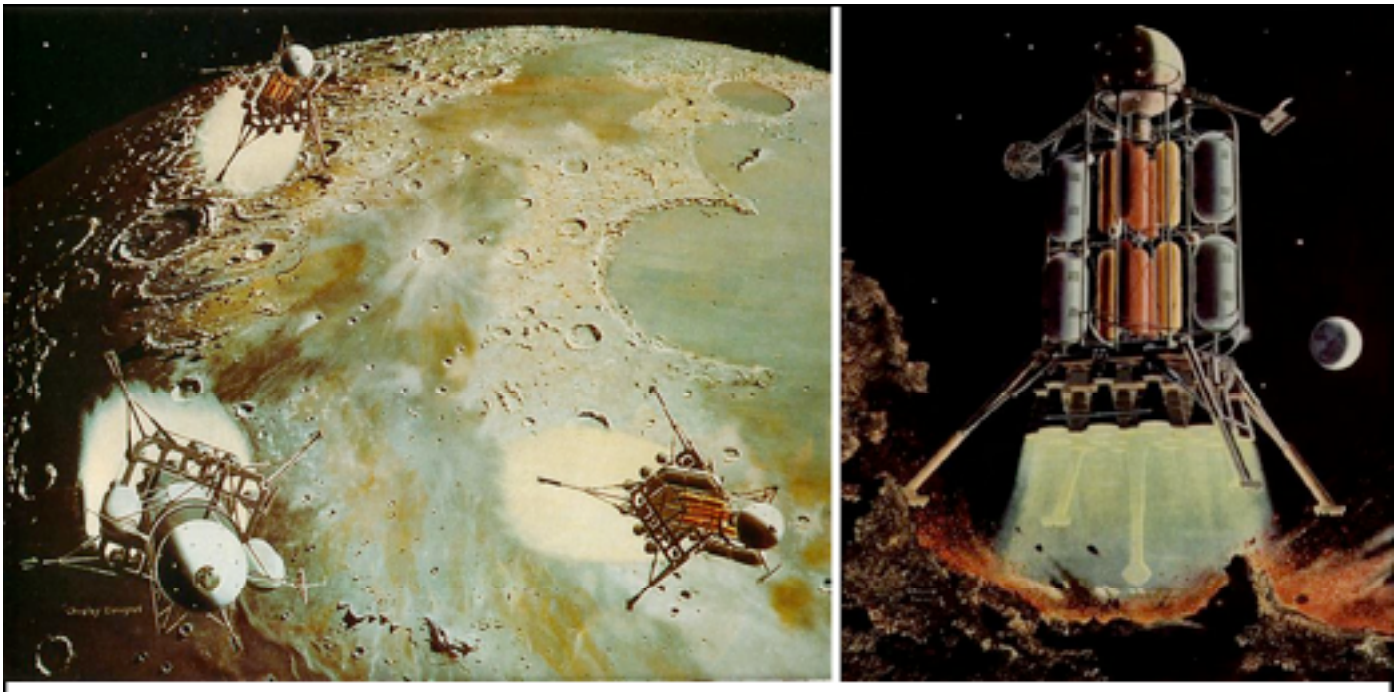
"Towards an Earth-Moon Economy - Developing Off-Planet Resources"

Moon Miners' Manifesto

& The Moon Society Journal

www.MoonMinersManifesto.com

#231 | Starting our 24th year! | DECEMBER 2009



Back to the core inspiration: the art of Chesley Bonestal: Above: Landing on Sinus Roris Middle plain is Mare Frigoris; at right Sinus Iridium, Plato above, Mare Imbrium far right.

Feature Articles in This Issue

Defining The Lunar Industrial "Seed" (Conclusion)
Dave Dietzler pp. 3-5

A Basalt Fiber Industry - MMM Special Report p. 5

Luna City Yellow Pages: Help Wanted Ads page 6

Lunar Analog Sites without moonlike terrain
Peter Kokh page 7

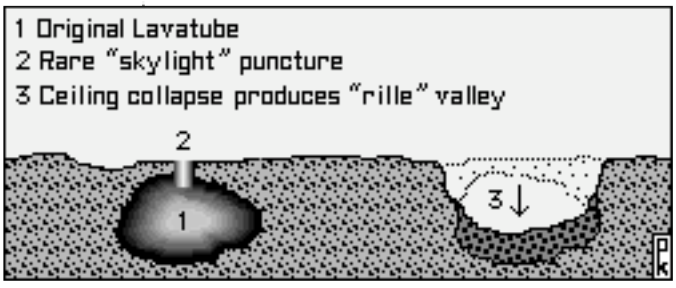
Augustine Commission Results in a Nutshell
John K. Strickland page 8

First Lavatube "Skylight" Discovered ➔

Ever since Apollo 15's visit to Hadley Rille, the Moon'a numerous winding valleys, dubbed "rilles", have been interpreted as collapsed lavatubes of surprising size. For Lunar advocates, the Moon's "Hidden Valleys" promise thousands of linear miles of readymade shelter for settlements, industrial parks, warehousing, and more. But most people continue to see the Moon as no more than a dusty "rubble pile." With Kaguya's recent discovery, that perception will hopefully change. See page 15.

IN FOCUS ◎ Zubrin: "Earth is to Moon and Mars *as* Europe is to Greenland and North America"

So says Mars Society founder Robert Zubrin in a recent release. Let's get real! ***Earth is to Moon and Mars as Europe is to Iceland and Antarctica.*** This comparison is truer both in distance and logistics costs, and in terms of economic viability. North America is every bit as fertile and livable as Europe. That certainly is not the case of Mars in comparison with Earth. [=> p. 2, col. 2]



Moon Miners' Manifesto

Published monthly except January and July., by the **Lunar Reclamation Society** (NSS-Milwaukee) for its members, members of participating **National Space Society chapters**, members of **The Moon Society**, and individuals worldwide.

© 2009, The Lunar Reclamation Society, Inc.

• **Moon Miners' Manifesto CLASSICS:** The non-time-sensitive articles and editorials of MMM's first twenty years have been re-edited, reillustrated, and republished in 20 PDF format volumes, for free downloading from either of two locations:
www.Lunar-Reclamation.org/mmm_classics/
www.MoonSociety.org/publications/mmm_classics/

• **MMM's VISION:** "expanding the human economy through off-planet resources"; the early era of heavy reliance on Lunar materials; early use of Mars system and asteroidal resources; and establishment of permanent settlements supporting this economy.
• **MMM's MISSION:** to encourage "spin-up" entrepreneurial development of the novel technologies needed and promote the economic-environmental rationale of space and lunar settlement.
• **MMM retains its editorial independence.** MMM serves several groups, each with its own philosophy, agenda, and programs. Participation in this newsletter, while it suggests overall satisfaction with themes and treatment, requires no other litmus test.
[Opinions expressed herein, including editorials, are those of individual writers and not presented as positions or policies of the **National Space Society**, **Lunar Reclamation Society**, or **The Moon Society**. **Copyrights** remain with the individual writers. Reproduction rights, with credit, are granted to NSS & Moon Society chapter newsletters.]
• **For additional space news** and near-term developments, read ***Ad Astra,*** the magazine of the **National Space Society**, in which we recommend and encourage membership
• **The Lunar Reclamation Society** is an independently incorporated nonprofit membership organization engaged in public outreach, freely associated with the National Space Society, insofar as LRS goals include those in NSS vision statement. LRS serves as NSS' Milwaukee chapter: www.Lunar-Reclamation.org
• **The National Space Society** is a grassroots pro-space membership organization, with 10,000 members and 50 chapters, dedicated to the creation of a spacefaring civilization.
National Space Society, 1155 15th Street NW, Suite 500, Washington, DC 20005; Ph: (202) 429-1600 - www.NSS.org
• **The Moon Society** seeks to overcome the business, financial, and technological challenges to the establishment of a permanent, self-sustaining human presence on the Moon." - Contact info p. 9.
• **NSS chapter**s and **Other Societies** with a compatible focus are welcome to join the MMM family. For special chapter/group rates, write the Editor, or call (414)-342-0705.
• **Publication Deadline:** Final draft is prepared ASAP after the 20th of each month. Articles needing to be keyed in or edited are due on the 15th, *Sooner is better!* - ***No compensation is paid.***

• **Submissions by email** to KokhMMM@aol.com - Email message body text or MS Word, Appleworks, pdf attachments
√ Mac compatible CD / or typed hard copy must be mailed to:
Moon Miners' Manifesto, c/o Peter Kokh,
1630 N. 32nd Street, Milwaukee WI 53208-2040
• **MMM is mailed 2nd Class:** *Second Class bulk mail is not forwarded.* If you move and rely on forwarding instructions at your former local Post Office, you will not receive your copy. It is the reader's responsibility to inform LRS or whatever other organization through which the reader receives MMM as a membership benefit, of any change in the reader's mailing address.

⇒ In Focus Editorial continued from p. 1.

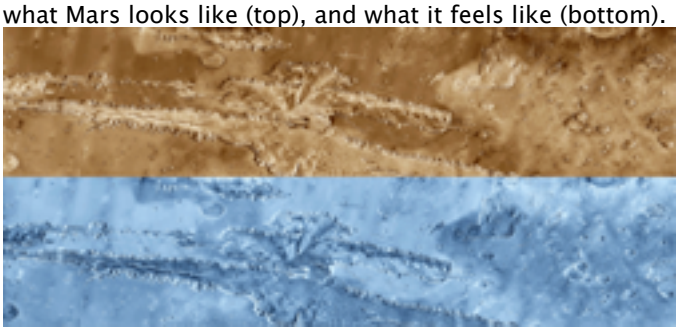
We agree 100% that Mars is destined to be the second most populous human world. But that will take some time. Meanwhile, there is an economic case for opening the Moon: first, lunar tourism, while expensive at first, is eminently doable. But who, no matter how rich, is going to spend three years of his/her life, a year of more just in transit to and from Mars, and then a year plus on Mars before being able to come back home?

More to the point, there is a real and significant market for lunar products: Anything that can be made on the Moon can be delivered to Low Earth Orbit and to Geosynchronous Earth Obit (LEO & GEO) at a significant transportation cost advantage over competitive products made on Earth and shipped up the steep gravity well; That means building products with which to make space stations, orbital industrial parks, and orbital tourist complexes – all in LEO, as well as giant satellite-hosting platforms in GEO (where there are only 180 available slots 2° apart), energy relay stations and solar power satellites. All of these things will be needed to further build out our terrestrial economy without further damage to the environment.

What is the economic case for Mars? Zubrin had reached into tenuous fantasy to come up with "pharmaceuticals made from soils on Mars that can't be made on Earth. We have been after him for two decades to work on *the Economic Case for Mars.* So far there has been only one realistic suggestion, and it is ours, and something RZ opposes or ignores: mining Phobos and Deimos for volatiles (should the postponed Phobos-Grunt probe confirm that one or both are of carbonaceous chondrite composition) and then shipping them in the form of liquid ammonia (NH3) and liquid methane (CH4) to volatile-thirsty markets on the Moon.

It does not matter that Mars has a much more complete set of resources on which to base a self-sufficient second human world. What matters is that no one, no set of companies, no set of governments, is going to pour that kind of investment into Mars, *with no hope of return, no hope of Martian exports to defray the cost of a world-making flood of capital goods imports!*

A point needs to be made. No how much wetter and warmer Mars once was in its past, it is now stuck in the same thermal range as Antarctica, a place with fresh breathable air, and surrounding sees full of seafood. Yet no one is beating down the gates of the Antarctic Treaty to earn the right to settle even the friendlier fringes of the western coast of the Antarctic Peninsula. The terrain may be similar, but the temperatures are not. Below: what Mars looks like (top), and what it feels like (bottom).



http://www.moonsociety.org/images/vallesmarineris.gif

Once this fact is driven home, the pool of willing Mars settlers will dry up, …. except for one source: hardy Lunans who will see Mars as a "walk in the park." **PK**

Defining the Lunar Industrial Seed:

By Dave Dietzler pioneer137@yahoo.com

Part 3B: Manufacturing

The "cle" part of the Industrial Development MUS/cle Strategy*

http://www.lunar-reclamation.org/papers/muscle_paper.htm

Complex, **l**ightweight and **e**lectronic (or expensive) small to medium sized items will be upported in the early stages and mass produced when the base grows and the masses of parts demanded exceeds the mass of the machines and manpower needed to produce them. Manpower involves not just the mass of the worker, but also the mass of the habitat and life support needed to support the worker. These items will include computers and telephones for a long time because it costs billions of dollars to build a chip factory, but there might be a miracle like nanofabrication with low mass nanoassemblers that changes this picture. Parts that will be Moon made after the MUS manufacturing stage is in full swing include hinges, nuts and bolts, pumps, switches robot parts and much more.

3D Additive Manufacturing

This method of automated manufacturing includes stereolithography, selective laser sintering and direct metal laser sintering. These machines build up material layer by layer. Guided by CAD data in computers they can make almost any small to medium sized part and not just simple ones but very complex detailed parts too. Accuracy is within thousandths of a millimeter, so precision parts can be made. Parts can be made of plastic, metal, glass or ceramic.

Stereolithography makes plastic parts up to 20" by 20" by 24." These parts could then be pressed into plaster to make molds for aluminum and magnesium casting; or they could be used to make impressions in sand molds for casting metals with higher melting points like iron or titanium. They biggest drawback to stereolithography is the cost of the photo-curable resin that costs $300 to $800 per gallon [1]. On the Moon, some way of recycling the resin would be needed so that we could make plastic parts for molds, convert the plastic back to photo-curable resin and make more molds.

Direct metal laser sintering can make parts from powdered metals. Parts can be made within dimensions of 250 x 250 x 215mm (9.84" x 9.84" x 8.46") [2]. The machine can run on its own 24 hours a day and make many parts faster than by conventional casting and machining. It is also possible to sinter metals with a device that uses an electron beam instead of a laser. This must be done in a vacuum and the Moon offers free vacuum. Since radiation can be emitted by e-beam sintering, piles of regolith for shielding will surround such machines during operation.

What kinds of parts will we make with Direct Laser (or E-Beam) Metal Sintering? I see casings and rotors for centrifugal pumps and pistons, rods, cylinders and crankshafts for reciprocating pumps. We will need pumps to move liquid gases, water and sewage. Electric motor armatures, bearing races and roller bearings, refrigerator compressor parts and high pressure gas compressor parts, perhaps parts for power tools also could be made. In the early years these could be upported. In time we will need very large numbers of these things. Everyone will want a small refrigerator in their cabin and some people with multi-room apartments will want full sized refrigerators. We will need lots of power tools and the plumbing systems will use lots of pumps. Compressors will be needed to drive oxygen gas through space radiators and pumps will be needed to move LOX into and out of storage tanks. Compressors will also be needed to drive hydrogen into hydrides or carbon nanotubes and to fill oxygen gas tanks in spacesuit life support backpacks.

While 3D sintering looks like the key to almost magical "Santa Claus machines" it might also prove that casting steel, aluminum, titanium, iron and magnesium parts is cheaper and quicker than using 3D sintering exclusively. Laser machining devices guided by computers would make the final cuts on the cast parts and drill holes in them. Robot arms and human workers would then assemble the parts.

Chemical Vapor Deposition

All sorts of items can be made by depositing carbonyl iron vapors on mandrels, heated to a few hundred degrees Celsius. The carbonyls would be formed by reacting iron fines with hot high pressure carbon monoxide gas made from Moon mined carbon and lunar oxygen. The work would be done in inert gas filled inflatable chambers so that when the carbonyls decompose and leave a steel coating on the hot mandrels the CO or CO2 that is released, can be captured by air scrubbers to recycle the precious carbon. Galactic Mining Industries Inc. has done lots of work on this technology. See: http://www.space-mining.com

The process of depositing carbonyl vapors on mandrels to make things is called chemical vapor deposition or CVD. Usually, this process is good for making objects that are only about 1/16 to 1/8 of an inch thick. A tank this thick could hold water, but not high pressure gases. High-pressure tanks, valves and piping will have to be made with more conventional processes. __Iron fines that are 5% nickel and 0.2% cobalt when subjected to hot high pressure CO gas form carbonyls that can be vaporized and distilled to separate them at moderate temperatures. Nickel can be used as a catalyst and to strengthen iron and steel. Cobalt can be used for tough cobalt steel drill bits and we might be doing some extreme drilling jobs on the Moon. It can also be used to stain glass. Just ten pounds of cobalt can stain a ton of glass deep blue. This would add color to the drab Moon where psychological survival is as important as physical survival.

Spinning Metals

Steel, iron, aluminum, almost any ductile metal, can be spun. A metal disk is placed on a rotating lathe and formed against a mandrel into a lamp vase, bell, pot, pan, wok, musical drum, even CO2 cartridges and high pressure gas tanks. HP gas tanks will be needed for spacesuits, life support systems, and welding gas tanks. CO2 cartridges might be used for dart guns used by security guards to subdue troublesome characters.. A metal spinning lathe and upported or Moon made mandrels will be useful on the Moon. See:

http://en.wikipedia.org/wiki/Metal_spinning and http://www.terrytynan.com/metalspinning.html

Blacksmithing

This ancient art might find use on the Moon. Lunan blacksmiths with electric forges and power hammers could make all sorts of things including tools, hinges, pins, bolts and ornate metal work from iron and steel. We won't be able to do much without steel tools and ornate iron work will help with psychological survival. Iron could also be used for nuts and bolts and just about everything else today made of mild steel on Earth. Lunar iron will be rather pure like wrought iron and have similar properties (about 40,000 psi tensile) as opposed to cast iron that has more carbon in it than steel. Cast iron has about 3.5% carbon and steel is about 0.2% to 1.5% carbon. Iron from molten silicate electrolysis should be rather pure while iron from meteoric fines will contain some nickel and cobalt that makes it stronger.

Nuts and Bolts

Eventually we will need tons and tons of nuts and bolts for all the machines and vehicles that we assemble on the Moon. Bolts can be made by rolling extruded rods between steel dies. They can be made of aluminum, iron, titanium and rarely steel. While titanium bolts will be almost as strong as steel bolts, iron bolts will not be that strong but they can be made thicker and heavier. This shouldn't be a problem in lower lunar gravity.

Electrical Parts

These will be upported in the early years, but the time will come when we need large numbers of them therefore large masses that will be costly to upport. Electric furnaces will require cables, switches, possibly microwave generators, electrodes and other parts. Cables and wires can be made by extrusion. Switches and other electrical parts might use cast basalt or glass insulating parts produced by casting or 3D sintering. Aluminum will be desirable for conducting components of electrical parts like switches as well as wiring. Titanium might be used for conducting components in some electrical parts too. Although it is not nearly as good a conductor as aluminum it has a much higher melting point and short thick sections of Ti in switches for instance won't offer a lot of resistance.

Glass Working

Silica is glass in its simplest formulation. Sodium and potassium can be added to lower its melting point and make it easier to work with. It could be used to make glass fiber reinforced glass composites, also known as glass-glass composites or GLAX. This material has a low coefficient of thermal expansion and has high tensile strength. Fibers could be made by extrusion. These fibers could also be used for fiber optic telecommunication cables on the Moon. Translucent GLAX could be used to make hangars for mining and other machines during the intense heat of day. Glass will also have mundane uses like windows, tableware, bottles, and laboratory ware. Glass fibers could even be woven into fabrics. We also need jars and bottles. A bottle blowing machine will be called for eventually.

Glass has other more exotic uses. Tubes filled with CO2 and rods doped with neodyminum from KREEP could be used for lasers. Quartz is basically pure silica and it can be used for high temperature windows in solar furnaces. Glass extraction and mining equipment as well as glass working equipment should be part of the lunar industrial seed.

Sand Mold Casting

Plastic forms could be used to make sand molds for casting iron, if we can make a decent sand mold with regolith. Regolith is like a very fine sand, but it is not like clay used to make sand molds. We must experiment with sieved and sized wetted regolith to see if it can be used to make sand molds. We must also look at the use of sodium silicate, an inorganic adhesive that can be made on the Moon from SiO2 and Na2O that is also used as a sand mold binder. Also, we must consider sintered regolith molds.

Robots and Electric Motors

Beyond materials and various items discussed above, we will need to make more mining and manufacturing robots. This will be very complex. Small titanium parts for robots could be made by 3D sintering. Massive, unitary, and simple parts could be made by casting and laser machining. Complex, lightweight and electronic parts for robots could be upported from Earth.

Robots must be capable of welding as well as assembly. Most welding will be done by simple electric arc welding with steel rod electrodes that won't need shielding in the vacuum. High voltage DC power sources will be needed, so DC from solar panels might be inverted to AC, stepped up in transformers and rectified back to DC with upported solid state devices.

Electric motors will be needed in large numbers and in a variety of sizes to drive pumps and compressors, and to provide motion for robots and vehicles. Titanium, iron and steel parts and aluminum wires will be the primary components of electric motors. This will not be simple and the equipment sent to the Moon to make electric motors will be essential for industrial seed growth. Motor winding machines will be part of this. Power hammers to knock out motor housings from plates of iron or steel will probably be needed too. Small motor parts might be made of 3D sintered titanium. Some silicone or vacuum grease might be upported to lubricate the motors' bearings.

Works Cited Part 3B

1] http://en.wikipedia.org/wiki/Stereolithography
2]http://www.morristech.com/dmls.asw

Part 4: Conclusion

At this point, we can list these things to be produced on the Moon:

Heavy furnaces of bricks and slabs, rolling mills, LOX, iron, steel, storage tanks, piping, pumps, radiators, solar panels and their components of silicon, aluminum, phosphorus and glass, wires, cables, electrical parts like switches, bricks, slabs, roads of bricks and slabs, sulfuric acid, leaching vats, plaster, titanium, molds, cement, water, electric motors, robot parts and robots, vehicles.

The equipment needed to do this includes (some made at least partially on the Moon, some upported):

Molten silicate electrolysis devices, solar panels, wiring/cabling, electrical parts (switches, transformers, solid state invertors and rectifiers), an aluminum rolling mill, extruders (for metal bars, rods, cables and wires and glass fibers); glass working equipment, electric arc welding devices, carbonyl vapor deposition systems, inflatable work chambers, furnaces for making cement,

sulfuric acid making systems, electrostatic separators, metal extraction equipment for silicon, Al, Fe, Ti, Mg, furnaces for carburizing iron to steel, brick and slab making systems, electric motor making systems, grinders, 3D sintering systems, laser machining and drilling devices, and robots for mining, assembly and welding.** Also some carbon and hydrogen for metals and water; chloride salts for metal extraction and argon to fill the casting chambers.

That's a start. I have no idea what the mass of this will be. That will depend on how small engineers think the seed can be and how fast and how large it can grow. There are sure to be many things I have not thought of or chosen not to discuss in this article for the sake of brevity.

As the number or mining and manufacturing robots grows, along with oxygen, metal and solar panel production, larger and larger machines will be built to make larger and larger parts for things like human habitat modules, pressurized vehicle cabins, and mass drivers. Also, larger and larger mining robots will be built to mine vast amounts of regolith to supply the solar power satellite builders. The process will probably be slow at first and mistakes will be made and corrected. Fortunately the Moon is only three days away, unlike distant Mars, and it won't take a long time to correct mistakes by rocketing up some extra equipment. There will probably be humans supervising the robots and doing fine tasks by hand that are beyond the abilities of the robots. Humans on the Moon could fix mistakes shortly after they occur. Progress will then accelerate after the learning phase as the lunar industrial seed grows exponentially.

Timeline - I believe that within months of setting up the initial manned and robotic base, production of cement, oxygen and some metals could begin. Aluminum might be produced early not just for solar panels but also for rocket fuel. Powdered aluminum mixed with LOX can make a monopropellant about as powerful as a solid rocket. Magnesium does not require upported chemicals to produce as does aluminum, but it is shock sensitive and will detonate if it's tried for a monopropellant. See: www.space-rockets.com Perhaps a mixture of Mg and LOX can be used as an explosive. Within a few years it should be possible to produce all the major metals in regolith and some minor ones: chromium, manganese.

Within just a few years time it should be possible to make all the low-tech items listed above and many of the more complex items. In ten to fifteen years of rapid growth, the base will have grown into a true lunar settlement with numerous outposts and railways in action. Mass drivers should be working at this time and materials for solar power satellites, space stations, ships to Mars, asteroid deflectors, robotic asteroid mining ships, and whatever else will be available in space at a tiny fraction of the cost that would be paid to launch them up from Earth. ** Mining robots will consist of robots with onboard furnaces for roasting out solar wind implanted volatiles-hydrogen, carbon, nitrogen and helium. There will also be robots with magnetic separators for extracting iron fines of meteoric origin that compose 0.15% to 0.5% of the regolith. Other robots will simply excavate regolith that has been gone over for volatiles and iron fines and load it in devices that extract oxygen, silicon and metals. **DD**

A Basalt Fibers Industry

New Basalt Fiber Industry Launched in India

MMM Special Report

http://www.fibre2fashion.com/industry-article/3/256/new-reinforced-material1.asp

Now there is a new reinforcing material for textile composites: basalt fiber

From the website above:

By: Hireni Mankodi - Sr.Lecturer, Principle Investigator of Career Award for Young Teacher (AICTE Research Grant): Textile Engineering Department, Faculty of Technology and Engineering, M .S. University, Kalabhavan, Baroda: 390001, Gujarat, INDIA. email: hir_mak@yahoo.com

Introduction

Basalt fiber or is a material made from extremely fine fibers of basalt, which is composed of the minerals plagioclase, pyroxene, and olivine. It is similar to carbon fibre and fiberglass, having better physico-mechanical properties than fiberglass, but being significantly cheaper than carbon fiber, It is used as a fireproof textile in the aerospace and automotive industries and as a composite to produce products such as tripods.

Basalt fibers are used in a wide range of application areas such as the chemical, construction and marine sectors, not to mention the offshore, wind power, transport and aerospace industries. This is due to their superior properties: not only do they boast good mechanical and chemical resistance, but also excellent thermal, electric and acoustic insulation properties.

Characteristics of Basalt Fiber

The raw material for basalt fibers is a naturally occurring mineral that belongs to the family of volcanic rocks. As a mineral, basalt ranges from dark gray to black. Basalt fibers are mineral fibers, which are 100% inorganic. Fiber compatibility with matrix resins can be ensured by using organic sizing agents. Basalt is well known in rock form and is found in almost every country around the world. It is traditionally used as crushed rock in construction and road building.

The fiber is 100% mineral continuous filaments. The focus is on the range of 9-13 microns for filament diameters. These diameters give the best compromise between tenacity, suppleness and cost. They are also safely larger than the 5 micron limit for non-respirability. As the fiber presents no hazard to health and environment, it is very suitable for asbestos replacement. The natural golden-brown appearance of the fabrics, can be covered for decorative purposes.

Main features of basalt fiber reinforcements

- High strength ● High modulus ● Easy to handle
- Corrosion resistance ● High temperature resistance
- Extended operating temperature range

Basalt fiber and Preformes for Composite

Luna City Yellow Pages

Help Wanted

The Lunar Infrastructure Development Corporation is seeking researchers for these and related positions described below for employment at the International Lunar Research Park Must be willing to relocate to the Moon for a period of at least one year barring serious illness or injury.

CONTACT INFORMATION:

Lunar Infrastructure Development Corp.
Human Resources Department Office
PO Box 6666, St. Louis, MO 63101, USA
attn: David Dietzler, Recruitment Officer
US code +314.562.6666 work.moon@lidc.com

BIOLOGISTS AND ECOLOGISTS

Responsibilities include R&D related to CELSS and food production on the Moon. Background in permaculture and organic farming desired.

CIVIL ENGINEERS

Surveying, site improvement. Design, construction and maintenance of the physical natural Lunar environment, including works such as roads, bridges, tunnels, retaining walls, and buildings

CONSTRUCTION WORKERS

Experience in extreme environments such as the Antarctica, offshore drilling, Athabasca Tar Sands, Deep Mining, etc., will be an asset.

ENGINEERING TECHNICIANS

Electrical, electronic, mechanical, manufacturing, chemical, bio-tech, computer and robotics technicians to test, operate, perform routine maintenance, repair, assist in research labs and shops, and do light assembly and manufacturing are needed for groundside and lunar positions.

EXTRACTIVE METALLURGISTS

Responsibilities include R&D related to development of cost effective methods of producing oxygen, metals and other materials on the Moon. Development of chemical processes in addition to production of equipment for such using lunar on-site materials is emphasized. Metallurgists will also develop alloys using only lunar materials including rare earth elements and thorium.

COUPONS for Luna City Pizzeria on Page 3

MACHINISTS & FABRICATORS

Experience in making and/or modifying metal parts. Steel, gas metal, and gas tank arc-welding. Stereolithography and electron beam free-form fabrication (sbf3) experience desirable.

MANUFACTURING HARDWARE AND SOFTWARE ENGINEERS

Numerous openings for the dedicated individual willing to work on teams to develop the multitude of products needed on the Moon for survival and industrial expansion using only on-site materials with the latest 3D printing and computerized manufacturing equipment and robots. Knowledge of traditional manufacturing processes required.

ORGANIC CHEMISTS & CHEMICAL ENGINEERS

Responsibilities include R&D related to production of cost effective methods for synthesizing silicones and other synthetic materials from on-site lunar materials and development of equipment for the same using lunar materials. Lubrication engineering also to be researched.

PRESSURE ENGINEERS

Experience with boilers and other pressure vessels is helpful. Experience helpful in areas of design, manufacture and/or construction and maintenance of pressure seals of airlocks, habitat and other modules designed to hold breathable air pressure against an exterior vacuum

ROBOT TELEOPERATORS

Groundside and lunar positions available for experienced robot teleoperators with at least two years experience operating submarine and underground mining robots.

SKILLED TRADESMEN

Machinists, tool and die makers, welders, plumbers, pipe fitters and electricians willing to work in spacesuits as well as "shirt sleeve" environments on the Moon. We will provide free spacesuit training and hazardous duty pay for work in vacuum.

On the Moon, as on the Earth,
You can rely on your friendly
Yellow Pages
For the assistance you need!

Lunar Analog Stations
Without "Moonlike" Terrain

By Peter Kokh

Not every organization that would like to start its own lunar analog research station program, is going to be able to find an ideal "vegetation-free picturesque desert" location, especially one located to minimize the logistics costs of frequent visits and support. In such a case, what are the options?

Situation I: You want to build a lunar analog station but do not have any "logistically convenient" "moonlike" terrain nearby.

Situation 2: You want to do analog research on activities at a Moonbase that would we confined to the outpost complex interiors.

The two situations, of course, are match-mates made in heaven. One suggests the other. In this article we would like to suggest some options.

SITUATION 1: you definitely would like to do "outdoor" type activities such as experimenting with bulldozer and rover designs, teleoperations experiments, etc.

Look for an abandoned quarry: *there are many!* The vegetated surroundings may well be out-of-sight from the quarry floor, and the floor may be vegetation free.

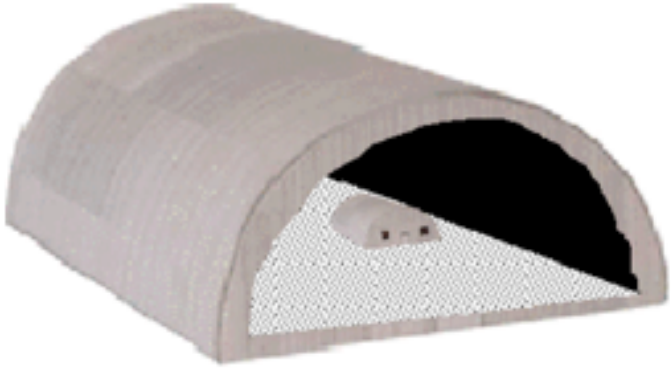
This is the active Hollister mine (NV?): imagine replacing the mine buildings and equipment with an analog station!

Option 2: an abandoned mine gallery, especially one that lies above the local water table and does not need constant pumping: better yet, one in a low rainfall area.

SITUATION 2: You have in mind experiments with life support systems; experimental agriculture under lunar dayspan/nightspan sunlight availability constrictions; you want to experiment with operations scheduling that tries to reserve energy-intensive chores for the two weeks of abundant lunar sunshine; with energy-light, manpower-intensive chores preferentially put off until the two-week long nightspan period when sunlight is not available.

This happens to be a dry, roomy, and spacious copper mine at El Salvador, Chile, near which the proposed Moon/Mars Atacama Research Station may be built. Another essential quality is that the mine gallery must be secure from cave in, roof or sidewall collapses.

Option 3: Build your own ideal environment!



Above: a small habitat module inside a much larger high ceiling warehouse or hangar, in which all interior "sky" surfaces are painted matte black; the floor a simulated moonscape complete with mini-crater. During nightspan, fiber optic "stars" would brighten the sky. In dayspan, a spotlight "sun" with a fresnel lens to broaden its light cone, could brighten the surface. An Earth" globe (ideally of proper size, axial alignment, and face turned toward the "Moon" in proper lighting phase, would be idea.

While a domed or curved space would be ideal, if need be, a spacious pillar-free big box warehouse would do, or an abandoned sports dome of some kind. Perhaps the best bet would be an available aircraft hangar.

This one would be ideal, minus the UFO, of course! A hangar has the advantage of unobstructed clearspan. **PK**

AUGUSTINE RESULTS IN A NUTSHELL

John K. Strickland jkstrick@io.com November 2009

With the obvious proviso that the US government should **not** be building launch vehicles itself, for the next decade at least, the government, for good or ill, will have a large influence on any exploration or activity outside LEO.

The Augustine commission has given us some real direct benefits with its discussions and conclusions, such as stating in plain English the following points, of which I consider these to be the 20 most important ones: (Paraphrased points – all are from items appearing in the original Commission release on September 8, 2009). Here is a link to the summary report for reference:
http://www.nasa.gov/offices/hsf/related_documents/summary_report.html

(1) Human spaceflight program planning should **begin with choices about Goals** *before* picking Destinations. (Here at last is Official Acknowledgement of the importance of first stating fundamental goals.) !!!!

(2) There is a strong consensus in the US that the next manned spaceflight **goal** should be to go **beyond LEO**.

(3) The intent or ultimate **goal** of the human program should be **expansion into the solar system**.

(4) The best human **exploration goal** (with an extended human presence on the surface) is Mars, for a variety of reasons. (NOTE: *This does not address the Moon as a* ***space*** *development goal or location*)

(5) Mars is the **ultimate long range destination** for human activities in the solar system, but it is **not** the best initial one.

(6) A **transportation architecture** should be created which is "**flexible**" and can support **multiple objectives**.

(7) (Human) Exploration will benefit from the availability of a **heavy lift booster**. (70 tons to LEO or more).

(8) Switching to a **single launcher** development program from a 2-launcher program is more economical and could speed development.

(9) Crew Transport to LEO should be turned over to the **Commercial Sector**.

(10) **A new competition** to create this crew transport service should be initiated.

(11) **Launch Service Guarantee Contracts** should be considered by the US Government to stimulate investment in and development of advanced launchers and to reduce ground to LEO costs.

(12) **Commercial Transport of propellants to LEO** is important (and the Committee members showed strong interest in **Propellant Depots** as key to future human space operations – you need them for commercial propellant delivery.)

(13) The Human spaceflight program should align with **national objectives**. (This could be an opening for **Space Solar Power** if clean energy is a national objective).

(14) NASA should **resume** its critical role in long-range and critical areas of **technology development**.

(15) **International Partners** should be engaged and integrated into the critical path components for future programs (This includes transport vehicles).

(16) NASA's Administration needs the **authority to manage its own budget** and funding once it has been authorized.

(17) The arbitrary **deadline** of late 2010 for ending the Shuttle program **should be relaxed** in the name of safety.

(18) The planned Human exploration program is **not feasible** with the current budget. (An "Emperor is Naked" notice)

(19) NASA will probably not have an Ares launcher ready **within 7 years.** (Another "Emperor is Naked" notice).

(20) The Space Station should **not be de-orbited** just after it is finished. Such a move would be **illogical and wasteful**; and keeping it until at least 2020 will allow continuing scientific work and further international cooperation in space. (Still Another "Emperor is Naked" notice).

The "Flexible Path" or Third Option

The "Flexible Path" or Third Option the Commission created can be both an obstacle and a benefit. *If the option results in the creation of specialized, expendable spacecraft to explore asteroids, we will get some good science results (and good practice for long duration missions) from a few human expeditions to asteroids, and that is all.*

If, on the other hand, it results in the creation of a set of flexible, re-usable spacecraft and a rational, integrated space transport system using private launchers to reach LEO, *we will be ready to go to either the Moon, Mars, or asteroids*. Let us hope it leads to the latter option.

FLEXIBLE PATH: GOOD OR BAD

A discussion about NEO missions under the Augustine Commission's "flexible path" option led to these conclusions.
http://www.telegraph.co.uk/science/space/6425811/Asteroids-should-be-next-small-step-for-man-in-space-panel-tells-President-Barack-Obama.html

In reference to flexible path missions to near earth asteroids, we should remember that: *The vast majority of asteroids are basically made of very primitive rocks (ordinary chondrites), neither pure nickel-iron metal mix nor water-rich carbonaceous chondrite. (There are, however, significant amounts of the nickel-iron in the ordinary chondrites, but it would have to be separated from all of the rocky material).*

Low Relative velocity Near Earth Objects tend to have very long intervals before they return to the vicinity of Earth again, since the orbits of NEO's are often similar in period to the Earth. *Thus any mineral extraction from a specific object is a process that would have to occur on the scale of decades.*

- Objects which have more elliptical or highly inclined orbits and which may be synchronized with the Earth by accident, will have much higher flyby velocities, making rendezvous and return harder.
- Before you create a mining industry to exploit asteroid resources, you need a reason for that industry to exist. (What are you going to use the asteroidal materials for?)
- No one has yet created a spacecraft that uses artificial gravity, so there would be no gravity on any asteroid mission until we develop such spacecraft.
- '**Asteroids only**' missions *could* become a near-term dead end, even though, long-term, they represent a vital source of bulk materials and minerals for a spacefaring civilization.
- We have to deal with the economics of space as it exists now, not in 30 years. *Thus we need generalized infrastructure (and transport) development first, missions second.* **JKS**

The Moon Society www.moonsociety.org

An international nonprofit 501(c)3 educational and scientific organization formed to further the creation of communities on the Moon involving large scale industrialization and private enterprise

Objectives of the Moon Society

include, but are not limited to:

- Creation of a spacefaring civilization which will establish communities on the Moon
- Promotion of large-scale industrialization and private enterprise on the Moon
- Promotion of interest in the exploration, research, development, and habitation of the Moon, through the media of conferences, the press, library and museum exhibits, and other literary and educational means
- Support, by funding or otherwise, of scholarships, libraries, museums and other means of encouraging the study of the Moon and related technologies
- Stimulation of the advancement and development of applications of space and related technologies and encouragement their entrepreneurial development
- Bringing together persons from government, industry, educational institutions, the press, and other walks of life for the exchange of information about the Moon
- Promoting collaboration between various societies and groups interested in developing & utilizing the Moon.
- Informing the public on matters related to the Moon
- Provision of suitable recognition and honor to indivi-duals and organizations which have contributed to the advancement of the exploration, research, develop-ment, and habitation of the Moon, as well as scientific and technological developments related thereto.

Our Vision says Who We Are

We envision a future in which the free enterprise human economy has expanded to include settlements on the Moon and elsewhere, contributing products and services that will foster a better life for all humanity on Earth and beyond, inspiring our youth, and fostering hope in an open-ended positive future for humankind.

Moon Society Mission

Our Mission is to inspire and involve people everywhere, and from all walks of life, in the effort to create an expanded Earth-Moon economy that will contribute solutions to the major problems that continue to challenge our home world.

Moon Society Strategy

We seek to address these goals through education, outreach to young people and to people in general, contests & competitions, workshops, ground level research and technology experiments, private entrepreneurial ventures, moonbase simulation exercises, tourist centers, and other legitimate means.

Our Full Moon Logo above:

The Moon in its natural beauty, empty and deceptively barren, waiting for human settlers to shelter and to mother as their adopted second human home world. We have work to do!

Masthead Design: Charles F. Radley, Society Vice-president\

Monthly Moon Society Progress Reports: visit our Homepage http://www.moonsociety.org and scroll down the center of the page to the prominent yellow **Frontlines** link. This report has been issued monthly since April 2008.

Announcing the Formation of Moon Society India: MSI

November 14, 2009 12:01 am India Time

Today (11/14/09) is the 1st Anniversary of Chandrayaan-1's Moon Impact Probe reaching the Lunar Surface with the tricolor Flag of India painted on all four sides. – India was on the Moon! This date for the impact was chosen to honor former Prime Minister Jawaharlal Nehru's Birthday. In his term, India's Space Program was launched in 1962.

On this day, we are pleased to announce the formation of The Moon Society of India as an autonomous affiliate of The Moon Society (International)

The founding **Executive** Committee has elected Jayashree Sridhar (Chennai) as President, with Pradeep Mohandas (Mumbai) as Secretary. Also involved are Srinivas Laxman (Mumbai) and Avinash Siravuru (Vellore).

Moon Society India will also be forming a Board of Advisors; in addition to prominent Indians, Peter Kokh, David Dunlop, and Madhu Thangavelu from the International Moon Society International will be included.

MSI priorities include starting a network of chapters throughout India, both city- and campus-based, and in the coming year, to assume publication of the MMM-India Quarterly, which publication has made this event possible.

MSI will be involved in conferences, contests and competitions, and hope to build and operate an Indian Lunar Analog Research Station – LARS-India.

And, of course, MSI efforts will focus on building public support within India for the ISRO's Space Exploration and Manned Space Programs.

Watch upcoming issues of Moon Miners' Manifesto – India Quarterly, "M3IQ" for more news and progress reports. The current and all previous issues can be freely downloaded from this page:

http://www.moonsociety.org/india/mmm-india/

At this same time, we welcome aboard Pradeep Mohandas and Srinivas Laxman (well-known Indian Space Writer), both of Mumbai, to the M3IQ editorial team, joining Peter Kokh, David Dunlop and Madhu Thangavelu.

The Moon Society congratulates Moon Society India on this auspicious occasion

From Peter Kokh, President, The Moon Society, and David Dunlop, Director of Project Development

We will work with Moon Society India to promote exploration of the Moon, both robotic and human, establishment of an International Lunar Research Park and earliest utilization of lunar resources, involving settlement, for the benefit of all mankind. **PK/DD**

Remembering Apollo 12

November 14-24, 1969

On the Moon, November 19-20 (31hr 31mn)

The Moon Society made a good effort to celebrate the 40th Anniversary of mankind's first lunar landing by the Apollo 11 crew, this past July. But looking ahead at the 40th Anniversaries of the remaining 5 missions, we decided not to repeat the public-boring media blitz of the Apollo years. In fact, while each mission blazed new territory and taught us more about the Moon while also expanding our ability to operate on its surface, the even numbered missions, 12, 14, and 16, seemed somehow less memorable than the odd numbered missions, 11 the first), 13 (narrow escape from tragedy), 15 (introducing the lunar rover and the exciting terrain of Hadley Rille), and 17 (spectacular Taurus-Littrow valley, and what was fated to be our last mission for a half century or more.

Perhaps the most memorable aspect of A12 was the planned visit to Lunar Surveyor #3, which had landed two and a half years earlier. The Yankee Clipper lander set down within 400 ft. of Surveyor, and was a principal EVA target for the mission. Examination of parts of the craft returned to Earth showed that Yankee Clipper's exhaust on landing had sandblasted the portions of Surveyor facing the lander, with implications that future space pads on the Moon be berm-encircled to contain such sandblasting dust sprays.

So this time, in lieu of a big "Apollo Moon Party" we offer these resources:

4 Videos Celebrating 40th Anniv. of Apollo 12

http://www.space.com/common/media/video/player.php?videoRef=SP_091118_apollo-12-1

http://www.space.com/common/media/video/player.php?videoRef=SP_091118_apollo-12-2

http://www.space.com/common/media/video/player.php?videoRef=SP_091118_apollo-12-3

http://www.space.com/common/media/video/player.php?videoRef=SP_091118_apollo-12-4

General Information about the Apollo 12

http://www.nasm.si.edu/collections/imagery/Apollo/AS12/a12facts.htm

http://en.wikipedia.org/wiki/Apollo_12

Books on the Apollo 12 mission

Apollo 12: The NASA Mission Reports Vol 1: Apogee Books Space Series 7 by Robert Godwin

http://www.apogeespacebooks.com/Books/Apollo12.html

Mission Control, This is Apollo: The Story of the First Voyages to the Moon by Andrew Chaikin and Alan Bean (Available from amazon.com)

Alan Bean: Painting Apollo (Available from amazon.com)

Our Next Apollo Moon Party

Apollo 13's 40th Anniversary

Sunday April 11th through Saturday April 17th, 2010

From Peter Kokh, Moon Society President

Only four months off, time is a-wasting to make arrangements at local, regional, national, and international levels to honor not "The Moon Landing That Didn't Happen," but the even more stupendous coup of human courage and ingenuity in the favor of the most daunting odds with the resut that three brave men, almost certain to die in space, made it home safely

How do we celebrate this mission in a way that scores major points with both the public, and more importantly, with our risk-averse leaders? That's easy! We announce an Essay Contest, with local, state, national, and international winners. The topic?

"Space Exploration is Worth the Risk"

Moon Society Announces Essay Contest

The Moon Society will organize the Essay Contest on a national-international basis. It will be up to chapters and outposts who want to participate, to attempt to do the same on a local and/or state level.

Organizing a Contest is not easy. Without attractive prizes, few entries will be forthcoming. Now the Society could decide to fund a prize on its own. But a better approach might be to find commercial cosponsors. Companies who stand to gain from the continuation and expansion of NASA's Manned Space Program and/or commercial Manned Space efforts would be logical partners.

Next we need a panel of judges. Within the Moon Society and the National Space Society, not to forget the leaders of commercial space initiatives, finding judges should not be a problem.

Deadlines are tight. We want to announce the winner on April 17th, the day when 40 years ago, the Apollo 13 crew landed safely. We want to present the prize at the International Space Development Conference in Chicago, May 27-31, 2010. Of course, transportation to ISDC, from wherever, must be part of the prize.

At our December 2nd, 2009 Moon Society Management Committee Meeting, Officers and Directors gave approval to this contest. And, "yes, it is open to present and former Moon Society Members, but closed to current officers and directors.

We are also starting a "prize bandwagon" with a Moon Society contribution of $1,000. A team of volunteer Society leaders has contacted the National Space Society, other pro-Space groups, and the ISDC 2010 committee. We will be contacting NASA contractors, NASA itself, commercial space companies, Google X-Prize, and Google X-Prize contenders, Virgin Galactic, and others.

Preparing *well ahead*

For Apollo 15's 40th Anniversary

July 26th – Aug. 7th

2011

Our first Apollo Moon Party was an idea born out of our very first Town Meeting, February 11th, 2009, with just 5 months to prepare. Looking back, though some of our chapters did manage to observe the 40th anniversary of our first Moon Landing on July 20th 1969, the grand global "Apollo Moon Party" was something much too ambitious to pull off within such a short time.

For Apollo 13's 40th, with six months plus lead time, our plans are much less ambitious, but nonetheless exciting: an essay contest with the theme: "Space Exploration is Worth the Risk." See the previous page.

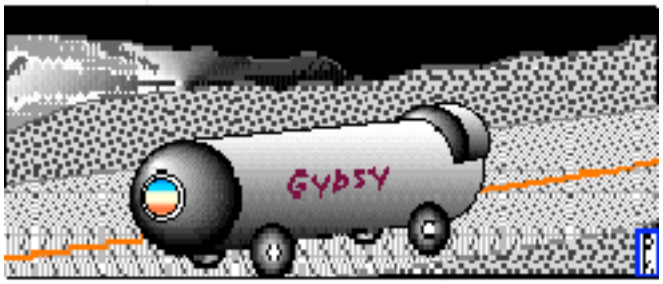
But looking ahead to Apollo 15 *(skipping A14),* we have a year and a half to plan something ambitious. This mission was notable on these counts:

- Introduction of the **first moon rover**
- The first manned lunar mission in **rugged territory** with mountains and valleys
- Sorties to the edge of **Hadley Rille**, most likely **the "ruins of a collapsed lavatube**

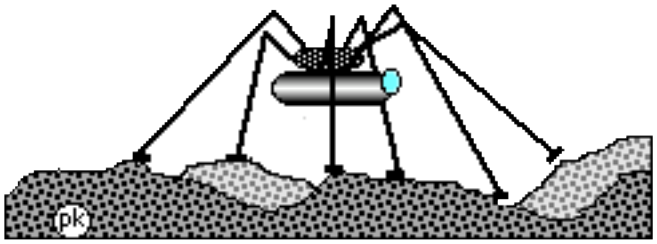
Three suggestions, all requiring lead time:

Two Design Competitions, One publication venture:

- **A pressurized lunar tourist coach**: classifications:
  a) One day round trips for 12 with no overnighting;
  b) Capacity to sleep crew plus 6, with supplies for 4-day round trip excursions



- **A pressurizes rugged terrain exploration vehicle** with a spider-like multi-leg chassis in lieu of wheels



- **A publication venture: "Lavatubes, The Moon's Hidden Valleys"** – An online mini-book? *or ????*

With 18-months' lead-time, this ambitious 3-part plan is doable. *But, we must get busy on all three items now!*

Expanded Analog Moonbase Proposal Presentation Available

From Peter Kokh

It is only natural that the intensive brainstorming involved in trying to develop concepts for the proposed Moon/Mars Atacama Research Station (MMARS), that I would further develop ideas and concepts that could apply to the Moon Society's own Lunar Analog Research Station conceptualization. I have added more than a dozen new slides, and improved others.

For MMARS fans and followers, the ideas in this presentation, may or may not find their way into the actual MMARS station design. As shown, this presentation does no more than reflect my current thinking on the possibilities.

As for the long-proposed Moon Society L.A.R.S., (for which we have neither an identified site, nor the beginnings of funds), this is something to be realized on a phase-by-phase timetable. In both cases, we will start with an initial core complex, and then grow as demand, money, and support personnel warrant.

You can send your constructive comments, favorable or not, to kokhMMM@aol.com and put "analog moonbase proposal – comments" in the subject line.

Both files are about 2.5 mb

Here are the free access download addresses

http://www.moonsociety.org/moonbasesim/proposals/AnalogMoonbaseProposal.ppt

http://www.moonsociety.org/moonbasesim/proposals/AnalogMoonbaseProposal.pdf

Note, *if you have trouble with the PowerPoint version,* do try the pdf file slide show version.

Meanwhile, the Moon Society is following closely the efforts of Niklas Jarvstrat, our member and Advisor in Sweden, to transform an abandoned iron mine into a lunar analog facility. For more on that effort, go to:

http://www.moon-mine.com

We continue to encourage the mobile modular analog effort undertaken by the Calgary Space Workers (Alberta, Canada) and a proposal by the newly organized Moon Society India to construct and operate a lunar analog station in that country.

http://www.calgaryspaceworkers.com

Our colleague in Mexico, Jesus Raygoza B, continues to seek support for his long-pursued dream of a MexLunarHab. Various sites are under consideration.

http://www.moonsociety.org/sem/mlh.html

The brand new Moon Society India hopes to field a lunar analog station at a location yet to be determined.

http://groups.google.co.in/group/lars-india/members

Meanwhile, we are watching with much interest a chapter project by our own Moon Society Phoenix team. Details on that effort are not yet available.

And, of course, we are always looking for ways to improve a business plan that could get us well underway to erecting an analog station somewhere in the US. We very much need the support of our members and of all the new members we can recruit.

Stay tuned.

Peter Kokh. President. The Moon Society

The Moon Society Chapters & Outposts Frontier Report

Chapters & Outposts

Moon Society St. Louis Chapter

http://www.moonsociety.org/chapters/stlouis/
Contact: Keith Wetzel <kawetzel@swbell.net>
Next meetings – Dec 16th, Jan 19th, Feb 16th
Meetings **3rd Wed** monthly at Buder Branch Library
4401 S. Hampton, in the basement conference room

Moon Society Phoenix Chapter

http://www.msphx.org
http://www.moonsocphx.blogspot.com/
Contacts: Don Jacques djmitzlplick@yahoo.com
Chuck Lesher: chuckmiester999@yahoo.com
Meeting the **3rd Saturday of the month**
Moon Society Phoenix' next meetings are on
Saturdays Dec 19th, Jan 16th, Feb 20th

Moon Society Houston Chapter

http://www.moonsociety.org/chapters/houston/
Contact: Eric Bowen eric@streamlinerschedules.com

The Houston Chapter's most recent meeting was held **Monday, November 16 at Coffee Oasis at 4650 NASA Road 1 in Seabrook;**

The Moon: "Houston, Tranquility Base Here. The Eagle Has Landed" at the Museum of Fine Arts, Houston

Through January 10, 2010 the Museum of Fine Arts, Houston will host a special exhibition dedicated to the past 500 years of humanity's fascination with the Moon. The exhibit will feature art ranging from Renaissance paintings up to and including some of artist/astronaut Alan Bean's very recent work. Alan Bean himself is scheduled to give an opening day lecture at the museum. In addition, there will be early scientific instruments, books, moon globes, maps, Galileo Galilei's 1610 treatise on the moon, and objects from NASA on display. We have been extended a special invitation to view this exhibition, with a discounted group admission. More information at http://www.mfah.org/moon. – Eric

College of the Menominee Nation-Green Bay* Student Chapter (*Formerly, Green Bay, WI Outpost)*

Contacts: Dan D. Hawk hawkd_0212@menominee.edu
David A. Dunlop dunlop712@yahoo.com
Meeting some Saturday afternoons at the College of the Menominee Nation, 2733 South Ridge Rd, Green Bay, WI

Activities: In connection with the Wisconsin Space Grant Consortium, we are working on **a lunar agriculture experiment** involving a high-altitude cactus in a pressure vessel with nutrients etc., that will be designed to fly on a future lunar lander. The proposal has received much interest and attention from several respected authorities.

News: A working prototype of this experiment is set for a test flight at Wallops Island, VA in July 2010!

Representatives from several other tribal colleges met at CMN for a **workshop on amateur rocketry** conducted by Dan Hawk October 23rd, as CMN endeavors to spread its enthusiasm for space among Native Americans.

Mission Statement of the Five Clans Rocket Team:
"to provide a venue to increase aeronautic STEM technologies by allowing students to design, build, test, and launch their own high-powered rockets."

CMN Team Rocketry Research Experiment:
www.menominee.edu/RocketWebsite/5clans/experiment.htm

Chapters & Outposts Map (North America)
www.moonsociety.org/chapters/chapter_outpost_map.html

Chapters & Outposts Events Page
www.moonsociety.org/chapters/chapter_events.html

===== Moon Society Outposts =====

www.moonsociety.org/chapters/chapter_outpost_map.html

Moon Society Nashville Outpost – Central Tennessee
Contact: Chuck Schlemm cschlemm@comcast.net

Bay Area Moon Society, CA Outpost – South Frisco Bay
http://www.moonsociety.org/chapters/bams/
Contact: Henry Cates hcate2@pacbell.net
Informal meeting at Henry Cate's home in San Jose
Thursday Dec 13th celebrating **Jon Goff**'s & Masten Space Systems' Lunar Lander Challenge 1st prize

Moon Society Longview, TX Outpost
Contact: James A. Rogers jarogers2001@aim.com

Moon Society DC Metro, DC-MD-VA Outpost
Contact: Fred Hills Fredhills7@aol.com

Milwaukee, WI Outpost (MSMO)
www.moonsociety.org/chapters/milwaukee/msmo_output.htm
Contact: Peter Kokh kokhmmm@aol.com
Sat. Dec. 12th, annual (23rd) anniversary holiday party, potluck luncheon and classic sci-fi film, **1-4 pm**
Mayfair Mall lower Garden Suites East level, Room G110

The Victorian Space Alliance (Melbourne, Australia)
Contact: Shaun Moss shaun@starmultimedia.biz

=== Space Chapters Hub Resources ===

http://nsschapters.org/hub/
Resources for chapters of the Moon Society, the National Space Society, and the Mars Society:
Chapter Handbooks, Meetings & Agendas, Newsletters, Project ideas unlimited, Events Calendar, Publicity/media contacts, downloadable flyers and slides and presentations, display blueprints, models and exhibits, chapter videos, chapter websites, cons & conferences, merchandise, and much more!

NSS Partner Chapter News – pp. 17-19

Oregon L5 (Portland), **Lunar Reclamation Society** (Milwaukee), **Minnesota Space Frontier Society** (Minneapolis-St. Paul), **San Diego Space Society**

Moon Society DUES with ***Moon Miners' Manifesto***
Electronic MMM (pdf) **$35** Students/Seniors: **$20**
Hardcopy MMM: U.S/Canada **$35** Elsewhere: **$60**
Join/Renew Online - www.MoonSociety.org/register/

Moon Society Mail Box Destinations:

Checks, Money Orders, Membership Questions
Moon Society Membership Services:
PO Box 940825, Plano, TX 75094-0825, USA

Projects, Chapters, Volunteers, and Information
Moon Society Program Services,
PO Box 080395, Milwaukee, WI 53208

< End Moon Society Journal Section >

GREAT BROWSING

How the Moon produces its own water
www.astronomy.com/asy/default.aspx?c=a&id=8718

POLL: Is Earth Ready to Meet an Alien Civilization?
http://www.space.com/common/forums/viewtopic.php?f=14&t=20907

Messenger sees changing seasons on Mercury
http://www.space.com/scienceastronomy/091103-mercury-new-images.html

Space Hotel Takes Reservations for 2012 Opening
www.space.com/news/091104-space-hotel.html

Water Geysers on Enceladus
http://www.space.com/scienceastronomy/091104-enceladus-plumes.html

Space Elevators: Best performance yet
www.space.com/news/091105-space-elevator.html

Russia Needs More Volunteers for 520 day Mars Flight Simulation
http://www.marsdaily.com/reports/Russia_Needs_More_Volunteers_For_Mars_Flight_Simulation_999.html

Budget Pressure on Robotic Space Missions
http://www.thespacereview.com/article/1502/1

Clinical immortality and space settlement
http://www.thespacereview.com/article/1496/1

A Legal Regime for the Mining of Helium-3 on the Moon: U.S. Policy Options
http://lunarnetworks.blogspot.com/2009/10/legal-regime-for-mining-of-helium-3-on.html

A Star Trek Like "Replicator" for the Moon & Mars?
http://www.colonyworlds.com/2009/11/almost-star-trek-ebf3-tech-could-help-replicate-tools-for-lunar-settlers.html

Moon, Mars Globe Apps for I-phone, Touch ***
http://www.planetary.org/blog/article/00002143/

'Trash Can' Nuclear Reactors Could Power Human Outpost On Moon Or Mars
http://www.sciencedaily.com/releases/2009/10/091004020806.htm

How Pluto fits in the Planetary Scheme
http://www.thespacereview.com/article/1507/1

NASA trims COTS Contenders to final five
http://www.spacenews.com/civil/091109-nasa-narrows-field-commercial-crew-development.html

Commercial Spaceflight Investments up to $1.46B
http://spacefellowship.com/2009/11/09/investment-in-commercial-spaceflight-grows-to-1-46-billion-industry-study-reveals/

NASA/Microsoft build interactive Mars map site
http://beamartian.jpl.nasa.gov/

LCROSS impact sees more Moon water, ice
http://science.nasa.gov/headlines/y2009/13nov_lcrossresults.htm

India Commits to Manned Mission to the Moon
http://www.ptinews.com/news/376698_Manned-mission-to-moon-soon--President

Planetary Society gives Solar Sailing 2nd Chance
http://www.thespacereview.com/article/1510/1

New Book on Life of Konstantin Tsiolkovsky
http://www.thespacereview.com/article/1508/1

GREAT SPACE VIDEOS

MOON COLONY VIDEOS – The Moon Society

30 plus thought-provoking videos, produced for the Moon Society by Chip Proser (Celestial Mechanics, Inc.) can be found at.
http://www.moonsociety.org/video/
or at:
http://www.mooncolony.tv/
http://www.stickymedia.com/

ASSORTED SPACE VIDEO

Geyser in Space: Cold Faithful on Enceladus
http://www.space.com/common/media/video/player.php?videoRef=Enceladus_web

Video of NASA's new Star Trek like "Replicator"
http://www.colonyworlds.com/2009/11/almost-star-trek-ebf3-tech-could-help-replicate-tools-for-lunar-settlers.html

Robotic rover that can drill on the Moon
http://www.sciencedaily.com/videos/2008/0309-moon_rover.htm

Earth's Magnetosphere charges Moon monthly
http://www.sciencedaily.com/videos/2008/1007-preparing_for_a_walk_on_the_moon.htm

Launch of Russia's Poisk Module to ISS (in Russian)
http://www.vesti.ru/doc.html?id=325718

Meteor Shower looks like alien invasion!
www.urlesque.com/2009/11/24/meteor-shower-video

"To love the Earth, it is not enough for humankind to become ever more environmentally responsible. We must also protect our Earth from asteroid impacts, use Lunar resources to produce clean energy, and establish human frontiers elsewhere, should Earth become uninhabitable despite our best efforts." ***Walden Clay***

Help us put MMM in a Library near You!

Whether you are a member of an NSS Chapter or of a Moon Society Chapter or Outpost, or a Moon Society member at large, you all get Moon Miners' Manifesto as a membership benefit.

A library subscription to a library in your community will help spread the word, whether about local or national or international Moon-focused programs and projects.

For chapters and outposts such subscriptions will be good advertising for your local efforts.

For Moon Society members, as all copies of MMM include the Moon Society Journal centerfold section, community library or school library copies of MMM will help grow name recognition and invite readers to join.

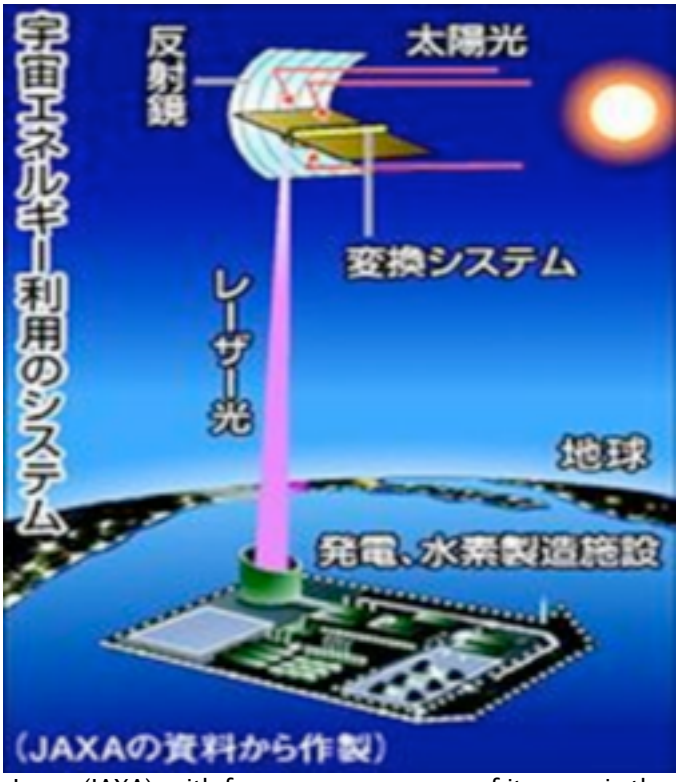
As membership services are not involved, the cheapest way we can do this is by submitting these subscriptions directly to the publisher at a cost-minus rate of $10 a year, available for libraries only.

How to participate in this program

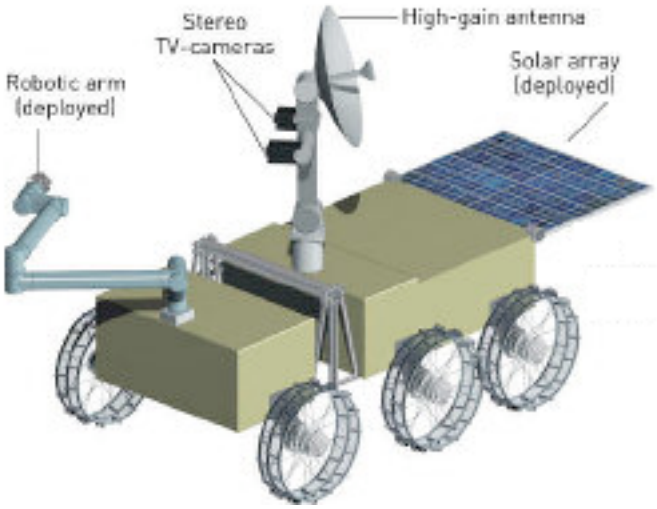
- Send *by postal mail only*
- Your check of money order for $10.00/per year
- With the complete name and address of the Library,
- Made out to

"Lunar Reclamation Society"
Attn: Library Subscriptions
PO Box 2102, Milwaukee, WI 53102

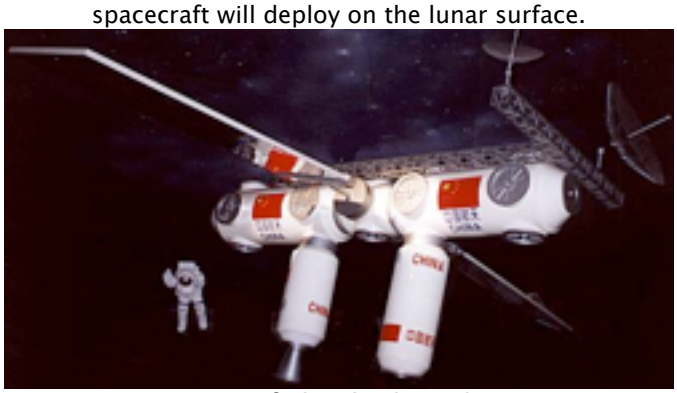
MMM PHOTO GALLERY



Japan (JAXA), with few energy resources of its own, is the first and only nation (national space agency) to commit to developing solar power satellites.



conceptual sketch of the rover India's Chandrayaan-2 spacecraft will deploy on the lunar surface.



Artist Conception of China's planned Space Station

Poisk – Russia's newest contribution to the ISS Complex. Poisk [Russian for "explore"] arrived November 12th. It provides an additional docking port for Russian vehicles, an airlock for cosmonaut spacewalks, and serves as a platform for external science experiments.

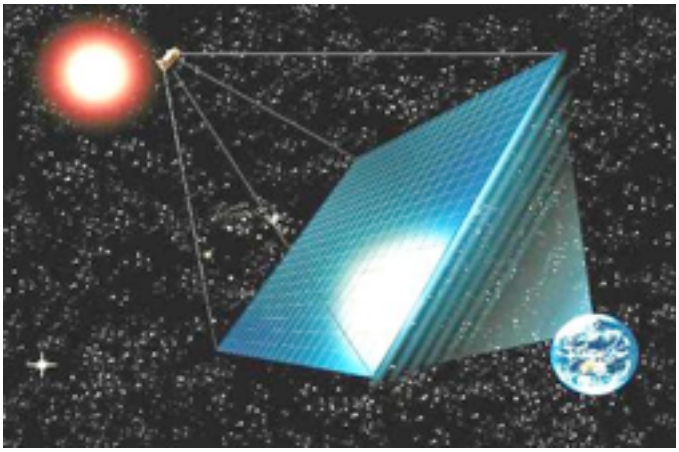


Illustration of Japan's proposed Space Solar Power System With few native power sources, Japan takes the plunge, in an effort that will take decades.

"Son of Dynosoar", the Air Force's X37B or OTV [Orbital Test Vehicle], built by Boeing, is ready for an April launch atop an Atlas 5. *(Why not use this instead of Orion?)* See: http://www.spaceflightnow.com/news/n0911/24otv/

There will be no MMM next month.

January and July are our two semi-annual burnout-prevention and regeneration breaks.

Look for **MMM-India Quarterly #5**, available as a free pdf file download along with previous issues of **M3IQ** at:

http://www.moonsociety.org/india/mmm-india/

and, two new **Classic MMM Theme Issues** "**Select Editorials**" & "**The Lunar Economy**" available as free pdf file downloads along with previous MMM Theme issues at:

www.moonsociety.org/publications/mmm_themes/

IN THE NEWS

"In Search of a Real Spaceship"

Buzz Aldrin ridicules Orion and challenges US to design and build something that makes more sense.

http://www.huffingtonpost.com/buzz-aldrin/in-search-of-a-real-space_b_371205.html

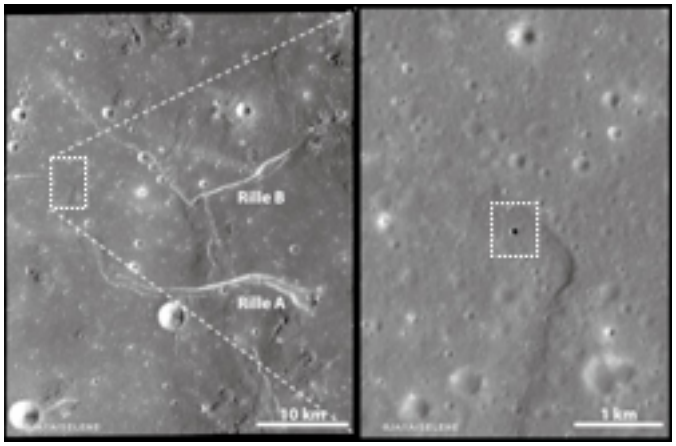
Musk says Space-X Falcon 9 "might" launch in February

http://spaceflightnow.com/news/n0911/26musk/index.html

Musk and Falcon 9 at Cape Kennedy

How big is the Lavatube whose "Skylight" was discovered by Japan's Kaguya orbiter?

http://www.universetoday.com/2009/11/25/kaguya-discovers-a-lava-tube-on-the-moon/



"The hole is 65m [213ft.] in diameter"

"Haruyama's team observed the hole nine separate times, at various illumination angles, and even when the sun was almost directly overhead it looked mostly black, suggesting that it is very deep. They calculate a depth of around 88m [289 ft.], so the hole is deeper than it is wide." [**Location:** 13.36°N / 56.27°W]

"Their calculations based on the multiple images of the hole show that the tube could be 370m [1215ft] accross."

[**Editor:** this is very much in keeping with expectations and back-of-the-envelope calculations based on the size of Hadley Rille (Apollo 15) and of other sinuous rilles that are now interpreted as collapsed lunar lavatubes. That they are so much bigger in scale than well-known terrestrial tube would seem to be an inverse relation to gravity. The lighter the gravity on a world, the larger naturally forming lavatubes might be. Thus tubes on Mars should be of an intermediate scale.]

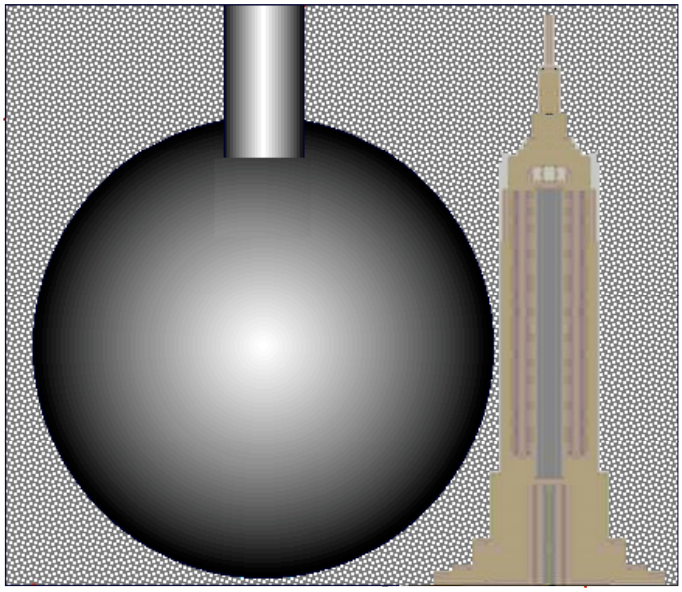
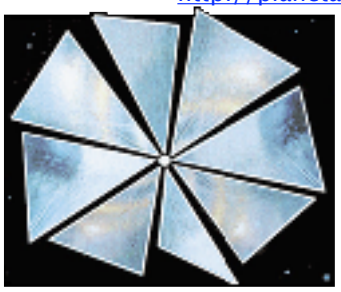


Illustration © MMM – the Empire State Building to scale

[**Editor:** Space enthusiasts have long speculated on the major role lavatubes could play on the Moon. Now with Kaguya's discovery of an actual lavatube "skylight," the vision of the Moon's "Hidden Valleys" is receiving long-overdue public attention.] **MMM**

Solar Sailing, Take II

Based on a Planetary Society Report
http://planetary.org/_____



In June '05 the Planetary Society launched its first solar sail, Cosmos 1, but the Russian Volna rocket that was to place the craft in orbit failed. So they were never able to test their design in orbit.

The Planetary Society was determined to move on, convinced that solar sails had a place in our future. Solar sails may be the only craft that we can build with present technology that could reach the stars.

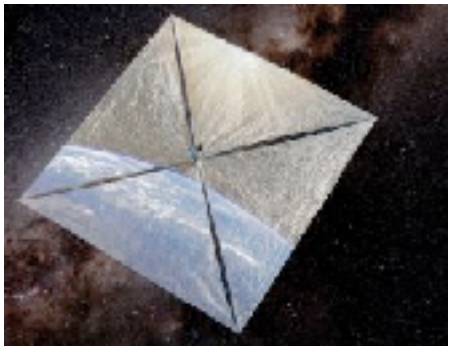
More importantly, to many space enthusiasts, is the possibility that *fuel free* solar sails could carry cargo from the Earth-Moon system to the Mars-Phobos-Deimos system without having to pay attention to the traditional 25+ month interval between "launch windows" required for rockets plying Hohmann transfer orbits.

Invoking the concept of the pipeline, it does not matter how long it takes cargo to pass through the "pipeline" so long as needed items are always being sent off, and always arriving. Solar Sail pipelines would be ideal for common and lightweight items always in need on the new frontier.

A new, simpler, cheaper design

If the Society was going to try again, given cost considerations, it had to reinvent the solar sail to be smaller, weigh less, and be capable of higher acceleration. The determining factor was the budget. This time, encouraged by an anonymous donation of one million dollars from a member, and with $400,000 seed money on hand, they needed to get everything to come together under a price tag of $1.8 million, basically matching the seed money amount with fresh donations.

There is urgency in raising the rest of the money, because that one million dollar donation was contingent on being ready to launch by the end of 2010, five and a half years after the failed Cosmos I launch attempt.



LightSail-1 will be packed into three Cubesats. One for central electronics and controls, and two to house the solar sail itself.

Cameras, more sensors, and a control system will be added to the basic Cubesat electronics bus.

With four triangular Mylar sails extending 32 square meters (420 square feet), and an initial orbit over 800 km to escape the drag of the upper atmosphere, the pressure of sunlight on its sails will increase the orbital energy, and as its orbit Is raised accordingly, and the influence of Earth's gravity decreases, ultimately, Solar Sail 1 will escape the Earth-Moon system into inter-planetary space. The Planetary Society is to be congratulated for its persistence in this key project. **MMM**

Lunar Reclamation Society, Inc.
P.O. Box 2102
Milwaukee
WI 53201
www.lunar-reclamation.org

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

2009 LRS OFFICERS | BOARD* | Contact Information

PRES. / MMM Editor – *Peter Kokh **NSS**
kokhmmm@aol.com 414-342-0705
VICE-PRES. Doug Armstrong **NSS** 414-273-1126
SECRETARY – *James Schroeter **NSS**
James_Schroeter@excite.com 414-333-3679
TREAS./ Database – *Robert Bialecki
bobriverwest@yahoo.com 414-372-9613

LRS News

• **Gene, Charlotte and Peter at Holiday Folk Fair**: Gene and Charlotte had been invite to have a booth about astronomy at this State Fair Park even on Fri-Sun, Nov 20-22. As a lot (thousands!) of school kids were expected on opening day, Friday 9am-2pm., Peter brought along his small moon/mars homestead and gravity bricks. The latter, of course, received the most attention, from kids of all ages.

LRS Upcoming Events

Saturday, Dec. 12th 1-4 pm – our 23rd annual holiday party, pot-luck luncheon, sci-fi movie

THE ADVENTURES OF PLUTO NASH

Starts 2pm sharp, come early for luncheon before!

Eddie Murphy, Randy Quaid. On the Moon 2080 (comedy)

This event will be our 23rd Anniversary Bash.
It seems only yesterday that we had our 20th!

Chapter displays will be on hand, including illustrations of some new displays to debut at ISDC 2010 in Chicago, next Memorial Day Weekend.

January 9th & February 13th

LRS Meeting, Mayfair Mall, Garden Suites Room G110

AGENDA: http://www.lunar-reclamation.org/page4.htm

Discussions of upcoming events:

• **Apollo Moon Party #2** to celebrate the feat of heroic courage and amazing ingenuity in the rescue of the **Apollo 13** crew "Houston, we have a problem!" **Essay Contest:** "Manned Space Exploration is worth the Risk."

• **Old, refreshed, and new displays** for ISDC 2010, building on those put together for ISDC 1998.

News & Events of NSS "MMM" Chapters

Space Chapter HUB Website:
http://nsschapters.org/hub/

OREGON

Oregon L5 Society

P.O. Box 86, Oregon City, OR 97045

voice mail / (503) 655-6189 -- FAX (503)-251-9901

[http://www.OregonL5.org/]

Allen G. Taylor allen.taylor@ieee.org
Bryce Walden moonbase@comcast.net
(LBRT - Oregon Moonbase) moonbase@comcast.net

* **Meetings 3rd Sat. each month at 2 p.m.**
Bourne Plaza, 1441 SE 122nd, Portland, downstairs
Dec 19th, Jan 16th, Feb 20th

WISCONSIN

Sheboygan Space Society
728 Center St., Kiel WI 54042-1034

c/o Will Foerster 920-894-2376 (h) astrowill@tcei.com
SSS Sec. Harald Schenk hschenk@charter.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 Thurs even # months 7-9pm
At The Stoelting House in Kiel, WI

At time of publication, the 2010 meeting schedule for Sheboygan Space Society had not been published. The 3rd Thurs of even # months in 2010 would be:

Feb 11th, Apr 15th, Jun 17th, Aug 19th, Oct 21st, Dec 16th

Minnesota Space Frontier Society
c/o Dave Buth 433 South 7th St. #1808
Minneapolis, MN 55415

David Buth (w) (612) 333-1872, (h) (763) 536-1237

Email: info@mnsfs.org
www.mnsfs.org/

Pix of 30th Anniversary Party
http://freemars.org/mnfan/MNSFS/2009-11-30th-Anniv-Party/

Congratulations to newly (re)-elected MNSFS Officers:
Dave Buth Executive Director, Jeff Root Assistant Director, Becky Huset Treasurer, Rich Brown Secretary, and Scott Shjefte State Councilor

Our ISS-21 / STS-129 Display at Radio City
http://freemars.org/mnfan/MNSFS/2009-11-STS-129-ISS-21-Display/

COLORADO

Denver Space Society
(FKA The Front Range L5 Society)

1 Cherry Hills Farm Drive
Englewood, CO 80113
http://www.angelfire.com/space/frl5/

Eric Boethin 303-781-0800 eric@boethin.com
Monthly Meetings, every 2nd Monday, 7 PM
Next: March 9th, April 13th, May 11th
Englewood Public Library, Englewood, CO 80110
1000 Englewood Parkway, First Floor Civic Center

ILLINOIS

Chicago Space Frontier L5
610 West 47th Place, Chicago, IL 60609

Larry Ahearn: 773/373-0349 LDAhearn@aol.com

Host of ISDC 2010 – May 27-31, 2010
http://isdc.nss.org/2010/

.

PENNSYLVANIA

Philadelphia Area Space Alliance
928 Clinton Street, Philadelphia, PA 19107

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

[http://pasa01.tripod.com/]
http://phillypasa.blogspot.com

• **PASA regular business luncheon/formal meeting 1-3 pm**, the **3rd Saturday of every month** at the **Liberty One food court** on the second level, **16th and S. Market.** Go toward the windows on the 17th street side and go *left*. Look for table sign. Parking at Liberty One on 17th St. Call Earl/Mitch 215-625-0670 to verify all meetings.

Next Meetings: Dec 19th, Jan meeting TBA

The January meeting may be on the sixteenth.

Event notes: Our November meeting was informal at the Philcon Science Fiction Convention on the twenty' first. Due to a snafu, one of several, some of us met earlier than planned and then gathered at our table at other times. Dorothy and Larry got us a table at Embers in the Crown Plaza Hotel the site of the convention. They where joined by Dennis Pearson of our group, Earl (after a call saying they had a table!) an interested friend of Dorothy (Roberta Rogow, filk singer, and writer) and Colin, an NSS member and teacher, attracted by our table display and banner. We had interesting conversations, not just on space exploration and the end of the shuttle, but also teaching, Most of these folks can do outreach and talk to children and families, outside of their daily jobs, that want to build the great future many of them, and we, envision. And meeting friends and people you know at the conventions act as stress relievers too. The only 'problem' is the many interesting talks and events that conflict!

After straightening out a communication problem, and getting us a table, I volunteered for two panels I thought I could contribute to: "Is Hydrogen the Future of Energy?, and "Space Inc.: Is Private Enterprise the Future of Space Development?". The panel on the hydrogen economy was fun. Frank O'Brien talked infrastructure and engineering physics of cryogenic storage, while John Moore (who came up from Houston for the event) argued from a chemists perspective. I posed questions, and pointed out earlier attempts to make hydrogen systems more common. I also pointed out the use of energy from a hydrogen power source we all use: the Sun. There are two fundamental problems with the visions for converting to "this" technology on Earth: the conversion efficiency of energy in to hydrogen out is poor for current processes: 25% was quoted. The second problem, in the phrase that Frank came up with, is that the fuel is volumetrically challenged. It just takes up too much room. Those large external tanks the shuttle uses are mostly for hydrogen. So conversion and storage are the killers of using this fuel generally. The moderator was Walter Hunt who also asked very good questions with humor and insight. He gave a "best panelist award" to John!

The second panel I was part of was moderated by Laura Burns, a young aerospace contractor, with Dr. H. Paul Shuch, rocket scientist, Mark Wolverton, technology consultant and science writer (see December Sky and Telescope), Frank O'Brien, infrastructure support expert and author, and me. No great leaps where seen by us and, indeed, the U.S. was viewed as slipping behind as other problems where seen to distract from investment and market growth in this area. The sudden collapse of investments last year was a factor in slowing some American efforts. People do want to go. Paul is planning to take a Space Ship Two ride in the future and others are considering it. But that is not space flight as Paul noted in his description of the energies and support needed for orbit and beyond. There are competing programs of both private and nationally sponsored rocket launchers doing business.

We did talk of advanced propulsion and reasons why the obvious, nuclear, would not fly (I would say "but yes; in space" but first you have to get it into space) The views in summary where that unless a major change happened, such as China announcing its time table for space and lunar exploration, we would see mostly satellite and cargo launch capabilities improve with passenger and human explorers very gradually coming along. I could repeat some other pessimistic talk on other areas of science and technology, but, will instead mention our visitors, talk on space from them and recent publications.

We had a number of visitors who thought our table displays where cool. Mitch and I brought a number

of talking point items that the fans enjoyed. I made several new handouts, including pages from *Moon Miners*, and had a good number taken from the table. This included material on the Analog Moon/ Mars habitat and the Lunar Dust Exploration Mission from the September issue. This included Geoffrey A. Landis' poem: "In '69" (ww.geoffreylandis.com).

I also wrote a new lunar lava tubes hand out, "Lunar Lava Tubes for All (Initially)" explaining the advantages of using them. We also had material on Solar Power Satellites (again using Moon Miners material for delivering the message) and a number of magazines. These included the December issue of Wired with its coverage of Space Ship Two (pages 130 to 137), the December and January issues of Sky and Telescope with Amateur Exoplanets and A New Infrared Sky (using the WISE mid I.R. telescope) in December, and Spacecraft Imaging for Amateurs in the January issue, as well as AMSAT's journal (asking for help with funding and technical support, with discussion of financial help needed for the Mars bound P-5 also noted).

The AMSAT journal did have an article that small satellite builders of "the standard model" could use: "A Cubesat Simulator" (part 1). And from Mitch we had his talking point book and his use of this coupled with the Mars globe from Gary Fisher and his own Moon globe. And we found Water! This was cause for some of the visitors to smile and be positive about going. We have another element in the "living off the land" scenarios that we talk of for Mars and now Luna.

It was a great event with Dotty and Larry "manning" the table at times and Larry developing his skills with the camera. We have sorely needed someone with a good camera and connection to our websites to take pictures of our public activities and Larry is ideal. We had the added presence of Dennis Pearson for Saturday, and a cameo by a former PASA member Edward Johnson. We may have more people at our December meeting! And there where the casual conversations with people from everywhere (and when). I talked to someone on middle ages jewish naming conventions in England and a member of The Society for Creative Anachronism who was visiting the Jedi (!) booth next to us.

Note: we should be thinking about judges for the George Washington Carver Science Fair coming up in February and March. Submitted by: Earl Bennett.

CALIFORNIA

SDSPACE.org

San Diego Space Society

http://sandiegospace.org/

info@sandiegospace.org

Meeting the 2nd Sunday monthly

Next Meeting: Dec 13th 2:30 to 4:30 pm
Serra Mesa Branch Library 9005 Aero Dr, San Diego

Quarterly Newsletter: ***The Bussard Scoop***

Saturday, December 12th 1:00 pm to 2:30 pm

Serra Mesa Branch Library: Disney in Space: Walt Disney and the Future of Space Travel in the 1950s

CALIFORNIA

OASIS

OASIS: Organization for the **A**dvancement of **S**pace **I**ndustrialization and **S**ettlement
Greater Los Angeles Chapter of NSS
P.O. Box 1231, Redondo Beach, CA 90278

Events Hotline/Answering Machine:(310) 364-2290
Odyssey Ed: Kat Tanaka – odyssey_editor@yahoo.com

http://www.oasis-nss.org/wordpress/

oasis@oasis-nss.org

Odyssey Newsletter Online
http://www.oasis-nss.org/articles.html

Regular Meeting 3 pm 3rd Sat. each month
Next Meetings: Dec 19th, Jan 16th, Feb 20th
Information: OASIS Hotline, 310/364-2290; website.

Saturday, December 12 3:00 pm, OASIS Board Meeting, Home of Bob Gounley & Paula Delfosse, 1738 La Paz Road, Altadena, CA 91001-3317

February 26-28 – Gallifrey One, Blackjack 21 will be held at the LAX Marriott. This is "our other" annual sci-fi convention event. We will be providing space programming and a fan table for this fun Dr. Who/Torchwood-based convention. http://www.gallifreyone.com/

==========

Intercontinental Chicago O'Hare
Official Hotel of ISDC 2010

http://www.icohare.com/

5300 N. River Road, Rosemont, IL 60018
Phone: (847) 544-5300

To obtain the ISDC conference rate of $115 a night, use the group code NSD.

- Easy access from I-294, I-90, I-190, I-88, I-80, I-94
- Just five minutes from Chicago O'Hare International Airport, with 24-hour complimentary shuttle available
- Only 14 miles from downtown Chicago
- A short drive to the Sears Tower, Navy Pier, Wrigley Field, and the Woodfield Shopping Center

Moon Miners' MANIFESTO

Lunar Reclamation Society Inc.
PO Box 2102, Milwaukee WI 53201-2102

Address Service Requested
Mail Carrier, Time Sensitive Material <==

PRSRT STD
U.S. POSTAGE
PAID
MANASOTA FL
PERMIT No. 802

Please renew promptly so as not to miss an issue

NAME _____

STREET _____

CITY/ST/ZIP _____

PHONE#S _____

- **$45 National Space Society dues** include ***Ad Astra***
- **$20** NSS dues **if under 22 / over 64.** *State age* ___

600 Pennsylvania Ave SE #201, Washington DC 20003

Moon Society dues include *Moon Miners' Manifesto*
Electronic MMM (pdf) **$35** Students/Seniors: **$20**
Hardcopy MMM: U.S. & Canada **$35** - Elsewhere: **$60**
P.O. Box 940825, Plano, TX 75094-0825, USA

INDEX to #231 DECEMBER 2009

p 1. In Focus Editorial: Zubrin: "Earth is to Moon and Mars as Europe to Greenland and North America"
p 3. The Lunar Industrial Seed (conclusion) D.Dietzler
p 5. A Basalt Fiber Industry for the Moon?
P 7. Luna City Yellow Pages: Help Wanted Sectiion
p 8. Augustine Commission Results in a Nutshell
p 9. Moon Soc. Journal; Moon Society India launched
p 10. Remembering Apollo 12 and 13
p 11. Apollo 15's 40th; Analog Moonbase Presentation
p 12. Moon Society Chapters & Outposts Report
p 13. Browsing Links; Video Links
p 14. MMM Photo Gallery
p 15. Misc. News; Size of Lavatube found by Kagua
p 16. Solar Sailing, Take II; LRS Chapter News
p 17. MMM NSS Chapters News

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

=> *For those outside participating chapter areas* <=

- **$12 USA** MMM Subscriptions; • US **$22** Canada;
- US **$50** Surface Mail Outside North America

Payable to "LRS", PO Box 2102, Milwaukee WI 53201

CHICAGO SPACE FRONTIER L5
- $15 annual dues

LUNAR RECLAMATION SOC. (NSS-Milwaukee)
- $12 low "one rate"

MINNESOTA SPACE FRONTIER SOCIETY
- $25 Regular Dues

OREGON L5 SOCIETY
- $25 for all members

O.A.S.I.S. L5 (Los Angeles)
- $28 regular dues with MMM

PHILADELPHIA AREA SPACE ALLIANCE
- Annual dues for all with MMM $25, due in March or $6 times each quarter before the next March

---

SHEBOYGAN SPACE SOCIETY (WI)
- $15 regular, • $10 student,
- $1/extra family member

"SSS" c/o B. P. Knier, 22608 County Line Rd, Elkhart Lake WI 53020