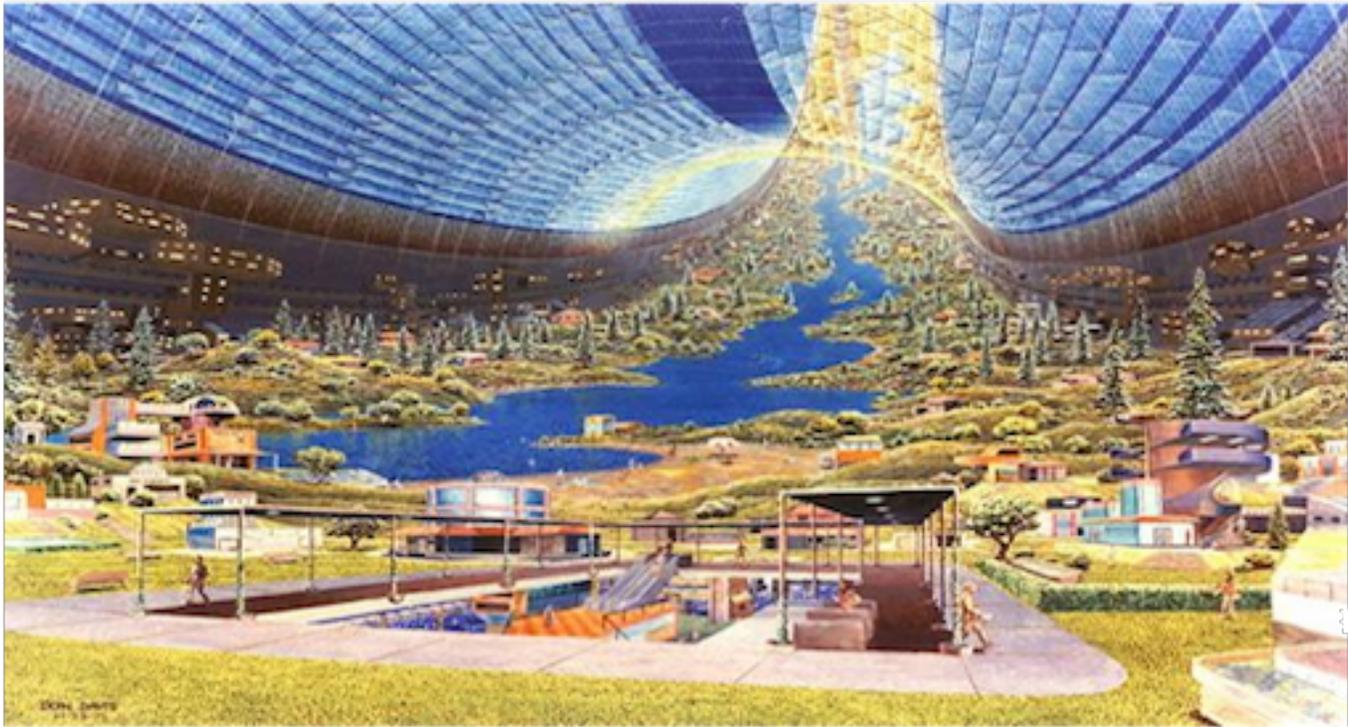


“Towards an Earth–Moon Economy – Developing Off–Planet Resources”

Moon Miners’ Manifesto

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



Inside the “Stanford Torus” – From early L5 Society visions to current concepts and beyond

2. In Focus: The role of “Space Settlements
- 3; Space Settlement Pictures and Designs;
4. Improving the Livability of Space Settlements
- 5 Beyond L5: Where Space Settlements” would be helpful
- 6 Space Settlements as Interstellar Arks; Space Settlements as Space Hotels in Earth Orbit
7. Space Settlement Metroplexes
8. The National Space Society’s annual Space Settlement Design Competition



A Space Settlement Outpost for scientists operating surface vehicles on Titan in real time.

Past articles http://legacy.moonsociety.org/publications/mmm_classics/
Or arranged by themes: http://legacy.moonsociety.org/publications/mmm_themes/

About Moon Miners' Manifesto – “The Moon - it's not Earth, but it's Earth's!”

- **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/)
 - **MMM Glossary:** new terms, old terms/new meanings: www.moonsociety.org/publications/m3glossary.html
 - **MMM retains its editorial independence** and serves many groups, each with its own philosophy, agenda, and programs. Sharing MMM may suggest overall satisfaction with themes and treatment, requires no other litmus test.
- Opinions expressed herein**, including editorials, are those of individual writers and may not reflect positions or policies of the **National Space Society**, **Milwaukee Lunar Reclamation Society**, or **The Moon Society**. **Copyrights** remain with the individual writers. Reproduction rights, with credit, are granted to NSS & TMS chapter newsletters.
- **MMM color online downloadable PDF file version option for Moon Society Members** using their username and password – do write secretary@moonsociety.org if you need help with your password.
 - **For additional space news** and near-term developments, there is a daily RSS feed space news section on <http://www.moonsociety.org>. You can also read **Ad Astra** magazine mailed to **National Space Society** members.
- Milwaukee Lunar Reclamation Society** is an independently incorporated nonprofit membership organization engaged in public outreach, freely associated with the National Space Society, insofar as LRS goals include those in NSS vision statement. MLRS serves as the Milwaukee chapter of both **The National Space Society** and **The Moon Society**: – <http://www.moonsociety.org/chapters/milwaukee/>
- **The National Space Society** is a grassroots pro-space membership organization, with 10,000 members and 50 chapters, dedicated to the creation of a spacefaring civilization.
National Space Society 1155 15th Street NW, Suite 500 Washington, DC 20005 (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, 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 The role of “Space Settlements

By Peter Kokh

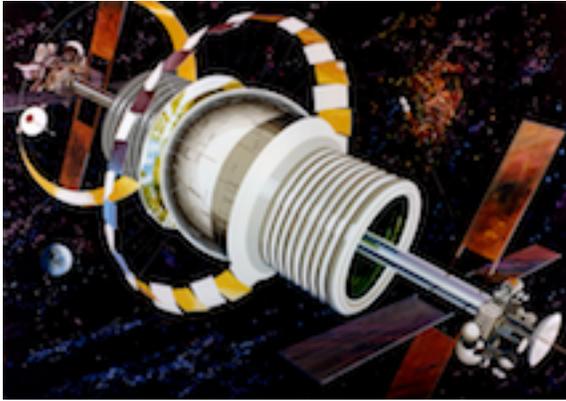
The concept of “Space Settlements” goes back as far as [Konstantin Tsiolkovsky](#). But it was given little attention until Princeton Physicist Gerard O'Neill thoroughly “reinvented” the concept in the 1970's as part of his vision for accessing lunar materials and resources for the purpose of building solar power satellites in Geosynchronous Earth Orbit. Rather than live in spartan conditions on the Moon's surface, and rather than become physically weakened by long-term stays in the Moon's 1/6th Earth level gravity,

The material for building and shielding these “space settlements” would be launched into space by his “mass driver.” His Space Settlement concepts came in three progressively larger and more complex designs: the “Bernal Sphere,” the Stanford “Torus”, and the Sunflower “Cylinder.” (See artwork, next page).

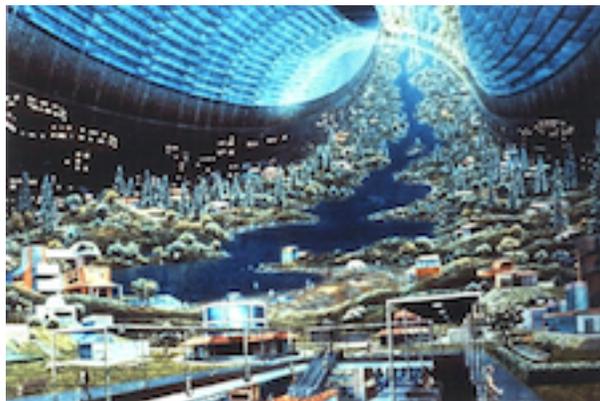
His efforts quickly led to the formation of the “L5 Society”, headquartered in Tucson, Arizona, and which I joined the day I heard about it. In March 1987 at the 6th International Space Development Conference in Pittsburgh, the L5 Society and the National Space Institute merged becoming the National Space Society. In anticipation of the merger, the new Milwaukee Lunar Reclamation Society L5 had incorporated National Space Institute members three months in advance, having received the NSI membership list from Lori Garver. ##.

Past articles http://legacy.moonsociety.org/publications/mmm_classics/
 Or arranged by themes: http://legacy.moonsociety.org/publications/mmm_themes/

SPACE SETTLEMENT PICTURES/DESIGNS



The Bernal Sphere (smallest design)



Stanford Torus (also page 1 cover image)



The Cylinder design (largest population)

Supporters of O'Neill's concepts have played a major role in the National Space Society.

www.space.com/22228-space-station-colony-concepts-explained-infographic.html

www.popularmechanics.com/space/deep-space/a11351/how-we-could-actually-build-a-space-colony-17268252/

https://en.wikipedia.org/wiki/O'Neill_cylinder

<http://www.nss.org/settlement/space/bernalsphere.htm>

<http://www.nss.org/settlement/space/stanfordtorus.htm>

<http://www.nss.org/settlement/space/oneillcylinder.htm>

In contrast, we believe that long term, even life-long settlement on the Moon's surface is possible.

Out inspiration? http://www.moonsociety.org/chapters/milwaukee/mmm/mmm_1.html

Past articles http://legacy.moonsociety.org/publications/mmm_classics/

Or arranged by themes: http://legacy.moonsociety.org/publications/mmm_themes/

Improving the Livability of "Space Settlements"

www.legacy.moonsociety.com/mmm moonminersmanifesto.com

Gerard O'Neill and many, if not most of his followers, lives in a world where the day starts with dawn and ends with sunset. To the contrary, it is not day-job people that make the world turn. It is factory workers, working day, afternoon, and night shifts that make the economy work. Factory equipment is expensive, and the only way to balance the books is to keep factory equipment running around the clock, 24 hours, even 7 days a week.

For many years, I made my living in such a factory, a can plant, making beer and soda cans. Instead of 3 shifts for 5 days, we worked 2 12-hour shifts with two crews working 3 and 4 days at the beginning of the week and 2 crews working the remaining 3 or 4 days: Yes: 24 hours a day, 365 days a year.

The Day shift chauvinism of O'Neill's space settlement designs

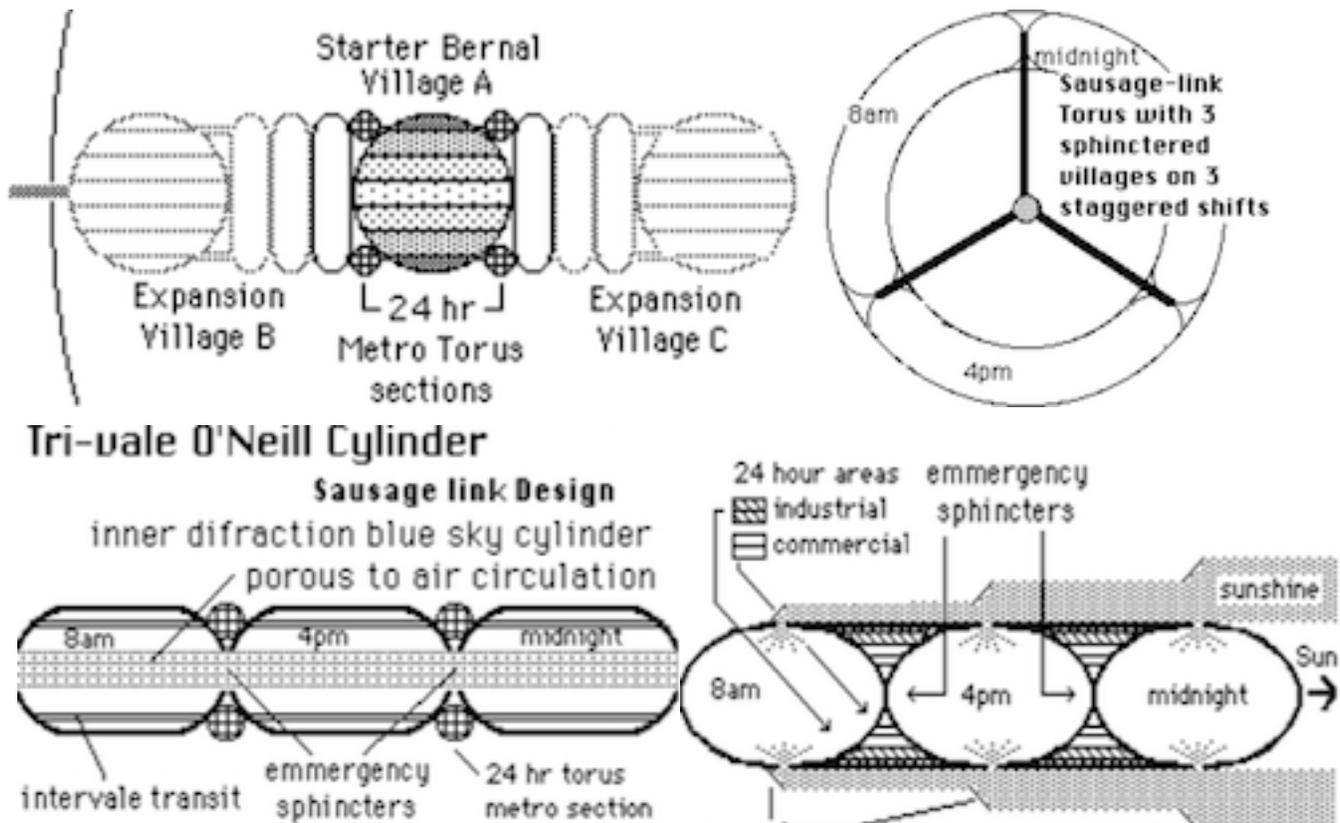
Our first redesign effort was to create an environment which in which workers in 3 shifts could work during "daytime" conditions.

"Reinventing Space Oases" - http://www.moonsociety.org/publications/mmm_papers/reinv_so.htm

"On Earth, frankly, there is no choice. The Sun rises and sets but once a day. Space oases people, who are proud of the fact that they can engineer more ideal environments, have failed to pick up on the fact that the above fact too can be "remedied" in free space.

"Build a triple module, tri-vale structure (three linked spheres, three torus sections side by side, a three-sausage-link cylinder) and engineer the solar access to each so that there are three staggered sunrises and sunsets and you create in effect a three village town, in which the residents of each have day jobs, everyone gets to go to work in their morning, come home in their afternoon.

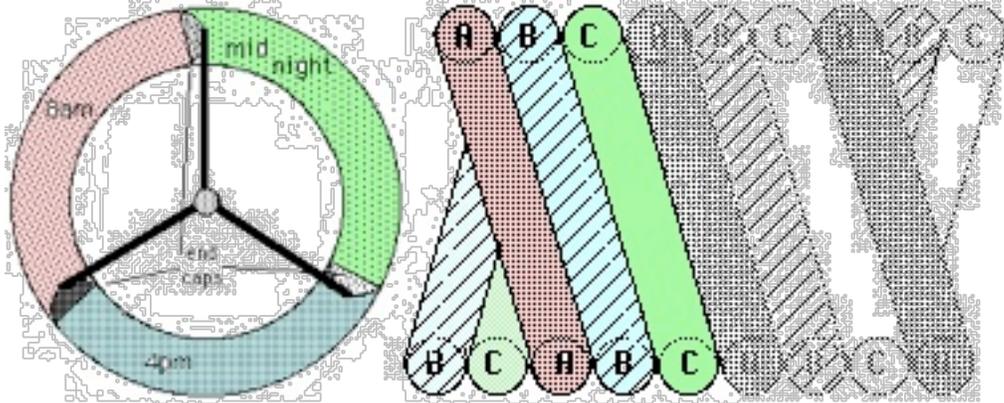
Yet not only does all capital equipment get operated around the clock but **all public facilities from offices, to schools, to entertainment facilities and parks get used 24 hours a day.** If a light assembly facility is located in village A, then, at the afternoon shift change replacement workers from Village B (where it is local morning) come in. And at 11 pm, workers from Village C come in (where it's morning there). The elegant final solution."



[inspired by a drawing sent in by Jeff Sanburg of Skokie, IL] In the event of catastrophic decompression of any one ovoid, the other two ovoids would remain intact, as would the industrial area between two intact ovoids. The industrial areas are more vulnerable in this design than the Metro toruses in the design above. Both designs above could use similar sunshine delivery systems.

An “open-ended” design that could support considerable growth

Last, but far from least: O’Neill’s designs did not include any that expanded in the line of motion while rotating: We would not have helix-shaped DNA if Nature had made the same omission! Slam dunk!



Three Villages with Expansion Potential: This is our preferred design because it can grow with time to serve a naturally growing population.

Helix design challenge: engineering solar access either with axis pointed at the Sun or perpendicular to the Sun. Nb: Al Werbos doubts the stability of such a design. I do not. The central core and radiating elevator tubes at 120° intervals should be backbone enough.

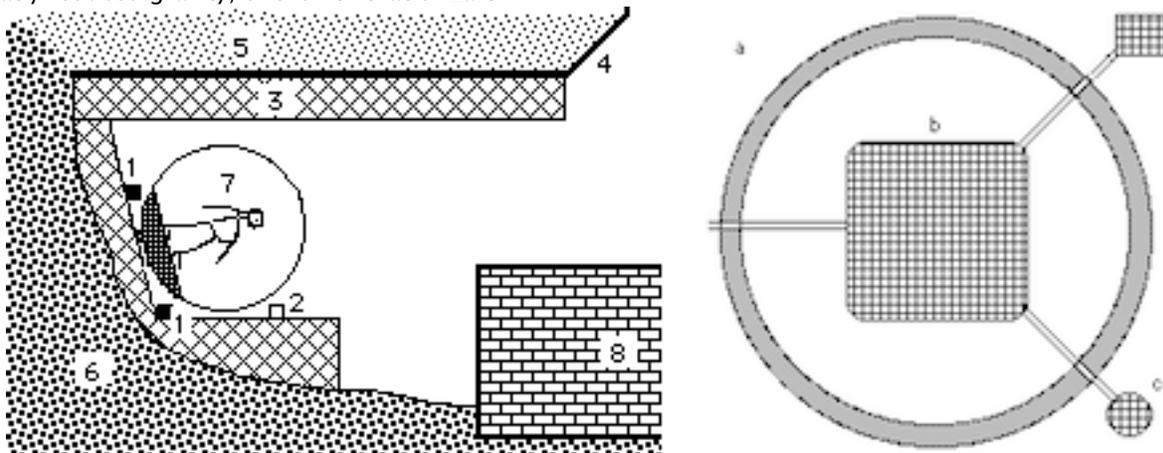
On which one of the above four options would I choose to live? The expanding helix above!

I am a person who likes a “world”, a natural body from any place on which you can only see a very small part. The Moon, or Mars, would do me just fine. PK

Beyond L5: Where “Space Settlements” would be helpful

By Peter Kokh

I personally believe that Space Settlements will not be built to use lunar resources to build solar power stations in Geosynchronous Orbit. They will be built, but workers on the Moon will manufacture the components. In other words, I do not believe that the strength and health of workers living on the Moon will necessarily suffer from the greatly reduced gravity, one-sixth that of Earth.



ALTERNATE MAG-LEV XITY SCHEME: Banked track (1, 2) is situated inside the lip of an appropriate-sized crater. 3) Space Frame support for shielding shed; 4) shed retainer; 5) regolith shielding; 6) crater bedrock; 7) mag-lev torus section module; 8) surface-stationary mini-g xity facilities in mid-crater.

A “Maypole” design is an option, if we can find a way to keep the spun vehicle from twisting this way and that.

There are ways to avoid physiological strength such as spending time on a train-like facility going round and round on an inclined circular track, producing higher “gravity” illustrated by the design sketch above. But I would go further, to predict that those who intend to spend their lives on the Moon and do not want to make the effort to keep up their Earth-level muscle tone by methods such as a “gravitrak” will do just fine.

But for those who hear the call of mineral wealth among the asteroids, except on the larger “Dwarf planets” such as Ceres, and maybe Vesta and Pallas, there is another option” a space elevator to shielded structure at a level where centrifugal force will create the desired gravity level.

In orbit around Venus or floating high in Earth's torrid sister world's atmosphere

Simpler "space settlement" design facilities could "hand out" in the atmosphere at a level where temperatures and pressures are not a problem. Such a facility would serve scientists tethering out probes into deeper, hotter, higher pressure areas of the planet in order to learn much more about this "sister world."

Providing artificial gravity would not be necessary. One would feel Venus' gravity, a tad less than Earth's/
Read: www.moonsociety.org/publications/mmm_papers/venus_rehabpaper.htm PK

"Space Settlements" as Interstellar Arks

By Peter Kokh

In the outer Solar System

Space Settlement enthusiasts envision these artificial micro (not mini-) worlds throughout the outer Solar System and beyond. One obvious challenge is that the Sun's warmth and energy declines with the inverse square of the distance. Nuclear Fusion would be needed, with the challenges that will bring.

Going home (Earth-Moon system) for a visit will be difficult if possible at all.

The small horizons inside these artificial mini worldlets will soon become overwhelming boring, giving rise to a variety of psychoses..

Interstellar Arks is a concept that has two versions: sending eggs and sperm to be united on "arrival" at some world out among the stars, then raised and educated by robots with enough lead time so that they are ready to "hit the ground running" on some distant exo-planet. Sending embryos in suspended animation would be another option

However, this may be the only way humans can reach suitable worlds around other stars. PK

When it comes to reaching out to the stars, the best choice is to trade info at the speed of light, not send representatives. The info may take seed, and send out cultural ripples.

- "Exploring New Ethics for Survival: The Voyage of the Spaceship Beagle" by Garrett Hardin

I encourage interstellar ark fans to read this classic book, if you have a ticket on the Beagle, you need to tear it up!

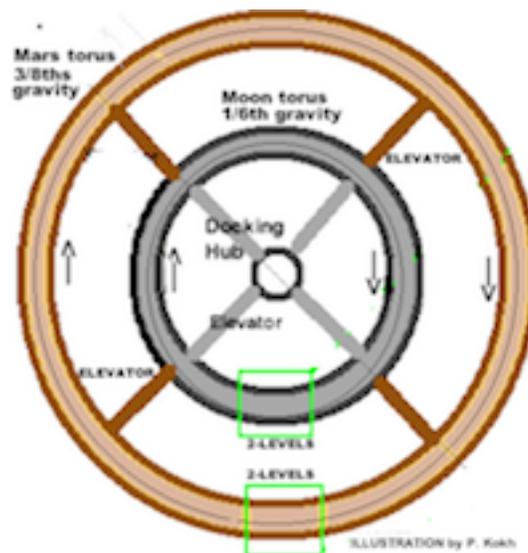
"Space Settlements" as Space Hotels in Earth Orbit

By Peter Kokh

Al Globus has some reduced-size Space Settlement designs for use as luxury hotels in Earth orbit. He points out that well below the Van Allen Belt, cosmic rays would not be a problem and megatons of "shielding on the facility's outer surface would not be needed.

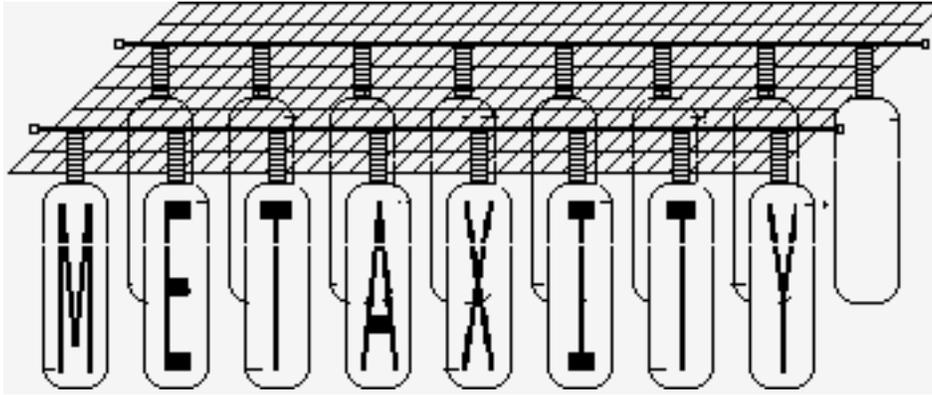
I would be more cautious here. We will want some reduced level of shielding to prevent damage from the ever-increasing high speed debris in Earth orbit. Otherwise, **yes!** Such structures would make superior space hotels.

In the last issue, MMM #298, on pages 3 and 4, I have even proposed such a structure, a dual lunar/Martian gravity level torus as a near-Earth place where people could pretend to be on the Moon or Mars, and/or consider volunteering to work on the Moon or Mars, and perhaps even settle one of these worlds. ##



“Space Settlement Metroplexes”

By Peter Kokh



[**Xity – Xities** – [Pronounced KSIH–tees – not EX–i–tees]

[**Beyond–the–cradle off–Earth settlements** (“Xities”) will be fundamentally different from the familiar Biosphere One–coddled “cities” that have arisen over the ages to thrive within the given generous maternal Mother Earth biosphere that we have largely taken for granted.

Elsewhere within our solar system, each “xity” must provide, nourish, and maintain a biosphere of its own . Together with their mutual physical isolation by surrounding vacuum or unbreathable planetary atmospheres, this central fact has **radical ramifications** that must immediately transform space frontier xities into something our back home terrestrial cities have never been.]

Could Large Space Settlements of the Cylinder type aggregate in Metropolian complexes?

Why not? A large platform **providing many types of services** to an attached cluster of Settlements. These should be in two (or larger number divisible by 2) rows **with each pair of rows anchoring the end of settlements half rotating clockwise, half counterclockwise to maintain overall directional stability.**

If the cylinders, by themselves, are all designed to rotate in one direction, **one row could have them anchored by the “front” end, the other row settlements anchored by the “aft end”**

Such a platform, in addition to allowing free personal traffic between all of the anchored units, could provide useful maintenance and repair services, as well as make easy the flow of people and goods between them. That is, the grid itself would have a transportation system for people and goods.

Such a **“metroplex” cluster** could house a significant population, with benefits similar to very large metropolitan complexes here on Earth. This type of “clustering” might be especially useful for Space Settlements far from Earth, supporting one another, and together offering far more amenities and services, as well as educational and recreational options.

----- **Back to Space Settlements in general** -----

How could/would space settlements earn income and what could they produce to trade?

- We can see a small space “village” of scientists teleoperating rovers and submarines on **Titan**, or teleoperating probes in the mysterious ocean below **Europa’s** crust. or probes on the very hot surface of **Venus**.
- We can see a space settlement in orbit around **Uranus** tele–harvesting that planets apparently “inexhaustible” amount of fusionable Helium–3 in its atmosphere.
- But just parked, say in an orbit around Saturn from which the beauty of the rings never becomes boring – such a space settlement could serve as a space hotel, but with no other source of income.
- It isn’t enough to just design a space settlement with a beautiful interior of parks and homes.
- The further a space settlement is from an inhabited world (Earth, Moon, Mars) the more difficult it will be to justify the enormous expense of building and maintaining such megastructures.
- Space Settlements have to justify their construction and maintenance economically in their near future as well as over a very long period of time.

##

The National Space Society's annual Space Settlement Design Competition

By Peter Kokh

One of the National Space Society's endeavors is to get young people interested in space development possibilities. There is an annual competition for "Enterprise in Space." <https://www.enterpriseinspace.org/winner/>
And there is an annual competition for students worldwide to come up with creative Space Settlement designs. <http://www.nss.org/settlement/space/>

These annual competitions have yielded many innovative and creative designs. To date, the winning 2007 entry, **Kalpana One**, is judged the best entry yet. www.nss.org/settlement/space/kalpanaimages.htm
(do check out the amazing and beautiful "tour" of Kalpana at this address)
and has been featured in the Society's quarterly magazine, Ad Astra.
www.nss.org/adastra/volume25/KalpanaOneAdAstra.pdf



Kalpana is a "torus" design

The original paper is online at www.nss.org/settlement/space/kalpana.htm
www.nss.org/settlement/nasa/Kalpana/KalpanaOne2007.pdf

These space settlement visions are **far future** with stress on both words, and the prizes include invitations to the next annual International Space Development Conference, usually held on/near the Memorial Day weekend. These "ISDCs" have attracted students worldwide. The largest contingent by far, each year, comes from India.

Meanwhile, efforts to interest students in nearer-term space developments such as outposts on the Moon and Mars take a back seat. Perhaps such competitions could be supported by other organizations such as the Moon Society, the Mars Society, etc. Either at the annual ISDC or other society-sponsored gatherings.

The Space Settlement competition if we continue to support it, should be divided into the three original classes: The Bernal Sphere: the Stanford Torus, and the Cylinder – perhaps it is, but we don't know that.

The big risk of these far future space settlement competitions is that when involved students realize that even their great great grandchildren will not live to see such dreams realized, they will be disillusioned and forever lost to the space development effort.

In big obstacle to any more realistic efforts is the belief, fed by Gerard O'Neill, the father of the Space Settlement concept, that people cannot live longterm in the reduced gravities of the Moon – 1/6th Earth normal – and Mars – 3/8th normal. But there are ways to keep Lunan and Martian settlers healthy. More to the point, no inside-facing space settlement can beat an outward-facing planetary surface.

Lavatube settlement and Moon/Mars surface settlement design competitions

Lavatubes: A competition somewhere inbetween could be designing settlements within both worlds' large and extensive lavatube complexes. Lavatubes on the Moon are larger in cross-section than those on Mars, inversely related to their different gravity levels. On the Moon, lavatubes are found in the maria, lava flood plains. On Mars they are to be found in the flanks of that world's very large shield volcanoes. Pavonis Mons, smack on Mars' equator, being the most promising, with an estimated total lavatube volume capable of supporting a population of millions, with a launch track up the western slope able to boost rockets Earthwards or elsewhere with far less fuel.

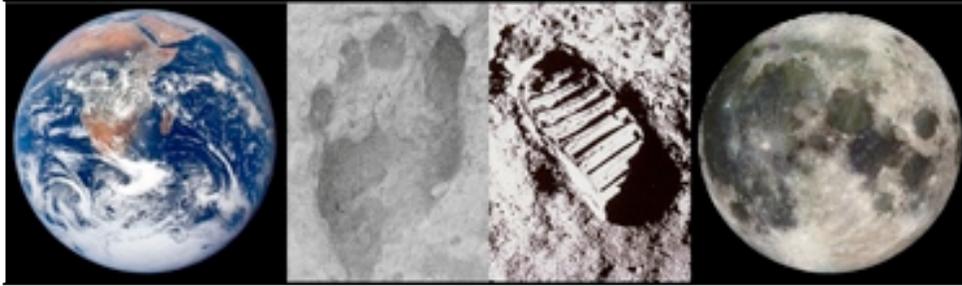
There is plenty of room for creative design in such a competition, along with the knowledge that student visions have a far greater chance of being realized someday.

Perhaps an ad hoc alliance of other space societies could co-sponsor such an effort. Something for us to work on. But designs of properly shielded surface settlements on both worlds should not be ignored. **Moon-focused and Mars-focused societies might hold annual or biannual competitions in this area also, or alternate with lavatubes in even-numbered years, surface designs in odd-numbered years or vice versa.**

Most importantly, **we owe it to students not to fill their minds with unrealizable dreams.** PK

Past articles http://legacy.moonsociety.org/publications/mmm_classics/
Or arranged by themes: http://legacy.moonsociety.org/publications/mmm_themes/

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

It seems sad that the best use the media has for the space industry is for 'gotcha' questions of political candidates to show how goofy and 'loonie' they are. An industry with the potential to contribute significantly to the U.S. economy, but which is seen as the dream realm of nerds and geeks, not 'grown-ups'.

The industry itself is much to blame for this state of affairs, and its still strong reliance on NASA as the source of funds for all things space. From building crewed spacecraft to probes of the Solar system, NASA is the fount from which the industry draws its nourishment. This is problematic to the extent that NASA itself is becoming a sclerotic and ossified entity more concerned with fulfilling past agendas and maintaining the status quo than in pursuing new visions of the future.

Some might see Elon Musk's Mars plans as something new and different, but after the unveiling of his plans recently the dissection quickly began, and the overall public response seems to have been a big yawn. Elon has the advantage of working with capital markets and industry to build out his cislunar infrastructure, whereas NASA must each year return to Congress, hat in hand, to ask if they may please sir have some more funds? Still, as we have seen with the timelines for something as basic and crucial as crewed transport to orbit, Elon's schedule is likely to see some slips, like substantial ones.

Past articles http://legacy.moonsociety.org/publications/mmm_classics/
Or arranged by themes: http://legacy.moonsociety.org/publications/mmm_themes/

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

Part of the issue is mis-directed focus. NASA has a goal of Mars. Elon has a goal of Mars. Many of the space advocate organizations want to see Mars. To be fair, Mars is a formidable goal, and one, if achieved, that would reflect enormous capabilities and will. Still, the question remains – what if Mars is a 'bridge too far' at this point in time?

Overlooked in all of this is the fact that if we focus instead on building out the cislunar economy, we can position ourselves to approach Mars in a much more robust manner, while at the same time developing access to the entirety of the Solar system. The steps for doing so are much simpler in their execution, and the path to profitable activities will be much shorter given the time value of money coupled with the proximity of cislunar operations. A cargo route of three days is much more compelling from a profit perspective than a six month cargo journey. Access to cislunar assets, like GEO sats, will provide a path for more sophisticated tools to be deployed to address our space needs and desires.

The Moon is our 'sandbox mode' for the rest of the Solar system. It is there that we will prove out the equipment and the processes for going elsewhere in space. It is by building up our infrastructure assets and capabilities that we will enable a vigorous trans-lunar exploration and development capability, moving beyond our current state of data gathering about the planets and into a state of data utilization to achieve useful ends for humanity.

As this year's political silly season progresses, one can't help but wonder if the U.S. really has what it takes to lead humanity into its space future. Until the space industry is recognized as a serious one, it's reasonable to have doubts. The status quo is fine with where things stand, as their rice bowls are safe. Everyone else who supports what the space industry could be should be thinking of how to shake things up, returning NASA (as the public face of space) to an organization focused on the future instead of recreating the glories of the past. KM

Growing the number of Moon Society “Outposts” and “Joint Chapters”

By Peter Kokh

Point 1: The Moon Society is a much smaller membership organization than the National Space Society

Point 2: **The goals of both Societies have a substantial overlap**

Point 3: At the 2005 International Space Development Conference in Washington, DC., as then President of the Moon Society (2004–2011) I proposed to the National Space Society which accepted the proposal as written with no amendments that Made the Moon Society an Autonomous Affiliate of NSS.

http://legacy.moonsociety.org/reports/affiliation_report.html

“Our chartered chapters, should they so choose (and if they include 3 NSS members), should be listed on their own in the NSS Chapter list. This would be a plus for NSS which would stand to gain a vigorous chapter in St. Louis, where it now has no organized presence. Others may follow.”

NSS Chapters and the Moon Society

[2005 Text continued] “Currently three NSS Chapters are listed on the Moon Society website as collaborating or partnering NSS chapters: **Oregon L5** (because of its strong lavatube interest) and the **Lunar Reclamation Society** (because it publishes **Moon Miners' Manifesto** which has served Artemis Society International, and its successor in membership services, The Moon Society, since 1995) has enjoyed a decade of informal collaboration with the Moon Society. The relationship has no formalities, no requirements, and each NSS chapter is free to define it in whatever pragmatic way they wish. It is about working together on projects, not legalities. Recently, Minnesota Space Frontier Society requested to come aboard in this informal association. We would welcome any other NSS chapters with a strong interest in the Moon to actively collaborate in our projects and various endeavors, again with no legal or formal constraints.”

In short, any NSS chapter that has 2 or more members who also belong to the Moon Society, can list itself as a joint NSS/Moon Society Chapter. Conversely, any Moon Society chapter that has 2 or more members who also belong to the National Space Society, may list itself as a joint chapter.

The Situation today: Currently, eleven years later in 2016, all listed Moon Society chapters are joint NSS/Moon Society chapters. Could there be more? In the coming weeks, I will check the Moon Society database for current Moon Society members within 50 miles of the listed NSS chapter address, and if there are 2 or more, endeavor to get those members to contact their area NSS chapter, as well as notify those NSS chapters of potential Moon Society joint members.

Where there are two or more Moon Society members in contact with one another, looking for more, I will notify them if there is an existing NSS chapter in their area, and meanwhile encourage them to list themselves as a Moon Society Outpost, joining the California Bay area and Nashville on our list. Together, we can do more, as the dynamic joint St. Louis chapter hosting the 2017 International Space Development Conference, clearly demonstrates. ## PK

Past articles http://legacy.moonsociety.org/publications/mmm_classics/
Or arranged by themes: http://legacy.moonsociety.org/publications/mmm_themes/

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

Should the Moon Society cosponsor a Lavatube Settlement Design Competition? What about Moon or Mars Surface Settlements and/or Lavatube Designs?

By Peter Kokh

Read our comments on the National Space Society's design competitions on page 8 above. The Moon Society has a much lower membership than NSS, but **together with other Moon-focused and Mars-focused societies**, such jointly sponsored competitions should be viable.

- **OpenLuna** <https://www.openluna.org> – http://www.openluna.org/resources/Intro_to_OpenLuna.pdf
- **The Mars Society** <http://www.marssociety.org>
- **Explore Mars Now** <http://www.exploremarsnow.org>
- **The Mars Foundation** <http://www.marsfoundation.org>

The National Space Society's annual International Space Development Conference attracts members from all these groups and might be the venue to discuss this, **Next ISDC 2017 in St. Louis** <http://isdc.nss.org/2017/> .

We will send out feelers and "invitations" to all Moon-focused and Mars-focused organizations, and, of course, to the ISDC St. Louis team.

And perhaps we have enough lead time to announce initial competitions in both fields (lavatube and surface) with winning designs featured at ISDC 2017 in St. Louis.

If you, or your group are interested, please contact me at kokhmmm@aol.com and/or 414-342-0705. Our presence at ISDC 2017 (Milwaukee Lunar Reclamation Society – joint NSS/Moon Society chapter)

At St. Louis, we hope to display (an) example(s) of **Moon/Mars outposts built by students using mostly recycled materials** (plastic bottles, styrofoam products, etc.) in hopes of starting an annual competition for younger students. If this effort interests you, or your chapter, why not consider attending? The St. Louis chapter is a dynamo, and we can expect an especially memorable conference.

Facts about lunar and Martian lavatubes that should be considered

- They can be winding, witness sinuous rille valleys, the relics of near surface lavatubes
- There may be sections that are partially or wholly collapsed
- Pressurization might allow water vapor to get into cracks, freeze, and lead to spallation: parts of the walls and ceiling might have collapsed, and more could collapse with pressurization
- Their interior height and width can vary from hundreds of meters down.
- Many will have sections where the roof has collapsed, or could collapse.
- It will be feasible to pipe in sunshine only near surface layer tubes
- Lavatubes can exist in each of several lavaflows: some maria (Latin for seas) have shallow lava flood deposits as can be noted from the relative abundance or scarcity of protruding craters formed before the lava floods. For example, Mare Crisium's many layers leave few pre-existing craters uncovered, while nearby Mare Marginis has many protruding craters and probably on one lava flooding.
- Lavaftubes in various layers might criss cross.
- Some lavaflows have had bullseye impacts creating surface holes that open up into a lavatube below.
- In general, lavatube cross-sections are bigger, the lower the host planet's gravity. Mars, considerably more massive than the Moon, has lavatubes with much smaller cross-sections than those to be found on the Moon.
- Lavatubes are also a feature of shield volcanoes, of which Mars has several, the Moon none

Assets of Lavatubes

- http://www.moonsociety.org/publications/mmm_themes/mmmt_lavatubes.pdf – many articles on **lavatube on Moon and Mars and their features and usage.**
- Lavatubes are pre-shielded from cosmic radiation, which makes these spacious volumes attractive for **area-intensive operations such as farming, industry, and warehousing.**
- Deep layer lavatubes probably have been intact for billions of years and should be secure for many billions of years to come: as such they are attractive for storing records and other items to be preserved for aeons to come.

Negative features of Lavatubes

- Absence of daytime sunshine, or views of the star-studded heavens above.
- Lavatube settlements may want a, or several, surface entry levels and access to surface activities
- The closer to the surface, the more prone to partial collapse

##

Past articles http://legacy.moonsociety.org/publications/mmm_classics/
Or arranged by themes: http://legacy.moonsociety.org/publications/mmm_themes/

October

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

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-Milwaukee.com>

Contact: Peter Kokh – kokhmmm@aol.com – MEETINGS, 2nd Sat 1–4 pm monthly except July, August/

Our August 20 Summer gathering at the Milwaukee Public Museum and Planetarium was fun for seven of us;

Lessons learned: For future such events, we need to have a banner for our table so new members can find us

Meetings: Mayfair Mall lower level room G150 for all meetings except December, in G110:

2016 Schedule NOV 12 – DEC 10 – **2017 Schedule** JAN 14, FEB 11, MAR 11, APR 8. MAY 13, JUN 10

After MMM #301: Peter plans to put out a new newsletter of no set publication schedule, no set length to be called “Outbound MMB” (Moon, Mars, & Beyond” available as pdf file only (you print it out).

Peter Kokh is also planning 2 exhibits (on one table) at the upcoming ISDC 2017 in St. Louis:

- (1) an exhibit showing the many benefits of starting a settlement on the north “shore” of Mare Frigoris over the much favored South Pole site.
- (2) an exhibit using recyclable items and materials, of a lunar outpost with the idea of having annual ISDC student competitions for similar exhibits using recyclables.

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. **2016** Nov , Dec – **2017** Jan , Feb , Mar , Apr , May , Jun

Gateway to Space 2017 – NSS annual International Space Development Conference Memorial Day Weekend. Thursday–Monday May 25–29 at the St. Louis Union Station.

Dave Dietzler has an article in Fall 2016 issue of Ad Astra: “Space Infrastructure for Lunar Tourism

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.

NEXT MEETINGS **2016 Schedule** Nov 19 – Dec 17

2017 Schedule Jan 21– Feb 18– Mar 18 – Apr 15 – May 20 – Jun 17 – Jul 15 – Aug 19 – Sep 16.

The Phoenix chapters of NSS and The Moon Society had their first meeting on Sat, September 17, 2016 a summer break. President Mike Mackowski gave a talk on NASA’s Gemini program of 50 years ago. Gemini paved the way to the Moon, proving out rendezvous techniques, extra-vehicular activities, and extended duration manned space missions. We had a dozen members hear the presentation as well as several concepts for follow-on Gemini adaptations that never got off the drawing board. We also discussed ideas for future meetings and how to deal with the trend towards social media versus face-to-face meetings and events. We are likely to try a mix for a while, sticking with at least quarterly traditional meetings but inserting social events and attending other groups’ events, such as the many space-related lectures offered by Arizona State University

Tucson L5 Space Society – Now serving Moon Society Members www.tucsonspacesociety.org/ (not updated)

– www.meetup.com/NSSPhoenix/events/161939572/ (not updated) Contact: Al Anzaldúa – Meets monthly, every 2nd Saturday, 6:30 PM – **2016** Nov 12, Dec 10, **2017** JAN 14, FEB 11, MAR 11, APR 8. MAY 13, JUN 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 of the Bay Area Community Center at Clear Lake Park:

2016 Dec 19 **2017** Feb 20, Apr 17, Jun 19, Aug 21, Oct 16, Dec 18

Past articles http://legacy.moonsociety.org/publications/mmm_classics/
Or arranged by themes: http://legacy.moonsociety.org/publications/mmm_themes/

OCTOBER 2018 SPACE NEWS BROWSTING LINKS

SPACE STATIONS + ROCKETS + COMMERCIAL SPACE

www.spacedaily.com/reports/First_commercial_space_base_to_be_built_in_Wuhan_999.html
<http://phys.org/news/2016-09-china-space-station-tiangong.html>
www.spacedaily.com/reports/China_eyes_year-long_stays_for_space_station_astronauts_999.html
<http://phys.org/news/2016-09-amazon-chief-jeff-bezos-unveils.html>
www.space.com/34218-dream-chaser-united-nations-space-plane-mission.htm
www.space.com/34138-boeing-and-spacex-closer-to-ferrying-astronauts-to-space-video.html

EARTH + NEAR SPACE

www.terraily.com/reports/In_eastern_Tibetan_forest_signs_of_tree_growth_amid_climate_change_999.html
www.space.com/34163-earth-atmospheric-oxygen-levels-declining.html
<http://phys.org/news/2016-09-space-rocket-fuel-power-revolution.html>

MOON

<http://phys.org/news/2016-09-chemistry-moon-proto-earth-mantle-relocated.html>
www.nasa.gov/feature/kplo-ao
www.space-travel.com/reports/Exploration_Team_Shoots_for_the_Moon_with_Water_Propelled_Satellite_999.html
www.spacedaily.com/reports/China_acquires_basic_technology_for_manned_lunar_missions_999.html

MARS

www.space.com/33941-inside-hiseas-isolation-habitat-hawaii.html
www.space.com/34164-spacex-red-dragon-mars-mission-nasa.html
www.space.com/34210-elon-musk-unveils-spacex-mars-colony-ship.html
www.marsdaily.com/reports/Mars_Rover_Views_Spectacular_Layered_Rock_Formations_999.html
www.marsdaily.com/reports/Mars_hosted_lakes_snowmelt-fed_streams_much_later_than_previously_thought_999.html
<http://phys.org/news/2016-09-hebridean-clue-life-mars.html>
www.spacedaily.com/reports/Earthquakes_Marsquakes_and_the_Possibility_of_Life_999.html
www.marsdaily.com/reports/NASAs_Mars_2020_Rover_to_Produce_Oxygen_on_the_Red_Planet_999.html
www.space.com/34160-what-manned-mars-missions-need-to-know.html
www.space.com/34209-spacex-mars-spaceship-animation.html

ASTEROIDS + COMETS

www.space.com/34016-why-osiris-rex-is-visiting-an-asteroid.html
www.spacedaily.com/reports/JPL_Seeks_Robotic_Spacecraft_Development_for_Asteroid_Redirect_Mission_999.html
www.space.com/34149-asteroid-impact-warning-system-scout.html
www.space.com/33934-dwarf-planet-ceres-ice-volcano-discoveries.html

OTHER PLANETS + MOONS

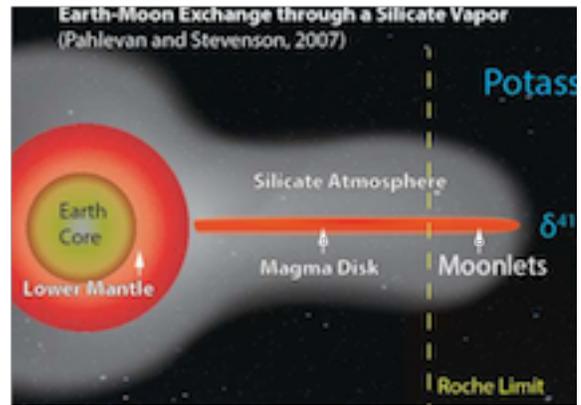
<http://phys.org/news/2016-09-mercury-tectonically.html>
www.space.com/34196-jupiter-moon-europa-giant-water-plumes.html
www.space.com/34172-europa-subsurface-ocean-what-we-know.html
www.spacedaily.com/reports/Titans_Dunes_and_Other_Features_Emerge_in_New_Images_999.html
<http://phys.org/news/2016-09-nasa-scientists-impossible-cloud-titanagain.html>
<http://phys.org/news/2016-09-x-ray-pluto.html>
<http://phys.org/news/2016-09-pluto-largest-moon-charon-red.html>
<http://phys.org/news/2016-09-pluto-glaciers.html>
www.space.com/34179-plutos-heart-hints-at-deep-underground-ocean.html

ASTRONOMY + ASTROBIOLOGICS

<http://phys.org/news/2016-09-china-world-largest-radio-telescope.html>
<http://phys.org/news/2016-09-hubble-planet-orbiting-pair-stars.html>
www.space.com/34184-stephen-hawking-afraid-alien-civilizations.html
<http://phys.org/news/2016-09-thy-star-planet.html>
<http://phys.org/news/2016-09-galaxy-milky-revealed.html>
www.space.com/34188-milky-way-bone-hunters-find-galactic-bounty.html
<http://phys.org/news/2016-09-astronomers-galaxy.html>
www.space.com/34189-universe-is-directionless-study-finds.html

Past articles http://legacy.moonsociety.org/publications/mmm_classics/
 Or arranged by themes: http://legacy.moonsociety.org/publications/mmm_themes/

RECENT SPACE NEWS IN PICTURES

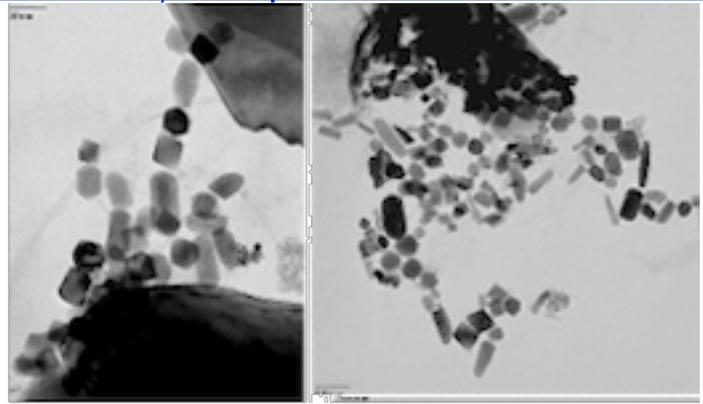


Jeff Bezos' new family of "New Glenn" super rockets

The Moon is proto-Earth's mantle, relocated

<http://phys.org/news/2016-09-amazon-chief-jeff-bezos-unveils.html>

<http://phys.org/news/2016-09-chemistry-moon-proto-earth-mantle-relocated.html>

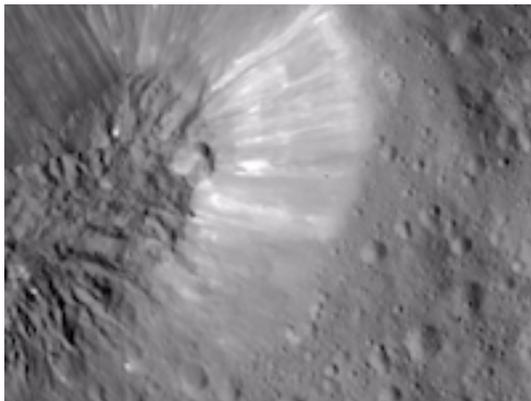


Tiangong 2 Chinese Space Station now in orbit

Supernova Ashes Found in Fossils Hint at Extinction Event

<http://phys.org/news/2016-09-china-space-station-tiangong.html>

www.space.com/33777-supernova-ash-found-in-fossils.html



Ice volcano on dwarf planet Ceres

Pluto paints its binary companion Charon red

www.space.com/33934-dwarf-planet-ceres-ice-volcano-discoveries.html

<http://phys.org/news/2016-09-pluto-largest-moon-charon-red.html>



China opens world's largest radio telescope

<http://phys.org/news/2016-09-china-world-largest-radio-telescope.html>



ISDC, 2017 - ST. LOUIS, MISSOURI

National Space Society

36TH ANNUAL

INTERNATIONAL SPACE DEVELOPMENT CONFERENCE

MEMORIAL DAY WEEKEND 2017

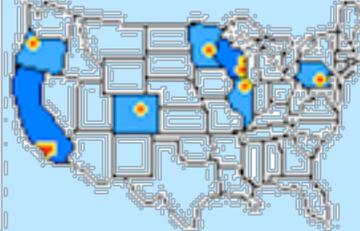
ST. LOUIS, MISSOURI

Past articles http://legacy.moonsociety.org/publications/mmm_classics/
Or arranged by themes: http://legacy.moonsociety.org/publications/mmm_themes/

National Space Society Chapters in the United States

http://chapters.nss.org/a/lists/#US_Chapters

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)

Meetings: Mayfair Mall lower level room G150 for all meetings except December, in G110:

2016 Schedule NOV 12 – DEC 10 – **2017 Schedule** JAN 14 – FEB 11 – MAR 11 – APR 8 – MAY 13 – JUN 10

Our August 20 Summer gathering at the Milwaukee Public Museum and Planetarium was fun for seven of us;

Lessons learned: For future such events, we need to have a banner for our table so new members can find us

Peter is also planning 2 exhibits (on one table) at the upcoming ISDC 2017 in St. Louis:

(1) an exhibit showing the many benefits of starting a settlement on the north “shore” of Mare Frigoris over the much favored South Pole site. (2) an exhibit using recyclable items and materials, of a lunar outpost with the idea of having annual ISDC student competitions for Moon/Mars outpost exhibits using recyclables.

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 **3rd Thur even # months:** **2016 MEETINGS:** Dec 15 **2017 MEETINGS:** Feb 16, Apr 20, Jun 15
 Call for location (920) 894-1344

Past articles http://legacy.moonsociety.org/publications/mmm_classics/
 Or arranged by themes: http://legacy.moonsociety.org/publications/mmm_themes/

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 Schedule** Nov 19, Dec 17
2017 S Jan 21, Feb 18, Mar 18, Apr 15, May 20, Jun 17, Jul 15, Aug 19, Sep 16, Oct 21, Nov 18, Dec 16

COLORADO



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

James W. Barnard 303-781-0800 trailrdr@central.com - Monthly Meetings every **3rd Thursdays, 7 pm**
 Englewood Public Library, Englewood, CO 80110 - 1000 Englewood Parkway, 1st Flr Civic Center
2016: Oct 20, Nov 17, Dec 15 - **2017** = Jan 29, Feb 16, Mar 16, Apr 20, May 18, Jun 15, Jul 20, Aug 17

ILLINOIS



LDAhean@aol.com

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

MINNESOTA



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

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 Schedule Oct 7 - Nov 4 - Dec 1 - **2017 Schedule** Jan 5, Feb 2, Mar 2, Apr 6, May 4, Jun 1, Jul 6, Aug 3

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

Meetings 3rd Sat Monthly 2 PM - **2016** Oct 15, Nov 19, Dec 17

2017 Jan 21, Feb 18, Mar 18, Apr 15, May 20, Jun 17, Jul 15, Aug 19, Sep 16, Oct 21, Nov 18, Dec 16

PENNSYLVANIA



NSS-PASA: NSS Philadelphia Area Space Alliance

928 Clinton Street, Philadelphia, PA, 19107 <http://pasa01.tripod.com/> - <http://phillypasa.blogspot.com>c/o Earl Bennett, Earlisat@verizon.net – 856/261-8032 (h), 215/698-26**Meetings 3rd Thursday monthly 2016; Oct. 20, Nov. 17, Dec. 15****2017: Jan 19, Feb 16, Mar 16, Apr 20, May 18, Jun 15, Jul 20, Aug 17, Sept 21, Oct 19, Nov 16, Dec 19**

The NSSPASA Report for September, 2016

Meeting times and locations: Our October meeting may be shifted due to a conflict between our meetings and several members' activities. Preliminary date: October 8, possible alternative: October 15. In either case this will be at the Liberty One Food court location at sixteenth and Market streets. Check our website and Mitch Gordon, who does our phone tree (215-625-0670). Our November meeting will be during Philcon, which is from November 18 and 20, on Saturday the 19th during the dinner time frame (4 to 7 p.m.) Elections are in December! We had an abbreviated meeting due to several members going away to the shore and work related activities. Thus most of the report is Earl's.

Hank Smith reported on the upcoming Philcon and the future Philcon in 2017. There are no details on that event, but, Hank brought us both bookmarks for the present event, and, the Chair for the 2017 event: Mike Hammon(d). The World Con will be in San Jose for 2018, and the 2017 Nasfic will be in San Juan, Porto Rico (where the I.S.D.C. was). Capclave, a science fiction convention, will be in October (7th to the 9th) in Gaithersburg Md. And, in April 2017, Lunacon will be in Chester County, New York, (exact location to be determined) with Guest of Honor Ben Bova (scientist and science fiction writer of some renown).

We had a rather long political discussion, started by **Rich Bowers**, on the stance of the candidates towards space exploration and habitation. Much talk with little resolved. Later, on the Chapters Leaders discussion thread, N.S.S provided statements from several of the parties. Hillary's points tend to be global (lots of points but not much concrete at this time in mid September) while the Trump campaign says that the exploration of space and development of habitation is very important with lots of emphasis on education and jobs in this country. Very short, but, again not much detail on actions. The Libertarian candidate had not responded to the request for his stand. The Green Party candidate, Jill Stein, had a number of points, both general and specific, on what the party thinks and plans for space. This includes a listing of the steps they want to engage in. This is more specific than the two main candidates and they should present their plans more formally as the Greens did. I suspect more will be placed on the parties sites. Thanks for the info. NSS!

Rich also brought up The Nordic Theory of Everything: that there is a large number of things that the Scandinavian countries have done right, socially, that make them good places to live and work. Finland was singled out as an example of this success with examples of child care, free health care, free higher education, and, low interest business loans. The result is an engaged population who are future oriented who do some space research. It would be helpful to United States voters if our politicians referred to this, or other, effective systems that included outward orientation for: resources, living room, and, the survival of humanity. We had a rather lively discussion as a result due to this years' distractive election!

Earl brought material on a number of space science and technology related topics: from NASA Tech Briefs Photonics Supplement (September, 2016): Dark Current and Influence of Target Emissivity, by researchers from Xenics Company in Brussels and as well as sInfraRed (a Xenics Company in Singapore). The work is on the application of a technique to reduce "dark currents" in a near infrared detector assembly (in this case an imaging array made of Indium gallium Arsinide material) with details of how the array and its' attachment to the electronics that send the signals out into the rest of the instrument are built. The researchers have built an "in house" readout circuit among other things to improve the signal to noise ratio of the system, and, use very high resolution A to D converters for the interface. All of this helps reduce the required cooling burden for a given level of signal to noise ratio (liquid Nitrogen, not Helium for example). This is possibly a spin off technology: instead of cool Brown

Dwarfs and Kuiper belt objects maybe it could be used for Earth based industrial and medical applications (under water sensing?).

From NASA Tech Briefs for September: a number of interesting technical articles and a report on astronaut training for deep space in the deep sea (“Finding NEEMO” on page 8), Next Mars Rover Heads Towards 2020 (same page); nasa.gov/mission_pages/NEEMO and mars.nasa.gov/mars2020 respectively. But I have been emphasizing the possibility of probes using sails to travel across the space between the stars as well as within the solar system: “Ultralight Self-Deployable Solar Sails” from research at J.P.L.. The report is on a technique using shape memory alloys of very low mass materials that can be formed and then stowed in a conventional launching assembly. Specifically mentioned is shape memory polymers that can be used, along with carbon nano fibers, to create a self deploying structure with mechanical properties that make it usable in place of more conventional designs (with a possible 20 to 1 mass reduction). The authors point out that the basic principle, self deploying structures based on shape memory materials, could be applied to shelters, camping tents, and sun shades among other applications. In some ways this could be considered a “spin off” possibility and NASA is looking for partners to develop the technology. Contact officer: Daniel.F.Broderick@jpl.nasa.gov.

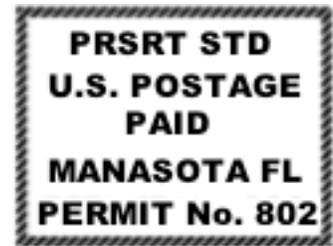
And on the topic of Photonic Sails (a more correct description of the technology): from the October, 2016 Analog, Science Fiction and Fact: John G.Cramer presents “STARSHOT: LASER SAILING TO ALPHA CENTAURI (as appears in the publication). Dr Cramer recapitulates previous information on the project and adds in further data on what some of the descriptions mean: he gives an equation for calculating the force exerted on the sail for a given power in the beam per unit area. $F = 2P/c$. Carrying out the calculation gives only one Newton of force on the sail requires 150 Mega Watts of incident light energy. He then goes on to show the numbers for a particular combination of mission particulars: it works out that a proposed mission of a sail accelerated to .2C for a trip to Alpha Centauri, with a push of 51,000 gees for two minutes, created by a laser producing 100 Giga Watts, would have to mass 1.33 grams. Dr. Cramer continues with the financial outlay for the laser system and other points. His report is a very good read. Note that he mentions the price of the laser system at \$5 to 10 billion dollars. There are certain advantages to this way of producing thrust for the probe: you don’t toss most of your craft, most especially the engine, away as your flight progresses. It can be used a number of times as is pointed out both in the Alternate View column and in the Breakthrough Initiatives site, for sending a fleet of probes to a number of destinations. Since the projected cost (in the Breakthrough website) could be as inexpensive as an I-Phone many could be purposed to a few highly interesting targets. We have just discovered that Proxima Centauri has at least one planet so it should get a number of probes. But: as pointed out in Dr. Cramers article a fleet might be needed to complete the mission due to dangers of travelling at substantial speeds into the local and interstellar medium: now the particles are quasi stationary and the craft is moving at relativistic speeds. See the article, reference and websites: his and <http://breakthroughinitiatives.org/Concept/3> for Mr. Milners project (he provided seed money).

As mentioned above I have been pushing the Photonic Sail concept. I found the idea intriguing many years ago when it appeared that the U.S. might send a Sail mission to Haley’s Comet. After that there have been some talk of other missions, both public and private, and speculation on future designs: K.Eric Drexler, in Engines of Creation from the 1980s, speculated on construction of an advanced sail using nano technology (he was one of the first authors to seriously write on the subject). He also wrote on the then near term possibilities in L-5 News. Arthur C. Clarke and Robert Forward both wrote on such flights with Dr Forward also being involved in several interstellar exploration studies using Sails (he also wrote on exploration of Barnards Stars “planets” using a Photonics Sail for the trip). I joined a private group myself that advocated the use of Sails for a circum Lunar race around the Moon, to have occurred in 1992 to celebrate the voyage of Columbus in 1492. In more recent events we have had a number of tries, and several successes, in getting sails launched and deployed. By the time this is printed we should see the second Planetary Societies sail go into orbit and then, after a shake down period, begin to move away from the Earth on photons alone!

I have neglected several other areas that may be of interest to the general readership and will put together a separate report on Sailing as a separate topic.

Submitted by Earl Bennett, President, NSSPASA, KD2CYA.

Moon Miners' MANIFESTO
 Milwaukee Lunar Reclamation Society, Inc.
 PO Box 2102, Milwaukee, WI 53201-2102



Please renew promptly so as not to miss an issue
 Address Service Requested
 -->> Mail Carrier, Time Sensitive Material

INDEX to MMM #299 October 2016

- 2. In Focus: The role of "Space Settlements
- 3; Space Settlement Pictures and Designs;
- 4. Improving the Livability of Space Settlements
- 5 Beyond L5: Where Space Settlements" would be helpful
- 6 Space Settlements as Interstellar Arks; Space Settlements as Space Hotels in Earth Orbit
- 7. Space Settlement Metroplexes
- 8. The National Space Society's annual Space Settlement Design Competition

Moon Society Journal Section

- | | |
|---------------------------------------|---|
| 9. The President's "rant" | 10. Starting more Society Chapters & Outposts |
| 11. Lavatube Settlement Competitions? | 12. Chapter & Outpost News |
| ----- | |
| 13. Browsing Links – Video Links | 14. Recent Space News in Pictures |
| 15. ISDC 2017, St. Louis | 16. NSS–MMM Chapter News |

CHAPTER MEMBER DUES -- MMM Subscriptions: Send proper dues to address in chapter section

- CHICAGO SPACE FRONTIER L5 • \$15 annual dues
- MILWAUKEE LUNAR RECLAMATION SOC. • \$15 low "one rate" to address above
- MINNESOTA SPACE FRONTIER SOCIETY • \$25 Regular Dues
- OREGON L5 SOCIETY • \$25 for all members
- O.A.S.I.S. L5 (Los Angeles) • \$28 regular dues with MMM
- PHILADELPHIA AREA SPACE ALLIANCE
 - Annual dues with MMM \$25, due March or \$6 per quarter before the next March
- SHEBOYGAN SPACE SOCIETY (WI) • \$15 regular, • \$10 student/teacher/friend • \$1/extra family member
- Individual Subscriptions outside participating chapter areas: • \$15 USA • \$25 Canada;
 - US \$55 Surface Mail Outside North America – Payable to "MLRS", PO Box 2102, Milwaukee, WI 53201

Past articles http://legacy.moonsociety.org/publications/mmm_classics/
 Or arranged by themes: http://legacy.moonsociety.org/publications/mmm_themes/