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Review Article

Heat Energy Properties of Terraforming Microorganisms

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Abstract

Drop point depot colonies on planets further out in the solar system than our planet Earth; are inevitable steps in the quest to explore other solar system's planets.

The question falls to as, what will be the favoured method for developing drop point depot colonies either on outer solar system planets, or for space stations orbiting those outer solar system planets. Which will support inter-solar space stations, or space vehicles, travelling into the neighborhood solar systems?

1. Fully automated robots with artificial intelligence?
2. Fully automated robots with artificial intelligence accompanied by humans almost encased in artificial environment robotic suits.
3. Fully genetically modified human beings to a new and different humanoid form.
4. Fully automated robots with artificial intelligence accompanied by humans who have been fully genetically modified to a new and different humanoid form. But still need to be almost encased in artificial environment robotic suits.
5. Send in genetically modified task specific, colonizing micro-organisms. In order to promote varying degrees of climate change on the outer solar system planets, and their moons.
6. Send in genetically modified task specific, colonizing micro-organisms. In order to promote varying degrees of climate change on the outer solar system planets, and their moons. But with dedicated observation computer and robotic systems to monitor success and failures of the introduced micro-organisms; and micro-organism ecosystems.

I would assume vigorous debate on both the ethics and the need for human beings to 'must know' if life has began spontaneously on other worlds within our solar system.

Therefore, introducing genetically modified Earth micro-organisms to other planets in this solar system might remain:

1. Theoretical for the moment, and
2. put upon the extreme, hostile, furthest out planets, of Uranus and Neptune, and Neptune's moon triton.
3. Of course it doesn't harm the discussion to use Saturn, and Saturn's moon Titan, as the more physically explored worlds. To further the Earth terraforming introduced micro-organisms; and micro-organism ecosystems.

I think it should be stated from the very beginning that simply introducing the Earth terraforming genetically enhanced and environmentally targeted micro-organisms; and micro-organism ecosystems into the atmosphere of a foreign planet. Is not an instant recipe for the transformation of that foreign planet into an earth like paradise beyond wild expectations.

The availability of the fundamental elements for life to reproduce itself absolutely must be available either in the solids (rocks), liquids, and atmosphere of that planet. While a driving energy source such as visible light, heat from volcanic activity, nuclear decay radiation, another external radiation source from outside the planet; or micro-organisms that generate radiation (visible to infrared radiation) from non-photosynthesis metabolism of available resources. All while needing to find a way of surviving the impossibly cold temperatures, before those temperatures can be alleviated by gas planetary global warming.

Keywords: *Heat Energy; Terraforming Microorganisms*

Green house gases

What is a gas, and why is a gas on its own not enough to create Earth like environmental conditions on a foreign planet?

Gas atoms and gas molecules seem to be specific as to what wavelengths of light pass straight through them. And what wavelengths of light stimulate either the gases electrons or the shape of the gas molecule to respond. Why is H_2 not a greenhouse gas compared to CO_2? [1]

Ultraviolet U.V. light is below λ 400 nm down to about λ 100 nm.

The wavelength region of the visible light spectrum starts at λ above 400 nm to 435 nm for violet light.

Then λ 435 nm - λ 480 nm for blue light. Then λ 480 nm- λ 490 nm for a more blue green light.

Then λ 490 nm - λ 500 nm for a more green blue light. Then λ 500 nm- λ 560 nm for green light.

Then λ 560 nm - λ 50 nm for a yellow green light. Then λ 580 nm - λ 595 nm for yellow light.

Then λ 595 nm - λ 650 nm for orange light. Then λ 650 nm - 750 nm for red light.

Near Infrared λ 780 nm - 2,500 nm [2].

The Earth's atmosphere is dominated in volume by nitrogen gas N_2 and Oxygen gas O_2. Yet much smaller amount of CO_2 have a critical role for life to be sustained on planet Earth. As it is carbon dioxide (CO_2) plus water (H_2O) in the presence of sunlight (photon packets of energy) that plants process with their enzymes (such as chlorophyll), to manufacture Oxygen (O_2) and sugar ($C_6H_{12}O_6$).

Yet gases such as the bar bell shaped molecules of O_2, N_2 and H_2 simply allow infrared radiation to pass through them with little or no affect! N_2.

The photons of infrared radiation do not have the exact amount of energy (measured in electron volts, eV) to either (1) effect an electron to be excited enough to jump higher into the atom's or molecules next higher orbital shell.

Without the exact quantity of energy electrons will not jump to an excited higher orbital level of their atom or molecule [3].

There is a possible exception in unlikely but possible scenarios. If a volume of H_2 gas, in say a planet's atmosphere, is bombarded with ultraviolet radiation. Some of the electrons of the H_2 gas molecules are excited into a much higher orbital. From this ultraviolet excited state, will these H_2 gas molecule electrons will accept, and be stimulated further, by infrared radiation photons?

Will these ultraviolet excited H_2 gas molecules electrons, having accepted, and being still further stimulated by infrared radiation photons. Behave as methane gas (CH_4) and carbon dioxide gas (CO_2) molecules, and water vapour molecules (H_2O); in twisting, rotating, vibrating, resonating within their molecular structures caused by the infrared photon radiation collisions [2].

Thus, stopping the infrared radiation leaving that planet's atmosphere?

Unfortunately, no! The H_2 electrons, having absorbed the infrared photon and jumped slightly to a higher energy level orbital, simply fall back down to their previous orbital and emit an equivalent infrared photon, or the same electron falls all the way down to its very original energy orbital level, and emits a photon of ultraviolet light energy instead!

Curiously H_2 gas molecules N_2 gas molecules O_2 gas molecules, all have a linear dumbbell shape. Neither absorb infrared photons of radiation.

Water vapour molecules (H_2O) and carbon dioxide gas molecules (CO_2) both have a "V" shape. When a photon of infrared radiation collides with one of these molecules (H_2O) or (CO_2) their electrons remain unaffected [4].

However, the photon of infrared radiation is actually absorbed into the (H_2O) or (CO_2) molecule's structure by causing bending, rotating, vibrating/oscillating, or resonance, of the entire molecule!

Stopping the photon of infrared radiation from leaving that planet's atmosphere of the (H_2O) or (CO_2) molecules. Dare I say the photon of infrared radiation is converted to kinetic energy within the (H_2O) or (CO_2) molecule's structure. Plus, the infrared/kinetic energy from increased collisions with other (CO_2) molecule's and the atmospheric O_2 and N_2 [2].

So, the 'V' shaped (H_2O) or (CO_2) molecule, or the pyramid shaped methane gas (CH_4), or possibly ammonia (NH_3) gas are critical for converting the infrared photons of electromagnetic radiation flying through the atmosphere, as components for greenhouse warming of a planet, through sunlight.

Even more so in sunlight/energy deficient, planetary environments.

Another greenhouse gas Nitrogen dioxide (NO2) absorbs in both the visible and infrared wavelengths!

Unfortunately, when absorbing in visible light it's (NO_2) electrons after absorbing a visible light photon, jump to a higher electron orbital, then fall back to their original electron orbital, releasing a photon of light. No kinetic or infrared energy to warm a planetary atmosphere! When the same Nitrogen dioxide (NO_2) absorbs an infrared photon of light, it's (NO_2) bonds twist, rotate, wobble or vibrate. Thus, maintaining conserving the infrared energy as kinetic energy [2,3].

Interestingly a similar greenhouse gas molecule, di-nitrogen oxide (N_2O), as well as being a known atmospheric greenhouse gas, absorbing infrared photons/wavelengths of electromagnetic radiation. Has been recently observed to absorb in the red part of the visible light wavelengths of the electromagnetic spectrum. The question has to be asked. Does di-nitrogen oxide (N_2O), absorb a visible red photon of light as an electron jumping to a higher energy orbital, or as a twisting and bend of the di-nitrogen oxide (N_2O), molecule itself; as it would if it was conserving infrared radiation? [2,3].

"The near infrared and visible absorption spectrum of nitrous oxide 14N216O has been recorded by Fourier transform absorption spectroscopy, between 6500 and 11000 cm^{-1} and by Intracavity Laser Absorption Spectroscopy, between 11700 and 15000 cm^{-1}. Nineteen new bands are observed and, altogether, 34 cold and 10 hot bands are rotationally analyzed. The related upper term values, vibrational assignments, and principal rotational constants, as well as the relative band intensities are quantitatively discussed in terms of the formation of vibrational clusters, on the basis of the effective Hamiltonian" [5].

Where 15,000 cm-1; λ=1/wavenumber⇒1/15,000 cm-1⇒λ=666 nm. And 1/11700 cm-1⇒λ=854.7 nm [2].

As 1/11700 cm-1⇒λ=854.7 nm, it is in the near infrared region of the electromagnetic spectrum.

So as above, does di-nitrogen oxide (N_2O), absorb a visible red photon of light (λ = 666 nm visible red), as an electron jumping to a higher energy orbital, or as a twisting and bend of the di-nitrogen oxide (N_2O) molecule itself, as it would when being stimulated by near infrared photon/wavelength of radiation (at λ = 854.7 nm invisible infrared); as it would if it was conserving infrared radiation?

More intriguing, and even more compelling is atmospheric water vapour (H2O).

As water vapour (H_2O) absorbs ultraviolet light, is transparent to visible light, allowing visible light to pass through it; then water (H_2O) absorbs infrared photons/wavelengths of the electromagnetic spectrum.

Logically, water (H_2O) will accept photons of ultraviolet light as causing it's (H_2O) electrons to jump to a higher energy orbital, before the water's electrons (H_2O) fall back down to their original, lower energy level. And water (H_2O), a known greenhouse gas will logically absorb infrared photons/wavelengths of energy as bending, twisting, rotating, or vibrating of the entire water molecule (H_2O) [2].

The near infrared absorption spectrum of liquid water at 20°C has been reinvestigated using a PbS cell detector system. The total spectral range investigated was from 0.70 to 2.50μ. A curve is included which shows five prominent absorption bands at 0.76, 0.97, 1.19, 1.45, and 1.94μ; and a table gives experimental results of water absorption at 20°C" [6].

Where 0.76*μ* = 760 nm. Where 760 nm is absolute borderline of what the human being can 'see' as red light (red photons of light in red spectrum of electromagnetic wavelengths) in the visible light spectrum; and the beginning of the near infrared region of the electromagnetic spectrum.

But how will water vapour absorb red light at the edge of the near infrared visible electromagnetic spectrum? [2].

Until this question is reconfirmed in the laboratory then the whole premise on which option 1 is invalid, and therefore a cause for misplaced resources! Why? option 1.

What an autotroph micro-organism needs

On the Earth, water (H_2O) + carbon dioxide (CO_2) + sunlight photons of energy in UV, visible and IR wavelengths (λ) + plant enzymes → sugars ($C_6H_{12}O_6$) + oxygen (O_2) [7].

Which oxygen (O2) is used for their own plant and microbe respiration; as well as animal respiration [7].

Additionally, elements to the above C, H, O, elements (for sugars {$C_6H_{12}O_6$} and carbohydrates), to sustain micro-organisms in their life cycles. Would be phosphorous or even arsenic for DNA structures, and Nitrogen for DNA base pairs.as well as amino acid production. Sulphur is an element needed for some amino acid production as well as potassium for plant lifeforms [8].

So, what is available on the Earth that could be genetically modified to create an organic source of infrared energy without having to start from scratch?

Lichens from the Earth's polar regions?

"A lichen is a composite organism that arises from algae or cyanobacteria living among filaments of multiple fungi specie" [9,10].

As the moss part of the lichen symbiont can burrow its fine filaments into any rock. This rock forms a protective, insulating home against the cold.

'Lichens are pioneer species, among the first living things to grow on bare rock or areas denuded of life by a disaster' [11].

The moss needs sugars ($C_6H_{12}O_6$), which on Earth are supplied by the algae part of this symbiont lichen; by using light to photosynthesize water (H_2O) and carbon dioxide (CO_2) into the sugars it needs and the moss needs to live and grow [9,10].

Pre-Option 1

- **Firstly:** As Hydrogen (H_2) atmospheric gases, nitrogen (N_2) atmospheric gases, as well as Helium (He) atmospheric gases are most common gases by volume in the solar system; but are not greenhouse gases. It might be obvious that micro-organisms could be used to alter those foreign planet atmospheric gases to greenhouse gases.
- **Secondly:** As some of our solar system's planets already contain amounts of greenhouse gases such as methane (CH_4); the second issue of planet terraforming outer solar system foreign planets to be addressed is: the substitute equivalent of sunlight radiation; near infrared photons or even thermal energy that might be created from micro-organisms.

Option 1(A) basics [terrestrial]

(1) An artificial or natural protective environment to begin a micro-environment on a foreign planet or moon.

(2) Lichen chosen as a consideration species:

- For its ability to form a micro-environment in rocks in order to withstand extreme weather temperatures; in both the Antarctic, Alaska-Siberia regions. (b) Lichens already form symbiotic relationships (c) The moss symbiont have related species of moss that are already bioluminescent [12,13]. (d) As bioluminescent moss ONLY fluoresces in the green wavelengths of the visible spectrum, genetic engineering in the laboratory would first have to produce a moss that was bioluminescent, and could fluoresces in the red region of the visible light spectrum; before any further work could proceed [2,6].

  "Bioluminescent fungi emit a greenish light at a wavelength of 520 - 530 nm" [12,13].

(3) If a lichen can be genetically engineered where the moss symbiont is bioluminescent and fluoresces in the red region of the visible light spectrum. Then (and if water absorbs visible red light [6] as molecular wobbles and rotations/kinetic energy) [2], a microenvironment of liquid water, within ice could be created; for the micro-environment of each individual Lichen. Liquid water which is critical for the transfer of nutrients to support life [11].

Option 2 (A) basics [Aquadic]

(1) An artificial or natural protective environment to begin a micro-environment on a foreign planet or moon.

(2) Lichen chosen as a consideration species:

- (a) For its ability to form a micro-environment in rocks in order to withstand extreme weather temperatures; in both the Antarctic, Alaska-Siberia regions. (b) Lichens already form symbiotic relationships (c) The moss symbiont have related species of moss that are already bioluminescent.

  "Bioluminescent fungi emit a greenish light at a wavelength of 520 - 530 nm" [12,13].

(3) If a lichen can be genetically engineered where the moss symbiont is bioluminescent, yet still only fluoresces in the green region of the visible light spectrum. Then if its was the Purple Sulphur bacteria [14,15], which needs a light source to survive and metabolize via photosynthesis [7]. Now supplied by the moss symbiont in the green light wavelength at of 520 - 530 nm [12,13]; the Purple Sulphur bacterium supplies the infrared radiant heat to this hybrid lichen lifeform. Thus, without an external sunlight light source available ice water creates an insulating protective layer from the-180 degrees Celsius, Where the radiant heat of the Purple Sulphur bacteria [14,15] melts the ice into water at its contact point surface. A microenvironment of liquid water, within ice, could be created; for each individual Lichen. Liquid water which is critical for the transfer of nutrients to support life.

Purple Sulphur bacteria have a characteristic where they generate and then radiate heat, or infrared radiation into their water environment.

"...in the South Andros Black Hole in the Bahamas, purple sulfur bacteria adopted a new characteristic in which they are able to use their metabolism to radiate heat energy into their surroundings [11]. Due to the inefficiency of their carotenoids, or light-harvesting centers, the organisms are able to release excess light energy as heat energy [14,15]: "CO_2+H_2S+ light$\rightarrow CH_2O+S$" [16].

'Purple sulfur bacteria found in salt marshes and mudflats produce organic matter in the presence of light' [16].

While other bacteria are required to create the precursor hydrogen sulphide (H_2S) from atmospheric hydrogen gas (H_2); but requires soluble sulphate ion SO_4^{2-} in the soil; via the formulae: $4H_2+SO_4^{2-}\rightarrow H_2S+2H_2O+2OH^-$ [16].

"Others, such as certain Desulfovibrio species, are capable of sulfur disproportionation (splitting one compound into an electron donor and an electron acceptor)" [17].

An important fraction of the methane formed by methanogens below the seabed is oxidized by sulfate-reducing bacteria in the transition zone separating the methanogenesis from the sulfate reduction activity in the sediments [18].

Option 1(B) basics [Terrestrial]

The second symbiont of a Lichen genetically engineered where the moss symbiont is bioluminescent and fluoresces in the red region of the visible light spectrum to the near infrared region of the electromagnetic spectrum at 760 nm wavelength. Needs to produce sugar for itself and the symbiont genetically modified moss. Thus, the second symbiont of Lichen is usually an algae/diatom [25,26]. Because of its small micro size and its ability to photosynthesize.

Where CO_2 is available in the atmosphere, and the ice interface surface melts to water via the energy from red/infrared photons of light at 760 nm. Then the ingredients of CO_2 (carbon dioxide) + H_2O (water) + (energy from red/infrared photons) $\rightarrow O_2$ (oxygen)+ $C_6H_{12}O_6$ (sugars). O_2 (oxygen) is available for the algae/diatom symbiont, and with excess is produced [25,26] the moss symbiont of the Lichen.

Where CO_2 is NOT available in the atmosphere.

Then, in an atmosphere of H_2, N_2 and CH_4, some of the greenhouse gas CH_4; needs to be sacrificed to make CO_2 Another less potent greenhouse gas (CO_2), but critical for the manufacture of both O_2 oxygen from H_2O water. And $C_6H_{12}O_6$ (sugars) from itself, CO_2 (carbon dioxide), plus water H_2O [9,10].

Then a 3rd symbiont, or a second pair of symbiont Lichen would be needed to form a microbial type community [11,12].

$CH_4 + 4NO_3– \rightarrow CO_2 + 4NO_2^- + 2H_2O$

$3CH_4 + 8NO_2^- + 8H+ \rightarrow 3CO_2 + 4N_2 + 10H_2O$ [19].

'Such as archaea *Methanoperedens nitroreducens* and bacterium *Methylomirabilis oxyfera*' [20].

And option 2(b) basics [Aquadic]

As above in option 1(b) basics [Terrestrial]

Plus, as previous:

(1) A third pair of symbionts may be required as a precursor Lichen, or a trident or trio of symbionts with the moss symbiont is bioluminescent, yet still only fluoresces in the green region of the visible light spectrum (520 nm - 530 nm), as the support and protect structure [9,10,12,13].

While other bacteria species are required to create the precursor hydrogen sulphide (H_2S) from atmospheric hydrogen gas (H_2); but requires soluble sulphate ion SO_4^{2-} in the soil.

By the formulae: $4H_2+SO_4^{2-}\rightarrow H_2S+2H_2O+2OH^-$ [16].

Alternately, a cyanobacteria that absorbs the green light of the moss symbiont and produces red light [22,24], creating enough sugar and oxygen for itself and the moss. May complement the purple Sulphur bacteria.

"In some cyanobacteria, the color of light influences the composition of the phycobilisomes [21-24].

In green light, the cells accumulate more phycoerythrin, whereas in red light they produce more phycocyanin. Thus, the bacteria appear green in red light and red in green light" [22,24].

(2) (i) The fungus symbiont of the lichen has been genetically altered to produce/fluoresces the green wavelength from bioluminescent fungus.

(ii) The cyanobacteria that absorbs green light for photosynthesis is genetically engineered and bred to do what it already does, photosynthesis under green photons of light [12,13]. And with the moss symbiont of this lichen [11] producing green photons of light. Thus, we have a lichen that can photosynthesis and produce sugars ($C_6H_{12}O_6$) with NO sunlight! Obviously liquid water (H_2O) and carbon dioxide (CO_2) gas need to be available [7].

(iii) The cyanobacteria that absorbs green light photons for photosynthesis [21] may or can emit red photons of light [22,24]
If this characteristic can be duplicated in a Lichen symbiont, then these red photons be able to cause a film of contact water ice melt into liquid water; as water will absorb photons at the 760 nm spectrum, and even at the 970 nm near infrared spectrum

[6]. Such a micro-environment of liquid water between the Lichen in a host rock surrounded by water ice. Both to absorb the water (H_2O) and any dissolved carbon dioxide (CO_2), for photosynthesis; and for nutrients to be soluble for the moss symbiont to draw into itself those plant nutrients, just like other plants [7].

(iv) Otherwise a third symbiont would be introduced. That purple Sulphur bacteria [14,15]. Even though the cyanobacteria symbiont that absorbs green light photons from the bioluminescent fungus fluorescing the green photons of light [12,13]; is already a complete competitive terra forming Lichen [11]. In extreme cold conditions the thermal energy output produced from the purple Sulphur bacteria [14,15], may be a critical 3rd symbiont for a Lichen [11] to terraform in CONTINOUS water ice bound conditions.

(v) The Sulphur needed by the new purple Sulphur bacteria [14,15], in a water soluble form [7], would actually be supplied by the bioluminescent fungus fluorescing the green photons of light [12,13]. Whose plant like function is to absorb available soil elements, such as Sulphur, and make those nutrients available for its symbiont cyanobacteria. In exchange for the sugars that the cyanobacteria produce from photosynthesis [7,11].

(vi) So, whether aquatic or terrestrial, an initial, artificial cocoon for the Lichen is developed for the genetically engineered Lichen. The Lichen would be then able to expand itself into surrounding rock and ice [11], on a planet far away from the Earth.

Option 3

1. Traditional diatom algae [25,26] as the photosynthetic symbiont for the genetically modified symbiont lichen [11], (gene transferred from the bioluminescent fungus symbiont that produces/fluoresces in the green wavelength of light) [12,12].

   Such that the diatom algae [25,26] no longer needs sunlight to photosynthesis.

   Although this new genetically engineered organism my now survive in extreme cold conditions of weak or no sunlight. Which still leave the objective and major problem of terraforming the foreign planet, by adding energy sufficient for planetary greenhouse gases to trap thermal energy into friction and kinetic energy [2]. Thus, the purple Sulphur bacteria [14,15] or a microorganism, or organism with the characteristic of producing excess thermal energy; and putting its produced thermal energy into its surroundings. Thus, providing the input thermal energy for greenhouse gases to absorb into their molecular structure [2]. Increasing collisions, increasing friction, increasing atmospheric temperatures [2].
2. A better idea would be to first try to combine a photosynthesizing cyanobacteria with the purple Sulphur bacteria [14,15]. With a genetically engineered lichen moss which now has the bioluminescence genes or fluorescing in a green wavelength [12,13].

Option 4

Option 4 is the radical option to begin terra forming of a foreign moon or foreign planet.

Atmospheric hydrogen gas (H_2) + atmospheric nitrogen gas (N_2) + genetically engineered lichen → H_2N_2 (exothermic product).

Where the exothermic product MUST be shock sensitive especially when frozen, such that a slight structural stress will cause the exothermic chain reaction and the release of infrared heat.

Local heat sufficient to allow the lichen to expand into adjacent rock/soil.

Until an equilibrium between the genetically engineered lichen in its protective rock structure and the foreign planet's atmosphere is reached.

I would therefore humbly propose the planet Uranus for this experiment in terra forming of foreign planets, via introduced, genetically engineered, Earth microorganisms, and or Earth microorganisms and symbiont Lichens.

Pre-Conclusion

When people of the Earth are able to travel at a satisfactory speed between solar systems, one objective would be to find a sister Earth. However, one size fits all, approach may mean that in not finding an exact copy of our planet Earth. Thus, a satisfactory planet or moon that may sustain Earth flora and fauna, may be missed. As an example. Jupiter is too large a gas giant and therefore its magnetic field would damage most life on moons. Those moons close enough for Jupiter's gravitational field to produce gravitational internal friction heat within their cores.

To find a goldey locks moon some characteristics might be: large enough to have a gravitational force of its own. The moon is close enough to its planet such that the planet's gravitational field creates a gravitational friction or internal thermal affect on the moon [27,28]. The moon is not so close to the planet that the gravitational force of the planet keeps the moon in a volcanic state [27,28]. There is already an atmosphere on the moon with some greenhouse gases. The planet and this moon are not so close to their sun that the moons atmosphere has been depleted.

This is where terra forming microorganisms have their chance to bring about a significant and profound influence on that moon's atmosphere and climate; in creating Earth like conditions.

Conclusion

Where foreign planets already have abundant greenhouse gases, are further away, or receive less solar radiation than the Earth does from its sun. Terraforming with microorganisms of any kind, will be required to generate infrared energy or heat from their metabolic processes. Sufficient to melt water ice into liquid ice. Making that liquid water available for a form of photosynthesis, and the uptake of soluble elements for nutrition. Such microorganisms might be adapted, and genetically engineered into a protective symbiotic Lichen. But introduced onto a foreign planet in a synthetic cocoon, to protect the introduced organism from freezing temperatures. In order to take advantage of the already high volume of greenhouse gases present. Therefore, further theoretical work is justified in creating terraforming microorganisms. And even the beginning of laboratory work in creating terraforming microorganisms could be now considered a reasoned proposal.

Post Conclusion

This manuscript is an "open patent document". Thus, I declare that all patent rights extinguished. Any ideas, organisms, systems or proposals in this manuscript, "Heat Energy Properties Of Terraforming Microorganisms" are available to anyone with no legal or economic restraint.

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