"Expanding the Human Economy through Off-Planet Resources"

Moon Miners' Manifesto

& Moon Society Journal

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In Focus ▣ Born Again Russian Capitalism

"Pride Goeth before the Fall!" Most of us with religious upbringing have heard this monition, one that is seldom, however, taken to heart. While it is apparently "beneath" NASA to do anything that would actually "earn" money -- after all, NASA is a not-for-profit arm of the U.S. Government, and the Congress has given it no such mandate, or permission -- the Russians are freer to do *whatever works*.

"Necessity is the Mother of Invention." We've all heard this one too. But it applies not only to technical and logistical challenges, but to economic ones. And the Russian Space Program desperately needs money, as does every part of the Russian government.

Converts are often more zealous, more deeply in touch with their new faith, than those born into that faith. In America, and in most of the rest of the Free Enterprise world, we take our economic freedoms for granted. There are so many opportunities to make money, many of them sadly predatory, that we feel less need to "hustle" up fresh options. The newly impoverished Russians, in contrast, are zealously turning over every new stone they can find.

Case in point. The American firm Space Adventures has brokered the ISS "Tourist" flights of both Dennis Tito and Mark Shuttleworth. And they

Far Ahead in Efforts to "Open Up" Space

are looking for more customers with $20 million in mad money to spend on the once in a lifetime ISS experience. Their market is confined to the super-affluent sub-percentile of the population, leaving the rest of us scrambling to buy Power Ball or Big Game lottery tickets in order to join the ranks of the *nouveau riche* so that we too can qualify.

But take heart. There is another firm out there, with American *and* Russian partners, headquartered in Amsterdam, that is busy exploring other options that will make it possible for the rest of us "economic commoners" to still *dream!*

MirCorp is working to help put together the orbital dreams of In Sync's Lance Bass, and of NSS's former Executive Director, Lori Garver (also, but far from only, a soccer mom.) And as you will read in Robert Perry's report, pages 9-11, television networks and individual agents are vying for the right to satisfy the Russian's thirst for profits.

NASA, steering clear of space tourism, is still doing its part to open up the heavens to the rest of us through its born-again Teacher in Space program, with Barbara Morgan to be the first in 2004. As long as the agency doesn't interfere with private enterprise, this is okay. - PK

The Deep Silence of the Moon, and Humans

The Moon is now a very quiet place. How will that affect humans over the long haul? How will human sounds and noises play on the Moon? It is a more interesting topic than one might think. In this issue, we take up the subject and look at it from a wide variety of perspectives. Read "In the Still of the Night," pp. 6-7.

Moon Miners' Manifesto

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® **MMM's MISSION**: to encourage "spin-up" entrepreneurial development of the novel technologies needed and promote the economic-environmental rationale of space/lunar settlement.

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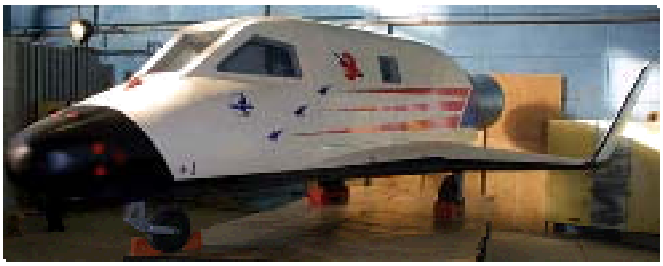
Enter the Cosmopolis XXI Tourist Shuttle



[www.spaceadventures.com/press/031402b.html]

The Cosmopolis XXI Aerospace Multi-Use System consists of a carrier aircraft, the M-55X Geophysica, and a manned rocket module, the C-21. The module is a lifting body Reusable Launch Vehicle built around a 3-seat passenger capsule. It includes an engine unit and an equipment compartment with rescue / environmental control / life support systems.

The rocket module is mounted on top of the M-55 carrier aircraft. A connection between the carrier and the rocket module provides information on status and efficiency control of all rocket module systems before take off and separation.

The carrier aircraft with the C-21 attached will reach an altitude of 17 kilometers (10.5 miles), and then gather speed to perform a vertical climb maneuver. Once the altitude reaches 20 kilometers, and the trajectory angle reaches 40-60 degrees to the horizon, the locks are disengaged and the rocket module begins to separate from the M-55X. As soon as a safe distance from the carrier aircraft is reached, the C-21's rocket engine is ignited automatically. The rocket module then climbs steadily under rocket power, on a gradual trajectory up to maximum altitude, around 100 kilometers (62 miles). Once the rocket engine burns out, it separates from the crew compartment. The C-21 then continues to gain altitude as it passes through Sub-Orbital space.

During the descent phase back to Earth, control surfaces are extended for optimal aerodynamic performance. The landing is divided into the glide-phase and the final parachute-assisted touch down.

Cosmopolis XXI System Specifications

Combined Take off weight: 27,000 kg

M-55X

Weight 25,000 kg Crew 1
Maximum Altitude: 27 km
Maximum Speed: 800 km/h
Max. Flight Duration: 6.5 hours

C-21

Weight 2,000 kg Crew / Passengers: 1 / 2
Maximum Altitude: 100 km

Next month, **Moon Miners' Manifesto** takes its semi-annual break. Readers will receive **Moon Miners' REVIEW #31** in its place.

Crop Selection Criteria for Lunar Settlements

by Larry Jay Friesen <ljfriesen@ev1.net>

The topic of crop selection for extraterrestrial life support systems, and particularly for lunar bases and settlements, is one that has received some attention but probably deserves more. I would like to address it not because I know what crops we should choose, but because I would like to put forward for consideration some criteria we might want to consider when we are making our choices.

Sometimes, when we don't know the best answers, it is useful to frame the questions carefully. In the long term, lunar residents will quite likely grow a wide variety of crops, and probably some plants that are not crops - that is, are not grown for food or usable materials. But where should we begin? What crops would we want to start with, and what criteria might be important in making our selections?

To look for a good initial crop mix, we will probably want to use a multi-dimensional search space. In other words, we will want to look at several types of criteria at the same time. Peter Kokh mentioned one dimension of crop selection in Issue # 149 of the Moon Miners' Manifesto: flavor, and menu diversity. I may touch on flavor in passing, but I would like to concentrate on two additional parameters of the search space: growing conditions and nutrition.

1. What crops will grow best under lunar conditions?
2. What combination of foods could we grow, to most efficiently satisfy our nutritional needs, while eliminating the need for supplements imported from Earth, or at least keeping such imports to a minimum?

While I will concentrate on plant foods, I will touch on raising animals as well. In some studies and initial experiments for self-contained life support systems, I have observed a tendency to concentrate on crops familiar to the people doing the experiments: frequently crops grown on North American farms. I would like to expand our horizons and look both at the crops we are familiar with and at all sorts of food producing plants from all parts of the world.

Lunar Growing Conditions

Optimizing crop selection for growing conditions on the Moon is a multi-dimensional parameter space by itself. Among the parameters to be considered are lunar gravity, the lunar day/night light cycle, the lunar temperature cycle, availability of lunar resources (water, soil), and the choice of atmosphere conditions for the settlement. To learn how plants grow in lunar gravity, and how their productivity compares to the same plants grown on Earth, we will probably have to wait for actual experience on the Moon, or at least for variable-g centrifuge experiments in orbit*, on the International Space Station (ISS) or some other orbiting research facility.

[* Editor: see last issue, page 16, “BioSatellite to Study Life in Mars Gravity”]

Lighting Conditions & Cycles

Some of the other parameters, however, we can check on Earth. Lunar Day-Night Cycle: We will very likely be able to light the areas in our settlement where we grow our plants on any schedule we choose, whether it is the 24-hour day we are accustomed to on Earth, or something entirely different. But it might be worth while investigating how plants respond to the Moon's natural month-long day-night cycle, whether we expose our plants to sunlight directly, through windows, or light pipes in as has been suggested more than once in MMM*.

[* MMM # 66 p.7 JUN ‘93, “Let There Be Light: light delivery systems for lunar settlements need to be rethought” and MMM #74, APR ‘94, p. 7. “Sun Moods” and MMM # 136 JUN ‘00, p. 3. “ Nightspan Lighting: Sulfur Lamps and Light Pipes”]

If the crop-growing areas are co-located with the human habitation portions of a lunar settlement, the plants will, of course, receive whatever light on whatever cycle the inhabitants choose for themselves. But if crops are grown in separately pressurized volumes, more flexibility is possible. Might we find ways to maximize the use of the natural lunar day-night cycle, and thereby minimize the need for artificial light in the farm areas, thus minimizing overall power requirements for the settlement? *

[* This was the subject of the LUNAX - Lunar Agricultural Experment Corp. efforts spearheade by LRS member at large, David A. Dunlop in 1990-1. See http://www.lunar-reclamation.org/page10.htm]

Selection of crops tolerant of extended periods of light and darkness can be part of this scheme. If we do have to supplement natural light, perhaps it is not necessary to hold strictly to a "12 hours light, 12 hours dark" timetable. For some crops, might it be enough to interrupt the 14 days of darkness with brief, occasional intervals of light? Or for crops that find 14 days of uninterrupted light difficult, may brief, occasional intervals of darkness suffice?

There are obvious opportunities for research here, to find what lengths of light, at what intervals, will be sufficient or optimum for crops, and what lengths of darkness, at what intervals, will work best during the lunar day. Some crops have a very rapid growth cycle: certain varieties of radishes, as one example. Might it be possible to grow such a crop from seed to harvest in a single lunar dayspan? This, too, would be a good research project. One place we might start our search for plants that can tolerate the long lunar day-night cycle is among plants that grow in far northern or southern latitudes. They may already have some pre-adaptation to extra-long days

(during the summer) and extra-long nights (during the winter).

Temperatures and "Climates"

I might also suggest that we not restrict ourselves to plants already domesticated. We might, for example, experiment to see if roots or berries presently gathered wild by arctic and subarctic peoples can be cultivated. Lunar Temperature Cycle: Neither crops nor people can tolerate the extreme swings of the lunar temperature cycle, which goes from about 100 kelvin (-173° C) for the majority of the lunar night to around 400 kelvin (137° C) at noon on the lunar equator - far above the boiling point of water. But it may not be necessary to hold the temperature absolutely constant, either. Some temperature fluctuation may be desirable, even necessary. As Peter Kokh has pointed out, some crops require freezing or frost temperatures, at least for short intervals, in order to set fruit.

To search for crop plants that can tolerate the greatest temper-ture fluctuations (and thereby minimize our power requirements for heating and cooling the farm areas), we might again start by looking at crops adapted to high-latitude regions. We might also try desert-adapted plants. In many deserts on Earth, temperatures can swing from an extremely hot day to a quite cold night in a single 24-hour period.

Lunar Resources: Soils versus Hydroponics

Some closed cycle life support studies have used, or assumed the use of hydroponics. But as Peter Kokh has pointed out, and as studies of Apollo returned samples showed, many plants will grow quite well in lunar soil, at least in the basaltic type soils of the lunar maria. This shouldn't be a complete surprise, since basaltic volcanic regions are often fertile farming country on Earth.

Since water is scarce on the Moon (and this will be true even when we manage to tap the polar ice resources), hydroponics may not be the best use of the available resources. An agricultural system based on lunar soil, augmented as necessary, may require less mass imported from Earth. I am not dismissing hydroponics out of hand. It may turn out, that after an overall systems analysis, hydroponics are necessary or advantageous for all or part of a lunar farm system. I am saying we should not simply assume hydroponics and plan from there. If we do use lunar soil as the basis for our lunar farms, it would be a good idea to find out what plants grow best, and produce the most food per unit input, in lunar soil. Studies of this type can be started on Earth, using lunar samples, or more likely, lunar soil simulants, since the amounts of actual lunar samples are limited.

I also suggest, since water is a limiting resource, that we investigate what crops produce the most food per unit water input. One place we might look for such crops is among desert-adapted plants.

Atmosphere Conditions:

The Space Shuttle and International Space Station are pressurized to Earth sea level atmosphere pressure, 14.7 psi or 1 bar. But there is no absolute requirement to do this. Airliners, for example, are typically pressurized to the pressure at 8,000 feet elevation, with no ill effects on passengers. Lunar settlers may likewise decide to pressurize their settlements at something less that Earth sea level. For Moon gardens in pressurized modules separate from human habitation, lab, and factory space, we can choose to optimize atmospheric pressure and composition in the garden modules for the crops. But plants that share volume with humans, will have to live with whatever the people are breathing. If this is at less than Earth sea level, we might look at crops that thrive at high altitude as a starting point.

Nutritional Needs

When considering crops from a nutritional standpoint, I'd like to keep in mind that some nutritional needs are more time-urgent than others. For example: the body can store a supply of some vitamins adequate for considerable periods of time, but not others. The approach I will attempt to describe will require some input from nutritionists. I am not an expert in this area, so if some of our readers are, here is where you can offer some useful information.

I'd like to find out what the most time urgent needs for nutritional inputs are. Consider each type of input we need from our food: carbohydrates, fats, proteins, vitamins, minerals. How quickly will a lack of a given nutrient cause us problems? What will put us in sick bay fastest, if we lack it? Raw calories? Some vitamin? Some mineral? Our bodies store reserve supplies of some nutrients, and we can run quite a while without eating foods containing them. For other nutrients, this is not so, we must have frequent supplies in our food, because we cannot store them, or not very much of them.

As examples, would we come down with scurvy first, or beriberi, if deprived of the key vitamins? I would rank human nutritional needs in order of their urgency, with those whose lack harms us most quickly at the top of the list. When we're just starting our lunar gardens, it appears to me that filling these needs will start to pay off in reduced shipping costs for Earth resupply most quickly.

Once the "urgency order" is determined, I would find the plant that produced the greatest amount of that nutrient, per acre, or per plant biomass, or - in light of the discussion above - per unit water input, and put that plant at the top of my list for food crops. I would probably make exceptions if the crop or crops at the top of this list turned out to be something extremely slow growing, such as a long-lived fruit tree. Once my first crop was selected, I would find out how much of each remaining nutrient requirement that plant would provide. Those whose "minimum daily requirements" are met by the first

crop would be checked off the list. I would then find the nutritional requirement at the top of the list among those remaining. The next step is to choose a crop which could most efficiently meet that requirement. Then we would need to find out how many "minimum dailyrequirements" for the remaining nutrients on the list could be met by crops one and two together. If any nutritional needs would still be unmet, a third crop would be selected that could efficiently meet the most "urgent" of the remaining unmet needs. This process would be repeated until a crop suite had been selected that could meet at least the minimum amounts of all the nutritional components a person needs to stay alive and healthy. Those that supply the most urgent nutritional needs would be planted first.

Food Animals & Livestock

If we are serious about cutting the umbilical cord with Earth, that is making a settlement *increasingly* independent of shipments from Earth, at least for life support, then at some point our farm and garden system will need to include animals. Not for protein - careful selection of plant foods can give us a balanced amino acid input - but for vitamin B12. This point was discussed in an earlier issue of the Moon Miners' Manifesto. Yes, we can supplement our diet with vitamin pills...but that means being tied to Earth for a very long time, because I suspect that complex organic synthetic chemistry will not be in the lunar industrial repertoire for quite some time.

As long as we need to raise animals, for any nutritional need, they will also contribute very effectively to the protein intake of the settlers, so we may as well include that in our nutritional computations for crop selection. Keith and Carolyn Henson mentioned to me at one of the early Princeton Conferences on Space Manufacturing, that it used to irritate the daylights out of their vegetarian friends when they could show that you can get more edible protein from the same amount of land by raising alfalfa and feeding the alfalfa to rabbits, than by raising soybeans. The reason for this is, of course, because rabbits can eat most of the alfalfa plant, while we humans can only eat the beans from the soybeans. There is enough meat on a rabbit that the overall efficiency of the system, from the standpoint of protein production for human consumption, is better than the soybean route.

Raising animals means, of course, that we must include in our crop list those we will use for fodder for the animals, if those include any not on our own menu. The first animals selected are likely to be small: perhaps rabbits, as mentioned above, or guinea pigs [a staple of Peruvian cuisine.] or chickens. When lunar settlements expand sufficiently, they can optimize their crop and livestock mix any way they choose, but we are talking about the beginning stages, where available space is likely to be limited. Here we can use some input from people with experience raising animals, who know something about the food and space requirements, and the meat (or egg) production efficiencies, for various animal varieties. I would hazard a guess that perhaps chickens are not the best first choice. From what little I know, their diet seems too much like ours, which would make them competitors for the same crops we are raising for ourselves. Rabbits, or animals with similar food requirements, may be able to eat some parts of plants, such as leaves and stems, that we can't, which makes their diet more complementary to ours, and probably would result in an overall higher efficiency in the system.

Our first domestic animals may be even smaller than rabbits or guinea pigs. Chef Emeril LeGasse, on one of his *Emeril Live* programs on the Food Channel, happened to mention he was preparing herbivorous snails that are raised commercially. Snails may not be at the top of everyone's preference list, and many of us may be unfamiliar with them as a food item. But as much as some of us may want the "taste of home" when we're living on the Moon, if we are to pioneer a frontier, we had better be prepared to cope with new situations. That may include our diet, if a systems analysis tells us that some new and unfamiliar food can be produced much more efficiently than the alternatives. If someone tells me that I can go to the Moon, but a condition will be that I must eat snails, or silkworm larvae (considered edible in some parts of the orient, I have read!), or some other strange unexpected food, you had better believe I will at least make an effort to try them.

This wouldn't be the first time in history that pioneers have had to learn to eat strange new foods. When Europeans began to settle the Americas, they found themselves faced with turkeys, corn (maize to non-Americans), tomatoes, potatoes, and squash, to name a few of the foods offered by their new homeland. Many of us now consider these things great stuff, but in each case, the first settlers had to overcome the barrier of unfamiliarity.

As I admitted at the beginning, I don't have final answers. What I hope I've done is frame some of the questions in a manner that will both provoke discussion and research, and guide that research in useful directions. Some of the work of finding how potential crops respond to lunar growing conditions may have to wait until we actually have lunar bases or settlements. But it appears to me that large chunks of that research can be done right here on Earth. I suspect that while some research may need to be done on nutritional values of crops (especially crops not commonly grown in North America or Europe), much of the information we need about nutrition is known. What we probably need here are some experts in nutrition and agriculture to help us pull the information together and organize it. Any nutritionists or farmers out there who can help us? **<LJF>**

The Still of the Night

The Moon is a *very* quiet place ... *now!* How will that Change with the Sounds of Settlement?

by Peter Kokh

Recently, Moon Society member John Schrock wondered about the Sounds of Silence on the Moon:

"I perceive in my own mind that the Moon is a quite place. No wind, no trees no animals, no cars nor trains. With human settlements, rockets landing and taking off, and the workings of manufacturing equipment and other things will add sound.

"What are the long term effects to humans of a lack of natural sounds, while landed on another space object far from their birth place, and working every day for at least the near future with [only] equipment sounds, and the constant checking of meters and gages and screens with data and lights blinking or lights constant on or lights constant off and of creaks in the shelter and expansion of metal from temperature extremes and meteor showers and no taped earth sounds as the equipment is down and the budget does not allow for new equipment and all because man wanted to sail away from home?"

Sounds and Vibrations

NASA is unlikely to have attempted to make any sound recordings on the Moon for the simple reason that sound requires atmosphere, and the Moon has none to speak of. Yet, as geologically and biologically dead as the Moon is relative to Earth, there are events on the Moon - from time to time - which would make sounds, if there were an atmosphere to carry them. Landslides, meteor impacts, etc. In the absence of appreciable atmosphere, these events can and do still transmit vibrations that ricochet through the fractured powder-blanketed surface. And NASA has left seismographic equipment on the Moon to register the telltale signs of such events.

Once humans are on the Moon, how much of our activity will be noticeable as vibrations? Perhaps not as much as one might think. The loose regolith of fractured stone and stone-derived powder will damp out most low-level vibration - vibration that does not reach the fractured bedrock below.

Inside our spacesuit helmets

Moonwalkers, spacesuited personnel on surface excursions, while exploring or prospecting or performing service duties, will hear the sounds of their own bodies, the whir of suit respirators and circulation equipment, and, of course, radio transmissions from others. But no nature sounds, no wind, no rustling of tree leaves, no chirping of birds or insects, no babbling of brooks, not even the sound of stones being knocked aside by their boots.

John raises the question of sensory deprivation from this unnatural quiet. Will it have long-term effects, at least for some individuals? Will morale and productivity suffer?

Actually, many humans have been in similar situations on Earth, at least briefly, where nature was unusually quiet. Some may chose the sounds of man-made music anyway, and be so accustomed to their Sony Walkmans that they would not ever notice that Nature had nothing to say, or sing, or shout.

I vividly recall listening to Jesuit Brother Guy Consolmagno S. J. telling a rapt science fiction convention audience of his experiences on the Antarctic expedition that found the alleged Mars Meteorite. using a pair of slide projectors to take us visually to the scene, he had playing in the background the same symphonic music that was playing in his Walkman. Antarctica, absent the howling winds, can be as quiet as the Moon. But he seemed to be in seventh heaven nonetheless and succeeded in recreating the experience in each of us.

Inside the Settlement: Indoors & Middoors

Life inside personnel quarters or private residences, or within labs and other pressurized work and activity spaces on the Moon might not be that much different, sound-wise than life "indoors" here on Earth. But there will be differences. No storm sounds from howling winds, driving rain, hail, or thunder will ever provide the stuff of conversation around the dinner table, in queue at a bus stop, or at the local bar happy hour.

Yet that is too simple a statement. Recall our distinction between indoor, middoor, and outdoor or out-vac. Middoor spaces are the air-filled spaces represented by pressurized halls and walkways, streets and transit tubes, parks and squares, etc. They are "outside" homes, offices, and workspaces, but "inside" the "hull-plex" of the settlement. One's habitat may be insulated to the point where no middoor sounds can penetrate, but such buffering is not strictly necessary and may be a matter of choice. Some may choose to tune their habitat speaker system to "play" the background activity noises of a nearby square, park, or market. Of course one could supply canned noise, but why when the sounds of real live life activities are available in unscripted format?

In the middoors itself, a variety of "nature sounds" can be provided. As the middoors areas will host the bulk of the shared biosphere, it is logical that there will be song birds and sounds of other planned urban wildlife. And instead of the steady drone of invariable ventilation, the air flow circuit between the settlement spaces -- from farms and orchards to residential areas, schools, commercial areas, offices, industrial areas and back through the farms for cleansing -- can be varied in direction and force to produce breezes and wafts within set ranges. This would provide for more random accompanying noises -- in the rustling of leaves, for instance.

If "rain" is programmed into the middoor

climate calendar, that too will have an effect on sound transmission. So will dawn and dusk, whether as a service of the rising and setting sun or as a programmed feature of artificial lighting.

Air quality in middoor spaces will benefit greatly from exposed water features: fountains, water falls, babbling brooks, and as mentioned, occasional programmed rain. These generate welcome "white noise." To some extent, as we noted in MMM # 154 April '02, p. 8. "Homestead Ambience: Waterfalls & Fountains," such sounds can easily be provided within private spaces as well.

There is a danger of internal noise pollution, however. Long straight line pressurized cylinder halls, walkways, and settlement streets will tend to channel sounds bullhorn style. The noise of traffic, even from electric vehicles, could become oppressive. The roar of loud conversation in crowded spaces could carry. We'll have to design in sound-muffling acoustical surfaces to keep accumulative sound levels down to a pleasant level. Just the right amount of texturing in surfaces should do the trick, along with intermittent sound-absorbing barriers and breaks to straight line transmission: trees, sculpture walls, etc. A little imagination and due proactive attention to the problem should take care of it. But it'd be naive to think that there won't be "learning experiences" and a "learning curve."

Intrusion of Out-vac Surface Sounds & Vibrations

Will we "hear" the vibrations of landing rockets at a nearby spaceport, of heavy cargo-laden trucks and regolith-moving equipment on adjacent roads? Vibration will work to weaken seals and could lead to eventual pressurization leaks. So it seems important to have an overall settlement plan that isolates regular and periodic vibration from the principal pressurized areas. Loose regolith not just as shielding above, but as bedding below and to the sides might help. We'll have to do on site tests to see how good such sound insulation is, and weather or not it degrades with time, e.g. through gradual compacting. If necessary, foamed glass and other buffer materials could be pressed into service.

What about Industry

It would seem logical to sector industrial activities between those that are low in vibration and low in waste heat production for incorporation in the settlement areas proper, and those with either high vibration levels and/or high waste heat output to well separated areas at a thermal and sonic buffering distance. Some of the later might be automatable and if they did not require pressurization, could be housed under simple ramadas or sun-shades on the open surface, areas open to the vacuum but perhaps baffled to reduce dust intrusion.

If most of the high impact high vibration industrial activities can be automated for unpressurized areas, the incidence of industrial *tonitus*, severe and constant ringing in the ears, should be much less common than on Earth. This would be a big plus.

Out-Vac Silence

Out on the surface, silence should remain supreme. With no air to transmit vibrations from settlement activities, and with little of that seeping into the bedrock, anyone outside would hear only the sounds from within his or her own moonsuit, plus whatever he or she chose to pipe in.

In some locations, out of line of sight with a satellite or radio tower, below the surface exploring a lavatube, for example, we'll need more than radio. We'll have to carry our own library of music and sounds with us -- or risk eventually going insane.

Near term problems

Given the above considerations, sound, or the lack of it, does not seem to pose a morale, health, or productivity problem for lunar settlements. But in the near term, spartan starter outposts may not be quite so friendly. Sound problems, both too much and too little, are likely to be the source of many early complaints. Morale and productivity will be at stake so we can only hope that the engineers and architects on Earth will be proactive and try to stay ahead of such problems, designing them out, or trying to. It will be a learning game, and it will be in everyone's interest to learn quickly. It's just the Prelude.

Summary

The Moon will remain overall a quiet silent place. Human activities will no more pollute the airless lunar silence, than they will the ground water, there being none of that either. We must remain within our pressure hulls: helmets and moonsuits, space ships, surface transports, and settlement spaces.

Inside those hulls, small h or big H, we will be alone only at the outset. Long term we cannot survive just by ourselves. On Earth, our existence is tight-hosted by a biosphere full of plants and animals. To succeed on the Moon we will have to do our best to recreate those conditions, reencradling ourselves with fellow-traveling populations of Earth life. Think of space as a great flood. Think of our transmigration to the Moon as a Noah-like journey.

If we succeed in surviving and thriving on the Moon, we will not be doing so alone. And to the extent that we bring water, select plants, and select wildlife with us, we will have much more than just ourselves and our machines to listen to. We will be able to enjoy many of the sounds of Nature as we do on Earth -- if perhaps a little less on the wild side!

Perhaps few of us have ever sat down to list our "favorite sounds." We take them for granted. Our descendants on the Moon will have theirs as well, and perhaps take them for granted also.

On this score I think we'll be okay. **<MMM>**

Mars Odyssey Finds Ground Ice But What does it Really Mean?

Report and Essay by Peter Kokh

After "the Great Ghoul of Mars" swallowed two Mars-bound spacecraft in a row, *Mars Climate Orbiter* and *Mars Polar Lander*, we die-hard Mars-enthusiasts badly needed a success to boost their spirits. The *Mars Odyssey* orbiter seems to have given it to us. After arriving at Mars last fall, and taking its time settling into its working orbit, Mars Odyssey's 3 instruments set to work.

- **THEMIS** (Thermal Emission Imaging System): distribution of minerals, particularly those that can only form in the presence of water -- http://emma.la.asu.edu/THEMIS/
- **GRS** (Gamma Ray Spectrometer): presence of 20 chemical elements on the surface of Mars, including hydrogen in the shallow subsurface (a proxy for determining the amount and distribution of possible water ice on the planet) http://grs8.lpl.arizona.edu/science/
- **MARIE** (Mars Radiation Environment Experiment), for studying the radiation environment.

MARIE has just recently come online and results are not yet in. Meanwhile the early readings from the THEMIS and GRS instruments are exiting. Mars surface is definitely "wet" over large expanses. The results have been reported in recent issues of *Science* magazine. Those of you who are online will want to call up the following map.

http://www.sciencemag.org/cgi/content/full/296/5575/1962/F1

Martian blues. Deep blue (denoting high neutron counts per second) maps out ice-rich dirt, but the light-blue splotches are water-altered rock, possibly from ancient, wetter days.

The deep blue areas would seem to represent permafrost layers of ice immixed with soil, overlain by a meter or less of parched dry soil. Two large areas fit this description, one surrounding the south polar cap up to about 60 °S. The other is in the north at similar high latitudes but principally in the deeper areas of the Vastitas Borealis, the great low basin thought by many to be an ancient ocean bed.

The lighter blue areas would seem to indicate the water-altered rock which is also a target of *Mars Odyssey* science:

carbonates, silicates, hydroxides, sulfates, hydrothermal silica, oxides, phosphates

These areas are at mid (temperate and equatorial) latitudes excluding the high altitude regions of the great volcanoes and the great canyonlands. The light blue indicates medium neutron counts per second by the GPS instrument. But actually, it is the THEMIS thermal emission imaging system that was supposed to find such rocks. So we can expect to get corroborating readings from THEMIS of this interpretation of what the light blue areas indicate.

Perhaps most of us heard the early hype that enough water ice was found on Mars that, if melted, it could cover the surface hundreds of feet deep. So far the principal investigators do not seem to be going that far. Richard A. Kerr reported to a Meeting of the American Geophysical Union [see Science, Volume 296, Number 5575, Issue of 14 June 2002] that the richer high latitude ice might have simply "snowed out" on falling dust particles in the recent--and dry--geological past, whereas the low-latitude hydrogen might record ancient water from an earlier, wetter Mars more hospitable to life.

In our lay opinion, there is probably two very different explanations, one for the southern deep blue areas which are at high altitudes (the snow hypothesis) and another for the northern low (below "sea level" altitude deposits in the great northern basin (I would venture this permafrost might be a relic of the northern ocean.)

The lighter blue areas would seem to be at mid-range altitudes and could indeed represent areas that were once periodically wet (lakes, river floods, rain, glaciers) but not regularly submerged as the northern basin may have been.

Homework

Now is the time to send in the Ground Crew. Yes, it's all interesting from a scientific point of view, and for the light it sheds on Mars' long-gone past, and certainly for the implications it has for the search for traces of lifeforms on Mars. But from the point of view of humans determined to establish a permanent outpost, perhaps at first scientific, but eventually developing into a viable full-fledged exclave of humanity, we need to know much more.

Permafrost:

- just how thick are these layers, in various parts of the globe?
- In some areas, is the ice-saturated area deep enough to pass into the liquid water state at depths below the surface where temperatures rise sufficiently?
- How saline or fresh is this water ice?
- What field methods work to tap these reserves for fresh water for hygiene, drinking, food production, biosphere use, and industrial use?

Water-altered rocks:

- Do any of these deposits represent economic resources, i.e. economically minable concentrations of useful elements and minerals?

The upcoming 2004 rover missions will hopefully shed some light on these questions, but the area they will cover will yield only teasingly spotty results. We'll need a wide-ranging fleet of dedicated ground-truth water-seekers. **<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 explor-ation and utilization of the Moon in cooper-ation 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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Malapert Mountain looms Mighty

from David G. Schrunk <DOC SCILAW@aol.com.

Information on Malapert Mountain reinforces its desirability as the first permanent base on the Moon. It is roughly the same size as Africa's Mount Kilamanjaro Mountain and it dominates the south polar region of the Moon, including the geographic south pole. The Mountain is in the southern "cold trap" region of increased hydrogen concentrations (potentially, highly valuable water and other volatiles) discovered by the *Lunar Prospector* and *Clementine* missions.

Large permanent facilities could be constructed inside the mountain (analogous to Cheyenne Mountain in Colorado), where occupants could be completely protected from space hazards and live in Earth-like conditions. Also, *the summit is in direct line of sight with the Earth* and receives sunlight for approximately 93 % of the time for solar power generation à la ISS), and for the operation of solar ovens and other thermal management systems.

The first robotic and human settlers could begin experiments with in-situ resource utilization (beginning of rail, power, pipeline, and communication facilities), and could establish telescopes at the base of the mountain, which offers ideal conditions for astronomy at all wavelengths.

The significant advantages of the mountain are an invitation to the establishment of an internationally cooperative effort for the peaceful and responsible human exploration and development of the Moon.

[Editor: This mountain has also been referred to as "The Peak of Eternal Light" (an exaggeration) and as "Mount Wasser," after a writer who extolled its advantages early on.

Arthur C. Clarke was probably the earliest proponent of a far southern site for the first lunar base. In the novel and film 2001: A Space Odyssey, the very large crater Clavius was the center of Moon operations, picked no doubt because of its proximity to Tycho, where Clarke had placed his "monolith."

David Schrunk wrote at length about his proposals, which include a lunar railroad system, with a south polar hub, in "THE MOON: Resources, Future Development and Colonization," David Schrunk*, Burton Sharpe, Bonnie Cooper, and Madhu Thandavelu, WILEY-PRAXIS Series in Space Science & Technology. © 1999 Praxis Publishing Ltd. ISBN 0-471-97635-0. We reviewed this seminal book in MMM #133 March 2000 page 11. We recommend it highly.

Readers can look for more on Lunar Railroads in a future issue of MMM, as well as more on our own reservations on the "South Polar Gambit." -- PK.]

[OPINION PIECE: The MSJ pages are open to members who wish to express alternative or opposing options.]

Space Tourism - Here come the Ad-Men, Here come the Agents

© 2002 Richard Perry <rperry@dial.pipex.com>

[An edited version of this essay was published online by Space Daily on May 6, 2002]

The dream is alive, has a price tag of $20 million and a small queue is forming.

Later this month, the Russians are required to announce who the next 'visiting crewmember' will be in order to meet the terms of the formal crew criteria agreed by the Multilateral Coordination Board for the international space station in January.

Most visibly in the queue is 23 yr old Lance Bass, a music artist, who has already successfully undertaken preliminary medical tests in Russia.

Thirty nine year old polish banking magnate Leszek Czarnecki is close behind, and being represented by Space Adventures (who sealed the deals for Tito and Shuttleworth).

Finally, former NASA associate administrator [and former Executive Director of the National Space Society] Lori Garver, a 40-year-old mother of two.

Competing Business Models Emerge

To make things more interesting, both Bass and Garver are represented by MirCorp, who wish to strike deals for flights to the International Space Station which are based on corporate sponsorship rather than just the private funds of high-worth individuals

So Space Adventures find themselves with a direct competitor vying for highly limited flights using a different business model.

Space Adventures' simplistic pay-to-fly model has proven lengthy and difficult to setup, but easy to maintain once the barriers (to flight and ISS visits) are removed - you just show the customer the price tag.

Pitted against them are two closely linked competitive models, aimed at either raising the money for the current flight ticket price, or more imaginatively, to seek to make a profit.

Running with these models are the re-grouped MirCorp (who in addition, claim to have plans for building their own destination station), Brainpool TV of Germany, and individual agents such as TV producer David Krieff of NBC.

MirCorp is seeking funding for its own 'mini' space station, which could solve the problem of flight and destination capacity limits with the ISS. MirCorp's existing relationships with the Russians could enable them to enact their business plan fairly rapidly if the funding is achieved, and every time a tourist pays his $20 m to fly that funding probability becomes more foreseeable.

Brainpool has long published a detailed description of their TV game show called "Space Commander", and have until now had to sit and let the frontier open before taking it much further. That said, they also reported last year that they had struck a complex deal with European and Russian space partners to effectively pre-book a number of seats to support several years of TV game show programming and several flights.

Lance Bass's producer become-agent David Krieff is reportedly working with the William Morris Agency and The Gurin Company on using Bass's flight as a launch event for a Scandinavian reality-TV show. This is the most complex of all the deals, but could simultaneously get Bass his flight, prove the TV market, and finally get the advertising business back on its feet with a new medium for the 21st century.

Interestingly, the rise of the commercial agent into the space business reminds us that most of these models have a large element of the media industry attached to them.

This is why we should expect to see agents increasingly being used for both high-worth individuals, and also for those trying to stitch sponsorship deals together.

Lurking in the background however is the gray area concerning Spanish astronaut Pedro Duque, who may have $13 m of backing from the Spanish government. Should that deal go ahead, then it could be met with legal action for commercial damages from the agents and ad men, plus some very awkward questions concerning how all international flight crew are selected and funded. For the governments to try to meddle with the infant commercial models at this time could be disastrous for the health of their agencies, and invite a stinging rebuke from the tax paying public.

Adverts gone for now, set to return in force

Whilst Dennis Tito effectively employed stealth advertising tactics (sneaking advertising materials onboard and filming adverts in the Russian space station segment of the ISS), he did so at the price of shocking NASA into producing the rules which later bound Mark Shuttleworth's flight.

Whilst the visiting crew member rules released in January are pretty open, they do highlight that the space shuttle cannot carry tourists, and neither can government astronauts get involved in commercial activities. So for now the tourists have to continue to use Russian launch services, and stay in the Russian model for any commercial activities.

Shuttleworth seemed to have no interest in corporate sponsorship or advertising during his stay on the ISS, which is just as well since it is banned in the US segment. Whilst adverts may be gone for now, the joint SPACEHAB Inc.\'99 and RSC Energia Enterprise module usage provisions allow for just about as much commercial activity as you can cram into a working day.

As a destination for commercial partners, that future portion of the ISS is likely to be center of attraction. It is planned for launch by 2005 and is specifically designed to support commercial activities such as broadcast content production and advertising.

Depending on who flies next, advertising will almost certainly return in some form with Bass or Garver and be a highly co-ordinated exercise. Tito had to sneak advertising into orbit simply because their were so many unknowns with his flight. With a flight slot confirmed at least six months in advance, the advertising machine will have more than enough time to go into overdrive. Never until this point will they have had an unrestrained agency employee available on orbit, and the guarantee of flight that allows media slots to be booked in advance. It is likely that space advertising will surpass even automotove brands as THE accounts to work on in the next year or two.

Pricing set to rise

It was rumored at first that Shuttleworth's flight would be a little cheaper than Dennis Tito's. However, long-term analysts of the space tourism market have often pointed to the likelihood of prices rising for space access before they fall.

The starting price is set by whatever historical, technical, commercial and political factors come to bear. These can only be hinted at for the Tito flight, but the $20 m price tag has stuck even though everyone knows that the Russians are making a considerable margin.

As the demand for space access grows, the very limited flights could lead to a bidding war. In a true commercial market, with two equally qualified space tourists, the carrier can accept the highest price. Hence once the space tourism market opens up, the price per seat rises *until enough seats to meet demand are put in place.*

MirCorp may help in the future by providing a dedicated tourist destination facility - which could support launches carrying perhaps two tourists per flight, and fly very much more often.

Aside from the simple pay-as-you go model used by Space Adventures, the emerging game show and lottery routes still promise the chance for everyday folks to have the chance to go into space in the next few years. But it is to be remembered that the only reasons why access is so restricted are that the flight opportunities are so few, so expensive, and that no attempt to seriously reduce the cost of man-rated launchers has been made in the history of space exploration.

With the travel sector now openly accepting the probability of suborbital flights in the next five years, three commercial sectors will diverge from each other before the converge again.

Orbital flight-and-stay

What NASA calls 'visiting crew', opportunities are restricted to a handful per year. Durations may increase from 10 days up to a month, but the price is likely to stay level or potentially increase.

Suborbital flights

Several companies now developing short-duration (several minutes only) space flights using new and dedicated vehicles. Prices currently hover around $100 k per flight, but with the potential to fall dramatically once technology is proven and vehicle design costs recouped.

Suborbital travel destinations

Lurking in the background and living off the suborbital technology development is the promise of suborbital travel. Most likely to be confined to the business traveler and special freight (including military payloads), this capability allows access to almost any point on Earth within the hour.

The above markets all exist in theory, and instead of working together, they look set to diverge. They all have very distinct customer bases, and costs of technology development. Of them all, the lowest development cost has actually been for the full on-orbit manned spaceflight product, since it rides off the back of government-funded research and development.

Whilst this sounds fortuitous, the downside is that in the long term, $20 m tickets to orbit are not going to be commercially viable. The market is simply too large to support that price indefinitely, and the existing queue of space tourists should be seen as a highly visible proof of concept for those seeking funding from skeptical investors.

The suborbital market has very limited appeal in the long term, but will serve to create the kinds of technologies required to support the aspirations of almost completely untrained people to experience the space environment.

Suborbital travel on the other hand, really only awaits the development of a technology to make this concept commercially viable. The suborbital market may do just that, and together these technologies drive commercial revenue streams and customer aspirations that support the development of new low earth orbit-capable vehicles that smash

the pricing structures by orders of magnitude.

So in the short term, prices for access to LEO are set to rise, but with the promise of seeing them replaced by something more inspiring to the mass market. By then of course, the ad men and the agents will have done their work and earned their keep.

"Its nothing to do with access to space, darling, it's all about which part of space!" In other words, by that time the space hotel market will have evolved it's own pricing structures designed especially to keep up standards.

Associated URL

- ISS crew selection criteria - www.nasa.gov/hqpao/isscrewcriteria.pdf
- MirCorp (and mini station) - www.mir-corp.com
- Space Adventures - www.spaceadventures.com
- Brainpool TV - www.brainpool.de
- Space Commander - www.space-commander.com (site down at time of publication)
- Space TV venture to spend millions - www.msnbc.com/news/500645.asp
- William Morris Agency - www.wma.com
- ISS Enterprise module - www.spacehab.com/enterprise/enterprise.htm

About the author: Richard Perry is a member of the National Space Society, The Moon Society, and a director of the commercial spaceflight company Transorbital Inc.

>>>> STAIF 2003 <<<<

Call for Abstracts on Lunar Bases

Geoffrey A. Landis <geoffrey.landis@grc.nasa.gov>

STAIF (Space Technology and Applications International Forum) is a set of conferences held annually in **Albuquerque NM**. The upcoming STAIF conference will be **February 2-6, 2003**.

This year STAIF will include a conference on Human space exploration and a symposium on space colonization/settlement. I am co-chairing the session on space bases (along with Wendell Mendell), and I'd like to invite people to submit abstracts. We're looking for papers on moon bases (or, for that matter, bases on Mars, Mercury, Ganymede, L-4, wherever).

Information is at
http://www.unm.edu/%7Eisnps/staif/default.html
and the call for papers is at:
www.unm.edu/%7Eisnps/staif/pdfs/call4papers.pdf

The deadline for abstracts on this page is listed as already past, but please ignore this! We're still vigorously looking for papers. The session we're co-chairing is E-02

Geoffrey A. Landis
NASA John Glenn Research Center
http://www.sff.net/people/geoffrey.landis

Why a "Moo"

From: Gregory Bennett <grb@asi.org>

Why a MOO: It's what we've got for real-time communication, and pretty much perfect for the job. It's programmable to do just about anything we want. And as best I can tell, the set of tools we already have provide all the functions we could get out of a web-based chat board like Yahoo, only better.

The MOO has a web-based interface for real-time user communication. Go to http://moo.asi.org/, scroll down the page, and picked the framed client. Instructions on that web page also tell you how to turn on the feature that shows pictures in the top frame. Some of the MOO locations have pictures, but most do not.

We can share images via the web site. Even if you don't have a WebSite Director account you can email a jpeg to the web management system. And of course you can submit web pages the same way.

For team collaboration, we have all the individual teams' web sites, where team members can upload stuff and get it only immediately without having to wait for the approval process for the public web.

A web-based chat system can be more colorful than an email list and a more convenient way to serve archives of the messages. Would those things make it valuable enough to implement such a system? And if so, who has the required expertise and time to do it?

The big commercial web-based chat systems (Yahoo and EZBoard) would provide some marketing value, exposing more people to the Moon Society. I don't know if that would be worth the effort it would take to maintain cybersquatting on the moonsociety board on Yahoo. I think it's one of us.

Greg

Research Reports on Helium 3

Tapping the Moon's vast surface deposits of rare Helium-3 to provide abundant clean energy for Earth is one scenario that could open the Moon big time. Research Reports on Helium-3 prepared by the University of Wisconsin for FINDS (Foundation for the Non-governmental Development of Space) are available for 1998, 99, 2000 at:

http://www.finds-space.org/He3.2000.html

In Next Month's MSJ Pages

Moon Society member Arthur Smith, fresh back from his first ISDC, The 2002 International Space Development Conference, held this Memorial Day weekend in Denver, has sent us a good report on the Moon Society presence at ISDC and more.

Meandering Through The Universe

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

This month I would like to look at a couple technologies which are in early stages of research with very limited sales of applications, if any, but which seem quite interesting. Though there are no guarantees, I feel that these technologies, among others, promise great things for the advancement of space settlement objectives. What I will discuss this month are bubble fusion, and superconductors.

Bubble Fusion

An interesting development reported on National Public Radio recently was about table top fusion. What?! You say you have already heard of that whole fiasco? Well, don't be so sure. This isn't your Mamma's cold fusion. In fact, it's not cold fusion at all. Actually, this report was about a process based on sonoluminescence, a process which is sometimes called bubble fusion.

Sonoluminescence is a process of producing waves in a liquid medium by using sound. When the sound is tuned appropriately, the waves in the water produce tiny bubbles which when they collapse, do so in such a way as to create a tiny region of extremely high pressure and temperatures in the ten thousand to one million degrees Celsius range. The medium is usually water or acetone and the bubble concentrates the phononic energy of its local region by around a trillion times.

Because there are such high pressures and temperatures — comparable to those found in the stars — there is considerable interest by the fusion science community in trying to harness the process for producing controlled fusion. And, indeed, in experiments with deuterium enriched medium, some researchers have observed what seems likely to be the neutron emissions which are the telltale sign of fusion. There has been speculation for some time that fusion might be achieved in this way. There is some reason to think that there could be some breakthroughs through the sonoluminescence approach in the near future ... nearer than the "within the next 50 years" which has been the unchanging mantra in magnetic bottle type fusion research for more than 50 years now. Of course, ya never know ...

Anyway, even if there are some breakthroughs in bubble fusion, it is way too early to make any grand projections with regard to the future of fusion or sonoluminescence. On the other hand, if bubble fusion were to progress even to the point of becoming interesting to industry it would open a fairly lusty market for He3. If applications ever come of it, there is little question that He3 would become well worth going to the Moon for, even by normal industry bottom line standards. And most readers of MMM realize that the Moon is the place to go to get it.

It is a truly antique saw that industry on the Moon would provide an open door — or at least a foot in the door — for permanent lunar settlement. And if demand for He3 were to leveraged into opening mining operations there, it would not be an exception to this premise — that is, if the premise turns out to be true, as many expect. That's one way that bubble fusion could pay off for space enthusiasts.

Another advantage to our space settlement goals *if* bubble fusion should happen to become a feasible means of storage and production, such energy supplies might well be about as compact as was promised by so many utopian projections of the 1950s. It also would probably be far safer than the best fission systems both while in operation and with regard to the wastes and end of service life materials. Even so, radiation is radiation. Nonetheless, if very compact, reasonably safe and not very pollution producing power supplies which are relatively inexpensive were to come along (from any technology) they would represent a huge assist to space settlement. It is only speculation, but judging from the history of energy production and storage, it seems to me that it is just about time for a commercially applicable breakthrough in this arena.

To learn more about sonoluminescence and bubble fusion you can pick up the internet threads at the npr.org *Talk of the Nation: Science Friday* page.

Superconductors

Things are really humming in the field of superconducting research where there are vast numbers of interesting developments coming one right after the other. One of the recent stars of that show is magnesium diboride (MgB2). Again, *Talk of the Nation: Science Friday* also has information about this material's superconducting characteristics and is a good a starting place to find further threads. To quote from the blurb there, MgB2 "is a stable metallic compound, is readily available from chemical supply stores, and" ... "it becomes superconducting at temperatures higher than other metallic compounds ..." Magnesium diboride has a peak superconducting temperature around 39 degrees kelvin which isn't room temperature by any stretch, but is notably warm — in terms of metallic superconductors.

Lattice stressing oxide superconductors has led to breakthrough in peak transition temperatures in those materials. Lattice stressing can be done by applying physical torque from the outside of a chunk of material, but a more stable and less complicated means is to grow a film of the oxide superconducting material on a substrate which has a smaller interatomic spacing. IBM scientists in Zurich have used this method to nearly double the peak transition temperatures of these amazing ceramics. At the time of the writing of the article that I found through http://superconductors.org the maximum superconducting temperature produced by this method was

about 49 degrees kelvin. But the researchers are confident that they will be able to take it to about 200 degrees kelvin (about -73 ° celsius). That's getting to a level at which careful shading and well designed heat radiation features could make reliable, totally passive cooling (i.e., no energy input for cooling), superconducting circuits for power transmission and applications feasible technologically as well as economically for many off-Earth settings.

Fullerenes are also players in the superconductivity arena — as they are in so many other areas of science and emerging technologies. For the uninitiated, fullerenes are based on geodesic lattices of carbon molecules — hence the name which refers to Buckminster Fuller, the master of geodesic architecture. On the fullerene front, peak transition temperatures of around 117 degrees kelvin have been reported by Bell Lab researchers. Other fullerenes and fullerides (geodesic molecules based on other elements) have also been found to be superconductors. One of these is a fulleride based on silicon. Rather than being organized in discrete molecules, it is organized in an infinite network. This might make it easier to make wires, integrated circuit, and other devices. It also makes me wonder about its potential for very dense neural network circuitry.

These and other technologies may or may not play a part in advancing the goal of permanent space settlement. But its worth keeping an eye out for anything which comes along that can be profitably turned to the benefit of our goals. **<RRR>**

Richard's homepage:
http://richardpatricia.homestead.com

[EDITOR: We discussed the possibility of superconductors on the Moon in MMM #66 JUN '93 "Superconductivity," in which we looked into superconductors that could be made entirely out of lunar materials and the power storage, power transmission, and transportation uses of lunar superconductors.

Richard mentions Magnesium DiBoride. Can this superconducting material be produced from lunar regolith? Magnesium is a very common element in the regolith and promises to be a workhorse metal on the frontier. But Boron is, unfortunately, present only in parts per million traces. Finding an all-Lunar superconductor formula is the Holy Grail!

Operating temperature: the idea of a superconductor that would operate in the chill of shade on the Moon is very attractive. However, if we are mining for Helium 3 on the Moon, we will be byproducing an abundance of garden variety Helium-4. Given the power input, regular Helium is liquid at 4.2° K * and that is low enough to accommodate a wider range of options. (* http://hyperphysics.phy-astr.gsu.edu/hbase/lhel.html#c2

We can hope that future research will open the door to this powerfull tool. -- Ed.]

Cosmos 1 Solar Sail Update - 16 April 2002

http://www.planetary.org/solarsail/index2.html

We continue to progress in our quest to fly the first solar sail: the Cosmos 1 spacecraft has now passed vibration and dynamic tests. In early April, our team conducted a series of tests simulating the dynamical environment of transportation, launch, orbit insertion, and flight with the mechanical spacecraft model - and Cosmos 1 passed all the tests.

The mechanical model (sometimes called an engineering model) is made of components that are either the flight units or exact mass and volume equivalents. The team subjected it to a complete simulation of the dynamical conditions expected to be experienced by the spacecraft. We had expected the weakest link would be the solar arrays, which are fragile structures hinged to the spacecraft. But they survived the testing nicely, and our project leaders gave a full go-ahead to begin manufacturing all components for the flight spacecraft.

We received more good news when the rocket motor for orbital insertion was successfully integrated on the mechanical model and all parts of the fuel flow system checked out.

This month the electronic parts of the flight hardware are supposed to come together for system and electrical tests - all mechanical and electrical components will be working together. Most of the communication and scientific components have been delivered, including sensors, the accelerometers, the star tracker and the UHF-band radio. But the panoramic camera and S-band radio are not complete yet, nor is the on-board computer. Their development is proceeding well, however, and we expect all components to be in the test area by the end of this month. Our biggest concern is the delivery of the on-board computer with compete software.

We hope soon to set up a live web camera in the test area in IKI, which you will be able to visit through our web site. There we will follow the test progress over the next several months as the spacecraft is put through its paces in a simulation of all functions. These tests will determine our readiness for launch, which we now expect to be no earlier than September.

We have had delays and have accepted those delays in order to develop the spacecraft as reliably as possible. Within the next few weeks we will conduct a launch date review and specify an official request to the Russian Navy for launch dates.

Meanwhile, back at The Planetary Society, we have delivered to the project the CD containing our member's names and other historical material about solar sailing. We also have started to configure our Project Operations - Pasadena (POP) room, which will be our control link to the Mission Operations - Moscow (MOM) center at Babakin Research Center in Moscow. **<TPS>**

♂ Mars Society Updates ♂

Mars-OZ Proposal Document Released

http://www.marssociety.org.au/

Mars Society Australia has released version 1 of the **Australian Mars Analogue Research Station** (Mars-OZ) proposal document.

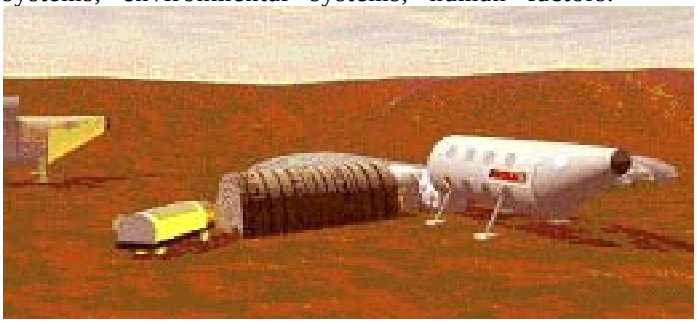
The **Lake Frome Plains east of Arkaroola** were selected for the site during the Jarntimarra Expedition, undertaken in Oct-Nov 2001. [MMM # 151 p. 15 map "Site 1"] Mars-OZ will provide a laboratory to study how humans will live and work on Mars, and will complement the three analog stations in Utah, Devon Island, and Iceland [Euro-Hab, right**>**]

Six regions, 200 km in diameter, were identified as potential sites with Arkaroola chosen as the preferred location, **200 mi. N of Adelaide.** The area offers a wide range of terrain types, has a complex geology, is relatively easy to access logistically, has outreach opportunities, and includes a number of localities previously studied as Mars analogues.

Mars Society Australia has chosen a configur-ation for the MARS-OZ habitat different from the 'tuna can' chosen for the other localities, preferring **a horizontally landed biconic**. The different design allows comparisons between different lander designs to be evaluated. Horizontally landed biconics have some advantages in an actual Mars mission over other configurations in terms of mission profile and surface operations. Further, we believe this long thin horizontal plan has considerable logistic advantages.

The habitat itself is part of a larger complex which will eventually include a simulated cargo lander, also of biconic design, inflatable structures and solar power systems. All operations will be carried out in conjunction with existing analogue research programs including the **Marsupial Rover** with its unique utility configuration, **MarsSkin** analogue mechanical counter pressure (MCP) space suit, and **SAFMARS** communications system.

Shown together in the illustration below by Jozef Michalek, these components comprise a significantly different vision for an analogue research station to those built or proposed to date. Potential research areas: engineering, science, information systems, environmental systems, human factors.



http://www.marssociety.org.au/technical/tech_images/MarsOZ_cover.jpg

[Calling all Chicago Area Mars/Space Enthusiasts!]

M.A.R.S. Euro-Hab comes to Chicago

3rd Mars Analog Research Station to debut at Adler Planetarium

from Matt Lowry, Illinois North Shore Mars Society

The Mars Society's new European Mars Analog Research Station will be coming to Chicago to be displayed at the Adler Planetarium soon. We've been working behind the scenes on this for quite some time now, and things are coming to fruition, but now we need your help. The Euro Hab will be on display at the Adler all summer, and we need volunteers to not only help with construction but for displaying it and giving presentations as well.

Here is the timeline:

- May 20-22 (?) - The trucks show up with the Hab materials at Adler and assembly of the steel frame, walls, and floors begins.
- May 22-31 - Ramps, stairs, and other sections of the Hab are built.

  During this time frame (May 20-31), Frank Schubert and the hired construction crew could use some gofers. Two or three would be good.
- May 28-June 7 - The inside of the Hab must be finished, everything painted, exhibits assembled, etc.
- June 7-13 - Finish up 'finishing' work and tie up loose ends

  May 28-June 13 is when the local construction volunteers are really needed. About half a dozen would be necessary on a given day, so if you're handy we need you!
- June 14(?) - Grand opening ceremony (with press, NASA types, sponsors, and maybe politicians?)

After the opening of the Hab, we need volunteers to display the Hab, accompany tour groups, and give presentations on Mars and the Mars Society. The Hab will be on display every day *through the end of September*, so we need volunteers! This is major exposure for the Mars Society and Chicago area chapters in particular, so here's your chance to get involved in any way you can - one day, one week, one hour, whatever!

If this works anything like the MDRS at Kennedy Space Center in Florida last year, roughly half the volunteers will be local and the other half will come from all over. So in addition to helping out, you'll get a great opportunity to meet many people from all over the country who are Mars Society members.

If anyone is interested in volunteering for either construction / gofering or being a tour guide, presenter, what have you, then please contact either me at lowryclan@yahoo.com or Bill Mania at billmania@earthlink.net **<ML>**

Mail For MMM

On Nitrogen & Air Pressure (MMM #154)

Say, I just finished your great piece in MMM on Nitrogen, and enjoyed it very much! The low pressure angle especially. The very day before I read the piece I was wishing I had the altitude vs. pressure data from that 'Clean Dry Air' site.

Anyway, one of the (many!) projects I am working on involves low pressure greenhouses for use on Mars. This is an off-shoot from Penny Boston's paper she wrote in the 1980s fro the Journal of the British Interplanetray Society, entitled 'Low-Pressure Greenhouses and Plants for a Manned Research Station on Mars.' I scanned in her diagram and it can be viewed here:

www.NorWebster.com/agribotics/ablpgh01.html

She said she would look into asking the BIS to see if I can make a Webpage from it. I'll let you know when she does. I do have an Acrobat version:

www.NorWebster.com/agribotics/docs/lpmarsgh.pdf

Doesn't have the tables and all the images yet though.

We're currently working with duckweek for use in an in-cave version of the CEMSS module, you may have heard about. If not, check the link below. We're looking at growing them at around 300 mmHg, (about 20,000 feet). At least, thats what my vacuum pump can pull!

I think its important to keep adaptability into perspective here, which I believe you showed graphically with the high-elevation cities example.

Gaia's critters & plants are VERY adaptable to different conditions. That simple fact is pretty much why the dinos all died except for the birds. At least according to a former OSU professor. He contends that the atmosphere in pre-KT impact times was considerably thicker than today, with a resulting higher O2 percentage, (as documented elsewhere from amber bubble analysis). The higher pressure AND higher CO2 AND higher O2 levels allowed the same genetic code that makes a sparrow to grow to a T-Rex. Well, similar code.

He demonstrates his position aerodynamically for the most part, with pterodonts. Pretty interesting though:

http://www.oregonl5.org/docs/thickair.pdf

The implication of course is that the big rock stripped away a large portion of the atmosphere, and the rest is [natural] history: The remaining genetic code grew different in the new conditions. But it grew.

On the Moon, a person conceived, born and raised at 1/6 g will no doubt be tall, spindly, and most likely unable to return to the surface of the Earth without at a minimum a wheelchair. Mars too. Micro-gravity colonies would eventually produce human whales not unlike Herbert's 'navigators' from Dune. Its not a mutational deal either. Simply the same set of 'instructions' developing under different conditions -- ADAPTING to those conditions.

But of course, anyone born & bred on the M & Ms would no doubt abhor the thought of venturing to such an inhospitable place as the Earth anyway!

Cheers!

Gus Frederik <gus@open.k12.or.us>
Oregon L5 Society

A Chapter Science Demonstration "Landing Without Rockets"

2nd in a Series of Writeups from Earl Bennett, President of PASA: Philadelphia Area Space Alliance

Landing Technique Demonstration, Talking Points:

The most popular active (talk and do simultaneously) involves Landing Without Rockets which I do using the Mars Lander(s!) as illustration (This Worked). First I explain that slowing things down means either launching lots of fuel to slow down at the end of the trip, and a small payload, or working smart and slowing the craft down by:

A) Aerobraking, then
B) Parachuting, and finally
C) Using Air Bag Systems for the final slowdown.

I use an umbrella as the aerobrake shell (pointing toward the ground) then invert it while explaining, tossing away the shell and opening the chutes. Explaining that the chutes stop working as it slows down.

The next step is showing a group of balloons attached to a toy car or rover. I do this while talking about deploying the bags and how high the system bounces when it hits. I also call the characters in the vehicle Vince and Larry (most people get the reference) and talk about deceleration forces. I bounce the array off the floor to illustrate landing.

For a Q and A type presentation I discuss the problem of landing and ask the people if this would work on the Moon and whether they know why or not. Serious but delivered with a smile. **<EB>**

We aren't finished
when we fail,
We're finished
when we quit !
So let's not !

The Lunar Reclamation Society, Inc.

PO Box 2102
Milwaukee
WI 53201

www.lunar-reclamation.org

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

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(* LRS Board Members)

LRS NEWS

• **Rockets for Schools:** At this annual rocket launch event in Sheboygan, Peter spoke on "Space Tourism" to a sparse crowd, on Saturday May 18th.

• **IMAX Outing:** The International Space Station is the focus of a new IMAX film. Those interested in a group outing, contact Peter with suggested dates. More info at: http://www.imax.com/spacestation/

Suggested date: second Saturday afternoon in August (10th)? Other suggestions? The film is 45 minutes long.

• **Budget Situation:** LRS & MMM are now operating in the black as far as monthly income and outgo are concerned, but we do have a $510 loan to pay back eventually. ISDC '98 funds remain unavailable.

LRS JULY Events

No Meetings in July or August

• **July 20th Summer Field trip to the M.A.R.S. Euro-Hab at Adler Planetarium in Chicago:** Those interested in joining us on Saturday, July 20th contact Peter 414-342-0705, kokhmmm@aol.com

As members of the Sheboygan Space Society and the Wisconsin Mars Society are also interested in going to Chicago for this opportunity, there may be a second group outing. If you cannot make it on the 20th, let us know what other dates are better for you and we'll try to see if we can get a match.

U.S. CHAPTERS

NSS Chapter Events
MMM
7 Chapters Strong

Space Chapters HUB Website:
http://www.nss.ac/hub/

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

WISCONSIN

Sheboygan Space Society

728 Center St., Kiel WI 54042-1034

c/o Will Foerster 920-894-2376 (h) <willf@tcei.com>
SSS Sec. Harald Schenk <hschenk@excel.net>
>>> DUES: "SSS" c/o B. P. Knier
22608 County Line Rd, Elkhart Lake WI 53020

http://www.tcei.com/sss

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

JUL 15th Foerster Academy of Dance, **Sheboygan**
AUG 19th Stoelting House, 309 Indian Hill, **Kiel**

OHIO

Cuyahoga Valley Space Society

3433 North Ave. Parma, OH 44134-1252

c/o George F. Cooper III, Phone 216-749-0017
E-Mail: geocooper3@aol.com [new]

Monthly Meetings, the 4th Thursday each month

7-9:15 pm, Parma Regional Library

NEXT MEETING DATES: **JUNE 27, JULY 25**

CALIFORNIA

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.

JUL 20th -- Business Meeting at the home of Steve Bartlett and Tina Beychok, 7108 E. Peabody Street, Long Beach.
AUG 17th -- Business Meeting, Redondo Beach
SEP 21st -- Business Meeting, Pasadena

- **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/.

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 <BWalden@aol.com>
(LBRT - Oregon Moonbase) moonbase@home.com

☞ Meetings **3rd Sat.** each month at **2 p.m.** **Bourne Plaza, 1441 SE 122nd**, Portland, **downstairs** NEXT MEETINGS: **JUL 20, AUG 17**

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: **Jun 15th, Aug 18th**

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

• **Scheduled PASA activities:** Regular monthly meetings on Sat., June 15th, and **Sun.** August 18th. NO July meeting, but Special event on **Mon. July 22nd**, a presentation to the World Future Society Annual Conference. Call Earl Bennett or Mitch Gordon, 215-625-0670, to verify all meetings.

from Earl Bennet <EarlBennett@erols.com>

• **Activities Report:** We where guests at the *SETI League's* second annual technical conference "Seti Con 02" held at the *College of New Jersey* in Ewing township. This marvelous event is a gathering of amateur and professional investigators into various aspects of the search for, and existance of, E.T.I. The first day, April 26, was primarily Optical Seti after a great Keynote by *Stephen K. Dic*k on "Seti and the Post Biological Universe" which as the title implies is about what may be the ultimate fate of our and other civilizations. Dr Dick has serveral books on this and other subjects and has written a number of papers . His "day Job" is as astronomer and historian at *The U.S. Naval Observeratory*. A counter point was given by *Dr. Allen Tough* on the possibilities that have resulted in no contact thus far including, but not limited to, the supplanting of biologic entities.

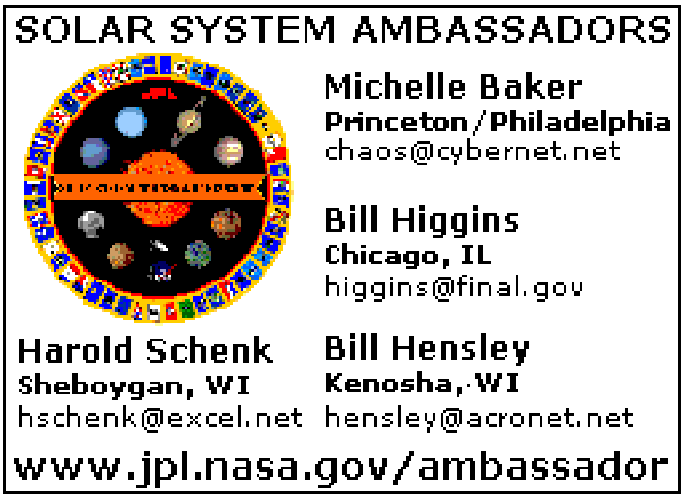
The presentations that followed included two by *Dr. Robert Lodder* et al on *Planetary Probe for Blue-Green Algae* and a paper on an opto-electronic tool for Near InfraRed scanning. *Dr. Claudio Maccone* had a paper on *A Far-Side Lunar Observeratory* as well as one on gravitational lensing. He also received the annual **Giordano Bruno Award** for Significant Technical Contributions to the Art and Science of Seti. The caliber of the papers and the audiance give

and take were excellent on this and Saturday's events with much informal discussion and exchange. It was great. If possible, check out the conference proceedings and particapants publications. Example:One of the papers on searching another galaxy for signals was presented by a biologist who came up with the idea and developed it as a research topic which he turned into a presentation of his reasoning. This from *Dr Dallas Bader* of Canada. M-87 was the target discussed.

On May 5th we went to *The New Jersey State Museum* as exhibitors. This was a special event, **The International Space Station Travelling Exhibit** was the reason for the activity by us at the invitation of *Tony Miskowski* of the Museum. Both myself as PASA Technical Director (aka science geek) with demos and *Gary Fisher* as exhibitor for *Independence Mars* (a Mars Society chapter) gave talks and demonstrations of science and technologies related to space and exploration and habitation of same, and a great simulated Mars scape at Gary's location, where kids could play "Rescue the Astronaut" while older kids and parents could peruse liturature and talk to Mars society members. Michelle and serveral other Mars members helped out there. I was in a different part of the museum near an amatuer rocket demonstration display reprising some of the talks I give including the popular *Landing Without Rockets* and other examples of mind expanding solutions to difficult problems. We had an abundance of handouts including those of the *Space Studies Institute*, *National Space Society*, *Seti League* and other groups. I also displayed T-shirts from the societies we are part of including new ones from *The Moon Society* and *Seti Institute*. This last was part of a prize package received at *Seticon 02* and included a membership in that group!

Due to the length of the activities report I will limit the meeting report to the visit to our area by a very active space entrepenuer, *Pat Bahn*. He is president of *T.G.V.Rockets Inc.* a company working on suborbital launch capabilities. He was going to Levittown PA to have a model made of one of the vehicle designs at a shop there and to show us his diorama of system transport modes his company could use for the launch system. We had an opportunity to question him on various aspects of the system and progress on its finances (he's getting there!) and talk of applications, with *Mitch Gordon* asking about Tourism, his favorite topic, and getting the answer that another customer base is being worked on at present but other ideas will be considered after the system has begun paying back. This happened on the 18th of May and was very exciting. Pat is running for region 7 director of the National Space Society and wanted to be personally in touch with local chapter members. He is very desirous of the post and wants our N.S.S. members votes in August.

In July, Serveral members will be presenters at the *World Future Society* annual Convention so we will not have a meeting.*Jay Haines*, *Michelle Baker* and *Gary Fisher* will give related presentations on The Future in Space. *Mitch Gordon* is working as Program Coordinator for the W.F.S. event. We should get some interesting reports on this.



Space Station Comes to IMAX

http://www.imax.com/spacestation/

You will need Macromedia Flash Player to view the above site. The following blurb is from the Milwaukee Humphrey Dome Imax.

Blast Off into Space! and rendezvous with the world's most accomplished astronauts in "Space Station," a new film at your local IMAX Theater.

A joint venture of IMAX Corp., Lockheed-Martin and NASA, "Space Station" sends you hurtling around the planet at 17,500 miles per hour and an altitude of 220 miles above the earth's surface!

See life in the International Space Station–the first major international space station, scheduled for completion in 2006. More than 13 miles of 70-mm film were shot between December '98 and July 2001. From the earth-shaking launch of the Proton rocket in Kazakhstan to close-up views of three space walks, "Space Sation" offers an unprecedented look at astronaut life.

- Strap in for zero-gravity training in outer space.
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- A fitness session with a unique view of earth.
- Repair one of the space station's support systems.
- First-person look at a rocket launch from Florida's Kennedy Space Center.

Narrated by Oscar-winning actor Tom Cruise, "Space Station" employs 25 astronauts and cosmonauts as its photographers. Produced by the makers of *Blue Planet*, *Destiny in Space* and *Mission to MIR*.

It's up to you to turn this into a chapter outing and/or new member recruitment opportunity!

NAME _____ ÷

STREET _____ ÷

CITY/ST/ZIP _____ ÷

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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

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  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

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

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

CHICAGO SPACE FRONTIER L5
○ $15 annual dues

MINNESOTA SPACE FRONTIER SOCIETY
○ $20 Regular Dues

OREGON L5 SOCIETY
○ $25 for all members

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

PHILADELPHIA AREA SPACE ALLIANCE
○ Annual dues for all with MMM $20, due in March or $ times each quarter before the next March

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

Moon Miners' MANIFESTO

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