"Expanding the Human Economy through Off-Planet Resources"

Moon Miners' Manifesto

& Moon Society Journal

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In FOCUS: Bush's ISS Downsizing & Slow Economy Stall Commercialization

The International Space Station, although still incomplete, is already larger in usable volume than Russia's former Mir Space Station. While the cash-strapped Russians found ways to accommodate for-profit activities in their sardine can collage, NASA, operating with a quite different culture, finds "no room" for such distasteful Americanisms as free enterprise aboard ISS. More than the NASA paradox (*socialized space* being as American as apple pie) is the cause.

NASA had a plan for how the ISS would be configured to support a wide menu of activities. When Bush canceled the U.S. main habitat module, this triggered a cascade of negative effects. The now-stunted station can support a crew of only three, barely enough to maintain the station with free time available for only anecdotal research and science, which were supposed to be the fundamental purpose.

The U.S. cutbacks blazed the cop-out trail for Japanese and Europeans contributions to ISS. Smaller crew, shrunken activity space. Given the priority of proposed Station activities, a lot had to go. No room, no available manpower. Low man on the totem pole is, of course, commercial space activities of any kind.

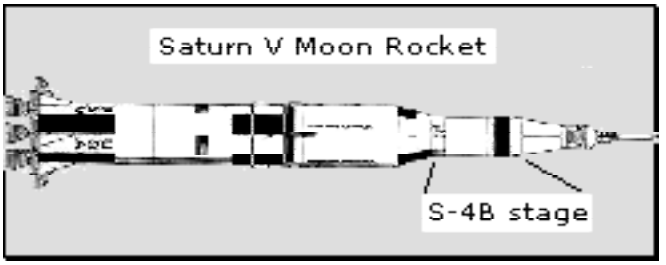
NSS leader Gordon Woodcock puts it this way: "NASA has so restricted the shuttle flight rate that there is probably no realistic opportunity to deliver commercial payloads to space station. With a crew of only three, there is probably also no realistic opportunity to operate them if you could get them there. NASA will give its own payloads priority for crew time."

Woodcock continues, "the only commercial opportunity for space station that exists today is the one the Russians exploit, of carrying tourists at $20M a head. If they get one tourist, I believe they will make more money than the rest of the "commercial" operations combined.

Alas, here the sluggish economy enters the picture. 'NSynch singer and teen idol Lance Bass, who seemed assured of an October ride aboard the next Soyuz ISS supply flight, has been forced out of the picture. Unlike Dennis Tito and Mark Shuttleworth who each paid the $20 M ticket price out of their own pockets, Bass was part of a "new model" according to which the money would be fronted by an array of commercial sponsors. Radio Shack made an early commitment but other "promises" were too slow to materialize. Evidently, until the world economy picks up a fresh head of steam, it will [=> p. 2, col. 2]

Move over Luna - for awhile, anyway!

Earth has a "temporary" new moonlet. Tiny J002E3 is likely the S-4B stage from Apollo 12, which had a slight malfunction during the deflection maneuver intended to slingshot it past the Moon and into solar orbit. Now in a 50 day orbit, it has an estimated 20% chance of impacting the Moon within the next year, according to NASA.



Moon Miners' Manifesto

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♦ **MMM** is being reedited for the World Wide Web by members of the Artemis Society International. => 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 societies and chapters can be labeled by this indirect mutual association is unwarranted.

♦ For the current space news and near-term developments, read *Ad Astra*, the magazine of the **National Space Society**, in which we recommend and encourage membership.

♦ **The Lunar Reclamation Society** is an independently incorporated non-profit membership organization engaged in public outreach, freely associated with the National Space Society, insofar as LRS goals include those in NSS vision statement. LRS serves as NSS' Milwaukee chapter => www.lunar-reclamation.org

♦ **The National Space Society** is a grassroots pro-space membership organization, with over 25,000 members and 80 chapters, dedicated to the creation of a spacefaring civilization.

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♦ **The Moon Society** is "dedicated to overcoming the business, financial, and technological challenges 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.

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⇒ IN FOCUS Editorial continued from p. 1.

take a lot more lead time to put together a sure deal of this type. This new model for financing space tourist tickets for the less than super-wealthy has a lot of failure modes: tentative commitment and drop-deadlines among them. The Bass effort failure will make it harder. It works both to discourage similar efforts and to make the Russians warier of them. This is a pity, especially in light of NASA's own recent enthusiasm for the Bass venture, as something that had the capacity to awaken enthusiasm among previously indifferent younger generations.

Meanwhile, the Russians are moving on. With no time to look for a substitute fare-paying customer, the Russian space agency spokesman has indicated that Bass' weight allotment will be given to a cargo container filled with equipment for the space station.

The sluggish economy too -- combined with the evidently unyielding high cost-to-space threshhold for commercial payloads and personnel -- have soured Boeing's enthusiasm for its partnership with Krunichev. " =Boeing is looking to exit an agreement with Russia's Krunichev State Research and Production Space Center to transform a spare space station module into commercial orbital real estate. Boeing agreed last year to consider investing millions of dollars in the completion of Krunichev's FGB-2 in exchange for the right to market the module for commercial uses. But Boeing no longer sees a market opportunity big enough to justify the investment," Boeing spokeswoman Kari Allen said.

The forces for space commercialization have run up against a pair of obstacles. But there is every reason to believe both these barriers are temporary. And Congress' long term intentions are clear: federal law requires NASA to "seek and encourage, to the fullest extent possible, the commercial use of outer space." Bush's downsizing, and the sluggish economy are forcing implementation of that mandate to the back burner. *For now.* Have faith! - PK

History of 8 "Tourists" in Space

[from www.msnbc.com/news/765523.asp]

- NASA flew a senator (**Jake Garn**) and a congressman (**Bill Nelson**) in space, but cut off such flights after the 1986 Challenger tragedy killed teacher-astronaut **Christa McAuliffe** .
- 1990: Japanese TV network TBS pays $28 M for a week on Mir for journalist **Tohiro Akiyama**.
- 1991: British consortium arranges similar Mir mission for chemist **Helen Sharman**, selected in a competition that drew 13,000 applicants.
- 1998: astronaut-turned-Senator **John Glenn** flew on the space shuttle.
- 2001: Millionaire **Dennis Tito** becomes first paying space tourist, visiting the ISS.
- 2002: South African millionaire **Mark Shuttleworth** rides into space.

Farming on the Moon

by Dave Dietzler <Dietz37@msn.com>

It has been argued that lunar agriculture is not feasible primarily because of the power demand for crop illumination. Greenhouses will need thick glass roofs, crops will be killed by solar flare radiations and overheating of the greenhouses during the two week-long lunar day will occur. None of these arguments are valid, and they reduce the credibility of the Mars First camp, of which most Lunans are actually members.

Thick glass roofs will not collapse in the low gravity of the Moon. Greenhouses will be exposed temperature extremes that will cause expansion and contraction of materials that could lead to cracking and other structural failures. Micrometeoroid damage is another hindrance. The fact is, greenhouses will not be used on the Moon. Freshnel lens collectors and light pipes will transmit sunlight to farm chambers in sub-selenar lava tubes which might be hundreds of feet in diameter and many miles long. Areas inhabited by humans in these lava tube cities will also be lit by light pipes and skylights. Underground farms will enjoy a constant temperature of a few degrees below zero in the surrounding rock rather than 250 °F. days and minus 250 ° nights. It will be easy to warm the chambers up to 72 °F. with waste heat from nuclear reactors. Radiation from galactic cosmic rays and even the strongest solar flares will be no problem deep beneath the Moon. Micrometeoroid punctures will be unheard of. Overheating or "supergreenhousing" will not occur.

Illumination during the two-week long lunar night will be produced by microwave sulfur lamps with flexible fiber optic light-pipes that direct the light to the places where it is needed most. Light will not simply be scattered all over the place to be absorbed by the stone walls. Sulfur lamps will provide light in the visible range with very little infrared or ultraviolet. These revolutionary light sources can produce 95 lumens per watt.[1] Incandescents yeild only 20 lumens per watt and fluorescents give 50 lumens per watt. Sulfur lamps don't even have electrodes to burn out!

In the past, illuminance recommedations were not as high as today's. In 1925, A Text-Book of Physics suggested that night time street lighting required less than one lumen per square foot. The average living room only a few lumens per square foot. Offices and classrooms needed 5 to 10 lumens per square foot. Workplaces where fine handicrafts, engraving, sewing or drafting were being done needed 10-20 lumens per square foot.[2] Today, we find values of 75 foot-candles (one ft. candle= one lumen/ sq. ft. or 10 lux) for reading and office work, 50 ft. c. for machine operation and 50-300 ft. c for bench work.[3]

The noon-day Sun gives off 10,000 lumens per square foot at Earth's surface! Plants need more light than humans and animals do, but not this much. Many plants only need 200 lumens per square foot for good growth! The small tropical Chinese Evergreen plant, Aglaonema modestum, only needs 100 lumens per square foot (same thing as 100 foot candles) and can get by on as little as 10 lumens per sq. foot.[4]

The Bamboo Plant, Chamaedorea erumpens, requires just 100 to 150 foot candles. The coffee plant, coffee arabica , a necessity for us groggy old lunar prospectors and rich travelers, needs 150 to 1,000 lumens per square foot.[5] Tomatoes, sweet peas and everbearing strawberries need 1500-2000 foot candles and cucumbers require 4000 foot candles.[6] If these plants receive 1500-4000 lumens per square foot from free sunlight during the lunar day and just 1000 foot candles for 16 hours out of every 24 hour period from sulfur lamps during the lunar night they will do just fine.

A thousand foot candles is like a cloudy day. Although the Sun might drench the Earth with the energy of 4 MW per acre, 1000 MW per square kilometer, and 2500 MW per square mile, only a tenth of this is needed for light hungry plants like the coffee plant. A one acre garden plot in a lunar lava tube illuminated by sulfur lamps will need 43,560,000 lumens to deliver 1000 lumens per square foot. Only 460 kilowatts will be necessary for one acre if sulfur lamps rated at 95 lumens per watt are used. To illuminate a square mile of lunar gardens, 290 megawwats is needed.

This is not impractical given the intense, constant solar energy that's never obscured by clouds available by day on the Moon that can be harvested with silicon solar panels or polished magnesium solar thermal collectors and stored in the form of hydrogen and oxygen that can energize fuel cells for electricity by night. Nuclear reactors can also be used on the Moon with impunity. There is no air, no groundwater, no wildlife and no ecosystem on the Moon that could be harmed by a meltdown or nuclear waste dump. Nuclear fuel could be reprocessed and breeder reactors could be used to tap the energy of plutonium. Massive containment buildings won't even be necessary. Terrorists will never make it to the Moon and if they do they will never make it back to Earth.

Although we can generate the electricity needed to furnish the crops with light, there are many other strategies to make lunar farming successful. It has been found that plants can be grown for two weeks at a time in sunlight and then put into "suspended animation" in darkness by refrigerating them for two weeks at a time. By doing this, some crops can be raised with no artificial light or power drain at all.[7] Mushrooms can be raised in the dark. Three pounds of edible fungi per square foot of garden space can be harvested every fifteen weeks.[8]

Algae like Spirulina can be cultivated during the lunar day. Since blue-green algae can double its mass four times a day, in five days 100 grams of algae could reach a mass of 100 metric tons if it has enough water tank volume, minerals and carbon dioxide. It is therefore possible to grow enough algae while free sunlight is available during the lunar day to feed livestock throughout the month. Fish can eat algae. Goats and pigs will eat anything. Alage is actually very nutritious, high in protein, minerals and vitamins. Chickens might eat pellets of algae.

Mushrooms could feed the animals too. Moon dirt could be mixed with algae and mushrooms, allowed to rot and form a rich compost, and earthworms could be farmed in the rich dirt. Chickens and fish will eat chopped worms. Livestock won't need more than a few lumens per square foot to see. Fungi and worms won't need any light and algae only needs to grow by day. Clearly, a lunar diet rich in fish, chicken, eggs, pork, goat meat, goat's milk, cheese, butter and cream can be produced without artificially illuminated crops at all!

Eggs and liver are rich in vitamin A, so no one will die due to a lack of carrots. Meat has plenty of B-complex. Milk contains vitamin D or people can just sunbathe for 10-20 minutes a day. Some vitamins C and E are still desired, and so is some fiber. Some wheat for whole wheat bread and dough, tomatoes, potatoes, lettuce, grapes, strawberries, cucumbers and pumpkins can be grown with sulfur lamp illumination by night or by using the nightime refrigerating technique, which will not require any heavy machinery; we will simply turn off the heat in the garden chambers and let them cool down.

A diet heavy on meat, fish and dairy products consumed during a two-week vacation on the Moon will not irreparably damage anybody's coronary arteries. Hotel workers, miners and scientists spending a couple of years on the Moon won't die of heart disease either if they stay fit. Fish, chicken and lean goat chops might be preferable to lots of eggs, heavy cream and bacon for the health conscious Lunans.

The Moon will never support billions of people as Earth does or Mars could after centuries of terraforming, but it doesn't have to. Millions of miners, scientists, workers and tourists who are the life blood of the Moon can be supported by the underground farms in lava tubes and man-made tunnels that will someday be planted in the Moon. Eventually, craters will be domed over with giant bi-layer silicone bubbles with five meter thick water shields for radiation protection.[9] Fusion powerplants will supply electricity for the sulfur lamps and the resources of near Earth asteroids will be utilized. Subway tunnels will interconnect the domed craters. The Moon will become a fantastic playground and a jewel for all citizens of Earth, like the Great American West today.

<DD>

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Extracting Silica from Lunar Regolith

by Dave Dietzler <Dietz37@msn.com>

Silicon can be extracted from lunar regolith by leaching it with hydrofluoric acid or treating it with fluorine gas to produce silicon tetrafluoride gas that can be decomposed at high temperatures to obtain silicon and recover fluorine. The silicon can be purified further by zone refining, a process that will be easier in the lunar vacuum. Large quantities of silicon will be needed for solar panels, but there will also be a huge demand for plain old silicon dioxide (silica), which composes about half of the lunar regolith, to make glass. It should be possible to take regolith that has been roasted to extract volatiles and exposed to magnets to remove iron, nickel and cobalt, and leach it with a sulfuric acid and water solution. Oxides of calcium, aluminum, magnesium, titanium, manganese, chromium, sodium and potassium will react with the acid to form

sulphates. Silica will not dissovle in the sulfuric acid and it can be filtered out. Calcium sulphate is only slightly soluble and will precipitate out. Traces of chromic sulphate may also precipitate.

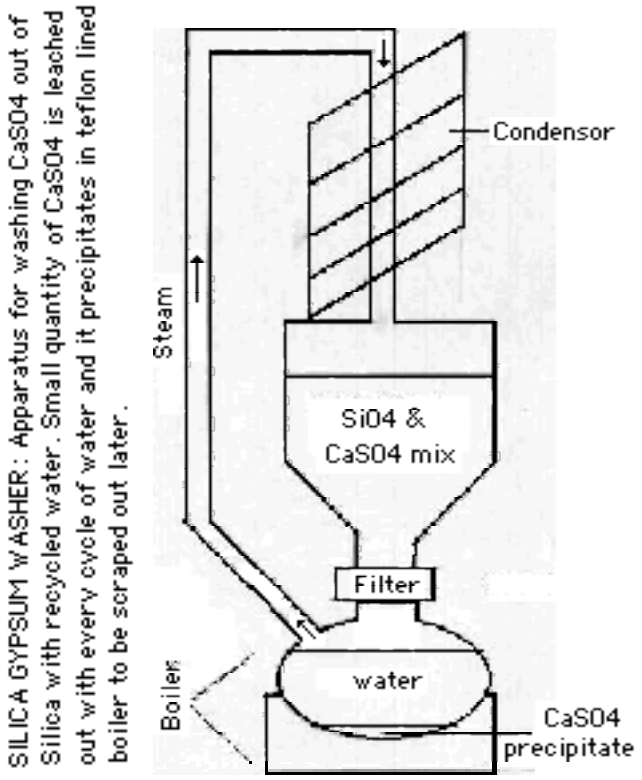
Separating the calcium sulphate (CaSO4) from the silica to get a good sand for glassmaking will require some ingenuity. Molten glass and molten calcium sulphate might simply be imiscible, thereby making it possible to just skim one substance off of the other. Calcium sulphate is found in nature as gypsum. I've never heard of a glass-gypsum mixture, so it's possible that they don't blend. If glass and gypsum do dissolve together, it may be possible to take the mixture of silica and artificial gypsum "sand" filtered out of the acid solution and heat it up to 1400°-1500° C. This will melt the calcium sulphate but not the silica which melts at 1700°-1800° C. The liquid CaSO4 will seep down and settle in the bottom of the vat. The silica sand can then be shoveled out and the mixture of artificial gypsum and silica at the bottom of the vat can be mixed with more iron-free regolith and water to make mortar. It may also be possible to calcine the mixture, that is to heat it to high temperatures, and decompose the CaSO4 to CaO and oxides of sulpur that can be used to restock sulfuric acid supplies.

The final strategy could be to take the mixture of silica and CaSO4 and leach it with hot water. Calcium sulphate is slightly soluble in water but silica is not. The CaSO4 bearing water will be filtered and boiled down. The steam will be condensed to get hot water that is piped back to the silica/gypsum mixture. In this way we can use the same water over and over again. My back-of-the-envelope calculations show that this will be very energy intensive. Hot water may have to be cycled hundreds of times to wash out the CaSO4. Several square miles of silicon PVs will be needed to power a system that can wash out the CaSO4 formed by treating a million tons of regolith over a period of several years! It would be wise to use waste heat from nuclear reactors to boil the water and recover the waste heat from the water condensors also for the sake of efficiency. However, a million tons of regolith is an off-the-cuff figure. I doubt that we will need the 400,000 to 500,000 tons of silica and glass that would be obtained from that much regolith. The sulfuric acid demand would also be enormous. It becomes obvious that iron and cast basalt will be our primary materials on the Moon, as these are easiest to obtain.

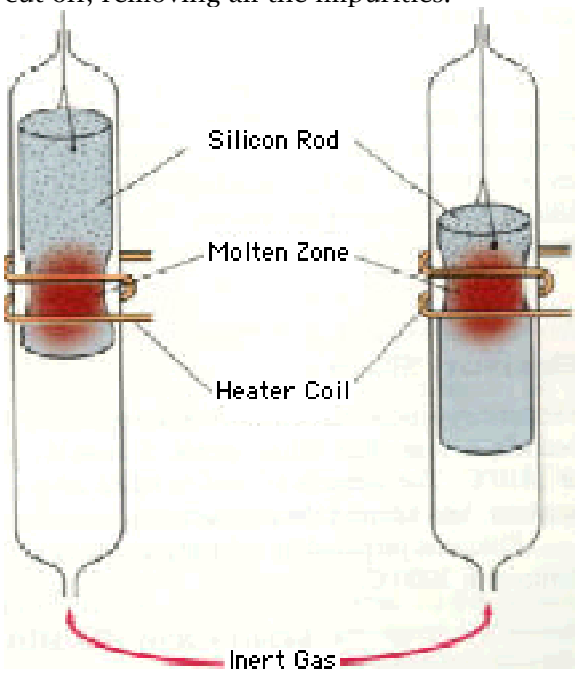
Glass made from regolithic silica might be purified by zone refining if necessary. Zone refining is usually used to produce small quantities of super pure material. In space, large scale use of zone refining should be possible. The sulphate salt by-products of silica extraction might be decomposed in a 3000° C arc furnace for sulfur recovery. **<DD>**

ILLUSTRATIONS for preceding article:

SILICA GYPSUM WASHER: A device similar to this could separate the SiO2 and CaSO4 formed after sulfuric acid (H2SO4) leach of regolith.



ZONE REFINING: a silicon rod is slowly lowered through a heater coil, which melts the rod. The impurities concentrate in the melt zone that moves upward. Surface tension holds the two parts of the rod together at the molten zone. After cooling, the previously molten zone at the end of the rod can be cut off, removing all the impurities.



Solar Power Satellites - a Way to the Moon

By Alfred Hexter <alhexter@worldnet.att.net>

"Solar Power Satellites may be
the best route to the Moon and Mars"

Why we need a Solar Power Satellite

World population is growing, and living standards are rising. The majority of the world's population lives in underdeveloped countries. They believe they are entitled to the same living standards we have, and I would agree. Growing population and higher living standards are strong pressures increasing demand for energy. Where is the energy to come from? Traditionally, most comes from fossil fuels. But fossil fuels are becoming more expensive, and have always been sources of pollution. The focus is turning to alternative sources. Hydroelectric power is not always available and has its own environmental problems, which can be severe, as China is finding out with its Three Gorges project. Nuclear energy has shown that it can provide the power, but it has its own set of environmental problems. Ground-based solar power has limitations. In some areas it is not a viable alternative, and even where feasible it is only available part of the time. A solar power satellite does not have the limitations of ground-based solar power. It is available 24/7/365, except for the few hours a year when it is eclipsed (times predictable months in advance). It can be beamed to almost any spot on the surface, and microwaves can penetrate cloud cover.

Looming on the horizon, and already present in some areas, is a worldwide shortage of fresh water. This will be a major problem for the next generation. Augmenting water supplies will require desalination and pumping water long distances, both requiring major inputs of energy at inconvenient locations. SPS is the ideal solution, because the energy does not have to be generated near the desalination plants or near the pumps.

A Solar Power Satellite is Good for the Space Community

Construction of a Solar Power Satellite provides a perfect solution to all the wants of the Space community. It would provide a strong incentive for cheaper access to space. Construction would require a base on the Moon (I hope on the Far side, out of sight of Earth), and a manufacturing facility to provide structural materials (iron, aluminum, silicon, and regolith as radiation shielding) and rocket fuel (oxygen). This would be the start of a Lunar colony. Wickman (www.space-rockets.com) has experimented with propellants that do not use hydrogen, and could be provided from the Moon. Construction would require a staging area in LEO for crews and for materials brought up from Earth; this could be done at the ISS, giving it a real use (at last!). The SPS or the Moon can be the port for Mars and beyond. Everyone in the space community wins with the SPS.

A Solar Power Satellite is Good for the Earth

A Solar Power Satellite is about as non-polluting as an energy source can be. Three SPS, 120° apart, can provide as much energy as is needed for the foreseeable future to almost any location, leading to the eventual phaseout of many fossil fuel, hydroelectric and nuclear plants. The SPS itself can provide a facility for communications and other space-based equipment, in a place where they can be serviced and upgraded; rental of space can provide an income long before power is sold. It would also permit removal of the present crop of geosynchronous satellites, and other "junk" in orbit.

Problems of the Solar Power Satellite

The principle problem of the SPS is cost. A number of years ago, NASA estimated the cost at more than one trillion dollars. That persuaded many people that an SPS is not financially feasible, and interest faded. However, NASA assumed that every fastener would be carried directly from Earth to geosynchronous orbit by the most expensive transport system ever devised, the shuttle, and they wanted a Cadillac facility. Cost-saving measures, such as linear assist for materials from Earth, using the ISS as a staging area, providing fuel from the Moon, and lifting materials from the ISS to the SPS by slow but efficient means, such as ion propulsion, would greatly reduce these costs.

There are two environmental problems to be considered. One is the beaming of microwaves to Earth. It has been said that the concentration of microwaves is too low to affect living beings, but I am not aware of any long-term studies to show that. What special precautions would be needed? The other is that the increased activity in launches may increase the atmospheric load of pollutants. How much of a problem would that be?

Zubrin, *Entering Space*, pp72 ff, thinks the economics are against the SPS. He estimates the cost at $6 trillion for a single 1,000 MW unit, small by today's standards, and does not think it practical to provide construction materials from the Moon. But he does not consider some of the cost-saving measures mentioned, or that plants could be much larger than 1,000 MW for proportionately lower cost.

How We Can Proceed

The bottom line is that we (the world) need the energy regardless of cost, and the choice will come down to SPS or nuclear energy. I don't discount nuclear energy, but it still has not solved its environmental problems. Even if Zubrin, and other critics, are correct, SPS is still a solution which merits serious consideration. The fact that it is very nearly non-polluting is a strong plus. Environmentalists are our natural allies in this, if they are convinced it is a viable and non-polluting solution. We need dialog with them, to show them that this is a way to provide more power while phasing out fossil fuels. Is this

possible? I believe it is, but only if we ourselves are convinced that this is a viable solution.

It would probably take at least forty years from the time the decision is made to build an SPS until the first such goes on line. The energy crisis will be on us long before then. I don't think we can wait. The space community needs to unify on this, and court the environmentalists as allies. Between us, I think the goal of a functioning SPS is attainable.

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CONCRETE

A Versatile Lunar Material of Choice

by Peter Kokh

In case you haven't noticed, concrete "isn't just for sidewalks and driveways anymore." Concrete is being reinvented, brought "into the 21st Century" and reformulated for a whole host of new applications old concrete people had never thought of before.

We've all been aware of "shotcrete" for some time now. Shotcrete is a refined homogenized mixture strengthened by fiber additives so it can be pumped through a hose and sprayed on interior and exterior surfaces over attached steel mesh. Common applications are on the ceilings of lofts and industrial buildings and the inside of dome structures.

But now manufactures are using it for high end flooring, tile, shingles, textured wall panels, and more. Concrete has these things going for it:

- it is poured at room temperatures (and below) and does not need high heat to fabricate as do glass, ceramic, and metal alloys
- it can be pigmented
- it can be stained and painted with many faux finishes to mimic other materials or with a unique character all its own
- it is an ideal for one of a kind and low quantity items and for outside the factory on site production.

Relevance for the Space Frontier:
Lunar Concrete Enterprises

These "selling points" make it an attractive material for frontier pioneer entrepreneurs catering to the Lunar and Martian homestead market, as well as to do-it-yourself inclined individual homestead owners. Future Lunans will have to show considerable resourcefulness in substituting for exotic (to them) materials commonplace on Earth: wood, plastics, other petroleum-based synthetic materials.

That making items for the homestead out of concrete does not require special factory furnaces or even small house-worthy kilns, as would on site manufacture of glass, ceramic, or metal alloy items, makes concrete an option that is sure to become a mainstay. Cured and used indoors, the water in the poured wet mix is recovered to the biosphere. It can be pigmented with metal oxide powders.

With all the new recently field-tested ways to play with concrete's surface appearance, one doesn't have to "settle for" concrete. Concrete can be made to mimic ceramic tile, terra cotta, even wood (in surface texture and color at least). However, not all the new tricks being applied here on Earth promise to be applicable on the Moon!

Here are just some of what *would seem to be* "Moon-appropriate" applications:

- tables, table tops and countertops
- contour-shaped seating surfaces & benches
- lamp bases
- planters - big, small, inside, streetside
- sink basins
- shotcrete interior finishes
- textured wall panels
- floors and floor & wall tiles
- trimwork (analogous to "woodwork")
- mantles & fireplace surrounds
- fountains & pools
- inside sculptures
- garden hardscapes
- "architectural" elements
- streetside entry trim
- streetscape sculptures
- embrassures (hold back shielding surrounding an airlock access)
- air lock entry trim
- shielding mound decorative cladding
- out-vac sculptures

Some of these items are likely to be mass produced, others custom ordered or even custom made by entrepreneurs in a shop or on site, and by do-it-yourselfers, for themselves, or as part of a "cottage industry" enterprise start-up. This wide range of applications and appropriate fabrication situations makes concrete so versatile.

The Devil is in the Details

Many of the new applications for concrete involve products made by extrusion. This requires a very smooth and homogeneous mixture with considerable strength. That strength is achieved by a high fiber content. Now on the Moon, it should be no problem to manufacture both glass and steel fibers. Relying on them alone will not produce the higher qualities of the cement formulations now being widely used. For in almost all cases, here the glass fibers are jacketed with polypropylene, a petroleum-derived material that will surely fall in the exotic category on the Moon. Further, these glass/PP composite fibers are complemented by PVA polyvinyl alcohol fibers, another Moon-exotic material.

In addition to this fiber content, most extrudable concrete mixes substitute "Illinois Fly Ash" for

up to 70% of the cement. Cement is a calcium based material that will be fairly easy to produce in large quantities on the Moon. As for the ash, a substitute that comes to mind is the fine powdery component of regolith, likely to be sifted out (and thus available as a homogenized byproduct) of most lunar regolith processing operations.

However, particle grain-size isn't the only thing that matters. Particle shape comes into play as well. While the irregular jagged shape of lunar "fines" gave the lunar simulated concrete prepared by Dr. T.D. Lin in the 1980s great strength, "twice that of everyday terrestrial concrete," that very same asset becomes a liability when it comes to extrusion of the liquid concrete mix. Illinois Fly Ash (IFA) has a spherical particle shape that makes it slippery, much like graphite powder. It should be possible, however, to further separate the lunar regolith fines for their high glassy spherule component. These spherules have been produced by the high extremely concentrated heat of impact in eons of constant micrometeorite bombardment.

But what about the fly ash chemical character - the regolith fines and glassy spherule inclusions should both be rather inert. According to the Fly Ash Resource Center [www.geocities.com/CapeCanaveral/Launchpad/2095/flyash.html] fly ash is "the finely-divided CCB [coal combustion byproduct] collected by electrostatic precipitators from the flue gases." It has a high 20% carbon content.

> "Using coal fly ash conserves energy by reducing the demand for typical pavement materials such as lime, cement and crushed stone, which take energy to produce. Each ton of fly ash used to replace a ton of cement, for example, saves the equivalent of nearly one barrel of imported oil."

The most important fact of life for would be pioneers of lunar industries to keep in mind at the very forefront of consciousness can be summed up in this one phrase: "The Path Not Taken." Here on Earth, when R&D discovers something that works very well, further experimentation on all other lines that has not yet produced equivalent promise, is halted. It's simply a matter of conserving research and development dollars. Let's translate that into a "Space Frontier Pioneering Guiding Light Principle."

> That R&D has been halted on a line of experimentation, doesn't indicate that there is nothing promising to be gained from pursuing it further.

We need to find people in cement industry R&D laboratories who are willing to find a way to sneak in some off-line experiments using strictly those ingredients we can produce or simulate on the Moon at acceptable energy and source material costs. Make no mistake, without that research, concrete will still be a mainstay building material on the Moon. But barring success in formulating lunar-appropriate extrudable formulations, some of the new wonder applications we are seeing here on Earth in the 90s and the current "double oughts" [as the first decade of the 20th C was called] will not be practical on the Moon. And that would be a shame.

Environmental Friendly Concrete

For the sake of argument, let's say that the suggested research is done and turns up nothing promising. Concrete would still be a space frontier workhorse even with out extruded products, without shotcrete. It can still be poured and molded and pigmented and textured.

But especially interesting from the environmental point of view is that concrete accepts aggregate inclusions: pebbles, stones, gravel - we all know about that. But if that is as far as your familiarity goes, you're no longer up to date. A California firm by the name of Syndesis [www.syndesisinc.com] has pioneered using the detritus of civilization in lieu of 'normal' aggregate:

> Syndecrete® is a restorative product, reconstituting materials extracted from society's waste stream to create a new, highly valued product. The advanced cement based composite contains natural minerals and recycled materials from industry and post consumer goods which contain up to 41% recycled content. Such materials include metal shavings, plastic regrinds, recycled glass chips and scrap wood chips to name a few. These materials are used as decorative aggregates, creating a contemporary reinterpretation of ... terrazzo. ... Syndecrete® uses no polymers or resins. ... a solid surfacing material which provides consistency of color, texture, and aggregate throughout ... less than half the weight with twice the compressive strength of normal concrete. Surfaces can be ground, polished, or textured to expose the natural porosity and aggregates. Form or mold surface finishes allow exacting detail, from wood grain to glass.

What is exciting to me about this is it will help minimize the need of lunar civilization to follow the sorry steps of their terrestrial ancestors "from mine to landfill" by creating an avenue, particularly attractive to entrepreneurs, to use the kind of manufacturing and domestic usage waste like that cited above (less the plastic and wood!) to make valued consumer goods for total less expenditure given to source materials. These inclusions have character of texture and color and visual interest, for which the energy has already been spent. Reusing that spent energy in this way will be one way to make lunar settlements more efficient and minimize what I call "throughput" - the percentage of, and rate at which, raw lunar materials pass through the lunar consumption system to end in some lunar crater landfill.

Concrete is a material with much promise for Lunan contractors and entrepreneurs and consumers. In the newborn space frontier tradition of spin-up (not off) entrepreneurs here can help pioneer the road, for profits here and now. **<MMM>**

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 Moonbase 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®

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Moving? Whom You Should Notify

If you simply notify MMM by mail or email, the correction will be made in the next set of labels, good for the next mailing. But such a change will not remain in effect. Each month, the Moon Society sends MMM the list of those who are to get the newsletter. If you have not also notified the Moon Society, your old address will keep reappearing in the labels. In other words, it is okay to notify MMM, but your first priority must be to notify the Moon Society.

Remember that MMM is mailed to domestic members (those in the U.S.) by second class bulk mail. Even if you complete a change of address form for the Post Office, that will not take care of every-thing - 2nd class / bulk mail is *not=never* forwarded by the Post Office. You must notify the sender, and that means the Moon Society.

Join/rejoin the Moon Society today!
http://www.moonsociety.org/register/

New Attention Getting Display Ideal for One-Person "Chapters"!

Earth><Mars><Moon Gravity "Jugs"

Lift any two at a time to transport people to the Moon or Mars for a brief eye-popping instant
make in less than an hour for less than $5

by Peter Kokh, Moon Society Milwaukee / LRS

You will need:
- **(3) Jugs with handles:** I bought (3) 48 oz. jugs of Bleach (cheaper and more durable than half-gallon jugs of milk or jugs of liquid detergent and you can always use the bleach)
- **Some Styrofoam Peanuts:** if you haven't saved any from packages you have received, you can buy them from package mailing stores.
- **Water**

Simple Instructions:
- **Earth Jug:** As is (you can replace the bleach with water *or* not)
- **Moon Jug:** Empty contents into spare container, rinse, and fill with styrofoam peanuts, then add only 1 cup (8 ounces) of water *(peanuts first!)*
- **Mars Jug:** Ditto, with 18 oz (2 1/2 cups) water.
- **Replace labels** with ones printed out from http://nsschapters.org/hub/gravityjugs.htm

Note: The styrofoam peanuts help distribute the water evenly and prevent tell-tale "sloshing"

ARTEMIS MAGAZINE®

SUMMER 2002 -- Issue #7

Science and Fiction for a Space-faring Age™

COVER

Crescent Wing by H. Ed Cox
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Landmark Decision Clears Way For First Commercial Lunar Flight

www.transorbital.net/PressReleases/press020828.html

22 August 02 SAN DIEGO, CA, USA - TransOrbital, Inc. has become the first private company in the history of space flight to win approval from the U.S. government to explore, photograph, and land on the Moon. The company expects to launch its Trailblazer Mission from the Baikonur Cosmodrome in Kazakhstan within the next 9-12 months.

The approvals and licensing by the U.S. State Department and the National Oceanographic and Atmospheric Administration (NOAA) position TransOrbital as the only company presently authorized by the U.S. Government to return to the Moon. Once launched, the Trailblazer will provide stunning, high-definition (HDTV) video and maps of the lunar surface (at 1 meter resolution), as well as new images of Earth-rises over lunar craters. Additionally, the Trailblazer mission should provide the opportunity to view the equipment left behind from past Apollo and Russian landings. The mission will culminate with the delivery of a time capsule containing personal cargo from Earth (such as messages and photographs), and a final "barnstorming" video as the probe impacts the lunar service.

The media collected during the mission will provide TransOrbital with an array of content vital to future scientific and exploratory endeavors, as well as educational and entertainment uses. "We're not returning to the Moon simply to explore... we're returning because there are true opportunities there - true revenue streams," said Dennis Laurie, TO CEO.

The regulatory approval is a significant hurdle for commercial space enterprises, as they must satisfy a number of design requirements and directives. For TransOrbital, the process took two years to complete.

"TransOrbital has the technology, the desire - and now we have the licensing," said Laurie. "It's a significant moment for our company, and a significant development for all of aerospace. People soon get to experience the moon in ways they never imagined."

TransOrbital Inc. is a privately owned supplier of aerospace design and analysis services, spacecraft and commercial space missions. Established in 1998, TransOrbital is the first company of its kind authorized by the U.S. government to photograph, explore, and land on the Lunar surface. The 2001 Trailblazer spacecraft's primary missions are to return HDTV video and other multimedia content from lunar orbit to market as commercial products, as well as the delivery of both personal and commercial cargo to the Moon.

Moon Society Chapters Page

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

In an effort to help and encourage the Moon Society chapters, this column will be set aside for chapter news and announcements.

- **notices:** this is *not* meant to be a/the primary vehicle for notifying chapter members of upcoming local activities. Publication and mailing delays make timely notice difficult.
- **recruiting:** this *is* a vehicle for reaching other Moon Society members and MMM subscribers in your area and hopefully attracting them to join your chapter or come to an event
- **encouragement:** more importantly, this is a vehicle to let chapter people in other areas see what your chapter is doing and be encouraged to do more in their own communities.
- **classifieds:** this is also a place where chapters can post help wanted and help available adds for talent and expertise with projects/events
- **collaborations:** this is an area where chapters wishing to start ambitious projects can put out a call for partners in multi-chapter projects

MMM's role: For our part, MMM will try to help update the chapter contacts list posted online. Much of the data is old and aging. Most chapter websites have not been updated in 2002. Some not since 1999 or even earlier. This gives the visitor the impression that the chapter is dormant.

Once the contact information and websites have been updated, and the Moon Society chapters page brought current, we'd like to start a Moon Society Chapters Web Ring to include in addition to the individual chapter websites the following:

- Moon Society Chapter Contacts list page
- Moon Society Chapters Council page
- Moon Society Chapter Rules page
- The Space Chapters Hub site (shared resources)

Challenge: The National Space Society, which had merged with the former L5 Society in 1987 and inherited the latter's chapters and chapter system, has a packed Chapters Handbook with a considerable history grounded in many years of experience. This handbook now exists in electronic form:
http://hiwaay.net/~hal5/assembly/library/handbook/

We hereby request all interested persons to help in the task of producing an online Moon Society version of this invaluable tool. If you are interested in helping with this task, contact Tim Cadell <chapters-coordinator@moonsociety.org> and/or Peter Kokh <KokhMMM@aol.com>

Hey all you frustrated go getters, *Let's roll!*

MoonSociety St. Louis Startup

July 31st Dave Dietzler here. We had the first meeting of the St. Louis Moon Society chapter (MSSL) tonight. There was only a small number of us, but it's a beginning!!!

As of September, we have three good people.

Sept. 14th Chapter member Burt Sharp, visiting in Milwaukee, takes in the Lunar Reclamation Society meeting and there is a lively discussion and exchange of views. LRS production of a set of Earth-Moon-Mars "Gravity Bricks" for MSSL was also discussed and is now in the works.

Contact: <Dietz37@msn.com>

MoonSociety Milwaukee Update

Sept. 15-20 - the chapter website has been updated: http://chapters.asi.org/milwaukee/

Situation: the chapter core of the Lunar Reclamation Society (NSS Milwaukee) is heavily involved in the production of *Moon Miners' Manifesto*, with the Moon Society being its biggest client. However, only one LRS member actually belongs to the Moon Society itself.

LRS is an active chapter with many projects, a considerable amount of display material and local contacts. Outreach events, up to half a dozen a year, are engaged in jointly with the Wisconsin Mars Society. We also supply speakers.

The Moon Society Milwaukee website lists many projects on its to do list, but some of them have been in the "to do" phase for too long.

An aggressive recruiting effort is being planned, both for new blood for LRS and for new Moon Society members in the SE Wisconsin area.

Events under consideration are an area SciFi convention (JVL-Con in Janesville, last weekend in October) and the opening of the IMAX version of Tom Hanks' Apollo 13 classic.

Until there is a core of dedicated Moon Society Milwaukee members, MSM meetings will continue to be held conjointly with LRS.

If you live in our area and would like to get involved, or just join in the monthly discussions, contact: Peter Kokh <KokhMMM@aol.com> or call him at (414) 342-0705.

Calling all ASI | Moon Society Local Contacts

This is your chance to get reenergized. Starting a chapter is difficult. Help and new tools are on the way. If you read this before we reach you by email or phone, please get in touch. Together perhaps we can forge the start of a gameplane to get things moving in your area.

To the Moon!

So You Don't Have a Local Chapter
What Can One Person Do?

Moon Society "Cells"

It isn't easy to form a chapter, not even in the hundred times as large National Space Society. The Moon Society chapter rules require five members, all of whom must be members of the national organization, before full chapter status is recognized and a charter granted. You send for the contact list of Moon Society members in your area and may find that there are less than five to contact about joining a chapter.

You get discouraged, and forget about it. But that needn't be the end of the line. If the invited don't come, go out and round up others. In other words, why limit the search to those who are already Moon Society members. Look for ways to recruit more!

What can one person do?

First, the Society allows chapters with less than five members the status of "chapters in formation," no minimum number of members is stated. That means you can use the name Moon Society Mytown (whatever it may be) and act on its behalf. That may involve a fiction of sorts, but it will get you more respect. No agency you will be dealing with is likely to ask you about memberships numbers. And if a person who shows some interest asks you? Why the answer is easy: "two counting me and you!"

It may sound brash, but on behalf of the Artemis Society of Milwaukee aka Milwaukee Moon Society, membership of one, I have been doing just that for several years. So it is with that experience that I say with confidence that acting on behalf of the chapter that you hope to help form, you can do a lot:

- create a website listing activity options
- offer your services as a speaker about the Moon
- set up information tables with free handout literature and displays (see p. 9 "Gravity Jugs")
- write letters to the editor
- more ambitious one person tricks are on the way

Resources are now available

Reinventing the axle is not easy, and no one should be forced to do so. To date, however, the Moon Society and its predecessor in membership services, Artemis Society International, have not given much time or attention to developing tools that chapters and individuals can use. But that is the case in the National Space Society and the Mars Society as well. So many end up complaining and quitting on the grounds of "no support." National organizations have other things to be concerned about.

Well, so what! The resources we need for outreach are better created by those in the field who use them and who can revise and fine tune them based on first hand experience of how well they work. Well-intentioned people holed up in an office are likely to come up with flyers and other outreach tools that don't just cut it.

The better course of action should be obvious. Those who produce and field test display setups, dioramas, models, flyers and brochures, slide sets, transparencies, and powerpoint presentations will be much more effective, if they share them with others, thus replicating their products, and thereby multiplying their effectiveness many times over.

That is the idea behind the Space Chapters Hub. This is a website, hosted by NSS Chapters.org, that serves as a watering hole for all chapters involved in space outreach and education, be they chapters of the National Space Society, the Mars Society, or the Moon Society. Despite their differing emphases, all space chapters face the same obstacles and challenges and have the same type of tool options available to them.

http://nsschapters.org/hub/
extensively updated 9|21|02

On this site's many pages, you will find quite a few tools to help you gets started. And more are being added all the time. Moon Society Milwaukee has committed itself to making a lot of materials available on this site, much specifically for Moon Society Chapters from one to a zillion members. Display instructions, flyers, speech outlines and talking points and more.

At hub/gravityjugs.htm -- the new "Gravity Jugs" page -- you will find quite a bit of help putting together a small, low budget, easily transported and stored, yet effective information table/booth display system tailor made for one-person operation.

Hopefully, by the time this issue reaches your mailbox, there will also be downloadable flyers and brochures you can use, at hub/flyers.htm

What is a one-person outreach operation?

By a loophole in the chapter rules, you can fly as a Moon Society "Chapter in Formation." But another word that comes to mind, and has had a lot of bad press of late, is the "cell." Defined in the dictionary as a local small group within a larger organization, cells have been units in the Communist Party as well as in the terrorist organization Al Qaeda. But it was also the word used by Robert A. Heinlein for the active units of the Lunan pioneer pro-independence movement in his classic novel *The Moon is a Harsh Mistress.* Cells are what we make them, and a seed for change would be a good description of just what we need. By local outreach and creative projects we can work alone or in small groups to help advance the opening of the Moon Frontier.

Meandering through the Universe

A Column on the Cooperative Movement on the Space Frontier © 2002 by Richard Richardson

Allow me to write specifically as a member of the Artemis/Moon Society for just a bit ...

Question: Why is the Mars Society so vibrant, dynamic, and active?

My opinion: Perhaps it has to do with Robert Zubrin's charisma, determination, ability to express himself and his network of connections. Of course, it might be that the members of the Mars Society are just better people than everybody else ... but, though they are undoubtedly very talented, motivated, good people, I honestly don't think that the quality of the people who make up the membership is the key factor. But if it isn't superior membership, then ***IS*** it connections? Or is it, after all, Bob Zubrin's personality? Or something else?

Question: What, if anything, can the Moon Society do to become likewise invigorated?

Answer: I don't know. I would like to see both societies flourish, but it seems to me that the Artemis/Moon Society would have to flourish a bit more to equal to the productivity and success of the Mars Society. But since I don't happen to know what could be done to cause the Artemis/Moon Society to "catch up" with the Mars Society let's take a little different slant and consider what might help *both* groups — and maybe others as well — to excel to the greatest possible extent.

Who knows how to make any two space groups equal in success? Anyway, I really doubt that trying to do so would ever be a productive area of concern. The important thing is that there are many areas of similar interest between the Artemis/Moon Society and the Mars Society. It's my belief that if both organizations are serious about opening space to widespread access, vigorous exploration, exploitation, and settlement (or even their narrower, shorter term goals of bases on the orb of their preference) — regardless of what differing interests they might have — then it ought to be possible for these groups to help each other in numerous mutually beneficial ways.

The Mars Society is the current unquestionable leader (in my humble opinion) of space organizations with regard to success in building and demonstrating hardware, testing well simulated procedures, and so forth — also (and importantly), *inspiring positive interest* of all sorts. It's not that they are the only ones which are doing anything important. Not at all! Vitally important work is being carried out *successfully* by many other groups. We're talking *"leader"* here, not *"only."* You can decide for yourself whether my appraisal is correct or not and you can judge for yourself the gap between one organization and the other. The points to remember are first, that careful and well considered cooperation will almost always leave all participating parties ahead of where they otherwise would have been, and, second, that things change — the parties providing the most benefit and the parties receiving the most benefit may not always remain the same. The stories of *The Lion and the Mouse* and *The Tortoise and the Hare* illustrate just two means by which circumstances can change ... *NOT* just in fables and fairy tales but in real life as well.

I'm not calling for the virtual merging of any space groups. The differences in perspectives, directions, philosophies, and styles are real and (I would argue) useful. But differences or not, it should be recognized that most mainline space organizations have a tremendous overlap in goals, perspectives, and philosophies and it should be possible to do a great deal more to assist each other to be productive and make progress toward concrete goals than is currently being done.

It is tempting to think that the responsibility for initiating partnerships, cooperative interactions, and "outreach" between organizations ought to be on the shoulders of those more dynamic, powerful, wealthy, or otherwise successful groups. But there are good reasons that the lion's share of onus should fall on the smaller, poorer, more challenged organization. Such groups often have surplus brain power not required by numerous challenging projects because such groups seldom have all of the other resources necessary to conduct many extensive and complex projects. On the other hand, those busier, more "advantaged" groups often have most of their most powerful brain resources fully employed in meeting the challenges of the many ongoing projects.

Spending much effort searching for ways to initiate and conduct interactive operations with, or offer assistance to another organization would seldom be the most advantageous use of that organization's brain power. But it could well be the case that what the more "challenged" organization needs (or at least would find very helpful) is fairly easily available at the more "advantaged" organization and could be shared, traded for, exchanged for, sold, or lent on terms which are not only affordable to the more "challenged" group but which would actually benefit both them and the "advantaged" group in significant ways. In essence, developing plans for mutually advantageous cooperative interactions elsewhere and presenting them complete and ready to "chew on" (so to speak) greatly reduces the "cost" of such a plan to the organization, making it viable, even attractive ... if it really is a good, workable, and advantageous plan.

And this would not have to only be *"working together."* It should include little "good neighbor" kinds of things equivalent to sharing tips over the backyard fence about which store has the best prices.

A little more in the realm of "working

together," here's an off the cuff example meant only to illustrate my point (and hopefully *not* touch close enough to home to upset anyone): Say society A reaches a point where they are fabricating (or ordering) a very certain, widely applicable and crucial life support system component. They need X number of these components (including back-ups) but realize that they can fabricate (or order) as many as X+N for little more expense. They don't want extras however because finding storage for the unneeded ones is not obvious and therefore could prove to be both a headache and expensive. However, society B will also need life support systems for its projects. Just a few minutes on the phone (and possibly a bit of time for society B to discuss the matter) could significantly advance society B's ability to progress toward its goals at virtually no cost to society A, generate good will, and like the lion who didn't kill the mouse, the little act of thoughtfulness might even pay off big at some point in the future. In the shorter term, such cooperation could help reduce costs and time frames for both groups once the details of the interaction are all worked out.

Launch systems, life support systems, EVA equipment, and all kinds of other hardware/hard science/tech matters, even "lessons learned" from whatever source or circumstance have a wide overlap in relevance and usefulness to the Mars Society, Artemis/Moon Society, and others. The Artemis/Moon Society is currently considering the construction of a base simulation. What that entails seems to be far from settled yet, so far as I can tell. But even if it is extremely different from the Mars Society's simulations there will still have to be many (very many!) similarities.* Perhaps the Mars Society would be willing to share tips, techniques, training, or who knows what else ... especially if they were to get something out of it in return. That's just one type of cooperative interaction that might be possible to arrange, to the mutual benefit of two separate organization.

[* and differences! This was the subject of an essay about a potential Lunar Base Analog Station one year ago in MMM # 148, SEPT. '01, pp. 10-12.]

Okay, so why include this discussion in an article for the general space interest community? Because pretty much all main line space interest/enthusiast/activist groups could work together to their greater benefit (and the advancement of space-faring goals) than is currently happening. Even the science fiction community could be involved. If I'm wrong sue me. [Not really, please! Just a figure of speech!] But if I'm right, let's do it! Or like the captain of the textile machine industry says, "Make it sew!" **<RRR>**

Richard's homepage:

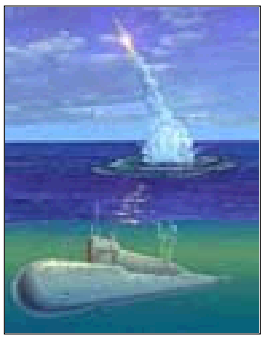
http://richardpatricia.homestead.com

SOLAR SAIL Project Update

[http:www.planetary.org/solarsail/]

Volna Testing and Development on Schedule

by Project Director
Louis Friedman



August 6, 2002: Testing and development of the *Cosmos 1* spacecraft in Russia continues to go well. During the first week of August, another critical trial will be conducted -- the firing of the orbit insertion motor in a test-stand. The motor has already passed cold flow tests, but this time the motor will actually be fired. The trial will take place at the Izaeev Design Bureau, responsible for Cosmos 1's motor development.

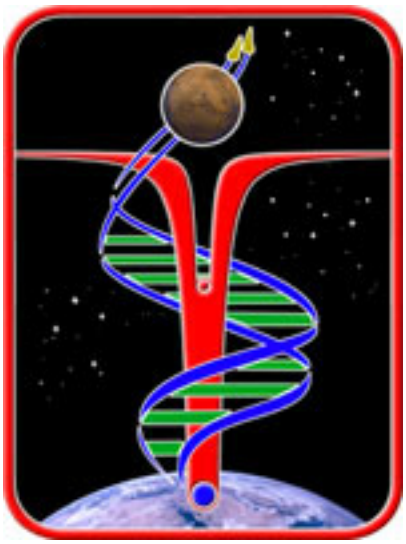
The motor is a civilian adaptation of a frequently used military motor. It is configured to provide the additional boost necessary for the Volna (the submarine lauched ballistic missile) to insert payload into Earth orbit. We are calling this the TPS motor - where "TPS" stands for both The Planetary Society (since it is being developed first for us, and later for possible planetary applications) and for the Tsander Propulsion System (after Frederikh Tsande, the inventor of the solar sail flight concept).

Also during the first week of August, the second unit of the on-board computer will be delivered to the Space Research Institute in Moscow. One of the two units will be used during the flight, and the other is a spare, used for engineering purposes. Visitors to The Planetary Society web site have seen this computer and flight instruments undergoing tests in July. These tests are proceeding well, with several of the flight sensors now having completed testing with data going through the computer. We still await delivery of the radio systems so that end-to-end data checks can be carried out. That should occur during the next several weeks.

Meanwhile we also await news about results of the July 12 sub-orbital flight of the Inflatable Re-entry Descent Technology (IRDT) vehicle. Just like the payload on our sub-orbital flight one year ago the IRDT is lost and has not been recovered.

Although the IRDT is not connected with our mission, we are obviously interested in the performance of the Volna launch vehicle. More on this in a future update. **<LF/TPS>**

[Editor's NOTE: Solar Sails have been on a lot of drawing boards for more than two decades. In the 1980s, the World Space Foundation was at the forefront of this effort, actually producing a test version to test unfolding techniques. A Solar Sail race was also supposed to be part of the 1992 World Geophysical Year Observance. The deadline was too short.]



The Mars Gravity Biosatellite Project

www.marsgravity.org

A Private Initiative to Study
the Effects of Martian Gravity on Mammals

Mission. The Mars Gravity Biosatellite will carry a small population of mice to low Earth orbit aboard a spinning spacecraft creating "artificial gravity" identical to that on the Martian surface. The 7-week mission will conduct the first in-depth study of how mammals live, grow, and develop in a reduced-gravity environment. Groundbreaking data from this mission and its successors will be essential in determining future possibilities for human space exploration.

Team. Students and faculty advisors from MIT (Cambridge), U. of Washington (Seattle), and the U. of Queensland (Brisbane) have joined with expert scientists and engineers around the world to create the world's first private life science mission in space. Mission highlights will include new duration records for artificial gravity and autonomous life support, and the first mammalian births in space.

Humans travel to Mars. No one yet knows whether humans can safely make the journey to Mars, for Mars has only 3/8ths the gravity of Earth. When astronauts stay in 0-g for long periods, bodies and brains suffer severe changes that make it difficult for them to return to Earth. While rotating "artificial gravity" craft may permit humans to stay in shape during the long journeys to Mars and back, no one knows how they'll adapt during a prolonged stay on the surface of Mars. The Mars Gravity mission will provide the first answers to this fundamental question.

Can humans live on Mars? Even if humans can adapt to Martian gravity and live on the Martian surface, what will happen to their children? No one knows how mammalian development is affected by altered gravity levels. The rodent crew of the Mars Gravity Biosatellite will include some pregnant mice, who will give birth in orbit (the first time for mammals); their offspring will grow and develop entirely in Martian gravity, revealing clues about how reduced gravity affects early developmental processes.

Mars Desert Research Station Hosts First Summer Youth Crew.

July 1, 2002 - from http://www.marssociety.org/

Twelve Utah Wing cadets of the Civil Air Patrol served as the first youth crew at the Mars Desert Research Station near Hanksville, Utah this summer, July 21-26. During this time the cadets experienced the rigors of living in and operating out of a Mars habitat.

Starting in 2003, the Mars Society will expand the program to offer hands-on, real-life "Mars Camp" educational opportunities for many school groups every summer. The Mars habitation module is used by professional researchers during the months of September through May.

A complete report on the MDRS Civil Air Patrol pioneering Mars education field experiment was presented at the 5th International Mars Society convention, August 8-11, 2002 at the University of Colorado at Boulder.

Radio Free Mars

http://www.robbinson.dynu.net/RRadio/
<probbins@sympatico.ca>

July 20, 2002 - Due to the rapidly expanding international interest in Radio Free Mars(RFM) it was decided to start broadcasting even though the station isn't quite organized yet. The preliminary playlist will change in an adhoc fashion for the present depending on what strikes my interest at any one moment and what others draw to my attention.

Field Reports from FMars 2002 on Devon Island have been received via satellite phone from the high arctic, thus the rather erratic audio quality.

FMars2002 mission page [playlist] includes some 21 transmissions.

NSS & Space Adventures team up to Support Commerical Space Exploration

Washington, D.C., Aug. 14, 2002 - The National Space Society and Space Adventures, Ltd., have announced a joint program to promote commercial space exploration and to advance the day when humans will live and work in space. The two organizazations will work together on a number of space tourism initiatives including joint conferences and events.

"Tourism will be critical in creating the market for space settlement," said NSS Vice President of Public Affairs, Christopher M. Pancratz. "This opportunity allows NSS to partner with the premier space tourism provider in anticipation that mass-market space tourism will soon begin with sub-orbital flights to altitudes exceeding 100 km."

The partnership is also intended to provide NSS members with unique benefits and to bring space advocates closer to the next frontier through a number of Space Adventures' experiences. NSS members will receive discounts on select programs such as terrestrial tours, zero-gravity and supersonic jet flights, and sub-orbital space flights. Space Adventures will also operate an NSS members-only tour.

"We are proud to be partnering with NSS, the world's oldest active space advocacy organization," said Space Adventures President and CEO Eric Anderson. "Space Adventures looks forward to make the dream of space travel a reality for their members and the general public." Space Adventures will also include a free one-year NSS membership with the purchase of select space experiences.

Space Adventures, Ltd., the world's leading space tourism company, offers a wide range of space experiences, from zero-gravity and Edge of Space flights, cosmonaut training and space flight qualification programs, to actual flights into space. Headquartered in Arlington, VA and with an office in Moscow, Russia, Space Adventures is currently developing sub-orbital space flights scheduled to operate in 2005. For more information, visit

http://www.spaceadventures.com
or call Tereza Predescu 1-703-524-7172.#

For NSS, visit http://www.nss.org
or call Alison Schutt, 202-543-1900

Silicon Sidekicks

Re: Directions for Space Robotics

"MUST Online Reading" - <PK/MMM>

http://science.nasa.gov/headlines/y2002/13sep_sidekicks.htm

National Space Society joins SETI Institute as Major Sponsor of NASA Haughton-Mars Project Summer 2002

8/8/02 -- The National Space Society has joined the SETI Institute as a major sponsor of the Mars exploration research program on the NASA Haughton-Mars Project for the year 2002 (HMP-2002). The NSS logo is included on the advanced planetary exploration concept spacesuit undergoing field tests during the HMP-2002 summer field season on **Devon Island**, Canadian High Arctic, and, to the extent possible, on mobile vehicles used this field season to support studies of Mars surface research activities. In addition, the National Space Society flag is being flown at the HMP Base Camp during the entire operational duration of the HMP-2002 summer field season.

[The Mars Society's Flashline Mars Arctic Research Station used in Mars exploration simulation exercises is a separate project, but is also co-ordinated in its activities with the Haughton-Mars Project.]

This project is in direct support of the NSS Mission: "To promote social, economic, technological, and political change, to advance the day when humans will live and work in space." It addresses a number of the Barriers to Space Settlement identified by NSS, including technology for life support and current lack of public interest.

The NASA Haughton-Mars Project (HMP) (http://www.marsonearth.org) is an international interdisciplinary field research project centered on the scientific study of the Haughton impact crater and surrounding terrains, Devon Island, Nunavut, Arctic Canada, viewed as a possible Mars analog. The rocky polar desert setting, geologic features and biological attributes of the site offer unique insights into the evolution of Mars, the effects of impacts on Earth and other planets, and the possibilities of life in extreme environments. The opportunity of scientific field studies at Haughton is also used to support studies in exploration research, to investigate the technologies, strategies, human factors and hardware designs relevant to the future exploration of Mars and other planetary bodies by robots and humans. HMP-2002 will be the 6th field season of the HMP. The HMP is managed by the SETI Institute at the institute's Center for the Study of Life in the Universe. Dr Pascal Lee, principal investigator at the SETI Institute, is Project Lead and Principal Investigator of the NASA Haughton-Mars Project, run under Cooperative Agreement with NASA (#NCC2-1185).

The National Space Society is an international grassroots space advocacy organization, promoting the exploration and settlement of space via social, political, economic, & technical change. It has 35,000 members, 50 chapters world wide. HQ Washington, DC. Visit www.nss.org or call (202) 543-1900.

Mail For MMM

[MarsAviation] Mars Analog Aircraft

from: Paul Gordon Swift <pswift@mtroyal.ab.ca>
to: <MarsAviation@lists.marssociety.org>

To those who have an interest in manned flight on Mars, yet have a little trouble coming up with even the one-way fare, my Mars plane is now under construction in Calgary, Alberta.

It is designed to operate in Earth's atmosphere (the only one accessible to me) at what would be considered to be an extreme altitude, somewhere around the same height attained by the Pathfinder solar powered unmanned vehicle (96,000 feet).

This may in fact not quite be possible; however, that is no excuse not to go for it.

It's a big plane, with a span around 120 feet, and will carry three people. Two engines are mounted on a high wing, each driving a seventeen foot diameter five bladed propeller.

The propeller blade is the smallest component of the aircraft, and since funding comes from what's left over after paying for the groceries, it made sense to start here. I've constructed a single blade to serve as a master, or plug, from which a female two piece mold will be built over the next six months or so. From the female molds, I can lay up the composite material for the actual blades.

I'm in the process of placing all this progress and toe-stubbing onto a website which should be operational by September:

http://airbornecontrol.com

[Editor's NOTE: NASA research to date has been with small unpiloted drones, looking towards robotic Mars missions. Paul Swift is the first to actually work on pioneering *manned* Mars Aviation.

Ad Astra per Ardua Nostra
To the Stars through our own hard work!

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(* LRS Board Members,plus Ken Paul ....)

LRS NEWS

• **September 14th Meeting Report:** Three members present: Peter Kokh, Bob Bialecki, Ken Paul.

Ken Paul accepted the position of 3rd Board member replacing Mark Kaehny, who has been inactive for more than a year. We filled out our annual state report as a Wisconsin 501 c3 nonprofit, as well as our request for meeting dates for the coming year at Mayfair Mall.

Ken passed out CD's of Kennedy's 1962 Going to the Moon speech, this its 40th anniversary.

We had a guest from the newly founded St. Louis (MO) Moon Society chapter, Burt Sharp and local friend Ellen, both enthused and 'on the same page' as far as taking the long ("100 year") view. The resulting conversations and discussions were very lively and stimulating for all of us. We discussed collaboration between LRS and MSSL.

• **More at:** www.lunar-reclamation.org/page4.htm

LRS OCTOBER/NOVEMBER Events

Saturday, OCT 12th, NOV 9th1-4 pm

LRS Chapter Meeting, Mayfair Mall, Garden Suites **Room G11** (lower level, NE part of Mall) near the ground-level entrance below General Cinemas.

OCTOBER AGENDA: • Space News updates: Station & Shuttle, Moon, Mars, Asteroids, Tourism; • Outreach events on the horizon; • Ways to better structure our meetings following the model of Philadelphia (p.19)

U.S. CHAPTERS

NSS Chapter Events

MMM 8 Chapters Strong

Space Chapters HUB NEW ADDRESS:

http://nsschapters.org/hub/

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

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

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

SEP 16th Foerster Hall of Dance, **Sheboygan**
OCT 21st MEETING at the Stoelting House in **Kiel**

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

Next Meeting -- No info as of press time: **Radio City Inc. 2663 County Road I**, Mounds View, Mn. 55122 (763) 786-4475 -- back meeting room. It's north of I694 just off of County 10, between Long Lake and Silver Lake Road, not Hwy. 10, close by, which runs along I-35W. You must be on *County* 10. For more directions or to add to Agenda call: (612) 333-1872

• **From Ben Huset** - Pics from North Woods Star Fest. My Thanks to Dr Moritz and the entire CVAS crew for another GREAT event. Enjoy.
www.freemars.org/mnfan/cvas/nwsf2002/index.htm

OHIO

Cuyahoga Valley Space Society

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 [new]

☞ Monthly Meetings, the 4th Thursday each month

7-9:15 pm, Parma Regional Library
NEXT MEETING DATES: **SEP 26, OCT 30**

NOTE: The **Oct. 30th** meeting is on a **Wednesday**.

Aug. 21st Meeting: Steven has invented an involved space game called Space Voyage, and invited six of us to play during a marathon 8 hour session. Brian brought a short video about DNA in space, and we heard audio tapes from National Public Radio Science Friday about Project Orion and water on Mars.

Aug. 26th Meeting: at Madison Branch, Lakewood Library. Space Simulations of flight over the surface of Mars on the library's six fast graphic Internet access terminals. After "debriefing", optional sortie to the nearby space-theme restaurant *Capsule.*

Sept. 26th (Thurs) Meeting: Parma: NASA Speaker on Rocketry.

Sept. 29th (Sun.) CVSS Picnic: 2pm at Annette Wood's home in Ridgeville. Potluck. (440) 353-0368.

Oct. 30th (Wed.) Meeting: Parma: NASA Speaker on ISS Experiments

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: **SEP 16, OCT 20**

News Flash: There is a report coming out of the recent Mars Society Convention held August 8-11, in Boulder, CO, that the 2003 Convention may be held here in Oregon, in Eugene. As Oregon L5 members are very much involved in Mars research, that will be a great opportunity for us to present.

CALIFORNIA

OASIS

OASIS: Organization for the **A**dvancement of **S**pace **I**ndustrialization and **S**ettlement

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.

SEP 16th -- Business Meeting at location TBD

OCT 20th -- 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 and fiction with interviews, news, radio dramas, artists, writers, stories, reviews. Info: 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)

NEW URL 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 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: Tentatively: **Sep 21**, **Oct 19**, **Nov 16**

Scheduled PASA activities: Regular Sat. monthly meetings on above dates. Special event: Philcon 2002, Dec. 13-15 (more info below). Call Earl Bennett or Mitch Gordon, 215-625-0670, to verify all meetings.

August 18th report: Rich Bowers discussed the movie *Pluto Nash,* which he considered a decent movie if for no other reason than it takes Moon colonies for granted; and the movie Signs.

Hank Smith discussed recent and upcoming science fiction conventions, including Philcon 2002, which will be at the Marriott Center City Dec. 13-15. Hank is accepting suggestions for science track programs. Philcon 2003 will also be at the Marriott Center City Dec. 5-7 next year.

Mitch Gordon reported that the World Future Society annual convention recently held in Phila. was considered a wonderful success, including presentations by Michelle Baker, Gary Fisher, and Jay Haines, and he'd like to bring the ISDC convention to Phila.

Jay Haines pointed out the Oct 31 deadline for proposals for the next World Future Society convention in San Francisco July 18-20, 2003, and suggested we contact chapters in that area. Mitch also discussed the Jul/Aug *The Futurist* article showing future timelines, including space activities; the Sep/Oct *The Futurist* article "The Future of Space Tourism;" the Nov. 15th deadline for proposing a space mural; and a possible next FutureFest.

Larry Pezzuto discussed the PASA web site, and passed out new PASA membership cards. Simon Koumjian told us what's been going on in his life as an architect since we last saw him.

Dottie Kurtz discussed the Sept. *Air & Space* articles "M, L, & XL Only" on space suit sizes, and "Ticket to Orbit" on space tourism. Also articles in the Jul/Aug *Planetary Report*, including "Mars Odyssey Continues" and "Extra Solar Planets."

Gary Fisher discussed and showed photos of his activities removing the old Mars Society Desert Research Station GreenHab, and replacing it with a new version. Gary also reported on the Mars Society Convention held Aug 8-11 in Boulder CO. Next year's convention may be in Eugene OR. Gary has two articles, one of which is reproduced on the included CD, in the book *On to Mars, colonizing a new world*, which is available on the Mars Society web site, or from www.cgpublishing.com. ISBN 1-896522-90-4 $19.95.

Earl Bennett discussed the article in the Apr/May *The Industrial Physicist* by David Criswell "Solar Power via the Moon," which generated so much reader response that the Aug/Sep issue contained a follow up article "Return to the Moon" - both available from the author at <dcriswell@houston.rr.com>.

Earl also discussed an Aug *NASA Tech Briefs* article "Water jet accelerator for launching a spacecraft", an Amateur Robotics article, and a Sept *Wired* article "I Can See: the race to build the artificial eye"

NAME _____ √

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○ $35 **NATIONAL SPACE SOC.** dues + **Ad Astra**
○ $20 NSS dues if under 22 / over 64. *State age* ___
600 Pennsylvania Ave SE #201, Washington DC 20003

Join **The Moon Society** - dues address on page 9

- **For members residing in the U.S & Canada:**
  Printed **MMM** delivered by postal mail: **$35**
  Electronic (pdf) **MMM** available on website: **$35**
- **For members residing in other locations:**
  Printed **MMM** delivered by postal mail: **$60**
  Electronic (pdf) **MMM** available on website: **$35**

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Member Dues -- MMM/MMR Subscriptions:
Send proper dues to address in chapter news section

=>for those outside participating chapter areas <=
○ $18 **Individual Subscriptions to MMM/MMR:**
Outside North America ○ $50 Surface Mail --
Payable to "LRS", PO Box 2102, Milwaukee WI 53201

CUYAHOGA VALLEY SPACE SOC. (Cleveland, OH)
○ $15

CHICAGO SPACE FRONTIER L5
○ $15 annual dues

LUNAR RECLAMATION SOC. (NSS-Milwaukee)
○ $18 reg. ○ $24 family ○ $15 student/senior

MINNESOTA SPACE FRONTIER SOCIETY
○ $20 Regular Dues

OREGON L5 SOCIETY
○ $23 for all members

O.A.S.I.S. L5 (Los Angeles)
○ $18 regular dues

PHILADELPHIA AREA SPACE ALLIANCE
○ Annual dues for all with MMM $16, due in March or $4 times each quarter before the next March

SHEBOYGAN SPACE SOCIETY (WI)
○ $15 regular, ○ $10 student, ○ $1 / extra family memb
"SSS" c/o B. P. Knier, 22608 County Line Rd,
Elkhart Lake WI 53020

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