



**OUTBOUND #6 JULY, 2018 - "Mars in Milwaukee"**



**Above: The Mitchell Park "Domes" in Milwaukee (built in 1964, '66, and '67)**

Some years ago, our local "Star Trek" club used it as a backdrop as a crew of three "Star Trek" persons who "beamed down" in front of it, for one of their films.

The one on the left is the "**Show Dome**" which is totally redone 4 times a year, with various kinds of temperate zone plants and flowers. Twice a year this dome features a "Garden Scale" railroad highly popular with kids of all ages.

The Dome on the right is the **Tropical Dome**, showcasing plants from tropical areas around the world - high humidity included. (ugh!)

(Now also serving the **Milwaukee Mars Reclamation Society Outpost**)

The one in the Middle is the **Desert Dome** featuring plants from desert like areas around the world. *It is by far my favorite dome, and the one I visit now and then to get my “Mars fix.” Below, a scene in the Mars, er “Desert Dome.”*



*You guessed it, this issue of OUTBOUND focusses on Mars.*

-----

In last month's *Outbound* #5 issue, we looked at all the many things that could be made out of basalt - the type of moon dust found in the dark mare (Latin for “sea”) areas of the Moon.

Fortunately, ***there are many basalt areas on Mars also, including all the great now-dormant shield volcanoes on Mars.***

Lunar settlers who had become experts in basalt technologies might be happy to bring potential Mars settlers up to date, ready to bring the same know-how to early Mars settlements. And having successfully left their former lives on Earth behind, and having adjusted to living on a world with no life of its own, the Moon, they would have no trouble getting used to life on Mars, once their muscles got used to Mars higher gravity!

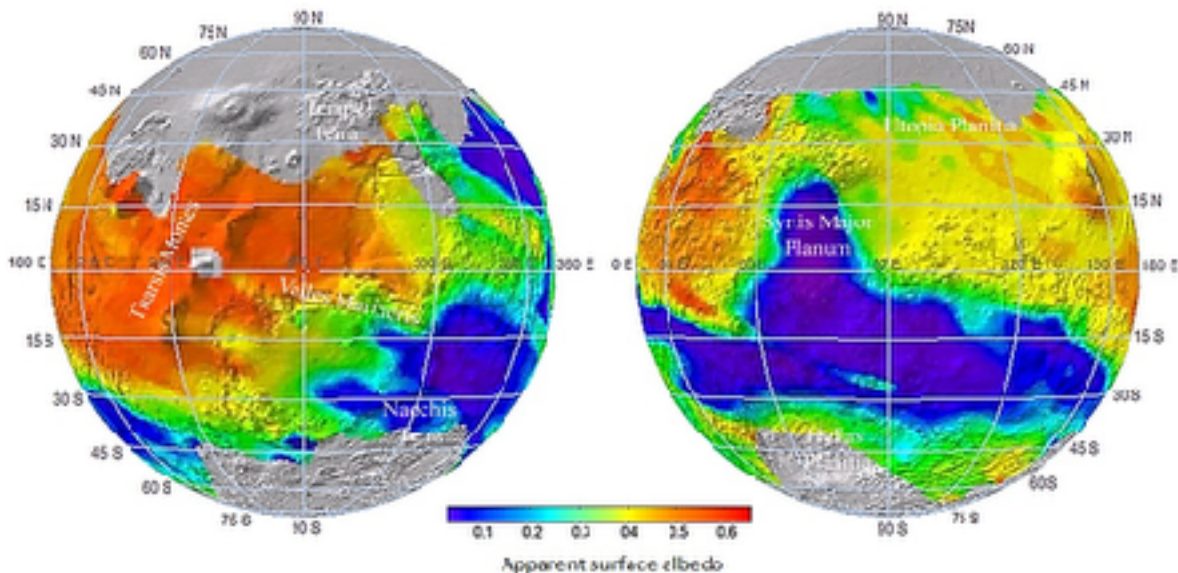


Figure: The Global MSM SWIR (1.65µm) band albedo map of Mars using Mars Orbiter Mission (MOM) data.

**Key to Map above:** *“The low albedo (blue colored) regions (< 0.15) are mainly localized in Syrtis Major and Southern highlands and parts of Northern hemisphere. In general low albedo values are associated with darker surface on Mars having volcanic rock basalt on surface.”*

*“The area shown in blue color indicates the presence of basaltic composition while red indicates the dust covered regions of Mars.”* So **all the useful things we can make out of lunar basalt, we can also make out of basalt on Mars.**

**Mars’ several large volcanoes are also basaltic**

Mars Pavonis, **the middle one of a SW>NW trio**, is smack on the equator, so a launch track could be built up its western slope giving a rocket on a carrier sled riding the launch track enough velocity when it got to the end of the track to put ships on a trajectory back to the Earth-Moon system. Having such a facility could extend launch windows to Earth appreciably.

As to lavatubes, Mars great shield volcanoes must be laced with intact lavatubes, enough to house millions of settlers. Indeed we have found on their flanks a number of “skylight” holes where the roof of a lava tube has collapsed, probably by a chance hit from a meteorite. ##

**What can Mars enthusiasts do (while we are waiting for the day when the first humans will rocket to Mars) to give the first Martian pioneers a heads up on making Mars the 3rd human world?**

**#1 Breed useful desert plants so that they can thrive and eventually bloom, in ever more Marslike conditions.** We wrote an article about this “project” dubbed **“Redhousing”** (yes, in contrast to **“Greenhousing”**) in which plants that thrive in desert conditions can be bred to thrive in every more “Mars desert” like conditions, both as to atmosphere makeup, and as to ever more Marslike conditions: towards Marslike atmospheric pressure, temperatures, etc.



Above: treeless areas of Asia and North America

---

### **Breeding “Mars Hardy” Plants in Compressed Mars Air**

In a previous “Mars Theme” issue, MMM # 83 MAR ‘95, on pp. 7-8 “Searching for OLD LIFE on Mars”, we broke the topic down into two separate questions:

**Question 1:** *What kinds of life forms may have had time to evolve on Mars before irreversible climactic decay, and could any fossil traces still endure?*

**Question 2:** *Could some anemic relic of a once far richer Martian Biosphere still subsist in “oases” here and there?*

***We concluded with a discussion of the implications for Martian settlement dreams that we might find some primitive (at least!) life forms still extant life on Mars; we had better hope that they are wrong.***

It is incomprehensibly naive to think that *should we find life on Mars of any sort*, that the political / rabbleocracy powers-that-be would allow humans (us!) to settle there. ***The Fourth Planet would forthwith be declared a quarantined biological preserve for the rest of time.*** “Humans and all Earth Life keep out!”

Many Mars fans were disappointed that the recent finding that the Viking “No-Life-On-Mars” experiment results were not flawed after all. Why? Because there would be strong pressure from extreme environmentalists to declare Mars off limits to humans, lest our presence would introduce toxins in the Martian atmosphere that would kill off all native life forms.

If all we find are fossil relics and perhaps a few incomplete strands of DNA (we should rejoice at finding that much!) there would be public pressure to make Mars off-limits to humans.

***Jurassic Park type reconstructions of native life form populations are most unlikely.***

***If an ecosystem did survive, we could not hope to see any significant further evolution (beyond anecdotal differential radiation of surviving species into new niches in a rejuvenated more benign Martian climate) within the lifetime of humanity, even if it be a million years - and not even if we succeeded in restoring, permanently, the former more life-accommodating climate with a stabilized all-Martian biosphere and biota.***

Romantic ideas to the contrary should not be entertained. *We would be left with only pre-metazoan life, one-celled plants and animals - nothing we could see with the naked eye!* (except, perhaps, “matts” of tiny life forms that lie together.)

***So rather we might rejoice if we found conclusively that Mars is empty of extant life!***

This is not the end of the story. Should we find that Mars has no existing life, and quite possibly that Mars never spawned life even in earlier wetter and warmer times, that would not make the planet “barren.” Rather it would only make the planet “virginal.”

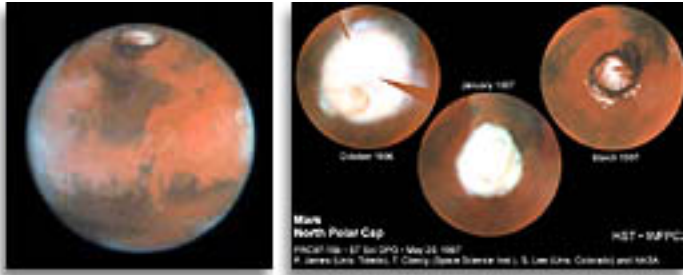
***That conditions may have never been such as to allow life to rise on its own, does not mean that life, originated elsewhere, (i.e. on Earth) might then be bioengineered to fit Martian conditions, could not be successfully transplanted to Martian soil, with intelligent guidance, corrections, and compensations.*** That is a tall challenge, however, but we hope to sketch how it might be accomplished. Or at least, the first steps one intending “to green the planet” might take.

The biological side of Greening Mars would have to be brought about *step by step* together with the geological rejuvenation of the planet. ***Rather than “terraforming” Mars by making it a copy of Earth, rejuvenation looks not at Earth, but at the early Mars itself,*** for its standard of achievement.

**Mars would need to be warmed,  $\sqrt$  first to the point where a third of the atmosphere no longer freezes out over the poles each winter (twice a Martian year, during northern and southern winters) i.e. paradoxically during southern and northern summers, i.e. atmospheric pressure is at its height only during spring alias fall).**

***Warming Mars still further would free up additional carbon dioxide bound up at the poles (the top layer of the icecaps is frozen CO<sub>2</sub>, not water ice, which lies below and never melts) or in permafrost year around.*** Below Mars frozen CO<sub>2</sub> ice cap melts in local spring and summer, leaving a much smaller water-ice cap. CO<sub>2</sub> will start freezing out in the fall.

***Both temperature and pressure have to be increased to the point that liquid water can exist in the open, even if only as seasonal dews.***



*But here, we want to look at the biological part of the equation. Obviously we want to, and very well may have to use genetic material from sundry terrestrial plants (possibly some cold climate animals too) and through many generations (each under ever more Mars like atmospheres) species hardy enough to survive and breed on a rejuvenated Mars.*

*What we have to start with is, species after species, a long way from being remotely Mars-hardy.*

*The harshest most demanding habitats on Earth are all much friendlier than the friendliest places on Mars, even possibly on the wetter, warmer Mars of yester-eon. Where do we start? How do we proceed?*

*The most severe habitats on Earth are the deserts, the ✓ Andean altiplano of Peru and Bolivia, the ✓ tundra of northern Alaska, Canada, Greenland, Scandinavia, and the northernmost parts of Russia-Siberia, and especially ✓ the Antarctic “dry valleys” where the annual temperature range is very close to what we have on Mars today.*

No trees grow in these areas, not even the stunted, wind-grotesqued caricatures we find at the tree line on mountain slopes and at the tundra limits. Animals fare better, thriving on seafood, other animals and very low ground-hugging plants - *but remember that while the seasonal temperature range in the Antarctic Dry Valleys is similar to that on Mars, the air pressure is Earth normal, and the atmosphere is that of Earth, not Mars.*

Animals, however, need an oxygen-rich atmosphere, which Mars does not have, and never had. In contrast, *plants thrive on carbon dioxide - it has been shown that most plants can be grown successfully in an artificial atmosphere of reduced pressure (e.g. 1/10th normal) of just carbon dioxide, the major component of Mars air. That is to say, that plants and crops can be grown on Mars in greenhouses pressurized with warmed Martian atmosphere, simply compressed tenfold - nothing else added, besides water, of course.*

**Question 1:** *What kinds of life forms may have had time to evolve on Mars before irreversible climactic decay, and could any fossil traces still endure?*

**Question 2:** *Could some anemic relic of a once far richer Martian Biosphere still subsist in “oases” here and there?*

We concluded with a discussion of the implications for Martian settlement dreams, pointing out that the Romanticists who hope against hope that we will find some primitive (at least!) life forms still extant life on Mars, had better hope that they are wrong. It is incomprehensibly naive to think that should we find life on Mars of any sort, that the political / rabbleocracy powers-that-be would allow humans (us!) to settle there. The Fourth Planet would forthwith be declared a quarantined biological preserve for the rest of time. “Humans and all Earth Life keep out!” We could hardly disagree more with the sentiments expressed by editor Jeff Liss in the recent issue of Inside NSS. He had called “disappointing” the recent finding that the Viking “No-Life-On-Mars” experiment results were not flawed after all.

If all we find are fossil relics and perhaps a few incomplete strands of DNA (we should rejoice at finding that much!) Jurassic Park type reconstructions of native life form populations are most unlikely. If an ecosystem does survive, we could not hope to see any significant further evolution (beyond anecdotal differentiatonal radiation of surviving species into new niches in a restored or rejuvenated more benign climate) within the lifetime of humanity, even if it be a million years - and not even if we succeeded in restoring, permanently, the former more life-accommodating climate with a stabilized all-Martian biosphere and biota. Romantic ideas to the contrary should not be entertained. We would be left with only pre-metazoan life, one-celled plants and animals - nothing we could see with the naked eye!

***So rather rejoice that Mars is empty of life!***

***It is not precise to say that Mars is "barren." Only that it is "virginal."***

That is not the end of the story. That Mars has no life, and quite possibly never spawned life even in earlier wetter and warmer times does not make the planet "barren". It only makes the planet "virginal". That conditions may have never been special to allow life to rise on its own, does not mean that life, originated elsewhere, and then bioengineered to fit Martian conditions, could not be successfully transplanted to Martian soil, with intelligent guidance, corrections, and compensations. That is a tall challenge, however, but we hope to sketch how it might be accomplished. Or at least, the first steps one intending to green the planet might take.

The biological side of Greening Mars would have to be brought about "pari passu" i.e. step by step together with the geological rejuvenaissance of the planet. Rather than "terraforming" Mars by making it a copy of Earth, rejuvenaissance looks not at Earth, but the early Mars itself, for its standard of achievement. The planet does need to be warmed, first to the point where a third of the atmosphere no longer freezes out over the poles each winter (twice a Martian year, during northern and southern winters, i.e. paradoxically during southern and northern summers, i.e. atmospheric pressure is at its height only during spring alias fall). Warming it still further will free up additional carbon dioxide bound up at the poles or in permafrost year around. Both temperature and pressure have to be increased to the point that liquid water can exist in the open, even if only as seasonal dews.

But in this article, we want to look at the biological part of the equation. Obviously we want to, have to, use genetic material from sundry terrestrial plants (possibly animals too) and arrive at species hardy enough to survive and breed on a rejuvenated Mars.

What we have to start with is, species after species, a long way from being remotely Mars-hardy. The harshest most demanding habitats on Earth are all much friendlier than the friendliest place on Mars, even possibly on the wetter, warmer Mars of yestereon.

**Where do we start? How do we proceed?**

***The most severe habitats on Earth are the deserts, the Andean altiplano of Peru and Bolivia, the tundra of northern Alaska, Canada, Greenland, Scandinavia, and Russia-Siberia, and the Antarctic islands, shores, and "dry valleys."*** No trees grow in these areas, not even the stunted, wind-grotesqued caricatures we find at the tree line on mountain slopes and at the tundra limits. Animals fare better, thriving on seafood, other animals and very lowly plants.

Animals, however, need an oxygen-rich atmosphere, which we don't have, have never had, on Mars. In contrast, ***plants thrive on carbon dioxide - it has been shown that most plants can be grown successfully in an artificial atmosphere of reduced pressure (e.g. 1/10th normal) of just carbon dioxide, the major component of Mars air.***

That is to say, that *plants and crops can be grown on Mars in greenhouses pressurized with warmed Martian atmosphere, simply compressed tenfold - nothing else added, besides water, of course.*

*The “Redhousing Plan” is to gradually lower temperature and pressure to meet the improving Mars climate halfway with bioengineered species that could be planted outdoors either to be tended and cultivated or left to grow wild.*

**We call this redhousing, rather than greenhousing.**

*We will be using the air of the red planet Mars and an improved but still Martian climate* - not the air of Earth nor in an idealized terrestrial climate. But we should have traditional greenhouses on Mars. We do have to eat and clothe ourselves and provide for pharmaceuticals and other needs, - while we are busy in the redhouses preparing to mate a rejuvenated red planet with a blanket of life bred and engineered to go native there.

Will there someday be forests on Mars, with real trees even if they look unearthly. That’s a possibility beyond our vision. *Our starting point will likely be the lichen, a moss-like plant that is basically a fungus able to survive thanks to a symbiotic relationship with green algae.* That this feat is cooperative is discouraging, that we have to start with a very specialized complex - compound creature. The best place to start in any plan to evolve a radiant family of diverse species is with something very generalized, able to survive in a wide range of habitats. We have **many species of lichens** in the northern hemisphere and a few in the southern.

But are lichens the only starting point? Not necessarily. *Many plants handle annual freezing in stride, but the much longer, much deeper freezes of Mars would likely be too much for them. Witness the tree lines here on Earth!* Some Antarctic animal organisms come equipped with an **intracellular antifreeze - glycol**. But plant cells have protoplasm as well.

*If the gene responsible for the ability to produce glycol can be transferred successfully to some plants, that might give us additional breeding stock for Mars.*

*The more starting points, the more diverse the ultimate possibilities, and the more niches on Mars that can be greened.*

But hard long freezes are not the only challenges Mars poses. Severe desiccation is another. Desert plants, like cacti and other “succulents” withstand prolonged very arid stretches well. On Mars the desiccating capacity of the cold parched winds is extremely intense. What the cacti and other desert plants have to offer, will not be enough. But it is a start. Nor is there any reason why the glycol gene cannot be added to the genetic consist of desiccation-hardy plants, and vice versa. Chile’s **Atacama**, California’s **Death Valley**, NW China’s **Takla Maklan** are among the most challenging niches for desert life.

And then there is the **untempered ultraviolet** of the more distant, cooler, Martian “Sun”. Mars tenuous atmosphere without free oxygen (O<sub>2</sub>) or ozone (O<sub>3</sub>) is *transparent to this tissue-killing radiation*. Here on Earth, the most UV-resistant species are those that live at very high altitudes. The nearer to the equator, the higher up the mountain slopes does life thrive. Plants growing wild in various niches of the Peruvian-Bolivian altiplano (high altitude 13,000-15,000 ft. intermountain basin-plateau between the Western and Eastern Cordillera) may yield genetic contributors to this resistance. — a third ingredient.

We must add one more characteristic. *On Earth many plants are pollinated by insects and birds.* Bioengineering animals to breath a carbon dioxide atmosphere seems science-fantastic, not merely science-fictional. So *we may want to end up with plants that are wind-pollinated or use some other assist than the help of sweet air breathing animal species.*



The list of favorable attributes doesn't end here. *We could select also for abrasion resistance to wind-borne dust, low reproductive rates, interruptible life cycles, etc.* What plant forms will be most receptive to such diverse genetic additions? Your guess is as good as mine. It is not impossible that the best Mars-hardy hybrids will have as ancestors plants that boast none of the assets mentioned, but will have proven receptive to all of them.

Nor do we have to wait until we are on Mars to begin the experimenting. *There are so many candidate plants to start with, so many recombinant genetic combinations to be tried.* The sooner we begin, and the more the facilities we set up, the sooner are we likely to have our optimism and enthusiasm rewarded - or discouraged.

On Mars, all we will need is a shelter that holds compressed, warmed Martian air.

*On Earth it will be trickier. Unbuffered, the facility would be subject to inexorable leaks from the higher pressure, vastly more oxygen-sweet air of the host planet: Earth.*

One way we can buffer the facility and prevent hasty degradation of the special atmosphere within, is to use *a surround chamber with either Earth air or Mars air at relatively low pressure.* Air would tend to leak out of the red house chamber, preserving quality, with makeup quantities from special tanks. If pressure gets too high (too close in value to that of the inner chamber) the excess could be pump-exhausted to the outside terrestrial atmosphere.

Or (the "on Earth 3" set up, above) the redhouse could be covered and buffered by water in a host lake or pool or tank. This would also tend to prevent atmospheric contamination. A wet porch could not be used for entry, however, as oxygen dissolved in the water would outgas into the carbon dioxide atmosphere within, polluting it.

### **An Art of the Possible**

The strategy is one of convergence, *breeding ever more cold-, drought-, and UV- hardy species for ever more Mars-like conditions in Mars redhouses.*

Meanwhile, outside (on Mars) the actual Mars climate is improved by human activity and intervention. In fact, the degree to which these experiments are successful, will codetermine the goals set for "rejuvenaissance" of the planet. Like politics, *the greening of Mars will unfold as the art of the possible.*

As politics should be (but isn't) it will also be the art of "co"-promise, not "compromise" ✓ what can be achieved in improving the climate, temperature, pressure, and wetness of the planet, and ✓ what can be achieved by recombinant DNA biological engineering and breeding for Mars-hardiness. We can only speculate at the results.

### **Now wait a minute! Plants do not live by atmospheric gasses and water alone!**

Or (the "on Earth 3" set up, above) the redhouse could be covered and buffered by water in a host lake or pool or tank. This would also tend to prevent atmospheric contamination. A wet porch could not be used for entry, however, as oxygen dissolved in the water would outgas into the carbon dioxide atmosphere within, polluting it.

Plants need water, and on the Mars of today, although there is water ice caps at both poles, is otherwise dry, very dry. So we might want to start transplanting our evolved plants along the edges of the polar water-ice caps, as soon as the carbon dioxide ice layers have sublimated, and before that CO<sub>2</sub> starts to freeze out. But that gives us a very short window, so we may have to test our evolved plants elsewhere, indoors, in a facility where there is ice at a temperature just slightly above freezing.

## The Redhousing Project Goals

(Taking plants and gradually evolving them to the point that they can grow on Mars (instead of importing them from Earth))

- 1) **FOOD PLANTS:** vegetables, grains, tubers, grasses
- 2) **WILD FLOWERS and WILD GRASSES** that can survive and spread on Mars
- 3) **BAMBOO:** Bamboos are perennial grasses that produce woody, hollow stems. There are approximately 100 species of commercially available bamboo, ranging from *knee-high dwarf species* to giant varieties with stems the height of large trees. Many bamboos are tropical, but some are cold hardy.

**Rufa bamboo** (*Fargesia dracocephala* "Rufa") can survive winters in USDA zones 5 to 9.

See map <https://www.seedsnow.com/pages/grow-zone-map-new>

<http://www.bamboogarden.com/Fargesia%20sp.%20%27Rufa%27.htm>

Maximum Height: 10' (avg. 7'), Cane Diameter: ½", Hardiness: -15° F

### Other Bamboo Products:

<https://www.bamboogrove.com/bamboo-products.html>

- Charcoal, Alcohol, Paint brushes
- Sugar (**sugar cane**), Deodorizers, Beer, Beehives, Bamboo Viagra
- Turbine Blades, Umbrellas, Bicycles
- **Bamboo Paper, Bamboo Fabrics**
- **Clothing & Bed Sheets & other Fabrics**
- **Bamboo, Bamboo Paper, Bamboo Fabrics, Bamboo Blinds**
- **Flooring & Panelling & Cutting Boards**
- **Bamboo Furniture,**

Explore samples of these Bamboo Products - all useful on Mars!

*- a big cut in product imports from Earth or from the Moon*

- Google "Bamboo Panelling"
- Google "Bamboo Flooring"
- Google "Bamboo Fabrics" (unbelievable!)(You can buy samples from this site)
- Google "Bamboo Furniture"

-----

Note: If these "Redhousing" projects will do better where Mars atmosphere is thicker (or thickest) - then the North West corner of Hellas Planetia (the largest impact basin on Mars) will be a good place to start.

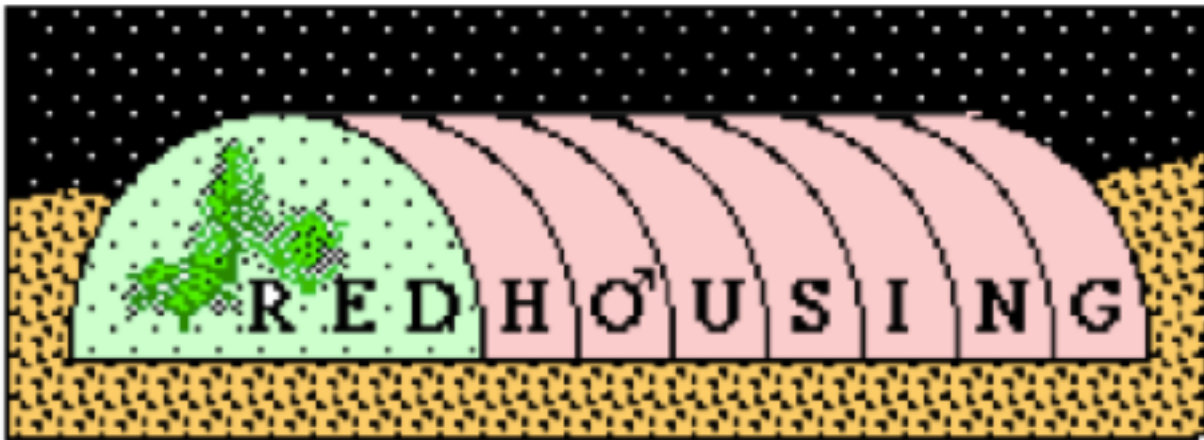
Another option would be on the "floor" of Mars' vast, miles long, Valles Marineris more than 4,000 km (2,500 mi) long, 200 km (120 mi) wide and up to 7 km (23,000 ft) deep and about 14° south of Mars' equator.

-----

**Add these to the vast range of Basalt Products also "made on Mars" - and the list (and tonnage) of things that Mars Settlements will need to import from Earth are cut drastically.**

And as with the suggestion for where to mine basalt on Mars, equatorial or near-equatorial sites will be best for "climate conditions."

*On to the Redhousing Project ....*



(“Greenhouses” for Earth, “Redhouses” for Mars, the red planet)

### **Breeding “Mars Hardy” Plants in Compressed Mars Air**

**Question 1:** *What kinds of life forms may have had time to evolve on Mars before irreversible climactic decay, and could any fossil traces still endure?*

**Question 2:** *Could some anemic relic of a once far richer Martian Biosphere still subsist in “oases” here and there?*

We concluded with a discussion of the implications for Martian settlement dreams, pointing out that the Romanticists who hope against hope that we will find some primitive (at least!) life forms still extant life on Mars, had better hope that they are wrong. It is incomprehensibly naive to think that should we find life on Mars of any sort, that the political / rabbleocracy powers-that-be would allow humans (us!) to settle there. The Fourth Planet would forthwith be declared a quarantined biological preserve for the rest of time. “Humans and all Earth Life keep out!” We could hardly disagree more with the sentiments expressed by editor Jeff Liss in the recent issue of Inside NSS. He had called “disappointing” the recent finding that the Viking “No-Life-On-Mars” experiment results were not flawed after all.

If all we find are fossil relics and perhaps a few incomplete strands of DNA (we should rejoice at finding that much!) Jurassic Park type reconstructions of native life form populations are most unlikely. If an ecosystem does survive, we could not hope to see any significant further evolution (beyond anecdotal differentational radiation of surviving species into new niches in a restored or rejuvenated more benign climate) within the lifetime of humanity, even if it be a million years - and not even if we succeeded in restoring, permanently, the former more life-accommodating climate with a stabilized all-Martian biosphere and biota. Romantic ideas to the contrary should not be entertained. We would be left with only pre-metazoan life, one-celled plants and animals - nothing we could see with the naked eye!

***Rejoice that Mars is empty of life! But Mars is not “barren,” rather it is “virginal.”***

That is not the end of the story. That Mars has no life, and quite possibly never spawned life even in earlier wetter and warmer times does not make the planet “barren”. It only makes the planet “virginal”. That conditions may have never been special to allow life to rise on its own, does not mean that life, originated elsewhere, and then bioengineered to fit Martian conditions, could not be successfully transplanted to Martian soil, with intelligent guidance, corrections, and

compensations. That is a tall challenge, however, but we hope to sketch how it might be accomplished. Or at least, the first steps one intending to green the planet might take.

The biological side of Greening Mars would have to be brought about “*pari passu*” i.e. step by step together with the geological rejuvenaissance of the planet. Rather than “terraforming” Mars by making it a copy of Earth, rejuvenaissance looks not at Earth, but the early Mars itself, for its standard of achievement. The planet does need to be warmed, first to the point where a third of the atmosphere no longer freezes out over the poles each winter (twice a Martian year, during northern and southern winters, i.e. paradoxically during southern and northern summers, i.e. atmospheric pressure is at its height only during spring alias fall). Warming it still further will free up additional carbon dioxide bound up at the poles or in permafrost year around. Both temperature and pressure have to be increased to the point that liquid water can exist in the open, even if only as seasonal dews.

But in this article, we want to look at the biological part of the equation. Obviously we want to, have to, use genetic material from sundry terrestrial plants (possibly animals too) and arrive at species hardy enough to survive and breed on a rejuvenated Mars.

What we have to start with is, species after species, a long way from being remotely Mars-hardy. The harshest most demanding habitats on Earth are all much friendlier than the friendliest place on Mars, even possibly on the wetter, warmer Mars of yestereon.

#### **Where do we start? How do we proceed?**

*The most severe habitats on Earth are the deserts, the Andean altiplano of Peru and Bolivia, the tundra of northern Alaska, Canada, Greenland, Scandinavia, and Russia-Siberia, and the Antarctic islands, shores, and “dry valleys.”* No trees grow in these areas, not even the stunted, wind-grotesqued caricatures we find at the tree line on mountain slopes and at the tundra limits. Animals fare better, thriving on seafood, other animals and very lowly plants.

Animals, however, need an oxygen-rich atmosphere, which we don’t have, have never had, on Mars. In contrast, *plants thrive on carbon dioxide - it has been shown that most plants can be grown successfully in an artificial atmosphere of reduced pressure (e.g. 1/10th normal) of just carbon dioxide, the major component of Mars air.*

*Plants and crops can be grown on Mars in greenhouses pressurized with warmed Martian atmosphere, simply compressed tenfold - nothing else added, besides water, of course.*

*The “Redhousing Plan” is to gradually lower temperature and pressure to meet the improving Mars climate halfway with bioengineered species that could be planted outdoors either to be tended and cultivated or left to grow wild.*

**We call this redhousing, rather than greenhousing. We will be using the air of the red planet Mars and an improved but still Martian climate** - not the air of Earth and an idealized terrestrial climate. This is not to say we shouldn’t have traditional greenhouses on Mars. We do have to eat and clothe ourselves and provide for pharmaceuticals and other needs, day in and day out - while we are busy in the redhouses preparing to mate a rejuvenated red planet with a blanket of life bred and engineered to go native there.

Will there someday be forests on Mars, with real trees even if they look unearthly. That’s a possibility beyond our vision. *Our starting point will likely be the lichen, a moss-like plant that is basically a fungus able to survive thanks to a symbiotic relationship with green algae.* That this feat is cooperative is discouraging, that we have to start with a very specialized complex - compound creature. The best place to start in any plan to evolve a radiant family of diverse species is with something very generalized, able to survive in a wide range of habitats.

Thankfully, we have **many species of lichens** in the northern hemisphere and a few in the southern. But are lichens the only starting point? Not necessarily. *Many plants handle annual freezing in stride, but the much longer, much deeper freezes of Mars would likely be too much for them. Witness the tree lines here on Earth!*

Some Antarctic organisms in the animal kingdom, come equipped with **an intracellular antifreeze - glycol**. But plant cells have protoplasm as well.

*If the gene responsible for the ability to produce glycol can be transferred successfully to some plants, that might give us additional breeding stock for Mars.*

*The more starting points, the more diverse the ultimate possibilities, and the more niches on Mars that can be greened.*

But hard long freezes are not the only challenges Mars poses. Severe desiccation is another. Desert plants, like cacti and other “succulents” withstand prolonged very arid stretches well. On Mars the desiccating capacity of the cold parched winds is extremely intense. What the cacti and other desert plants have to offer, will not be enough. But it is a start. Nor is there any reason why the glycol gene cannot be added to the genetic consist of desiccation-hardy plants, and vice versa. Chile’s **Atacama**, California’s **Death Valley**, NW China’s **Takla Maklan** are among the most challenging niches for desert life.

And then there is the **untempered ultraviolet** of the more distant, cooler, Martian “Sun”. Mars tenuous atmosphere without free oxygen (O<sub>2</sub>) or ozone (O<sub>3</sub>) is *transparent to this tissue-killing radiation*. Here on Earth, the most UV-resistant species are those that live at very high altitudes. The nearer to the equator, the higher up the mountain slopes does life thrive. Plants growing wild in various niches of the Peruvian-Bolivian altiplano (high altitude 13,000-15,000 ft. intermountain basin-plateau between the Western and Eastern Cordillera) may yield genetic contributors to this resistance. — a third ingredient.

We must add one more characteristic. *On Earth many plants are pollinated by insects and birds*. Bioengineering animals to breath a carbon dioxide atmosphere seems science-fantastic, not merely science-fictional. So *we may want to end up with plants that are wind-pollinated or use some other assist than the help of sweet air breathing animal species*.

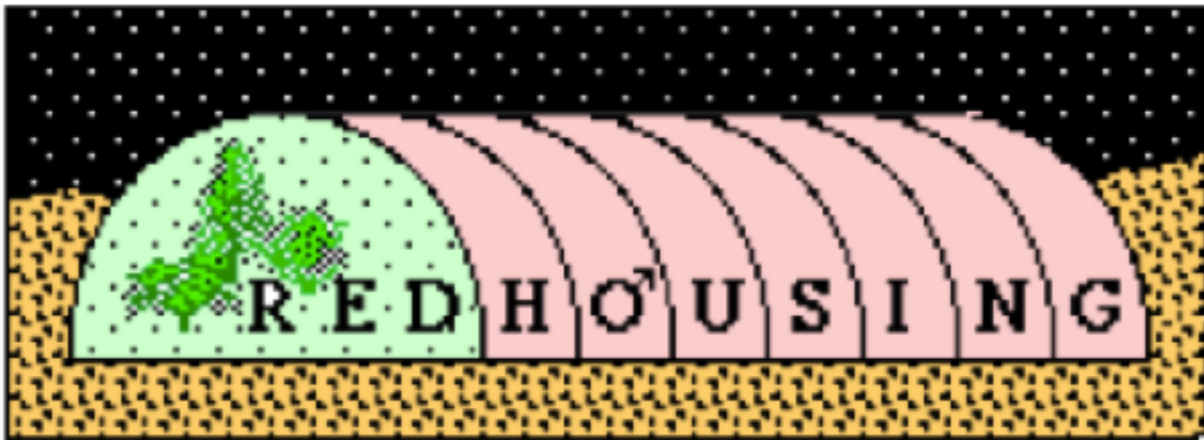
The list of favorable attributes doesn’t end here. *We could select also for abrasion resistance to wind-borne dust, low reproductive rates, interruptible life cycles, etc.* What plant forms will be most receptive to such diverse genetic additions? Your guess is as good as mine. It is not impossible that the best Mars-hardy hybrids will have as ancestors plants that boast none of the assets mentioned, but will have proven receptive to all of them.

Nor do we have to wait until we are on Mars to begin the experimenting. *There are so many candidate plants to start with, so many recombinant genetic combinations to be tried.* The sooner we begin, and the more the facilities we set up, the sooner are we likely to have our optimism and enthusiasm rewarded - or discouraged.

On Mars, all we will need is a shelter that holds compressed, warmed Martian air.

*On Earth it will be a bit trickier. Unbuffered, the facility would be subject to inexorable leaks from the higher pressure, vastly more oxygen-sweet air of the host planet: Earth.*

One way we can buffer the facility and prevent hasty degradation of the special atmosphere within, is to use *a surround chamber with either Earth air or Mars air at relatively low pressure*. Air would tend to leak out of the red house chamber, preserving quality, with makeup quantities from special tanks. If pressure in the surround got too high the excess could be pump-exhausted to the outside terrestrial atmosphere.



**Question 1:** *What kinds of life forms may have had time to evolve on Mars before irreversible climactic decay, and could any fossil traces still endure?*

**Question 2:** *Could some anemic relic of a once far richer Martian Biosphere still subsist in “oases” here and there?*

We concluded with a discussion of the implications for Martian settlement dreams, pointing out that the Romanticists who hope against hope that we will find some primitive (at least!) life forms still extant life on Mars, had better hope that they are wrong. It is incomprehensibly naive to think that should we find life on Mars of any sort, that the political / rabbleocracy powers-that-be would allow humans (us!) to settle there. The Fourth Planet would forthwith be declared a quarantined biological preserve for the rest of time. “Humans and all Earth Life keep out!” We could hardly disagree more with the sentiments expressed by editor Jeff Liss in the recent issue of Inside NSS. He had called “disappointing” the recent finding that the Viking “No-Life-On-Mars” experiment results were not flawed after all.

If all we find are fossil relics and perhaps a few incomplete strands of DNA (we should rejoice at finding that much!) Jurassic Park type reconstructions of native life form populations are most unlikely.

If an ecosystem does survive, we could not hope to see any significant further evolution (beyond anecdotal differentational radiation of surviving species into new niches in a restored or rejuvenated more benign climate) within the lifetime of humanity, even if it be a million years - and not even if we succeeded in restoring, permanently, the former more life-accommodating climate with a stabilized all-Martian biosphere and biota. Romantic ideas to the contrary should not be entertained. We would be left with only pre-metazoan life, one-celled plants and animals - nothing we could see with the naked eye!

***So rather rejoice that Mars is empty of life!***

***It is not precise to say that Mars is “barren.” Only that it is “virginal.”***

That is not the end of the story. That Mars has no life, and quite possibly never spawned life even in earlier wetter and warmer times does not make the planet “barren”. It only makes the planet “virginal”. That conditions may have never been special to allow life to rise on its own, does not mean that life, originated elsewhere, and then bioengineered to fit Martian conditions, could not be successfully transplanted to Martian soil, with intelligent guidance, corrections, and compensations. That is a tall challenge, however, but we hope to sketch how it might be accomplished. Or at least, the first steps one intending to green the planet might take.

The biological side of Greening Mars would have to be brought about “pari passu” i.e. step by step together with the geological rejuvenaissance of the planet. Rather than “terraforming” Mars by making it a copy of Earth, rejuvenaissance looks not at Earth, but the early Mars itself, for its standard of achievement. The planet does need to be warmed, first to the point where a third of the atmosphere no longer freezes out over the poles each winter (twice a Martian year, during northern and southern winters, i.e. paradoxically during southern and northern summers, i.e. atmospheric pressure is at its height only during spring alias fall). Warming it still further will free up additional carbon dioxide bound up at the poles or in permafrost year around. Both temperature and pressure have to be increased to the point that liquid water can exist in the open, even if only as seasonal dew.

But in this article, we want to look at the biological part of the equation. Obviously we want to, have to, use genetic material from sundry terrestrial plants (possibly animals too) and arrive at species hardy enough to survive and breed on a rejuvenated Mars.

What we have to start with is, species after species, a long way from being remotely Mars-hardy. The harshest most demanding habitats on Earth are all much friendlier than the friendliest place on Mars, even possibly on the wetter, warmer Mars of yestereon.

### **Where do we start? How do we proceed?**

*The most severe habitats on Earth are the deserts, the Andean altiplano of Peru and Bolivia, the tundra of northern Alaska, Canada, Greenland, Scandinavia, and Russia-Siberia, and the Antarctic islands, shores, and “dry valleys.”* No trees grow in these areas, not even the stunted, wind-grotesqued caricatures we find at the tree line on mountain slopes and at the tundra limits. Animals fare better, thriving on seafood, other animals and very lowly plants.

Animals, however, need an oxygen-rich atmosphere, which we don’t have, have never had, on Mars. In contrast, *plants thrive on carbon dioxide - it has been shown that most plants can be grown successfully in an artificial atmosphere of reduced pressure (e.g. 1/10th normal) of just carbon dioxide, the major component of Mars air.*

That is to say, that *plants and crops can be grown on Mars in greenhouses pressurized with warmed Martian atmosphere, simply compressed tenfold - nothing else added, besides water, of course.*

*The “Redhousing Plan” is to gradually lower temperature and pressure to meet the improving Mars climate halfway with bioengineered species that could be planted outdoors either to be tended and cultivated or left to grow wild.*

**We call this redhousing, rather than greenhousing.**

*We will be using the air of the red planet Mars and an improved but still Martian climate* - not the air of Earth and an idealized terrestrial climate. This is not to say we shouldn’t have traditional greenhouses on Mars. We do have to eat and clothe ourselves and provide for pharmaceuticals and other needs, day in and day out - while we are busy in the redhouses preparing to mate a rejuvenated red planet with a blanket of life bred and engineered to go native there.

Will there someday be forests on Mars, with real trees even if they look unearthly. That’s a possibility beyond our vision. *Our starting point will likely be the lichen, a moss-like plant that is basically a fungus able to survive thanks to a symbiotic relationship with green algae.* That this feat is cooperative is discouraging, that we have to start with a very specialized complex - compound creature. The best place to start in any plan to evolve a radiant family of diverse species is with something very generalized, able to survive in a wide range of habitats.

But thankfully, we have **many species of lichens** in the northern hemisphere and a few in the southern.

But are lichens the only starting point? Not necessarily. *Many plants handle annual freezing in stride, but the much longer, much deeper freezes of Mars would likely be too much for them. Witness the tree lines here on Earth!*

Some Antarctic organisms in the animal kingdom, come equipped with **an intracellular antifreeze - glycol**. But plant cells have protoplasm as well.

*If the gene responsible for the ability to produce glycol can be transferred successfully to some plants, that might give us additional breeding stock for Mars.*

*The more starting points, the more diverse the ultimate possibilities, and the more niches on Mars that can be greened.*

But hard long freezes are not the only challenges Mars poses. Severe desiccation is another. Desert plants, like cacti and other “succulents” withstand prolonged very arid stretches well. On Mars the desiccating capacity of the cold parched winds is extremely intense. What the cacti and other desert plants have to offer, will not be enough. But it is a start. Nor is there any reason why the glycol gene cannot be added to the genetic consist of desiccation-hardy plants, and vice versa. Chile’s **Atacama**, California’s **Death Valley**, NW China’s **Takla Maklan** are among the most challenging niches for desert life.

And then there is the **untempered ultraviolet** of the more distant, cooler, Martian “Sun”. Mars tenuous atmosphere without free oxygen (O<sub>2</sub>) or ozone (O<sub>3</sub>) is *transparent to this tissue-killing radiation*. Here on Earth, the most UV-resistant species are those that live at very high altitudes. The nearer to the equator, the higher up the mountain slopes does life thrive. Plants growing wild in various niches of the Peruvian-Bolivian altiplano (high altitude 13,000-15,000 ft. intermountain basin-plateau between the Western and Eastern Cordillera) may yield genetic contributors to this resistance. — a third ingredient.

We must add one more characteristic. *On Earth many plants are pollinated by insects and birds*. Bioengineering animals to breath a carbon dioxide atmosphere seems science-fantastic, not merely science-fictional. So *we may want to end up with plants that are wind-pollinated or use some other assist than the help of sweet air breathing animal species*.

The list of favorable attributes doesn’t end here. *We could select also for abrasion resistance to wind-borne dust, low reproductive rates, interruptible life cycles, etc.* What plant forms will be most receptive to such diverse genetic additions? Your guess is as good as mine. It is not impossible that the best Mars-hardy hybrids will have as ancestors plants that boast none of the assets mentioned, but will have proven receptive to all of them.

Nor do we have to wait until we are on Mars to begin the experimenting. *There are so many candidate plants to start with, so many recombinant genetic combinations to be tried.* The sooner we begin, and the more the facilities we set up, the sooner are we likely to have our optimism and enthusiasm rewarded - or discouraged.

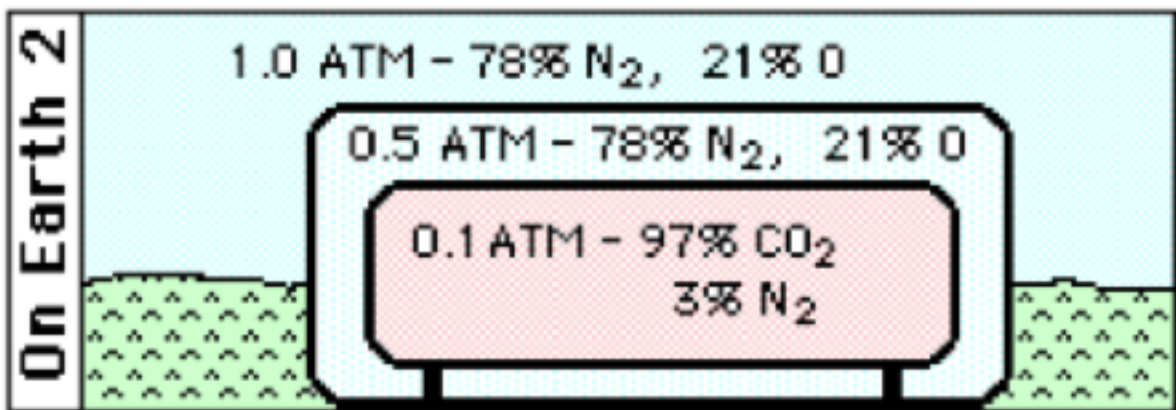
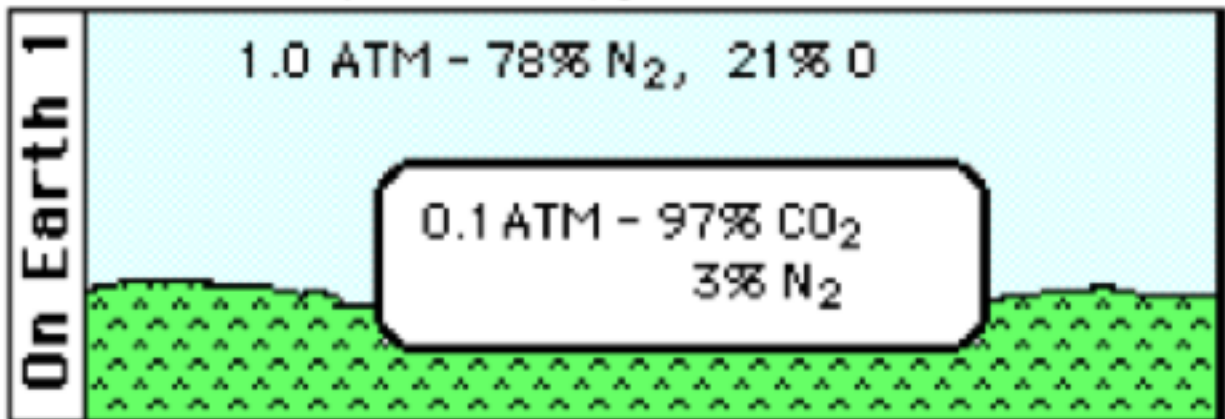
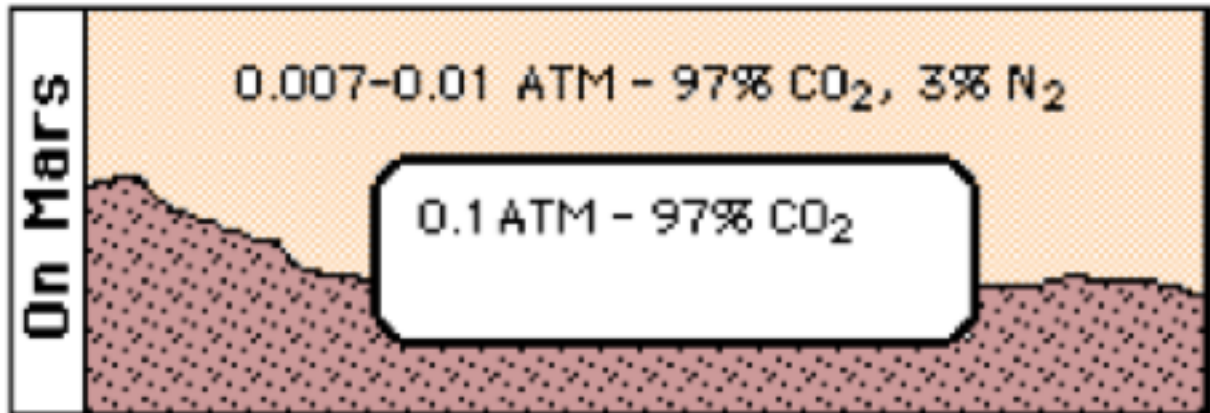
On Mars, all we will need is a shelter that holds compressed, warmed Martian air.

*On Earth it will be trickier. Unbuffered, the facility would be subject to inexorable leaks from the higher pressure, vastly more oxygen-sweet air of the host planet: Earth.*

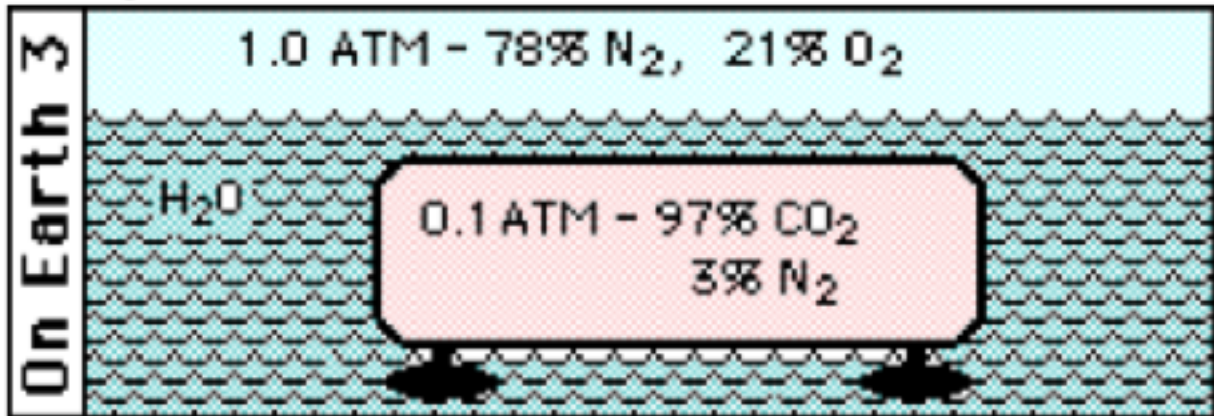
One way we can buffer the facility and prevent hasty degradation of the special atmosphere within, is to use *a surround chamber with either Earth air or Mars air at relatively low pressure*. Air would tend to leak out of the red house chamber, preserving quality, with makeup quantities from special tanks. If pressure in the surround got too high (too close in value



to that of the inner chamber) the excess could be pump-exhausted to the outside terrestrial atmosphere.



Or (the “on Earth 3” set up, above) the redhouse could be covered and buffered by water in a host lake or pool or tank. This would also tend to prevent atmospheric contamination. A wet porch could not be used for entry, however, as oxygen dissolved in the water would outgas into the carbon dioxide atmosphere within, polluting it.



### An Art of the Possible

The strategy is one of convergence, *breeding ever more cold-, drought-, and UV- hardy species for ever more Mars-like conditions in Mars redhouses.*

Meanwhile, outside (on Mars) the actual Mars climate is improved by human activity and intervention. In fact, the degree to which these experiments are successful, will codetermine the goals set for “rejuvenaissance” of the planet. Like politics, *the greening of Mars will unfold as the art of the possible.*

As politics should be (but isn't) it will also be the art of “**co**”-promise, not “compromise” √ what can be achieved in improving the climate, temperature, pressure, and wetness of the planet, and √ what can be achieved by recombinant DNA biological engineering and breeding for Mars-hardiness. We can only speculate at the results.

### Now wait a minute! Plants do not live by atmospheric gasses and water alone!

It will not be enough to take plants that we will want to have on the Moon that have been bred to survive in Mars atmosphere and its “thinness” compared to Earth’s atmosphere. Mars’ “soils” will be low in “nutrients” needed for plants to feed on. Mars’ “soils” are likely to be “poor” - to say the least - in Nitrogen, Phosphorus, and Potassium - needed for plant growth.

We will need **fertilizers**, “any material of natural or synthetic origin that is applied to soils or to plant tissues to supply one or more plant nutrients essential to the growth of plants.”

Typically, fertilizers are composed of **nitrogen**, **phosphorus**, and **potassium** compounds. They also contain trace elements that improve the growth of plants. The primary components in fertilizers are **nutrients** which are vital for plant growth. Plants use **nitrogen** in the synthesis of proteins, nucleic acids, and hormones. So our pioneers on Mars will need fertilizers, chemical or natural substances added to soil to increase its fertility.

While these substances can be shipped to Mars free as **insulation** on ships bound for Mars, we will need shortcuts to produce a useful product from ship crew and passenger feces, as well as settlers (and any animals they brought along (pets, milk and meat producing animals, fish etc.) and from those already on Mars. (Moon Settlers will have had to do likewise)

### Sneaking in “fertilizers” to Mars as

- 1) packaging, or package stuffing (Settlers on the Moon will have had to do likewise)
- 2) Dry manure in sealed bags as insulation on incoming passenger and freight space ships
- 3) Human dung processed on location ##

## Types of Edible Plants

[<https://www.betterhealth.vic.gov.au/health/healthyliving/fruit-and-vegetables>]

### √ Fruit:

- Apples and pears
- Citrus – oranges, grapefruits, mandarins and limes
- Stone fruit – nectarines, apricots, peaches and plums
- Tropical and exotic – bananas and mangoes
- Berries – strawberries, raspberries, blueberries, kiwifruit and passionfruit
- Melons – watermelons, rockmelons and honeydew melons
- Tomatoes and avocados.

### √ Vegetables:

- Leafy green – lettuce, spinach and silverbeet
- Cruciferous – cabbage, cauliflower, Brussels sprouts and broccoli
- Marrow – pumpkin, cucumber and zucchini
- Root – potato, sweet potato and yam
- Edible plant stem – celery and asparagus
- Allium – onion, garlic and shallot.

√ **Legumes:** Legumes or pulses contain nutrients that are especially valuable. Legumes need to be cooked before they are eaten – this improves their nutritional quality, aids digestion and eliminates any harmful toxins. Legumes come in many forms including:

- Soy products – tofu (bean curd) and soybeans
- Legume flours – chickpea flour (besan), lentil flour and soy flour
- Dried beans and peas – haricot beans, red kidney beans, chickpeas and lentils  
Green peas, green beans, butter beans, broad beans and snow peas. Asparagus

## And the most useful Redhousing Produce by far: Bamboo

**Why Bamboo?** √ *fast growing*, √ *lightweight*, √ *many many many uses*)

<https://www.bamboogrove.com/bamboo-products.html>

- *Charcoal, Alcohol, Paint brushes, Sugar (sugar cane), Deodorizers, Beer, Beehives*
- **Bicycles, Blinds, Paper**
- **Clothing & Bed Sheets & other Fabrics**
- **Flooring & Panelling & Cutting Boards**
- **Turbine Blades, Record player needles, Umbrellas**
- Roofing
- **Bamboo Viagra**

**And, if settlers are successful in growing bamboo,  
perhaps the most useful of all: Bamboo Furniture**

## BAMBOO FURNITURE for Settlers on Mars



05

Here on Earth, Bamboo furniture, with its casual look, is a common choice for vacation homes, as well as for patios, etc.

**For more images, simply Google “Bamboo Furniture”**

and browse through the many photos

*Bamboo Furniture will be an option for Mars Settlers through the Redhousing Project* by which we can learn in advance how settlers might grow bamboo (as well as other plants), *outdoors on Mars.*

**Other Furniture options for Mars Settlers**

(anything available to Moon Settlers should work on Mars as well)

✓ *Cast and Carved Basalt items* ✓ *Basalt Fiber items*

**There are many bamboo fabrics also!**

*Bamboo Fabrics will be an option for ✓ clothes, ✓ bedding, and other uses, in addition to basalt fiber products.*

Google “Bamboo Fabrics - images”

**The Goal? Fewer costly imports from Earth**

*Any and all items that can be manufactured (or grown) on Mars*

*✓ is a step towards Mars Settler “self-reliance” ##*

*Note: it should be easy to create showroom exhibits of the interior of Martian homes*

*And bamboo furniture and other bamboo products could well be a trade item in exchange for products made on the Moon, shipped to Mars at far less cost than equivalent items shipped from Earth’s deep gravity well. ##*



**Above:** Green houses covering hundreds of acres, outside St. Petersburg, Russia which I visited in 1981, when the city was still “Leningrad.” “Xities” on Mars (and perhaps also on the Moon) may have something similar.

## **An Art of the Possible**

*Lunar and Martian settlers have much to gain by working together.*

*But this works best if we “do the Moon first!”* ##

The strategy is one of convergence, breeding ever more cold-, drought-, and UV-hardy species for ever more Mars-like conditions in Mars “redhouses.” Meanwhile, outside the actual Mars climate is hopefully being improved by human activity and intervention. In fact, the degree to which these experiments are successful, will codetermine the goals set for rejuvenance of the planet.

Like politics, *the greening of Mars will unfold as “the art of the possible.”* As politics should be (but isn’t) it will also be **the art of “co-promise,”** not “~~compromise~~” - that is, what can be achieved **A**) in improving the climate, temperature, pressure, and wetness of the planet - and what can be achieved **B**) by recombinant DNA biological engineering and breeding for Mars-hardiness. We can only speculate at the results.

### **The Role of Intervention**

On Earth, and most likely on all life-bearing planets, evolution has not been smooth. Each outburst of new species origination slows into a self-stabilizing rut, impeding further progress. **It is the periodic decimation of existing species by comet and asteroid impacts that has cleared the way for new evolutionary growth.** The future of redhousing will include man-made catastrophes to severely purge prematurely stabilizing indoor ecosystems and clear the way for new rounds of the game of survival of the most (man-determined) fittest.

### **Redhousing and the Plan for Mars**

As progress allows us to preview the eventual results, we will know better **what areas of Mars to set aside as future areozoic parks and preserves.** ✓ **Low-elevation basins and canyons** will have the highest atmospheric pressure, the warmest temperatures (latitude for latitude) and be the first to experience dews and eventually free standing and/or flowing open water. The Mars Orbital Laser Altimeter aboard the Mars Global Surveyor (November ‘96 launch, September ‘97 arrival) gave us a good idea of where these oases-to-be are located. We will then even be able to speculate about setting aside right-of-ways for future parkways.

### **Redhousing in the Grand Design of Things**

To return to the point we made at the outset, *“if Mars is devoid of life, that makes it a virgin world, not a barren one.”* *The cosmic vocation of humanity*, unsuspected by all the world’s pretentious scriptural traditions, *may indeed be to bring life to places where it can survive, but never originate on its own.*

Only an intelligent species can do this. *Humanity then becomes “the” reproductive organ of Gaia* (the name of Earth-Life in aggregate, not as some mythic meta-individual).

Further, through interstellar flight, even if it only be of ships bearing nothing more than seeds, spores, and fertilized eggs, this particular human vocation takes on a more general Cosmic significance, in the Solar neighborhood (probe-reachable limits to be determined!) beyond this nursery womb-world nano-turf we call Earth. ##

***Be a Doer, not a Watcher.***

*The watcher is likely to be disappointed. The doer has the comfort of knowing that he has tried, and perhaps laid foundations, for others who follow, and may reach the goal. ##*

***Make a Mars “Redhouse”*** • with controls, entry safeguards etc., • as a chapter or school project  
• for public display, including at ISDCs.

=====

***NOTICE:*** *As of this issue, Outbound will also serve as the newsletter of both the **Milwaukee Lunar Reclamation Society** NSS chapter and of the **Milwaukee Mars Reclamation Society Outpost** (free membership to any member of the Mars Society.)*

*Both groups meet conjointly the 2<sup>nd</sup> Saturday of the month, 1 pm at Mayfair Mall in Wauwatosa. Except July and August when there will be no meetings, but a possible “outing.”*