[An online publication of the Milwaukee Lunar Reclamation Society,
a chapter of the Moon Society and of the National Space Society
as well as an "Outpost" of the Mars Society]
Past issues* of Outbound *are online at:
http://www.moonsociety.org/publications/outbound/

OUTBOUND #27, February, 2020

My early glass paintings, an art form for the Moon and Mars

By Peter Kokh

One of my lifelong interests has been paining pictures etc. I started with colored chalk when I was only eight. So many years later, and very much interested in space, and in particular the Moon, I wondered how you could paint pictures if you were on the Moon. What would you paint on? What kind of paints could you make from elements found on the Moon?

What to paint on? I thought of painting on glass which you can make on the Moon and also on Mars. Then I started collecting paint (in tiny art bottles) that you could make on the Moon. ***The hardest one to find was blue,*** but I finally found it $128 for a 3 ounce bottle, but as my favorite color I had to have it.

Once I had all the principle colors, all in small hobby bottles , each color that could be made from moon dust, I decided to try painting on glass. The first one (photo above, 8"x10") turned out very nice, but in a short while, the paints peeled off the glass. I have a photo of that one.

I went a to glass shop, and the owner there took a piece of glass and sandblasted one side and told me to paint on that side, with the unpainted side facing the observer. That worked and I still have that painting to show.

I also found that you could use those paints on **cement board**, the substitute for dry wall commonly used in bathrooms and showers.

When settlers move to the Moon or Mars, they will want to express their experiences in art. After all, ***art is a big part of human life.***

If I have room for these first paintings on an exhibit table I bring them along (so long as someone is at the table, in case some visitors have sticky hands.) Peter Kokh

[None of these paintings seem to be online. They were at one time. I will publish them in an upcoming issue of "Outbound: to the Moon, Mars, and Beyond"]

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As for <u>sculptures</u>, both the Moon and Mars have abundant material:

<u>BASALT:</u> *Carved and/or Cast* <u>Basalt,</u> *✓ cast ideal for products in quantity, and ✓ carved items ideal for items meant to be unique and when cost is not an issue:* bed headboards, planters, lamp bases, statues, other furnishings, etc -

On both the Moon and Mars, carved basalt items will be the choice for those for whom cost is not an issue. Would be settlers who have been artists on Earth, will find basalt here, to practice carving, ***or casting***, in this material so that they will be ready to continue their artistry on the Moon or Mars. To find examples, simply google "cast basalt" and/or "carved basalt." And for those whose artistry has been with cloth, google: **basalt fabrics**, and basalt fabric products (clothing and bedding of course, but also casual furniture) [Google for examples.]

One handy feature of basalt fabrics, and basalt in general, is that they are not flammable. (I have tried and failed to burn samples!) On either Moon or Mars, you can't simply open the door and stay outside until the firemen arrive to put out the fire, *not without putting on a space pressure suit, which takes time*.]

Another, Enormous opportunity for artistic expression: Living Walls

There is another "canvas" (for want of a better word, on which to express one's art, "**Living Walls**" - google "Living Walls: click on images and you will find a***n endless array of designs: ✓ <u>choice</u> of plants ✓ <u>which</u> plants you put where, etc.***

This is a medium that should be left to settler youth to express themselves.

Settler homes will open onto a cylindrical walkway, say 20 ft. In diameter, with "Living Walls" on the other side. Not only are they a form of art, but their number one function is

to keep the air in setter neighborhoods "fresh." The plants can include those that bear **fruit**, and **vegetables**. **Hummingbirds** will help them reseed. **Talapia** **are a good tasting fish** that would do well in the troughs at the bottom of the Living Walls that catch the water that will be recycled to the top then drizzled down to keep the plants fresh. #

Mars is Losing Its Water Even Faster Than Anyone Thought

1/9/2020 - https://www.space.com/**mars-water-escape-into-space-rapidly**.html

This surprising find could help researchers better understand

why modern Mars is a desert world.

Water might escape Mars more effectively than previously thought, potentially helping to explain how the Red Planet lost its seas, lakes and rivers, a new study finds.

Although Mars is now cold and dry, winding river valleys and dry lake beds suggest that water covered much of the Red Planet billions of years ago. What remains of the water on Mars [https://www.space.com/17048-water-on-mars.html] is mostly locked frozen in the Red Planet's polar ice caps, which possess less than 10% of the water that once flowed on the Martian surface, prior work has suggested.

Previous research has also indicated that Martian water mostly escaped into space. [https://www.space.com/31031-mars-atmosphere-discovery-nasa-maven.html]

Ultraviolet radiation from the sun breaks apart water in Mars' upper atmosphere to form hydrogen and oxygen, and much of this hydrogen then floats off into space, given its extraordinarily light nature and Mars' middling gravity, just 40% as strong as Earth's.

Recent findings [https://science.sciencemag.org/content/333/6051/1868] suggested that large amounts of water might regularly make rapid intrusions into Mars' upper atmosphere. To shed light on these events, scientists analyzed data from the Mars-circling Trace Gas Orbiter. [https://www.space.com/exomars-orbiter-methane-mystery.html], part of the **European-Russian ExoMars** program. The scientists focused on the way water was distributed up and down the Martian atmosphere by altitude in 2018 and 2019.

Researchers found that seasonal changes were the key factors driving how water vapor was distributed in the Martian atmosphere. During the warmest, stormiest part of the Red Planet's year, for example, large portions of the atmosphere became "supersaturated" with 10 to 100 times more water vapor than its temperature should theoretically allow, allowing water to reach the upper atmosphere. These extraordinary levels of saturation "are observed nowhere on any other body of the solar system."

Scientists were surprised that such large amounts of water vapor could reach the upper atmosphere. Previously, they expected "it should have been limited by the cold temperature up above and be bound to condense into clouds."

For more, read the article and links underlined above.##

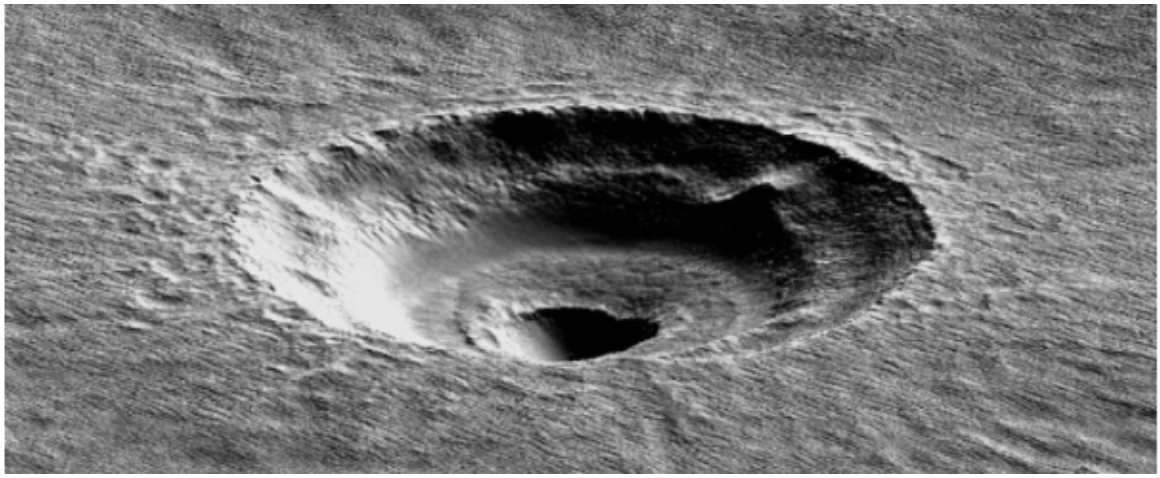
[**Editor:** If we are going to send immigrants to Mars, **we must find ways 1) to reduce and 2) even to halt this water loss rate**. One way would to **keep as much water as**

possible in sealed reservoirs, for settler use *and reuse over and over again. Beyond that, we ought to find ways to increase the amount of water on Mars, by capturing water-rich asteroids, for example. If we fail to do this, any human settlements on Mars, will, may well in the long term, become temporary.]* PK

Gigantic Ice Slab Found on Mars Just Below the Planet's Surface

https://www.space.com/30502-**mars-giant-ice-sheet-discovery**-mro.html

By Charles Q. Choi September 10, 2015



(Notice the clear "**terraces**" in this crater! They are a clue.)

This image shows a digital terrain model of the "**terraced crater**" investigated by the U. of Arizona's Ali Bramson. Image released August 26, 2015. **These terraces, "indicate something weird is going on in the subsurface."** (Image: © American Geophysical Union)

A giant slab of ice as big as California and Texas combined lurks just beneath the surface of Mars between its equator and north pole, according to researchers.

This ice may be the result of snowfall tens of millions of years ago on Mars.

Mars is now dry and cold, but lots of evidence suggests that rivers, lakes and even seas once covered the planet. On Earth, scientists have discovered life virtually wherever there is liquid water on Earth, leading ***some researchers to believe that life might have evolved on Mars when it was wet, and that life could be there even now, hidden in subterranean aquifers.***

The amount of water on Mars has shifted dramatically over the eons ***because of the Red Planet's unstable obliquity — the degree to which the planet tilts on its axis of rotation.*** Unlike Earth, ***Mars does not have a large moon to keep it from wobbling (yea Moon!)***, and so the direction its axis points wanders in a chaotic, unpredictable manner, a critical flaw regularly leading to ice ages.

Although researchers have long known that vast amounts of ice lie trapped in high latitudes around the Martian poles, ***scientists have recently begun to discover that ice also is hidden in mid-latitudes, and even at low latitudes around the Martian equator.***

Learning more about past Martian climates and where its water once was "could help us understand if locations on Mars were once habitable," study lead author Ali Bramson, a planetary scientist at the University of Arizona in Tucson, told Space.com. To look at ice hidden beneath the Martian surface, Bramson and her colleagues focused on strange craters in a region called Arcadia Planitia. This area lies i**n the mid-latitudes of Mars**, like Earthly latitudes between the U.S.-Canadian border and Kansas.

These odd craters are about 1,075 to 1,410 feet (328 to 430 meters) wide. ***Unlike most craters of their size, which are bowl-shaped, the craters the scientists focused on had terraces on their walls. Such terraces can form when layers of different materials, such as dirt, ice or rock, lie beneath a planet's surface.***

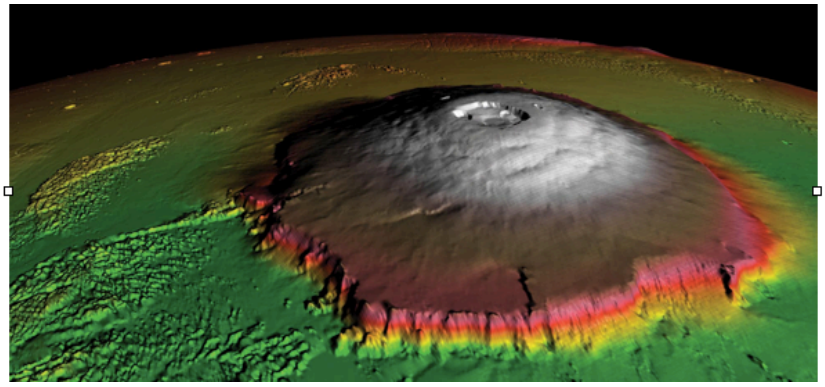
When a crater forms because of a cosmic impact, the shock wave from the collision can push aside weaker materials more easily than strong ones. "The result is terracing at the interface between the weaker and stronger materials." Terraced craters of the size the researchers saw are virtually unknown outside of this area of Mars, Bramson said. However, ***all 187 craters the researchers studied have terraces***, "which indicates something weird is going on in the subsurface."

The researchers used data from the High Resolution Imaging Science Experiment (HiRISE) camera aboard NASA's Mars Reconnaissance Orbiter [https://www.space.com/13962-photos-nasa-mars-reconnaissance-orbiter.html] to create ***3D models of the area's craters, which allowed them to measure the depth of the terraces.*** They next used the orbiter's Shallow Radar instrument to beam radar pulses at Mars, which helped them determine ***the composition of the layers making up the terraces***. The ice the scientists found measures 130 feet (40 m) thick and lies just beneath the dirt, or regolith, or Mars.

"It extends down to latitudes of 38 degrees. ***This would be like someone in Kansas digging in their backyard and finding ice as thick as a 13-story building that covers an area the size of Texas and California combined.***" ##

Editor: ***This would seem to be "the find of the Century!" And certainly, this is the area in which (or near which) our first settlement needs to be placed.***

[Editor's note: water is only one of the critical two resources upon which our Settlements on Mars must be founded. **The other being basalt** (cast, carved, or fiber) on which pioneer industries must be based if Mars is to keep imports from Earth to a minimum (settlers and tools).However, in this area, ***basalt will be abundant in the enormous, long dead volcano***, **Olympus Mons**, (below) a few hundred miles to the SE.]



Back to the Moon Bonanza! For future Lunar Pioneers, this is the best news that we could wish for

NBC NEWS article by Robert Z. Pearlmen, space.com Houston

NASA's newest astronauts are ready to come out of their shells and walk on the Moon. **Nicknamed the "Turtles,"** NASA's 22nd class of astronauts graduated from basic training and became eligible for spaceflight assignments on Friday, January 11, 2020. A ceremony at the Johnson Space Center in Houston honored the 11 Americans, together with two Canadian Space Agency (CSA) astronauts who trained with them. The new class, which includes six women and seven men, expands NASA's active corps to 48 members. CSA has now doubled its ranks to four with the graduation of this, its fourth group of astronauts.

A long, too long wait!

Selected in 2017 from a record-setting pool of candidates, the new astronauts are the first to receive their astronaut pins under NASA's "**Artemis" Program, which aims to land the first woman and next man on the Moon by 2024,** the first astronauts to fly to the Moon since the Apollo program 50 years ago, *or they may be assigned to launch to the International Space Station aboard U.S. commercial crew spacecraft.*

The candidate "**Turtles**" (nicknamed such by the prior astronaut class, the "8 Balls," after a joke about turtles on fenceposts), were put through more than two years of basic training. They took part in neutral buoyancy underwater dives to learn how to spacewalk, were sent out on geology field trips, received training in operating robotics and were taught wilderness survival skills.

They also became proficient in space station systems, took Russian language classes, experienced weightlessness on parabolic aircraft flights and flew NASA's T-38 supersonic jets.

The NASA members of the Turtles include:

- **Kayla Barron**, a 32-year-old U.S. Navy lieutenant who served as a submarine warfare officer and the flag aide to the superintendent of the U.S. Naval Academy.
- **Zena Cardma**n, 32, a marine biologist who studied microorganisms in subsurface environments, ranging from caves to deep sea sediments, on multiple expeditions to Antarctica and NASA analog missions in British Columbia, Idaho and Hawaii.
- **Raja Chari**, a 42-year-old U.S. Air Force colonel who served as the commander of the 461st Flight Test Squadron and director of the F-35 Integrated Test Force at Edwards Air Force Base (AFB) in California.
- **Matthew Dominick**, 38, a U.S. Navy lieutenant commander who served on the USS Ronald Reagan aircraft carrier as department head for a strike fighter squadron.
- **Bob Hines**, 44, a U.S. Air Force lieutenant colonel who flew as a Federal Aviation Administration (FAA) flight test & NASA research pilot at Johnson Space Center.

(**Nb: The "Moon Society"** is a direct "offspring" of the former "**Artemis Society**.") ## **Note:** The Apollo program was halted short-cancelled after the 6th successful landing, the victims being three Apollo landers in locations on the Moon, unlike any of the places the first 6 missions had visited.

When *Apollo 11* landed on the moon, NASA's plan was to continue manned lunar missions through *Apollo 20*. But history turned out differently. The last three missions, still in planning stages, were canceled. Hardware that would have flown to the moon ended up as museum exhibits.

And scientists and space enthusiasts were left to contemplate what Apollos 18, 19, and 20 might have accomplished.

As the United States's lunar landing program wound down, plans for its last three Apollo missions were canceled, leaving unused hardware and questions of what might have been.

https://www.scientificamerican.com/article/canceled-apollo-missions/

"Citing budget cuts and his desire to make a large Space Station NASA's post-Apollo goal, NASA Administrator Thomas Paine cancelled three Apollo missions in 1969-1970."

https://en.wikipedia.org › wiki › Canceled_Apollo_missions

According to "NASA OMSF, Manned Space Flight Weekly Report" dated July 28, 1969, **Apollo 18 would have landed at Schröter's Valley in February 1972, Apollo 19 in the Hyginus rille region in July 1972, and Apollo 20 in Copernicus crater in December 1972.**

These three expeditions were canceled for multiple reasons. Tighter budgets, imposed by Congress and the Nixon administration, were a major factor. NASA's spending had peaked in the mid-1960s, at which time its labor force of staffers and contractors totaled some 400,000. In January 1970 that workforce had shrunk to 190,000, and NASA was unveiling plans to eliminate another 50,000 jobs.

But "the simple fact that each mission was providing a great scientific return didn't really impress very many people other than lunar scientists."

All three of the cancelled missions had features different from the six sites already visited, the latter (Schroter's Valley) especially noted for its variety of geologic materials. Whereas some areas were more scientifically attractive than others, "anyplace you land on the Moon and collect samples intelligently would've been valuable. Also discussed was the **Tioskovsky crater on the Moon's far side**.

[The cancellation of the Schroter's Valley mission disappointed this writer most.]

For those of us wanting to learn more about the Moon, these cancellations, mostly on political and financial grounds, were a great tragedy, along with a loss of public support, (the "what's in it for me attitude), which has always been casual.

To our encouragement:

A cluster of successful Moon missions, <u>though without human crews</u>, by China, India, and Israel, has helped increase public support for future manned Moon missions. It is time! We have let 60 years go by, <u>all for stupid political reasons</u>.

What has now improved chances of NASA resuming Moon missions:

The successes of Chinese missions, including to the farside, as well as missions by India, and tiny Israel. While the Israeli mission failed when the descent rockets did not kick in, the near success of such a tiny nation, while America rests too long on its laurels, is "a well deserved embarrassment" for NASA, *and for the U.S. Congress*.

But to our encouragement, NASA has flown, and continues to fly missions to Mars that will better inform us of Mars' future habitability for us humans. That said, we still need to know more about the Moon and its potential role in the expansion of human settlement, *"on its route to the stars!" "**Ad Astra**"*

That we have learned to make so many useful and necessary items for human settlements on the Moon, and then on Mars, out of basalt, (cast, carved, and fiber) widely available on the Moon (in the maria) and also on Mars, is making human settlement beyond Earth ever more likely.

But the other partner in a basalt marriage is water. The Lunar Prospector probe (we suggested the name) found water ice in craters as far as 30° south of the Moon's North pole and 30° North of the Moon's South pole, makes the rise of substantial settlements on the Moon, beginning in Mare Frigoris. And we expect to find locations on Mars where both these vital assets will be found, and where settlement can thus begin. ##

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Living Walls

Plant Life as a partner in Settling both the Moon and Mars

We here on Earth take plant life for granted. But there is none anywhere on the Moon, Mars, or anywhere else in our Solar System. Here on Earth, where soil exists everywhere, we plant vegetables and fruit plants in many acres of farmland or in backyard gardens.

On Mars and the Moon, where a breathable outdoors atmosphere is not to be had, and to be established only in structures, in homes, factories etc. it is much more economical to plant vertically, on walls of walkways and streets, or in vertical room dividers.

Why not learn how to do this best, here on Earth, so that we will have the needed expertise once we return to the Moon, and/or fly to Mars to speed humanity there as well.

There are hundreds, if not thousands, of Living Walls plantings here on Earth. That gives us ***tested methods of growing vegetables and fruit***, as well as just pretty green leaves, **in cramped space *<u>on the walls</u>*** of connecting walkways linking homes on the

frontier. **Inside our homes here on Earth,** we could use vertical Living Walls technology in ***room dividers*** where the sun shines part of the time.

To see the vast variety of **"Living Walls"** or **"Green Walls"** or **"Vertical Gardens"** just "**google**" any one, or all of the above.

[**Above, one of countless designs of Living Walls**]

And if, by happenstance, your home's structure and orientation allows "importing" sunshine inside, you can test this technology there. In cities, where homes cast shadows on homes, this is not practical. ***But if you are lucky, and the morning or evening sun shines on a dining room "living wall", imagine how special that would make your home, to your family, and visitors!*** *[Alas, my home is totally in the shade to the East, and my dining room is on the wrong side to benefit from the rising sun.]*

Nothing will better make settlers on the Moon and/or Mars feel more at home than Living Walls. And as a significant benefit, ***Living Walls will keep your air fresh*** on worlds where you cannot just "open a window" to let in fresh air!

And if perchance, you will be moving, do look for a home where other structures do not block the sun most of the time. In suburbs, there is often greater separation between neighboring homes. You want greater separation to the East (morning sun) and/or the West (afternoon sun.)

On the Moon especially, where there are never "clouds" in the skies to block the sun, Living Walls technologies will make settlers "at home" on a world that is otherwise anything but. ***This technology will also be essential if Martian settlers are ever to feel at***

home. While the Sun won't shine as brightly as on Earth, ***without clouds on Mars, sunlight will be bathe the surface from dawn to dusk, something most welcome.***

If you are in the market for a new home (here on Earth), do take "sunshine inside the home" morning and/or evening as a must, and learn more about Living Walls.
"Living Walls" is gardening expertise that will make you "at home" wherever! ##

Six Decades Wasted, NASA is considering resuming Moon Missions

√ **But** will it pick the right place, where basalt abounds, and craters partially filled with ice are nearby?

We don't think so. And if not, this will be just a repeat of "visit and forget about it" goals of the Apollo program.

1) NASA does not seem to be interested in landing where the moon dust is rich in building materials - ***basalt***

2) Nor in areas within reach of craters partially ice-filled - ***water***

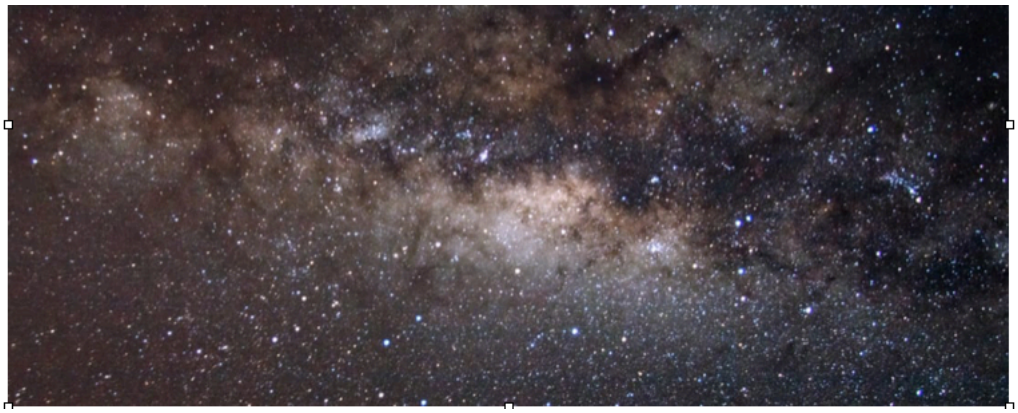
3) Nor in areas where a string of settlements East to West allows sharing electrical power for much longer periods than 2 weeks (such as Mare Frigoris)

An international, ***but non-governmental effort*** may be the only way, with funding by private industries more free to use common sense. ##

Could the Tourist Industry help open the Moon?

There are two areas (4, if you include both northern and southern hemispheres of the Moon - about ***7 degrees into the Moon's "Farside"*** where Earth is never above the horizon, and ***where the Milky Way (our galaxy) will be visible all the time, with a brilliance we can only imagine: an experience that none of us can possibly picture.***

"Hotels" will be built at both East and West longitudes on the Moon, eventually, with the Western one first (closer to basalt construction materials).



As we live around a star (our Sun) that is in the Milky Way, this rich ribbon of stars surrounds us 360°, but it is not as visible on Earth skies lit with urban city lights.

*It is likely, that such a sight will be **a "must"** for those who could afford it, and as the ultimate "paid in full prize" for the lucky.*
*Again, such facilities are **not likely to be built without lunar basalt.** We suggest that the first such facility will be built around the North Western limb of the Moon with access to water and basalt from settlements in the Westernmost areas of Mare Frigoris.*

*To those of us who live in megacities where city lights drown out the stars in the nighttime skies, may not be able to imagine such a sight, your best chance is in the countryside, **far from urban city lights**, on a night when there are **no clouds in the sky**.*

*So if you haven't seen such a sight, put it on your must list! Remember, **the Moon must not be above the horizon, even in its crescent stage.***

***And if and when you see the Milky Way, remember that "our galazy" is but one in a godzillion of galaxies in our universe, which may be but one of perhaps an infinite number of universes, with no connection between them. Humbling!** ##*

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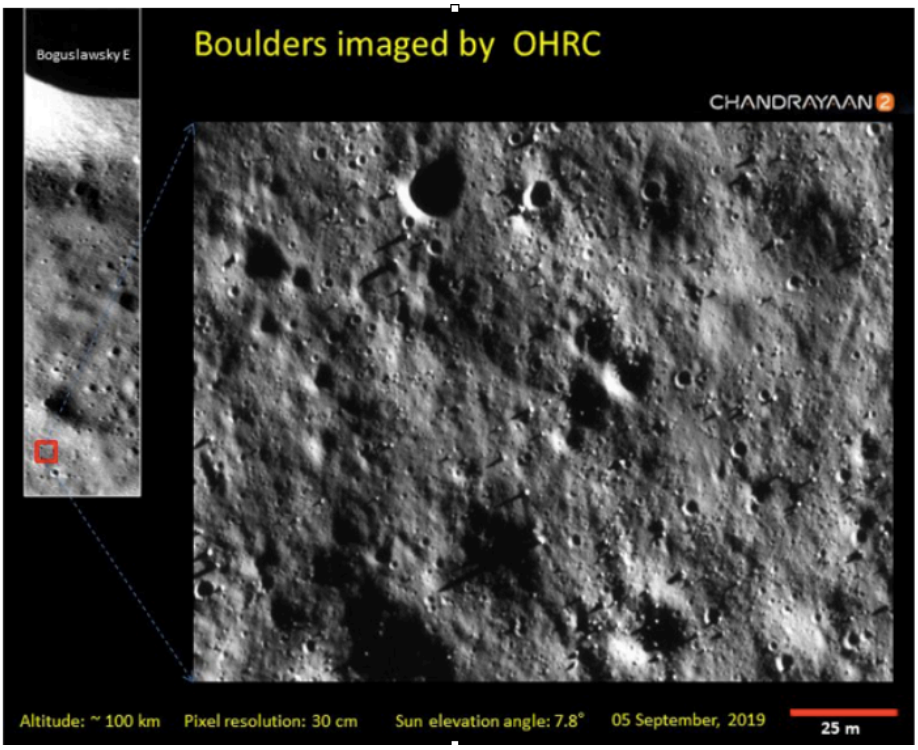
India Is Going Back to the Moon with Chandrayaan-3 Lunar Lander



https://www.space.com/india-confirms-moon-landing-mission-chandrayaan-3.html
India's Chandrayaan-2 probe in orbit around the Moon took this high-resolution photo of the Moon's south pole Sept. 5, 2019.(Image © India Space Research Organization)

It's official: **India will try again to land on the Moon.** The **Chandrayaan-3 mission**, which will consist of **a lunar rover and a stationary lander,** has been

approved by the Indian government, according to K. Sivan, chairman of the Indian Space Research Organisation (ISRO), announced January 1, 2020).

India's first moon-landing effort failed this past September when the Chandrayaan-2 lander crashed hard into the lunar surface.

Related: India's Chandrayaan-2 Mission to the Moon in Photos

The Chandrayaan-3 news is not exactly a surprise; Indian media outlets reported in November that ISRO had already begun designing the mission and that a launch could come as soon as November of this year.

Sivan did not announce a target launch date in the news conference. But he did reveal an estimated cost for Chandrayaan-3, according to Space News: 6.15 billion rupees, or about $91.2 (US) million at current exchange rates. That's considerably cheaper than Chandrayaan-2, which cost 9.7 billion rupees ($136.1 million).

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Milwaukee Lunar Reclamation Society *welcomes 4 new members*

Pablo Brandenburg Pabrandenburg@gmail.com

Dandin Kelman dandinkelman@gmail.com

Max Trevisan trevisanmax8@gmail.com

Marcin Klapczynski m_klapczynski@yahoo.com

In an era when most people "do not join anything," you are all most welcome!

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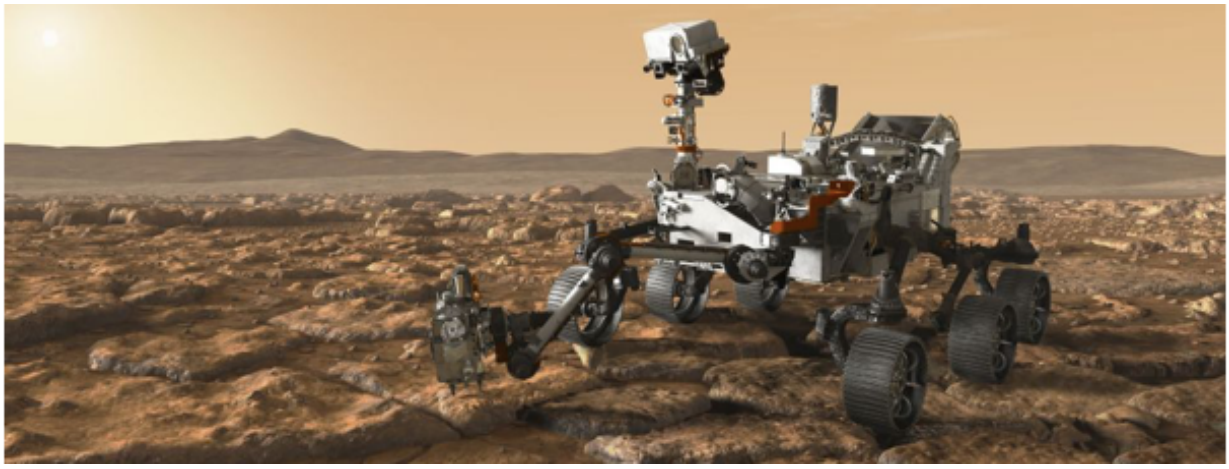
Basalt fiber fabric samples and Basalt "rebar" *("rockbar")* ***are available, c. $12 each.***

https://www.basalt.guru/shop/product/basalt-plain-weave-fabric-sample-pack

(Note: these fabrics are fireproof. *(I tried to set one on fire, and couldn't) and that is essential for Moon and Mars pioneers, who can't just open a door and runaway from a fire (there is no outdoors air on the Moon, and the thin air on Mars is unbreathable.)*

That's important, not just for the space frontier, but for all of us here on Earth!

We encourage all our readers to join the Moon Society*, if you have not done so already. My old computer was going downhill, and I spent far more time recovering what*

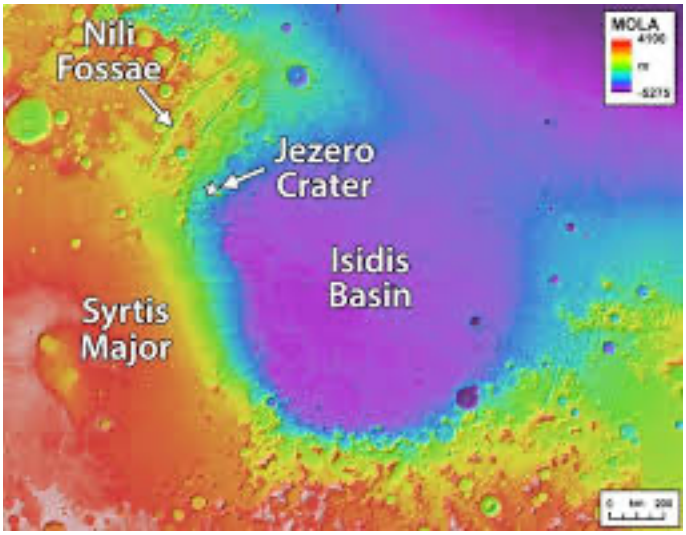


I had just written than writing new articles. ***The Moon Society came to my rescue and purchased a new MacAir (Macintosh) for me.*** *What a wonderful gift! And it works like a charm. With the old one "quitting" so frequently that it sometimes took hours to publish what should take only minutes.* ***Moon Society members are also encouraged to heed the "Call to Action." at*** moonsociety.org/volunteer/

The National Space Society has also been encouraging.

We will be sending to all Milwaukee chapter members pdf files of each new issue of "Outbound: to the Moon, Mars, and Beyond" each issue, and make back issues available, from an online Outbound Library,

Unlike Moon Miners' Manifesto, ***Outbound issues have no page limit.*** *They can be short, they can be long. Much easier for me.*



Also, unlike Moon Miners' Manifesto, Outbound has as many articles relevant for Mars as for the Moon (and beyond!). *That should make it good reading for those interested in Mars, as well as the Moon, and indeed beyond both. ##*

++++++++*NEWS!*+++++++

*https://www.space.com/nasa-tess-**first-earth-size-habitable-exoplanet**-toi-700d.html*

https://www.space.com/mars-sample-return-public-engagement.html

*https://www.space.com/39984-**mars-2020-rover**.html*

A Mars sample-return mission is coming. Scientists want the public to know what to expect.

The first pristine pieces of Mars won't be coming down to Earth for at least another decade, but the time to start preparing society for the epic arrival is now, scientists say.

NASA's **2020 Mars rover** is scheduled to launch in July of this year and land inside the Red Planet's **28-mi-wide** (45 km) **Jezero Crater** [below] in **February 2021**.

The **six-wheeled robot** will do a variety of work once it gets there, but **its headline task is hunting for signs of ancient Mars life.** The upcoming rover **will hunt for signs of habitable environments on Mars** while searching for **signs of past microbial life**. The robotic traveler **will also cache a series of samples that can be returned to Earth with a future mission**.

The mission is currently slated to blast off from Cape Canaveral, Florida, in a few months **in July or August 2020**. It is **scheduled to land on Mars in February 2021**, with **an initial mission duration of at least one Martian year, or 687 Earth-days.**

The car-sized rover is about **10 feet long** (not including the arm), **9 feet wide**, and **7 feet tall** (about 3 meters long, 2.7 meters wide, and 2.2 meters tall). At **2,314 lbs. (1,050 kilograms)**, it **weighs less than a compact car**.

If photos and sketches of the Mars 2020 rover look familiar, that's because the robotic explorer is largely based off its predecessor, Mars Science Laboratory (MSL)'s Curiosity rover. Roughly 85% of the new rover's mass is copies this "heritage hardware."

Like Curiosity, Mars 2020 will have **a rectangular body, six wheels, an arm and hand, cameras and instruments, and a drill for sampling rocks.** But the new rover has different goals that require a suite of cutting-edge instruments. Using a**n X-ray spectrometer and an ultraviolet laser,** Mars 2020 **will seek out bio-signatures from the past on a microbial scale.** A **ground-penetrating radar** will be the first instrument to look under Mars' surface, mapping rock layers, water & ice up to 30 ft (10 m) deep.

As the mission hardware approaches the Martian surface, it will use ***a computer to compare the landscape with pre-loaded terrain maps***, guiding the descending mission to a safe landing site and making corrections on the way down.

A **range trigger**, will use location and velocity to determine when to open the spacecraft's parachute, narrowing the landing ellipse by more than half. Terrain-relative navigation enables us to go to sites that were ruled too risky for Curiosity to explore, The

ranger trigger lets us land closer to areas of scientific interest, shaving miles — possibly as much as a year — off the rover's journey." It will provide not only awe-inspiring imagery but also scientific data about Mars atmosphere. ##

TOI 700 d is a landmark discovery for NASA's Transiting Exoplanet Survey Satellite.
*www.space.com/nasa-tess-**first-earth-size-habitable-exoplanet**-toi-700d.html*

For the first time, the agency's Transiting Exoplanet Survey Satellite (TESS) has discovered **a roughly Earth-size planet in the habitable zone of its host star, the zone of orbital distances where liquid water could be stable on a world's surface**, researchers announced January 6, 2020.

The newfound exoplanet, known as **TOI 700 d**, lies just **101.5 light-years from Earth**, making it a good candidate for follow-up observations by other instruments.

"TESS was designed and launched specifically to find Earth-sized planets orbiting nearby stars. Planets around nearby stars are easiest to follow up with larger telescopes in space and on Earth. Discovering TOI 700 d is a key science finding for TESS."

TESS, which launched in April 2018, ***hunts for planets using the "transit method," looking for telltale dips in stellar brightness caused by orbiting worlds crossing stars' faces from the satellite's perspective.*** This same strategy was used to great effect by NASA's **Kepler space telescope**, ***which discovered about 70% of the roughly 4,000 known exoplanets***. ##

Join the Moon Society! *By Peter Kokh*

I was chair of the conference in **Las Vegas** in **2000** to create **the Moon Society**. Prior to this, there was **the Artemis Society [www.asi.org]** for which I had been publishing **Moon Miners' Manifesto** for nine years, as well as for our Milwaukee members of the Lunar Reclamation Society chapter, and members of the **National Space Society. MMM #301 was the final print issue, after 30 years.**

The Moon Society still exists and has been a strong advocate of my sequel publication, Outbound. "Outbound: to the Moon, Mars, and Beyond!"

While MMM was 20 pages long, *Outbound's length depends on the length of the articles in it. This made it easier for me, as editor and principle author.*

All Moon Society members now get **Outbound**, **an "online" newsletter only**, with persons receiving it welcome to print it for themselves, if they so choose.

Many members of the National Space Society have subscribed to Outbound, at no cost. Chapters of all space-focused organizations are welcome to send Outbound to their members, whether they belong to the Moon Society, the Mars Society, the National Space Society or not. After all, Outbound's subtitle is "**of the Moon, Mars, and beyond**".

Personal Note:

I have a heart condition, *right bundle branch block,* and when it was first diagnosed (I was 16), I was told that *if I was extremely lucky, and careful,* I just might make it to 60. Well, now I am 82 and going strong. And I think ***continuing to write may be keeping me alive.*** None of us know when our lives will end. ***Time is priceless!*** But writing keeps me going!

My first book, **"A Pioneer's Guide to Living on the Moon"** is available from Amazon, My second Book, **"A Pioneer's Guide to Living on Mars"** should be available sometime this summer. The third and final in this threesome, will be **about the rest of the Solar System** (a collection of past Moon Miners Manifesto articles *plus*)**.**

Will I stop then? No, *not if I am still alive*. A book about **the "Omniverse"** - this was the book I started writing in my head first, back when I was a student at a private college in Totteridge, London, England in 1961, age 23. The title? *a* ***clue*** *(not the title) is* "the ***Omni****verse*" - *(****there must be an infinite number of "universes".****)* (Another clue, "**Omega**" not "Alpha.")

Possible title: **"The Omega Factor: what makes the Universe tick and why there may be an infinite number of "universes."** My thoughts are on hundreds of unorganized 3x4" index cards. My fingers are crossed. ##

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Where's All the Water on Mars?
Scientists (and Future Astronauts and Settlers) Need to Know

By Meghan Bartels December 19, 2018

"***Water, water everywhere, nor any drop to drink***" epitomized terrestrial seafaring exploration, and precisely the same problem may haunt any future explorers on Mars.

There is plenty of **water on Mars,** but ***it's frozen, locked in water-rich minerals, tucked away below the surface*** — or a combination of those challenges, which is why we still don't know where it all is. That's a problem for Rick Davis, assistant director for

science and exploration in the planetary science division at NASA, because he is heading ***NASA's project to evaluate potential human base sites on the Red Planet.*** But he thinks tackling this problem could help bring scientists and would-be explorers together.

"**Water and Ice** represent a cure for, on the one hand, all the ways humans rely on water to survive, and, because it can be split into hydrogen and oxygen, as rocket fuel to carry people and cargo back to Earth. And scientists want to study Martian ice in hopes of learning more about the planet's climate history and potential past habitability."

Scientists are stymied by ***an important blind spot in current instruments***, which means ***they can't understand what's happening just below the surface, less than 33 feet (10 meters) down. That's a particularly important region of the subsurface because it's the most accessible, for humans and robots alike.***

We would need to put an instrument called **synthetic aperture radar** — commonly used in Earth science to study the impacts of natural disasters, among other uses — into orbit around Mars. (That's an idea that has been discussed, but is not yet an official target for a future mission.)

We need to monitor and forecast the weather on Mars. That will help scientists better understand planetary processes, and would-be explorers will ***need to know when weather conditions could deter their flights to or from Mars*** — think of rocket-launch scrubs and airport- flight delays here on Earth. ***We really need to understand what we're dealing with. ##***

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Want to read past Issues of Outbound?

You will find them here

http://www.moonsociety.org/publications/outbound/

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Why did I end publishing **Moon Miners' Manifesto** after 30 years

by editor and principal contributor, Peter Kokh, *kokhmmm@aol.com*

√ *MMM had a set number of pages*
√ *MMM had a set publication date*
√ *I wanted to concentrate on publishing* ***books!***

Since published: "**A Pioneer's Guide to Living on the Moon**"
*Soon to be published; "**A Pioneer's Guide to Living on Mars**"*
*Started: "**A Pioneer's Guide to the Rest of the Solar System**"*

√ *I want to start work on* ***yet another book, quite different, about the origin of our universe, and the likelihood that there are an infinite number of universes,*** *differing in several ways such as ……. and what makes them tick!"*

*(My notes for this book go way back to August 19**61**! in London, England.) ##*

The canceled Apollo missions to the Moon would have been epic

By Mark R. Whittington, Opinion Contributor — 07/12/19

https://thehill.com/opinion/technology/452747-the-canceled-apollo-missions-to-the-moon-would-have-been-epic

"As the 50th anniversary of the Apollo 11 Moon landing nears, we should remember that seven more flights to the Moon were mounted in the three years that followed. One of them, Apollo 13, failed to reach the lunar surface but returned safely with its crew, thanks to the heroic efforts of NASA engineers.

"However, ***three more missions to the Moon — Apollos 18, 19 and 20 — could have been flown, but instead were canceled. All of the hardware for these missions had already been built, and trained astronauts were ready to fly. The savings of those cancellations amounted to only a few tens of millions of dollars."***

An article in Seeker suggests that what was lost by this cancellation must be one of the most outrageous, bureaucratic decisions in space history.

"If the Apollo 18-20 flights were realized, school kids today could be looking at stunning photographs taken from the mountain-rimmed floors of the young impact craters Copernicus or Tycho, ***or*** the terrain on the far side of the Moon, ***or*** the frozen volcanic lava flows from billions of years ago."

"Looking back, one would think that the great success of the Apollo missions to the Moon would have inspired the United States to mount more voyages of discovery, not to be so anxious to bring the program to a close that it would ***cancel missions for which hardware had already been built.***

"However, ***the stress of the Vietnam War, racial tensions, and the efforts of some unscrupulous politicians to paint the space program as a drain of money that would better be spent on social programs contributed to Apollo's early close.***"

[remaining paragraphs skipped] #

Editor's [Peter Kokh] take.

The cancelled missions, each to a part of the Moon "*significantly different*" from the six sites already visited would have taught us much more about the Moon, and may have laid the grounds for possible human settlements on another world.

This cancellation was a Crime against Generations to follow. **PK#**

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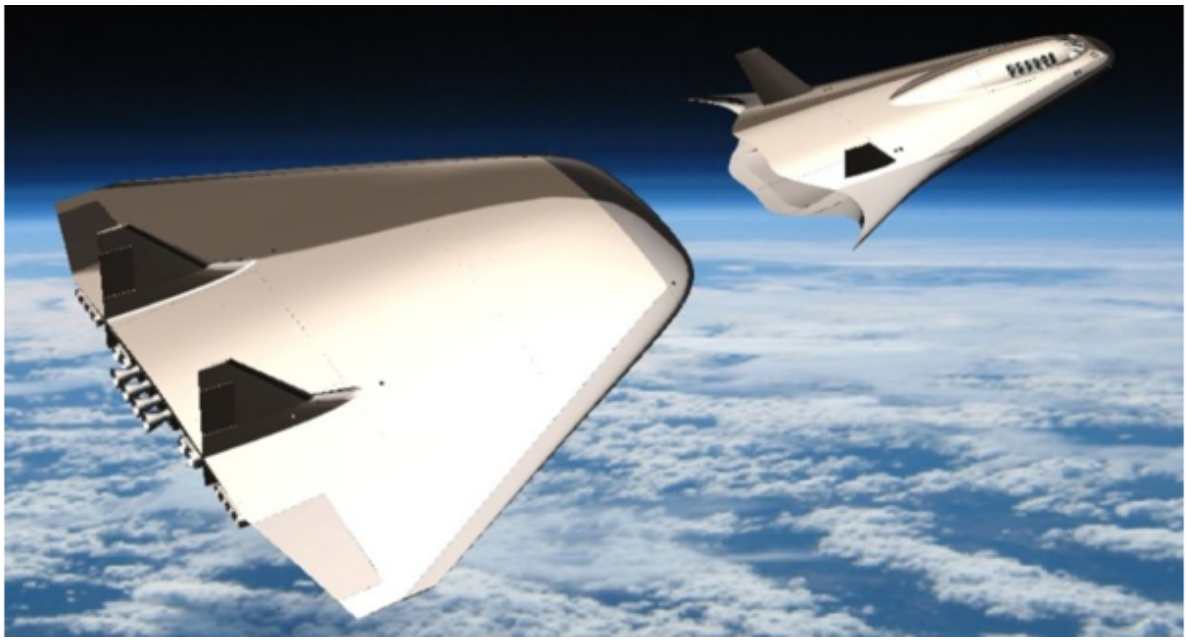
Are there other intelligent civilizations around other "Suns"?

What Nature can do once, it can do again, and again, and …
No matter how far apart in √Space and/or √Time
Some relatively few, may be mutually nearby & current

Fancy a rids on a Space Plane?



Artist's depiction of the Exodus Space Corp.'s **AstroClipper** space plane separating after launch.(Image: © Exodus Space)

https://www.space.com/astroclipper-space-plane-concept-cargo-passenger-flights.html

Startup **Exodus Space Corp**. plans to build a space plane to ferry cargo around Earth. ***Eventually, that cargo could include people, if the spacecraft is deemed safe enough.***

The spaceship — called "**AstroClipper"** — ***will take off from a runaway, make a flight into space and then land again, plane-style.*** A heft booster at the space plane's back end will help it get into orbit by giving AstroClipper the speed it requires to break out of Earth's atmosphere.

The company's first step is a technology demonstrator in 2022 that would remain within Earth's atmosphere but eventually lead to suborbital and orbital spacecraft. The eventual dream, in the 2030s, would be carrying passengers if Exodus can get the necessary human-rating regulations achieved.

"This has been a very private project that was in the works for the last 10 years," the focus on human passengers will come only after Exodus feels confident it can launch reliably and regularly.

If all the funding and development goes to plan, Pico should fly in about 2022.

EDITOR: ***Few of us could afford a ride on this beautiful ship. Maybe there will be a lottery for each flight, so that at least one person will get a free ride on each trip***. ##

Another view of the plane, below

“Sexy, no?” Gotta start saving my pennies, nickels, dimes and quarters!
Read the full article:
https://www.space.com/astroclipper-space-plane-concept-cargo-passenger-flights.html

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Where do Black Holes Lead?

Scientists have theorized about the other side of a black hole for decades
Here is what they have come up with so far.
https://www.space.com/where-do-black-holes-lead.html

Professor Richard Massey explains, "Who knows?" As a Royal Society research fellow at the Institute for Computational Cosmology at Durham University, Raleigh-Durham, North Carolina, Massey is fully aware that the mysteries of black holes run deep.

"Falling through an event horizon is literally passing beyond the veil — once someone falls past it, nobody could ever send a message back," he said. "They'd be ripped to pieces by the enormous gravity, so I doubt anyone falling through would get him/her anywhere."

Editor: When your time is up, this might be a quick (but hardly exciting) end to it all!

LOL!

Note: *I have a nephew who is a professor of geology at this university and he gave me a tour. Wow! What a complex! In the university library, robots fetch the book(s) you want - you just type in the title etc. and zoom! The library is about 2 city blocks long! PK*

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End of this Outbound