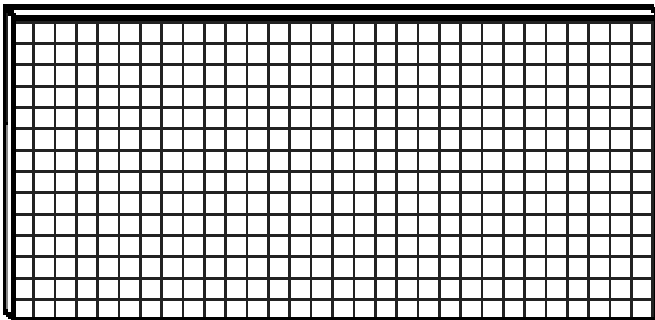
The next step beyond Moon-relayed messages and advertisements could be tele-art. We are still in the realm of products delivered to Earth-bound customers electronically, no physical objects shipped. What more could tele-operable landers and lander rovers do or produce for telesales on Earth? As with video games, progression from the first ping-pong games to today's multi-megabyte games played on high definition screens, the potential for progress from first humble offerings to sophisticated products is great. And what better prospectus could you have for a tele-operable space enterprise!

The idea is simple. The lander, or lander-rover is equipped to make things in, or out of, the regolith moon dust at its location, and relay photos of these creations back to Earth for the enjoyment of their telecreators, gift-recipients, and others. What are the possibilities?

Drawing in the moon dust with a "stick" or wand: the moon dust is cohesive enough to hold crude shape. The crisp Apollo bootprints are ready proof of that.

Getting beyond the stick, a stamper made of tele-extendible pixel rods or bars could stamp any sort of pattern/picture in the soil, dependent on its "resolution" (pixels high by pixels wide).

Illustration: top view suggestion; below: side view example.



The ability to "fix" the stamping by microwave sintering would be an asset. People could order "moon bricks" (to remain on the Moon but with their photos relayed back to the person placing the order) with their own name or the name of a beloved or departed person. The stamping could be a handprint or footprint or bootprint. Or it could be a simple

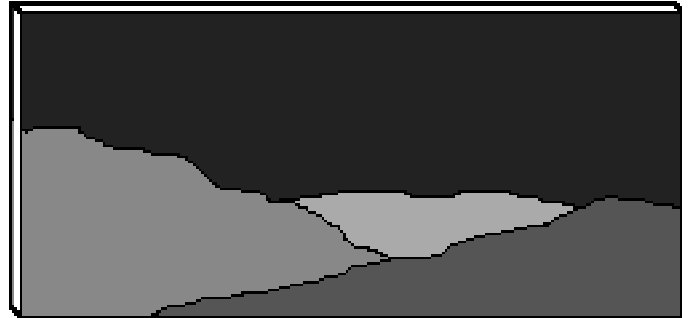
message. The apparent drawbacks of this idea are (at least) these three:

1. the scale would probably have to be large, if keeping with the degree of detail and resolution desired

2. the lander rover would have to keep on the move, as it would quickly run out of stampable terrain within reach of its landing spot.
3. if microwave sintering is used to ensure "permanence" the power requirements of the rover would be greater

The next step beyond simple stamping would involve altering the moon dust to telecreate art objects and sculptures out of crude moon glass and ceramics. Once we get beyond simple microwave sintering, the power demands go up along with the temperatures involved. Iron fines gathered by a magnet, could be shaped and sintered (powdered metal technology) into objects of art. Glass making would be more ambitious. A solar concentrator mirror could supply the high temperature needed. Designing tele-shapable mold apparatus would be the trick. But perhaps someone out there is up to the challenge.

Quite another idea is to sift the moon dust and then run it through an apparatus capable of sorting the particles for shade and color. A teleartist on Earth could draw on the bin sorts to create "sand paintings" in twin-paned glass frames open at the top, and webcast to Earth. If these could be preserved somehow, they could be traded on some sort of Art Futures market, against the day further into the future, when they might be retrieved and shipped to the high bidder on Earth.



The same sort of thing could be done with glass spherules sorted from the moon dust, and again sorted for color. The visual effect and texture of the "painting" would be different and richer. The coarser rock and aggregate bits removed by the sifting process, could always be added back in, sparingly and deliberately placed for the desired accent. Preservation of such art objects could be by microwave sintering. The big trick is to supply, or make, a suitable durable substrate for these fragile creations.

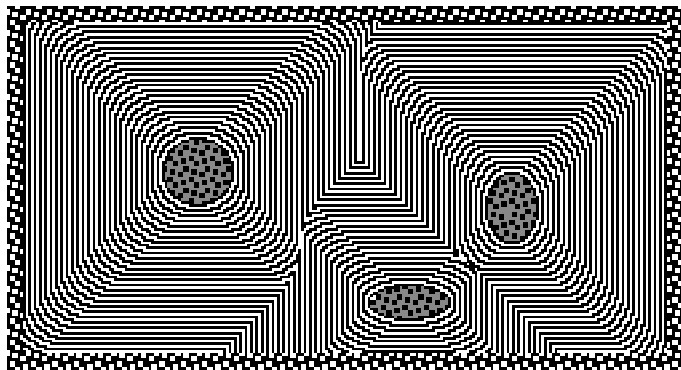
Glass and iron-fine jewelry and coins have been suggested, but again, these ideas are for the next round, when shipment back to Earth is possible and affordable. We are more concerned with objects of art that can be tele-created on the Moon, and enjoyed long-distance via the web or relayed photos, auctioned off in an Art Futures market against the day when they might be retrieved, or become part of a lunar sculpture garden for future Lunans to enjoy.

A more ambitious idea would require a rover with a manipulator arm that could pick up tele-selected rocks or

breccia aggregates and pile them up into interesting sculptures. Without some sort of glue or binder, however, this possibility seem limited to gravity-shaped piles. In that case, the art would be in the choice of rocks and the overall visual "texture." On a grander scale, a sculpture on Earth could create a lunar Stonehenge of sorts. A lunar Stonehenge could even be designed to showcase astronomical events. An installation of this sort along the 90° E or W longitudes, in the middle of the limbs, could be designed to show maximum elevation of Earth above the horizon, i.e. librational extremes. How long it takes for the teleoperated device to create any such grand object is immaterial, if the device is solar-powered. All that is of concern is that the device be strong enough to handle the largest sculpture component that needs to be moved, as opposed to being left in place.

Primitive prehistoric stone works could serve as inspiration. Such larger scale art projects would endure indefinitely, to the delight of the eventual pioneers. And for them too, such rock works would be "prehistoric," tele-made on the Moon before the arrival of first settlers. Perhaps this doesn't conjure up anything of much interest to most readers. But then most of us do not have the unbridled imaginations of artists, and of an artist turned loose in a brand new medium!

In addition to Stonehenge-inspired creations, Earth-bound artists could make serene Zen/Japanese rock gardens with well-selected and carefully placed rocks set in a pool of ripple-racked moondust, bordered by a peripheral row of smaller rocks.



Zen gardens can be created around any trio (the desired number) of nice boulders left in place, simply by raking the regolith around them, piling up the rake-removed smaller rocks in a row around the perimeter. That would remove the need to select and move the bigger rocks that are to be the garden's focal points.

All the artistic creations accomplished through a given lander-rover-manipulator would remain in one general area. A sunset task for this teleoperated art machine might be to grade and tamp down, and possibly sinter, a "sculpture garden pathway." Then the rover would make a final video tour complete with documentary script, with the original artists making the voice over commentary.

Such sculpture gardens would in time be visited by actual tourist visitors, from the settlements and from Old Earth itself. Such a park could be named after the lander-rover-sculptor ("Moonsculptor I"), or after the most award-honored individual creation in the park (e.g. Moonhenge III Sculpture Garden), or simply after a prominent nearby geographic feature ("the Taurus-Littrow Prehistoric Sculpture Garden.") The finishing touch of working all these tele-creations in a Garden Park would help counter those who object that we are "defacing" the Moon.

Without the presence of any weathering agent other than the light but incessant micrometeorite "rain" that should take many of thousands of years to erode the Apollo bootprints, these creations will endure in their exposed setting for a very long time. The more highly-valued can always be relocated within some future settler museum.

### Prospects for Tele-art on the Moon

We are not talking about art created by robots - robot art. Real human artists on Earth, their hands inside virtuality teleoperation gloves, would go through the motions of placing, shaping, working moondust and moon rocks into the object conceived in their heads. For first timers, this will be a learning experience and preconceived ideas of what they will be able to do may quickly go out the window as they learn hands on what they can and cannot do, both via teleoperation, and with actual moondust and rock. Some will get the hang of it faster than others. And some will produce objects of more widespread appeal than others.

Can we do the same thing on Mars? The short answer is no! There is less than a 3-second time delay in the execution of a teleoperated command on the Moon. For Mars that delay would range from 6 to over 40 minutes. The long answer, however, is yes. One could create a teleoperation program and let the computer execute it, removing the artist from the time delay loop.

Where would the money come from? Outside of contracts for future delivery, money might come from friends of art sponsors and benefactors, or by sale of lottery tickets for the chance to tele-craft, to extend one's artistic abilities virtually to an alien material on an alien shore. A considerable fringe benefit may be from media exposure and publicity.

The public at large will begin looking at the Moon as a place on which mankind can put a gentle print. The precedent of treating the moonscape with artful respect will strengthen the case for prior agreement on environmental protocols. The Moon has no biosphere to pollute, but that does not mean that it can't be visually "trashed." Tele-created art objects may lead to prior set-asides of geological and scenic preserves, and other guidelines that will guarantee the Moon remains beautiful for its future inhabitants. Meanwhile, the expectation that human pioneers cannot be far behind, will spread.

<MMM>

## Creating "Nature Walks" on the Moon

by Peter Kokh

Perhaps most of us have been somewhere in the countryside, mountains, forest, desert, shoreline, and have noticed a sign "Nature Trail" and decided to talk the plunge. Chances are we will have enjoyed it, and if we took the time to read all the signs attempting to inform us about what we were looking at, emerged with a bit deeper insight into nature's wonders and mysteries.

Some Nature Trails may point out a few geological features such as rock outcrops, waterfalls, and so on. But by and large, most of our Nature Trail educational tidbits are about flora (plants) and fauna (animals.) We tend to take the host geological setting for granted. And precisely because there seems to be a so much greater wealth of detail to wonder about and to delight in when it comes to plants and animals, the subtle differences in texture and color of rock and soil are at best, enjoyed as is, with no felt need to learn names, classifications, or significances. We simply take the inanimate context for granted.

I think on the Moon it will be different. Yes, we will have flora and fauna nature trails, but inside human-created mini-biospheres. Out-vac, on the barren lifeless surface, Nature Trails through the "magnificent desolation" will have only geological items to highlight and educate us about.

We do have a primeval need to identify salient things and details in our environment. It is the *Adamic* urge to "name" things. In the absence of visually distinctive plants and flowers and birds and other creatures to identify and "tag" with a name, I think our attention will automatically shift to subtle differences in the inanimate setting that we would not have paid attention to if plants and animals were present. Nature abhors a vacuum, goes the old saying, and so does the mind. The way this rock is shaped and textured and colored differently from that one will take on new significance and importance, in the absence of other things upon which to focus.

### An Analog Moon Nature Trail Experience

This was all brought home to me most vividly in the summer of 1992, when, as the guest of Bryce Walden and Cheryl York of the Oregon L5 Society, I had a walk (and at one point, crawl) through tour of the pair of lavatubes that, at that time, constituted the "Oregon Moonbase" just outside Bend, Oregon. Being rather familiar with limestone caves full of interesting stalactites and stalagmites and other water-flow and drip-created features, I had expected a tube created by flowing lava to be rather uniformly devoid of interest. But I was amazed to see how the texture of the lava-flow-formed walls varied from place to place. I counted at least eight distinctive surface types. I felt the need to be able to identify this texture from that one and to understand what caused the differences. These details are things I may perhaps have noted, but paid no more attention

to in a setting with plants and/or animals in the foreground to hog my attention. And there we have it. Geology for most of us remains in the background, because the living foreground pops out and monopolizes our awareness. Absent life, the geology becomes the foreground and zooms into focus.

### On the Moon

When we look at Apollo Moon mission footage, we notice differences, but perhaps do not dwell on them. The scene seems desolate at monotonous. Hello! There are no plants and animals - things we are used to seeing most everywhere on Earth. But for the Lunan pioneer, once the ingrained expectation of living entities no longer fogs our interpretation of what we see before us, I think we will start noticing this and that about the moonscapes - the subtle yet somehow interesting differences between this view and that, between this location and that. In the absence of other things to "recognize" by name, we will want to know the name of this feature or that, and in the absence of that information, start creating names from scratch.

A lunar settlement will soon create nature trails through areas in which there are a variety of features that are noticeable, and about which the history of their formation, the mineralogical, and potential economic importance will be of interest (again, lacking anything else - read: living - to focus upon).

With the best of attitudes towards the Moon, most of us, given the chance to take a coach tour on the Moon, will become a bit bored after a few hours or miles. We don't appreciate the distinctions in what we are seeing. Consider these parallels on Earth. In the absence of the cultivated ability to see and appreciate differences, "when you've seen one waterfall, mountain, or city you've seen them all." Boredom is not without guilt. It comes from failure to cultivate an appreciation of distinctions and differences.

### In the near and not to distant future

Nature trail education will help Lunan pioneers and visitors to enjoy what they see more thoroughly. But why wait? In the very near future, any of us will be able to go to the nearest IMAX theater and enjoy as never before possible, in wrap-around attention-captivating detail, the moonscapes actually photographed by the Apollo astronauts, thanks to Tom Hanks and his crew and Lockheed-Martin. Look for "Magnificent Desolation" to open soon, and go see it again and again. See MMM #174, APR '4, p. 12

And why not fly a photographic lander-rover to an interesting spot on the Moon, do a lot of video-taping, and have Moon geology experts edit the footage for the more interesting and significant items, and with the help of science popularizers, create a DVD or IMAX Nature Tour of this or that moonscape we can all enjoy while stuck here on Earth. In the process we will be learning to appreciate the subtleties, and find the Moon a much more interesting and intriguing place. .

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## The Moon Society



## JOURNAL

<http://www.moonsociety.org>

Please make NEWS submissions to [KokhMMM@aol.com](mailto: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:

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

- Artemis Reference Mission
- Artemis Data Book

**Project LETO™**

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

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

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

**Join/Renew Online at**

[www.moonsociety.org/register/](http://www.moonsociety.org/register/)

**Or mail check or money order to:**

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

Please send all mail related to Memberships to:

**The Moon Society Membership Services**

at address above.

## Moon Society and Artemis Society invited to join new Space Exploration Alliance

The press release on May 8th by the newly formed Space Exploration Alliance (see page 1) caught Moon Society leaders by surprised. It was quickly learned through George Whitesides, the new Executive Director of the National Space Society, that not inviting the Moon Society and the Artemis Society to participate was an inadvertent oversight.

Whitesides has been in contact with Moon Society Board Chairman Randall Severy, and we will be counted as full-fledged partners from this point on.

## NASA's new Moon Orbiter Project

Sources include a Space.com article by Leonard David

NASA has begun working on a Lunar Reconnaissance Orbiter (LRO) to fill in the many holes in our knowledge of the Moon that still remain after the Apollo Missions and the two more recent non-agency missions: Clementine and Lunar Prospector. The once common belief that we had covered the Moon fairly well has now dissipated. Last year a panel of planetary scientists identified a vast area on the Moon's southern farside, the so-called "South Pole Aitken Basin," that seemed to be so atypical as to merit a lander mission. Further, if we are to commit to a manned lunar outpost in the coming decades, we will need to know much more about the Moon to select a site wisely. In addition to prime site identification, searching for "potential lunar resources" is a prime objective. This fits NASA's list of "priority ordered" objectives for the robotic phase of the Lunar Exploration Program:

- Characterize the lunar radiation environment, biological impacts, and potential mitigation by determining the global radiation environment, investigating shielding capabilities, and validating other deep space radiation prototype hardware and software
- Determine a high resolution global, geodetic grid of the Moon (in 3-D) that provides the topography necessary and sufficient to identify future landing sites;
- Assess in detail the resources and environments of the Moon's polar cap regions;
- Determine in great detail the elemental composition, mineralogy, and other regolith characteristics of the Moon's surface.

The Lunar Reconnaissance Orbiter would not be launched until the fall 2008 at the earliest, the prime mission lasting at least a year. An Announcement of Opportunity (AO) for Moon orbiter investigations was to be issued in May. NASA will be working with a tight total annual budget for all investigations selected in connection with the new Announcement of Opportunity of less than \$120 million. This has to cover design, development, test, launch, and mission support and data analysis.

### Inflatable Space Structures Project Eyed by Bigelow Aerospace

Excerpt from SPACE.com on May 3, 2004 concerning Bigelow Aerospace written by Leonard David and published on the BigelowAerospace.com main page

Here's a big idea...meant to get bigger once in space. An inflatable space structure project is moving forward at Bigelow Aerospace of North Las Vegas, Nevada. Tagged as the Genesis Pathfinder, the hardware is now slated for launch late next year. Once in Earth orbit, the one-third scale hardware is to produce important data regarding multiple features of a full-scale spacecraft.

"The Bigelow Aerospace work is led by entrepreneur Robert Bigelow, owner of Las Vegas-based Budget Suites of America Hotel Chain. The space firm is keen on spurring private ownership and use of space stations by making habitable space modules affordable for corporate communities. Under several agreements with NASA, Bigelow is drawing upon NASA's TransHab inflatable structures program, although the company is pioneering its own design.

"Our goal is to create a new cost paradigm for space station construction. We intend to so reduce costs of station habitable structure as to make the difference between space stations being only government available or having space stations affordable for general business ownership," explains the company's website.

Bigelow Aerospace confirmed to SPACE.com that the Genesis Pathfinder module would be lofted by a Falcon 5 booster, provided by Space Exploration Technologies Corporation (SpaceX). That launcher is a derivative of SpaceX's Falcon 1 rocket, now set for maiden flight mid-year. Bigelow Aerospace has executed a launch agreement with SpaceX and "money has changed hands," said Mike Gold, corporate counsel for the company. No details regarding price or conditions of sale or now available, he added.

The purpose of lofting the Genesis Pathfinder on the Falcon 5 is to embark on an aggressive regime of launching subscale spacecraft demonstrators that will test systems and subsystems in actual on-orbit microgravity environment, Gold said. -- Leonard David

### Galileo's Colorful Moon

Check it out at:

[www.lpod.org/Images/LPOD-2004-05-10.jpeg](http://www.lpod.org/Images/LPOD-2004-05-10.jpeg)  
(Lunar Photo of the Day, www.lpod.org, May 10, 2004)

The Moon is a mono-color sphere - shades of grey, chromatically bounded by some whitish glare and black shadows. The problem is that our eyes, so wonderfully sensitive to faint light and subtle hues aren't good enough.

But spacecraft can use filters to image in wavelengths that are sensitive to particular elements, and then computers can exaggerate the colors so that our humble Moon looks like a gaudy Christmas ornament.

Such colorized views are good because they help us understand the differences in composition and sometimes age of different parts of the Moon. And we can carry that knowledge back to the eyepiece when observing.

The colors show, as we know from black and white views, that there are two major types of lunar materials. The cratered highlands are made largely of iron-poor rocks which show up red in this 3-filtered image.

You can see though that not all highlands are the same - an orangish area near Schickard (bottom left), and near the north pole must have some compositional differences. And the maria also have differ shades of blue and even some golden hues, showing that they are not all identical. The brightest blue in Tranquillitatis is due to titanium-rich lavas, and the orange mare (parts of Imbrium, Frigoris and Serenitatis) are lower titanium lavas.

Patches of purple blue (SE of Copernicus) are due to pyroclastic (ashy, sort of) rocks. The brightest areas are the freshly (well, in the last billion years or so) crushed and exposed surfaces of young impact craters. Tycho and its rays are clear, but so are Aristarchus, Copernicus, Proclus, and various smaller craters west of Nectaris, near the north pole, and even just west of Plato. Take a look.

**Technical Details:** Imaged December 8, 1992 by Galileo Solid State Imaging CCD Camera. <LPOD.org>

**Editor's Comments:** Note that the maria, in factt the major low elevation basins on the Moon, are suggestively blue, as if to confirm their nature as "seas" - and they are indeed seas, but of frozen lava rather than liquid water.

This exaggeration of the Moon's subtle colors gives us a challenge. As is, the magnificent moonscapes will be sources of "color deprivation" for settlers, and we'll have to make that up in our habitat interiors, our vehicle and space suit colors, and other ways. Perhaps we can come up with a form of lunar sunglasses that enhance the subtle color differences already there, much as Galileo's filters did..

Outward bound to Jupiter, Galileo snapped the Moon's colors on its 2nd lunar flyby on Dec.ember 7, 1992

#### MMM Back Reading on Inflatable Structures

- # 50 NOV '91, p 6. Lunar HOSTELS Part IV: Some Appropriate Architectures
- # 51 DEC '91, p 2. Hybrid Rigid-Inflatable Structures in Space
- # 101 December '96, p 16. Study on Inflatable Lunar Habitats, W. Mook
- # 127 August '99, p 4. TRANSHAB - The Architecture and the Promise of "Hybrid Rigid-Inflatables"

Crashing the Moon vs. Trashing the Moon

"MoonCrash: Orbital Development Inc. is offering the chance to lob 22 pounds (10 kilos) of whatever you want at the Moon. Smashed into the Moon. Just bid on eBay. Your package will hit the Moon at 5,500 mph, so the condition of the contents on impact are not guaranteed."

A recent exchange on Artemis List highlights some common misunderstandings by environment- sensitive persons.

From Gregory Nemitz <gnemitz@orbdev.com>

I listed the MoonCrash Project on eBay three times, for a week each time. The first week the media was slow to pick it up as a story and only about 1200 page views were shown on the eBay counter by the end of that auction.

The second week, there were a total of about 14,000 page views. The media picked it up and it was on Space.com, CNN.com, TV's CNN news, the London Times, and many other newspapers around the world. I gave telephone-radio interviews about 10 times in Ireland, England, USA, and Australia. There was one bogus bid the second week, by Mike Oxhard.

The third week, there were only about 500 page views. My total cost for the 3 weeks of marketing activity was about \$14. Showing the world that a lunar mission can be fairly cheap was very cost effective, using eBay. The media didn't question the validity of the project, they mostly focused on the story as a fun, quirky item.

The most overriding observation from this marketing program was that the environmentalists are a group of fanatics that MUST be addressed by the Space Activist movement. I received about 30 to 40 emails from irate tree-huggers venting their concerns about trashing, polluting, and despoiling the Moon. They just don't understand that a little spacecraft like MoonCrash is a pin-prick on something the size of the Moon.

Their collective viewpoint about lunar activities is entirely irrational. But as a group, the environmentalists are a fairly powerful political voice. One focus we are going to have to undertake is re-educating the Enviros that their knowledge about environmentalism is inappropriately applied to the Moon. The Moon is a huge, dead rock. There is no rational reason to be concerned about altering the lunar "environment" as there are no species that will be impacted by any human activity there.

All environmentalist concerns stem from the observation that human activities degrade the Earth's environment to the detriment or extinction of many, many species. That concern is entirely appropriate on the Earth, and their collective efforts to reduce human industrial impact on the Earth is a good thing.

When they mis-apply their knowledge and concerns to our arena, they will cost our businesses a huge amount of capital by forcing us to reduce our "impact" on the lunar "environment". I guarantee you that any restrictions that the Enviros manage to place upon our space and lunar activities will tremendously raise the cost of our projects.

For a relatively extreme example, what if they legislate a "pack it in, pack it out" regulation that requires removal of all human detritus from commercial lunar activities, when the activity ceases? No project will have money for that. Ok. So where do we go from here in this necessary re-education?

from Charles F. Radley <c.radley@comcast.net>

There is already 650 tons of human material on the Moon already, and many tons of natural material impact the Moon every year. Another 100 kg will make no difference.

from the MMM Editor: <kokhmmm@aol.com>

The Moon's surface is covered with a blanket of impact debris including rock, glass spherules, and powder. Called the "regolith" this blanket covers the entire surface from 2-10 meters (6-31 ft.) thick. Anything manmade that crashes into the Moon will merely add a miniscule and indistinguishable portion to this debris. Any impact crater so caused would be indistinguishable from zillions of others resulting from "natural" impacts. In this light, it is absurd to single out any man-made impacted contribution as polluting or trashing the Moon.

As for mining, all the elements we need to produce are present in this "pre-mined" surface blanket, so there is no need for either "open pit" mining scars or deep tunnel mining. We extract what we want from the debris blanket, and leave the residual tailings in place with little if any visible evidence that we were there. The idea that moon-mining will trash the Moon is simply based on lack of awareness (the ignorance of innocence) about these facts.

Cf. "Moon-Mining and Eco-Sense" MMM #39 October '90, pp. 4-5. Available from the MMM submission address on page 1 via SASE (Self-Addressed Stamped Envelope)

As for items of hardware and supplies left on the Moon by Apollo astronauts (to reduce the weight of the Lunar Ascent Vehicle so that it could safely get to lunar orbit rendez-vous with the Command Module) these items are all historic and, as such, not trash, but items in future Lunar Historic Site Monuments or in future Frontier Museums.

In general, Lunar pioneers will be highly motivated to recycle and reuse on economic grounds, the prohibitive cost of replacement imports, and not to pollute their painstakingly created and delicately maintained mini-biospheres. They will be living "immediately downwind and downstream from themselves. They won't pollute because they dare not!

## **International Lunar Conference 2004 Nov. 22-26, in Udaipur, India <http://www.prl.ernet.in/~ILC6>**

Co-hosted by Professor Narendra Bhandari and J. Goswami of India's Physical Research Laboratory / ISRO [India Space Research Organization] and Bernard Foing of the European Space Agency (ESA), the conference, which is also the 6th meeting of the International Lunar Exploration Working Group (ILEWG), continues the upward lunar momentum set by ILC2003 / ILEWG 5 last November in Hawaii.

Main themes include:

- lunar science
- robotic landers, rovers, and outposts
- International collaboration
- considerations for human missions

The 1st day of the event will involve "Young Lunar Explorers" and an overview of participating nations' current lunar programs and activities.

Day two and three are dedicated to status and first results from ESA SMART-1, future missions of Japan's SELENE, Lunar A and B, India's Chandrayaan-1, Chang'e-1 of China, USA new missions (including South Pole-Aitken Basin sample return) and possible Russia activities.

Day four continues with next generation initiatives (such as ESA Aurora Program) and "science of, from and on the Moon." The concluding day of ILC2004 features a round table discussion, reports from sub-committees, ILEWG recommendations and the "Udaipur Declaration," a decisive manifesto that will set forth future directions & initiatives.

### **About ILEWG**

ILEWG consists of dedicated scientists, engineers, policy makers, business people, educators and advocates primarily from the world's six major space-faring powers (US, India, China, Europe, Japan and Russia). More recently, representatives from Canada and Mexico have participated.

### **Past & Future ILEWG Conferences**

The first meeting was held in Beatenberg, Switzerland in 1994, followed by Japan in 1996 (chaired by Hitoshi Mizutani), Russia in 1998 (Erik Galimov), The Netherlands in 2000 (ILEWG Executive Director Foing) and Hawaii in 2003.

Plans are underway to possibly hold next year's conference in China.

Info: [ILC6@prl.ernet.in](mailto:ILC6@prl.ernet.in); fax 91 79 6301502.

## **Several Moon Society Members planing to attend ISDC 2004**

As of press time, several members of the Moon Society were planning to attend the annual International Space Development Conference sponsored by the National Space Society. This year's ISDC will be held on Memorial Day Weekend (as usual) in Oklahoma City, Oklahoma.

Board chairman Randall Severy, and Board Members Arthur Smith, John Schrock, and Peter Kokh are expected to be there. Randall, Arthur, and Peter will be taking part in several panel discussions. While we all hope to do some major networking, making others aware of our existence and planning joint projects and endeavors, it appears that we will be limited as to the Moon Society display materials we will be able to bring along. This is an unfortunate effect of logistics: limited space in baggage allowances, car trunks, etc. However, we do plan to have some sort of display.

Peter and John have been brainstorming larger and more ambitious Artemis Moonbase mockups (Peter's a 1:10 scale model; John's a much larger trailerable 3:4 scale mockup), both are running out of time to get these exhibits ready.

There will be some opportunity at the 2004 Mars Convention in Chicago in August, with Peter committed to attending (he has an abstract submitted on a unique Mars Calendar). A Moon Society presence there would emphasize potential commonalities of infrastructure, structure, equipment and systems between Moon and Mars beachhead ventures, and the benefits for both space constituencies to be gained from our mutual collaboration.

## **Brigham Young Univ. (Provo) Outpost dba BYU Space Development Club**

from Jonathan Goff <[jag42@et.byu.edu](mailto:jag42@et.byu.edu)>

New Igniter Project blog update with pictures:  
<http://www.et.byu.edu/groups/sdc/IgniterProject>

The update includes an explanation of what we're doing and why we're doing the project. The last week of April we finished the last of our sheet metal, and when we went to pay for all the material, Tristar offered to just donate the whole thing! So we probably saved \$60-100. After speaking with a few people on the ARocket mailing list, we found out that our igniter is very oversized. We should be able to get away with 2-3g/s flow rate instead of 24g/s. This will make the fluids design tons easier, and will also allow us to do more tests on a single tank of hydrogen. As it is, we're likely looking at being able to do ~200 tests on a single tank. That's about \$.20/test for all the propellants we'll be using. Barring any showstoppers, we should be set to fire the igniter sometime in early June.

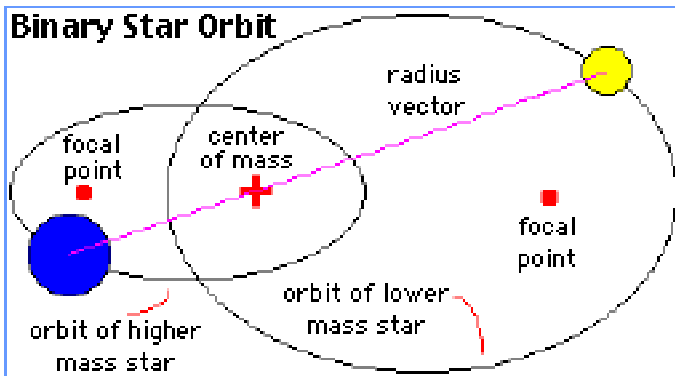
# The Future of Intelligent Life in the Universe

## The Drake Equation revisited

By Bob McGown < bobmcgown@comcast.net >

How can we estimate the future number of technological civilizations that might exist among the stars? What is the next step? It may be that the future of intelligent life is to evolve into a space-faring society and shape the very universe. Dr. Frank Drake conceived an approach to integrate the terms involved in estimating the number of technological civilizations that may exist in our galaxy or even the universe. The Drake Equation, as it has become known, was first presented by Drake in 1961 and identifies specific factors thought to play a role in the development of such civilizations. Although there is no unique solution to this equation, it is a generally accepted tool used by the scientific community to examine these factors.

Our present knowledge and theories of the evolution of the universe modify the original Drake equation. We had recent discussions with Freeman Dyson and he has considered these concepts for many years. The Drake equation could be extended to include double stars (do), life evolving into space (nl), digital life in space (nt), and closed loop universe evolution (ce). Additional factors that shape the equation change the life of a civilization. We view the possible evolution of life into much differently in the 21st Century.



### The modified Drake equation follows:

$$N = R^* \cdot do \cdot fp \cdot ne \cdot fl \cdot fi \cdot fc \cdot nl \cdot nt \cdot ce \cdot L$$

N = Number of civilizations in Local Galaxy group whose communication emissions are detectable.

R\* = Rate of formation of stars suitable for the development of intelligent life.

do = The double star multiple orbit in the life zone

fp = Fraction of those stars with Planetary systems.

ne = Number of planets, per solar system, with an Environment suitable for life.

fl = Fraction of suitable planets on which Life actually appears.

fi = Fraction of life bearing planets on which Intelligent life emerges.

fc = Fraction of Civilizations that develop a technology that releases detectable signs of their existence into space

nl = Number of planets that self replicating life has been genetically engineered to evolve into space and evolve into Intelligent beings

nt = Number of self replicating and programmable digital life Technologies that are engineered to evolve in space.

ce = Critical Engineering level that an intelligent civilization would have to reach to alter the out come of the evolution of the universe to make future universes life friendly.

L = Length of time such civilizations release detectable signals into space (There is a question whether non-local faster than light communication may also need to be considered in the future).

### [Book Announcement]

#### "Lunar Prospector: Against All Odds"

[http://www.lunar-research-institute.org/lunar\\_prospector\\_book.htm](http://www.lunar-research-institute.org/lunar_prospector_book.htm)

New book due out, July 2004

by Dr. Alan Binder {principal investigator for the highly successful Lunar Prospector mission, 1998-9}

#### Quote from the book:

"..the incompetence and self-serving activities of the entrenched NASA bureaucracy and the big aerospace companies, which together waste a large fraction of the more than \$13 billion that NASA receives from the federal government every year."

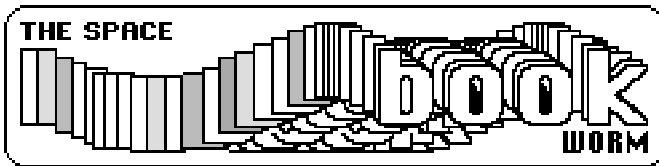
#### Background:

The Lunar Prospector Mission was chosen by NASA for its second Discovery Class Mission Opportunity. These mission proposals were all brainstormed and engineered outside NASA. NASA selected from among many proposals on various grounds of "worthiness" including scientific merit, maturity of design, and estimated cost to fly.

Lunar Prospector's pre-history goes back to the mid to late 1980s, and began as a grass roots effort involving people from Space Studies Institute, the former L5 Society, the Space Frontier Foundation, and the National Space Society.

You can read the story online at:

[www.lunar-reclamation.org/lp\\_prehistory\\_paper.htm](http://www.lunar-reclamation.org/lp_prehistory_paper.htm)



## REINVENTING NASA - HUMAN SPACEFLIGHT, BUREAUCRACY, AND POLITICS

Author: **Roger Handberg**

Publisher: Praeger/Greenwood/Heinemann  
(www.greenwood.com)

PO Box 5007, Westport, CT 06881, USA  
ISBN 0-275-97002-7; Published 2003;  
Hardcover, 273 pages, \$ 64.95

Reviewed by Philip R. Harris, Ph. D.\*

The National Aeronautics and Space Administration (NASA) may be described as an American governmental agency of great accomplishments and expectations, as well as of being constantly overbudget and overblown. In ten concise chapters, the author traces the organization's dream and beginnings, through its successful launches to its implosion with two Shuttle disasters, and then forecasts its future. Roger Handberg is a professor of political science at the University of South Florida who has published extensively on matter of space policy.

The content is both comprehensive and mind-expanding, but the text lacks any visuals beyond some interesting tables as exhibits. The one appendix provides an insightful chart of the U. S. taxpayers expenditures for governmental space activities from 1962 to 2002; though it does include both NASA and DOD outlays, it would have been more useful if it had totaled those space investments for the last forty years. The tally appears to be in billions of dollars. The selected references cited at the end do offer a useful bibliography, but with some notable and classic omissions (e.g., **PIONEERING THE SPACE FRONTIER** by the National Council on Space in 1987; **SPACE RESOURCES** by NASA-SP 509 in 1992).

Handberg shares perceptive historical perspective on NASA and its high frontier endeavors. The professor wisely observes that the world's premier space agency usually "does difficult things well, but has difficulty dealing with the more mundane vicissitudes of American politics." The writer astutely details NASA's aspirations, struggles, and setbacks with human spaceflight since the shutting down of the successful Apollo lunar missions. After analyzing numerous agency strategies and attempts from space transportation systems and stations, to fixing technological and management failures. the book examines various policy initiatives and needed organizational changes. As a political scientist, Handberg raises an interesting question as to whether NASA is living off its past intellectual capital and momentum.

He puts forth an argument that the International

Space Station holds the key to moving civil space activities to higher level of international cooperation. or compartitive political isolation. Those in the global space community are disillusioned with the agency's loss of technological innovation, expertise, and leadership; its acceptance of reduced circumstances, and its lack of vision in creating a space-faring civilization.

Whether the new Presidential mandate to concentrate on a return to the Moon and beyond to Mars will reinvigorate NASA's organizational purpose and culture remains to be seen. Although this volume has an afterword on how the COLUMBIA shuttle loss may affect our space future, it was released before the latest Administration directives to NASA were issued regarding a refocusing on human spaceflight to the Moon, and hopefully to Mars, before the end of this century. How the organization responds to that challenge may yet determine whether the agency can reinvent itself, or whether it should be broken into two entities - R & D and mission operations. Further, the entire emphasis of these 273 pages is on the public sector's role in space development, without considering that of private enterprise in offworld utilization and development of space resources.

As a management and space psychologist with extensive NASA consulting experiences, I would like to see Professor Handberg write a second edition that not only addresses some of the above issues, but these specifically: (1) the need for a five-year Federal budget allocation to NASA; (2) the cutting back of unnecessary organizational infrastructure, while realigning spending priorities; (3) the greater and broader involvement of the private sector in partnership with NASA that goes beyond aerospace industry contracts; (4) the over-riding goal of developing an international lunar infrastructure in the next 25 that will advance scientific, technological, commercial, and settlement on the Moon!

<PRH>

\* Philip R. Harris, Ph. D., Management/Space Psychologist, LaJolla, California, USA (philharris@aol.com). Dr. Harris is the author of *Living and Working in Space*, and also of *Launch Out* (www.univelt.com).

\*\* In next month's MMM, Dr. Harris eviews **MARTIAN EXPEDITON PLANNING**, Editor: Charles S. Cockell

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## GREAT BROWSING !

### "Stanford on the Moon" Alumni Project

"Placing a radio telescope on the lunar surface that could be operated by the School of Engineering"

[Steve Durst, a Palo Alto science editor (of SpaceAge Daily) is spearheading the Effort]

<http://www.spaceagepub.com/SOM/index.htm>

<http://www.stanfordalumni.org/news/magazine/2003/sep/oct/red/moon.html>

### "Review: Lost in Space"

The Space Review

<http://www.thespacereview.com/article/110/1>

### "Fossils" on Mars?

<http://msnbc.msn.com/id/4480097/>

<http://aix1.uottawa.ca/~weinberg/mars/>

<http://mainlymartian.blogs.com/semijournal/>

### Google goes to the Moon

[http://www.google.com/jobs/lunar\\_job.html](http://www.google.com/jobs/lunar_job.html)

A super April Fools Day Teaser

### Want/need a globe of Mars for your PC?

#### Check out this free download.

<http://www.geofusion.com/MarsDemo/>

Navigate the whole planet of Mars, fly from location to location, explore the terrain, view the landing sites.

System Requirements:

- Operating system: Windows XP, 2000, ME, NT4
- RAM: 128 MB or more
- Disk Space: 34 MB
- Graphics accelerator card: GeForce2 MX or better
- Graphics driver: OpenGL

### LUNEX - Lunar Explorers International

<http://www.lunarexplorers.nl>

#### Powerpoint Presentations of 6 Groups

#### Participating in LUNEX' June 2002

#### Lunar Base Design Workshop

<http://www.lunarexplorers.nl/LBDW/>

There is quite a bit on the LUNEX site worth exploring

### Apollo Maniacs

[http://www2k.biglobe.ne.jp/~t\\_muto/apollo/indexe.htm](http://www2k.biglobe.ne.jp/~t_muto/apollo/indexe.htm)

### [Free Book Opportunity]

### "Quest: The History of Spaceflight"

A few years back, the NSS actively promoted the journal, "Quest: The History of Spaceflight" to its member-ship within several issues of 'Ad Astra'. So, when talking to a number of long-standing NSS members recently, I was surprised to hear that they were unaware of it.

As I am sure that a great number of NSS members have an interest in preserving the history of spaceflight and to encourage you to tell your local membership about 'Quest', I am willing to send a FREE copy of the issue with Valentina Tereshkova's memoirs or the book, "In Their Own Words: Conversations About America's Journey Into Space" to any NSS member who becomes a new subscriber to Quest.

The Quest website is [www.spacebusiness.com/quest](http://www.spacebusiness.com/quest) and it contains a list of all articles that have appeared since 1992. As an FYI, a one-year, four issue (64 pp each) subscription to Quest is \$29.95. If you plan to order online, just type NSS and either Valentina or book in the company or address2 field so that we'll know that they are an NSS member and we can send them the freebies.

Scott Sacknoff <[scott@spacebusiness.com](mailto:scott@spacebusiness.com)>

Quest: The History of Spaceflight

[isbc1@spacebusiness.com](mailto:isbc1@spacebusiness.com)

## NOTICE - NOTICE - NOTICE

from Peter Kokh, MMM Editor, [kokhmmm@aol.com](mailto:kokhmmm@aol.com)

To avoid passing on new steep printing cost rises to our client chapters, to the Moon Society, and to our individual subscribers, it is necessary for us to make the following three adjustments:

- The 2 **Moon Miners' Review** issues (July and January) *will be dropped*
- The 10 **Moon Miners' Manifesto** issues will be published as usual, with the following changes
  1. The slightly gray, heavier weight cover sheet with the pre-printed blue moonscape has been replaced by plain white paper with the moonscape in grayscale.
  2. The blue centerfold sheet has been replaced with white paper.

Thank you for your continued support



## Can the Precious Radio Silence of the Moon 's Farside be preserved? Will it be an early casualty of lunar development?

A recent email exchange between Dave Dietzler  
Dietz37@msn.com and Peter Kokh KokhMMM@aol.com

**DD** Aren't there other good places to listen for signals from ET Civilizations, should the Moon's Farside Radio silence become compromised by development? There's always the far side of the Sun, at the Earth-Sun L3 point.

**PK** Nowhere in the entire solar system except in the cone of the Moon's radio shadow is the tremendous and ever-growing volume of radio clatter and noise from Earth's communications networks blotted out. Even on a moon of Jupiter, or out by Pluto, noisy Earth would be above any horizon some of the time. Earth-Sun L3 is too far out from the Sun to escape the reach of radio-noise "lensing" around the Sun. The Moon is close to Earth, and more importantly, its surface is rotationally locked so that Farside is always Farside, always quiet.

**DD** The day will come when large numbers of people come to the Moon and radio chatter becomes a problem. Lasers are a good idea. Fiber optic cables to link lunar outposts and towns also. It might also be possible to work out a deal with radio astronomers by ships using only radio frequencies that don't interest them. Perhaps all ships, mobile phones, and radios, etc. could use several bands. When the astronomers were searching on one band, all others could switch to a band that is not being observed. The relay at L2 would always be in close contact with the astronomers and it could serve as the nerve center of communications on the far side. Band switching could be done automatically without users even thinking about it. If we must make this sacrifice, it is no big deal.

**PK** You wrote: "When the astronomers were searching on one band, all others could switch to a band that is not being observed."

But the holy grail of SETI is to be checking *all* bands *all the time*, so we don't accidentally miss something. They may have got *an* answer by then, but why prevent them from catching the signals from still other civilizations in addition to that first one.

**DD** That does present a problem. Fortunately, it will be 100 years, in my estimation, after our first outpost before travelers turn the Moon into the new Yellowstone. Will we still be listening by them? I don't know. Tight band lasers and fiber optic land lines are the only solutions. What about lunar GPS satellites? Can we do without them? They will create noise that prevents listening on some wavelengths.

Navigating by the stars is fine by night but by day the glare blots out the stars. Nothing is ever perfect.

**PK** Most people will lose interest once we confirm that there *is* someone out there. The media will get bored first and their boring reports will bore the public. But that's the typical shallow "been there, done that" response. Now if all we get is an answer "we are here" but learn nothing about "them" and the 2nd and 3rd "contact" proves as empty of "interesting content" then maybe everyone will lose interest.

Did you read my series of articles on SETI in MMM # 61 December 1992? These articles are not yet online.

"Are we alone?" "What is a Humanoid?"  
"Galactic Topography 101" "The Heliades Cluster"  
"Sending Interstellar Signals" "Cheshire Messages"

My gist is that I think everyone is listening (takes little power, can be done intermittently.) But *probably, no one is effectively sending* (takes lots of power, beamed in *all directions, constantly* for life of the civilization - certainly, centuries.) Yet there may be some civilizations willing to embark on such cathedral-building endeavors for vanity sake or in the name of religion.

## Will Lunans have a paperless culture? (reserving hydrogen, nitrogen, and carbon for the food-production and biosphere cycles)

Same correspondents, different topic

**DD** I have read your early article "Paper Chase II" [MMM #4 APR '87 - /www.asi.org/adb/06/09/03/02/004/paperchase2.html]

That [1987] was before the LCD screen. I find the LCD screen of laptops to be much less straining on the eyes than CRTs. We will only have as much paper as there is farm area to produce hemp or any other plants. I don't know anything about hemp tissue paper, but I did read that it can be recycled 8 times versus 3 times for tree paper. The final fate of recycled paper would be the Super Critical Water Oxidizer where it becomes CO<sub>2</sub>, H<sub>2</sub>O and minerals for plants and fresh paper.

Old paper could also be used as mushroom substrate. Cereal from a mason jar with metal lid won't bother anybody. Fiberglass "paper" that we can paint on would be fine for signs and posters. An ink jet poster printer that feeds on fiberglass paper? Why not? Laser etching devices could print out metal labels of all sorts. Could a laser etch stone? Probably so.

Is there a substitute for slate and chalk on the Moon? Or can we use white boards with biodegradable recyclable ink? The Moon seems like a great place to do sand paintings, if we can come up with the colored sand.

**PK** But how much will it cost to import LCD screens? I must have been thinking of them (before laptops became common) when I wrote about "readers" - thin screen tablets in which you'd plug a book chip and read the book.







Washington in July but from July 31st to August 2nd. Again, see their website. In addition Mitch brought "The Futurist" for May-June with articles on studying biological clocks, as in the mechanisms that control when processes happen in the development of most multicellular life, and another piece describing the use of helper robots for the elderly. I wonder if this is a spin off from "our" work on exploratory systems? And last but not least we discussed the need for a presentation of ideas on the public outreach display we are seeking money for via his friend Sandra. Contact Mitch with your suggestions and copy our other members (I will forward non board member material). Thank you Mitch!

Dorothy brought material from Air & Space, a publication of The Smithsonian Institute, on Retro Rocketeers which are people and organizations advocating and, in some cases, building manned space vehicles based on known working systems and variations on them: expendable launch vehicles, simple orbital structure like Gemini and Apollo capsule and other equipment - X Prize anyone? This engendered discussion on other things we did that worked well, especially Skylab (some members are too young to remember it) and how this "upper stage," read fuel tank, gave us a real space habitat. Thank you Dotti.

Hank Smith reported that, as Head of Science Programming, our conversations on launch costs is causing him to consider "The Economics of Space Flight" as a presentation topic at the 2004 Philcon. He has thought of this for some time and may do this *if* qualified panelists are available. Hank also talked of attending the Balticon convention this Spring and The World Future Society event referenced earlier. Thanks Hank.

Gary Fisher gave a very short report (thanks Gary) on the forthcoming Mars Society Convention in Chicago this year and drew out interest in his possible appearance as a poster session presenter and, of considerable interest to members who may attend this and other events, the availability of low cost air fares. He may use Southwest Airlines with an offered fair of \$75.00!. Taxes etc. does raise this above \$100 but it is a very good price. Attendance rates, \$150 members, \$210 for non Mars Society people, and the M.D.R.S. performance. The Greenhab is doing well, with several environmental engineers checking it out, and the habitat is currently hosting its twelfth crew.

Larry the Webmaster reports we've had an increase in visits but could use more material I am to add captioning to some of the material, and supply the few additional pictures from the March Science Fair presentation.

Earl brought material on several topics including The Near Space Program inaugural column featured in Nuts & Volts magazine for April. There is an interesting series of letters and comments, starting with "In Regards to the Bova Letter" by Jeffery D. Kooistrain the Alternate View Column in Analog for June including a reprint of the initial Ben Bova letter commenting on Jeffery's Alternate View column of

November 2003. The unassuming looking title of the article "Isaac Was Wrong, Maybe". The topic is the search for evidence of extra terrestrial life. There is much material here and the level of dialog is high (i.e. what precisely is said and is the description of the evidence, and the process used to gather and analyze it, adequate.) An interesting ongoing discussion you should try to read.

From NASA Tech Briefs is a report on a contest called "Creating the Future" sponsored by Emhart Technologies. Of particular interest for space farers, and people like me recovering from a back trauma, is the grand prize winner: The Osteosonic(tm) Noninvasive Bone and Joint Damage Detection Device. This device, designed by Michael Liebschner is described as a small, light weight sensing system for use "in the field". The technique of analyzing the echoes from the ultrasonic sensing head is used to assess the probability of damage of various kinds. Details on the winners and the contest at: [www.emhartcontest.com](http://www.emhartcontest.com). The 2004 contest starts in September.

Other material in this April issue includes Virtual Reality visualization capability using Nvidia graphics cards and "Hairlike Percutaneous Photo chemical Sensors" (pg.28) And, from The AMSAT Journal comes ongoing work on several programs which includes the launch push back of the Echo Satellite. Happily this is simply a delay, not a problem with Echo. The other articles on the P-3 System which is an advanced design using relay equipment up to 47 Giga Hertz (4x the frequency of direct satellite t.v.) and a mention again of work on the P-5 craft that will be a Mars bound craft someday. The technology proven out on the P-3 systems will allow confidence in the system that could be adopted to this future mission. Comment: Hams have been interested in Mars and signaling over this distance for some time: in the mid 1970s I read of the requirements for Mars Bounce in a publication for advanced (technical) topics by Hank Cross ( call: W1OOP) who was known as a Moon Bounce communications expert. Its still a challenge.

It was a good gathering with several threads developed via face to face meeting. Submitted by Earl Bennett

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<p><a href="http://www.jpl.nasa.gov/ambassador/">www.jpl.nasa.gov/ambassador/</a></p>	<p><b>Harold Schenk</b> Sheboygan, WI <a href="mailto:hschenk@excel.net">hschenk@excel.net</a></p>
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