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**Till the Ductile Anchor hold:
Towards space settlements in the 21st Century**

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Humans are restless explorers. For 99% of humanity's time on Earth, we have been nomadic wanderers, not farmers, warriors, factory workers, developers, or NASA employees.

Only recently--for only a few thousand years--have most humans been tied to the land as many are now. But as more and more of us live in information societies and some indeed in dream societies where our identity derives from the knowledge we share and the image we project, and not from the property we own or the manual work we do, the time may be coming when we should break free from the land, and roam once again.

But beware: the reality of Man and Woman the Explorer has a very dark side as well. Many people where I live view the recent experience of Man on the Move as a history of theft, murder, racism, exploitation, and genocide.

So we need to be very careful if we say that space exploration is only natural for humans, since the experience has not been very uplifting and noble for most recipients of the exploring of others.

But such warnings are not new. Humans have been alerting each other to the dangers of change and novelty from the very beginning:

Who and what is this?



Yes, Icarus. Icarus who, with his father, Daedalus, fashioned themselves wings so that they could fly like the birds, something they were totally unable to do with their wingless, flightless natural bodies. So they first imagined flight, and then developed the technologies that would enable it. As you know, Icarus also received a warning from his father before he took off:

According to Ovid, Daedalus said:

*“My Icarus, I vow thee fly
Always the middle track; nor low, nor high;
If low, thy plumes may flag with ocean’s spray
If high, the sun may dart his fiery ray.”*

So there you have one of the very first examples of a technology risk assessment.

But Icarus, being a typical son--and a typical human--disregarded his father’s warning. He did fly. But then he sailed too close to the sun which melted the wax on his wings and cast Icarus to his death in the ocean below.

The daring and hubris of Icarus has been a very popular theme in Western art and literature, warning us of the eternal tension between what we want to do and then can do because we develop *technological* capabilities, on the one hand, in contrast with what we ought to do, given our *ethical* limitations and frailties, on the other.

There have been scores of paintings about Icarus from early Greece down to 20th century artists. Without a doubt the most famous painting about the Fall of Icarus was by Pieter Bruegel (or one of his sons). I am sure you have seen it:



But wait. Is this a picture of the fall of Icarus, or about early contour plowing and shepherding. Where is Icarus in this painting?

That is what makes it such a great work of art. Icarus is barely visible. This whole great human tragedy just doesn’t seem to matter at all.

But there he is--down in the right hand corner of the picture--only his feet and legs showing as he splashes into the briny deep. Puny humans defeated by preening pride and technological over-reach.

This painting has inspired scores of poems as well. Probably the best known in English is by W. H. Auden. But I am going to read one by a much less well-known poet, but a poem I find to be more fitting for a high tech bunch of guys like you. It is by Ronald Bottrall who is a British poet who actually was a contemporary of Auden:

**In his father's face flying
 He soared until the cities of the Aegean
 Opened like blood vessels lying
 Under a microscope. End on
 He saw below the trunks of trees
 While space-time flowered in his sunward eyes.
 His feathered arms, extension
 Of nimble thoughts, pride of invention,
 Were lifting him high above man.
 "And if I fly,"
 He said, "to the source of mortal energy
 I shall capture the receipt
 To administer light and heat."
 But sunlight to all eyes is not bearable
 Or sunheat to all blood.
 His motion turned to Earth, unable
 To sustain its presumptuous mood.
 Falling he saw the cantilevered birds,
 Their great humerus muscles bearing
 Them in their spacious veering
 Over shores and sherds
 Over swords and words.
 Like a detached leaf, feeble
 In the wind, he fell,
 A multitude of molecules
 Organized in equal and parallel
 Velocities (according to the rules
 Of motion) to seek the ground.
 And on the slope above the sea
 The hard-handed peasants go their round
 Turning the soil, blind to the body
 Ambitious and viable, whose pride
 Will leave no trace in the quenching tide.**

So far, I have given only Western examples.

But every culture has its own stories about space flight and exploration. The other culture I know best is Japan, and there are various examples there.

One of the best known stories that came to Japan from China and Korea is currently recalled during the *Tanabata* festival. It is held on the seventh night of the seventh month during the annual meeting of the stars Vega (or *Orihime*, the seamstress, in Japanese) and Altair (or *Hikoboshi*, the Ox-Herder) two stars that, for the rest of the year, are separated by the Milky Way (or *Amanogawa*) and only allowed to be together once a year for a brief time.

The reasons vary as to why the two lovers--and stars--are separated and allowed to meet each other only briefly for once a year, but they are all based on plots that have humans being punished for doing what they *want* to do rather than doing what they know they *ought* to do, very much like Icarus.

Interestingly enough, the Japanese space agency, then known as NASDA, named a pair of Japanese satellites *Orihime* and *Hikoboshi*. The two were launched together as ETS7 (Kiku 7) and separated before coming together again in 1999. It was the first time such docking had ever been done automatically. There were problems with the attitude control system when the maneuver was repeated, but the two star-crossed lover satellites did finally successfully rendezvous again.

One of the oldest and best known Japanese stories is about *Kaguya Hime*, a maiden who it turns out was born on the moon, came to live on Earth for a while, and returned to the moon in splendor.

A final example is the well-known Japanese folk tale about Momotaro--the Peach Boy. It features a baby who is discovered in a huge peach (momo) when it is cut open. The man and his wife nurture the baby to adulthood. Momotaro then rights various wrongs on Earth and eventually sails off to a land far away.

It is a kind of Christ story, or superman story, or as some interpret it now, a story about ET. Or it may just be a story.

There are many more such stories in all cultures. Both the desire to go to space and the dangers implicit in that desire are part of every culture on Earth.

But many things had to happen before that feat became possible. For one thing, more compelling stories, such as those of Jules Verne and H. G. Wells, had to be written showing that, just as humans had discovered unknown worlds on Earth, so now it was possible to imagine and discover--or to create--new worlds in space.

No one was more visionary in that regard than the Russian, Konstantin Tsiolkovsky.

Tsiolkovsky had everything it took to be a visionary: Though born in an obscure part of Russia in 1857, his father was a poor woodcutter from Poland and so Konstantin was not a native Russian. He was deaf. He never went to school and received no formal education at all. Rather, he was tutored privately by the eccentric Russian philosopher Nikolai Fedorov, who himself was a leading proponent of a marginal movement called "Russian Cosmism". Konstantin also read the works of Jules Verne. He lived and worked in Kaluga, far from the sights and influences of modernizing Moscow.

So you can see that he had what you need to be creative--not wealth, a happy, successful family, proper socialization, and graduation from a prestigious school. All of that is a recipe for mediocrity that can make you a successful bureaucrat or even President of the US. But Tsiolkovsky had the Right Stuff needed for genius: he was handicapped, an immigrant, uneducated, and socially isolated.

What could he do but think and dream? And he did both on an unimaginably broad and deep scale. Under the influence of Fedorov, he formulated the "Cosmic Philosophy" which included the belief that

"Humanity will not remain on the Earth forever, but in the pursuit of *light and space* will at first timidly penetrate beyond the limits of the atmosphere, and then will conquer all the space around the Sun."

He also wrote the often-misquoted statement that contains the greatest rationale for space exploration ever expressed:

"The Earth is the cradle of the mind, but we cannot live forever in a cradle".

Tsiolkovsky was certain that it was the destiny of humankind to occupy the solar system and then to expand into the cosmos, living off the energy of the stars to create a cosmic civilization that would modify nature, abolish natural catastrophes, and achieve happiness for all. That was the "Cosmic Philosophy".

But, even more incredibly, at the same time he was developing these ideas--and writing science fiction stories to support them--he was also coming up with sophisticated and largely accurate drawings and mathematical formula for actually doing what his philosophy required and his fiction explained:

Tsiolkovsky died in 1935 but shortly after it seemed that his dreams would come true.

Once upon a time, in a heroic period called "the 1960s", humans--true supermen, of course--actually did go to the moon. They also invented Rock and Roll, but that is another story.

I know it is very difficult for some of you to believe any of this since the moon is so far away from any place you can go now. But the story is no hoax. Once upon a time humans did actually walk on the moon. Though impossible now, this is not a myth but a fact.

I think more and more people now understand that our journeys to the moon and plans to go to Mars in the 1960s perhaps were very premature, being weird byproducts of an even weirder political struggle between the US and the USSR. Humanity at that time was testing the limits of its technologies, will, and finances in many ways, but none more spectacularly than by walking on the moon and then returning safely to Earth to tell about it.

But it all turned out to be so daunting and exhausting and expensive that humans have not ventured out of immediate Earth-orbit since, and we may never do so again.

Humans, 100, 500, 10,000 years from now may look back on the Apollo Era as indeed an time of supermen like Icarus and Momotaro who are said to have done impossible and daring things once upon a time, long, long ago, and never again, as our courage failed and as pressing Earthly problems, real or imagined, overwhelmed us.

Now, after four decades of dormancy, the stories about going back to the moon and on to Mars are growing again and are becoming ever more intense everywhere. Can it happen? Will it happen?

Recently, there is a stirring in the space community again. Plans for going to the moon and beyond are being seriously discussed in many parts of the world, including the US. Yet how realistic are any of them? Does the US, most of all, have the money, talent, and will to push outward into space for peaceful purposes again? The current American president seems to think so, but of all of Bush's faith-based initiatives, none seems to me more faith-based than the thought of going back to the moon and on to Mars according to his time table.

But brothers and sisters, I Believe! I have the Faith. Faith is defined as the Triumph of Hope over Reason, and like all of the faithful whatever the object of their faith, I very much want humans to go back to the moon and on to Mars, and to do so very soon.

However, "Civilization," HG Wells once wrote, "is a race between education and disaster" and humanity is presently even more seriously engaged in such a race than when Wells wrote it. One aspect of the race sees humanity wasting its resources and human talent on meaningless wars while the other sees humanity wasting its resources and human talent on endless consumerism that endlessly eats its own planet. Neither leaves much reason for hope of human space exploration.

Of course the destruction of Earth may end up being a major driving force behind space exploration and settlement too--the super rich of the world may leave a polluted and war-scared Earth for fresher environs. While that may be a contributing reason, somewhat like the Cold War earlier, I very much hope it does not become our main reason. It seems pretty irresponsible to me.

Rather, I would prefer that we use our ability to make artificial environments in space to learn how to create and manage a sustainable artificial Earth. We need to come to realize that "nature", in the sense of "places and processes untouched by human actions" no longer exists on Earth, and that the once-"natural" Earth is becoming more and more "artificial".

Over the tens of thousands of years of human existence (and not just recently), humans have increased their number and, by technology, the impact of their presence so massively that what was once a self-managing, evolving wilderness became recently a garden requiring human attention and care, and now is in danger of becoming an Iron Lung if we do not learn, in the words of the title of a book by Walter Truett Anderson, that humans must "Govern Evolution."

Most plans for human settlements in space that I have seen assume taking humans as we presently exist biologically and socially, and creating Earth-like artificial environments in space where humans can live Earth-like lives in Earth-like societies. Applying lessons learned during the creation of such artificial space environments to the creation of a sustainable, evolvable Earth is one of the possible themes for the Earth 3 working group that I will touch on briefly tomorrow.

But as important a reason as this is might be for space settlements, there must be something more compelling and grand.

One of the basic tenants of futures studies is that the future cannot be predicted, but it can and should be envisioned and invented. What is needed, clearly, is a compelling vision coupled with a plausible way to make the dream come true.

I believe we live in a world in which increasing novelties will overwhelming any continuities from the past. We should expect more, greater, and unprecedented change in all of our alternative futures.

If this is so--if most of the future will be composed of things we do now experience now and never have before in human history--then Dator's "Second Law of the Futures" becomes very important for you to consider:

"Any useful idea about the futures should appear to be ridiculous."

Developing compelling visions for future space settlements is difficult for many of us to do in 2006. To most people, it is ridiculous even to try.

But it is even harder, in 2006, to come up with a plausible way to bring even compelling visions into reality.

But it is not impossible.

Futurists such as myself use a variety of theories and methods to anticipate and guide things to come. Bruce Cordell, former program manager of Mars/Lunar Advanced Programs at General Dynamics, and now Dean of Natural Sciences at Fullerton College nearby, has recently used several futures methods specifically to forecast the future of space exploration.

Based on the theory of Kondratieff Long Waves, a socio-economic theory that has been used to forecast major social changes for many years, and the theory of Positive Psychology developed more recently by Martin Seligman of the University of Pennsylvania, Cordell's forecast is also supported by age-cohort work done by William Strauss and Neil Howe, initially in their book, *Generations*, and in several publications subsequently.

All three theories--Kondratieff Long Waves, Positive Psychology, and Strauss and Howe's Age-Cohort analysis--independently show that societies cycle through long waves of social and technological change of between 50 and 60 years length.

During certain periods in these cycles, big projects, such as space exploration, are possible while when society is in other periods during the cycle, big projects of any kind are impossible, both technologically and psychologically.

In an article to be published in *Futures Research Quarterly*, titled "21ST Century Waves: Forecasting Technology Booms and Human Expansion into the Cosmos," Cordell specifically predicts when the next era of space exploration will be possible even though it seems impossible now:

"[L]ong-term trends in science, technology, and human history strongly suggest that the decade from 2015 to 2025 will be the economic, technological, and political analog of the 1960s [the last time big projects were possible]. We should expect unprecedented activities in technology, engineering, and human exploration [then]. The focus will be on large-scale human operations in space."

I am not willing to agree with Cordell that we can be confident enough in these theories and the historical evidence to predict with certainty that humans WILL return to the moon and go to Mars during the 2015-2025 period. But I do think that the evidence is strong enough that we can use these theories to develop a vision and begin the work necessary to make such a prediction a self-fulfilling prophecy on the basis that what seems to be impossible now, in fact is impossible now, but may seem almost inevitable in ten to twenty years.

But we need more.

At the present time, most effort towards space is still under the control of a very few national governments. But the future of the nation-state system itself is in doubt. It is by no means clear that the current international system is sufficient to address environmental and economic challenges ahead. And there is every good reason to believe that space settlement also should be at least a multinational effort, if not entirely a transnational venture.

At the same time, what was once a fantasy, and then a dream, is becoming a reality--private entrepreneurial ventures into space.

Even though the future of the current global economic system is in doubt, it is utterly reasonable to assume that vision, risk-taking, and entrepreneurship will continue to be expressed and grow as age-cohorts worldwide, accustomed to having the nation-state tell them what to do and to having the nation-state do all the difficult things for them die, and are replaced by people--like you--far more accustomed to doing things for yourselves, but in cooperation with other willing and able selves, uncoerced and unfunded by the old-fashioned authoritarian nation-state.

It is the self-reliant, yet highly cooperative and creative spirit of the Millennial Generation worldwide that gives me the greatest reason to be hopeful about space exploration in the future. And that spirit is almost irresistible, if the forecasts based on the rising K-Wave are also accurate.

In addition, from my perspective, one voluntary sector that seems to have enormous and growing power, wealth, and vision is that of various religious groups.

There already are some religious organizations that have expressed interests in space exploration and settlement and there may be more in the future if governments fail, the neoliberal global economy falters, but faith strengthens and continues to bloom.

Akio Inoue, "Concepts related to the Japan International Space Culture Congress," Tenri City

At the present time, Malaysia is the Islamic nation that seems to be taking the lead in developing spacefaring capabilities. I do not know of any discussion of pan-Islamic cooperation in space yet, but I expect to see it emerge. Islam does not fit easily into the structures of narrow nationalism, seeing itself primarily as a global community of believers.

"Malaysia Conference Considers How To Practice Islam In Space" *SpaceDaily*, April 20, 2006

So also, the Roman Catholic Church, which has expertise in astronomy and has expressed theological perspectives on space exploration, could mobilize the faithful for space settlement.

The Significance of The Martian Frontier: A Roman Catholic Perspective

And if you are going to call yourself "Moonies", then you certainly need to give serious thought to living on the moon.

In what is still one of the most important volumes on space exploration and settlement, *Interstellar Migration and the Human Experience* (University of California Press, 1985), Ben Finney and Eric Jones argue that

“Living in space would represent a logical extension to the technological path our ancestors have been following for some five million years.”

At first, humans in space will almost certainly try to make space as Earthlike as possible, but it is highly likely that Earthkind in space will eventually become Spacekind--no longer defining everything, or even anything, by “what it was like back home on Earth.” Thus, as Ben Finney says

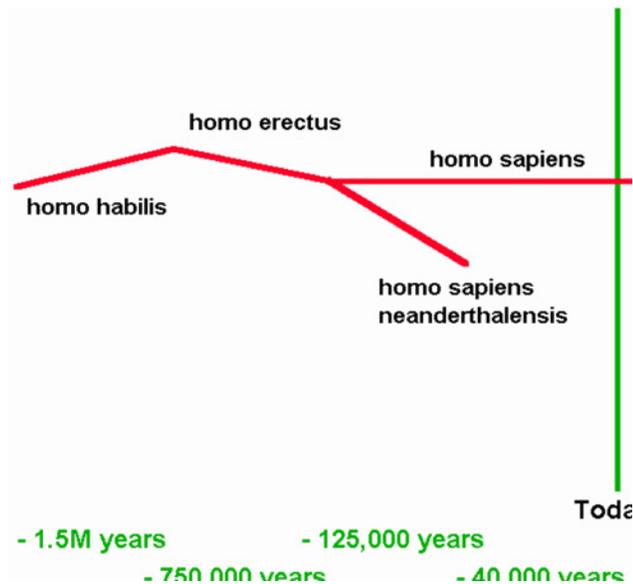
“Evolutionary processes pent up on Earth will be unleashed in space, and the most dramatic explosion of speciation the universe has ever seen will occur.”

This “natural” evolutionary process may be greatly aided by advances in genetic and molecular engineering so that a myriad of new intelligent lifeforms may arise or be created as life moves from Earth to various places in the solar system and beyond.

Continuing rapid advances in artificial life, artificial intelligence, and genetic engineering seem to be pushing humanity and all life on the planet towards what the Sri Lankan futurist, Susantha Goonatilake, calls Merged Evolution, or what the American futurist, Ray Kurzweil, calls, *The Singularity*.

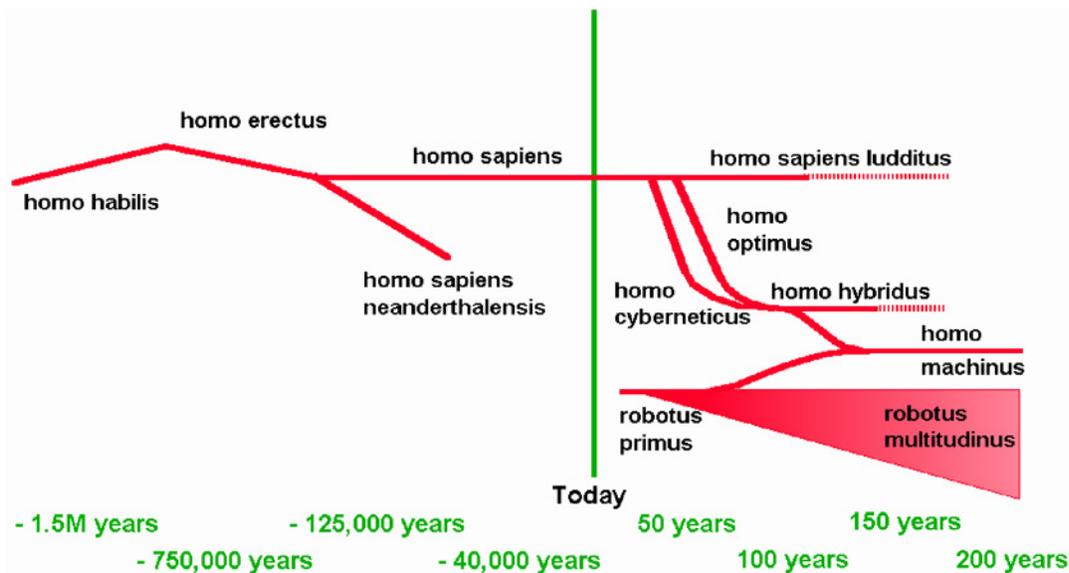
One consequence of this is that instead of making space settlements as Earth like as possible--the process you know as terraforming--we might instead try to modify human life for extraterrestrial environments.

However, Ian Pearson reminds us



that once there were several species of homosapiens living on Earth together--most notably *homosapiens Neaderthal* and what we now proudly call *homosapiens sapiens*.

Pearson, along with Kurzweil and myself, suggest we now might be on the verge of an explosion of intelligent life forms and cultures of which humans are not necessarily the dominant form.



Some, such as Bill Joy--and I suppose most of humanity--deplore and fear this potential development.

But not me: I welcome it.

My last name, Dator, might be the key for why I feel that way. As any of you know, who know Swedish, my name, in Swedish, means, "computer". If you were to google my name you would find many pages that look like this:

Dator.sladd.net

Personlig hemsida om gamla datorer och vad man kan ha dem till.

dator.sladd.net/ - 7k - Cached - Similar pages

Dator - susning.nu

Dator är ett svenskt ord för datamaskin . Ordet dator tillskrivs Börje Langefors år 1968 och är avlett från data. Först i tryck i DN 26 april detta år. ...

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Jim Dator - Wikipedia, the free encyclopedia

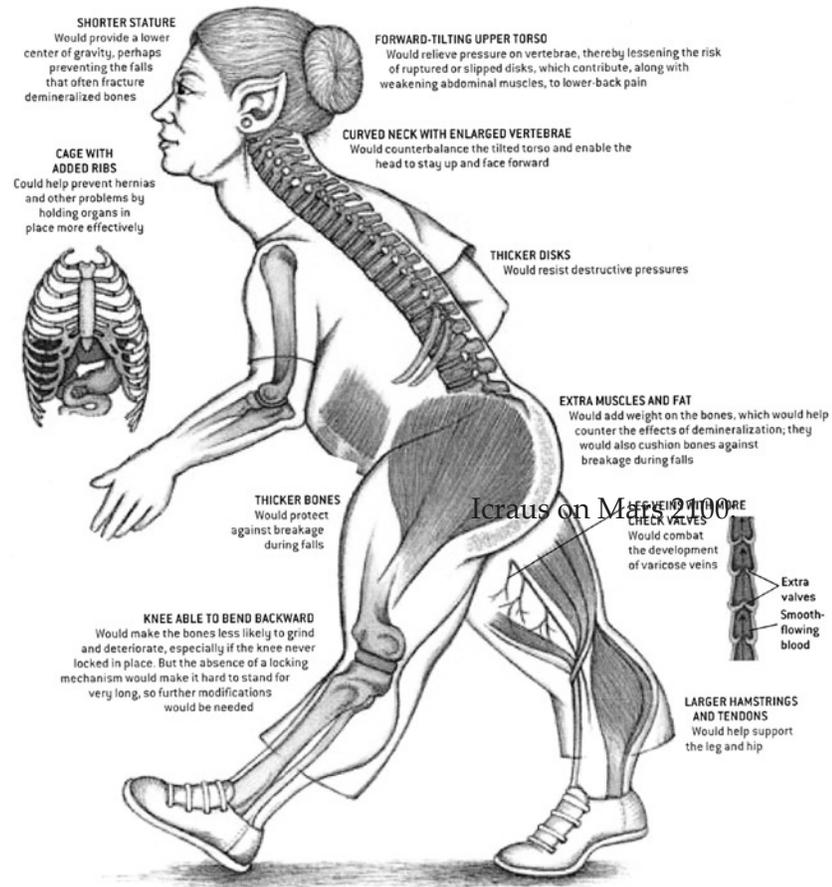
James Allen (Jim) **Dator** is Professor, and Director of the Hawaii Research Center for Futures Studies, Department of Political Science, University of Hawaii ...

en.wikipedia.org/wiki/**Jim_Dator** - 12k - Cached - Similar pages

and I will neither confirm nor deny at this time that I am an inferior beta version of robotic artificial intelligence.

But I can assure you that, though inferior now, I am the wave of a future. If beta comes, can delta be far behind?

Recently Jay Olshansky pointed out several severe flaws in human body design even for life on Earth. Here is what humans should probably look like if we were to be intelligently re-designed for living on Earth:



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But note how much that design does in fact already look like me. And I can confess to you that I am indeed slowly adapting myself for life on Mars. My once sleek, thin, muscular body has, over the years, become more hunched, with a firm thick-plated back, and a soft underbelly.

I am convinced a good design for intelligent life on Mars is like that a turtle with head and limbs that can quickly retract into a stiff shell to protect itself from sudden blasts of solar or cosmic rays.

But I also look forward to flying, or at least gliding on Mars, so that intelligent life on Mars might instead resemble a winged turtle.

Icraus on Mars 2100:

What do you think?

I have tried to suggest several ways and reasons for human settlements in space in the foreseeable future. I challenge you to come up with more and better ones. I am certain you can and will do that.

So I will end with my favorite space poem, which was written, not at all actually to be about outer space--free space--but nonetheless seems to capture the essence of my message today.

It is by the late 19th, early 20th century poet, Walt Whitman:

**A noiseless patient spider,
I mark'd where on a little promontory it stood isolated,
Mark'd how to explore the vacant vast surrounding,
It launch'd forth filament, filament, filament, out of itself,
Ever unreeling them, ever tirelessly speeding them.**

**And you O my soul where you stand,
Surrounded, detached, in measureless oceans of space,
Ceaselessly musing, venturing, throwing, seeking the spheres
To connect them,
Till the bridge you will need be form'd,
Till the ductile anchor hold,
Till the gossamer thread you fling catch somewhere, O my soul.**