"Expanding the Human Economy through Off-Planet Resources"

Moon Miners' Manifesto

& Moon Society Journal

#145 May 2001

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Submission address: "MMM", 1630 N. 32nd Street, Milwaukee, WI 53208-2040; **E-Mail**: kokhmmm@aol.com

In Focus ▣ Cheap Access to Space — Back to the Drawing Boards at Last!

Many of us saw it coming -- for years! It was easy enough to tell, if you were honest: the NASA Marshall / Lockheed-Martin X-33 project was "Dead on Conception". But we went through the painful process of watching the lifeless fetus get fed sundry electrifying juices in the hopes that when we threw some lever, the monster would rise, Frankenstein-like from the cold slab of a mis-chosen Process.

For it was the Process, not this or that design that doomed this creature. The Process called for proposals, an early short-list of these approved for further work, and a final decision deadline. Thus NASA at the outset locked itself into a process that was not guaranteed to produce the best choice.

Why? Because there is no greater danger for a technological civilization than premature selection of a technological path *before all the promising options can be pushed far enough so that a decision can be made on fully revealed merits.*

Our characteristic national impatience only exarcebates the situation. A tell tale symptom of our impatience is *preassignment of a fairytale budget limit we will tolerate.* In effect, we decide not on the best path, but on whatever we can get in an impatient amount of time for a naively fixed amount of money. *This is not frugality. It is a recipe for guaranteed waste of money because we set out to do something that we will not let ourselves finish.* Budget maximums are "prior constraint" and absurd as new technology cannot accurately be guestimated. For either the Administration or Congressional Committees to expect otherwise only shows the generally common sense-challenged caliber of leadership our election process guarantees.

The "Market"

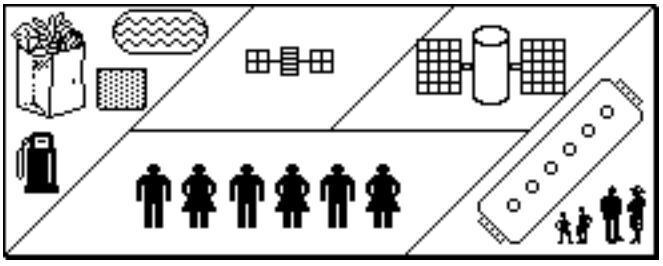
That is not how a market, e.g. for affordable transportation to orbit, would work. But to NASA, "market" is a foreign concept that does not compute. The only "market" it sees, the only market whose demands it feels, is its own needs:

> large assembled structures and component sub-assemblies that fit its payload bay (essentially, a mid-ship reusable faring.)

NASA's market is not smaller stuff, except in make-up-a-load combinations of convenience. Nor is NASA's market people, as such -- only assem-blers, operators, and payload specialists who happen to be human, because they are a necessary compo-nent of its mainstay market: the ISS. [=> p. 2, col. 2]

Cheap Access to Space for What? It Matters!

What do we want to transport to space? Commodities like water or iron ore which can be sent in variably sized portions? Hundred kilogram micro-sats? A satellite weighing several tons? Human passengers - alone? Or people and cargo both? Large habitat modules? For each case, their could be a different "cheapest" and/or "safest" solution.



Moon Miners' Manifesto

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® 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.

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See contact information on page 9.

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÷ EMAIL to KokhMMM@aol.com (*preferred*)

÷ Mac or IBM diskette or *typed* hard copy to:

Moon Miners' Manifesto, c/o Peter Kokh,
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fi IN FOCUS Editorial continued from p. 1.

This market (bulky payloads) is not the only market in search of cheap access to space. Thus NASA's X-33 Requests for Proposals (RFP) only addressed part of the need -- its part. The space activist community, in applauding the RFP, largely failed to notice this. We dropped the ball in not continuing to press for R & D on any vehicles meeting other launch needs. An economical Cargo Truck (with a crew cab) is not necessarily the most economical dedicated passenger carrier, nor the most economical way to carry those bulk cargos that can go up in any amount at a time.

One can argue that the need we have now is for a bulky item cargo truck to help build the ISS. But the whole point of the Cheap Access to Space campaign was to remove contraceptive barriers to developing other kinds of space markets. Activists correctly saw/see that space tourism cannot really begin until we have an economical space "liner" and that many other logical space developments cannot get off the ground without other types of vehicles that economically serve there needs, be it bulk (not bulky) cargo (for which a rail gun or launch track might be ideal) or really large assemblies requiring a heavy lift vehicle. When we relaxed our efforts upon the announcement of NASA's original X-33 RFP, or upon the selection for further work of Lockheed Martin's design, we dropped the ball.

More on the "Process"

Let's get back to our statement that the death knell of X-33 was not a flawed Design, but a flawed Process. The selection of the Lockheed-Martin X-33 contractor proposal was defended as offering the greatest technological breakthroughs. *Per se High Risk, but on a low-risk budget.* Absurd!

In the past, X-craft have attempted to demonstrate one new technology at a time. Introducing too many "variables" guaranteed that a fixed budget would be exceeded. To cancel X-33 for being over budget demonstrates a level of government duplicity that we are wrong to let go unchallenged.

Granted, R&D is an essential part of NASA's charter. But it may or may not bet an essential means to realization of the goal of affordable transit to space, per se. Thus the goal of the project was subordinated to NASA's need in response to criticism, to be seen as promoting cutting edge R&D.

The Ramifications

By cancelling X-33 project, the government is accepting the premise that we no longer have what it takes. Ideally, flawed as it may be, the Lockheed Martin X-33 technology development effort should be pushed to the limit, even if a flyable product does not result. If even one of the multiple new technologies Lockheed-Martin was pursuing turns out to be workable, we cannot afford not to develop it.

In parallel, the DC-X, air-breathing boosters, and other options also need to be pushed with no premature or political choosing of favorite technologies. These too are "unfinished business."

Cheap access to space and NASA may not have been a marriage made in heaven. While most supporters of the bureaucratic space program cheered NASA's apparent conversion to our cause, the more wary of us moaned prophetically, "oh, no!"

The deck was stacked. NASA is only comfortable with the kind of mission it is used to flying: vertical takeoff, horizontal land: VTHL. Thus, the highly successful DC-X prototype never had an honest chance. Adopting the CATS cause implied in the Delta Clipper Project was essentially the most effective way for NASA to kill *something alien: VTVL* - astronauts were pilots and the idea of descending vertically and landing on a pad instead of a runway made them uneasy.

Neither did HOTOL (HOrizontal TakeOff and Land) concepts stand a chance. This would have produced a vehicle with which the airplane-traveling public would have been most comfortable. But NASA is in the business of flying rocket-jocks to orbit, not common tourists, nor even businessmen and industrialists. Keeping the high-G fitness barrier for vertical takeoff serves to help keep space a Restricted Area.

As we said, the X-33 was dead at conception. Sadly, no one is more to blame than the masses of the space-supporting public who "just don't get it." *The bureaucracy cannot give us space. The political process cannot produce anything rational.* Whether we cheered NASA's "getting religion" in *apparently* taking on the cause of fully reusable and affordable space transportation, or whether we merely accepted it, we're the ones to blame for half a dozen lost years.

So where do we go now? We seem to be caught in a pair Catch-22s:

- Major aerospace contractors, the ones with the expertise and money, are not in the business of taking risks.
- Startups who can/will take risks, have no money.

Markets produce money; but no vehicle, no market. We won't have cheap*er* space until the humble startups find money. Whatever we can do to bring that about, is what we need to be doing:

- Public reprimand of NASA spokesman statements aimed at Venture Capitalists that denigrate technologies pursued by commercial startup launch companies. The "market" these ventures pursue is not the bulky item market the shuttle serves. Thus their efforts are in no way a threat to NASA. NASA should not hide under the skirts of government immunity to be sued for slander.
- To the extent that it remains the government who has the big pockets, funding for launch vehicle technology development from BMDO or other militiary agencies is welcome. Having NASA as the only big pocket in the game is dangerous. Two heads (and two Attitudes!) are better than one. In retrospect, shifting the Delta Clipper project to NASA (for axing) was an incredible blunder.
- We must agitate for direct government incentives for private launch company projects.

In the end, *it is our responsibility* to find a way or ways to recover from the death of X-33. -- PK

"The X-33 vehicle is nearly complete, with more than 75% of the hardware installed in the assembly stand at the Palmdale plant. 95% of the hardware has been delivered. Extensive testing on all components was nearing completion, including tests of the innovative linear aerospike engines. The launch and operations facility is complete, combining for the first time the streamlined efficiency of an airport and the high technology requirements of space transportation.

"... many valuable lessons have been learned. ... significant breakthroughs in launch vehicle technology. ... we've met the many challenges we've encountered, and moved ever closer to a more reliable system that, if brought to fruition, *will* one day reduce the cost of access to space."

Lockheed-Martin -- http://www.venturestar.com/

A Grim Assessment which we Share

"20 YEARS LATER, CAUGHT IN SHUTTLE TRAP"

Fleet eats NASA's budget; no replacement in sight

By Alex Roland

A FLORIDA TODAY special essay April 8, 2001

http://www.floridatoday.com/news/editorial/stories/2001/apr/edit040801b.htm

Comments on Possible Italian-built Habitation Module for ISS [cf. p. 15]

While we would have preferred a commercially-procured substitute for the Bush-whacked U.S. Habitat module, the expansion of Italy's role in the ISS is very welcome and a healthy development. The more truly "International" ISS is, the more viable it will be in the long run, and the more likely will be the eventual appearance of an independent ISS "Authority" to manage the station and oversee its future growth into the first orbital village.

While it is unlikely that the lead will pass from NASA to other hands anytime soon, any diminution of NASA's dictatorial boss man role is welcome. The greater the role other partners like Italy and Russia play, and the more additional international partners (like India and Brazil) become involved, the less subject will the future of ISS be to the irrationalities of any one nation's political winds.-- PK

Murphy Beds & More on the Space Frontier

Multi-Function Living Spaces in Space Frontier Private Quarters

by Peter Kokh

At the current "toe-in-the-water stage of "space settlement," "personal quarters" are spartan to say the least. Aboard the shuttle orbiters, sling hammocks attached to a handy wall are as coddling as they get. Aboard ISS, telephone-booth-sized personal berth cubicles are still just a promise, given the recent cancellation of the U.S. Habitat module.

Crew tolerate such conditions well for the relatively short periods of time they are on location. Given ample experience in submarines and other naval ships, that comes as no surprise. Yet astronaut duty is not supposed to be military duty, and morale is not served by lack of private quarters for people on extended tours. We are each private persons and need periods of time and reserved spaces in which to escape from duty and communal life.

"As soon as it is practical to do so," spaces each can call his or her own should be provided. Places one can decorate with items of personal value and fitting personal taste. Places in which one is king or queen - cubbyholes in the world which are extensions of ourselves. Places in which no one else is welcome uninvited. Places which are not *common*.

At first the mini-berths planned for the ISS habit modules will do. Indeed, they will be an enormous improvement. At the other extreme, long down the road of maturing space settlement, we may someday be able to provide ample living spaces for pioneers built in modular fashion from locally produced building materials. Here, on the Moon or Mars, as expansion of pressurized structures is difficult, it will be wise to provide at the outset, all the square footage a large family might want, growing into it over time, finishing it off as needed, renting out unused space being an option. [box, top next page]

While this should be the carrot we hold before ourselves, we are not going to reach that state right away. Living Spaces will be much smaller than current North American standard (750 sq. ft. per person). This may take some revolution in the way we handle floor space today. It is common in American homes for each function to have its own dedicated space or room, whether that function is exercised for several hours a day or infrequently. It does not concern us that most of the space in our homes is unoccupied most of the time. It is there when we want it. That is the kind of luxury which we are unlikely to be able to afford on the early frontier.

> The Size of Lunar Homes - the Great Home Conce
> MMM #75, MAY, 1994, pp. 4-6. "A Successful Lunar Appropriate Modular Architecture", page 4:
>
> Considering that lunar shelter must be overburdened with 2-4 meters of radiation-absorbing soil, and that vacuum surrounds the home, expansion at a later date will be consi-derably more expensive and difficult than routine expansion of terrestrial homes. Better to start with "all the house a family might ever need", and grow into it slowly, than to start with initial needs and then add on repeatedly. Extra rooms can, of course, be blocked off so as not to be a dark empty presence. But they can also be rented out to individuals and others not yet ready for their own home, or waiting for one to be built.
>
> The extra space could come in handy for start-up cottage industry before the new enterprise is doing enough business to be moved into quarters of its own. At the outset, with every available hand employed in export production, the demand for consumer goods, furnishings, occasional wear, arts and crafts, etc. will *have to* be met in after-hours spare time at-home "cottage industry". The lunar "Great Home" could meet this need elegantly.

Time for an attitude change! Take a look at the various rooms in the usual types of homes or apartments. Part of the floor space in each room is occupied by items that make the room what it is:

- beds, etc. in bedrooms
- cabinets and appliances in kitchens
- water closet, sink, shower/tub in bathrooms
- table and chairs in dining rooms
- sofa and easy chairs in living rooms, etc.

The space not occupied by such furniture and furnishings is for walking around and through. In the "efficiency apartment" or "studio", in which some of us have paid the dues of our "independence," the idea is to provide the furniture in compact interchange-able ways, sharing common floor space, in a multi-function space. The room will have a day bed, a futon, a sofa-bed hide-away, that provide living room seating by day, reasonably comfortable sleeping by night. The kitchen will be all on one wall, or at most, a small "galley", enough for one at a time use.

In short, an efficiency is a single room or room and a half with bath, in which all the walk-around space is shared, and the furniture is either compacted or multi-functional. One space serves as bedroom, living room, dining room, etc.

Perhaps the epitome of efficiency living is the Murphy Bed* or "wall-bed", a full-size bed which pulls down from a wall-cabinet or closet. When not in use, it is out of sight, taking up only hidden space.

There are also dining room sets which fold up into small consoles that can be used as desks. It is this kind of inventive multi-functionality that may shape frontier private quarters in the early periods. By today's standards, such compact "efficient" living,

hardly meets “dream home” standards. But in fact, compacted multi-function living space just takes a little getting used to. It provides privacy, supports all one’s at-home activities, and becomes a sanctuary in which we can express our personalities.

Call it 3-shift usage of space. Where space or equipment involves high capital cost, the only way to make it affordable is to see that it is used as in as time-intense a manner as possible. Thus on the space frontier, we’ll need to shed our current unexamined day-shift chauvinism to arrange living, work, and play patterns so that facilities as factories, schools, parks, and other common spaces are in use around the clock. That brings down their per hour cost of use to a third. Or, conversely, we then need only a third as much factory capacity, school rooms, parks, etc.

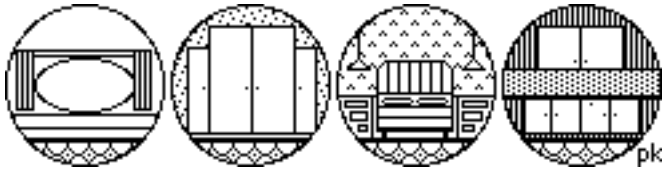
For our private living quarters, it may be our only affordable option to adopt a similar philosophy of squeezing the most livability out of minimal space. We are used to efficiencies for singles. Adapting the concept for families will take some doing.

Pushing the concept to the fullest, each wall would hold the collapsed elements to serve a particular room usage. These would extend, pull out, or pull down to turn the common floor space into a specialized living space. There would be a bedroom wall, an office-den wall, a living room entertainment wall, a closet/storage wall, plus a semi-separate “necessary room” pull-out.

A vertical cylinder shaped module could have an internal hexagonal shape with six “roommaker” wall units (not of wood, of course!) Exercise centers and additional guest bedroom walls are options. Not every efficiency home would have to be the same!

One thing is sacred. To serve as a home a dwelling must be able to express the personality of its occupants. It must be customizable both as to its external façade and as to its internal decor. In that respect, homes on the froniter will be no different.

Habitat module end cap options from MMM # 75



Some of these ideas may prove impractical or only be realized in less than satisfactory fashion. Nonetheless, this may be one direction in which early pioneers will have to exercise their resourcefulness in search of some of that “home sweet home” contentment and satisfaction. From time immemorial the humblest of homes have been homes nonetheless, serving to anchor the lives of those it harbors.

On the Moon and Mars, we have to start somewhere. And how could those who get to go first be “pioneers” without some unspeakable hardship to describe to their grandchildren? **<MMM/>**

* The Murphy Bed

William L. Murphy, born in Stockton, CA in the late 1870's, moved to San Francisco at the turn of the century where he met his future wife. He lived in a one-room apartment with a standard bed taking up most of the floor space. Because he wanted to entertain, he began experimenting with folding beds, applying for his first patent in 1900.

The "Murphy Door Bed Company" came into being that year. The first folding beds were manufactured in San Francisco. In 1918, he invented the pivot bed which pivoted on a door jamb of a dressing closet, and then lowered into a sleeping position - many of which are still in use today.

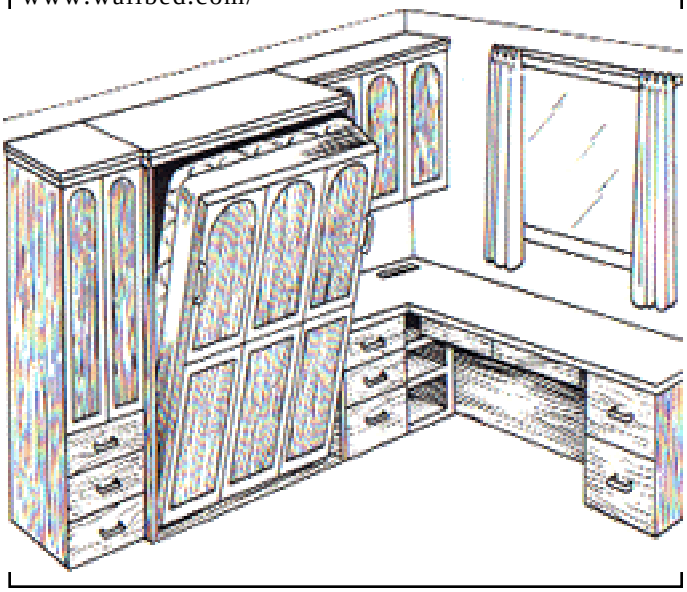
http://www.murphybedcompany.com/history.html

animated gifs of a wall bed opening and closing
http://www.wallbed.com/images/bav6.gif
http://www.wallbeds-cabinets.com/animatedwb.gif

In 1928, Murphy Door Bed Company began manufacturingcompact kitchens, called Murphy Cabrinettes, and is still doing so today.

During the 1920's and 30's, the popularity of both the Murphy Bed and compact kitchens was high. After WW2 Individual homeowners were not interested in space saving products because of their ability to buy larger homes relatively easy. But the 70's changed this attitude - how to make the most of limited space -- as families found it too expensive to move to larger homes,

Murphy Beds or wall-beds have gained new popularity in fire houses, hospitals, dormitories, and hotels. Homeowners purchase them for double duty guest bedrooms / sitting rooms, dens or media rooms. Often the Murphy Bed is purchased as part of a an office and entertainment wall system. (illustration below.) One company even offers the mechanisms so that you can build your own -- www.wallbed.com/



1. What is Mars surface made of?
2. Where is the water?

THEMIS & MARSIS

Mars Science with the Right Stuff
Finally, we get Serious!

by Peter Kokh

[From http://mars.jpl.nasa.gov/odyssey/]

Mars Odyssey took off for the red planet on April 7th, 2001, scheduled to arrive in the vicinity of Mars on October 24th, gradually tightening its orbit to begin its work in January, 2002, the debut of NASA's decade long Mars Exploration Program.

"We expect *Odyssey* to remove some of the uncertainties and help us plan where we must go with future missions," said Ed Weiler, Associate Administrator for Space Science at NASA Headquarters.

"*Odyssey* will help identify and ultimately target those places on Mars where future rovers and landers must visit to unravel the mysteries of the red planet," said Jim Garvin, lead scientist for NASA's Mars Exploration Program.

Some 10 missions to Mars over the next 20 years have been planned by NASA, with a whopping $1.6 B devoted to the project over the next four years.

In addition to thermal mapping, *Odyssey* will act as a "virtual shovel" and dig into the planet's crust to analyse Mars' hydrogen content, to measure permanent ground ice and its seasonal changes.

The *Odyssey* orbiter will also set up a communications relay for future Mars landers and rovers. Its primary science mission will end in July, 2004.

- For the first time, the mission will map the amount and distribution of chemical elements and minerals that make up the Martian surface.
- The spacecraft will especially look for hydrogen, most likely in the form of water ice, in the shallow subsurface of Mars.
- *Odyssey* will also record the radiation environment in low Mars orbit to determine the radiation-related risk to any future human explorers.

To do this, *Odyssey* is equipped with three special instruments:

- **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.

Comment: Cheers for THEMIS

So far, those of us who would like to speculate reasonably about how a Mars settlement might be established and grow into a second viable beachhead for humanity, have been stuck with the same old problem: we do not really know much about the makeup of the Martian surface and soils. Given that, all our proud speculations are so much "garbage in, garbage out." On the Moon, thanks to the Apollo return samples, we have plenty to go on. Mars science has been three decades behind, relying almost exclusively on visual photographic data. THEMIS will at last begin to unlock the geochemical secrets of Mars.

Able to see in the infrared as well as the visible parts of the spectrum, THEMIS will be able to detect the "signatures" of some key minerals:

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

All of these will show up as different colors in the infrared spectrum, allowing researchers to detect in particular the presence of those minerals that form in water and understand them in their proper geological context.

This will give Mars geologists some first real "clay" in which to sink their hands into, and into which to read a more probable picture of Mars' geological past. If THEMIS finds little or no such minerals formed in the presence of water, it will be disappointing: it will mean Mars did not have a wetter past after all, and that it probably did not support primitive lifeforms at any time. It will mean that we are left with carbon dioxide slurries and other "liquids" as the agents that have carved Mars' spectacular landform features.

Regardless of those results, THEMIS' findings will give settlement-brainstormers a much better idea of what kinds of building material feedstocks there are on Mars, and in what areas they are more especially enriched, and which building materials seem the most promising in the near-term.

In short, THEMIS has the key that may finally unlock both Mars' past, and its future, by telling us tell-tale aspects of its present. How will it do this?

Remote-sensing studies of natural surfaces, together with laboratory measurements, have demonstrated that 10 spectral bands are sufficient to detect minerals at abundances of 5-10%. In addition, the use of 10 infrared spectral bands can determine the absolute mineral abundance in a specific location within 15%. This multispectral approach will also provide data on localized deposits associated with hydrothermal and subsurface water and enable 100-m (328-ft) resolution mapping of the entire planet. It will also allow searching for thermal spots during the night that indicate hot springs on Mars.

And next, in 2003, MARSIS !

http://www.sci.esa.int/marsexpress/
http://www.marsis.com

The next part of our "Good News" story comes via a European Space Agency Mars orbiter, due for a 2003 liftoff (launch opportunities coming only every 25+ months when Earth and Mars come back into favorable orbital alignment): ***Mars Express***. It will carry an instrument whose radar will penetrate many miles into the Martian surface to search for reflections from pools of subsurface water. This radar sounder instrument, called MARSIS (Mars Subsurface and Ionospheric Sounder), is a joint project of NASA and the Italian Space Agency (ASI).

> Over subsequent days, optimal conditions for ground penetrating studies will occur over different regions of the surface, allowing MARSIS to build up a 3-D picture of the upper layers of the entire crust over the mission's lifetime.

Water *is* present as water-ice at the poles, and especially in the north polar cap. Most *expect* that Mars' crust is a reservoir for a substantial cache of water-ice permafrost and maybe even liquid water further down, where the temperatures and pressures are higher. How deep will we find water and or ice below the surface? MARSIS will be *the first instrument on any spacecraft* to really test the validity of some of our ideas about water on Mars.

We've said often that a ***permafrost mapper*** should be top priority for the robotic Mars exploration program. At last, it looks like we will get it!

MARSIS' findings will tell us how much water Mars still has, and by inference, how much it may have had in the past. This knowledge will either validate or demolish current speculations based on the appearance of flow-shaped land forms. The implications will either encourage or discourage astrobiologists in their search for evidence of past and present microbial life forms on Mars.

And for those of us who look forward to the day when human settlements will dot Mars, MARSIS will have either good or bad news for us as well. How much ground water and ground ice is still on Mars? How accessible is it? How deep do we have to drill? How *aquafluent* will our future Martian settlers be? Will they find the good life, or have to eke one out their existence like the *Fremen* of fictional *Dune*?

Other Instruments:

The other *Mars Odyssey* instruments (GPS and Marie) and on *Mars Express* (High Res. Stereo Color Camera, Atmospheric Planetary Fourier Spectrometer, Visible and Near-Infrared Mapping Spectrometer, Atmospheric UV Spectrometer, Analyzer of Space Plasmas and Energetic Neutral Atoms, and Radio-Science Investigation) will yield their share of new insights. But THEMIS and MARSIS are the ones about which we wanted to share our excitement. **<MMM/>**

The Independent Lunar Farmer

by Peter Kokh

Peter, I'm thinking, iabout Communities in Space. Is there a Bachelor Farmer equivalent on the Moon in 2050? How do the low-tech families earn their living? Does <earn> mean what it does here and now, when you have to earn air and water as well as food and shelter? Who subsidizes?

David Anderson, Abingdon, VA

Readings from MMMs Past:

MMM #13 MAR '88 Rural Luna
MMM #85 May 1995 p 7. FARM TARNS

The Moon is 14.5 million square miles of quintessential rural boondocks. A settlement or two or three will not change that. There are a lot of other places to hunker down, if one is bold enough, or "foolish" enough, to try to go it alone. Civilization will cluster tightly around the main settlements and the roads that connect them.

Safety and survivability will increase with numbers, and the Moon may always be highly urban. That said, one must keep in mind that a lunar city must "include" the farms necessary to produce its food and fiber, and maintain the quality of its air and water. The lunar city will be "whole" as no Earth city has been before. (Island city-states such as Singapore and Hong Kong offer faint analogies.)

But if one were to set up a private farming operation with a small band of determined pioneers, it would be foolish to locate far off the beaten path. It will take a large pool of people to make any reasonable quorum of the necessities of life on the Moon. If that population is split between communities, some major, some small, all of them had better be linked by regular trade routes.

The smaller the community, the more likely it is to experience an emergency that it does not have the wherewithal to handle. Equipment will not be so simple that a local blacksmith can make do. The farm must be successful enough to sustain its own biosphere, something every terrestrial farmer takes for granted as a given. The farm must maintain not only the quality of its atmosphere and water reserves, but the integrity of its pressurization envelope or hull.

Needs can be kept simpler than in the towns and cities, but not so simple that a lone nuclear family could manage them. A rural farming operation would stand a better chance if it has a couple dozen working adults at the minimum. A superfamily commune might work. Or a localized cooperative cluster of nuclear family farms might thrive.

Another possible formula, for those with the right special stuff, is the monastery farm operation. Monasteries can be sizable communities of highly motivated individuals with minimum needs for gratification from consumer goods.

The essential requirement is a critical mass for a viable biosphere, and for the mix of necessary chores. The smaller the farm "family," the more overburdened with chores will each member be. The original goal, a satisfying life, may be a casualty.

The critical difference with the situation on Earth, is that, on the Moon, one cannot "live off the land." The land is not "fertile" as is. Air and water, rainfall and fertile soil - these are not givens. The farmer cannot just plant seed. *He has to create his own fertile valley.* It can be done. It will not be easy.

Reasons to establish an independent rural farm:

- The "climate" of the settlement biosphere may not be suitable for the growth of the crops species one wishes to plant. One may want a climate that is colder, has periodic frosts, is more tropical, more moist, or more dry. While special climates can be effected in semi-separate parts of a main settlement, it may be simpler to have total separation.
- "Variety is the Spice of Life." Specialty export and domestic crops overlooked in tightly planned and eco-balanced settlement biosphere farming operations might include:
  - coffee, tea, wines and brandies
  - spices & herbs
  - fruit and vegetable specialties
  - meat producing animals and animal products
  - fish farming, bees & honey
  - additional fiber producing plants (cotton?)
  - pharmaceutical feedstock plants
  - dyestuff plants, and more
- Practitioners of one type of farming will want to experience for themselves the proper temperate, subtropical, tropical, or arid climate -- that is, in their own habitat area common spaces, not only just in the farms. Climate is interwoven with culture as well as with agriculture. That is the total experience everywhere on Earth.
- Settlement zoning and land use practces may not favor the farming or horticultural methods to which one is attached. Thus the settlement may have a decided tilt toward hydroponics, as it is more stingy in its pressurized space demands. Others may be determined to try a regolith-based analog of more traditional soil farming needs.
- There may be a need to quarantine some crop specialties from others, reducing risk of transmitted blight and disease. That works both ways, and the settlement may put out the 'not welcome' sign even as rural farmers declare their own intent to sequester their chosen crops.
- Many brought up in agricultural settings on Earth will cherish the rural experience and not want to be a part of the city experience, however large an agricultural operation the larger settlement needs to integrate into its biospheric underpinning.

Filling out the rural farmstead economy:

The challenge is to find the right formula, and it will differ from operation to operation depending on the specialty crop or mix of crops, on whether or not the farm produces other goods as by products or in a supplemental industry. It is not impossible that the special character of the local regolith that is ideal for the farm's specialty crops is also a source of some element or substance not mined and produced by the settlement(s). Wherever the farm is located, other advantages of the site should be explored.

If the farm is located convenient to a main trade route highway in order to ensure its produce has access to markets, its income can also be supplemented through offering roadside services:

- vehicle repairs and servicing
- bed and breakfast lodging
- produce and byproducts market

Such farm-to-market routeside locations are essential. A "Tea & Sugar" fleet of trucks could ply the route regularly, supplying each farm with its needs, and taking farm products to the other farms as well as to the main settlements

Rural farms will not be alone in the vast stretches between settlements. Scattered mining operations, science outposts, and tourist stops will keep them company. In the settlements, outfitters and supply houses will arise to serve their common needs. True isolation will be in no one's interest.

The rural farm might also supplement its income as well as shore up its own labor pool by offering working farm vacations to "city folk" who might eagerly pay for the privilege as an ideal change of pace and change of scenery vacation. The rural farm could also offer "farm camp" experiences to settlement young. Such extension activity will also serve to introduce fresh cultural experiences into both rural farm and larger settlements. Granted, there will be reclusive rural farm hamlets that may want to avoid such cross-pollution!

Not to forget outside markets:

Rural lunar farms need not justify their operations in the lunar settlement market alone. Almost any food grown on the Moon with lunar oxygen and lunar-sourced macro- and micro-nutrients may be cheaper to purchase in any space venue, even low Earth-hugging orbits, than food raised on the Earth's surface, no matter how much more cheaply and efficiently, but brought up the steep gravity well at high fuel expenditures. Only special delicacies or treats available from Earth alone will make it onto space pantry shelves and into space eatery menus.

Rural Farms add to the total biospheric mass in place on the Moon, increasing the overall chances that lunar civilization will thrive and be indefinitely viable. As such rural lunar farms can play a key role in the future of the Moon. **<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 the 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®

Join/Renew Online at
www.moonsociety.org/register/

Questions? email:
membership@asi.org

The Artemis Project™
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Project LETO™
http://www.projectleto.org/

Please send all mail related to Memberships to:

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

How to fix MMM Subscription Errors:
www.asi.org/adb/06/09/04/1999/09/news-19990915.html

PDF format suggested for MMM in lieu of mailings outside North America

by Peter Kokh, MMM Editor, Lunar Reclamation Soc.
and R. Scott Gammenthaler, Moon Society Treasurer

Recent U.S. postal rate increases have caused a major problem for LRS and the Moon Society. It now costs over $2 an issue to mail copies of MMM to our members outside North America. Neither LRS nor the Moon Society can continue to absorb these costs.

Scotty Gammenthaler, Moon Soc. Treasurer, has proposed this solution. We produce MMM both as hardcopy and as a PDF file that can be downloaded from the web and printed. Members and subscribers who preferred to get MMM this way would pay an annual fee for user name/password access to the PDF files. This would be reflected in the dues rate. Those members living outside North America (postage to Canada is not a problem) who prefer to get mailed hardcopy would see a hefty hike in their annual dues to cover the real postage rates. Perhaps $60. Getting MMM by PDF could halve that figure to perhaps $30.

The "devil," of course, "is in the details." For some, putting out PDF files is old hat. But with this old dog editor, its a brand new trick. The first part of the problem we have dealt with. Up until now, MMM was printed out from 6 separate document files: page one graphics, page one text, page nine, pages 10-12, page 20, and everything else -- diverse formats being the reason. But rising to the challenge, we have now figured out how to handle the different formats in one file (we use Claris Works 4.0 for Mac) with very minimal and acceptable changes in appearance.

We do not personally have the software to put this file into PDF format but will try emailing the file to someone who does. If that works, we will put this May 2001 issue, MMM #145 at this address:

http://www.lunar-reclamation.org/mmm_pdf_test.htm

So look for it there and try it out.

Progress at last on MMM Web Archives

by Peter Kokh, MMM Editor

The MMM Archiving Process has been stuck in a rut for some time. Joe Bentley, not a member, has tediously keyed in most of the major articles from the type-written early issues of MMM, #s 1-20. Some articles MMM #s 1-8 are online at www.asi.org/mmm/. Others are languishing because no one was available from the ASI web team.

Now member Arthur Apsmith has agreed to help out, putting the transcribed articles from #s 9-20 on the web, and scanning the two years of C64 issues #s 21-40. You can watch our progress at a temporary placeholder site:

http://www.lunar-reclamation.org/mmm_archiving_folder.htm

Moon Society Liaison Project

Report by Peter Kokh, Committee Chair

Space Studies Institute

P.O. Box 82, Princeton, NJ 08542
(609)-921-0377 ssi@ssi.org
http://www.ssi.org/

One ongoing effort of the Moon Society is to keep in touch with all the "other players in the Moon Game", looking for good projects in which we might assist, and for possible joint venture partners in new projects. This month, we want to familiarize members of the Moon Society with perhaps the most venerable "player" in the Return to the Moon arena. Space Studies Institute, based in Princeton, New Jersey, was founded by Gerard O'Neill of Space Colony fame to outline a "critical path" back to the Moon and to identify the key technological issues and promote research and experimentation accordingly.

Over the past 27 years, "SSI" has funded an impressive variety of research. Below is an outline with some comments about the Moon-related items, all from http://www.ssi.org/research.html

While "The Institute" is still active, in these days since Gerard O'Neill's death, it would seem to some that its focus has shifted -- off the Moon and onto Near Earth Asteroids. Many of the Moon-related items in this list are no longer active projects.

But we do not need to repeat research already done. This research by SSI is invaluable to us.

SSI Moon-Related Research Report Overview

- Prospecting for Space Resources
  - Lunar Polar Probe
  - Lunar Prospector
  - Lunar Sodium Search
- Mass Drivers
  - Mass Driver I
  - Mass Driver II
  - Mass Driver III
  - Mass Driver Simulations
  - Advanced Mass Driver Studies
- Processing Space Resources
  - Chemical Processes
    - HF-Acid Leach Process
    - Silicon Coatings as a By-Product of Lunar Electrolysis
    - Magma Electrolysis Project
    - Lunar Simulant Project
  - Physical Processes
    - Glass/Glass Composites
    - Solar Powered Glass Pilot Plant
    - Magnetic Beneficiation of Lunar Soil
    - Iron as a By-Product of Ilmenite Reduction
    - Fused Soil Products for Space Construction
- Lunar Bases
  - Lunar Mining Simulation
  - ISU Lunar Base Study
  - Lunar Mining Contest
  - Orbital Transfer Vehicles
  - Lunar Teleoperations Demonstrations
  - Lunar Excavation Experiments
- Space Power
  - Solar Power Satellites from Lunar Materials
- Systems Studies and Conferences
  - SSI's Space Manufacturing Conferences
  - SSI Co-Sponsored Conferences
  - Research Matrix and Data Base

Some Notes: [abridged by MMM from web site cited]

Lunar Polar Probe: In '85, SSI commissioned a study by James French of JPL on the concept of a small dedicated spacecraft which could fly to lunar orbit and search for trapped volatiles and other useful resources present on the Moon, particularly in permanently shadowed regions near the Moon's poles. Study results were sent to the President's National Commission on Space, which wrote that searching for such volatiles should be a "first priority."

Lunar Prospector: In '89, SSI began planning a private, dedicated spacecraft to complete geochemical mapping of the Moon begun during the Apollo program. Lunar Prospector will carry a NASA-supplied gamma-ray spectrometer capable of sensing hydrogen and other elements from low-lunar orbit and will also provide gravity and magnetic mapping during its one-year lunar mission.

Lunar Sodium Search: Using ground-based spectroscopy, Francis G. Graham of Kent State U. conducted a search for sodium vapor on the Moon.

International Lunar Polar Orbiter: Under SSI support, Dr. Gay Canough of our Lunar Prospector team assisted in the International Space U. project to design a Lunar Polar Orbiter during the summer of '89 at the Universite Louis Pasteur in Strasbourg, France. The leader for the design project was SSI Trustee James D. Burke of the JPL.

Mass Drivers: The purpose of the mass driver is to accelerate payloads of material to high velocity by transforming electrical energy to the mechanical energy of motion. For lunar soil payloads, the mass driver on the Moon's lunar surface would accelerate payloads to escape velocity, to be collected at a point in space as a source for space manufacturing.

Mass Driver I: The first practical device was constructed by Dr. Gerard K. O'Neill and Dr. Harry Kolm in 1977, who, with MIT grad students built Mass Driver I from $3,000 of scrounged electronic parts. This push-only machine achieved over 33 g's.

Mass Driver II: Mass Driver II demonstrated magnetic levitation of the moving portion of the mass

driver (the bucket), and optical triggering of the drive coils. It operated at nearly 500 g's, demonstrating the feasibility of the circuitry to store and direct the electrical power required for operation.

Mass Driver III: Mass Driver III demonstrated O'Neill's pull-only design, which provided automatic centering for the buckets as they traveled down the length of the accelerator. By removing the apparatus for magnetic flight and improving the coupling between the drive coils and the bucket, Mass Driver Ill demonstrated over 1,800 gravities acceleration.

Length of a lunar machine required to obtain escape velocity with each demonstrated technology.

Mass Driver I	33 g's	8905 meters
Mass Driver II	500 g's	587 meters
Mass Driver III	1,800 g's	160 meters

Mass Driver Simulations: Sr. Asso. Mark Senn of Purdue upgraded the computer programs originally designed by Dr. O'Neill for mass driver design. Dr. Leslie Snively, who conducted the Institute's Mass Driver III project, has also prepared a mass driver simulation in order to better understand issues such as powering the bucket coil as it moves through the accelerator without physical contact.

Advanced Mass Driver Studies: SSI continues to track advances in the field of electromagnetic launch and related technologies. In particular, high-power switching devices; power storage equipment.

Processing Space Resources: SSI has investigated a broad spectrum of lunar resource processing techniques from use of raw lunar soil as shielding to systems to process lunar soil into its constituent elements. The research trend has gone from examination of the more complex processes to the near-term possibilities of product systems producing such materials as oxygen, aluminum, silicon, and iron.

Chemical Processes

HF-Acid Leach Process: SSI's initial chemical processing research endeavor was an examination of an HF-Acid Leach technique to obtain a wide range of constituent elements from lunar soil. This work was under an SSI contract to Rockwell International.

Silicon Coatings as a By-Product of Lunar Electrolysis: Dr. Rudolf Keller of EMEC, explores producing silicon materials on substrates as a by-product of molten salt electrolysis of lunar soil.

Magma Electrolysis Project: Under joint funding from SSI and the U. of Arizona, Dr. Keller is refining lunar electrolysis techniques for production of oxygen and other materials using technologies developed in the electrochemical industry.

Lunar Simulant Project: to promote further research into processing lunar soils, SSI commissioned a study by the Energy and Materials Laboratory of the U. of North Dakota on the production of lunar simulants. Examined simulants manufactured all over the world for the U.S. and Soviet Iunar programs and is proving valuable to SSI's present lunar processing initiatives.

Physical Processes: simple processing techniques to produce construction materials & other feedstocks.

Glass/Glass Composites: Brandt Goldsworthy has demonstrated the production of glass fibers and glass matrix materials from lunar simulant. Combination of these materials into fiberglass-like glass/glass composites could provide a basic construction material supply for solar power satellites, space habitats, lunar installations, and other uses.

Solar Powered Glass Pilot Plant: SSI entered into a joint project with McDonnell Douglas Corp. and Alcoa/Goldsworthy Engineering for the construction of a pilot-scale solar power glass composite production facility.The 10.3 meter concentrator has a focus capacity of 10,000 suns; it will be the first large-scale demonstration of lunar processing techniques.

Magnetic Beneficiation of Lunar Soil: Dr. Robin Oder;s (ExporTech) project to demonstrate new techniques to remove native iron from actual lunar soil samples. SSI supplied lunar simulant and simulant data to enable him to acquire actual Apollo lunar materials for magnetic separation tests.

Iron as By-Product of Ilmenite Reduction: Researchers at Worcester Polytechnic Inst. demonstrated techniques to recover iron as a by-product of hydrogen reduction of ilmenite to produce oxygen.

Fused Soil Products for Space Construction: Architect Nader Khalili of the Geltaftan Foundation and Sr. Assoc. Joseph Kennedy demonstrated techniques to use concentrated solar thermal energy to produce fused soil structures and building materials which may be used for lunar paving and habitats.

Lunar Bases

Lunar Mining Simulation: SSI has constructed a lunar mining simulation tested and demonstrated dragline hardware and surface mining techniques.

ISU Lunar Base Study: SSI personnel participated in the 1988 ISU Lunar Base Design Project at MIT, which developed a lunar base designed to launch raw materials for solar power satellite construction.

Lunar Mining Contest: SSI sponsored a lunar mining contest for students of the International Space U. at MIT in 1988. Portions of the contest were televised worldwide on Cable News Network.

Orbital Transfer Vehicles: SSI conducted a study to examine long lead time items for orbital transfer vehicles capable of transporting people and materials from low-Earth orbit to lunar orbit.

Lunar Teleoperations Demonstrations: SSI's Lunar Teleoperations group has conducted a series of

teleoperations demonstrations which enable users to simulate controlling machinery on the surface of the Moon from the Earth [with a built-in 3 second time delay]. A lunar teleoperations display designed by the Institute is now a permanent part of the Franklin Institute Museum in Philadelphia, PA.

Lunar Excavation Experiments: SSI and U. of Maryland have proposed a series of experiments to determine appropriate tools for lunar surface and lunar subsurface mining activity. These experiments take advantage of simulants arid soil compaction techniques developed by Dr. Leonhard Bernold.

Solar Power Satellites from Lunar Materials: SSI commissioned a landmark study on the design of the solar power satellite, optimized for maximum use of lunar materials This study concluded that over 99% of the mass of a solar power satellite could be lunar in origin, reducing the cost by nearly 97% compared to terrestrially launched power satellites.

SPS from Early Space Resources: As SSI's research projects have evolved, we have learned that some forms of space resources may be considerably easier to process than others. As a result, SSI commissioned a follow-up study to our original SPS design project. This new study looked at SPS designs which could be constructed from the simplest forms of non-terrestrial materials. including Space Shuttle external tanks and lunar oxygen, glass, and iron.

SSI Space Manufacturing Conferences: Since 1974, SSI has sponsored nine Conferences on Space Manufacturing at Princeton U. They provide an outlet for publication of work conducted by SSI principal investigators, and to inform the space community of progress in nonterrestrial materials research. Proceedings of the conferences have been published by the AIAA and American Astronautical Society. These provide the principal literature on the use of space resources for space construction and industry.

SSI Co-Sponsored Conferences: The Institute regularly co-sponsors technical and educational conferences where appropriate. Examples include the American Society of Civil Engineers, Space '88 and Space '90 Conferences the Lunar and Planetary Institute's Lunar Bases and Space Activities of the 21st Century Conference, the IAF Space Power Conference, and the Space Development Conference series. In addition, SSI has cosponsored the new series of Lunar Development Conferences.

Research Matrix and Data Base: experiments with an information matrix/database to enable researchers to locate work in a variety of research subjects and career and interest areas.

[FOR IMMEDIATE RELEASE]

Lunar Development Conference III

Lunar Experts Plan Permanent Human Settlement on Moon

Los Angeles, CA (March 20, 2001) - Experts in lunar science, engineering, urban design, and life support will gather at Caesars Palace, Las Vegas, July 19-21, 2001 to create a blueprint for permanent human settlement of the Moon. Hosted by the Space Frontier Foundation, the Return to the Moon III conference is co-sponsored by the Foundation for the International Non-governmental Development of Space (FINDS), National Space Society, Space Studies Institute, International Space University, and American Astronomical Society (AAS).

Dr. Mike Duke of the Lunar and Planetary Institute and planetary scientist Dr. Wendell Mendell are confirmed as conference chairs, and Apollo 17 astronaut, former Senator Harrison Schmitt is tentatively confirmed as a speaker.

"It has been so long since humans have been to the Moon that some believe the landings were faked," remarked Space Frontier Foundation President, Rick Tumlinson, when asked about the timing of the conference. "It is time to make good on the legacy of Apollo; it is time to return to the Moon - this time, to stay."

With recent cutbacks to NASA's human exploration budget, government and private cooperation will be critical to any near-term lunar missions. The conference will revisit older work done on lunar missions and base design with today's technology in order to determine the cost and viability of collaboration.

"The Moon has fallen from NASA's radar screen," said conference chair Mike Duke. "This conference will contribute to identifying the rationale and objectives that can bring industry and government together to explore the Moon for science and commerce."

Unlike its predecessors, Return to the Moon III will take a systems-integration approach to lunar base design. After a day and half of presentations, audience members will be invited to join experts in finding "best-fit" solutions - the most functional base design, rather than the most advanced technologies, which may not work well together.

Abstracts on any aspect of lunar base design may be submitted to the Space Frontier Foundation before May 4, 2001. For submission guidelines, contact the Foundation at RTM3@space-frontier.org.

Info on registration prices and Caesars Palace, go to: www.space-frontier.org/Projects/Moon/ldc2001.html

Meandering Through The Universe

A Column on the Cooperative Movement on the Space Frontier © 2001 by Richard Richardson

What to do about Weightlessness

Weightlessness in space can and does cause many medical problems with potentially serious consequences. There is no doubt that these effects need to be thoroughly researched and solutions found for them. But, if weightlessness is such a problem, then I can't help but wonder why there is so little research and development in, even so little interest in, the means of providing a weight inducing environment. Maybe it is because weightlessness seems so alluring. Maybe the means of producing weight in free floating space habitats seem so obvious. Whatever the reason, it is a crime that the option of producing weight in masses in space is so overlooked.

It seems like if there are serious problems caused by weightlessness, then one would try to find ways to avoid weightlessness. Of course, that *IS* the party line, so far as I can tell. However, not being one who has much grasp of complicated biology, physics, or politics, I'm inclined more to want to think of ways to overcome weightlessness in space rather than just keeping "the unwashed masses" out of space as a solution to the problem. I would advocate designing and debugging weight inducing systems rather than only developing draconian medical and therapeutic interventions to combat the symptoms caused by exposure to weight free environments.

Am I completely off my rocker to think that rather than trying to overcome the effects of weightlessness *entirely* through treating symptoms, that maybe -- just maybe -- there might be some value in looking at ways to treat the weightlessness itself? Am I wrong to think that a real and meaningful answer to the problems caused by prolonged exposure to weightlessness is to provide weight (via artificial gravity)?

Certainly it will be difficult, if not impossible, to avoid *all* exposure of living organisms including, and most importantly, humans to weightless environments even in the course of every day events. One could expect humans to be involved in construction, repair, and other activities which would occasionally or even frequently expose them to micro-g. And, of course, there are bound to be occasional incidences of critical infrastructure failure or other emergencies which will result in people being exposed to weightlessness for up to very long periods of time potentially as long as years. So it is and will remain very important to continue to study the effects of such exposure and try to find the best possible medical and therapeutic interventions.

Yet, just because buildings occasionally burn down, blow up, or are filled with toxic air pollutants, we don't feel the need to do all of our living and working outside. And just because airplanes occasionally fall out of the sky, we (the vast majority of people) don't stop flying. So just because there will be occasions when humans and other organisms will end up in a weightless environment, does that mean we ought to choose between either staying out of space altogether or closing our eyes to alternatives to micro-g space environments and concentrating only on ways to treat the resultant symptoms?

In fact, just as with sky diving, scuba diving, bungee jumping, and many other sports where people choose to do things which have the potential to cause harm to their health, we will certainly want some recreational access to weightlessness. But, just as folks don't live *all* of their lives in wet suits under the waves (though, admittedly, that sounds appealing to some, though I think probably in a somewhat hyperbolic sense) or in vertical wind tunnels which simulate constant falling, neither should we blindly accept the party line that space outside of planetary gravity fields *MUST* require living in weightlessness.

However, accepting a place for artificial gravity in free floating space habitats is not the end of the story. Once a real and meaningful answer to this difficult and troubling issue of human presence in space is finally faced and taken seriously, there are some significant questions about the weight inducing systems themselves that must be addressed.

- How can weight best be induced are there any currently feasible options besides centrifugal gravity systems?
- What is the smallest radius for a centrifugal gravity system which can be generally tolerated by occupants?
- If a system's radius is small enough to cause interfering coriolus effects, then what are the most effective means of enabling personnel to cope and adapt effectively?
- What kind of problems result from long term exposure of humans and other organisms to weight inducing systems?
- What mechanical problems are likely to present themselves in artificial gravity systems?
- How would stationing and navigation systems work?
- What is the range of sufficiently good methods of constructing weight inducing systems?
- Are there concerns regarding life support systems or other essential systems which require special attention?
- If so, what are they and how are they best addressed?

Other, as well as myself, have tried to think through a few of these issues over the past several years. But it is rather unsettling that the be-alls and end-alls who hold the keys to the door to space seem

to feel that the *only* answers to the medical hazards of weightlessness are and ever shall be found entirely in the realm of medicine, therapy, and suffering.

Well, it's one way to keep the average person locked out of space. But I wonder if that is what you and I really want? Do we agree that the many problems presented by weightlessness *MUST NOT* be addressed in any other way than throwing up our hands and exclaiming, "Well, that's the way it is in space! Nothing can be done!"?

I believe that such a mind set (regarding weightlessness, as well as other issues) is a kind of leg iron from which we must break free. For it is this kind of thinking which holds our future more firmly to the earth than any problem of physics.

Space Tourist Draws: Cake and Icing

Since last month I've been to and returned from southern Spain: Seville and Granada as well as side trips to Tangiers, Morocco and Gibraltar. What a great experience! I highly recommend it to everyone.

But one thing occurred to me as I reluctantly returned home, if we want to develop a real tourist trade in space we will not only need a somewhat bearable ticket price and halfway decent accommodations, but we will also need real, meaningful, and awe inspiring experiences. Yes, just going to space will present a good deal of what tourists would want to go for. And yet, human development ... human *artistic* and *esoteric* creations -- especially awe inspiring ones are what seem to motivate most tourists to spend the most money, time, and discomfort in order to experience. These kind of things do include sports and related events, along the lines that so many space activists have spent so much time contemplating.

But, it seems to me that we must also consider art, culture, ways of living, and architecture in our total package. Of course, people are the most inclined to visit places which also just happen to have exotic natural wonders and/or opportunities for uncommon activities at the destination to serve as icing on the cake. Space has heaps of icing. Now we just need the cake! **<RRR>**

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

Flashline Mars Arctic Research Station on Devon Island -- UPDATE

http://www.marssociety.org/

An expedition led by Dr. Pascal Lee and Frank Schubert are now at the Flashline Mars Arctic Research Station getting it prepared for this summers field season. The station appears to have weathered the harsh arctic winter weather well on first inspection. The expedition is to last about two weeks.

A wintry snapshot of FMARS (great wallpaper!)
http://www.marssociety.org/fmars2001.2.html
For a virtual tour: http://www.marshabitat.com/

M.A.R.S. Volunteers Selected for 2001 Field Season on Devon Island

http://www.marssociety.com/bulletin.asp?ID=72

Thursday, March 15, 2001. In a meeting held in Denver, March 4th and 5th, the Flashline Management Committee completed selections of the volunteers slated for the Flashline Mars Arctic Research Station on Devon Island during the summer of 2001.

The selections were made out of a pool of some 250 volunteers who responded to a Mars Society public call issued during November of 2000. Because there were many more qualified volunteers than the slots available, the crew selection process was quite difficult, involving successive downselects to narrow the field. Thus, in addition to those chosen for slots this year, about 100 others were ranked as fully qualified for crew service and were awarded alternate crew status. We hope to include many of these alternate crew members in future operations on Devon island, or in the Mars Desert Research Station which we plan to have operational in the American southwest by late fall.

All volunteers will receive letters informing them of their status during the month of March.

The volunteers selected this year include 25 people, 12 new crew members and 13 returning crew members of whom 19 are men and 6 women. Fifteen are from the US, four are Canadians, two are French, two British, one is from Belgium, one from Denmark. One of the Americans was born in Australia and one of the Canadians was born in Sri Lanka.

Those selected include 4 geologists, 2 biologists, 1 chemist, 7 engineers, 2 doctors, 3 physicists, an optical scientist, and industrial psychologist, and internet technologist, an architect, and an independent filmmaker. The crews will be divided into 6 rotations, of which Flashline Project Scientist Pascal Lee will lead 4 and Mars Society president Robert Zubrin will lead two.

Volunteer selections for 2001 - Returning Crew:
Robert Zubrin, Pascal Lee, Marc Boucher, Steve Braham, Bill Clancey, Charles Cockell, Jeff Jones, Larry Lemke, Darlene Lim, George Martin, Kelly Snook, Frank Schubert, Carol Stoker.

New Volunteers: John Blitch, Roboticist, DARPA
Brent Bos, Optical Scientist, U. Arizona
Sam Burbank, Filmmaker, Independent
Cathrine Frandsen, Niels Bohr Institute, Denmark
Charles Frankel, Geologist, France/US
George James, Engineer, JSC
Christine Jayarajah, Chemist, U. Toronto, Canada
Jaret Matthews, Engineer, Purdue U.
Rocky Persaud, Geologist, U., Canada
Vladimir Pletser, Physicist, ESA, Belgian
Katy Quinn, Geologist, MIT born in Australia
Chris Shank, Engineer, USAF **<FMARS>**

Italian Built ISS Habitation Module Looms

[Joint NASA / Italian Space Agency Release: 01-76]

NASA and the Italian Space Agency (ASI) announced ... the framework for a potential bilateral cooperative agreement, that may result in ASI development of a Habitation Module for the International Space Station. It allows the U.S. to explore an alternative approach to achieve full crew Habitation for the ISS within the constructs of the President's FY2002 budget blueprint guidance and budget run out.

The Habitation Module which was to house crew quarters and other essential habitability functions for 3-4 additional ISS crew was considered a high cost-risk element, and as such, its funding was redirected to address cost challenges in maintaining the core U.S. assembly elements and high priority ISS objectives. ... Restoration of a habitation capability for six or more crew would significantly increase the availability of crew time for important research.

NASA and ASI are discussing launch services, additional Shuttle and ISS astronaut crew opportunities and assignments, ISS utilization, and increased visibility for the Italian role in the ISS partnership ... Any increase in U.S. research utilization provided to ASI would be enabled through the increased capabilities realized through the provision of habitation for an expanded crew complement.

... The Framework signed today would form the basis for a potential MOU which NASA and ASI would sign after completion of the program assessment and subsequent negotiations. -end-

Details:

http://www.space.com/spacenews/europe/italian_hab_module_010419.html?Enews=y

The Italian ISS dormitory module will most likely be an enhanced version of the multi-purpose logistics modules [MPLM] that Italy already has built for the station project. The pressurized moving vans are designed to ferry supplies and equipment to and from the space station. Italy built three (Leonardo, Donatello, and Rafaello) of the 21-foot (6.4-meter) modules at an estimated cost of $450 million.

The NASA/ASI negotiations are aiming at a barter agreement that would boost the number of experiments Italy can carry out on the station and increase the frequency with which Italian astronauts would fly to the station. NASA likely would agree to provide space shuttle launch services for the Italian-built crew quarters as part of the deal.

NASA and the Italian Space Agency hope to wrap up negotiations by this fall (2001).

More on the Italian contribution to ISS:

http://www.space.com/news/spacestation/leonardo_module_010226.html

http://www.space.com/news/spacestation/italian_module.html

NASA RELEASE: 01-83 -- 4/24/2001

International Space Station Partnership Grants Flight Exemption for Dennis Tito

The International Space Station (ISS) Partnership today granted an exemption for the flight of Dennis Tito, an American businessman, to the space station aboard the Soyuz 2 Taxi mission, which is scheduled for launch April 28.

Following intense and extensive consultations among all space station partners, the Multilateral Coordination Board (MCB) achieved consensus on the proposed Tito flight.

The ISS partners reaffirmed that safety is the paramount consideration in the space station program. Further, the mechanisms that implement the ISS international agreements have been tested and worked well to resolve a difficult issue facing the ISS partnership.

The Joint Decision Statement by all ISS partners, which outlines the background, process and conditions for granting an exemption for the April 28 Soyuz flight of a non-professional to the ISS is available on the Internet at:

ftp://ftp.nasa.gov/pub/pao/reports/2001/tito_decision.pdf

The MCB completed its work in accordance with the recommendations of the Stafford-Anfimov Commission. As part of the board's deliberations, there was *agreement that no ISS partner would propose another flight of a non-professional crewmember until the detailed crew criteria had been finalized and adopted by the ISS partnership.* This agreement among the ISS partners should preclude a similar issue arising in the future.

COMMENT: Russia, Tito, and Space Tourism win the battle. But *NASA wins the war*. There should be no joy among space enthusiasts on this twist.

But neither should we indulge in defeatism. Implicit in the language of this agreement is a loophole opening (see the language in italics above) -- not that NASA will not do its best to slam it shut. We must work together, putting pressure on our congresspeople to see that these "detailed crew criteria" are reasonable and that they do not pose unwarranted thresholds so high as to guarantee that no one will ever succeed in meeting them.

It needs to be said that NASA, more so than the other international partners, in its objection to allowing tourists on board ISS "on safety grounds" is indulging in blatant hypocrisy. Consider that NASA "invited" a number of untrained politicians aboard the shuttle (Senator Jake Garn R-Utah and others). "Methinks thou dost protest too much." The safety issue has the guise of legitimacy, but the urgency with which it is argued suggests it is riding as a stand-in for a deeper fear of Tourism, big "T". - PK

Mail For MMM

Mission to Mars' Moons, NUKES & RTGs

4/30/'01. A few days ago, I read your recommendation in the March MMM #143 to duplicate the NEAR-Shoemaker spacecraft and send it to Phobos and/or Deimos. You just might get your wish. I spent the first 3 days of last week attending the meeting of the American Astronomical Society's Division for Dynamical Astronomy (DDA) here in Houston at the LPI. Don Yeomans, one of the scientists on the NEAR-Shoemaker mission, gave a presentation about Eros. The MMM had just arrived, and I showed the article to him. When I did, he told me that Robert Farquhar, an orbital dynamics whiz and another of the leading scientists on NEAR-Shoemaker, was planning to put forward just such a proposal for a Discovery-class mission. No guarantee it will get picked, of course, but at least someone is planning to try for it.

But I must offer a caution about your proposal for a Deimos base. The article seems to assume that Phobos and Deimos have volatiles available. This goes back to the idea that Phobos and Deimos look somewhat like carbonaceous chondrite meteorites.

A couple of years back, I was discussing this topic with a planetary scientist at a Lunar and Planetary Science Conference. I learned that at least some planetary scientists currently think that Phobos and Deimos look more like ordinary black chondrites than carbonaceous chondrites. And ordinary black chondrites are not volatile rich.

The fact that Deimos is less dense than Phobos doesn't tell us that Deimos has more volatiles, either. If the two moonlets turn out to have "rubble pile" structures, different densities could arise simply from different proportions of void space.

That doesn't mean we can't have a forward base on Deimos. Such a base would be quite a good idea. You presented many excellent reasons for having one, and for locating it at Deimos. However, any plans should not assume volatiles are locally available until we have some actual data that tell us what the compositions of the two moons are.

On my earlier comments in the March issue's mail column -- part of the point I was trying to make about reactors vs. RTGs seemed to have been missed. I expect I should have made it explicitly, rather than expecting people to infer it. The point I was aiming at was: if some members of the public are alarmed, however unduly, about RTGs, would not the use of nuclear reactors cause even more alarm? Thus if you are advocating nuclear reactors, and by implication accepting whatever public outcry arises from that, why did improving (the already excellent) RTG safety get so high on the priority list?

Larry Jay Friesen <ljfriesen@ev1.net>

EDITOR'S REPLY:

Larry,

Thanks for the news and comments on a possible Mission to Mars' Moons.

On Nukes & RTGs: Reactors can be shipped through the atmosphere unfueled. For the public, I should think that the question is more about shipping radioactive fuel through the atmosphere.

I have written previously about the "fall back option" of developing a thorium to U-233 nuclear fuels fast breeder industry on the Moon as a possible way around objections should they be codified into law or treaty.

MMM# 116 JULY. '98 p 7. URANIUM & THORIUM on the Moon, P. Kokh

MMM #123 MAR '99, pp. 1, 6-7. Lunar THORIUM: Key to Opening Up Mars, P. Kokh

I am not a nuclear "fan". I do realize that it is an *important option* that can make some things doable that will be harder or even impossible to do. I do recognize the public fear and have no confidence in our ability to reeducate the public. That's why I push hard for the consideration of a lunar thorium-based nuclear fuels industry as a priority industry. It may be unrealistic for the near term, but I think it needs to be looked at. Otherwise, I agree, the public may well succeed in slamming the door in our face.

On the Moon, deep craters and lavatubes have been proposed as safe shelters for nukes.

I very much doubt a Mars "frontier" can be opened without faster nuclear ships. With chemical rockets, we will be lucky to get in an exploration sortie or two. -- Peter

"Snatching Defeat from the Jaws of Victory" -- USAF to Resurrect X-33 from its Ashes?

From Frontier Status Report 4-13-01 # 50

First Iridium arose from the ashes and then the ISS Habitation module [see page 15], now the X-33 program appears to be given a second chance at life. In early March, NASA decided not to extend the X-33 technology demonstrator program, leaving Lockheed Martin with a partially constructed vehicle, aero-spike engines nearing the end of testing and an advanced thermal protection system. Technical problems and delays within the program and cost overruns on the ISS spelled doom for the new launch system. Having spent $400 million of its own on the program, Lockheed was forced to quit work at the end of March when the program terminated.

However, it turns out that the X-33 may not be completely dead after all. Lockheed Martin and the U.S. Air Force have approached NASA for interim funding to keep the program alive until the end of the fiscal year. At that point, Air Force funding would kick in to resume development of the X-33 as a military system. Lockheed Martin has offered to pay half of the estimated $15 million necessary to keep the program viable until development can resume under the new patronage. Both NASA and the USAF will be carefully considering the new proposal before any approval is granted.

It is estimated that it will take $400 million through several years of funding to overcome the ruptured composite liquid-hydrogen fuel tanks that ultimately derailed the program. Lockheed-Martin is expected to replace the composite tanks with tanks made of the same aluminum-lithium material used in the upgraded Shuttle external tanks. The USAF appears to be interested in the X-33 program as a way to jump-start the study of next- generation weapon delivery systems that would make obsolete expensive stealth technology such as the $500 million B-2 bomber (Washington Post).

COMMENT: This can hardly be called a "rescue" unless the technologies brought to maturity in such as development are made available to industry, i.e. to private industry launch vehicle developers. If space is "cheap" just for the Air Force, it will still be expensive for everyone else. Presumably, the USAF and Lockheed would make this technology available to NASA, but not necessarily to commercial outfits. So put the champagne glasses down for now.

We are glad, however, that the "X-33 bundle of technologies" will be developed, that the promise in these technological pathways will not be buried in the pages of alternative histories. - PK

The Lunar Reclamation Society, Inc.

P.O. Box 2102
Milwaukee
WI 53201

www.lunar-reclamation.org

www.neighborhoodlink.com/org/lunarbase

Ad Astra per Ardua Nostra

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LRS NEWS

• **Wisconsin Space Grant Consortium Conference:** This year's WSGC Conference is set for Thursday and Friday, **August 16th and 17th** at **UW-Whitewater**. More information at:

http://www.uwgb.edu/WSGC/conferen.html

• **MMM Ed. Peter Kokh and Ken Paul are working to produce future copies of MMM as PDF files:** See Page 9 of this issue for what it's all about.

LRS MAY Events

Saturday, MAY 12th, 1-4 pm

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

Collaborating Milwaukee Area Space Groups

Wisconsin Mars Society c/o Matthew Giovanelli
7133 West Wells Street, Milwaukee, WI 53213
414-774-8952 - chooy@execpc.com
http://chapters.marssociety.org/usa/wi/
WMS usually meets at address above on 3rd Sat. 1pm
contact Matt by phone or email address above

U.S. CHAPTERS

NSS Chapter Events

MMM 9 Chapters Strong

Space Chapters HUB Website:

http://www.nss.ac/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

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

May 15th at Foerster Academy of Dance, **Sheboygan**
June 19th MEETING at the Stoelting House in **Kiel**

MINNESOTA

Minnesota Space Frontier Society

c/o Dave Buth, 3331 Cedar Ave. S. #2
Minneapolis, MN 55407

612-721-4772 (Dave Buth) 612-375-1539 (Jeff Root)
Email: mnsfs@freemars.org

http://www.FreeMars.org/l5/index.html

Upcoming MN SFS Events planning:

- Marscon (May 11-13th, 2001) http://www.marscon.org/
- ConVergence (July 6-8, 2001) http://www.convergence-con.org/
- ASP (July 13-18th, 2001) http://www.aspsky.org/meetings.html

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 **7-9:15 pm**, **rm 106**, **Wilker Hall**, **Baldwin Wallace College**, **Berea**
NEXT DATE: **May 24th, June 28th**

CALIFORNIA

OASIS

OASIS: Organization for the Advancement of Space Industrialization and Settlement

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

Events Hotline/Answering Machine: (310) 364-2290
Odyssey Ed: Craig Ward - cew@acm.org

E-mail: oasis-leaders@netcom.com

http://chapters.nss.org/oasis

Odyssey Newsletter Online

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

☞ **Regular Meeting 3 pm 3rd Saturday of each month.**
Information: OASIS Hotline, 310/364-2290, website.

- **May 19th** -- OASIS Monthly Meeting, Long Beach.
- **June 16th** -- OASIS Monthly Meeting, Pasadena.
- **July 21st** -- OASIS Monthly Meeting, Redondo Beach Public Library, Main Branch.

• • Looking Ahead

- **May 19-20, 9 a.m. to 5 p.m.** -- The Jet Propulsion Laboratory will once again open its doors to the public during its annual Open House. For more information, please call (818) 354-0112 or see http://www.jpl.nasa.gov/openhouse/.
- **May 24-28, 2001** -- 20th annual International Space Development Conference, Albuquerque, New Mexico. ISDC 2001 *The Odyssey Begins...*
- **June 8-10, 2001** -- *AgamemCon V*, Hilton Burbank Airport, Burbank, California. Information: http://www.agamemcon.org/ OASIS will again be providing a full track of *real* science programming for this science *fiction* convention. Read about our past efforts in our articles section: *AgamemCon 3 Science Programming* and *All Space/All the Time.*

MICHIGAN

Ann Arbor Space Society

P.O. Box 130118, Ann Arbor MI 48113-0118

John Wolter (734) 665-1263 johnswolter@provide.net

☞ 2nd Wednesday (**May 9th, June 13th**) **7 pm**,

MEETINGS at members' homes. Contact above

PENNSYLVANIA

Philadelphia Area Space Alliance

PO Box 1715, Philadelphia, PA 19105

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

http://region.philly.com/community/PASA

Note NEW WebSite - CAPS required [PASA]

☞ **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 17 th street side and go **left**. Look for table sign. Parking at Liberty One on 17th St. Verify meetings with Earl.

NEXT MEETINGS: **May 12th, June 10th**

• **Scheduled PASA activities**: Monthly meeting schedule for the first six months of 2001: 3rd Sat. of every month, exc. Sun.. May meeting May 12th at Liberty. and Sun., June 10th, location TBA. Call Earl to verify.

Report by PASA President Earl Bennett

• **April Activities:** Our umbrella organization met with *The Independence Chapter of the Mars Society* at Gary Fishers home. We had a good turn out partly due to interest in the display the group has been working on. This terrain (arain?) model will be used with a rover that Gary's son Ben will allow us to use. We got to practice after the main meetings which included:

• **PASA Reports:** We had a variety of subjects come up from material in the *Planetary Report* on the Solar Sail Project (see there website for progress) and the use of *Mars Global Surveyor* by school students. Great public outreach making Mars a personal place for them.

This from *Dorothy Kurtz* with timely updates added by the audience (from sites and lists). The use of small vehicles (balloons, gliders) deployable in quantity over Mars and other planets with atmospheres was discussed with Earl and Tobias (Mars Society) bringing up various points and the other members adding to the talk. The glider material was brought up with a reference to *NASA Tech Briefs* as the source (April 2001) of a new report.

Michelle informed us of two new members and the *Sun-Earth Day* event that she was doing on the 27th. This is a new public education event on the Sun-Earth connection being put forth by NASA and ESA. The attendance was good.

Hank Smith called on us for more input on topics for panels at the **World Science Fiction Conv.** this *Labor Day* weekend (2001).New topics will be selected in May or early June and may include the *Virtual Classroom* and *Cheap Access to Space* as well as presentations and panels already scheduled. Besides work on the science programs Hank will also be traveling to S.F. cons making contacting local members of NSS, Mars Soc. and other organizations.

Larry Pezzuto gave a brief report on our website (http://region.philly.com/community/PASA) where our meeting notes with added material is posted. *Mitch* Gave a report on his activities with the *Future Fest* that will be held in October and his progress on getting funding for this. He also reminded us of *The World Future Society's* event *Future Transportation* which was primarily about problems of urban transport and sprawling suburbs. Michelle and Earl attended this event also.

Gary Fisher gave samples of the new brochure of the *Independence Chapter of the Mars Society* and was complimented on the clarity and quality of the product. Excellent! We also received a print out of material on the use of the Shuttle External Tanks by the Space Island Group's site (spaceislandgroup.com). This group was putting forth the idea of a 100 person (!) mission with spin for gravity based on the use of the tanks (cf. website for details). The new "Natural Light" Mars globe was also shown and appraised as a little dark by some of us.

Ben Fisher gave us the use of the *Mind Storm* rover as the final event of the day with much fun on the Mars terrain being had as we drove the vehicle.A small truck was also put on the course with much competitive, and some cooperative, activity resulting. We started at 1 p.m.. and adjourned at 5 p.m. - EB

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 <agt@transport.com>
Charles F. Radley <Cfrjlr@aol.com>
Bryce Walden <BWalden@aol.com>
(LBRT - Oregon Moonbase) moonbase@home.com

☞ Meetings the **3rd Saturday** of each month at **2:00 p.m.**
Bourne Plaza, 1441 SE 122nd, Portland, **downstairs**

NEXT MEETING DATES: **May 19th, June 16th**

ILLINOIS

Chicago Space Frontier L5

610 West 47th Place, Chicago, IL 60609

Larry Ahearn: 773/373-0349

Call Larry for MEETING INFORMATION

NAME _____ ÷

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PHONE #S _____ ÷

❍ $35 **NATIONAL SPACE SOC.** dues w. **Ad Astra**

❍ $20 NSS dues if under 22 or over 64. *Must state age* ___ NSS, 600 Pennsylvania Ave SE #201, Washington DC 20003 (Make payable to local chapter *for 1st year **free** local dues*) (Offer not honored by Oregon L5 Society)

❍ $35 **MOON Society** dues with **MMM**

❍ $25 **Moon Society** dues for those already getting MMM ASI Membership, 4572 Keever Ave., Long Beach, CA 90807

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Send proper amountto address listed in chapter news sections.

=>*for those outside participating chapter areas* <=
❍ $15 **Individual Subscriptions to MMM/MMR: Outside North America** ❍ $45 Surface Mail -- Make payable to "LRS", P.O. Box 2102, Milwaukee WI 53201

ANN ARBOR SPACE SOCIETY
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MINNESOTA SPACE FRONTIER SOCIETY
❍ $20 Regular Dues

OREGON L5 SOCIETY
NOTE DUES RAISE: ❍ $23 for all members

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