"Expanding the Human Economy through Off-Planet Resources"

Moon Miners' Manifesto

& Moon Society Journal

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Guest Editorial ▣ The Next Two Decades With NASA

By Robert P. Kleinberger

In the early 60's, the U.S. began the Apollo Program short some 450,000 engineers and scientists. By the time Neil Armstrong set foot on the moon, more Phd's had been awarded than in any other decade since, and was due in no small part to the expansion of the space program.

These educational and technological leaps enormously invigorated the U.S.economy. How many people for instance know that every American dollar spent on the Apollo Program resulted in a $7 to $8 dollar return to the economy in goods and services? That amounts to nearly three-quarters of a trillion US dollars over a span of thirteen years. (See Paper written by Bruce Cordell and Joan Miller "Young People and Rationales For Human Mars Mission," The Case For Mars IV, Considerations For Sending Humans, An American Astronautical Society Publication, Volume 90).

The American public, however, was never sufficiently informed about the great benefits resulting from the Apollo program, or any other space program for that matter. Even today the general public still suffers from many popular misconceptions. Many, for instance, believe that NASA's budget lies somewhere between 5-8% of the national budget, whereas in reality NASA's budget is less than 1% of the total (See Research Study conducted by the University of Texas, led by Janet Osimo).

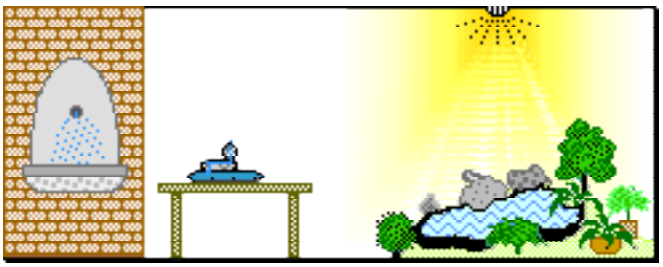
How many among us, for instance, realize that the Apollo Program that reached the Moon in less than 9 years had cost some 120 billion in today's USD, and in contrast the International Space Station (ISS), an equal feat in technological marvel and complexity, was more economical to build, thus far, at about 25 billion USD. Even if the ultimate cost is much higher, the ISS may prove itself to be an even greater boon than the Apollo Program by becoming one of the most powerful research facilities for the international scientific community and may ultimately generate commercial enterprises that will regularly service the station with perishable goods, trash removal, and boost capability.

Similar to the Apollo Program the completion of the ISS was suddenly stopped short primarily for funding reasons and unless the Earth is threatened by an asteroid impact, or some other unforeseen critical event, funding will most likely always play a key role in any future space endeavor.

With the temporary stalling on [=> p. 2, col. 2]

Water Features Calm Pioneer Homesteads

Whether they are hung on a wall, placed on a table, or worked into interior garden spaces, water features such as fountains, waterfalls, and ponds could bring soothing sounds, visual interest, and opportunities for color to spartan pioneer habitats. More, they will be evidence of the "hydrosphere" that underlies every biosphere. More, page 8.



Moon Miners' Manifesto

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fi IN FOCUS Guest Editorial continued from p. 1.

the completion of the ISS for now, what is NASA's future and where is it headed?

Well first of all NASA is a technology development company and should continue to be so in the future, because advancements in technology directly improve our national scientific, economic, and military capabilities. One of our strengths as a nation is that we possess the most advanced technology in the world and we are capable of accomplishing things other nations cannot imagine, much less execute. America can remain strong and secure only with a technological base that is equal to the challenges of a world that is increasingly characterized by change.

The way NASA develops technology is through exploration of our solar system,both through robotic and human exploration. Technology developed specifically for use in the space environment far exceeds any terrestrial technology research and developments, and this was proven during the Apollo Program, the development of the Space Shuttle, ISS, and many robotic spacecraft programs.

In the next two decades NASA should continue and expand its robotic exploration of the solar system. There is no better way to push technology to its limits other than through advanced robotic exploration of the planets. We have learned much from our robotic explorers such as Pioneer,Mariner, Viking, ICE, Pathfinder, Cassini, the very successful Galileo in the Jovian System, and many others.

The technology spinoffs resulting from these robotic explorers have been enormous and the scientific community learned much about technologies such as shielding against radiation, advance propulsion, power generation, communication, astrodynamics, surface sensing, and much, much more. Some of the more popularly recognized developments have been those of tin foil, the microwave, satellite TV, pacemakers, improved computer technology, and all sorts of sensing technologies that were developed by the space program, from monitoring weather to scanning the human body for various maladies that would otherwise remain undetected.

In the next two decades we should continue to push technological development by sending robotic explorers to every corner of our solar system, with landings on our sister planets and their moons. We should resurrect the now famous Pluto-Kuiper Express that hasn't left yet, we should explore and land on the Jovian moon Europa and have it burrow beneath the ice and try to find the ocean that may exist there. We should explore Saturn, Neptune, and Uranus. We should land on the poles of Venus because sometimes the temperatures are moderate there, and explore the backside of Mercury. We should send a fleet of explorers to land on Mars, and lastly we should send automobile-sized remote rovers to explore the lunar surface in depth to find

out if ice indeed exists on the poles of that planet.

We should do all of this because it will advance technology and expand the growing field of Planetology that our nation's young men and women in our universities will want to join and study, with every dollar spent on technological development bringing brilliant young minds into the field.This will improve our national capability, because it isn't necessarily technology alone that improves our capability, it is the upgrade in our human resources that is the real long-range national benefit.

In the immediate future, NASA should finish the International Space Station even if it means rebudgeting. The space station must become a national priority. There is much to be gained from assembling and operating a complex space vehicle such as the ISS as this itself is research on a grand scale. Remember that the ISS is very much like a spacecraft that just happens to be orbiting the Earth. Future spacecraft that are manned by astronauts may be assembled using component designs that owe their heritage to the ISS and instead of orbiting the Earth these spacecraft may be launched to the Moon or Mars, and even beyond. The next spacecraft destined for Mars may very well owe its lineage to the ISS, a fact that seems to be forgotten by many space enthusiasts who oppose the completion of the ISS.

Not many major programs in US history have been finished under budget, but there were some. At 352 million USD spent over a ten-year period, the Panama Canal came in at 4% under budget, but only after 5000 American deaths had been piled onto the previous grueling experience of the French.In the end, that project was a costly experience for both nations, both in blood and in treasure.

The stellar performance by NASA personnel in the assembly of the International Space Station, a major accomplishment unparalleled in history to date, deserves more praise than has been meted out, as well as funding to finish the job.

In addition, the shortfall completion of the ISS has caused the "Unintended Effect", which means that fewer astronauts will be needed for the assembly and manning of the space station. As a result NASA pushed back astronaut selection for the class of 2002 to the year 2004. As it is NASA selects less than 1 percent from about 2600 qualified candidates and a three-year delay will no doubt mean that some men and women will never have the opportunity again to qualify. In one fell swoop, the lifetime dreams of a number of men and women have been shattered, by a simple budget shortfall of 5 billion USD.

The US Congress considers the space shuttles as national treasures, but without the astronauts the shuttles might as well be museum pieces. Without the astronauts, we could not have fixed the Hubble Telescope or built the ISS or landed on the moon. It is the men and women of the astronaut corps that have accomplished the great feats of the last four decades in our space program that are the deserving objects of American pride. We should;therefore, complete the ISS in the near future as originally planned and expand our astronaut corps to levels sufficient for meeting the challenges of a vigorous, adequately funded space program.

In addition, over the next decade we desperately need to design, build, and operate a shuttle replacement vehicle. We have been operating our current space shuttles for over 20 years, and it appears that we will continue to do so for at least another ten. We need a shuttle replacement vehicle that allows low-cost, routine access to LEO. However, we should strive to accomplish this by incremental means, rather than trying to leap technologies that may not yet be sufficiently mature.

It is unwise to wait for some new technology to be developed that will reduce the current cost of getting one (1) pound into orbit from $10,000 USD down to $1000 or $100 USD. We should set our sights on lowering these costs in parallel with any new shuttle development. Certainly, lowering launch costs as much as possible should be our goal, but we cannot wait 50 years to reach it. The US Space Program needs a vehicle that is better than the current shuttle, more efficient and with additional capabilities, but which,in the near term, may result in only halving the cost of reaching orbit.This incremental approach is only common sense.

The new Space Launch Initiative (SLI) office at the Johnson Space Center(JSC), which is charged with the responsibility for managing research and development technologies for a shuttle replacement vehicle has been underfunded from its very inception. Granted, the funding may be for technological development, but in comparison, JSC's SLI budget of 5 billion dollars over the next five years is far less then the original space shuttle development costs that were nearly 12 billion in 1973 USD. Even taking into account the great strides in technology development since the 1970's,can we realistically develop a shuttle replacement vehicle for 5 billion USD that is 100 times safer and 10 times cheaper to fly? I am not saying that it cannot be done because we have learned much in the last 20 years of operating the current shuttle system, but we have handicapped ourselves right at the start. Certainly the odds are not in our favor, not without performing some miracles, and what will the US Congress say when JSC determines that much, much more funding is needed. Is the SLI another double-edged sword for NASA similar to the ISS Program?

We should realistically invest some 1.5 to 2 billion USD per year over the next decade for a next generation shuttle system; and not only that, this shuttle system should be developed in a combined effort with the U.S. Air Force. The Air Force has a

crucial need, even in the near term, for a shuttle vehicle to safeguard space systems and help reach military targets in 10 minutes around the globe. It is only reasonable that they participate in the next generation shuttle design as well as fund 50 percent of the development effort. There should be no more free rides for the Defense Department at the expense of NASA.

In the next decade, then, the US Air Force and NASA should receive adequate funding from Congress to develop the next generation shuttle system. The result should be a vehicle capable of launching to Low Earth Orbit (LEO) and landing at practically any major airfield on the planet. It should be a vehicle whose turnaround for another launch is much shorter than the current space shuttle, but which is achievable with current technology. Unrealistic expectations, such as an extremely low turnaround time are impractical and may cause the program to be significantly delayed.

In the next two decades we should do our best to promote the human exploration of space. We may want to use the step approach to reach Mars by first establishing a lunar base. There are advantages to this in that we can use a lunar base as a test bed for system architecture, power systems,rover design, base construction techniques, life support, plant growth,living in a low-g environment, and examining the physiological and psychological effects of living together in close quarters for extended periods. Lunar Liquid Oxygen (LLOX) production could also be accomplished on the moon to support future Mars missions, and this could reduce tanker vehicle mass for certain Mars missions by as much as 30 percent.

I know that there are many opponents of the step approach to Mars. For instance there is considerable fear among Mars proponents that going to the Moon first will delay a Mars mission. I maintain that a step approach would accelerate the Mars program, because the high cost of a Mars mission may simply be unpalatable for the U.S. Congress to justify to constituents.

The overriding reason for NASA to go the Moon first, however, is a human one. The exploration of space is about human development, "People Exploring Space." People of all origins, races, colors, genders, and ages will want to go into space and we should give as many as possible that opportunity. Unlike a mission to Mars where a select few will actually get to participate as astronauts, maybe seven in each mission, exploration of the Moon will involve a vastly greater number of participants. Exploration of the moon is less elitist than a tightly focused concentration on Mars.

We can place many more people from this planet in a Moon base and its infrastructure than we can send to Mars. A lunar base could rapidly expand to about 25 astronauts and a crew rotation would involve approximately 100 astronauts. This is a lot more then would be involved in a Mars mission in the next two decades. A lunar base may eventually expand to a small city and several research stations involving several hundred. Thus, here lies the real power of getting to Mars. We humans are a restless lot and many will continue to dream of the Mars endeavor. The combination of the larger astronaut corps, the increased participation in the sciences by many of our youth, and the public exposure of Moon exploration would be a natural impetus for a Mars mission and much of the necessary technology would already be in place.

One of the priorities for NASA's new chief administrator, Sean O'Keefe,should be to successfully marshal the support and focus all of the various space societies and groups within the United States. Societies such as the National Space Society, Ad Astra, the Mars Society, the Moon Miners' Manifesto (MMM) and many others comprise a considerable portion of public opinion. Without the support of these groups, NASA will have difficulty fulfilling a vision, or appearing cohesive in front of the US Congress or the public. NASA's new head must involve these groups in the creation of a vision and a philosophy for our national space program. By doing so, we can reduce the divisions among ourselves and present more cohesive and coherent options to the U.S. Congress and the American people.

Whether we decide to explore the Moon or Mars first, or neither, we must unite in our efforts to support the national space program, even if it means swallowing some pride and surrendering allegiance to our personal preferences. NASA cannot survive, much less meet its goals, without the active support and involvement of every American who recognizes space as our final frontier.

This is an ambitious undertaking, one that will not be easily achieved.Rather than being daunted by the task that lies ahead, however, we should remember the adage: "No man moves without ambition or moves without a dream." If our children are to develop ambitions and dreams of their own,they must learn from watching us try to realize our own. What greater gift could we bequeath to them?

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Time doesn't do things.
People do things.
Nothing happens
If we don't make it happen.

Gregory R. Bennett

N Nitrogen N_2	
Symbol **N**	Molecular Gas N_2
Atomic Number **7**	Molecular Weight **28**
Atomic Weight **14**	

Nitrogen and the Moon's Future: Conservative use of this scarce critical element is key to "limits to growth" of Lunar Settlements

by Peter Kokh

Cosmically speaking, Nitrogen is one of the universe's more abundant elements. Earth's atmosphere is 79% oxygen. There is three times as much (by weight, not by percentage) on Venus. Mars' thin atmosphere is 3% nitrogen. Titan's thick atmosphere has more Nitrogen than that of Earth. There is plenty in the deep atmospheres of the gas giants.

All that does little good on the Moon. Unlike the Earth, the Moon formed "hot", condensing out of the hot plasma debris of a major crash between the proto-Earth and another early planet-in-formation. In the heat from the impact, almost all "volatile" elements, those with relatively low boiling points, were driven off into the surrounding space, never to be recovered. When the Moon coalesced from this debris, it formed "dry" - no water, no free gasses. Any carbonates were disassociated and the carbon driven off. Only oxygen, which forms tight stable bonds with most metals, was retained.

What nitrogen is found on the Moon is from two *external sources*, one known, the other surmised:

- **Known regolith reserves:** nitrogen atoms in the thin but incessant solar wind have become affixed to the fine particles in the dusty topsoil blanket that covers the Moon: the regolith. This resource is primarily in the top meter or so at an average of 82 parts per million.
- **Possible polar ice reserves:** if the suspected polar ices "found" by Lunar Prospector are confirmed by a "ground truth" probe, it is almost certain that they are derived from cold trapped vapors released when comet fragments have impacted the Moon. Comets consist not only of water ice, but of nitrogen oxide and carbon oxide ices as well, in a mixture dubbed "clathrate." One of the primary goals of a polar ground truth probe would be to qualify and quantify this mixed ice bonanza. Someday there may be refineries at the poles producing CH4 methane and NH3 ammonia as well as water, for shipment by truck, rail, or pipeline to industrializing settlements in other areas of the Moon.
- **Off-Moon sources:** import of nitrogen in the form of ammonia, from comets and aster-oids if and when such resources can be economi-cally developed to provide steady "pipeline" supplies.

The Bottom Line:

On Earth, an 1800 square foot home with 9 ft. ceilings, at sea level, contains a half ton of nitrogen. *To provide that much on the Moon would require gas scavenging an average of 6,100 tons of regolith at 100% efficiency*. Anything we can do to cut that burden will allow settlement to grow more quickly.

Of all the elements essential for life (oxygen, hydrogen, carbon, nitrogen) it is nitrogen that is in shortest supply on the Moon in comparison to the amounts of it we are accustomed to using -- simply as the buffer gas for our oxygen-based breathable air. As settlements grow, it will not be shortages of hydrogen (water) or carbon that put on the brakes. It will be nitrogen that becomes the pinch point.

The Case for Reduced Air Pressure

One way to "go easy on the nitrogen" would be to simply maintain and regulate low ceiling heights in lunar settlements, not just in private quarters, but also in public places. Less volume of air means less tonnage of nitrogen. Such a Spartan constraint would not exactly foster high morale, especially over the long haul. But without other ways to conserve, we may well be facing such a gloomy prospect .

What else can we do? Reduce the air pressure in habitat areas. Additional savings could come from reducing the relative abundance of nitrogen in the reduced atmosphere, keeping the partial pressure of oxygen closer to what we are accustomed.

Readers who frequent the Artemis Discuss List will no doubt be exasperated by this suggestion.

> "Oh no! We've been through all this before! It can't be done, and NASA uses Earth normal pressures and mixtures in space. A discussion on the Artemis-list hashed this out in considerable detail. It is not true that we can live in lower air pressure. The atmospheric pressure at 7,500 feet is *not significantly less* that at sea level."

With all due respect to those who took part in this discussion, we believe *all* the premises behind these assertions are flawed and inaccurate. It is vital for those of us who have faith in a bright future for lunar settlement to seek out a second opinion.

The Facts:

A table on the reduction of air pressure with increasing altitude is available online at:

http://www.cleandryair.com/AltitudePressure.htm

Sea level air pressure is the equivalent of a column of Mercury 760 mm high (30 inches). Here is what the table shows for some higher altitudes:

Altitude	Pressure	% (1 ATM = 100%)
7,000 ft.	586.7	77%

(Mexico City's 22 million live at 7,600 ft.)

8,000 ft.	564.6	74%

(Bogota's 7 million live at 8,600 ft)

(Nairobi's 2 million live at 8,800 ft)

9,000 ft	543.3	71.5%

(Quito's 1.5 million live at 9,500 ft)

10,000 ft	522.7	69%

(Cuzco's 300,000 live at 10,600 ft)

(La Paz, Bolivia's 1.5 million live at 11,800 ft)

Millions have been on top of Pike's Peak, 14,000 ft

15,000 ft	429.0	56.6%

Can thirty five million people be wrong? It is quite clear from these figures and the interposed list of high altitude cities where millions live, that the Artemis-list conclusions are *prima facie* in error.

> "Nevertheless, a very large portion of the population has difficulty adjusting. Also note the life spans of the places you've listed."

It was noted during the Mexico City Olympics (1968) that those athletes who live at lower altitudes had enormous difficulties competing, *unless they had exercised the foresight to come to Mexico City a week or two early to acclimatize themselves.* Those who did so did well. And life spans relate to medical care.

The argument from the experience of some people who have difficulty adjusting is irrelevant. It cannot be expected that everyone would be able to adjust to life on the Moon or Mars, and there are a lot of reasons for that: claustrophobia, black sky blues, loss of open-air living, lower gravity, air pressure. We know all that, and have always known it.

Pre-screened settlers will come from the ranks of those who tolerate all these conditions well.

> All that is necessary for settlements to thrive is that there are enough who can adjust.

Those who argue from the admitted fact that some cannot adjust ignore the rules of simple logic. *"Some people do not make good parents, therefore parenting is unwise."* Same type of argument.

There are a great many skeptics about the rationality of our faith that humankind can sow itself on other shores beyond Earth's. "We were evolved at 1 ATM and 1 G and it is not possible for us to be pre-adjusted to tolerate anything less!" If we are to give in to them on the atmospheric pressure question, then we might as well give in to them on the gravity issue. *But let's not.* Life is about adaptation, not only over many, many generations, by evolution, but within the experience of individual lifetimes. Humans originating in East Africa have dared to step out of "their niche" over and over again to the point where we now thrive from the polar arctic to the high altiplano of Lake Titicaca and La Paz, Bolivia.

Why Air Pressure is a Critical Issue

The suggestion to use reduced air pressure in our outposts and settlements on the Moon and Mars is not lightly made. It is simple physics that

the higher the inside/outside pressure difference,
the greater the propensity to leak air,
and the greater the likelihood of seal failure.

And this likelihood increases on a geometric scale. Choosing a reduced air pressure is then first of all a matter of common sense safety. The Moon and Mars are very unforgiving places. If we respect the dangers and the risks, our chances of successful transplantation to either world will be that much greater. Not to do so based on assumptions born out of history or habit or respect could invite failure. We have a saying that "it is easier to find forgiveness than to get permission." That approach works with people and institutions, but not with Nature.

Extra incentives for Lower Pressure on the Moon

On the Moon we have three additional incentives to use reduced air pressure in our habitats:

1. The more our habitats leak, the more likely we will end up "polluting" the lunar vacuum to the point that it ceases to be a major industrial and scientific resource.
2. The more our habitats leak, the more nitrogen we will lose (nitrogen is enormously more difficult to come by on the Moon than oxygen) and the sooner we'll reach the Moon's "carrying capacity"
3. The less nitrogen we use as a buffer gas in our habitat atmospheres, the less expensive it will be to provide higher ceilings in public spaces as a welcome relief to eye strain and cabin fever.

Reducing Nitrogen Richness as well

One of the cases made against reduced air pressure is that "some" people have difficulty adjusting to it. Aside from the irrelevance of this argument, the difficulty cited comes entirely from the proportional reduction in the amount of oxygen. But who says we have to keep the same gas ratio we have on Earth (79& nitrogen, 21% oxygen)? What if we were to keep the oxygen partial pressure at comfortable levels and achieve all of the reduction in total pressure by reducing the amount of nitrogen gas used as a buffer? The following table assumes just that:

Mix (N/O) (N2/O2)	Pressure (%1ATM)	N2 Savings (tonnage)
75/25	84%	20%
70/30	70%	38%
65/35	60%	51%
60/40	52.5%	60%

But, but ... fire risk and oxygen poisoning

Most of us know the dire consequences to the Apollo 1 crew of using an atmosphere of 100% oxygen. One spark and they were toast. There is, however, an enormous difference between 0% nitrogen and say 60%. But let's humor those concerned about fire risk and admit, for the sake of discussion that a 60/40 nitrogen/oxygen ratio makes combustibles more likely to ignite.

On Earth we are surrounded by combustibles. For one thing we use a lot of wood, a lot of plastics. On the Moon, however, items made of wood and other organics, natural or synthetic, would be very very pricey. We will need to reserve all the nitrogen, hydrogen, and carbon we can harvest for biosphere biomass and food production cycles. On the Moon we will rely much more heavily on inorganic substitutes: metal alloys, ceramics and cast basalt, glass and glass composites. The typical lunar home, office, school, or other kind of space will have very little in the way of combustible materials *outside of clothing, bed sheets, towels and the like.* Even the casings for electrical wiring are more likely to be of woven fiberglass than Romex plastic. Electrical fires will be much less common than on Earth.

All this is good, because fire is far more likely to be fatal on the Moon than on Earth, You can't just open a window to let out the smoke. You can't just open a door and escape outside. Future Mars settlers will be under no such materials rationing restrictions. The sad twist is that the incidence of fire and fire fatalities on Mars is likely to be much greater.

Some fear oxygen poisoning in an oxygen enriched atmospheric mix. But this phenomenon only occurs when the oxygen mixture is near 100%.

Don't sea level crops need sea level nitrogen?

On the Moon we are surely going to want to grow more than coffee, tea and other crops usually associated with high altitude. The altiplano of Peru and Bolivia are not exactly gardens of Eden or breadbaskets to the world! Yes, but!

It is true that this high altitude area on Earth is no green paradise. Is that the result of reduced nitrogen? If that is the conclusion you want to reach, it will be the most plausible answer. But in fact, the altiplano is relatively infertile for climate reasons that have nothing to do with the reduction in nitrogen partial pressures. The are is colder because it is higher up. An because it is on the lee side of the Andes, it is drier, and windier.

Dry, cold, windy -- not exactly the conditions that make for rich, fertile soil. But to jump from that fact to the conclusion that reducing nitrogen partial pressures will mean cold, dry, windier lunar settlement interiors with poor soil is absurd.

In fact, in response to the quickly rising population of the area, especially around La Paz, there has been much agricultural research of late and the results are amazing.

- http://www.idrc.ca/books/reports/09highla.html
  - onions, radishes, beets, and carrots and lettuce at 4,200 meters (13,839 ft.)
  - potatoes: three harvests a year in greenhouses
- http://www.eco.utexas.edu/graduate/Blubaugh/papers/ISEEpaper.htm
  - sustainable development in Bolivia's Altiplano

If you do a web search for altiplano crops or altiplano farming, you will find much more evidence to support the conclusion that high altitude and lower nitrogen partial pressures do not mean having to live on coffee alone. But how can this be?

Simple. Most plants do not get their nitrogen directly from the air. They absorb nitrogen from the nitrates in the soil, put there by microorganisms that *can fix nitrogen directly* from the air. Some plants, like legumes (bean family) live in symbiotic association with such micro-organisms and planting them enriches the nitrate content of the soil. But the bottom line is that nitrogen-fixing micro-organisms thrive at all virtual altitudes under discussion. "Sea level plants" do not require "sea level nitrogen."

NASA Studies

What about NASA studies? The assertion is that NASA has studied all of these questions exhaustively and come to the conclusion that sea level air pressure and mixture is best. Why else would both the former Mir and the International Space Station use 14.7 pounds of air pressure?

NASA has done many great things. But there are good reasons to believe that it is *highly unlikely* that research on this question has been exhaustive.

- NASA has never looked that far ahead to the point that human expansion might be limited by the availability of nitrogen. NASA's lunar outpost studies have focused on small crew installations with individuals serving short terms of duty. For NASA to spend research dollars on "far future" options would be wasteful in that light.
- NASA has wisely chosen standard sea level air pressures and mixtures *because man-hour time in space is prohibitively expensive,* too much so to waste any of it on "adjustment time." Once we start talking about settlements, where people have come to spend the rest of their lives, a short period of adjustment difficulty (for which all volunteers will already have been pretested before leaving Earth) is hardly a major concern.

But is it not brash and rash and disrespectful to NASA to request fresh research? In science, it is standard practice to check and recheck results of others. In medicine it is standard practice to request second opinions. If NASA is offended, then it has put itself on some sacrosanct pedestal above other scientists and researchers. *No disrespect is intended.*

There is simply too much at stake on this question to settle for results of past studies there is every reason to believe have not been exhaustive or free from preconceptions that tend to color results. Instead, let's put all prior conclusions on hold, and mindful of the non-trivial consequences, examine the facts afresh with an open mind.

We owe our dreams that much. **<MMM>**

Therapeutic Indoor Recycling Water Features

by Peter Kokh

Thanks to strong marketing by suppliers for garden pools and water features, both indoor and outdoor, these delights are finding their way into more and more gardens and homes each year. One can buy fully assembled pre-designed units in a bewildering array of sizes and styles, or buy key parts and create one's own. Imagination, not cost, is the only limit.

Indoor "water features" would seem to be just what the doctor ordered to make lunar homesteads inviting retreats. The reasons are that they:

- use only recirculating water reserves
- require only lightweight imported pumps, hoses
- can use basins made of many lunar materials
- are an opportunity to "domesticate" moon rocks
- are an ideal setting for plants
- can be combined with fish ponds
- offer several ways to add color
- provide a treat for four of the five senses

Recirculating Water

The water used in these water features recirculates over and over. One must make up for evaporation, of course, but evaporated water is not lost to the biosphere as it can be recovered by dehumidifiers. It is essential that the outpost or settlement have more than marginal reserves of water as a matter of safety and security. But why not put such reserves "to work" in ways that improve overall morale? (see MMM #67, July '93, p. 6. "Reservoirs")

Imported Pumps

These water features use small pumps that are relatively light weight, plus hoses and clamps. It can be argued that the intangible benefits of having water features in homes, home gardens, and public common spaces is great enough to justify their import -- after all, the vast bulk of the weight (basin, water, and sundry adornments) can all be made locally.

Made on Luna Basins

Basins, pools and step pools need to be impervious to water and are commonly made of inorganic materials. On the Moon we can make such items from glassified regolith, glass composite, cast basalt, various metal alloys, glass-sulfur composites, and concrete. The choices are quite wide and will support a wide variety of sizes and variation in design.

Incorporating Moonrocks

Water feature designers often incorporate rocks in their creations. After all, in nature, rocks are invariably associated with waterfalls and rapids. We won't find "river rock" anywhere on the Moon, of course, but we should be able to make interesting arrangements using larger moonrocks and breccia. As an alternative, we could "make" rocks by casting basalt or concrete in various shapes. In the first path, we find one more way to "domesticate" moonrocks and thereby make the surface that much less alien to the eye.

Working in Foliage

Again, in Nature, foliage is commonly more dense and rich in proximity to water. We can make our house plants look more natural clustered around a water feature. With a little ingenuity and extra plumbing, we might even train the water feature to meet the watering needs of the plants.

Integrating Fish Ponds

In larger size fountain pools and waterfall basins, we can raise a variety of common aquarium fish species. Fish add surplus motion and color, and reinforce bonds with nature that would weaken if we had only plants to enjoy.

Avenues for Color

Integrating a water feature into the home or home garden, provides several opportunities to add extra color for the eye to feast upon:

- moon rocks in direct contact with water or even just splashes of water, may tend to take on rusty patinas, to the extent of their iron content. Rust will be a warm tone that will provide welcome contrast to background gray tones of structural concrete, cast basalt, glass composite, or metal.
- the many greens of foliage. Plants go well with rust tones, by the way. Think terra cotta pots!
- flowers and blossoms
- colorful fish

Treats for Four of the Five Senses

The reader is welcome to try to identify ways in which water features provide a taste treat for the tongue. We didn't try. As to the other four senses:

- **Eyes:** The designs and shapes of fountains and waterfalls can be designed are limited only by the imagination. They can be rustic or crisply geometric, incorporating many textures. Amateur-friendly, they are also inviting to artists as well. Spot lighting can be used and/or underwater lighting. Plus colors!
- **Ears:** Soothing "white noise" that varies with flow and design.
- **Nose:** That fresh "after-the-rain" smell in the air.
- **Touch:** Textures of the different surfaces can vary from ultra smooth to quite coarse or even sharp. A randomizer added in to the ventilation system, could waft gentle fresh breezes around the surroundings.

Settlers need ample morale boosting perks. Water features will be among them. **<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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The Moon Society Membership Services
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Chapter Outreach Opportunity

Apollo 13 Blockbuster to be re-released in IMAX format this summer

LOS ANGELES, March 21 (Reuters) - Big movies got bigger on Thursday when Imax Corp. unveiled plans to convert 1995 blockbuster "Apollo 13" for its giant screens this summer, marking a first for mainstream, live-action Hollywood movies....

This is sure to present great outreach opportunities for Moon Society chapters (*and* chapters in formation!) in urban areas with IMAX theaters.

- *Chapters in cities without IMAX* could put together charter bus trips
- *If you do not have a chapter in your area*, this could be the event that will help you recruit new people to make your chapter a reality.
- *Start planning now* to take advantage of this special occasion, brainstorming their displays and handout literature specially designed for the event.

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

Oregon L5 Society has Five Papers at 2002 Space & Robotics Conference

from Bryce Walden
[Oregon L5 Society Lunar Base Research Team is a Moon Society Affiliate Organization]

Five papers were presented by researchers from the Oregon L5 Society to the 2002 Space and Robotics Conference (American Society of Civil Engineers) and are now available online at:

http://www.OregonL5.org/l5sr2002.html

Just follow the links

[NOTE: These are PDF files. Hold the cursor down on the link until you get the prompt to download the link to your hard drive. Use Adobe Acrobat Reader (free) to open and read.]

- Gecko-Tech in Planetary Exploration & Base Operations
- Lavatube Entrance Amelioration on the Moon & Mars
- Illumination for Lunar Base Construction & Operations
- Secondary Profit Generators for Moon & Mars Bases
- Lunar "West Pole" Prime Meridian

In next month's issue, we will print the Abstracts of each of these papers.

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

Growing The Moon Society:
Part I: Projects

by Peter Kokh

The Moon Society has two "Flagship" projects:

1. The Artemis Project™ to design a viable commercial Moonbase.
2. Project LETO (Lunar Exploration and Tourist Organization) to build an Earth-based facility for educating the public and conducting research.

These "metaprojects" are not an example of what we mean by "projects" in this paper. We are speaking instead of bite size projects that advance one or both of those larger goals. It is the evident pursuit of such concrete nearer term projects and the evident success of at least some of them, that signal to members and outside observers alike that this society is actually working towards its goals.

Project progress reports encourage existing members to renew their association, and new persons to join. The desired fruit is new members joining to participate in specific projects, bringing with them talents, and perhaps even funds.

Letters from members complaining that the Society isn't "doing anything" or "getting anywhere" are disquietingly frequent. For all of us who habitually or even sometimes feel this way, it is time to stand up and take ownership of the problem.

If you want to talk to someone responsible,
look first in the mirror.

The Moon Society is small. Even if it had ten times the current membership, it would still not be able to afford a paid staff, much less paid project managers and researchers. We are a Society of volunteers not only from bottom up, but from top down.

In short, there is no one to DO projects except ourselves; yes, you and me. Let's dust off the spirit of the early sixties so well put by John F. Kennedy in his inaugural address - but we'll paraphrase:

Ask not what your Society can do for you.
Ask what you can do for your Society.

Projects come in all sizes and shapes

The easiest place to start is with a one person project, an idea you have half-baked on your couch, and which, if you actually put some time into it, you could bake more fully. Start by taking pen and pad in hand and trying to analyze your project idea.

1. If your project idea is something physical (two or three dimensional) sketch it out. This process may reveal unsuspected problems or constraints.
2. Next analyze it *as a project* by dividing it into steps arranged in an order that leads to completion or realization. Estimate man hours for each.
3. List any tools or materials or other resources you may need and estimate dollar amounts after each.
4. List any steps you are not prepared to undertake yourself without further learning or practice.
5. List other resources you may need to tap.
6. Adopt a Game Plan to tackle whatever you have identified as step or phase I. One step at a time.

If it turns out that your idea will require additional *hands* and/or *talents* and/or *time* and/or *funds* and/or *experience* than you can throw at it, then what? First get as far as you can on your own in analyzing your project as above and sketching out ideas, listing needs and resources. Now you have two options:

1. Use your pre-scoped project to enlist neighbors, friends, associates and others in your community both to join the Moon Society at large and to form a local project-centered chapter. In preparing to do this, write up your project and sketches in a flyer or brochure or storyboard to use in recruiting. Show how this project will help the Society towards its goals.
2. Post your project on a special website of "Ready to Go Projects" where others can see them and decide whether or not they are up to taking the ball and running with it. We'll talk more about that website later.
3. If your project will help the Society more if it is replicated by other chapters or individuals in the Society, do both (options 1 and 2)

Outreach Projects: Education & Recruiting

An obvious area for projects is creation of displays and other outreach materials that will allow you to educate the public about the goals of the Moon Society and the prospects for a commercial return to the Moon and enterprising Lunar Settlement. NOTE: *Never gauge your success by the number of new members you sign up, though that is the prize we hope for.* Every person whose horizons you widen helps the cause, even if intangibly.

For inspiration, there are several outreach display projects on the Lunar Reclamation Society site (www.lunar-reclamation.org) (also check out chapters.asi.org/milwaukee) and you can also peruse the websites of other space chapters whether of the Moon Society, the National Space Society, or the Mars Society. If you cannot adapt them, try using them as brainstorming springboards.

If your outreach project is something you think other chapters can use successfully as well, consider publishing instructions and plans so that others can replicate what you have pioneered, thus making your project that much more fruitful!

Fundraising Enterprise Projects

The Artemis Project hopes to terrace a series of individually profitable enterprises to pave its way to the Moon. You don't have to be an impatient observer. Whether you have ever thought of it or not is irelevant. If you have had an idea for a product that "someone else" should do, why not make yourself that "someone else"? At least it costs nothing to imagine, to push the notion as far as it will go. If you can imagine it, the chances are that you can do it. Take responsibility for your own suggestions!

Your enterprise customer base may include those who are already members of the Society but should extend to the population at large. It's not just a matter of reaching into more pockets, its also a matter of reaching into more minds and hearts.

We have a ready-made marketing tool: Lunar Traders Inc, Official Outlet of the Artemis Project™ at www.lunartraders.com may be willing to market your product on consignment on a non-exclusive basis, leaving you free to sell elsewhere as well.

Depending upon your project idea, it may take surprisingly little initial outlay to start a spare time, spare room enterprise. If it does not succeed, you will have risked little and gained the satisfaction of having tried. If you have an idea that is worth replicating in quantity and in many locations, you may have the start of a business plan.

If your product is something that others might be willing to pay for, and if, the more it spreads, the more the climate for realization of the goals of the Society will be improved, analyze your project idea again from a business perspective. How much time and effort and money would it take to produce a first salable product? Can you do this in the spare time you have, given all the other demands on your time? If you are a parent, can you turn this into a family project?

If you can start a chapter around this enterprise, then you will have a source of funding that will enable you to branch out and diversify your chapter's output. Once you have a field-tested and successful product, you might allow other chapters to replicate it or at least encourage them by example to follow suite. Publishing DIY (Do It Yourself) Project instructions, plans, and lists of tools, materials, etc. can become a product as well.

Your business plan should include a name, market research, cost analysis, and a game plan that starts with the simplest and easiest and surest bet products first and grows gradually. Never bet the bank! Crawl, walk, fly, orbit, warp - in that order.

The entrepreneurial goal here is not to help fund the Society's goals directly, but to help grow your chapter and perhaps other chapters and in turn recruit more Society members at large.

An Enterprise Product Sampler

In today's world, we have not only desktop publishing, but the start of desktop manufacturing.

- Buttons with catchy back to the Moon phrases
- Bumper Stickers / luggage stickers
- Artemis Moonbase Kits (at least detailed plans with parts lists and instructions) These can be preprinted on cardboard for cut out, folding, and assembly at much less cost than extruded plastic mold items. But they still help visualize.
- Modular settlement kits (starter combo with additional modules for sale) Cardboard kits.
- Board games (back to the Moon race, Farside SETI project, building a prosperous lunar settlement, retrieving resources from asteroids and comets, inter outpost trading, etc.)
- Apparel: caps, T-shirts, blazers, patches
- Computer screen savers and computer screen wallpaper (the one available, asi200000003.jpg, is a collage that is too busy to be enjoyable and could be replaced by a slide show succession of scenes) using existing art (with permission) or new art.
- Wallpaper Murals. In a bedroom, family room or den or elsewhere, wallpaper murals produce an instant mood setting focal point. the standard formula is 8 pieces, 4 across the top, 4 across the bottom, total trimable width 13'8", total trimable height 8'8"] Currently only three space murals are available (from Environmental Graphics in Minnesota and retailing in the $70-$130 range): Earthrise (over Apollo moonscape scene), Columbia in orbit, Saturn and its moons. The standard way to manufacture such murals involves a hefty setup price just to produce the master, but with ingenuity, it should be possible to use today's millennium computer & photocopy technology to get started for significantly less. To broaden your market, design trimable 36"x80" murals for flat doors as well. Your theme can be strictly lunar or embrace other space destinations as well. All money is green!
- Souvenir staples: mugs can be transfer printed
- Jewelry: tie clasps, pins, earrings, belt buckles

There are, of course, more ambitious ventures galore. Our aim is to get as many members doing some thing productive as possible, no matter how humble. Take on a project, and not only will that improve your attitude towards the society, it may be the start of something bigger than you have imagined. We all stand on the shoulders of those who have gone before us. In turn it is only fitting that we provide the shoulders for those who follow to stand on. Returning the Moon and establishing a viable civilization there will be a work of many generations.

Research Projects

In the end, we must do more than educate the public and promote the Society's goals. We must do more than just raise funds for more projects.

We must never lose sight of the need to meet and overcome many a technical challenge. Technical and engineering projects are not for everyone, but they demand to be undertaken. If we drop the ball here, the day will come when we find ourselves back on the Moon, but it will be no more than another short term grand stunt because we will not have done the homework necessary to enable us to stay. The time for head scratching is now, not when we get there. We need to hit the regolith running.

Some of us are game for technical projects. If we find ourselves in over our heads, at least we will have identified challenges and hurdles for others to tackle. Some technical projects will transcend the capacities of individuals, and become ongoing team efforts. But individuals can launch them, finding and recruiting help as needed.

If we do not collectively have the technical talent within the small membership of the Moon Society, then what? We recruit the talent we need. That's easy to say, hard to do. But more on Special Recruiting efforts in a future installment.

Keeping Track of Projects worth sharing

There is already a place to list and keep track of chapter scale projects: the **Space Chapters Hub**

http://www.nss.ac/hub/

Yours truly is the webmaster. If you have taken on a project that has reached a point where either it needs assistance or is ready for other Moon Society chapters to replicate, simply email me all the details and I will post them.

kokhmmm@aol.com

Or alternately put everything on a web page of your own and send me the link. The whole purpose of the Space Chapters Hub is to make it possible for chapters to share resources and replicate successes.

There is no reason why the Space Chapters Hub cannot expand to include a Classified Projects section for help and resources offered, help and resources wanted. We can post instructions, plans, parts lists, photos, you name it.

Again this is important not just for mature projects but also for faltering projects. You may have taken an idea as far as you can. But why waste all that effort by letting it die in the dark? Expose your uncompleted project so that others can take over when and where you have had to leave off. That way, your efforts will not have been in vain.

Even if you have undertaken a project totally on your own, if it is something a chapter could copy, post it on the web at the Hub. Yes, the Space Chapters Hub is meant to serve space chapters of all space-dedicated societies, and those from the National Space Society and the Mars Society will be able to look at Moon Society projects posted here. That would seem to be a plus, not a minus.

Another place to post would be the Artemis Society of Milwaukee -- admittedly more a website than an actual chapter

http://chapters.asi.org/milwaukee

We can add pages to serve as a watering trough for Moon Society chapter projects.

Both these sites (along with the Lunar Reclamation Society website) are hosted and maintained by CyberTeams, Inc. and CyberTeams software.

Pointers to these Project Watering Holes can easily be put on both the Artemis Society and Moon Society websites.

Turn Key Business Plans

Say you work hard on developing a business plan only to find that for one reason or another, you are not the one to carry it further. You can sit on your idea and let it die, or hoping that someone else can take over where you have left off, do one of two things:

1. Post a description of your business plan along with a price for anyone who wants the complete report.
2. Post the full business plan for anyone who has what it will take to do with what he or she can.

Which choice you make depends entirely on you. In either case, there ought to be a place where you can post business plans for sale or for the taking. There is one such orphan business plan ready in the closet waiting for takers at no cost [a business plan to make money here on Earth pre-developing the technologies needed for a glass composites industry ideal for the Moon.] If we get more requests for this service, we'll come up with a special "Space Business Plan Exchange" website.

Summary

The idea here is twofold.

a. Get Moon Society members to take ownership of their own suggestions, and thus of the progress of *their* Society.
b. Greatly increase the Gross Societal Product.

Whatever project you dream up, consider passing the buck to the guy in the mirror. After all, who knows better exactly what you mean, what meets your standards of excellence and performance? Who else could possibly be more dedicated to taking the ball and running with it and sticking to it until the goal is achieved. That man in the mirror is the most priceless resource you have. Don't just join, join in!

"Engage!" is not just for Captains anymore!

Meandering Through The Universe

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

Minimum Cost Design, continued ...

For the last few months I've been discussing the economics of opening the space frontier to settlement. The focus has been on something called MCD -- Minimum Cost Design and the example to which we've been applying MCD is the Earth to Orbit launch vehicle.

We've discussed the potential cost advantage of building our rocket out of steel rather than aluminum. The questions that then arise are just what would the mass difference be for an optimal real implementation and whether or not there are propulsion systems capable of lifting such a steel rocket and sufficient payload to a secure orbit? Some factors to consider are that it requires considerably less steel to make sufficiently strong structural components and, considering that the cost of the metal itself is less, the cost of design is less (because the stronger metal requires less complicated designs), and the cost of fabrication is less (because steel is a lot easier to work with than aluminum) ... since the total cost of the components in question is less, one could use part or all of the savings to invest in more engines or to purchase more powerful engines and thereby address the additional mass. Without in-depth research it is difficult to say whether any or all of the possible strategies of compensating for the greater mass of a steel vehicle would provide any final benefit and whether any benefit there might be would be sufficient to justify using steel in the first place. The point is that without that deep and careful analysis it is only one wild guess against another.

Ground-bound Boosters

Now, for an atmosphere free launch site such as the Moon, things look considerably simpler. From Earth a launch vehicle MUST get its cargo sufficiently high, sufficiently quickly, and impart to the payload sufficient velocity all in a single mighty heave or the friction of the atmosphere will slow it enough that it will fall back to the ground. But in an atmosphere free setting such as the Moon, atmospheric drag is *not* a small factor as a consequence of the vehicle passing out of the atmosphere so quickly. Rather, it is an infinitesimal (and thus, non-relevant) factor because the lunar atmosphere is *so* tenuous that it does not create any meaningful drag whatsoever.

Therefore, a space flight vehicle could attain all necessary velocity horizontally, if desired (and if appropriate provision is made to prevent impact with any land forms, of course). So for settings like the Moon a whole new scenario is opened. Since space vehicles could remain in close proximity to the ground while accelerating, it becomes possible to provide all or most of the thrust from a ground bound source — i.e., leave the "engines" on the ground, so to speak. The infrastructure in these circumstances could use rocket sleds, electric or electromagnetic sleds, electromagnetic rail guns, lazer/gas ionization, or even compressed gas/piston and tube contrivances, and who knows what else. For many mission scenarios a vehicle launched from a body like the Moon would need only small navigation/course correction engines.

In such a system, if it had a long track, the force of acceleration could be held fairly low, and without the launch engines aboard, the mass of the vehicle would be much less. With total mass lower to start with and for a vehicle made to experience only gentle accelerations, it is possible to come up with a vehicle made largely of steel which has only a small difference in the total-mass to payload-mass ratio as compared to similar vessels constructed of aluminum. Of course, in such a setting it may even be conceivable to construct vehicles of silicon, concrete, other artificial/semi-artificial rock materials, more or less pure iron, or some other on site appropriate material.

Back on Earth

But we are getting ahead of ourselves. Oh how easy things will be once we've escaped the surly bonds of Earth! ... Well, to start with, it is unlikely that it will actually be all that easy for humankind to survive (much less prosper) in space for quite some time after first setting up house there. And second, *we haven't escaped the surly bonds of Earth yet* (in any truly meaningful way relative to the permanent settlement of space).

So let's bring it all down to Earth again. First, we've got the start thinking "out of the box." It's not good enough to just turn halfway around, stare at a different side of the box, and call it a new box. We have to climb out of the box, look around, and decide, based on what we see, which box contains the best answers for our needs. The old box *might* have the best answer for any particular challenge we face, but until we honestly and uncompromisingly appraise our resources we won't actually know. Making major space transportation system vehicle components out of steel might be a rewarding avenue to pursue, or it may not produce any useful results at all, or it may only be a technique that is useful in a niche application. Or, since I have steel on my mind for the moment, what about steel fuel tanks? Maybe steel tanks would allow such compression of fuels that it would more than make up for the additional mass, or maybe it would only *almost* break even in dollars per *delta*V yet would significantly improve safety and/or reliability (which would actually improve the dollars per *delta*V ratio if an honest evaluation is made — one must remember costs of things like insurance). Who knows? And what about all of the other details relevant to our goals whether they have anything to do with vehicle components, steel vs. aluminum, or

even technology, or not?

There are many many *many* other details of areas relevant to our goals — things like: strategies for financing, infrastructure, commercial opportunity, technology, etc., which require a very thorough reevaluation. It behooves us all to take upon ourselves the spirit of the Moon Miners' Manifesto ... of deeply, seriously, and stubbornly questioning all of the assumptions and searching for the truth where ever it may be found. I suppose I may be preaching to the converted (or the reader may think I'm completely cracked), but there still seems to be plenty of room between where we are and anything that might be reasonably described as "too far."

Not many of us are rocket scientists or necessarily experts in sciences or technology, but as MMM and certain space organizations (most of which have a connection to MMM to varying degrees) have shown, enough questioning, brainstorming, and persistent positive activity and involvement can indeed change things for the better. Yes, there will be missteps, dead ends, and lost opportunities ... as there has been for us in the past. That is just the way life is.

But those who are content floating down the river will proceed to their destination only at the rate the river flows. If their destination happens to be upstream or overland they will never arrive. And if they aren't careful they can wind up out of the mouth of the river and lost at sea. Our destination is, at least, upstream. In other word, just floating — no matter how "spacey" the raft — is unlikely to present us with the optimal scenario. But it doesn't have to be that way. With our own individual efforts and working together constructively, we can dig out the false assumptions, find the truly valuable innovative solutions, and grasp the stars. Do what you can.

On "satellites" and "spacecraft"

I pose this question: Should the industry develop a vocabulary that differentiates between "satellites" and "spacecraft?"

I have seen the Hubble, the ISS, the DC-X, the shuttle, Pioneer and Voyagers and Stardust, and garden variety commercial satellites all called "spacecraft" at one time or another, but is that what the average person calls to mind when hearing that term?

Can anyone suggest some specialized vocabulary that would better distinguish between these various kinds of space travelers?

I don't think that the matter is so simple, especially with the inconsistent way the press reports things: Both Hubble and ISS, for example have been called spacecraft. On a gut level, neither is what I would intuitively call either a spacecraft OR a satellite, though arguably each is both. If Mir and ISS were flying together, what would you call their group -- satellites, spacecraft, or a only a third category -- space stations -- in which case what would be the definitional difference between that a shorter duration crewed spacecraft? In which category would you tput an Industrial Space Platform?

Also, is it clear when and how you would apply the term "spacecraft" to, e.g., the Cassini probe, first as an integral unit before payload separation and then as two separate portions after payload separation? Or three, after the payload further separates into two portions?

What portion(s) of Apollo were spacecraft, or when? Also, what is "Stardust," with a long looping return orbit?

I would think a standardized vocabulary used by all of government, industry, the media and ultimately the schools would be somewhat useful.

Jeffrey Liss <JGLJGL@aol.com>

Mars Aviation Task Force

Postscripts to last month's article
From Paul Swift (1) and Peter Kokh (2)

(1) **Paul Swift's 2000 Paper** "Aviationon Mars: Five Concepts for Airborn Access" is online at:
http://www.css.ca/marsaviation.htm

(2) **Severe Cold** is yet another challenge to be overcome in the realization of Crewed flight on Mars:. Recall that the recent rescue of a doctor with breast cancer from the South Pole Antarctic Station was problematic because of the danger of the airplane's fuel jelling in the tanks at the temperature of -60 °F. It gets regularly much colder than that on Mars.

How do we keep fuel from jelling?

How do we keep lubricants lubricating?

The first question may be easier. If we are using fuels derived from Mars' atmosphere, such as methane and oxygen, they will be pressurized gasses rather than liquids. There is no danger of it getting cold enough anywhere, anytime on Mars to liquify or freeze either of these gasses.

- methane liquifies below - 161.5 °C (-258.7 °F)
- oxygen liquifies below -183.0 °C (-297.4 °F)

Lubricants are another matter. They are usually semi-viscous liquids or jells and they will harden at very low temperatures. Silicone-based (not hydrocarbon-based) formulations are stable to lower as well as higher temperatures, but would still limit flying operations. This is a problem that must be solved for ground transportation as well.

Ultra-fine graphite powder? Heating the lubricants and bearings? Magnetic bearings? The latter may be ideal for Mars using high temperature superconductors. - **<PS/PK>**

WORLD WATCH
AFD News Service

BARANQUILLA, COLOMBIA Naval Yards. A. recommissioned surplus nuclear missile submarine carries a special payload. a strange looking rocket with no motor -- just a bell filled with some sort of ablative material, two small boosters built into its sides and a payload of outpost-making equipment destined for the Moon.

The sub, heading NNE, reaches dead center of the eye of Caribbean hurricane Bonnie at the moment moving slowly westward between Haiti and Venezuela and fires its bird. The engines stop firing at 60,000 feet and slide out from hinged faring doors, lightening the load. A generator on board builds an immense positive charge and enormous lightning bolts from all directions within the fast swirling clouds hugging the storm's eye strike the underside of the bell, over and over again, as the vehicle accelerates swiftly into space.

Project MoonEye is a success. Three tons of equipment are landed at an unknown lunar site on the farside at a cost of under $800 a pound. The reinvigorated Cali Cartel claims the Moon.

This unbelievable scene hasn't happened and may never happen. But a captured Colombian senior lieutenant of the Cali Cartel, in an effort to buy some bargaining rights with his captors, has produced documentation showing that this Sci-Fi plot-like plan is being seriously pursued. Indeed, the Cartel has already managed to buy and take delivery of a retired Russian missile launching sub and is in process of refurbishing it. Plans for the strange MoonEye missile are said to be "ready to come off the drawing board". An expatriate Russian laser physicist, Piotr Korashchov, known to the CIA and NSI, is alleged to be the brains behind the project. He had written a paper about harnessing the unimaginable electric potential of tropical hurricanes and typhoons. An abstract of this paper is online at:

http://www.nsu.ru/english/

(follow the links to Research > Dept. of Scientific Research > Physics > Korashchov)

But what would the drug kings want on the Moon? Our source claimed it is part of the biggest money laundering scheme ever hatched, a way to for the Cartel to get out of the cocaine traffic business and into an instant monopoly aimed at being in the drivers seat for either space solar power systems or helium-3 production and delivery. Most observers, some with evidently diminishing confidence, are claiming that the documents are manufactured, and the captive lieutenant is just trying to pull a fast one. But several unnamed authorities seem "nervous."

PANAMA CITY, PANAMA - First it was the cryonics gurus of the Scottsdale, AZ-based Alcor Life Extension Foundation (**www.alcor.org**) and others, who assured us that they could freeze us just before the moment of death, and bring us back once a cure for whatever ailed us is found, so that we could enjoy decades more life in the better, more exciting world of the future.

Now it is Starchildren, Inc. For a million dollars (more for frills, of course) they will clone anyone, safely freeze-store dozens of their viable embryos until "interstellar drives " are invented, guaranteeing that "your later day alter egos will have guaranteed priority consideration for interstellar flight slots as soon as or whenever these flights begin." Just how they would be able to deliver on that promise, granting that they might just succeed in the cloning effort, they do not say. Perhaps they plan to use the billions they hope to make to develop a warp drive of some sort themselves. First, no doubt, they intend to develop virtual reality warp simulators to help with the hard sell!

It is likely that they will have some takers. People will do anything if they think it is a way to cheat death if there is just a slight "believable" chance. Nor can anyone stop Starchildren, Inc. from trying. They are operating in the unrestricted enterprise zone of Panama City, Panama, beyond the jurisdiction of the U.S. or any other responsible power.

An intense and seductive advertising campaign is being test market abroad and is expected to be unwrapped for worldwide cable and satellite television audiences , hopefully by years end. The U.S.A. debut of the ad campaign is tentatively set for Super Bowl 2003.

Check out their website still under construction:

http://starchildren.com/

They are not publicizing a mailing address or phone number at this time. "It is premature." explains Starchildren founder Dr. Andraster Cronos. "We are not quite ready to deal with inquiries at this stage. We are more concerned with perfecting our methods and our business plan. All I can tell you is that we have letters of intent from some three dozen persons in half a dozen countries, none of which will I name."

HILO, HAWAII -- A small team of experienced "tubers" has been scouring the innards of the world's largest shield volcano (Mauna Loa / Mauna Kea) on the Big Island of Hawaii in search of the best lavatube site for a joint Moon/Mars simulation outpost. "Accessibility and supportability, which are related but not the same," says team leader John Underhill, "will probably be the tie-breaking consideration among three ideal sites we have identified to date." The group intends to continue exploring through the end of May.

The team's five members include two with tubing experience on the Big Island, and three who have considerable experience in the Bend, Oregon area. One former Oregon Moonbase associate who declined to be identified, explained that this project has great significance for the viability of settlements on both the Moon and Mars. "Lavatubes offer 'hidden valley' safe harbors on both these worlds where life could be better, and safer, than out on the exposed surface."

The team members include two affiliated with the Mars Society, two with the Moon Society, and one with both. They are proposing a separate organization, tentatively called, ET Hidden Valleys, Inc.., that would do contract research for both Societies. "The first outposts on the Moon and Mars will probably be surface ones," says Underhill. "We are looking beyond that."

MMM's 16th annual Happy April Fools Day News

TransOrbital's TrailBlazer Mission Plan from liftoff to final impact, the Time Capsule surviving intact

by Paul Blase <PBlase@aol.com>, TransOrbital
http://www.transorbital.net

At left is a side view of the TrailBlazer stack, as assembled for launch, showing the spacecraft (at top) with the TLI (TransLunar Injection) kick motor and the connecting interstage (below). The kick motor and interstage are jettisoned immediately following the TLI burn, which in turn occurs shortly following the ejection from the launch vehicle (LV).

Since TrailBlazer will not be the only payload, the LV will drop the spacecraft off in Low Earth Orbit (LEO), where it will spend a short time "waking up", checking the systems out, and waiting for the proper point to begin the journey to the Moon. During the Trans-Lunar cruise, which will last about 3 days, the spacecraft will return a variety of imagery showing the trip. On reaching the Moon, the spacecraft will fire its on-board motor and enter into a polar orbit. In this orbit it will take images of the lunar surface and other "targets of opportunity".

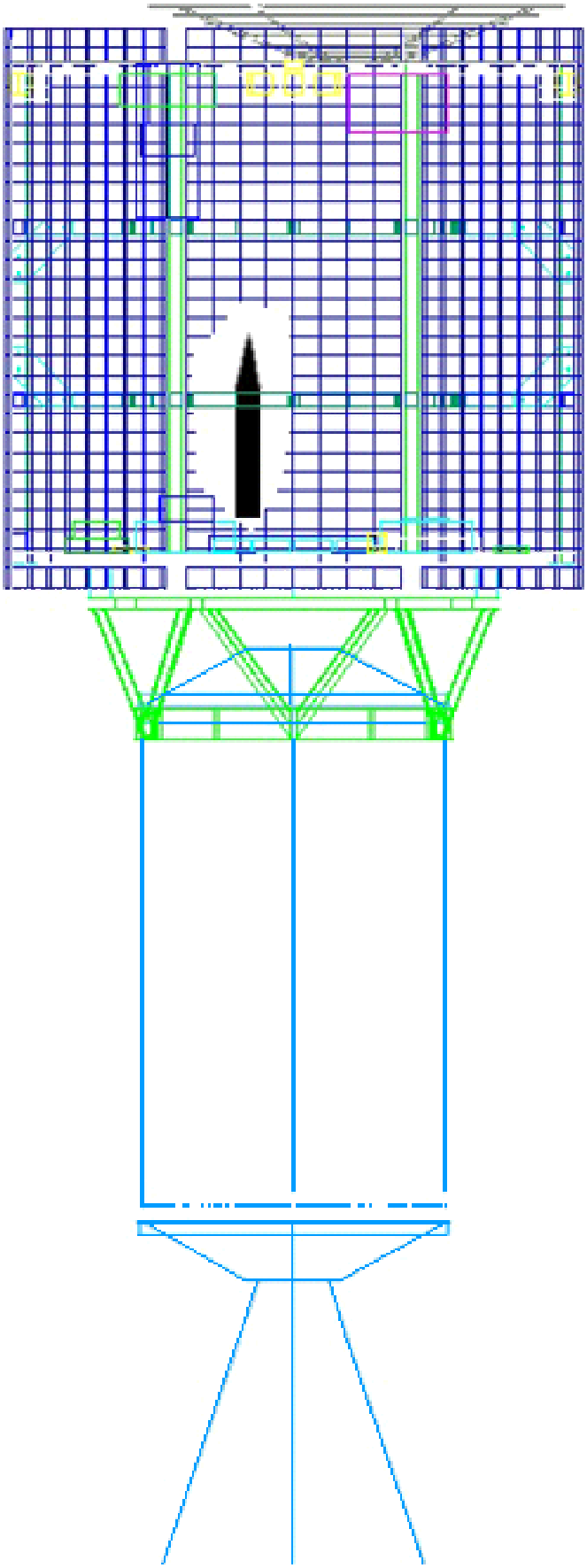
After an initial sweep at a higher altitude, primarily to gather a high-resolution lunar surface atlas, the spacecraft will lower its periselene (closest point of approach to the Moon). This will enable very-high resolution images of selected targets - including Apollo and Lunakhod hardware.

The problem, of course, is that at the end of this phase the spacecraft will not have sufficient fuel to raise its orbit again, much less leave lunar orbit entirely. Since the lunar gravity is very "bumpy", due to the "Mascons" (impact rebound upthrust dense mantle material below the center of mare basins plus the subsequent dense mare infill itself), low orbits are unstable causing spacecraft to crash eventually.

Since international treaty requires us to control the impact point, and so that we can determine the final resting point of the Time Capsule carried on board the spacecraft, we need to end the mission in a controlled impact. Currently, we are planning to bring the spacecraft down just inside of the limb of the Moon in the north-east quadrant of the Front Side, near to Mare Crisium - far away from any landing sites.

The spacecraft will, of course, be destroyed by the impact. However the Lunar Time Capsule and other inert cargo will be carried inside of a hardened kinetic penetrator - based on the penetrators used by NASA to hard-land instrumentation - within the spacecraft, as shown in the image. The penetrator will not be jettisoned, but will simply punch through the structure at impact. We anticipate that it will end up several meters into the lunar surface, but will survive the impact intact - hopefully to be found by future explorers in the future.

The hardened Time Capsule Penetrator is the missile-shaped object shown within the spacecraft below.



Five Mission to Mars Issues in Dispute

from Paul Swift <pswift@mtroyal.ab.ca>

A few comments on the TV show "Mission to Mars" (on TLC I think, mid February).

NASA's reference mission as outlined in the latest issue of Popular Science, and the Mission to Mars TV special, both suggested that a substantial amount of resources be sent ahead of the first manned expedition. These resources can in fact work semi-autonomously to prepare the return fuel supplies. They can also serve to extract water from the environment, create rocket fuel, etc., all of which I have no problem with.

The problem is the Spartan living conditions on board. The bones in their bodies will be substantially deteriorated by the time the crew returns to Mars if there is no artificial gravity. This means the vehicle must rotate en route in both directions to produce an effective gravitation.

Secondly, the NASA scientist said that crew dwelling area would be optimized for each person (read minimized). For a few days in a camper, we can operate that way. But out halfway to nowhere for this very lengthy voyage, being cooped up like sardines in a tin can, tempers will flare, proximity will be the enemy, cliques and animosities will form in the crew, and it will be ugly.

People need their space. Some figure like 128 cubic feet is what is supposed to be the minimum per person, but this is only a six foot square by less than four feet deep! So my number two issue with design of a Mars transfer vehicle is roominess.

Number three is water. Mir had a tiny shower area that the crew ultimately made into a storage closet. But I like a nice 10 minute shower every morning. They need a lot of water on board anyway. It serves as a nice mass for solar flare protection, is easy to heat, to filter, to recycle, to convert to H2 and O2 and vice versa, is good for cooking, drinking, washing, and more good stuff. But the picture in mind is that nice 10 minute shower.

Fourth is food. I've seen the projections for self-grown slime mixed with flash-frozen floof and how the taste and texture pros and the vitamin and mineral experts will chemically tailor some kind of mush for the crew to dine on. This is wrong-thinking of the most insidious kind, by ill-informed and cloistered nerds who have never lived for months and years in remote work camps or on nuclear subs.

Food may be fourth, and during mealtime and snacktime, when on a nine month voyage could be almost all the time, meal preparation and variety are absolutely vital to the mental health of a crew. Nothing quite so satisfied as a happy camper with a 12 oz. steak under their belt, ice cream with caramel sauce and a cherry for dessert, followed by a hot cup of coffee, freshly ground.

Next is compensation. These people should know that they will receive substantial rewards and benefits for making this trip. With the cooperation of governments and corporations and various institutions, the future well being of the astronauts and their families must be an iron-clad assurance.

These five points must underlie the foundations of vehicle design for the Mars mission. Anything less is Mickey Mouse, stupid, ignorant, short-sighted, and generally no good.

These opinions are mine alone, and seem to differ considerably from those of Robert Zubrin and Dan Goldin and almost everyone else. **<PS>**

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

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(* LRS Board Members)

LRS NEWS

- **Panel Discussion on Mars April 14:** Peter will Kokh will take part in a discussion at the new Kenosha Public Museum on the Lakefront
- **Aviation Career Day April 25-26:** Peter will have a table at Mitchell Field on "Aviation on Mars.
- **Rockets for Schools May 18th:** Peter will be giving a talk on Space Tourism at the Sheboygan Armory from 2-3 pm.

LRS APRIL / MAY Events

Saturday, APR 13th & MAY 11 1-4 pm

LRS Chapter Meeting, Mayfair Mall, Garden Suites **Room G11** (lower level, NE part of Mall) near the ground-level entrance below General Cinemas. AGENDA: Space News Updates, Outreach Plans.

CALIFORNIA

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

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Events Hotline/Answering Machine: (310) 364-2290
E-mail: nssofla@yahoo.com

http://chapters.nss.org/oasis

Officers: Pres. Steven Bartlett; VP Diane Rhodes: Treas. Karin Ward; Secr./Database Robert Gounley; Newsletter Ed. Kris Cerone: webmaster Craig Ward

☞ **Regular Meeting 3 pm 3rd Sat. each month**

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

APR 20th -- Business Meeting at location TBD *OASIS Hotline*, 310/364-2290

MAY 18th -- Business Meeting at location TBD

MAY JPL Open House Canceled -- Reference: - http://www.jpl.nasa.gov/pso/oh.html After a review of security and logistics required, it is not possible to hold this event in May.

- **Recurring Events**
  - **The Griffith Observatory** is undergoing renovations and upgrades to reopen in 2003.
  - **The Griffith Observatory** is temporarily closed to the public forrenovations and upgrades. It should reopen in 2005. More information: http://www.GriffithObs.org/renovation.html
  - **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

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: **APR 25, MAY 23**

MINNESOTA

Minnesota Space Frontier Society

c/o Dave Buth, 5120 Ewing Avenue North, Brooklyn Center, MN 55429
612-721-4772 (Dave Buth) 612-375-1539 (Jeff Root)
Email: mnsfs@freemars.org

www.FreeMars.org/l5/index.html

Marscon 2002 FanFaire and Sci Rm Pics
http://www.freemars.org/mnfan/marscon/2002/fan-faire-sci-rm/

MN SFS displays for shuttle flight STS-110/8A
Display Info is based on the current STS press kit at: http://www.shuttlepresskit.com/index.html
We've been doing this for every flight since STS-26.
Locations: Radio City, 2663 County Rd I, Moundsview, http://www.radioinc.com/ 763-786-4475
Or Minneapolis Planetarium, 300 Nicollet Mall, 612-630-6155 http://www.mplanetarium.org/
ISS & STS-110 are visible from MN in evening skies. Listen to LIVE shuttle audio on 145.150 MHz

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: **APR 20, MAY 18**

• Five papers presented by researchers of Oregon L5 Society to the 2002 Space and Robotics Conference (American Society of Civil Engineers) are now available online at:

http://www.OregonL5.org/l5sr2002.html

- Gecko-Tech in Planetary Exploration & Base Operations
- Lavatube Entrance Amelioration on the Moon & Mars
- Illumination for Lunar Base Construction & Operations
- Secondary Profit Generators for Moon & Mars Bases
- Lunar "West Pole" Prime Meridian

Bryce Walden, Lunar Base Research Team

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 (*except 2nd Saturday this March*), at the **Liberty One** food court on the second level, 16th and S. Market. Go toward the windows on the 17th street side and go *left*. Look for table sign. Parking at Liberty One on 17th St.

NEXT MEETINGS: **APR 20th**, **May 18th**, **June 15th**

• **Scheduled PASA activities:** Regular monthly meetings on Saturdays April 20th, May 18th, and June 15th. Special event Saturday, May 4th (see below). Call Earl Bennett or Mitch Gordon, 215-625-0670, to verify all meetings. In July, members are to appear as speakers at the World Future Society Annual Convention -- details later.

by PASA Secretary Jay Haines <hainesjb@netaxs.com>

• **March 9th Meeting Report:** Earl Bennett reported on our judging efforts at this year's George Washington Carver Science Fair. Michelle Baker and Mike Fisher judged at the elementary division, our first time at this division, held at the Academy of Natural Science 3/5.

Earl Bennett awarded the "James H Chestek Award for Achievement in the Area of Space-Related Science and Technology" to fifth grade student Linda Malinowski for her project "Does the shape of the magnet affect its areas of strength?" Her award consisted of a kite, and an Intel/Mattel QX3 microscope.

Gary Fisher and Mike Fisher (no relation) judged the middle and high school division on 3/12 at Temple University. Earl awarded the "Oscar H Harris Award for Space Science and Education" to Rayhan Blankinship for her project "Which plants are the most effective at removing CO2 from the air?" Her award consisted of a $50 money order, and an Intel/Mattel QX3 microscope. Earl also discussed PASA and Mars Society plans to exhibit at the NJ State Museum (Trenton) on 5/4-5. The NASA International Space Station exhibit, consisting of a two-trailer walk-through traveling exhibit, will be at the museum the week of 4/29 through the weekend of 5/5. Call Earl if you want to help at the exhibit table.

Dottie Kurtz discussed her trip to the Air & Space Museum in Washington DC, which now includes a 1/10-billionth scale model of the Solar System. Hank Smith discussed recent and upcoming Science Fiction conventions, including Philcon 2002 to be held 12/13-15.

Mitch Gordon discussed the 4/8 appearance of John Glenn at the Kimmel Center for a performance of Peter Nero's Voyage into Space (www.phillypops.com). Mitch also discussed applying for a Philadelphia Mural Arts Program space-oriented mural for a local building. Deadline for the application is 11/15, so think of a Philadelphia building on which you'd like to see a mural.

Earl Bennett also discussed the 4/02 "Galactic Society" article in *Analog* by Robert Zubrin, a condensed version of his 1999 book *Entering Space - creating a space faring civilization;* and the 4/26-28 SETI League conference to be held near Trenton NJ (www.setileague.org)

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**

APR 16th MEETING at the Stoelting House in **Kiel**
MAY 21st UW-Sheboygan, **Sheboygan**

Apollo 13 Blockbuster to be re-released in IMAX format this summer

LOS ANGELES, March 21 (Reuters) - Big movies got bigger on Thursday when Imax Corp. unveiled plans to convert 1995 blockbuster "Apollo 13" for its giant screens this summer, marking a first for mainstream, live-action Hollywood movies....

This is sure to present great outreach opportunities national Space Society and Moon Society chapters in urban areas with IMAX theaters.

Chapters should start planning now to take advantage of this special occasion, brainstorming their displays and handout literature especially designed for the occasion. Chapters in cities without IMAX could put together charter bus trips.**</MMM>**

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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

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○ $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 $16, due in March or $4 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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