



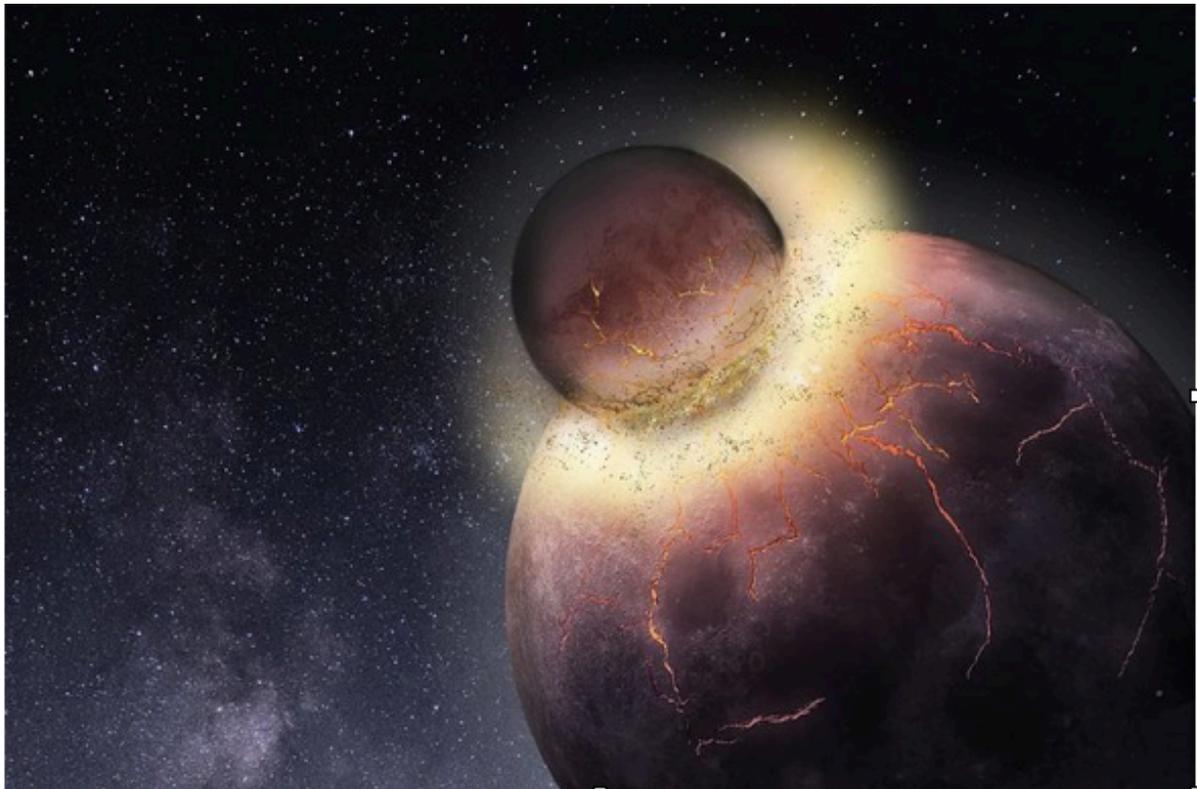
**[A publication of the Milwaukee Lunar Reclamation Society,
a chapter of the National Space Society & the Moon Society]**

OUTBOUND #20 AUGUST 2019

Earth Swallowed Another Planet and (Maybe) That's Why Life Exists

By [Yasemin Saplakoglu, Live Science Staff Writer](#) January 24, 2019

<https://www.space.com/43103-planetary-collision-life-earth.html>



A new theory holds that Earth might have received the elements it needed for life to form from a massive collision with a Mars-sized planet.

<https://www.space.com/43103-planetary-collision-life-earth.html>

Credit: Image courtesy of Rice University

The ancient collision that formed the Moon may also have brought with it all the ingredients needed for life, a new study finds.

Over 4.4 billion years ago, a Mars-size body smashed into a primitive Earth, launching our Moon into permanent orbit around our planet.

But a new study finds that this event could have had a much larger impact than previously thought. The collision could also have imbued our planet with the [carbon](#), [nitrogen](#) and [sulfur](#) needed for life to form, scientists reported today (Jan. 23) in the journal [Science Advances](#).

Back then, Earth was a little like Mars is today. It had a core and it had a mantle, but its noncore portion was very poor in volatile elements such as nitrogen, carbon and sulfur.

Elements in the noncore parts of our planet, called the "bulk silicate Earth," can intermingle with each other, but they never interact with the elements of the core. Though some volatiles existed in the core, they couldn't make their way to the planet's outer layers. And then a collision happened.

One theory holds that special kinds of meteorites, called carbonaceous chondrites, slammed into Earth and gave the bulk silicate Earth these volatile elements. This idea rests on the fact that the ratios of different versions — or isotopes — of nitrogen, carbon and hydrogen seem to match those found on these meteorites. So, proponents of the theory argue, the meteorites must be the source of these elements.

But there's just one problem: the ratio of carbon to nitrogen is off.

While the meteorites have about 20 parts carbon to one part nitrogen, Earth's noncore material has about 40 parts carbon to each part nitrogen, according to study author Damanveer Grewal, a fourth-year Ph.D. student in the Department of Earth, Environmental and Planetary Sciences at Rice University in Houston, Texas.

An ancient collision

So, the study authors' group decided to test another theory: What if another planet brought the goodies? "Earth could have collided with many different kinds of planets," Grewal told Live Science. Could one of those planets have given the bulk silicate Earth the correct proportion of elements? If this collision happened, the two planetary cores would have merged and the two [mantles](#) would have merged. So, they set out to create a possible planet that could have collided with our own.

In the lab, in a special kind of furnace, Grewal and his team created the high-temperature, high-pressure conditions under which a planet's core might form. In capsules of graphite (a form of carbon), they combined metallic powder (which represents the core and includes elements such as iron bound to nitrogen) with different proportions of silicate powder (a mixture of silicon and oxygen, meant to mimic the hypothetical planet's mantle).

By varying the temperature, the pressure and the proportions of sulfur in their experiments, the team created scenarios of how these elements could have divided between the core and the rest of the hypothetical planet.

They found that *carbon is much less willing to bond with iron in the presence of high concentrations of nitrogen and sulfur, while nitrogen bonds with iron even when a lot of*

sulfur is present. So for nitrogen to be excluded from the core, and be present in other parts of the planet, it should have contained very high concentrations of sulfur, Grewal said.

They then fed these possibilities into a simulation, along with information about how different volatile elements behave, and the present-day amounts of carbon, nitrogen and sulfur in Earth's outer layers.

After running over 1 billion simulations, they found that *the scenario that made the most sense — the one that had the most probable timing and could lead to a correct ratio of carbon to nitrogen — was one that posited a collision and merger of Earth with a Mars-size planet that contained about 25 to 30 percent sulfur in its core.*

This theory "is very probable," said Célia Dalou, an experimental petrologist at the Centre de Recherches Pétrographiques et Géochimiques in France, who was not a part of the study. "This work is a very successful result of years of research of various different teams." ##



Above: examining rocks by “telepresence” seeing through its eyes, touching with its hands.

While this will work on the Moon because of the mere second and a half time delay between commands sent from Earth to the “telerobot” (above), it will be much more difficult to “telecommand” operations on Mars from Earth or from the Moon, because of the much longer time delay between the operator on Earth and a telerobot on Mars - However, such telerobots could be controlled from orbits above Mars surface. And indeed, this will be the best way to pick settlement sites: lowering such a telerobot to promising sites to determine slopes, rock debris that might have to be moved, etc.

WATER from under Mars’ polar Carbon Dioxide Ice Sheets

Spring melted polar ice running equatorwards through “channels” must be put in covered warm reservoirs as close to the source as possible, with pipes in protected covered trenches delivering this water to reservoirs near established cities and planned cities.

When the flow stops, these trench Channels should be mapped from orbit, and those Channels that are the same “Spring after Spring” should be given cement bottoms and covers to avoid dissipation of the flowing water.

[Where the carbon dioxide ice ends in winter, these channels should end in reservoirs large enough (area x depth) to preserve the water flow for emergency use.

A second look at CANALS on Mars: from Self-Deception to Reality

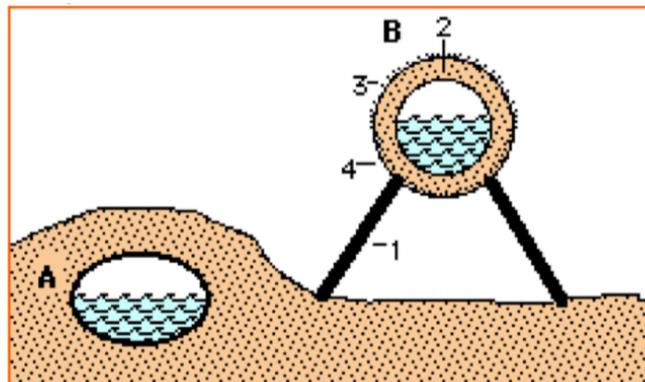
The “canali” or ‘channels’ “discovered” on Mars during the opposition of 1877, by the Italian astronomer Schiaparelli, and subsequently embraced and promoted *as sapient-made watercourse canals* by Percival Lowell, were never more than wishful thinking grounded in optical illusion. Supporting evidence of “seasonal” color changes (darkening and thickening “irrigated vegetation” strips between the polar caps and the equator were shown by Carl Sagan to be seasonal redepositions of darker and lighter dust or sand by the prevailing trade winds. The Mariner and Viking probes showed the canals themselves did not exist and that climactic conditions on Mars have been too extreme to allow liquid surface water for a billion years or more. Further, surface-drenching solar ultraviolet made the vegetation allegedly hugging the canal routes quite impossible.

At the same time a taunting picture emerged of *a once water-rich Mars with an ocean, some small seas, great rivers, islands and shorelines*. Some of this once generous endowment must remain: in the polar caps, in permafrost, and in possible subterranean reserves.

If the canals never existed, *the rationale of transporting water equatorwards from the polar caps*, now known to be mostly water ice, remains intact: *a tempting goal for a future human Martian Army Corps of Engineers*.

Actual and proposed terrestrial models exist. *Water has been rechanneled on Earth by canal and aqueduct for many millennia*. And there have been grandiose schemes to do even more on unprecedented scales: ✓ Wally Hickel’s fresh water pipeline from Alaska to California; ✓ proposals to divert Great Lakes water to the arid Southwest; ✓ abandoned Soviet schemes to reverse the flow of 3 great Siberian rivers (Ob-Irtysh, Lena, Yenisei) currently emptying into the Arctic Ocean (a scheme sure to trigger a real ice age by increasing the ocean’s salinity).

Any logical canal route on Mars would have to follow land contours - valley routes with pump portages over frequent sills in Mars’ immature drainage topography. We do not yet possess an adequate topographical map of the planet with accurate elevations. Hopefully, a future Mars Mapper satellite will improve our knowledge here to the point where some candidate routes can be sketched out, for later survey confirmation. *We do need such a mapper, irregardless.*



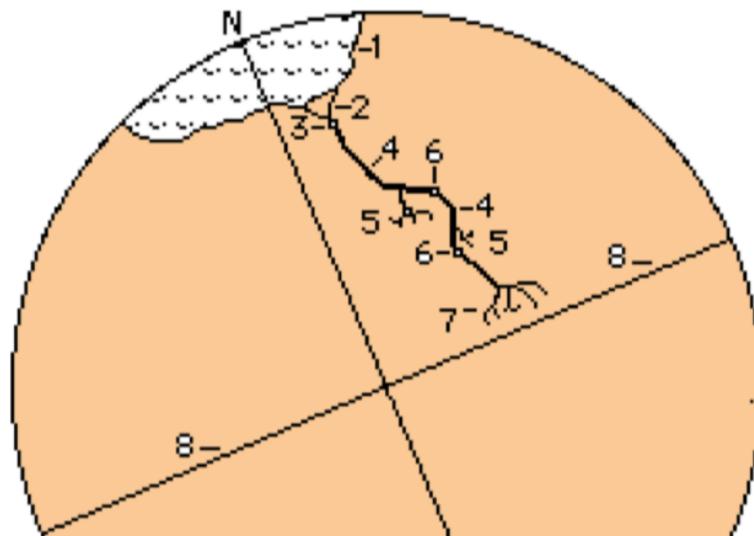
ALTERNATE THERMAL STRATEGIES: In (A), the sealed canal aqueduct is placed in a trench and covered over with shielding soil. But this will only tend to keep it as warm as the surrounding permafrozen soil. In (B), as with the Alaska oil pipeline, the aqueduct is raised over the permafrost from which it is thermally insulated by special nonconductive stilts (1). It is then jacketed by some sort of eutectic thermal mass (2) with its upper surface (3) coated IR-black to passively soak up what little solar heat is available, and its lower surface (4) silvered inward to help retain heat and prevent its radiation toward the cold ground. Here the goal is to use passive solar to keep the jacketing thermal mass just over the freezing point.

While we might romantically choose to call them canals in deference to the shattered dreams of yore, the proposed aqueducts will almost certainly be enclosed to help meet the daunting thermal challenge of keeping the water liquid. It must flow over very long stretches throughout in which Antarctic-like temperatures prevail.

The thermal mass could be some ceramic or concrete solid. It could also be some eutectic compound, if a suitable one can be processed from Martian soils, *that stores surplus daytime heat by changing phase from solid to liquid, resolidifying as it surrenders that heat when needed at night.*

The atmospheric pressurization within the enclosed pipeline could use the available CO₂ ambient atmosphere as is, or with additive gasses that help retain heat. The inner surface of the pipe could be coated so as to be ice-repelling.

The freezing point of the water in transit could be lowered by antifreeze additives if some can be formulated for local manufacture that can be easily removed at outflow points to render the water potable again. Could percussion sound waves or microwaves help keep sub-freezing-point water liquid? All the options must be investigated to zero in on those that are workable under Martian conditions, *and for which the raw materials needed are locally available on Mars*, and the components locally producible: “Made on Mars.”



CANAL ROUTING ON MARS: A number of feeds (2) from the edges of the North Polar Ice Cap (1) could feed into a main pumping station (3). From there, an arterial canal (4) would follow logical land contours on its route southward feeding into a number of midcourse delta

diversion areas (5), and crossing passes and divides via pumping stations (6) to a final delta dispersal area (7) in the equatorial regions (8).

[**Note:** The **top northern hemisphere target area** would be the Utopia Basin in which a subsurface glacier has been found. Top Southern target? Given that there is no “ocean sized basin” in the Southern Hemisphere of Mars, it would not make sense to similarly “channel” temporarily melting the south polar icecap.

Considering that Mars’ celestial north pole lies in the constellation Cygnus, the Swan, a few degrees from Deneb, the principal pumping station near the polar cap edge might be colorfully named “Swan Lake”. Here the water ballet begins.

Manufacturing plants (“Schiaparelli Manufacturing & Construction Company” ?) to produce the components needed (pipeline sections of varying diameters and couplings, thermal jacketing material, IR-black coatings, ‘silvering,’ stilts, pump station machinery, etc.) might be best located at some midpoint along the route (5). Settlements would preferentially cluster at (3), (5), (6), and (7). Permafrost water extraction along the arterial (4) could serve as a supplement to usage at midcourse diversion areas (5) with surplus fed into the canal for use ‘downstream’ (i.e. a cogeneration scheme).

Will more than one such canal be built? That depends on the number of feasible routes and the number of economically attractive townsites each would serve.

Prosaic names could be chosen: the **Trans-Utopia Canal**, the **Chryse-Marineris Canal**, etc. There are many who would prefer a fresh start that makes no allusion to the tainted past of runaway Mars speculations. But why not dip into the available pool of names from Lowellian canal mythology? *Unfounded early public daydreaming aside, Mars will need all the ‘romance’ we can give it.*

Some Lowellian Martian Canal Names:

Indus, Oxus, Euphrates [also on Earth], Nilosyrtis, Chryse, Phison, Hiddekel, Gehon, Candor, Antæus, Deuteronilus, etc.

Some Lowellian Names for Canal-linked “Oases”:

Lacus Solis, Phoenicis Lacus, Nuba Lacus, Lunae Lacus, Charontis, Læstygon, Zea Lacus), Ismenius Lacus, etc. ##

Author’s Comments in 2019: We still do not know enough about these seasonal water flows once the larger carbon dioxide ice caps evaporate into the atmosphere, thickening it temporarily.

[**Note:** *as one cap melts, the opposite polar cap grows, so the amount of CO₂ ice planet-wide should remain the same.*]

More to the point, to my knowledge, we have not put an orbiter into orbit around Mars, pole over pole, to map the carbon dioxide ice cap’s shrinkage, ***and then watching for H₂O water flows.*** One would think that such an orbiter would be high on NASA’s “must fly list,” but apparently it is not. Even if it found no such “canals,” ***finding routes along which future Mars settlers could build them would definitely be useful.*** PK

Photolimage map of the Great Northern Basin

Mars versus Earth; Two Similar but So Different Worlds

Hello, Mars!

√ **Climate:** all desert-like, with no surface water or ice, save some frozen water ice “lakes” underneath frozen polar carbon dioxide ice caps

√ **Temperatures:** cool, cold, *very cold!*

(Arctic and subarctic peoples may feel at home on Mars, followed by those who live in areas with snowy winters)

√ **No signs (so far) of surface life, current or past**

√ **Uncertain hints of a “once upon a time long long ago” northern ocean**, far from verified, and if so, irrelevant for pioneers on Mars in the future (one irregular “elevated continent” and one ocean-sized dry basin, two smaller sea-sized basins, all dry)

√ **Four Seasons? Yes, but all dry (or drier), and cool (or colder)**

√ **Earth Colors of the whole rainbow. Mars colors? Just a small section of rusty shades**

√ **Ways to “exaggerate” or “shift” nature’s colors**

√ # 1 remedy, “**LIVING WALLS**”: *dominant shades of green leaves, colored flowers and blossoms, fruits and vegetables, pollinating birds and butterflies. Possibly with “4 season plants” at least here and there - (do Google “Living Walls” for dozens and dozens of photos.)*

√ Mars’ “blueberry” pebbles, put to many “decorative accent” uses

√ **Eyeglasses that exaggerate color shifts** from butterscotch browns in both directions

√ **Colored Vehicles, Signs, and Clothing to stand out from the monochrome background** (*outlawing vehicles colored to blend into the background, except for police cars, which might “change colors” when in pursuit.*)

√ **Roadside signs that stand out**

√ **Hello Blue!** (besides “blueberry” pebbles and their uses)

√ **Projected blue ceilings** in Middoors walkways and in large buildings (City Hall, Hotels, Office buildings, train and/or bus depots and terminals etc.) **Some static, other\$ with white cumulus “clouds” in motion.**

√ **Prominent use of “blue” may be a sign of “look at me” “standout pride.”**

√ **Blue shirts and other clothing, (bluejeans? blue accent ties?) Imported from Earth along with pioneers, or left behind by visiting tourists.**

√ **MARS’ Atmosphere CO2 (carbon dioxide)**

√ **EARTH’s Atmosphere 78% nitrogen, 21% oxygen, 0.9% argon, only 0.03% CO2** with very small percentages of other elements. Our atmosphere **also** contains **water vapor** and traces of *dust particles, pollen, plant grains and other particles.*

√ **Mars’ Surface temperatures** seldom rise above freezing point, and that for short periods, in isolated areas; Mars’ “climate” is more like Earth’s Arctic and Antarctic areas (*in particular, Antarctica’s Dry Valleys where would be Mars Settlers should spend a few months to make sure that they are not fooling themselves about wanting to settle Mars. ##*

On the 50th Anniversary of Apollo 11's 1st Manned Visit to the Moon

James Burk asked me (by email) the following questions (my answers are in bold type)

Q: What are your thoughts on this anniversary of Apollo 11 landing?

It is a crime for Congress to have killed 3 additional Apollo missions to more interesting parts of the Moon. NASA might have cut its budget by getting equipment for extended missions donated by companies involved at no cost, for the favorable publicity.

Q: What did the Apollo program get right?

Separating the lander into two sections, the bottom part remaining on the Moon.

Q: What did the Apollo program almost get right?

The design of the Apollo lander

Q: What did it get terribly wrong?

Not providing pop up awnings to keep the lander in the shade.

Not designing the cabin so that crew members could sleep stretched out instead of curled up.

Q: What are the biggest lessons of Apollo for upcoming efforts?

Plan extended stays if all is going well after the advertised stay, providing that food and other supplies are sufficient. Design the cabin for more comfortable sleeping.

Q: What could have been done for a better followup to Apollo?

Any new lander could have wheels to move to more interesting places once it had safely landed (if there were more interesting places nearby.)

Taking pictures of the lander and a crew member from nearby high ground.

Q: What could have been a better buildup for Apollo 11 that could have better motivated the general public at the time? ***Well, I think it would have been a mistake to broadcast all the things that "might go wrong."***

We could have given a look at the possibilities of a permanent outpost on the Moon, but given Congressional indifference, that might have backfired. NASA did give Congress and the people a preview of future missions in the planning stages.

Could we have convinced NASA to choose one of each 3 person Apollo crew to be someone picked blind from a pile of interested healthy and talented volunteers to go through the training exercises?

Q: Same question, but for the general public of today -- how can we motivate them about a lunar return? ***Describe more visually interesting locations, such as a collapsed entry into a lava tube or a hole in a lava tube ceiling created by an asteroid hit by sheer chance "right on target," with equipment to take astronauts down into it to look around. A drive down the scenic "Alpine Valley" linking _____ on the North and _____ on the South would spark much interest.***

Q: What projects and/or policies should the Moon Society be pursuing?

Reinstate the three cancelled Apollo missions to more interesting parts of the Moon

- ***Apollo 15 (J1) Hadley–Apennine, July 1971.***
- ***Apollo 16 (J2) Descartes Highlands, April 1972.***
- ***Apollo 17 (J3) Taurus–Littrow valley, December 1972.***

And demonstrate all the things that can be made of Lunar Basalt in and for a permanent "Outpost" on the Moon: ✓ bodies of surface vehicles, ✓ habitat cabins, ✓ furniture, ✓ furnishings ✓ fabrics and much more.

Given the Moon's assets, we can do so much more for less.

And inform Congress, Corporations, and the public at large that using components made on the Moon, of glass/fiberglass composites, and/or basalt fibers, to make giant platforms in Geosynchronous orbit, at each available slot, then each platform, with solar electric power, might be capable of holding as much as a hundred satellites, with a robot to anchor them, service, repair, and replace them as need be.

It would take far less power and fuel to ship these items down to GEO from the Moon, than up from Earth's surface.

There are only fixed number of allowable slots in Geosynchronous Earth Orbit (GEO) and they are filling up fast, but with such platforms, the number of satellites in GEO could increase a hundredfold or more. ##

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BOOK REVIEW : A Pioneer's Guide to Living on the Moon

7/12/2019: A friend alerted me to a lengthy review of my first book on the NSS website. The reviewer had read the kindle version, which has been shortened in the hard copy version by removing repetitive sections. I had not been aware of this review. *Peter Kokh*

<https://space.nss.org/book-review-a-pioneers-guide-to-living-on-the-moon/>

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Tramp Art a la Mars

Settlement leaders should encourage these forms of artistic expression

√ **Urban Murals a la Milwaukee?** > <https://www.google.com/Milwaukee Murals>

In corridors and parks, on blank building walls, or inner walls of pedestrian tubeways, and more, an opportunity for young people to develop and express their artistic talents.

√ **Tablecloths, curtains, pillows, sweaters, jackets skirts, comforters of potpourri fabric patchwork. Red and Orange items would blend in and expand Mars hues.**

√ **Collect Mars “blueberries”** (“Martian spherules (also known as blueberries due to their blue hue in false-color images released by NASA) are the abundant spherical hematite inclusions discovered by the Mars rover Opportunity at Meridiani Planum on the planet Mars.”)

> https://en.wikipedia.org/wiki/Martian_spherules

> <https://www.space.com/42645-mars-blueberries-formation-mystery-earth-analogs.html>

“Blueberries” could be used as a color accent in many ways, as edges for window curtains, as necklaces, (add your own ideas!) Mars is a “monochromatic” world and finding ways to create things in other colors will be most welcome: clothing, vehicles, Living Walls, and more.

√ **In the same spirit, “sculptures”** [a better word would be the opposite of sculptures, such as “compositures”] *made of no longer useful parts of motors or anything else (e.g. checkers and chess sets, etc.) things scavenged from equipment and vehicles no longer in use, including broken things etc.) ##*

Nudging Mars' Climate from *Cold* to *Cool*

A number of people have suggested ways to shift Mars Climate **from cold to cool**, “cool” being the climates of Northern Alaska, Northern Canada, Northern Europe, Northern Russia and Siberia, climate zones sparsely inhabited on Earth, but to some millions, climates to which they are well adjusted. If we could find a way to do so, there would be more people from Earth willing to make the big trip to Mars, and find the red planet “quite livable.”

But it is more than just temperature. Mars has an atmosphere that is not only thin, but more importantly, unbreathable. On Earth, we are used to an atmosphere that is mostly Nitrogen, but with enough Oxygen, that we can breath it just fine.

If we could find a source of Nitrogen on Mars that we could warm and thicken Mars' atmosphere, that would be great. But without a healthy fraction of Oxygen (19% on Earth) we could still not breath it.

Of course, there is a Science Fiction method of warming up Mars: bring Mars inward towards the Sun, still out beyond Earth, but not as far. However that would have an unwelcome effect of considerably lengthening the time between windows for ships to and from Earth to Mars. We are stuck with the Solar System as it is.

Here on Earth, there are many people quite at home with the near arctic conditions they were born and raised in. On the other hand, many “would-be Mars settlers” born and raised in northern climates, have moved to the American southwest, to get away from the snow and cold. Go figure! *We don't want to pick Mars settlers from among their kind.*

Those who live in the “snow belt” and love it, will be much happier Mars pioneers, even if they won't have to shovel snow! LOL!

Each Spring (North or Southern Hemisphere) the polar ice caps of frozen CO2 will evaporate, adding to the atmosphere (at the same time the opposite is happening at the other polar area.) Will that make ***a subtle change in the color and brightness of Mars' skies?*** To our knowledge, NASA has not taken note of any such subtle changes in Mars' daytime skies.

But Mars Settlers will have something “Moonies” will not have - *a bright daytime sky!*

Even if Mars' sky is not blue! nor with clouds of any kind! I'll bet that settlers will notice these subtle seasonal changes. And I'll bet that they will wear “sunglasses” that exaggerate these subtle hues. ##

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Searching for signs of subsurface life on Mars, from Extinct to Current

<https://nai.nasa.gov/seminars/featured-seminar-channels/workshops-without-walls/2019/8/8/searching-for-signs-of-subsurface-life-on-mars-extinct-to-extant/>

This NAI Workshop Without Walls will develop community ***recommendations for future missions and exploration strategies for subsurface life on Mars.*** The deliverables of this activity will be a series of white papers that will be presented to the community, and then submitted to the decadal committee. ##

**Settlers will get to Mars much faster in nuclear powered ships
burning fuel produced on the Moon,
and thus exposed to much less interplanetary radiation**

<https://www.space.com/space-radiation-damage-mars-astronauts-brains.html?>

Space radiation will take a toll on astronauts' brains during the long [journey to Mars](#), a new study suggests. Mice *exposed for six months to the [radiation levels prevalent in interplanetary space exhibited serious memory and learning impairments, and they became more anxious and fearful as well, the study reports.](#)*

The trip to Mars takes six to nine months one way with current propulsion technology. So, these results should ring a cautionary bell for NASA and other organizations that aim to send people to the Red Planet, study team members said.

A reason not to send settlers to Mars until the space ships taking them there have nuclear propulsion, *burning Uranium 233 derived from Thorium mined on the Moon (by settlements in Mare Frigoris)*, as outlined in our first book,

“A Pioneers’ Guide to Living on the Moon” (\$19.95 from Amazon.) ##

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From Trash to Treasure

Recently, I received a letter from someone who wanted to know what he could tell young people what we would do with toilet trash on a round trip to Mars.

What follows is my answer

“Trash that can be biodegraded could be left on Mars in windproof containers.

√ Other kinds of trash (paper and cloth) can be recycled

(this is supposing that people will go to Mars to stay, not to look around and go back home)

√ Any waste/trash materials that can be recycled (eventually) can stay on Mars, in bins (to prevent winds from blowing it all over the place)

√ More rationally, ***nothing should be brought to Mars that is not biodegradable, or reusable.***

And what is left behind should be left in containers so that the winds do not scatter it.

√ ***Metal parts, carefully left in a pile, even if not reusable, can be the stuff of future sculptures***

I myself have arranged such stuff into sculptures. (I used to work in a metal treatment factory. I have made 2 inventive chess sets for myself, 2 or 3 more as gifts, the pieces made of odds and ends, some by themselves, some in combinations)

An inventive artistic attitude will go a long way.

"Trash to Treasure" is the needed attitude

So ***besides scientists and industrialists, we need pioneers with such an inventive artistic attitude.*** I hope this article inspires some students and young people to try making things, useful or artistic (or both) out of odds and ends, out of **wood scrap, plastic scrap, metal scrap, cloth odds and ends** (e.g. patchwork quilts etc.). ##

President Trump wants to buy Greenland but it is NOT for sale

My experience flying over Southern Greenland on my way to Russia in 1981
(to see a total eclipse of the Sun in Bratsk, Siberia - the trip of my lifetime!)

Our Finnair plane was delayed 7 hours from leaving New York for Helsinki.

Most everyone on the plane was asleep. I was awake.

Some hours into the trip, ***we were passing over Southern Greenland, right at local dawn.*** I had a left hand window seat, and ***wow!***

The ice sheet was a soft purple, lit by the just rising sun,
and the Nunatuks, *mountain peaks poking out of the ice sheet,* were a sight to be seen, say an easy #1 in my lifetime.

I woke up everyone on the plane and told them to look out the left hand windows.

At first they all cursed me, but once they saw this sight of all sights, they profusely thanked me.

We were lucky to have been delayed in New York, or it would have been dark when we flew over Greenland. P.S. While Denmark owns Greenland, the local people in a handful of coastal settlements, are happy with this political standing and enjoy autonomy, Denmark only assisting and taking care of international relations. **Google: “Greenland towns” for images.**

As to our tour of Russia, **Moscow, Sochi, Tblissi, Georgia, Yerevan, Armenia, Bratsk** Siberia, Moscow to **Leningrad**, I was off on my own, able to read Russian (but there were many signs in English, the Summer Olympics having been held in Russia the year before, in 1980.)

As to the eclipse, it was cloudy, and our Intourist Guide promised us that if we didn't get to see the total solar eclipse, they would fly us some 600 kilometers NNW to the site of the famous 1908 Tunguska meteor crash. But the clouds parted with 2 minutes to go and we saw our eclipse. I didn't know whether to cry or smile. LOL!

As to not seeing the Tunguska meteor sight, a few years later I got to see Mt. St. Helens that had erupted 20 years earlier, with the dead, leafless trees all lying on the ground, tops pointing downhill, with beautiful wildflowers poking up between the dead tree branches. Beautiful is not the word. **Awesome!!!!**

(P.S. Having read **Jules Verne's** novel about **Irkutsk, Siberia** (“**Michael Strogoff**”), a few hundred miles south of Bratsk, I asked our tour guide, how I could arrange to visit Irkutsk. Her answer? “That's easy! Go back to the U.S. and get a new Visa”. (#\$%@&!) I never got there.

Highlights of my Russian trip: Moscow of course and its awesome subway system, Sochi (a *most beautiful*** Black Sea coastal city), Tblissi, Georgia (off on my own again, ***the #1 experience of my entire lifetime***), Yerevan, Armenia with Mt Ararat, Turkey looming over the southern horizon), being invited by people into their homes, Leningrad (now back to its original name, St. Petersburg- by then I was too tired to appreciate this city.)**

Back to Helsinki and wait, wait, wait — President Reagan had just fired all the air traffic controllers! I had time to tour the city, 5 hours it turned out to be, but of course, we never knew when planes would be flying again. **P.S.** Traveling to other countries widens your view of the world. **NEVER EVER turn down a chance to do so!!! #####**