

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

Moon Miners' Manifesto

& The Moon Society Journal

www.MMM-MoonMinersManifesto.com

MMM's 27th Anniversary Issue



This ship will not make it to the Moon. How must our "Moon Ship" be designed both to reach the Moon and open it?

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- **MMM's VISION:** “expanding the human economy through off-planet resources”; early heavy reliance on Lunar materials; early use of Mars system and asteroid resources; and 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.
- **Moon Miners' Manifesto CLASSICS:** The non-time-sensitive articles and editorials of MMM's first twenty years plus have been re-edited, reillustrated, and republished in 23 PDF format volumes, for free downloading from this location: http://www.MoonSociety.org/publications/mmm_classics/
- **MMM THEME Issues:** 14 collections of articles according to themes: [.../publications/mmm_themes/](http://www.moonsociety.org/publications/mmm_themes/)
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- **The National Space Society** is a grassroots pro-space member-ship 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 (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 chapters** and **Other Societies** with a compatible focus are welcome to join the MMM family. For special chapter/group rates, write the Editor, or call (414)-342-0705.
- **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, Text files, and pdf file attachments or mailed CDs, DVDs, or typed hard copy [short pieces only, less than 1,000 words] to:
 Moon Miners' Manifesto, c/o Peter Kokh, 1630 N. 32nd Street, Milwaukee, WI 53208-2040

In Focus “Backing up” our Civilization

Most of us who are online and increasingly dependent on our computers, have learned, sometimes the hard way, how important it is to “backup” everything, lest hours, days, months, even years of work be lost in an instant in a “crash.” But stop to think on a much larger scale, how fragile is everything mankind has achieved and built and learned really is. A global electronic crash is possible given a large enough solar storm.

But beyond that, a large enough asteroid impact could throw us back into the Dark Ages, or worse, because those who lived in that era, knew more about living without modern inventions than we will have remembered.

It is high time to be prudent and work on a strategy to back up our civilization – all we have built here on Earth through the centuries and through the millennia – all that is at risk, until we have backed it up “elsewhere”.

And the most effective, most prudent way to do that is **by becoming a multi-planet species**. We need to backup our civilization on the Moon, and on Mars, and everywhere else we can in our Solar System. This means we must think beyond Antarctic scale “outposts” and work towards real and substantial self-reliant settlements on both worlds. The more the better. If we can do the same in the outer solar system that would be wise.

And by then we should be working on becoming a “**multi-stellar species**.”

“Ad Astra!” “To the Stars!” “Of stardust thou art and to the Stars thou shall return!” – Peter Kokh

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Market Economics: Options for the Moon, Mars, and the Asteroids

By Peter Kokh

Forward

Perhaps a majority of the public, and of the representatives they elect to Congress, and perhaps even a significant number of space enthusiasts, if not a majority, see the value of space exploration – learning more about the Moon, Mars, the asteroids and other bodies in our Solar System. But they do not see “what’s in it for Earth” in the idea of establishing manned outposts on the Moon or anywhere else, let alone permanent civilian settlements.

But when they ask what’s in it for Earth, their horizon’s are limited to Earth itself. They fail to realize that Earth’s economy has already established a significant foothold in space above. The value of operations in orbit above the Earth, particularly in GEO – Geosynchronous Earth Orbit, some x km (mi) above the Earth’s surface where satellites take 24 hours to make a full orbit, the same amount of time it takes Earth below to make one full day–night cycle. The result is that satellites in ‘GEO’ remain “parked” above the same spot on Earth’s equator – for the lifetime of the satellite.

This coincidence makes GEO a very valuable ring of “property” in Space. It is here that we park our weather satellites and our communications satellites for radio, telephone, and television. The amount of business conducted in this orbit, GEO, is now approaching \$300 billion dollars US annually, and growing at an ever faster rate. That’s an amount that exceeds the Gross National Product of many nations.

This valuable real estate in space does have some limits. To avoid interference between satellites in GEO, by international agreement, there are only 180 locations – 2 degrees apart (a circle is 360 degrees) where we can park them. So what do we do if demand for space begins to exceed slot availability?

Host Service Platforms in GEO

One suggestion, that we have made repeatedly, is to put up very large platforms, one at each of the 180 locations, on which platforms an indefinite number of satellites can be parked. Each platform could provide station-keeping service, power, and robotic servicing and repair. The challenge is obvious. We do not have, and may never have, the capacity to launch such platforms from Earth in a ready to go stage. And sending parts up, batch by batch, will be expensive. Further, if we were doing something like this for more than a few of the 180 slots, so many launches may be needed so frequently that atmospheric pollution from rocket exhaust could become a problem. Switching to fuels whose combustion components are environmentally benign will help.

World Power Relay Grid

These platforms are not the only large structures that could be of significant economic value to a world whose population continues to expand at a rate that challenges the growth rate of the economy. We could build another kind of large platform in GEO, one to which excess power generated here and there on Earth can be beamed, then reflected to areas on the planet where power availability is short of power needs. Large “rectennas” would receive the surplus power, then beam it to one or more sites where it is needed. We talked about this concept in MMM #210 November 2007 “World Wide Power Grid.*” This would even out power distribution around the world. There are countries whose capacity to produce power, whether by hydroelectric, coal, wind, nuclear, or other means is significantly more than their own national needs. And there are countries who cannot produce all the power for which there is demand. Again, the components for such a grid need to be fixed in space relative to the surface of Earth below, that means that they must be placed in Geosynchronous Orbit. Could these power dispersing structures combine with the large satellite host-platforms we talked about above? That might be a challenge for designers. * (Republished in MMM Classic #21 – www.moonsociety.org/publications/mmm-classics/)

Solar Power Satellites.

An older concept, especially to those who were enthused by the ideas of the former L5 Society in the 1970s and 80s, many of whom are still influential in the National Space Society, is to use materials mined on the Moon and turned into needed components in factories in space and then assembled into giant solar power satellites, again in GEO, to meet Earth’s ever growing power needs.

Many space advocates whose interest in space comes after this era, see Solar Power Satellites as too expensive, and the idea of using lunar materials too prohibitive. That assessment does not stand up.

The rationale for lunar sourcing of components needed for construction in Earth orbit

Why not manufacture everything here on Earth? Well there are two killer problems with that concept.

- That many heavy booster launches from Earth, from daily to hourly or even more frequently, might have very serious consequences for our atmosphere upon which all life on Earth must be considered.
- It takes only 1/23 the fuel to launch something from the Moon’s surface “down” to GEO as it does it takes to launch the equivalent mass “up” from Earth’s surface to GEO. Now surely, it will cost more to produce components on the Moon, and that will “eat up” some of that 23:1 advantage, but not all of it, probably not most of it.

- There is a formula by which we can decide what parts are best made where. The “MUS/cle” formula: MUS = **mas** – **sive**, one of a kind or few of a kind (**Unitary**), and relatively **Simple** to manufacture – even if the materials used are not as sophisticated or ideal as those we’d pick here on Earth, and even if they are heavier than those we’d manufacture on Earth, the difference in fuel costs may very well still tilt the selection of components to the Moon, rather than Earth. As to the “cle” = complex, lightweight, electronic – we can ship them from Earth.

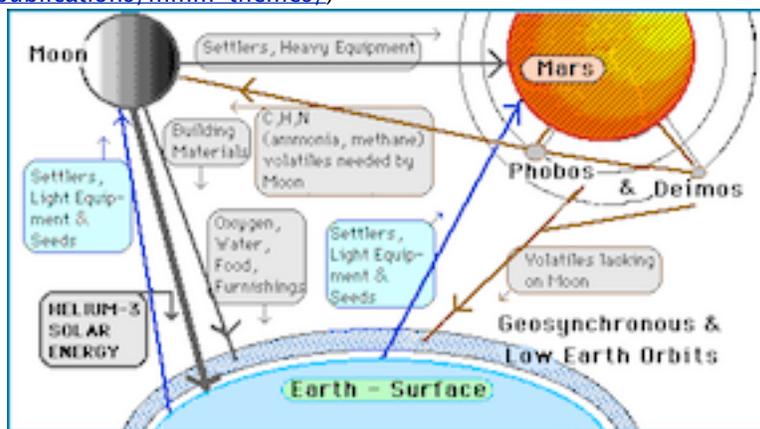
[http://www.moonsociety.org/publications/mmm_papers/muscle_paper.htm]

All this considered, if we can manufacture usable simple and heavier items needed for solar power satellite construction on the Moon, that will make SPS systems more affordable as a remedy for Earth’s ever increasing power needs. And this goes for components needed for the proposed World Wide Power Grid system as well, should we find it unnecessary to use Solar Power Satellites because of increased efficiencies of power needing systems on Earth, of development of new terrestrial power systems (sea bottom methane? etc.)

While we may be able to automate raw materials handling and manufacturing on the Moon, we will still need a permanent population there. The Lunar Economy will have become an essential enabler of a brighter future for the much larger population on Earth. To sort all this out, read “The Import/Export Equation” in MMM #32, reprinted in the “**Lunar Economy**” theme issue (www.moonsociety.org/publications/mmm-themes/)

The Moon will have become an essential part of Greater Earth and the Greater Earth economy

Options for Mars: It is difficult to identify any product that can be made on Mars that could be shipped to GEO (much less to Earth’s surface) at a cost savings compared to Lunar sourcing. Even if products produced on Mars small moonlets Phobos and Deimos could be shipped to Earth at a cost advantage compared to lunar products, that launch windows between Earth and Mars open up only every 25.5 months, and remain open for a relatively short time, make lunar sourcing (daily or even more frequently when needed) much more attractive. In fact, there seems to be no realistic practical market for products made on Mars, other than the Moon. Shipments of liquid ammonia and methane would be welcome on the Moon where carbon, nitrogen, and hydrogen are significantly more scarce than they are on Mars, and possibly on Mars moonlets, Phobos and Deimos. There is no escaping the fact that without the Moon, a viable Martian economy is most unlikely.– reprinted in the “Lunar Economy” theme issue (www.moonsociety.org/publications/mmm-themes/)



Options for the Asteroids: Some asteroids have resources that would be invaluable on Earth. Yet that the Moon has been bombarded by asteroids throughout its history, means that the most convenient place to mine asteroids is right on the Moon’s surface. More, the cost in consumables for sending human crews on missions taking years, render mining them exorbitantly more expensive than prospecting asteroid debris on the Moon’s surface.

Comets are another story, but in general, their orbits are more eccentric, some highly inclined to the ecliptic or main solar system plane, if not also retrograde, orbiting in the opposite direction, than those of most asteroids, making mining comets for volatiles anything but a near term option.

Summary; Unless we want to put unnecessary brakes on Earth’s economy and accept unnecessary hardships as a result, we need to build out an integral component of that economy in Geosynchronous Earth Orbit. And to do that, we need people living on the Moon where perhaps the bulk of needed components can be less expensively produced and shipped “down the gravity well” to GEO rather than shipping them “up the gravity well” from Earth’s surface. The Moon is an asset. Not to use it, means accepting that we (Earth) must accept an unnecessarily limited future. Further robotic exploration will be helpful in determining what resources are best tapped where on the Moon and that definitely means that we must look beyond the Moon’s polar areas. Robotic exploration along with further manned missions, are not an end in themselves. To know and not to use, is not enough. We need to look on the Moon not as a foreign object in our skies, but as Earth’s Eighth Continent, separated, yes, by a different kind of sea, one we know how to traverse.

Back Reading Import/Export Equation (MMM #32 February 1990 – reprinted in the “Lunar Economy” theme issue (www.moonsociety.org/publications/mmm-themes/) ##

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Lunar Spaceport Salvage Yards and the path to Permanent Residence

By Peter Kokh

Importing things needed on the Moon, will always be an expensive proposition, though with new transportation technologies, costs will come down appreciably. Yet many reusable or function reassignable items will make the trip one-way, as part of the various cargo shipping and packaging system.

Here on Earth, people with less money than their needs would seem to demand, are very creative in finding new practical uses for transportation and shipping items that have made their final trip. Take vehicles for example: below are some retired ones turned into homes (of course, on the Moon all housing structures must be shielded):



Anything that makes it to the Moon, or Mars, and is not returning to Earth, is likely to find new use. Through the ages here on Earth, pioneer settlers have always been most ingenious in turning abandoned items into something useful or decorative, something that makes their homes, their recreational opportunities, their hobbies – whatever – “easier, less expensive, and more enjoyable.” And with that, comes considerable satisfaction. Cargo holds will be in demand, but so will fuel tanks, landing legs, crates, boxes, packaging materials, etc.

Indeed there is a very real sense of achievement in putting something abandoned, left over, or unclaimed into new use, whether for lodging, storage, or furnishings: tables, headboards, chairs, lamp bases, planters, jewelry, interesting “whatevers.” The author comes from a long line of “pack rats” and junk collectors know the satisfaction of turning abandoned items into something new and “Shabby Chic”.

In **MMM #65**, May 1993, we ran an article “**Stowaway Imports.**” This article is reprinted in **MMM Classics #7**, a free download: http://www.moonsociety.org/publications/mmm_classics/mmmc7_Jan2006.pdf

Another relevant article was “**Tramp Art**” in **MMM #139**, October 2000, reprinted in **MMM Classics #4** – http://www.moonsociety.org/publications/mmm_classics/mmmc14_July2006.pdf

The same opportunities exist for people stationed in Antarctica, should they choose to live “off base” and get permission to do so. Getting permission may be the harder part, however. See **MMM #256** June 2012 p. 3. **Antarctic Cottage Industries based on “Found” Objects and Materials.**

But far more important than pioneers being able to use salvaged items from the base scrapyards to decorate their private quarters, far more important than their being able to establish homes off base, is that such a “**cottage industry pathway**” is a way to escape the Company Town monopoly, the NASA or International Moonbase monopoly, and establish the humble roots of free enterprise settlement. **Private garden based food canning and other byproducts**, and various **private enterprise services** will also help break the grip.

In the early days of lunar settlement, sources of desired furnishings, and other items may be scarce. But people, like Nature herself, abhor a vacuum, and will creatively “make do” with anything abandoned, or “free for the taking.” This will give their homes or apartments a unique personal flavor, something as priceless as it is satisfying. This kind of free-sourcing will be satisfying to those with creative instincts, those who see new possibilities in anything free or unwanted. And if they give the item a personal “makeover” it will be especially satisfying and appreciated, something that will make their quarters on the Moon, however otherwise plain, spartan and minimal, into a place that feels like “home” because it has been given a personal touch. For some, this will be a source of income.

Again, in the early period of settlement, before there are enough people in a location to warrant on location manufacturing of furnishings and other artifacts, “repurposing” of items that will otherwise just take up warehouse space, will be a popular pursuit. Yet not everyone has the imagination to see a new use for an object made to serve a quite different purpose. Those who do have the imagination, may find conversion and resale of such objects a profitable cottage industry enterprise. There may even be fairs where converted items are judged, or resold. This is just one of many enterprising possibilities on the space frontier.

Why would national or international bases allow these opportunities to be used? That’s simple. Every time someone in the outpost/base “re-ups” or even goes out on his/her own, that is a seat back to Earth that does not have to be paid for. And if the person chooses to remain a full time employee but take advantage of opportunities to make sideline income, or switch to part time, that is a seat or half-seat to the Moon for replacement personnel for which the outpost does not have to pay. Of course, a lot more will be involved when it comes to legalities. But the pathway to lunar settlement, as opposed to temporary workers in “bases” is clear. PK

For past articles, Visit http://www.moonsociety.org/publications/mmm_classics/ or http://www.moonsociety.org/publications/mmm_themes/

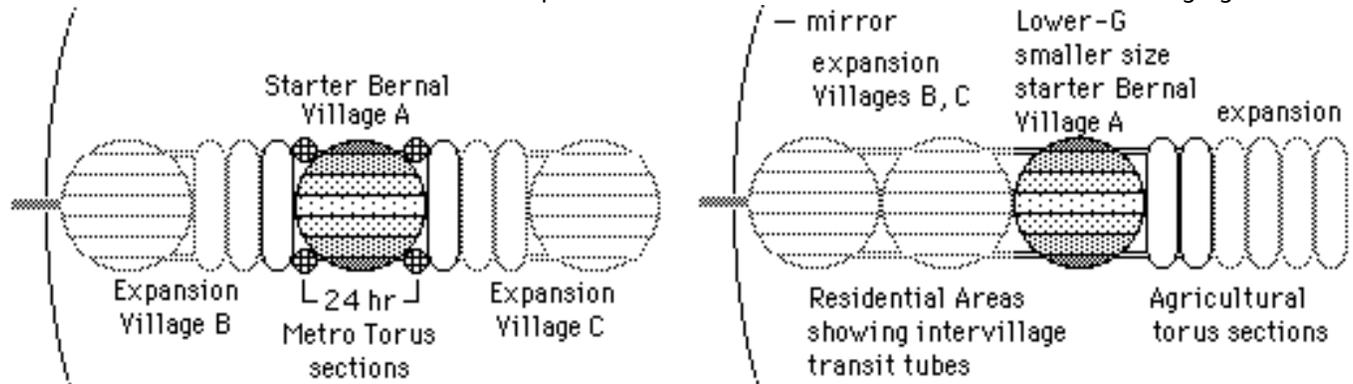
Lavatube and Space Settlements have some Common Design Challenges

By Peter Kokh

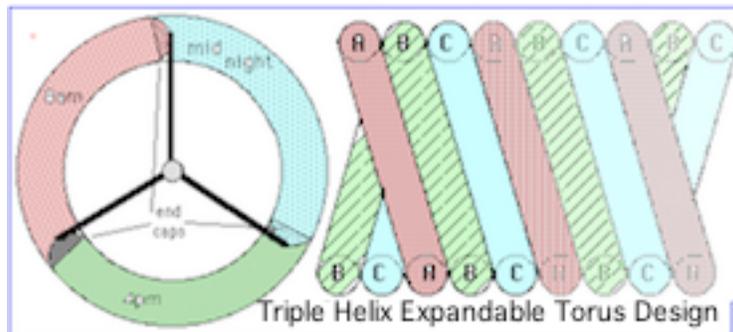
Large Lavatube Settlements could borrow design patterns we have proposed for Space Settlements

In 1995, we wrote a paper pointing out that Space Settlements as proposed and designed by Gerard K.O'Neil and his followers (who accused others of being "planetary chauvinists") could also be accused of incorporating a hidden "day shift" chauvinism, in that everyone lived on the same day-night schedule while factories, to be efficient, **must** operate on a 24 hr, 7 day schedule. www.moonsociety.org/publications/mmm_papers/so_rein.html

We proposed a Tri-Vale "three valley" approach wherein residents would live in three separate neighborhoods with day-night schedules off set by 8 hours. Everyone would work on his/her daytime hours, while manufacturing and other 'round-the-clock' operations run continuously. A shared "downtown" and schools would also operate on all three shifts. Here is how a BernalSphere settlement could be re-rendered to meet this design goals.



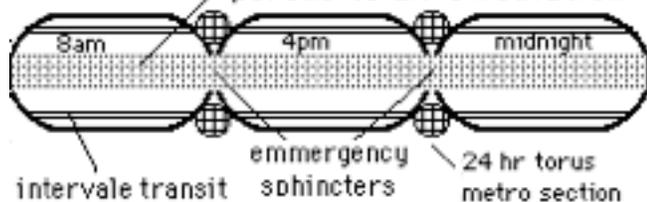
Above: Bernal Sphere Trivale (three valley) Expansion to allow 24 hr manufacturing shifts & a 24 hr. "downtown" with no work shift being at an advantage socially or in any way over the others.



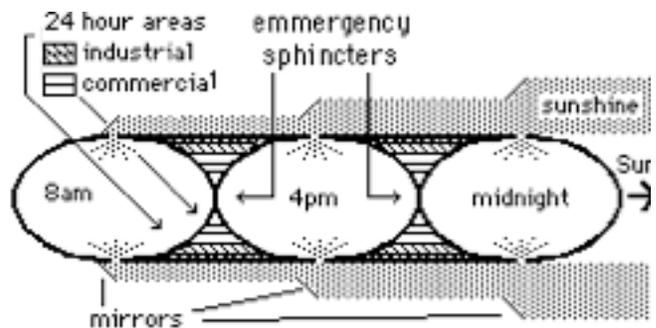
Stanford Torus: three "shift valleys" plus Indefinitely helical expansion along axis of rotation.

Of the Three Designs, it is the torus which has the greatest potential for expansion. Note: We have defined "world" as "an environment from no point in which can the whole be seen." Both the Bernal Sphere and Sunflower Cylinder flunk this test, though providing for three "valleys" helps.

Tri-vale O'Neil Cylinder - 2 designs inner diffraction blue sky cylinder porous to air circulation



Sketch by Peter Kokh



[inspired by drawing by Jeff Sanburg. Skokie, IL]

Lavatube settlements could just as easily be divided into three time/shift-staggered neighborhoods with both a 24 hour "downtown" shopping and business district and 24-hour manufacturing zones.

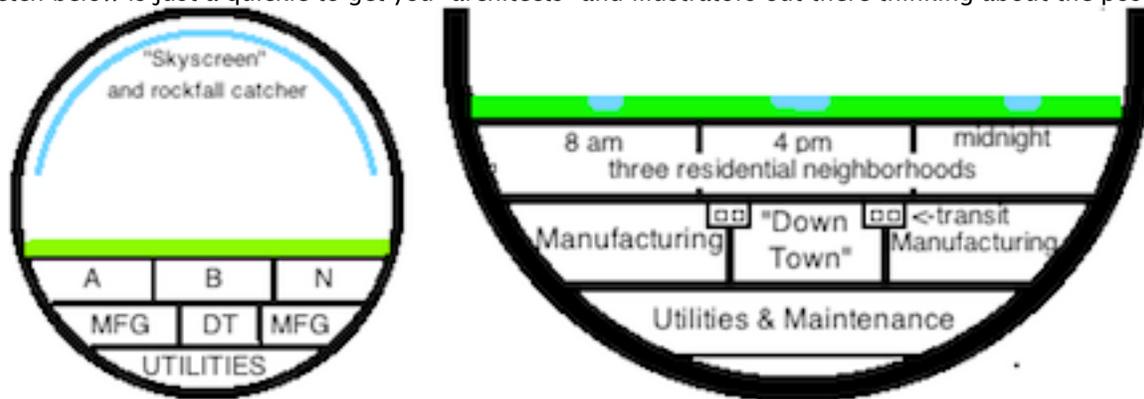
Applications to lavatube settlements

- Divide lava tube settlements into 3 neighborhoods on staggered day/night shift cycles plus one 24 hour downtown and 24 hour industrial area
- Fake sky options: No sky? – Project one – project with a variety of clouds on blue background – at “night” project stars above, accurately, on schedule – sunrise and sunset could be created –
- Advantage over surface settlements – option to recreate Earth’s 24 hour day/night cycle, with seasonal variations, while ignoring lunar surface time, although some lavatube residents will be working on the surface with real “Moon Time” – 14.75 days of sunlight, 14/75 days of starlight.

Disadvantages for lavatube settlements

While lunar lavatubes are far larger in width and height than those on Earth, they are still not of the scale to which space oases can be designed. Further gravity in lava tubes is real and lunar-core-centric, not radial, so only the lower third or so of a tube can be used for settlement neighborhoods, commercial and industrial areas alike. Yet some lunar lavatubes could be many miles/kilometers long and have more room than space oases, not less. But lavatube settlements can start small and grow. Space Settlements have a much higher minimum size threshold.

The sketch below is just a quickie to get you “architects” and illustrators out there thinking about the possibilities.



The three shift scheduled neighborhoods could just as easily be tube wall to wall, one after the other, not adjacent. The setup above more easily allows for expansion of all three “shift hoods.” If they were placed one after the other, the ones at both ends could grow while the one in the middle would be stuck within its original footprint.

- **Important Note: pressurization of lavatube sections is not likely to be feasible in foreseeable future**, so what we propose to model is the surface of a Moon that has been speeded up to 24 hour cycles. still vacuum, but with a bright day sky (not feasible on the surface. Sort of a compromise.
- These are all things that can be done “eventually” – whereas in space oases they must be done from the start
- **Architects, artists, and illustrators are most welcome to send their ideas: mmm@moonsociety.org** PK

The Challenges in Producing Aluminum on the Moon

By Dave Dietzler

Prevailing thought has it that aluminum will be a major construction material on the Moon and in outer space. This is debatable. The problem is that aluminum production requires lots of energy (a minimum of 13–16 kWhrs. per kilogram of Al), and it also demands elements that are in very short supply on the Moon like chlorine, fluorine, and lithium. Asteroids are not rich sources of these elements but Mars has chlorate in its soil so Martians will not face a shortage of chlorine. Chlorine and fluorine are also very corrosive and will take their toll on aluminum production equipment. If they are imported from Earth or even Mars at great cost they must be recycled and no system is without leakage and contamination. So what can we do?

First of all, we can use other materials that are plentiful. Basalt fiber reinforced basalt and glass fiber reinforced glass and even foamed glass come to mind for SPS frame construction and lunar construction. Iron, nickel, steel, ceramics like fused anorthite, basalt, silica, alumina, titania, and magnesium can be produced on the Moon with available materials. Magnesium is an excellent reflector and a fairly sturdy lightweight material for vehicles and spacecraft and it will not burn in the vacuum. Plain steel and iron will not rust in the vacuum. Yet, copper is almost non-existent except for traces on the surface of pyroclastic glass beads, and so aluminum is our only realistic electrical conductor. Calcium is a superior conductor but it can ignite spontaneously in air and calcium metallurgy is not highly developed; so out-vac although lunar power lines might someday be made of calcium we will still need aluminum. But what about space colonies? Perhaps they can be made of asteroidal iron and carbon (steel) and prestressed concrete instead of aluminum.

Dr. Peter Schubert has patented a device that can produce silicon, aluminum and other solar panel ingredients that does not use any chemical reagents lacking on the Moon; however, it does require some exotic materials

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not available on the Moon. I still like his machine because it will not endure corrosion by halogens nor will it require imports of reagents and recycling. If we make those parts of the machine with lunar materials that we can and only import exotic parts like the thorium oxide free fall shaft and platinum–rhodium bushings we can scale this thing up. Better yet, if we can extract platinum from meteoric iron fines which are also our source of nickel for steel or buy platinum from asteroid miners much cheaper than imports from Earth we will make those bushings on the Moon. Platinum–rhodium bushings are also needed for drawing basalt filaments. Magma electrolysis typically might use platinum electrodes but cheaper alternatives are ceramics that are conductive at high temperatures.

From: <http://www.moonsociety.org/spreadtheword/pdf/UsingMoonRockstoSavetheEarth.pdf>

We find that Dr. Schubert's Lunar Dust Roaster and All Isotope Separator consists of:

- Hopper 257 kg.
- Free Fall Shaft 143 kg.
- Supersonic Nozzle 44.8 kg
- Drift Tube 9.69 kg.
- Expansion Bell 1.28 kg
- Pumps and cryochillers 62 kg.
- Passive cooling pipes 260 kg.
- Storage tank 100 kg.

Subtotal 876 kg.

Grand Total with power supply 1302 kg.

Yearly oxygen output with sunlight 70% of the time at a polar location is 61 metric tons. From 1.3 tons of equipment that isn't bad at all. What if we make the storage tank(s), passive cooling pipes, pumps and cryochillers out of lunar steel in 3D printers? This gets us down to 880 kg. If we make the SS nozzle out of some lunar ceramic we are down to 835 kg. Since we will use the first few units to make solar panels and wires for more units, we can stop importing power supplies and make those on the Moon too and this will mean that subsequent units will only amass 409 kg. imported from Earth. The expansion bell could be made of a lunar ceramic: that knocks us down to c. 408 kg. When we get the hopper made of a lunar ceramic and lunar platinum bushings we are down to 151 kg.

Since oxygen is 40% of the regolith on the average, silicon is 21% and aluminum is 7% we can estimate that this device will produce 30 tons of silicon and 10 tons of aluminum per year. If we make most of the device on the Moon, and import enough stuff to make one hundred of them, or 15.1 tons, we can produce 6100 tons of oxygen every year with 3000 tons of silicon (enough for plenty of solar panels) and 1000 tons of aluminum (enough for plenty of conductors). The machine should not endure too much wear. I only worry about the Pt–Rh bushings but those could be refurbished with lunar and/or asteroidal PGMs [platinum group metals]. The steel pumps might wear out but we can just rebore and re–ring them.

How do we extract the platinum? On Earth complex aqueous chemical processes are used involving nitric acid and other nasty stuff. I am venturing to say that we can take meteoric metal fines and run them thru the LDR–AIS and separate the iron, nickel, cobalt, germanium and PGMs found in those particles.

The value of iron might not seem to be very high unless you are doing construction on the Moon and don't want to pay for imports! Nickel is used as a chemical catalyst. Cobalt is used for high speed drill bits. Germanium for electronics. And PGMs have many uses including bushings for LDR–AIS hopper, basalt fiber drawing, and more. So this machine offers materials of high value besides oxygen, silicon and aluminum.

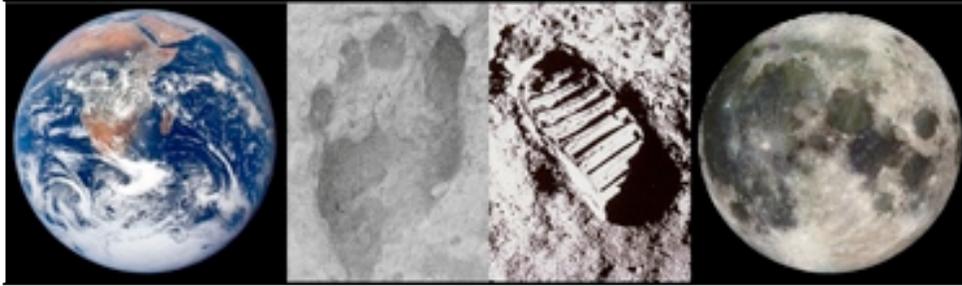
When we start mining KREEP we could separate out the potassium and phosphorus by simple high temperature roasting then run the leftover material thru the LDR–AIS to get REEs which have many uses including magnesium alloys, thorium and uranium. Chemical processes for REE extraction are very complex and involve water and various acids and that's not desirable on the bone–dry Moon. KREEP [Potassium, Rare Earth Elements, Phosphorus] only contains about 10–50 ppm thorium but if we get some of these devices going and get some thorium we can make the ThO₂ free fall shaft that amasses 143 kg out of the last 151 kg imported and we can then import only 8 kg per machine if that much even. We could probably make the whole machine on the Moon. Of course we have to process a million tons of KREEP to get 10 to 50 tons of thorium.....

Given the abilities of the machine, it should pay for itself by the production of all sorts of lunar materials including high value stuff like PGMs, REEs, Th and Uranium nuclear fuel. The cost of importation of complete initial units and partial units after that once we get lunar parts production going will be offset by the value of these high priced commodities. Thus, the Lunar Dust Roaster and All Isotope Separator is a good investment.

Furthermore, a slag of CaO and MgO results and this can be mixed with pure silicon or crude ferrosilicon from magma electrolysis and heated to about 1200 C. under vacuum. Magnesium vapor will boil off and be condensed. The only other ways to get MgO are the roasting of anorthite during cement production and sulphuric acid leaching to get sulphates of Al and Mg which are then separated and roasted to alumina and magnesia. While it should be possible to make acid leaching equipment on the Moon from basalt, I hate the complexity of the devices involved and the need to use precious water. The LDR–AIS is an entirely dry process and that's worth much on the Moon, a desert drier than any on Earth.

DDZ

From Africa
to the Moon,
the Human
Epic, told in
footprints,
Continues
to the Stars!



Our Goal is
Communities
on the Moon
involving
large scale
industrializa-
tion and
private
enterprise.

The Moon Society Journal Section (pages 9–12)

About the Moon Society

Objectives of the Moon Society include, but are not limited to:

- **Creation** of a spacefaring civilization, which will establish communities on the Moon involving large-scale industrialization and private enterprise.
- **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 and utilizing the Moon.
- **Informing** the public on matters related to the Moon
- **Provision** of suitable recognition and honor to individuals and organizations that have contributed to the advancement of the exploration, research, development, and habitation of the Moon, as well as scientific and technological developments related thereto.

Our Vision says it all – “Who We Are and What We Do” – www.moonsociety.org/spreadtheword/whowhat.html

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, from all walks of life, 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, competitions & contests, workshops, ground level research and technology experiments, private entrepreneurial ventures, moonbase simulation exercises, tourist centers, and other means.

Interested in having input? Any member may ask to join the Leadership Committee and attend our Management Committee meetings held twice monthly. You may even express opinions. Decisions are often made by consensus, so this input has value. Write president@moonsociety.org

From Moon Society President Ken Murphy

December is turning out to be quite a month for Moon fans. Chang'e-3 is on its way to the Moon, with a landing anticipated for mid-month. This will supplement the LADEE and LRO missions currently in lunar orbit. This month also marks the release by Google Lunar XPrize of their new planetarium show '**Back to the Moon: For Good!**' highlighting efforts of international teams to place rovers on the Moon. Companies like Golden Spike and Shackleton Energy continue to be in the news.

At the same time, STEM initiatives are starting to come to the fore, and space is the most effective STEM hook that there is. Not only does space encompass most all of the other scientific disciplines, but it also ignites a passion of interest far more quickly and easily than just about any other topic of scientific interest.

Still, space still has something of a mythical, 'science fiction' air to it. It seems so difficult to imagine things like Moon bases and asteroid journeys as an actual reality, and not just the idylls of brilliant minds. Seeing it as an actual, direct contributor to our economy remains beyond the capacity of most to conceive.

The Moon Society – Lunar Frontier Settlement – www.moonsociety.org p.2

This can change. Greater private investment in the industry is greatly needed, but the way our financial ecosystem has evolved has effectively block potential investment. Money that in generations past might have been used for such investment has instead been captured into 401K and IRA plans with limited options. Institutional investors lack the analytical capability to be comfortable with the sector. Angel investors have been unable to bring sufficient heft to the sector for the growth that is needed.

In a sense, we're in a kind of stand-by mode. The industry is poised for growth, lacking only sufficient capital. The public is looking to NASA for guidance in our space activities, as they've always done, while NASA struggles under Congressional mandate and its own ossified systems to figure out just what it is that it should be doing. It's a pickle.

One of the best things that members of The Moon Society can do is to carry the message of the Moon as a place of exploration, of science, and of development. It is our sandbox mode for the solar system; the place where we will learn how to live and work off-Earth. This is a potent message that members can convey to their communities, one that promises future economic benefit, a concept that's desperately needed right now.

On the solstice I will be doing exactly that, with a series of presentations as part of a Winter Moon Fest that will cover Moon 101, Cislunar Space, and Future Moon. This will be complemented by screenings of the GLXP Planetarium show, and displays from local groups.

Let us know what you're doing in your community so that we can share it with the membership. We want to hear your stories.
Ken Murphy, Moon Society President

December **Chapters & Outposts** 2013

MOON SOCIETY CHAPTERS

Moon Society ST. LOUIS Chapter – <http://www.moonsociety.org/chapters/stlouis/>

Contact: Robert Perry surfer_bob@charter.net – Meetings 2nd Wed monthly at Buder Branch Library, 4401 S. Hampton, in the basement conference room – Next meetings – **JAN 8 – FEB 12 – MAR 12 – APR 9**

The St. Louis Moon Society chapter had their regular meeting on November 13th with Bob Perry, David Dietzler, Karl Strassman, Tom Kullman, Mark Rode, and Jim Merimann attending. With Mark's 16:9 projector and Karl's laptop Bob showed a video he had archived to a thumb drive from YouTube, "Solve for X: Peter Diamandis and Eric Anderson on space exploration". The title is a bit misleading – their company, Planetary Resources, Inc. will launch a cubesat in 2014 to verify their mini satellite's lasercom system and its telescope's ability to find small NEAs. NASA's search for one kilometer and larger NEAs, asteroids large enough to cause a global catastrophe if they impacted, has discovered about 90% of them – the discover rate for such large NEAs has rolled off to a mere trickle of new ones. But the discovery rate for 140 meter sized NEAs, the "city busters / region wreckers" is climbing – only about 8,000 have been found and there must be, literally, a million of them. Note that the "Chelyabinsk event" resulted from a 15 to 20 meter asteroid coming in from the direction of the sun, and thus unnoticed.

Planetary Resources, Inc. intends to find and use asteroids that are easier to access than the surface of the Moon. Bringing resources from such asteroids to LEO is much easier than bringing them up from the surface of the Earth, especially when you are talking tons. Some asteroids have water ice as well as hydrated minerals. Others are nickel-iron with platinum group metals. Water is valuable for several reasons – for life, for radiation shielding, and especially for electrolysis to provide fuel and oxydizer, sure to be a large market. PGMs can easily be exported to Earth for established and new uses. Several hundred pounds can be formed into something like steel wool and de-orbited. With effective density similar to a wiffle ball, such an object would decelerate quickly. In the Q & A after their presentation, Eric was asked about depressing the current price of \$1500 per ounce for platinum. He replied that new uses would be found and the demand would go up, just like what happened to aluminum whose metallic form was once more valuable than gold and now it's everywhere.

Bob followed up the YouTube video with the "Asteroid Mining" Power Point presentation he gave at Archon37. Before asteroids can be mined, they must be found. NASA and Planetary Resources will be joined in the search in 2016 by the B612 Foundation when they will launch Sentinel. B612's infrared space telescope will be at Venus' distance from the Sun and will find "small" asteroids that are much more obvious at infrared wavelength than optical wavelengths. The typical asteroid is as black as a piece of charcoal but is warmed by the sun and really glows in IR. Sentinel should find 10,000 new asteroids per month. Once found and tracked for an appropriate amount of time, their orbits will be calculated. If any will impact the earth, well, that's another story.

St. Louis Space Frontier Society (NSS) report: we had 13 members at our November meeting at the Arch Reactor location in St. Louis. Saw a movie and heard a presentation about sending a balloon up 20 miles. Had a tour of the facility where members pool their resources to build things and saw a 3D printer in operation.

For past articles, Visit http://www.moonsociety.org/publications/mmm_classics/ or http://www.moonsociety.org/publications/mmm_themes/

The Moon Society – Lunar Frontier Settlement – www.moonsociety.org p. 3

Christine Nobbe, Amy White, Jim Merriman, and Bob Perry – all members of both The St. Louis Space Frontier, a chapter of the National Space Society, and the St. Louis chapter of the Moon Society – participated in the 10th anniversary event of the Challenger Learning Center at the CLC facilities and the adjacent McCluer South-Berkeley High School on November the 16th. Bob brought the "gravity bricks" and several posters; Jim brought the chapter's plackard with logo; Christine, pictures of proposed facilities on the Moon and Mars and a large number of LEGO bricks for creating models; and Amy, one of her telescopes and a picture of astronauts on Mars on a far wall and her laptop with Mars information. All had many conversations with kids and their families and friends.

We had a second "floating" meeting, at ArchReactor, www.archreactor.org, a "maker" organization on Tuesday, November the 19th. We were invited to that open house by our member Colleen Forrest who is also a member there. We had a tour of their space – a metal-working and wood-working area; their prototyping area including an UltiMaker 3D printer and a laser cutter; a snack area with refrigerator and microwave; and a lounge area with a wall of white board and a 16:9 projector. The business meeting, in the lounge area, called by our president, Paul Baldwin, was brief with a short discussion on where to hold the December meeting, a summary of our participation of the CLC anniversary event, a reminder to pay the modest \$10 chapter dues to our treasurer, Philip Newell, and a request by Bob Perry for each member to enter his or her information in an attendance DOC in his laptop. Thirteen members signed in: Paul A. Baldwin, Stephen Block, Barry Branham, Dave Dietzler, Colleen Forrest, Chris Jensen, Larry Krupp, Sally Kula, Jim Merriman, Philip Newell, Bob Perry, Karl Strassman, and Judy Tippet. After the meeting we were treated to a presentation by Derek Sigler of ArchReactor with video from twenty miles up. He told us that he has had five balloon launches with payloads of a GPS system, a ham radio tracker to report the GPS info, and a cell phone to report the video. Amazing. And, of course, we ordered pizza and socialized. Bob Perry
Our next meeting is on Friday, Dec. 6, at the St. Louis Science Center, to help celebrate the Planetarium's 50th anniversary. We will be able to enjoy special events AND we will have an exhibit table. The event runs from 6 – 9 PM

Greater FORT WORTH Space Chapter c/o Patricia Ferguson tricia3718@gmail.com (meeting online)

JOINT MOON SOCIETY / NATIONAL SPACE SOCIETY CHAPTERS

NSS/Moon Society PHOENIX Chapter – <http://nssphoenix.wordpress.com/> – c/o Mike Mackowski.

Meeting 3rd Saturdays monthly at HSGP Community Center, Mesa, 627 W. Rio Salado Parkway. – Mike Mackowski
JAN 18 – FEB 15 – MAR 15 – APR 19 – MAY 17 – November 16 meeting notes: Our guest speaker was Henry Vanderbilt of the Space Access Society) who gave us an update on the NewSpace business. He surveyed the current space-launch scene, with particular attention to the emerging low-cost commercial contenders and the different constraints and issues they're dealing with. We are planning a holiday party in mid December. We are looking for ideas for venues or perhaps a member to host it at his/home.

NSS & AIAA Trip to the Lava River Cave, Coconino National Forest, Coconino County, Arizona. October 26, 2013. Report by **Rick Kale** (an ASU student and Phoenix AIAA member who led the trip.)

On Saturday, October 26th, 2013 a group of AIAA Phoenix and NSS members took a trip to the Lava River Cave (Lava Tubes) near Flagstaff, Arizona. A carpool was arranged for those interested by meeting at the Happy Valley Park and Ride. A total of 13 people attended the event (10 via carpool from Phoenix, 3 met at the cave).



Post-Hike Group Portrait (minus 1)

Entrance to Lava River Cave (hard to tell scale, but those are large rocks)

The concept for the trip was to investigate the possibility of using a subterranean tunnel on the Moon as an environment for manned living space and of course have fun while doing it. As the cave was explored, this idea was pondered by various members of the group. One of the first observations to be made was during the initial climb down into the cave. A safe path over loose rocks and areas with low ceilings had to be navigated in order to reach the main part of the cave. It was noted that explorers of a similar extraterrestrial tunnel would require compact and flexible spacesuits to safely move in that type of terrain or a robotic system employed first.

For past articles, Visit http://www.moonsociety.org/publications/mmm_classics/ or [mmm_themes/](http://www.moonsociety.org/publications/mmm_themes/)

The Moon Society – Lunar Frontier Settlement – www.moonsociety.org p. 4

Once in the main tunnel the space opened up and seemed like a suitable location to build a facility to live in. While the main cave structure would be large enough to build such a facility, the challenges associated with doing so were also recognized. As mentioned above, repeated access to the tunnel would be difficult so digging a shaft may be required to make it easier. The structural stability of the cave would also have to be carefully reviewed since visible rock fractures and falls were present throughout the cave. Lastly, the temperature of the cave was about 35–40 degrees Fahrenheit. In order to make a comfortable living space, insulation would be required to keep that space warm, and pressurized in the case of the Moon. This would all require extra equipment to be sent to the location at increased expense. Any construction equipment would likely also be heavy compared to a surface exploration rover/buggy.

Being in the cave itself was a different environment than what is experienced in daily life. During a break, everyone shutoff their flashlights and just sat quietly for a few moments. There are few places that offer an opportunity to experience no light and nearly no sound. A decision was made at the end of the hike to all go to a restaurant in Flagstaff for lunch/dinner. This allowed for some socializing among the group before the trip back to Phoenix. Overall, everyone had a fun and enjoyable day. Rick Kale

TUCSON L5 Space Society – <http://www.tucsonspacesociety.org/> Now serving Moon Society Members
Contact: Al Anzaldúa – Meets monthly, every 2nd Saturday, 6:30 PM **JAN 11 – FEB 8 – MAR 8 – APR 12 – MAY 10**

Clear Lake NSS/Moon Society Chapter (HOUSTON) – <http://www.moonsociety.org/chapters/houston/>

Contact: Eric Bowen eric@streamlinerschedules.com – Meeting 7 pm in the conference room of the Bay Area Community Center at Clear Lake Park – Even # months, changing to Odd # months in 2014 (to be confirmed: _

November 18th Meeting Report: Thanks to everyone who attended our meeting this past Monday night. Our chapter had one of its best turnouts so far; the food and beverages may have helped contribute to that. Based on the reception to the refreshments at our last few meetings, I hope to make that a regular feature of future meetings. We also enjoyed a very informative talk about activities at the Golden Spike project's workshop held in Houston last month, presented by Larry Friesen.

There was one very important item of discussion which I need to call to the attention of our leadership in the National Space Society and the Moon Society: We are changing our regular meeting dates. For the past five years we have met on the third Monday of odd-numbered months except when there was a conflict with holidays or major space related events.

However, this scheduling means that we always run into conflicts with ISDC, LPSC, and Martin Luther King day. After some discussion the members present agreed that for 2014 we would continue to schedule our meetings on third Mondays, but that we **would shift from the odd- to the even-numbered months**. The precise dates will be published after our host, the Bay Area Community Center, has a chance to review and confirm availability. In addition, if opportunity presents we are looking to sponsor a social gathering sometime in the month of December this year. If this happens we will send out notices as soon as the particulars are confirmed.

At the November meeting we held our annual election of officers. For the year 2014 the chapter officers are Eric Bowen, president; Doug Hall, vice-president; and Jay Lewchanin, treasurer. Marianne Dyson was re-elected to a seat on the chapter board of directors. The position of chapter secretary and two board member slots remain open; if any member has an interest in serving in those capacities then by all means let us know.

We are planning a Christmas party in the home of one of our members on Monday, December 16. Members, their family members, and their guests are welcome. We ask that you make other arrangements for pre-teen children as alcohol will be served. See the Chapter web site for full particulars. – Eric H. Bowen

MILWAUKEE Lunar Reclamation Society (NSS/Moon Society) – (Publishers of Moon Miners' Manifesto)

<http://www.moonsociety.org/chapters/milwaukee/> Contact: Peter Kokh kokhmmm@aol.com

Mayfair Mall lower level Garden Suites East Room G110 – 2nd Saturdays 1–4 **JAN 11 – FEB 8 – MAR 8 – APR 12**

The upcoming December 14th meeting will be our 27th Anniversary pot-luck & sci-fi film special!

Moon Society OUTPOSTS (2 or more local members in search of more and not yet organized)

Bay Area Moon Society, CA Outpost – South San Francisco Bay – <http://www.moonsociety.org/chapters/bams/>

Contact: Henry Cates hcate2@pacbell.net Meeting the 1st Tuesday of the Month at Henry's home

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

Moon Society members who live in other areas are encouraged to check to see if there is a **National Space Society chapter** nearby. If two or more Moon Society members join an NSS Chapter, that Chapter could be listed as a joint chapter (if they so wish). Here is where to check: http://chapters.nss.org/a/lists/#US_Chapters

If you do have an NSS chapter in your area, and their meeting times and places are convenient for you, why not take in a couple of meetings? It will be a start!

GREAT BROWSING LINKS

SPACE STATIONS + COMMERCIAL SPACE

<http://www.space.com/23237-virgin-galactic-spaceshiptwo-science-flights.html>
<http://www.space.com/23503-google-lunar-xprize-milestone-prizes.html>
<http://www.space.com/23527-olympic-torch-spacewalk-webcast.html>
http://www.spacemart.com/reports/What_might_recyclable_satellites_look_like_999.html
<http://www.bbc.co.uk/news/world-europe-24881425> (Sochi Olympic Torch on ISS)
<http://www.urthecast.com>
Gunter's Space Page - <http://space.skyrocket.de>

MOON

http://www.space-travel.com/reports/Shanghai_built_lunar_rover_set_for_lunar_landing_999.html
NASA GRAIL findings - <http://www.jpl.nasa.gov/news/news.php?release=2013-322>
http://www.space-travel.com/reports/Moon_mission_yields_clues_to_face_of_moon_999.html
www.spacedaily.com/reports/Historic_Demonstration_Proves_Laser_Communication_Possible_999.html
<http://www.space.com/22680-nasa-lunar-laser-communications-experiment-infographic.html>
<http://nextbigfuture.com/2013/11/asteroids-can-be-moved-into-lunar.html>
<http://www.space.com/23503-google-lunar-xprize-milestone-prizes.html>
<http://moonandback.com/2013/11/25/penn-states-google-lunar-xprize-team-lunar-lion-sets-launch/>

MARS

<http://timesofindia.indiatimes.com/india/Isros-frugal-Mars-mission-launchpad-for-India-in-global-space-market/articleshow/25546753.cms>
<http://www.newyorker.com/online/blogs/elements/2013/11/a-mission-to-mars-on-the-cheap.html>
www.forbes.com/sites/saritharai/2013/11/07/how-indias-isro-launched-its-mars-mission-at-cut-rate-costs/
http://articles.timesofindia.indiatimes.com/2013-11-07/india/43773125_1_spacecraft-orbit-istrac
<http://mars.jpl.nasa.gov/programmissions/missions/future/maven/>
<http://en.wikipedia.org/wiki/MAVEN>
<http://www.livescience.com/31650-mars-like-places-on-earth.html>
http://www.marsdaily.com/reports/Martian_moon_samples_will_have_bits_of_Mars_999.html
<http://www.space.com/23587-curiosity-s-road-on-mars-where-its-been-and-where-its-going-video.html>

ASTERIODS

<http://www.space.com/23501-russian-meteor-explosion-asteroid-threat.html>
Smaller asteroids greater threat -
<http://online.wsj.com/news/articles/SB10001424052702304448204579181823461263590>

OTHER PLANETS + MOONS

http://www.spacedaily.com/reports/UI_Researchers_Help_Decode_New_View_of_Saturns_Moon_Titan_Contribute_to_Cassini_Mission_999.html
http://www.spacedaily.com/reports/On_the_Path_to_Pluto_5_AU_and_Closing_999.html

ASTRONOMY + ASTROBOTICS

<http://phys.org/news/2013-11-astronomers-key-common-habitable-planets.html>
Largest Structure in the Universe - <https://medium.com/the-physics-arxiv-blog/267ddcb8057b>

EDUCATION + OUTREACH + MEDIA

<http://www.space.com/23240-3d-printing-space-photos-amaze-program.html>

BOOK REVIEWS

"Alien Universe" by Don Lincoln reviewed by Jeff Faust <http://www.thespacereview.com/article/2397/1>

SPACE VIDEOS

<http://moonandback.com/2013/10/29/dream-chasers-first-free-flight-approach-and-landing-test/>
<http://www.space.com/23526-barren-blasted-mercury-revealed-in-new-fly-over-time-lapse-video.html>
www.space.com/23525-why-is-mars-a-desert-wasteland-nasa-maven-mission-will-investigate-video.html
India's Mangalyaan mission to Mars - <http://www.youtube.com/watch?v=whjipGPAHIE>
<http://www.space.com/23424-amazing-3d-mars-video.html>
<http://www.space.com/23373-huge-martian-landforms-detail-revealed-by-european-probe-video.html>
<http://www.space.com/10214-galileo-imperfect-world-moon.html>
<http://www.space.com/20400-the-search-for-another-earth.html>
<http://www.space.com/23540-olympic-torch-taken-out-on-spacewalk-video.html>

<http://www.space.com/23426-chris-hadfield-gives-surprise-performance-at-space-com-video.html>
Peter Diamandis and Eric Anderson on Space Exploration <http://www.youtube.com/watch?v=dVzROkzkIRE>
<http://www.space.com/23437-one-in-five-sun-like-stars-have-goldilocks-planets-video.html>
<http://www.space.com/23445-mars-missions-superfast-propulsion-incredible-technology.html>
<http://www.space.com/23532-3d-printer-space-station-video.html>
www.nasa.gov/press/2013/november/levar-burton-shares-maven-s-story-in-a-new-nasa-psa/
<http://www.space.com/23704-commercial-space-program-closer-to-human-transport-video.html>
<http://www.space.com/23703-ladee-starts-science-operations-from-lunar-orbit-video.html>
<http://www.space.com/23711-how-to-deploy-tiny-satellites-from-space-station-video.html>
<http://moonandback.com/2013/11/24/asteroid-minings-importance-explained-planetary-resources/>
<http://moonandback.com/2013/11/25/lunar-lion-to-the-moon/>
<http://www.youtube.com/watch?v=ABAKb22YtnC> (asteroids)

Robots doing the Gangman Style

<http://www.youtube.com/watch?v=kmejvkN4ntI> <http://www.youtube.com/watch?v=51vQo-imc4Q>
<http://www.youtube.com/watch?v=3X5YUzSOsCI> <http://www.youtube.com/watch?v=pkL8xyUK4LY>
<http://www.youtube.com/watch?v=ml9WORziVsl>



November 8, 2013 "phileklund@aol.com" writes:

"I was always taught that lunar orbits were unstable, even satellites at Earth-Luna L1 and L2 required weekly station-keeping impulses. But this article [link below] shows that retrograde orbits within a certain radius from Luna and within the Earth-Luna orbital plane are stable.

These are called **Selenocentric Distant Retrograde Orbits (SDRO)**.

Of particular interest are having space colonies in SDRO for directing robonautic operations on the lunar surface. It includes a plot of two different approaches to SDRO insertion, one using a close pass (like a Moon boost) and the other a more distant insertion. (Both assume high thrust engines that operate only for a brief period, with two impulses for the close pass and one for the distant insertion)."

<http://nextbigfuture.com/2013/11/asteroids-can-be-moved-into-lunar.html>

- Address your comments and letters to mmm@moonsociety.org or to kokhmmm@aol.com



The **American Lunar Society** is dedicated to the study of Earth's Moon. Members receive the quarterly journal **Selenology** which includes results of members' projects and examinations of historical and current scientific research. Members include amateur astronomers and others interested to the continued study of Earth's Moon'

This is accomplished through both observation and attention to current research. ALS goals also include the education of our youth through age-specific projects. ALS created the **Lunar Study and Observing Certificate program** now cosponsored by the Moon Society. Despite the name, ALS has a worldwide international membership.

ALS has been collaborating with Milwaukee Lunar Reclamation Society, publishers of Moon Miners' Manifesto since the summer of 1987. MLRS is now a joint chapter of the Moon Society and of the National Space Society.

SELENOLOGY is the Quarterly Publication of the American Lunar Society, An Affiliate of the Moon Society since 2005. Many issues of Selenology run an ad for the Moon Society and MMM.

Moon Society members can use their username and password to download pdf files of these publications by going to <http://www.moonsociety.org/members/selenology/>

Hardcopy subscriptions of future Selenology issues can be had by sending \$15 US (checks payable to "American Lunar Society" to Andrew Martin OFS, 722 Mapleton Road, Rockville, MD 20850.

Questions about membership and/or subscriptions? Email steveboint@earthlink.net

For past articles, Visit http://www.moonsociety.org/publications/mmm_classics/ or http://www.moonsociety.org/publications/mmm_themes/



Marshall Mike Moondust and the Sinister Selenian Subterfuge

[MMM Fiction by George von Mond]

MISSED PREVIOUS INSTALLMENTS? The whole series is now online, Chapters I-XII (1-12):

<http://www.moonsociety.org/publications/fiction/MMMSSS.pdf>

Chapter XIII

Mike fought down the natural panic response as his flimsy temporary helmet gave way under the onslaught of a projectile. He relaxed his lungs to let the air flow out as he stumbled through the still opening outer airlock door. Desperately he punched at the emergency close button as the edges of his vision started going grey. Focusing his calm, he held a finger over the emergency flood button as he waited for the outer door seal indicator light. After a seeming eternity, his last sight noted the seal and he punched the button that would flood the airlock with life-saving oxygen.

As he recovered his senses, Mike looked around the airlock. The inner door signaled green, indicating that the pressure level matched the interior of the emergency shelter. Opening the door, he quickly located the suit locker and grabbed a new helmet that he set into place. He also grabbed a spare oxygen bottle that he clipped to his suitback.

With his immediate security established, Mike scanned the remainder of the shelter. There was a comm station, but Mike was sure it only communicated with the operations center below. Otherwise it was your typical emergency solar storm shelter - some folded cots, a supply of food, some boardgames and an e-book reader, as well as the obligatory video panel. A light flashing at the comm station indicated that the control center had been informed of the occupation of the shelter and was requesting a status update.

Mike leapt to the airlock and prepared to return to the surface. There was still the issue of the unknown sniper outside, so Mike grabbed one of the folding cots and the suit from the locker. He scanned through the small window in the door to locate some cover, inviting a sharp tick and the view of a small web of fractures growing in the glass. Clearly his assailant was waiting for him. Mike crouched beside the airlock door as it opened to vacuum of the lunar surface, then pitched the cot through the opening. It silently flew through the vacuum, silently shredding as projectiles ripped through it. Mike paused, gauging the source of the fire, then threw the spare spacesuit as hard as he could while bolting through the door in a different direction. Mike dove behind cover as projectiles sparked in their ricochets off the equipment around him. He scooted around behind a large digging unit, looking around to take stock of the situation.

A number of converted mining units were moving off towards the horizon, presumably continuing their attack on the cities of Luna. Below him and to the side, he could see the large airlock of the huge cavern deep below him, its disgorgement of assault vehicles slowed to a trickle, presumably the result of his venting of the cavern to space. He shuddered to think of the lives lost in that act, but they were men and women who had chosen an evil path, one of tyranny and oppression. A path chosen in the selfish hope of special treatment under a new regime. Mike pushed the thoughts from his head as he searched for a landing field. His best hope was a transport craft that he could shanghai during the confusion. Finally, his eyes alighted on a small hopper parked off to the side.

Mike moved carefully from cover to cover, trying to ensure that the sniper wouldn't see his last dash to the hopper. He debated dealing with the sniper first, but the longer he stayed the more likely reinforcements would show up. Trusting to luck, he scuttled the last short distance to the hopper. Climbing inside, the first thing he checked was the fuel gauges. Full, excellent. His wrist unit told him he was on the back side of the Moon, well into the lunar wilds. He fired up the engines and quickly flung himself high into the sky. At the apolune of his initial jump he redirected the engines to take him to the nearest facilities from his location, the ice mining facilities at Shackleton crater. From there he could raise the Lunar Guard and fill them in on the situation. The whole time he was near the hidden base he made random zigs and zags in this trajectory to throw off any attempts to bring him down.

After a short flight, Mike found himself descending to the famous ice mining base of Icehole Associates. Here, some of the toughest hombres on the Moon worked in the punishing conditions of the hypercold everdark craters near the lunar pole. In their off hours they liked to turn the heat up in the party areas of the more metropolitan areas of

the Moon like Armalcolopolis. Mike smiled to himself as he remembered some of the more infamous brawls he had helped break up over the years.

As he approached the landing field, he noted with horror that the assault had already begun on 'Icehole Central', as it was known. Several breaches in the buried facilities could be identified from the debris strewn on the Lunar surface by the venting of the pressurized interiors, and Mike could see that the communications arrays were in disarray, probably the first objective in the attack. Any interruption in the flow of precious water from these facilities would be a serious threat to the cities of the Moon.

Recycling could only go so far, and the burgeoning population of the Moon needed water. Asteroids had proven disappointing in being able to supply water in sufficient quantities to eliminate reliance on the polar ice of the Moon, mainly because the Martians were paying a fortune for it. Only now were the first probes reaching the Kuiper Belt, and lunar leaders had hopes of being able to supply huge quantities of water to the Moon within a decade. In the interim, the lunar residents had to pry it from the rigid permafrost of the lunar poles.

As the hopper touched down, Mike leapt from the seat and ran to the nearest airlock, his long low strides giving his movements an almost dreamlike quality. Mike remembered the layout of the base from previous inspection trips. After passing through the airlock, he headed for the ops center by way of the cafeteria. Approaching the cafeteria, he saw that it was being used as a temporary hospital for the many wounded in the attack. He quickly spotted Katie, the corporate nurse who always gave him such a hard time every time he checked the facilities. He moved through the scattered people sitting on benches and lying on tables, and gently touched her arm as she leaned over a patient. "Whaddaya want?" she snarled as she turned towards him. "Who are you?"

"Marshall Mike Moondust, Katie, even though it doesn't look like me."

"Is this a joke?" she snapped back. "Marshall Moondust is dead, and I don't have time for nonsense," she concluded as she turned back to her patient.

"Katie," Mike replied, "it's me. Who else would know that you slipped me a mickey on my last trip here and I still behaved like a gentleman? I'm deep undercover and I need your help to fight the bad guys. Where's Director Kelvin?"

The nurse looked deeply into Mike's eyes, and then collapsed into his arms. "Oh Mike," she sobbed, "I thought you were gone forever. Jeff is dead. I saw him shot by one of those bastards. They're in a standoff at the operations center, with a few of the miners protecting the cafeteria while we try to regroup."

"I can't stay, Katie. This is part of something bigger, and I've got to get word out about this. Do you have any communication with your Ops Center? I've got a few ideas on how to chase these guys off." Mike declared with a firm conviction in his voice. -----

What does Marshall Moondust have in store for the brigands of the Sinister Selenian Subterfuge?

Find out in the next installment! (MMM #272 - February 2014)

ISDC 2014 – Los Angeles, CA – May 14–19, 2014 – “A Space Renaissance”

<http://isdc.nss.org/2014/> – Sheraton Gateway Hotel at LAX Airport



<http://www.starwoodhotels.com/sheraton/property/overview/index.html?propertyID=344>

NOTE: THERE WILL BE NO JANUARY ISSUE of MMM – as usual

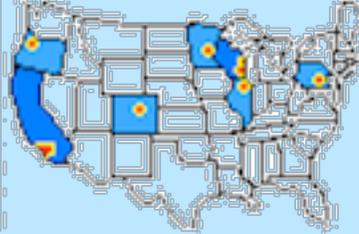
Since its beginning in 1986, MMM has taken a break twice a year, in January and July. The initial rationale was to keep a sequential numbering of MMM issues, ten per year.

But these two breaks have also worked well to prevent burnout

By giving the editor a time to refresh. We are go for years to come!

For past articles, Visit http://www.moonsociety.org/publications/mmm_classics/ or http://www.moonsociety.org/publications/mmm_themes/

NSS Chapters that share Moon Miners' Manifesto



Space Chapter HUB Webiste: <http://nsschapters.org/hub/>
 Feature Page: Project Menus Unlimited <http://nsschapters.org/hub/projects.htm>

WISCONSIN



MLRS – Milwaukee Lunar Reclamation Society

PO Box 2101, Milwaukee, WI 53201 – www.moonsociety.org/chapters/milwaukee/

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

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(• MLRS Board of Directors)

December 14th Annual Chapter and MMM Anniversary Pot Luck and Sci-Fi film : (Mayfair Mall Garden Suites East G110) 1-4 pm, Movie "I-Robot" shown at 2 pm sharp. If you can, bring a food item to share!

√ 2014 Meeting Dates: JAN 11 – Feb 8 – MAR 9 – APR 12 – MAY 10 – JUN 14 |><| SEP 13 –OCT 11 – NOV 8

WISCONSIN



SSS – Sheboygan Space Society

728 Center St. Kiel, WI 54042-1034 – www.sheboyganspacesociety.org

c/o Will Foerster 920-894-1344 (h) astrowill@frontier.com

SSS Sec./Tres. c/o B.Pat Knier dcnpatknier@gmail.com

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

Meetings are at The Stoelting House, 309 Indian Hill, Kiel WI 53042 - 3rd Thurs even # months

NEXT MEETINGS: DEC 14 (SAT in Milwaukee)

2014 Meeting Schedule: FEB 20 - APR 17 - JUN 19 - AUG 21 - OCT 16 - DEC 13 (in Milwaukee)

ILLINOIS



CSFL5: Chicago Space Frontier L5 – 610 West 47th Place, Chicago, IL 60609

CALIFORNIA



SSDS – San Diego Space Society

8690 Aero Drive, Suite 115, #77, San Diego, CA 92123 – <http://sandiegospace.org>

CALIFORNIA



OASIS: Organization for the Advancement of Space Industrialization & Settlement
Greater Los Angeles Chapter of the National Space Society
 PO 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 www.oasis-nss.org/articles.html

Regular Meeting 3 pm 3rd SAT monthly – DEC 14 – JAN 18 – Feb 15 – MAR 15

OASIS NEWS AND EVENTS

SAT DEC 14 3 pm OASIS Board Meeting, chez Bob Gounley/Paula Del Fosse, 1738 La Paz Road, Altadena, 91001
 SAT JAN. 11, 1 pm OASIS Board Meeting, A-MAN International Science Discovery & Learning Center, 101 South La Brea Ave., Inglewood, CA 90301

SAT JAN 11, 3:30 pm, OASIS Lecture Series, Warren James Talk, A-MAN International Science Discovery & Learning Center, 101 South La Brea Ave., Inglewood, CA 90301 – <http://www.aman.org/about/isdl.html>

SAT FEB 15, 3 pm, OASIS Board Meeting, Home of Craig and Karin Ward, 1914 Condon Ave. Redondo Beach, CA

SAT FEB 22, 3:30 pm, OASIS Lecture Series, 10th Anniversary Landing of Mars Exploration Rovers, John Callas, Project Manager, JPL, Long Beach City College Planetarium, 4901 East Carson Street Long Beach CA 90808

COLORADO



DSS: Denver Space Society fka Front Range L5

1 Cherry Hills Farm Drive, Englewood, CO 80133

Eric Boethin 303-781-0800 eric@boethin.com – Monthly Meetings 6:00 PM on 3rd Thursdays, 7 pm
 Englewood Public Library, Englewood, CO 80110 – 1000 Englewood Parkway, First Floor Civic Center

NEXT MEETINGS: DEC 19 – JAN 16 – FEB 20 – MAR 20

MINNESOTA



MSFS: Minnesota Space Frontier Society – <http://www.mnsfs.org>
 c/o Dave Buth, 433 South 7th St. #1808, Minneapolis, MN 55415

OREGON



ORL5 – Oregon L5 Society – <http://www.OregonL5.org>

PO Box 86, Oregon City, OR 97045

(LBRT – Oregon Moonbase) moonbase@comcast.net

Meetings 3rd Sat. each month at 2 p.m. - Bourne Plaza, 1441 SE 122nd, Portland, downstairs

Regular Meeting 3 pm 3rd SAT monthly – JAN 18 – Feb 15 – MAR 15

PENNSYLVANIA



NSS-PASA: NSS Philadelphia Area Space Alliance – 928 Clinton Street, Philadelphia, PA, 19107

c/o Earl Bennett, Earlisat@verizon.net - 856/261-8032 (h), 215/698-2600 (w)

<http://pasa01.tripod.com/> - <http://phillypasa.blogspot.com>

Meeting times and locations: We will meet for our annual officers election meeting on December 14 at the Liberty One food court, on the second floor, and on the west side of the food court near the windows, from 1 to 3 p.m. Look for a table display with a space related theme or the table display flags Mitch has bought for us.

November Meeting Notes:

In lieu of our regular location we had our **annual Philcon outreach event** and also met at supper time on Saturday the ninth. Since it was an informal meeting we did not do reports as usual. However, Larry advised that we should visit the website and send in material for posting both photos and text (we have not done videos of our activities at this time), and should invite people that we are in contact with to do the same. I will be sending an invite to one of the panelists I met, who was interested in our Science Carnival activity and joining this event.

Larry has done our web sites for thirteen years! Dorothy and Larry are done for this year with Cons, but, are planning both visits to interesting science and technology (in the broad sense) related locations and science fiction events next year. If you check at Dorothy's Facebook site you will see her latest Dotty's Dimensions on her, and Larry's, recent travels and locations you may wish to visit.

At Philcon, several of our members did public outreach from our table in the Dealers Room, and, much of the material was contributed by NSS. Mitch also set up his placard size displays on the table as well and you can see this in several pictures we have supplied Moon Miners and NSS. Hank helped between his other Con duties (he volunteers for this event), and most of us did table duty and volunteered in various capacities for the Con.

Frank O'Brien, Earl, Mitch and several former members appeared on panels including: Who Will Survive the Commercial Space Shakeout, Religion in the Year 3000, The Future of Education, and, Would YOU Sign Up for Mars 1 or Inspiration Mars? (Mars 1 is one way, Inspiration is a fly by and return). I had a panel with an interest of mine: The Home Factory, Frank has an interest in the new Space Race: The Chinese Space Program, and Mitch, our philosophic member, was on: New Myths for Our Times. And several past members who have science backgrounds also where part of the "Fact Based" talks with John Ashmead, speaking on gravity and antigravity, and, invisibility (or sometimes apparent invisibility!). And lots more! I should mention two things: H. Paul Shuch, friend and SETI League Director Emeritus, was away this year upgrading his aircraft skills in California, and, Frank O'Brien gave a lecture in northern New Jersey, on Curiosity, between the morning and late afternoon panels. Three hours each way. Yes, he wants a Spacefaring Civilization!

There were quite a lot of other interesting things reported and going on: the evening of November 19 29 small satellites were launched from Wallops' Island in Virginia. Among other satellites on the carrier will be a "smart phone" unit with major functions derived from this technology. Google this and check out the many experiments being sent up (I may have reported this data from an Amsat Journal report previously. See our website for those small satellites!).

The November Medical Design Briefs (from the NASA group of publications) included the winners of the Design The Future contest. The Grand Prize was won by a device for improving the delivery of chemotherapy drugs and there various combinations. This allows the patient more freedom of action than has been possible. Think about a spacefarer with a constant, controlled, dosage of medications that could reduce the effects of radiation on trips to Mars or other places. See the website: medicaldesignbriefs.com. The magazine also has a great R&D roundup section.

From NASA Tech Briefs where several articles on advanced instruments including: An All Solid State, Room-Temperature, Hetrodyne Receiver for Atmospheric Spectroscopy at 1.2 Thz. This does not need the cyrogenic cooling systems of earlier models and the processes used to make the components could be used for other far infrared sensing systems and communications devices. There was an additional section on photonics and special cameras for non-destructive test, and, the winners of the Create the Future contest in a number of categories, including the drug delivery system previously mentioned, and some great stuff that could be used in space development. A retired NASA engineer came up with "Microwave Extraction of Water for Space Propellant," by Edwin Ethridge, PH.D.. His design (which got an honorable mention) heats lunar regolith, as an example, by transmitting a beam of the appropriate frequency down a borehole in the material. The volatile fluid then comes out of the hole. And many more cool ideas. Go to the Tech Briefs site.

Finally, for the report side, Amsat Journal for September/October includes an educational outreach project: Exploring the Fox-2 Maximum Power Point Tracking System, by Mark Spencer WA8SME, and: Ham Video Transmitter Aboard Columbus ISS module. There is also mention of the launch of the Funcube satellite in November. There are 22 other small satellites on the same flight which is to launch a primary payload of a T.V. satellite for Dubai.

A Comment: We try to get young people interested in space exploration and be inspired to get involved in this great future. Astronaut, and singing star, Commander Chris Hadfield saw the Moon landing as a nine year old. From that event he followed a path of actions that led him to being in space a number of times with the most recent as Commander of the Space Stations' Expedition 35 crew. That's the effect we would like to have! See his book "An Astronauts Guide to Life on Earth" available in a number of formats.

And: I have been reading "Fabricated" by Hod Lipson and Melba Kurman. This has a very good history of Additive Manufacturing and present day (and future) software and technologies. This whole field is expanding into our lives: from the flight of a 3D printer to the I.S.S. (see the above cited Tech Briefs), and the development of skin substitute structures for research (from fellow panelist Rebecca Robare on the Home Factory panel).

Submitted by Earl Bennett, KD2CYA., President NSS-PASA.

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Moon Miners' MANIFESTO
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