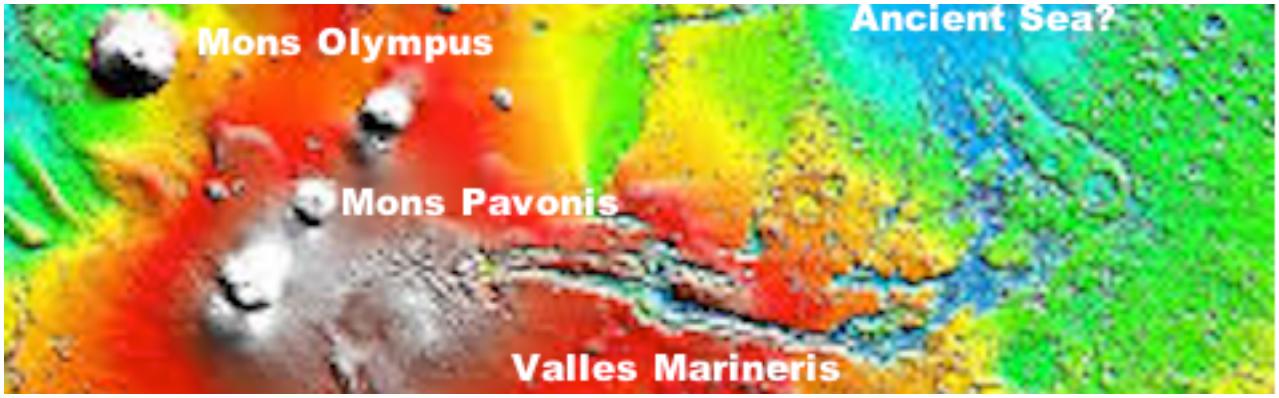
"Towards an Earth-Moon Economy – Developing Off-Planet Resources"

Moon Miners' Manifesto

& The Moon Society Journal www.MMM-MoonMinersManifesto.com

The awesome beauty of Valles Marineris on Mars – above, a smaller, less glaring sun rises or sets

Feature Articles



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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/**
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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.
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• **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, Open Office 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 Why not send Commercial Probes to Mars?

By Peter Kokh

POSSIBILITY OF COMMERCIAL PROBES to find information that NASA may not be interested in but **essential to commercial priorities**.

- **MINING**, Utilities testing, launch track location, road routes, pole-equator "canal pipe routes"
- **Settlement site selection**
- **EXPLORATION OF LAVA TUBES ON MONS PAVONIS**: future **industrual parks; agriculture; warehoousing**
- **SOIL MAKEUP IN HELLAS PLANITIA**, ETC. Redhousing plant growth experiments
- **Travelog productions: viewpoints and features in Valles Marineris, Hellas, Pavonis, Olympus, northern basin, polar caps, prize viewpoints and features in V Marineris. Pavonis launch simulation, pole cap skimobiles?**
- **Industries for export on Phobos and/or Deimos (less transport cost to Earth)**
- **Valles Marineris:** Slow and thorough maping and photographinc in multi-telltale specrra to identify sites of particula scenic and commercial value
- Attempts to "fly" on Mars in Hellas basin, in botttom of Valles Marineris
Passenger flights of commercial high value.
- **Redhousing experiments here, then on Mars**
- **Landing on snow caps- tourist interest? Skiing on Mars?** ##

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Where the Editor would choose to settle on Mars, if I had the chance

By Peter Kokh

Two years ago, I wrote an article (MMM #276 June 2014) "**Avoiding Cabin Fever on the Moon and Mars**"

Now, rereading this article, it is clear to me that personally, consideration #1, taking precedence over all other issues, is **picking a site where I would enjoy living for the rest of my life** (er, another 78 years, lol!)

Picking a site not just for resources but for lasting scenic interest!

Long term, **a site that is interesting enough to keep morale high and motivate one to "re-up" for continuing tours of duty.** A site that catches one's interest at every turn, along every path – to me, that trumps everything else. Without that, all other choices lead to boredom and sinking morale.

Site features that reduce boredom

- A "border" site where two or more types of terrain converge: highlands and mare plains.
- Nearby scenic attractions: hills, rilles, overlooks, lavatube skylights, etc.
- A nearby but "over the horizon" "getaway cottage" for both change of scenery and "hobby" usage

My Choice? Somewhere high up on the slopes of Valles Marineris with easy paths to the bottom of the Valley and to other sites "up valley" and "down valley." At the bottom, air pressure will be highter, though not quite as high as in Hellas Basin, or as in some "primeval oceanic" locations to the North. Probably somewhere halfway between the canyon rim and the canyon floor, where there are easy paths to both.

A site that catches one's interest at every turn, along every path – that trumps everything else. Without that, all other choices lead to boredom and sinking morale. A place where sunrises and sunsets are especially beautiful. A site where the colors change along with the shadows, as each Mars date (a "Sol") passes.

Also, I like to make things, and basalt, common in the canyon, is a ready material for carving and/or casting into statues. Plaques, dishes, planters, tiles, lamp bases, and on and on.

And if water once carved this canyon, or deepened it, there might still be some underground at the lowest elevations. Now, not every "settler" will feel this way. I wouldn't care how close my chosen site would be to a spaceport (or in the distant future to an "airport").

As to what my homestead should look like and what activities it would provide for, that's a question that I will take up in MMM #301, the December 2016 issue, my last as "principle editor." (I plan to continue on the editorial team, submitting articles now and then.)

If there were no Valles Marinaris? I.e. my second choice?

On the floor of the Hellas Basin, probably in the Northwesternmost "corner"

√ where Mars air pressures will always be the highest,

√ where we will first learn to fly on Mars,

√ where plants will first take root outside a greenhouse (or "redhouse')

√ and hopefully, where there is a relatively easy "trail" route to an overlook above this basin

And my third choice?

Somewhere on the western flanks of Pavonis Mons, smack on Mars' Equator

√ This giant shield volcano has enough lavatube volume to housel millions of settlers

√ Its location makes it the best spaceport possible – a launchtrack up the western slope would make it the economic capital of Mars, cutting shipping costs to Earth (and/or the Moon) to a minimum.

√ on the rim, high above most of Mars' atmospheres, you should be able to see the stars during the "daytime."

##

Martian & Lunar Frontiers will have Much in Common

By Peter Kokh [Reprinted in abridged form from MMM #133 March 2000]

We are in this together. While the Mars Society and the Moon Society are each properly focused on different human frontiers, there are many areas in which their interests coincide, overlap, or come togethers.

The basic reasoning is this. **As different as the Moon and Mars are from one another, in comparison to our homeworld, Earth, they are in many ways quite alike:**

• **Neither world has a breathable atmosphere** - we must establish self-contained minibiospheres on both to house and support our outposts and settlements. We need a modular approach, one that provides primary waste treatment at the point of source, to allow our biosphere encradled settlements to grow without trouble. There is no one-size fits all biosphere approach. Modular biospherics is the most promising approach.

• **Neither world is well protected from "the cosmic elements"** - cosmic rays, solar flares, solar ultra-violet, etc. While Mars has significant protection from the incessant micrometeorite rain than the Moon, it is much more exposed than Earth, with its much thicker atmosphere. Outdoor surface activities such as construction will be hazardous duty. Construction and assembly methods that minimize man-hours spent on the surface will needed.

• **Both worlds experience very cold temperatures.** Lubricants and fuels and materials that hold up under those conditions are needed on both worlds. Of course, the Moon has extreme heating to deal with as well, but to a much lesser degree, so do Phobos and Deimos, also without atmospheric heat sinks.

• **Both worlds have dust management problems.** Whether the fine dust on Mars is as intrusive and abrasive as that on the Moon is not sure. But dust control measures are needed on both frontiers.

• **Safe and reliable modular nuclear power units, add-a-unit-as-needed, will be a big benefit on both frontier,** though both worlds have solar power access, the Moon much more so than Mars. And Mars. with good luck but little reason for optimism, may have some geothermal hot spots that can be tapped.

• If a treaty banning shipment of nuclear fuels through Earth's atmosphere should ever be enacted, fuel for nuclear power plant modules, and for nuclear propulsion space ships, can tap substantial Thorium deposits on the Moon, using fast breeder technology to process this into fissionable U-233 - abig boon to both frontiers.

• Both worlds are without road networks - infrastructure is expensive and labor intensive - on both we will need pressurized ATVs, all terrain vehicles, that can travel fairly fast of boulder strewn stretches.

• **Lavatubes for ready-made shelter are expected on both worlds.** - used for settlements, industrial parks, warehousing, etc. Construction inside them offers the advantage of substantial regolith shielding already in place. Workers can use light=weight, light duty space suits, not have to worry about outdoor radiation exposure times.

• **Areas of subsurface ice , or frozen soil, are expected to exist on both worlds**

• **Both worlds are more economically challenged by themselves** than if they trade goods and services and work together to develop other in space markets to further the rise of an interplanetary economy that could withstand interruption of support from Earth. Mars, Phobos & Deimos will be cheaper sources than Earth for things the lunar frontier cannot provide for itself, while the development of markets on Earth for these same items is unlikely. Furhter, the Moon can probably supply the Martian frontier with some items at a lower expense than they can be shipped from Earth. In short, the Economic Case for both worlds is much better if they develop together.

The hardships and challenges of life on the lunar and Martian frontiers will bear many similarities.

The pioneers will have left behind much , forsaking Earth for a fresh start on a brand new world.

√ The ability to go outdoors without a spacesuit and enjoy the sunshine under an open blue sky.
√ Many outdoor forms of recreation that attempting to do in a spacesuit would have comic results.
√ An endless and ever increasing variety of consumer goods; Many food and beverage specialties
√ Many hobbies, even indoor ones, that cannot be supported on the frontier, at least not yet.
√ An endless list of tourist destinations when it is time to escape for a while
√ A still very diversified biosphere rich with special niches for plants and animals
√ A much wider and more varied list of occupational options and opportunities

They will be chasing similar dreams

√ A chance to pioneer a virgin, unspoiled, pristine world; to get in on the beginnings, \trying new ways of living, starting over fresh; A chance to appreciate more deeply what life is all about,, to be all that one can be.
√ A better chance to rise to the top rather than be lost in an immense pile
√ The chance to take a barren world and make it fertile, something it could never be (again or at all) on its own
√ The chance to learn to be "at home" in a setting where no man could ever have felt "at home" before
√ The chance to take a step in spreading human and terrestrial life to the stars
√ The list goes on, and it will the same on both Moon and Mars

They will need to be made of the same "right stuff"

√ Resourcefulness, ingenuity, creativity, and adaptability; Willing to make sacrifices, ttry new ways to do old things

UPSHOT - The Moon's sky may be black while Mars is bright. They have di fferent color pallets, di fferent gravities, di fferent landscapes. But underneath, the Moon and Mars and the pioneers of each, will have much in common. ##

Mars' Assets and what we can do with them - patiently.

By Peter Kokh

- **Mons Pavonis** on Mars Equator - enough lwvw tubes to house millions of people, maglev launch track up the western slope could send freight and passngers to Earth=Moon faster and with less fuel. Rim observatories (far suprerior to Chile's Atacama sites)
- **Hellas Basin** - Here is where Mars atmosphere is densest: where we wil first learn to fly on Mars; where we will first be able to grow plants in the open, possible evaporation mineralsZ (sea bed salts?)
- **Valles Marineris** - scenery, geographic strata, tourism-focused settlements: 4,000 km (2,500 mi) long and 5-7 miles deep - not far from the equator - the second place (after the Hellas basin) where we will learn to fly, and grow plants in the open
- **Ancient Ocean Bed**s: ocean bed salts
- **Phobos and Deimo**s - here, on the shoulders of Mars gravity well, goods and materials manufactured here can be shipped tot he Moon at a considerable savings over equivalent products from Mars surface

Looking for Ancient Shorelines of long-evaporated Ancient Martian Seas

We have not yet fielded orbiters with instruments capable of finding clear evidence of ancient "shorelines" - not even partial stretches here and there. That we have not, leaves open the door for hope that we might find such evidence, in due time. We predict that we will find traces here and there and be able by filling in the gaps, to map out Mars" ancient "oceans" or "seas."

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Mapping permafrost areas on Mars as we have on Earth. A low-orbiting probe in a high inclination orbit coveing in time all of Mars beyond the residual ice caps, should be able to find any areas lf sub-surface permafrost and any near surface aquifers - this will map areas on Mars where settlements will have access to water.

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Terraforming Mars? No! - Rejuvenating Mars? Maybe, maybe not.

Making Mars over as another, smaller "Earth" would seem impossible- . Bringing back Mars to the most life friendly state it enjoyed eons ago seems more reasonable, but that might be impossble too. For in the interim, Mars has lost most of the atmosphere and water it once had, to the solar wind, and that wind continues to blow.

What we can do to make Mars a more life friendly place, in which we can live out in the open instead of in tightly pressurized homes and settlements as we hope to do on the Moon, is, at this time, just a popular dream. Our challenge is to find "work arounds" that will make "living out in the open" on Mars, both for humans and life-supporting vegetation, is more of a challenge than most Mars fans realize.

Nothing ventured, nothing gained. Mars does have more life-supporting factors than does the never life-friendly Moon.

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And in a future when "Far Far Bolder Things" might be Possible - Relocating Mars?

Mars orbit lies too far out for "rejuvention" of the planet to be feasible. If only we could move it! (No, I haven't any suggestions as to how we might to that!) But if we could, where might we move it?

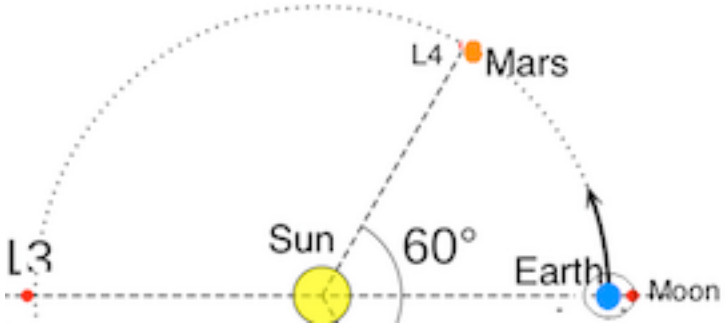
Keep in mind that the bad part of orbital mechanics is that the closer two orbits lie, the less frequent the opportunities to go from one to the other.

In some future age when finding the immense power needed to relocate planets becomes possible, locating Mars **in Earth's orbit** would offer an always open transportation window. I would suggest at either Earth-Sun L4 or L5 (50 million KM = 93 million miles ahead or behind Earth in its orbit around the Sun, would give Mars access to the same amount of solar heat as Earth receives (area of surface to area of surface.) The transport windows, both Earth to Mars and Mars to Earth would be open all the time.

But would this much warmth work against us to boil off what little atmosphere Mars has left?

It would be interesting to have the experts have a go at **Mars Relocation scenarios**.

Meanwhile, for our generation, we have to brainstorm ways to "rejuvenate" Mars right where it is now.



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. Let's send a fleet of "CubeProbes" to Mars

By Peter Kokh

Cubesat landers on Mars - some suggestions

A **CubeSat** (U-class spacecraft) is a type of miniaturized satellite for space research that is made up of multiples of 10×10×11.35 cm (4"x4"x4") cubic units, has a mass of no more than 1.33 kg (2.9 lb) per unit, and often sees the use of commercial off-the-shelf (COTS) components for its electronics and structure.

- **Weather stations:** wind, air pressure, air dust, humidity, snow depths etc., CO_2 snow physical characterization - on top of the great Volcanoes; and at low altitude points along the bottom of Mars Valles Marinerins canyon.
- **Cameras** on points along possible seasonal water flows
- **Polar cap landers** with capacity to take physical and chemical studies
  - (on winter CO_2 ice caps to monitor their seasonal evaporation,
  - on exposed H_2O summer ice caps to monitor CO_2 ice buildup as summer turns to winter)
  - Close photo-mapping of each.
  - Chemical and physical tests of aspects of "ice" and "snow" - will we find commercial and/or tourist activities that could be pursued in the different polar seasons?
  - Determine the feasibility of "canal" piping water to population centers elsewhere on Mars
- **"Drones" to attempt flight** at low elevations in Hellas Planitia, testing flight seasonally: depending on their findings, settlements in this basin could someday be interconnected by air freight and pasenger service.
- **"Redhouse" experiments** to see if plants can grow in compressed Martian atmosphere and at what temperatures
- **Missions to Phobos and Deimos testing soil consistency and geochemical makeup. etc.** - depending on the finding of such tests, industries on Phobos and/or Deimos would be able to ship materials and/or products to the Moon at a competitive advantage over equivalent products made on Earth in its deep gravity well. ##

Supporting Moon and Mars Science Missons that will help both

By Peter Kokh

Missions that could help explore and open both the Moon and Mars

- **Lavatube mappers**
- **Permafrost mappers (even within lava tubes** - another way to find some lavatubes

Supporting Mars Science Missions that could help explore and open the Moon

- **Geochemical Missions to Phobos and Deimos: It may be possible to make thing on Phobos or Deimos needed on the Moon and that can be shipped** To the Moon at less cost than bringing up similar loads from Earth's surface. It all depends on what Phobos and Deimos "are made of."

Supporting Moon Science that could help explore and open Mars:

Thoriun 233 Nuclear Reactoe Fuel could fuel fast ships between Moon and Mars. Thorium is abundant in the Mare Imbrium splashout area - the highlands strip between mare Imbrium and Mare Frigoris.

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Mass Production, Reusability and Scavenging for CATS

by David Dietzler

Mass Production

Mass production is the key to making anything cheap. Automobiles, trucks, electronics, war materials and every other other product of our industrial age have become affordable thanks to assembly lines. The growing role of automation promises to make everything even less expensive. If we cranked out rockets on assembly lines they would be cheaper. The problem is that the market for all those rockets does not exist. A limited number of satellites are launched every year. If we struck up mass production of rockets like bombers for a war effort the result would be an enormous pile of hardware that could not be sold! High supply and low demand would spell bankruptcy for the rocket companies after they liquidated their stock. This is a case where the reverse law of supply and demand operates.

If there was a higher demand supply could meet that demand for a reasonable price. However, as we all know, expendable rockets will never make any more fiscal sense than using a jet airliner once and then throwing it away. If space tourism is going to be the driving market force that leads to the opening of the high frontier and a space faring civilization then we must have reusable space vehicles.

Reusability

Mass production will not work if we don't reuse launchers. Many of us dream of a single stage to orbit vehicle like the British Skylon. When such a vehicle is perfected and proven to be safe and reliable and the price to LEO falls within a range that can be afforded by the millionaire class the mass market will emerge. Almost everyone is interested in space tourism. Spaceplanes could be churned out in factories and spaceports with fueling facilities and perhaps mag-lev launching tracks will be built. At first the wealthy will take a ride into space but eventually space travel will drop in price until ordinary middle class citizens can afford an orbital jaunt.

Things won't stop there. A few hours in orbit will not be enough for many tourists. They will want prolonged stays in space and even travel to the Moon and Mars. This will require space stations in LEO, GEO, EML1, spacecraft that can reach other worlds and infrastructure to support those spacecraft. The Skylon will put 15 metric tons in LEO. That's enough payload capacity to move plenty of passengers and some inflatables for space stations.

A reusable heavy cargo lifter would help. A rocket based on the Shuttle external tank with four LH2/LOX burning engines on the bottom and a cargo module on top along with a kerosene or methane and LOX powered flyback booster that could put 100 to 200 tons of cargo in LEO would be ideal. The flyback booster would be reusable and so would the hydrogen and oxygen burning engines. These engines would be part of a module with heat shield and parachutes that disconnects from the ET in space and returns to Earth. The ET and cargo module would be used in space. They would contain valuable titanium and aluminum alloys bearing copper and lithium, plastics, composites and fiberglass. Repurposing or recycling the ET and cargo module as well as finding uses for all cargo packaging materials will mean that they belong to the payload sent into space. Nothing would be wasted or thrown away. The relatively simple external tanks and cargo modules, compared to engines, could be mass produced on robotic assembly lines to cut costs.

Scavenging

External tanks could be used for space station modules, spaceship hulls, propellant depot tanks, liquid storage tanks for space freighters that haul NH3, CH4, H2O, organic chemicals, and scrap metal for space construction. The titanium alloys will contain aluminum and vanadium which is rare on the Moon. The aluminum alloys will contain copper and lithium which are also rare on the Moon. Since these alloys cannot be made with lunar or asteroidal materials this scrap metal will be very valuable. Pure aluminum from the Moon will not be good for much besides electrical wiring. Unalloyed aluminum is not very strong or hard. It could be alloyed with lunar magnesium, silicon, chromium and/or manganese to make half-way decent alloys but this will not suffice for high stress applications that demand copper and lithium aluminum alloys like the ones ETs are made of. For some applications ET scrap metal will be indispensable. Lunar titanium might be used instead of aluminum when high strength and light weight are required. Titanium might be more of a substitute for aluminum than a substitute for steel in outer space.

Cargo modules and cargo packaging materials consisting of plastics, composites, fiberglass, styrofoam and even cardboard will all be valued for their light elements--hydrogen, carbon and nitrogen. The modules might simply be cut up and the pieces machined into various products or melted down and injected into molds. Styrofoam and cardboard boxes might be valuable as is. They could also be decomposed with solar heat to get light elements for Closed Ecological Life Support Systems.

Huge space hotels made from external tanks, inflatables and recycled materials will emerge. There will be no shortage of customers even when the millionaire class is the only group that can afford to stay in a space hotel. Global standards of living are rising. Barring an environmental catastrophe or a terrible world war there will be more millionaires than ever in the future and the middle class will be able to afford things that only rich people can have today. Billionaires, deca-billionaires and cento-billionaires, even trillionaires of the future will be able to afford their own space programs entirely! It's rather obvious that the tech giants of today will have the money to capitalize space travel industries of the future and this will not be a shameful luxury when it means the creation of

jobs on Earth and in space, and the birth of a space faring civilization for a world where frontiers have all but disappeared.

Beyond LEO

Going beyond LEO requires large amounts of rocket propellant. The only way to get it for a reasonable price will be to bootstrap up industrial bases on the Moon. Polar ice and lunar regolith could supply hydrogen, oxygen and metal powders including silicon which could be combined with hydrogen to make silane, SiH4, to fuel inter-lunar spacecraft. Eventually asteroids could be mined for propellant but common sense dictates that the development of the Moon should come first.

Inter-lunar spacecraft will include tugs with solar electric propulsion that use only small masses of propellant hauled up from Earth. These tugs will move cargos from LEO to a station at EML1. They will be produced in factories on Earth, rocketed to LEO, and reused. When their service lifetime ends they will be dismantled for the gallium, arsenic, indium, phosphorus and selenium in their solar panels to make new solar panels and the aluminum alloys, plastics and composites that compose their structures will be repurposed. Landers or "Moon Shuttles" that move cargo from EML1 to the lunar surface where they deposit their cargo, are refueled, and ascend back to EML1 numerous times will meet a similar fate.

Mass production and reusable hardware will make space travel affordable, but even then it will be pricy. In orbital space there is nothing but free vacuum, lots of solar energy, and microgravity that can be useful for containerless manufacturing and electrophoresis. There is quite a bit of space junk in Earth orbit and this may or may not be worth some money to salvage. External tanks, cargo modules and packaging that contain elements rare on the Moon and therefore unavailable in space even after the Moon is industrialized will be valued commodities.

If a time comes when hundreds, even thousands, of cargo rockets are leaving Earth every year to support a fluorishing space hotel industry and maybe a microgravity manufacturing industry, then there should be plenty of titanium and aluminum alloys that can't be made on the Moon and other materials rich in hydrogen, carbon and nitrogen available in space. Space dwellers will learn to use the resources of space like lunar and martian basalt, low and mid-grade titanium and aluminum alloys, iron, magnesium, stone, glass, and platinum group metals from lunar meteoric iron-nickel particles and Near Earth Asteroids.

We must wonder about industrial processes and alloys that could use platinum group metals (PGMs) but are not used commonly due to their high cost. When asteroidal PGMs become abundant this might change. On Earth, copper, lithium, tin, vanadium, zinc, thorium, zirconium, yttrium and many other metals are essential for industry. What if PGMs can substitute for or even surpass these metals in different applications? The Spaniards found a curious "white silver" later determined to be platinum possessed by the South American Indians that made their cannons stronger. Could steel alloys made with PGMs that are uneconomical today but might be cost effective in the future when asteroids are mined be possible? Even then, in the deserts of outer space, the Moon, Mars and beyond everything will be reused and recycled, especially if it came from a deep gravity well. ##

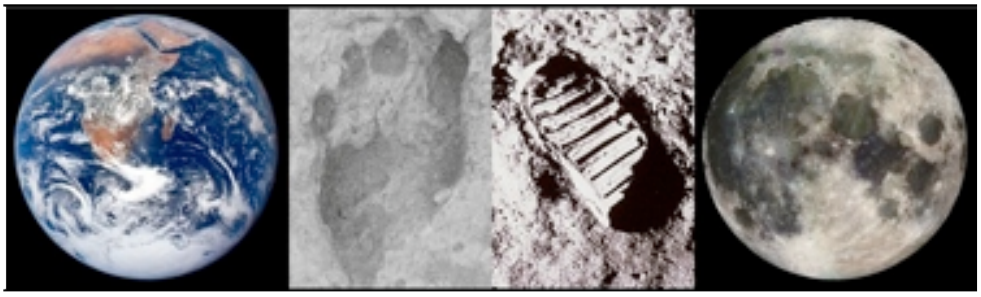
Smuggling Nitrogen and Halogens to the Moon

Nitrogen, fluorine and chlorine are useful if not essential elements for lunar settlements. Nitrogen is necessary for atmospheres and fertilizer. It will not be wasted by using it for nitrate explosives. Oxyliquit explosives consisting of tanks of aluminum or magnesium powders mixed with LOX that are detonated with an electric spark will be used for blasting. Chlorine is needed for salt, fertilizer, silicones synthesis, silane production and electrolyte for the FFC Cambridge process for extracting titanium metal from titanium oxide. Fluorine might be needed for aluminum and silicon production. Unfortunately these elements are rare to non-existent on the Moon and they are not abundant in Near Earth Asteroids either. It is possible that nitrogen exists in the form of ammonia, NH3, in polar ices and there might be some halogens there also. Presently not much is known about the polar ices.

If the polar ices lack these elements we can smuggle them in along with other useful elements. Nitrogen could be brought in not as a super cold liquid in heavy insulated tanks but as liquid ammonia or hydrazine. These could be decomposed with heat and catalysts to get nitrogen and hydrogen separately and both of these will be useful at Moon bases. Another way to smuggle in nitrogen is in the form of metal nitrides like lithium nitride, boron nitride, zirconium nitride, yttrium nitride, tungsten nitride, vanadium nitride, tantalum nitride, niobium nitride and zinc nitride. Nitrogen trichloride might seem like a neat way to import two handy elements but it is to unstable and explosive. Boron nitride is useful as is for a high temperature lubricant. Nitrides can be decomposed with intense solar heat, hydrolysis with water and reaction with oxygen. LIthium could be used for aluminum electrolysis and batteries. Boron is a plant nutrient and can be used to make Pyrex glass and a dopant for silicon solar panels. Zirconium and yttrium oxide sands can be used for casting molten titanium in the vacuum. Tungsten can be used for welding rods.Tungsten, tantalum and niobium are refractory metals for high temperature applications like rocket motors. Vanadium is used to alloy titanium and zinc makes magnesium more easily machined. Halogens might be smuggled in not as super cold liquids but as salts of copper, zinc, lithium and other elements in plastic containers that are repurposed on the Moon. The salts could be decomposed with solar heat and electrolysis to free up the halogens and get the metals. There are perchlorate minerals on Mars not to be confused with chlorite which is a phyllosilicate mineral and Mars might sell chlorine to the Moon and Earth orbital space stations someday. ##

THE MOON SOCIETY – LUNAR FRONTIER SETTLEMENT – WWW.MOONSOCIETY.ORG

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: to inspire and involve people everywhere, from all walks of life, to create an expanded Earth-Moon economy that contributes solutions to the major problems that 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

"Selengineering" [Selene: the Greek word for the Moon]

With the increasing popularization of the concept of cislunar space, and economic activity therein, it may be time to introduce a new idea into the popular culture – Selengineering.

This was the title of a lecture I recently gave at Brookhaven College during a recent STEM event. The idea for the word came from the combination of Selene (as in Selenology – the science of the Moon) and Engineering, and I chose the title to highlight the fact that engineering on the Moon is going to be a new challenge for the field. It was quite edifying to see a number of young students playing hooky from the displays to come see the talk, and one of the audience members was a professor who had worked on the original Apollo 11 samples. His only critique was that what I was calling ilmenite they referred to as ulvo-spinel.

I think the key lesson here is that people are ready for Moon information that isn't just Apollo re-hash. This is the time to go out and start a dialogue on the Moon as we understand it now, as compared with the traditional Moon phases and Apollo landings. Now is the time to start laying the groundwork and planting the seeds for new generations of Lunar explorers and workers.

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

A rather different aspect of the Moon was found in my judging experience at this year's regional Science Fair, where I judged in the Junior High Energy: Physics category. Basically windmills and solar cells, but with a few interesting diversions, including a tidal power project, as well as one that looked at generating solar cell power from moonlight. Turns out it would take at least 1,000 hours to charge his phone, so, not promising. Still, it's interesting how the Moon shows up in unusual places. I would like to see our chapters doing special awards at their local Science Fairs as a way to encourage Moon studies.

In the larger context of Cislunar Economic Development, things are progressing slowly but steadily. Political efforts remain dubious, as government space programs remain beholden to various agendas. In my personal opinion, this is the result of a lack of dollars and a lack of votes deliverable to the Congresscritters that is the hurdle. There's just not enough capital in the industry yet for it to be of serious interest (and it's sooo complicated), and the various organizations can't pool a sufficiently large base of potential voters to be of interest. In general, I've found members are generally politically ambiguous when it comes to Moon Society efforts, likely the heritage of our foundation in the Artemis Society. As such, it seems most appropriate to avoid political entanglements and to continue to focus on private sector efforts and education.

Part of that can start with this year's Yuri's Night on April 12th. Find an event near you at https://yurisnight.net/events/, and offer to help out in a Lunar capacity. Events big and small happen all over the world, and it's a way to tie space exploration into a larger cultural context. If there's not an event near you, it's not too late to organize one! KM

No Moon Society Chapter near you? You might have options

By Peter Kokh

Merged TMS/NSS Chapters

At ISDC 2008 in Washignton DC, I presented a proposal to the National Space Society:(I was still TMS President at the time) briefly, **wherever one of our Societies had a chapter and at least two members of the other Society joined that chapter, It could be listed as a "Merged" chapter of both Societies.** This agreement was accepted by NSS as written, with no alterations or ammendments. .

If you check our chapter page just below, you will find that all our chapters are now "merged" serving as chapters of both organizations: **Milwaukee, St. Louis, Phoenix, Tucson, and Claer Lake (Houston**) now are merged, seving Moon Society and National Space Society members alike.

Now if you flip to pages 17 and 18, you will find those NSS chapters whose members already get MMM as a membership benefit. If you live in or near (enough to participate in) any of these chapters, you might want to join. And if a second Moon Society imember did likewise, then that chapter would join the list of merged chapters – Minnesota (**Minneapolis/St. Paul)**, **Philadelphia**, **Los Angeles**, **Portland** (Oregon), **Denver** – you could join that chapter. And if a second Moon Society member did likewise, that chapter could join the list of merged chapters. ##

Like to start a chapter? Are there other Moon Society members I your area?

From Peter Kokh

To find out if there are other current, and/or former Moon Society members in your area, send us [kokhmmm@aol.com] the **"central" zip code** of your area, and **how many miles out from that point you want us to search**. We'll send you the list of names and addresses and contact information.

It takes two members to form an "**Outpost**" and three or more to form a chapter. We can even arrange to send copies of the next 2 or 3 issues of Moon Miners' Manifesto to those people who respond to you.

It is possible to form a chapter in an area where there is no major city.

The perfect example is the **Sheboygan Space Society** in Wisconsin in the area between Green Bay and Milwaukee, whose members come from a cluster of cities in the 2,000 to 80,000 population area. The meeeting place can rotate between the larger cities in the area.

While this is the only example, there is good reason to believe that the SSS example can be copied elsewhre. We did have a **university-based chapter** in the Provo/Orem area of Utah. As leaders graduate, university chapters tend to disappear, however unless there is an involved faculty supporter.

Find more members by starting as a **joint Moon Society/National Space Society chapter.** We can put you in touch with someone in NSS who will send you a list of NSS members in your area.

What will happen to Moon Miners' Manifesto after issue #301 ??

From Peter Kokh, Editor of MMM for 30 years

In MMM # 289, I announced that issue #301, December 2016 30th anniersary issue, will be the last issue that I will put out: I will retire as editor. So what will happen to MMM? Will it disappear? Will someone take it over?

There are a number of options:

√ Another Moon Society member could step in to take my place

√ Someone, not an TMS member, but a member of the National Space Society could take over, with a Moon Society co-editor supplying the centerfold sheet of 4 pages devoted to Moon Society news.

√ Fred Becker (National Space Society) has shown interest in becoming MMM Editor, if no one in the Moon Society steps forward. In this case, an online or pdf file version only of MMM could be sent out free to anyone/everyone.

- **In either case, the Milwaukee Chapter is willing to continue to arrange for hardcopy printing and mailing** to those Moon Society members who have indicated a preference for the hard copy version.
- **it is our intent to continue to submit articles now and then.** This may include anything new I write for the Essay section of To The Stars International Quarterly. One per issue? Maybe, but no promises.
- **I will also continue to contribute the Space News Browsing Links** page as these are all news items I will have gathered for the To The Stars International Quarterly. I will also contribute a **photo page** using images from TTSIQ.
- **Could I add a section in TTSIQ for organization and chapter news?** Yes, but keep in mind, TTSIQ comes out only 4 timea a year, January, April, July, October, in pdf file format only. While I very much enjoy collecting all the news items for TTSIQ, this is time-intensive, and I do not promise to keep putting out TTSIQ too much longer.

On the other hand

If no one in the Moon Society rises to the occaision, and steps in **either as primary or secondary editor**, the Moon Society will have to find some other way of providing news etc. to its members. This could well mean the end not only of MMM, but also of the Moon Society. I have supported the Moon Society, and its predecsor, the Artemis Society since the Spring of 1995 through MMM from MMM #90 to current:

I have so far one expression of interest, from frequent contributor **Dave Dietzler**, who publishes an **online-only** newstletter for the joint TMS/NSS St. Louis chapter. Online newsletters have no page or format limits..

As for myself, I may or may not still continue to put out **To The Stars International Quarterly** which has always been available to Moon Society members at: www.moonsociety.org/international/**ttsiq**/

I need to turn my attention to two other publication efforts:

1. "**A Pioneer's Guide to the Lunar Frontier**" (title could change)
2. **An as yet to be titled work on the origin of the universe, and what makes it (and us) tick**

I have been collecting notes for this project since a September 2, 1961 personal "eureka" moment. This work has priority over everything else. Fifty-five years later, I can only hope I have enough time to finsih this work, or at least enough of it to get across the main life-transforming ideas.

The title? I wanted "The Omega Factor" but unfortunately someone beat me to it. Yes, that's a hint. I will probably record a short oral preview first, as insurance should I not live to finish a book. PK

March Chapters & Outposts 2016

ORGANIZING "OUTPOSTS"

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

ORGANIZED CHAPTERS

Milwaukee Lunar Reclamation Society – **http://www.moonsociety.org/chapters/milwaukee/**
http://www.meetup.com/Milwaukee-Space-Exploration-Meetup/ – **http://www.space-Mlwaukee.com**
Contact: Peter Kokh – kokhmmm@aol.com – **MEETINGs**, 2nd Saturday 1-4 pm monthly except July, August,
At Mayfair Mall lower level Community **room G150 for all meetings except December, in G110:**
February 13th Meeting Report: (1) We decided **not to continue our Milwaukee Space Exploration Meetup** both because of poor response and rising Meetup prices. **(2)** We will celebrate Yuro's night again at the April Meeting and work on a list of other space pioneering firsts. **(3)** We also discussed summer field trip options.

We are looking for a place to bring our Mother-Earth / Father Sky exhibits for Earth Day April 23rd
Meetings 2016 : FEB MAR 12, APR 9. MAY 14, JUN 11, ~~JUL/AUG~~, SEP 10, OCT 8, NOV 12, DEC 10

Moon Society St./NSS Louis Chapter - http://www.moonsociety.org/chapters/stlouis/
http://www.meetup.com/Saint-Louis-Space-Frontier-Meetup/
Contact: Robert Perry surfer_bob@charter.net – – Meetings **4th Saturday of the month** in **room 162** of **McDonnell Hall** of Washington Univ. Meetings **4th Saturday of the month**.
2016 MAR 26, APR 23, MAY 28, JUN 25, JUL 23, AUG 27, SEP 24, OCT 22, NOV 26, DEC 17

NSS/Moon Society Phoenix Chapter - http://nssphoenix.wordpress.com/ – c/o Mike Mackowski.
http://www.**meetup.com/NSSPhoenix**/events/161939572/
Meeting 3rd Saturdays monthly at **Humanist Community Center, Mesa**, 627 W. Rio Salado Parkway.
surfer_bob@charter.net – **2016 Mar 19, Apr 16, May 20, Jun 18, Sep 17, Oct 15, Nov 19, Dec 17**

The February meeting of the Phoenix Chapters of the National Space Society and Moon Society wase a field trip visit to Biosphere 2 near Oracle, AZ Saturday afternoon, February 13th. This was a joint activity of the Phoenix and Tucson chapters of NSSy and the Phoenix Section of the American Institute of Aeronautics and Astronautics.

Biosphere 2 is one of the world's most unique facilities dedicated to the research and understanding of global scientific issues. The facility serves as a laboratory for controlled scientific studies, an arena for scientific discovery and discussion, and a far-reaching provider of public education. Its mission is to serve as a center for research, outreach, teaching and life-long learning about Earth, its living systems, and its place in the universe; to catalyze interdisciplinary thinking and understanding about Earth and its future; to be an adaptive tool for Earth education and outreach to industry, government, and the public; and to distil issues related to Earth systems planning and management for use by policymakers, students and the public.

We had 13 people total from all groups. A few of us got together for dinner afterwards, mostly to plan future joint events.

Tucson L5 Space Society – Now serving Moon Society Members **www.tucsonspacesociety.org/** (not updated) – **www.meetup.com/NSSPhoenix/events/161939572/** (not updated)
Contact: Al Anzaldua – Meets monthly, every 2nd Saturday, 6:30 PM
2016 FEB 13, MAR 12, APR 9. MAY 14, JUN 11, JUL 9, AUG 13, SEP 10, OCT 8, NOV 12, DEC 10

Clear Lake NSS/Moon Society Chapter (Houston) –http://www.moonsociety.org/chapters/houston/
Contact: Eric Bowen eric@streamlinerschedules.com –**Meeting 7 pm 3rd Mondays of even # months** in the conference room Bay Area Community Cntr, Clear Lake Park: **2016 APR 18, JUN 20, AUG 15, OCT 17, DEC 19**
Report on the Monday, February 15th meeting at the Bay Area Community Center in Clear Lake Park.: Jim Akkerman presented some good ideas on commercial access to orbit, manufacturing techniques unique to zero-g, and plans for solar power satellites.

MARCH 2015 SPACE NEWS BROWSING LINKS

SPACE STATIONS + ROCKETS + COMMERCIAL SPACE

www.space.com/32051-**reusable-military-spaceplane-darpa-budget**.html
www.space-travel.com/reports/**ASU_satellite_selected_for_NASA_Space_Launch_Systems_first_flight**_999.html

EARTH + NEAR SPACE

www.nasa.gov/press-release/nasa-university-study-shows-**rising-seas-slowed-by-increasing-water-on-land**
www.space-travel.com/reports/**Phase_of_the_moon_affects_amount_of_rainfall**_999.html
www.spacedaily.com/reports/**NASA_Radar_Brings_a_New_View_of_World_Heritage_Site**_999.html
www.nasa.gov/press-release/nasa-partners-on-air-quality-study-in-east-asia

MOON

www.space-travel.com/reports/**NASA_chooses_ASU_to_design_and_operate_special_satellite**_999.html
www.space-travel.com/reports/**Chinese_scientists_invent_leak_detection_system_for_moon_exploration**_999.html
www.space-travel.com/reports/**Lunar_Flashlight_Selected_to_Fly_as_Secondary_Payload_on_Exploration_Missio n_1**_999.html
www.space.com/32014-**human-outpost-near-moon-cislunar-space**.html
www.space-travel.com/reports/**NASA_releases_strange_music_heard_by_1969_astronauts**_999.html
www.space-travel.com/reports/**Chinese_scientists_invent_leak_detection_system_for_moon_exploration_999.html**

MARS

www.marsdaily.com/reports/**Site_of_Martian_lakes_linked_to_ancient_habitable_environment**_999.html
www.esa.int/Our_Activities/Space_Science/**Mars_Express/Footprints_of_a_martian_flood**
www.marsdaily.com/reports/**Jarosite_in_the_Noctis_Labyrinthus_Region_of_Mars**_999.html
www.marsdaily.com/reports/**Getting_real___on_Mars**_999.html

ASTEROIDS + COMETS

www.spacedaily.com/reports/**NASA_Tests_Solar_Sail_Deployment_for_Asteroid_Surveying_CubeSat_NEA_Scout_** 999.html
www.spacedaily.com/reports/**Puzzling_asteroid_observations_explained_by_destruction_of_asteroids_close_to _Sun**_999.html
www.space.com/31797-**flyover-tour-dwarf-planet-ceres-video**.html
www.esa.int/Our_Activities/Space_Science/**Rosetta/Rosetta_s_lander_faces_eternal_hibernation**
http://news.discovery.com/space/**asteroids-meteors-meteorites/water-may-have-once-gushed-from-massi ve-asteroid-150128.htm**
www.space.com/31978-ancient-impacts-erased-asteroid-vesta.html

OTHER PLANETS + MOONS

www.space.com/31765-**ancient-babylonians-tracked-jupiter-with-math**.html
www.space.com/31831-**juno-jupiter-spacecraft-engine-burn**.html
www.spacedaily.com/reports/**New_study_challenges_Jupiters_role_as_planetary_shield_protecting_Earth_from_ comet_impacts**_999.html
www.space.com/31887-**nasa-europa-mission-launch-late-2020s**.html
www.space.com/32044-**doctor-cassini-takes-titans-temperature.**html
http://phys.org/news/2016-02-**friendly-enceladus-ocean-life**.html
www.space.com/31841-**pluto-floating-hills-photo-new-horizons**.html
www.space.com/31930-**pluto-geology-map-new-horizons**.html
www.space.com/32013-**pluto-hulk-like-moon-charon-photo**.html
www.space.com/32037-**saturn-probe-cassini-planet-nine-search**.html

ASTRONOMY + ASTROBIOTICS

www.nasa.gov/press-release/**nasa-introduces-new-wider-set-of-eyes-on-the-universe**
www.space.com/32038-**cubesat-satellites-hunt-alien-worlds**.html
www.space.com/31982-eying-exomoons-in-the-search-for-e-t.html

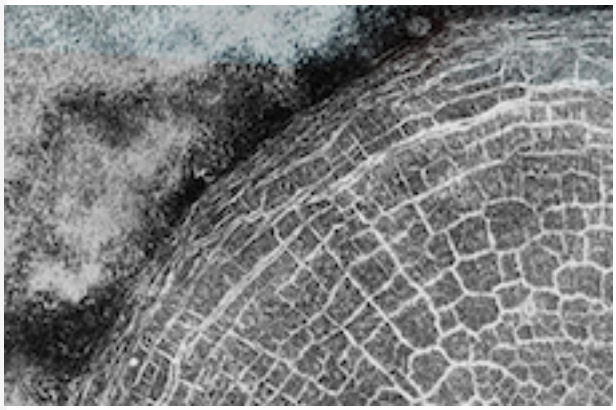
EDUCATION + OUTREACH + MEDIA

www.nasa.gov/press-release/**nasa-invites-public-to-send-artwork-to-an-asteroid**
www.spacedaily.com/reports/prnewswire-**space-news.html?rkey=20160107DC93791&filter=1639**

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

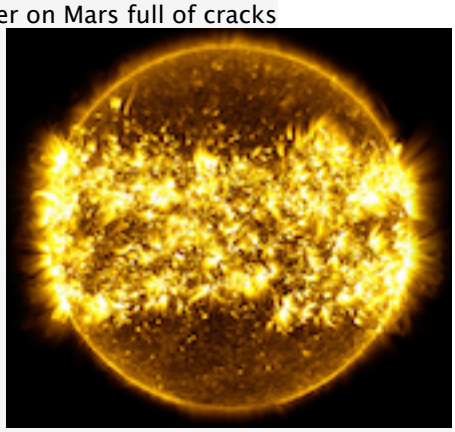
MMM PHOTO GALLERY

Space Ship !! Unity

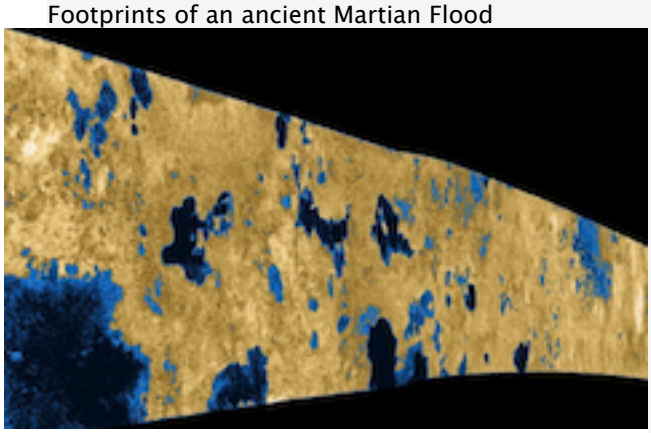


A Crater on Mars full of cracks

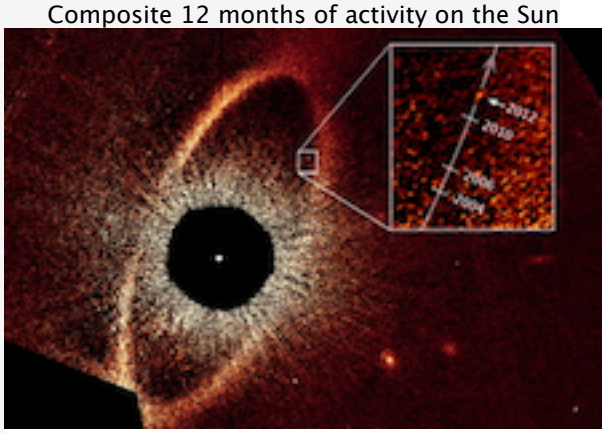
Footprints of an ancient Martian Flood



Composite 12 months of activity on the Sun



Dark pols of liquid methane on Titan



False-color composite image of the planet **Fomalhaut b**

NASA's Wide Field Infrared Survey Telescope (WFIRST)

Blue Origin's succesful landing

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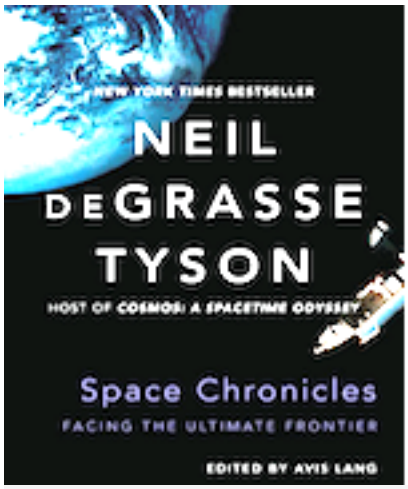
THE book WORM



Space Chronicles: Facing the Ultimate Frontier

February 27, 2012
W. W. Norton & Company

"A compelling appeal, at just the right time, for continuing to look up."—Air & Space

"America's space program is at a turning point. After decades of global primacy, NASA has ended the space-shuttle program, cutting off its access to space. No astronauts will be launched in an American craft, from American soil, until the 2020s, and NASA may soon find itself eclipsed by other countries' space programs.

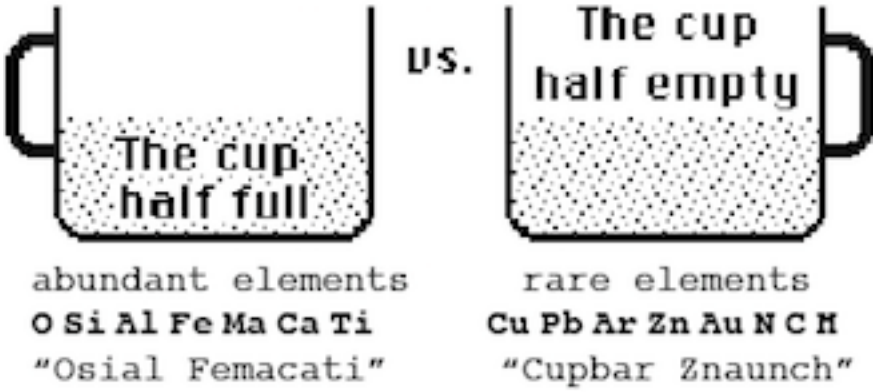
"With his signature wit and thought-provoking insights, Neil deGrasse Tyson—one of our foremost thinkers on all things space—illuminates the past, present, and future of space exploration and brilliantly reminds us why NASA matters now as much as ever. As Tyson reveals, exploring the space frontier can profoundly enrich many aspects of our daily lives, from education systems and the economy to national security and morale. For America to maintain its status as a global leader and a technological innovator, he explains, we must regain our enthusiasm and curiosity about what lies beyond our world.

"Provocative, humorous, and wonderfully readable, Space Chronicles represents the best of Tyson's recent commentary, including a must-read prologue on NASA and partisan politics. Reflecting on topics that range from scientific literacy to space-travel missteps, Tyson gives us an urgent, clear-eyed, and ultimately inspiring vision for the future."

https://play.google.com/store/books/

Selections from the Moon Miners' Manifesto GLOSSARY "MMM Speak"- New Words & Old Words with New Meanings
http://www.moonsociety.org/publications/m3glossary.html

On the Moon, our materials formulations will be limited by ingredients scarce in its regolith.



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ISDC 2016, San Juan, Puerto Rico

"A Bridge to Commercial Space"

200 Convention Boulevard · San Juan, Puerto Rico, 00907 - Phone: (787) 993-3500

Program Theme: A Bridge to Commercial Space

Early Bird Regitration - www.nss.org/cgi-bin/register/tdregister?$Origin=ISDC16

(Full = Wednesday, May 18 to Sunday, May 22)	Full Conference - (meals separate)
Non-Member Adult	$200
Sponsor* / **Co-Sponsor*** (see Section I to activate)	$185
Join NSS for Member rate (includes $20 for first year of membership)	$170
NSS Member* rate (see Section I to activate)	$150
Student* / **Youth*** (Must be full-time student or under 22 years of age)	$ 50
NSS Senior Member* (Must be over 64 years of age) (see Section I to activate)	$ 50

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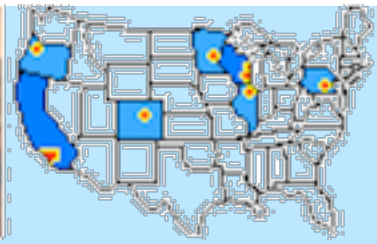
NSS Chapters that share Moon Miners' Manifesto



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/
www.Space-Milwaukee.com - http://www.meetup.com/Milwaukee-Space-Exploration-Meetup/

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

PRESIDENT/MMM EDITOR • Peter Kokh NSS 414-342-0705 - kokhmmm@aol.com VICE-PRESIDENT Doug Armstrong NSS (414) 273-1126 - **SECRETARY - Charlotte Dupree NSS** (262) 675-0941 grdupree@charter.net James Schroeter (414) 333-3679 - james_schroeter@yahoo.com TREASURER/Database • **Robert Bialecki** (414) 372-9613 - bobriverwest@yahoo.com (• Current Members of the MLRS Board of Directors)

We are looking for a place to bring our Mother-Earth / Father Sky exhibits for Earth Day April 23rd

Meeting Place Mayfair Mall: Lower Level Community **room G150 for all meetings** except December, in G110:
Meetings 2016 : MAR 12, APR 9. MAY 14, JUN 11, ~~(summer break)~~**, SEP 10, OCT 8, NOV 12, DEC 10**

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.org
DUES: "SSS" c/o B. P. Knier, 22608 County Line Rd, Elkhart Lake WI 53020
2016 MEETINGs: **APR** 21, **JUN** 18, **AUG 18**, **OCT 20**, **DEC 15**- Call for location (920) 894-1344

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 902

Events Hotline/Answering Machine: 310-364-2290 - Odyssey Ed: Kat Tanaka odyssey_editor@yahoo.com
oasis@oasis-nss.org - Odyssey Newsletter www.oasis-nss.org/articles.html
Regular Meeting 3 pm 3rd SAT monthly -**2016 Mar 19, Apr 16, May 20, Jun 18, Sep 17, Oct 15, Nov 19**

ILLINOIS

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

LDAhean@aol.com

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

COLORADO

DSS: Denver Space Society fka Front Range L5
1 Cherry Hills Farm Drive, Englewood, CO 80133
http://www.denverspacesociety.blogspot.com/

Eric Boethin 303-781-0800 eric@boethin.com - Monthly Meetings every 3rd Thursdays, 7 pm
Englewood Public Library, **Englewood, CO 80110 -** 1000 Englewood Parkway, First Floor Civic Center
2016 MEETINGS: MAR 17. APR 21. MAY 19, JUN 16, JUL 21, AUG 18, SEP 15, OCT 20, NOV 17, DEC 1

MINNESOTA

MSFS: Minnesota Space Frontier Society - http://www.mnsfs.org
c/o Dave Buth, 433 South 7th St. #1808, Minneapolis, MN 55415
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MNSFS monthly meetings are held on the first Thursday of each month at the Fairview Community Center (Great Room), 1910 County Road B West, in Roseville, MN 55113 Meetings usually start at 7:00 p.m. and last about two hours. Each meeting features Board member introductions, general announcements,
2016 MEETINGS: MAR 3. APR 7. MAY 5, JUN 2, JUL 7, AUG 4, SEP 1, OCT 6, NOV 3, DEC 2

OREGON

Oregon L5 Society - http://www.OregonL5.org
PO Box 86, Oregon City, OR 97045

(LBRT - Oregon Moonbase) moonbase@comcast.net - Charles Radley: cfrjlr@gmail.com
We meet the 3rd Saturday of the Month at 2:00 PM
2016 Schedule Feb 20, Mar 19. Apr 16, May 20, Jun 18, Sep 17, Oct 15, Nov 19, Dec 17

PENNSYLVANIA

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

c/o Earl Bennett, Earlisat@verizon.net - 856/261-8032 (h), 215/698-2000 (w)
http://pasa01.tripod.com/ - http://phillypasa.blogspot.com
Meetings 3rd Thurs 2016 MAR 17. APR 21. MAY 19, JUN 16, JUL 21, AUG 18, SEP 15, OCT 20, NOV 17, DEC

The February NSSPASA Report

Meeting times and locations: Our next two meetings will be at The Liberty One food Court on the second level of the building on the west side of the court. Look for our table display. Dates: March12, April 9 between one and three p.m.. A possible event with the N.J. State Museum conflicted with other activities and was not scheduled. Instead we will do an August event at that location.

Meeting notes: Dorothy and Larry did not attend this month.
Check our Facebook and Dorothys' Facebook as well as our NSS site for some more material on us and the couples other activities.

Mitch has put the papers together for our annual report to NSS headquarters for us to continue to be a chapter in good standing. We should get confirmation of our standing by the time this report is in print; Mitch also reported on several other activities and events: he has bought tickets to a 50th anniversary concert at The Tower Theater in our area. Since this is a travelling exhibit it may come to your area during this year. Many of us began our interest in space exploration by exposure to "The Future" this series presented. Mitch is working on a billing problem that has occurred with the Lunar Reclamation Society. There has been some progress, but, I think any chapter that has not been billed in some time contact the treasurer of Moon Miners and keep the publication financially solvent.

He reported on several future probes: the Juno Probe should arrive in July, 2016, Insight will be going to

Mars and will use a ground penetrator (to a depth of 16 feet). Both from the February Popular Sceince. And: the Allen Array has been investigating a star, at 1400 light years, that has generating enough interesting data from its' detection systems that the large, narrowly focused, antenna at GreenBank to gather more definitive information. What this is should be available through the Seti Institutes site and, for Green bank results, there reports and web presence. Mitch also added material from Ad Astra on the Space Settlement Contest and student comments on how inspirational the contest were to them as a result of there involvement. The Winter Ad Astra.

Reminder from Mitch: March is membership renewal month.

From Janice: from Science: the failure of the Greenland Ice Sheet could cause a rise in the sea level of .5 meters. This is projected from data gathered by satellite observations over several decades.

Hank reported on the PSFS meeting and ongoing problem getting information on finances connected with the Philcon event(s). He has been asking about this for quite some time. In other Philcon news: the 2016 Guest of Honor will be C.J.Cherry. His other activities include a spring convention called Ravencon in Virginia in late April. And then there is (?) Lunacon.

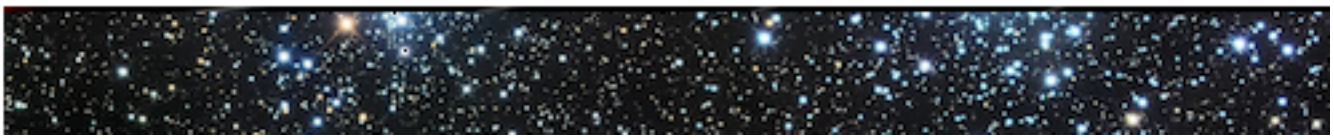
Earl has been put on the contact list for **Lunacon**, a science fiction convention in March. From some of the postings it looks like the promoters are trying to put together a decent hard science, asking for people who are professional people in various fields. Since I am a generalist (dilettante?) I might not be what they are looking for (although I tend to be very useful as moderator and advancing technology interpreter). However: there seems to be a timing issue for this year. I doubt that it can be put together in time.

On other fronts: **Graphene** is a very useful emerging material in a number of science and engineering applications: in the materials processing field it is being used to lengthen the life of Diamond cutting tools. Yes, even diamond tools wear. The lifetime of such tools can be extended by cutting wear by about 74%. The report, from S.M.E. Journal of Manufacturing Processes (appearing in Advanced Manufacturing Magazine for December, 2015) was in the Tech Front section of that issue. The work was done at Rensselaer Polytechnic Institute. Why the tool deteriorates is described as well. From NASA Tech Briefs special Sensors Issue: "Graphene Supports" NASA-Developed Nanosensors. NASA Technologist Mahmooda Sultana is reported as leading the development of the Graphene based sensors. The application in this case is for chemical sensing, down to single molecules, but, a number of other applications for these two dimensional materials.

Because the atoms of these materials are all exposed surface (Graphene has an extremely high surface to volume ratio) they ca n be used for a number of things. The article answers one of my questions: the material is radiation hard as a consequence of its low cross sectional area. See the February Sensors Technology issue for this and much more. Back to the Advanced Manu- facturing publication for one more thing: there was an interview with Al Siblani founder of Envision TEC. His company has, and is, creating 3D printers of very high quality and useful for a variety of materials including biological. Some of the units are capable of 15 micron (reducing or eliminating much post processing) and are used in a variety of custom products. Mr Siblani has developed a production system using Digital Light Projector Tech- nology (like a special version of the video projectors in common use). This is the kind of equipment to use in space!

There is much more, but, I comment on two things that have happened recently: First, **our Sceince Fair winner at the elementary level,** Brady De Grand, did an excellent job of researching, and then explaining, his work on paper airplane flight dynamics. On close questioning Dennis Pearson and I determined that he did the work and understood how to do research. H made several types of aircraft and made multiple copies of each kind to create data on the flight characteristics of each. He could average the flight times and remove data anomalies caused by construction variation to get a typical performance for each version. He even built, with parental help, a standard launching device to eliminate the variable of muscle force variation of hand launched planes. Excellent! We gave him the James H. Chestek Award.

The other item: at our February meeting Mitch Gordon asked " what's the big deal about the detection of gravity waves? What use are they? " I believe a local guy had a very good answer when this sort of question came up during one of his talks. A member ogf the audience asked " what use is this Constitution you are working on?". Since a women asked the question, Benjamin Franklin replied" Madam: Of what use is a baby?" The answer to both questions is: only time will tell. Earl Bennett, President, NSSPASA, KD2CYA.



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