The Everything Else Disasters Preparedness Plan

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I. INTRODUCTION

I have worked my entire career for the Department of Defense. One of the peculiarities of working for a large organization is something called *mandatory training*. This is training deemed by someone in the upper echelons of the organization as being of critical importance. It's as if the entire world will come to an end if any individual in the organization fails to take this course. Whenever the term *mandatory training* is used, it is set against a background of "take this training or else (*bad things will happen*)". Over the decades, I had cheerfully taken many such courses. But this time, I felt like I had exceeded my lifetime quota. I had nothing against this course. Like all courses, I could find a few trinkets I could later use. It was just that I would really like to focus my energy on productive work. Maybe it was a little rebel in me. So, I declined. And then I declined again and again and again. I thought that if I could drag my feet long enough, the edict would simply disappear or maybe I could drag it on until I retire. After about a dozen declinations, I could perceive the chatter. It had reached a squealing high pitch. So I finally, regrettably signed up for the course.

The course was a weeklong part-day workshop titled "The 7 Habits of Highly Effective People". The stated goals of this training were to: improve interpersonal communications, take initiative, establish trust, strengthen relationships, increase influence and balance priorities. These seemed like productive objectives. The course included a copy of *The Seven Habits of Highly Effective People* by Stephen Covey and a massive leather-bound weekly planner.

During the second day of the training, the instructor rattled off a key slogan. *Change what can be changed and forget the rest!* In other words, don't waste your energy on things you have no control over. To drive the point home, the instructor cited an example: "Suppose there is a threat such as asteroid colliding with Earth. It is entirely out of our control. There is nothing you can do about it! All you can do is worry yourself sick. That is very non-productive. Just accept the threat and focus on the things that you can change." The example struck me as being very odd, very fatalistic. This may be because I had just completed putting the final finishing touches on a disaster preparedness plan for asteroid and comet impacts.

But I conceded the point. There are always threats beyond our control that we could not protect against. Why focus our energy on completely impossible objectives instead of focusing on those objectives, which are possible to achieve? There are threats like our sun dying (our sun will eventually run out of fuel and die, becoming a white dwarf in the process). This is projected to occur around 10 billion years from now and I think my watch will stop ticking and my bones will turn to dust long before this event approaches.

Several years have passed, and I used this time to productively address a variety of threats facing our civilization, including:

<u>Asteroid and Comet Impacts</u>

Impact Disaster Preparedness Planning
http://www.aero.org/conferences/planetarydefense/2007papers/P5-2--Marusek-Paper.pdf

Comet and Asteroid Threat Impact Analysis
http://www.aero.org/conferences/planetarydefense/2007papers/P4-3--Marusek-Paper.pdf

Comet Threat Mitigation Approaches and Challenges
http://www.aero.org/conferences/planetarydefense/2007papers/P1-6--Marusek-Paper.pdf

Nearby Supernovas

Supernova: Disaster Preparedness Plan
http://www.breadandbutterscience.com/SDPP.pdf

Massive Solar Storms

Solar Storm Disaster Preparedness Plan
http://www.breadandbutterscience.com/SSDPP.pdf

Solar Storm Threat Analysis
http://www.breadandbutterscience.com/SSTA.pdf

Quiet Sun (Solar Grand Minima)

Solar "Grand Minima" Preparedness Plan (i.e. Little Ice Age Preparedness Plan)
http://www.breadandbutterscience.com/GMDPP.pdf

Solar Grand Minima Threat Analysis
http://www.breadandbutterscience.com/SGMTA.pdf

Yet, there are some threats that are so great that mankind could never hope to survive; being doomed like the ringing of a massive bell hidden in the mountains of Tibet. These cataclysms usher in planet disintegration and sometimes disintegration down to the atomic level. I kept remembering the gentle words of wisdom: *Change what can be changed and forget the rest!* So what, we are to roll over and die as a species? Just let ourselves become extinct? Give up without a fight? I don't think so! I don't roll over easily! I decided to adopt my own slogan: *Nothing is off the table*! I reasoned that all I needed to do is to stretch my mind a little more and various bits and pieces of dangling thoughts might reassemble into a coherent plan to deal with the rest of what life might throw at us. So that is the basis of this Disaster Preparedness Plan – to identify a roadmap for survival in the extremes. "Everything Else" is written in the broadest of brushstrokes, conceived in science almost bordering on science fiction and is intended to identify pathways for human survival.

The concrete objective of this plan is to cover all the other cataclysmic threats not covered in previous preparedness plans. Examples include:

* Earth's ejection from our solar system.
* Collision of Earth with a wild massive body (such as a great comet, planet, star).
* Gravitational tugs from a rogue black hole.
* Fiery blast wave from a breathlessly close supernova.
* Our sun's last gasp before its death.
* And a billion other extremely rare earth-destroying events.

It covers Doom on a truly cataclysmic scale.

The answer to these cataclysmic threats can be summed up in one word —» *mobility*!

II. THE ROADMAP FOR DEALING WITH THE WORST-OF-THE-WORST NIGHTMARES

A. One Word Solution

The first concept is *mobility*. We are planted on this world, which has been a very good home to us. Earth is a rare gem, far rarer than anyone could imagine. It provides us all that we require for our survival. But events can happen and it is essential for humans to achieve *mobility*. We need to travel between the stars and galaxies. In a way, it is probably our destiny.

B. The Need for Speed

One of the barriers to interstellar and intergalactic space travel is *time*. It is commonly believed that if man attempted to travel to the nearest star, the length of time required by even the fastest spacecraft would be measured in tens of thousands of years. Thus manned interstellar space travel is nothing more than the stuff of pipe dreams and the domain of science fiction.

But let me introduce you to a new theory named the Theory of Intergalactic Space Travel:

$$D \approx 2\ y$$

The distance [D] between any two points in space (whether it is a nearby star or across to the other side of the known universe) is approximately 2 years [y].

The following is the reasoning behind this theory. We live on Earth and are subjected to the gravitation force exerted by the planet. This is a constant force, which is defined as one gravitational unit (g). At sea level (and latitude 45°), this acceleration (g) is 32.1725 feet per second squared. Astronauts have lived in space free floating in zero gravity. Fighter pilots and astronauts (wearing G-suits) have experienced extreme g-forces in the range of 10g's for short durations of time. Beyond that range, man experiences loss of consciousness and death. Therefore, the human body can under ideal conditions sustain accelerations from 0 to 10g's but our physiology is tuned to 1g. Our bodies are physiologically designed for this level of acceleration.

The speed of light, a constant denoted by (c), is approximately 671 million miles per hour. If we travel through space at a constant acceleration rate of 1g, we will obtain the speed of light in approximately 1 year. One of the concepts that came out of Einstein's General Theory of Relativity was the Relativistic Time Dilation Theory. Simply stated, "The faster an object moves, the slower the time increments (for the object in motion). If the object in motion reaches the speed of light (c), time would stand still (for that object). Therefore at the speed of light, large distances can be traversed in a twinkling of an eye. To decelerate from light speed at the 1g rate will take approximately one year. Thus from the reference frame of a space traveler, the total time for such a journey is approximately 2 years (1+0+1).

This is an idealistic theory and that is the reason why there is an approximation sign in the equation. Finding a means to accelerate at a constant 1g rate would be very difficult to achieve. And also, matter can never reach the speed of light otherwise it would convert into pure energy.

Our solar system is constantly being bombarded with galactic cosmic rays (GCRs). These are primarily protons or ions accelerated by strong magnetic forces to relativistic speeds within a supernova explosion. Some of these GCRs with energies of 1 TeV (teravolt) (and higher) have been detected on Earth. At these energies, the particles are traveling at velocities of 0.99999956 c (or greater). If these particles can be accelerated to these speeds, then I assert that spacecraft can also reach these speeds. In other words, one can never really attain the speed of light, but one might come very close.

Thus to achieve intergalactic space travel, there is a *need for speed*.

C. Jet Boat vs. Sailboat

Antigravity engines, warp drive, wormholes, antimatter engines, teleportation machines and a host of hypothetical devices have become the mainstay of science fiction. The word to emphasize here is *fiction*; rather than being grounded in cold hard scientific facts. It is like we have stepped out of reality and into the blinding fog of wishful thinking.

Presently our expertise in space has focused on conventionally spacecraft propulsion systems. These propulsion systems have taken several forms. The most common types are monopropellant and bi-propellant (solid fuel) rockets. Another type is ion engines (such as Electrothermal DC Arcjet, Electrothermal AC Arcjet, Electrothermal Pulsed Arcjet, Electrothermal Hydrazine, Microwave Electrothermal, Pulsed Electrothermal, Resistojet, Ion Bombardment, RF/Microwave Ion, Colloid Ion, Radioisotopic, Plasma Separator, Contact Ion, FEEP [Field Emission Electric Propulsion], Hall:SPT [Stationary Plasma Thruster], Hall:TAL [Thruster and Anode Layer], Electron-Cyclotron Resonance, MPD [Magnetoplasmadynamic] Arcjet Steady State, MPD Arcjet Quasi-Steady State, Pulsed Plasma, Helicon Pulsed Plasma, Pulsed Inductive, and Variable Specific Impulse Plasma).[1]

Intergalactic space travel cannot be achieved by conventional propulsion systems because these systems must consume fuel in order to accelerate/decelerate. This precludes these systems from reaching relativistic speeds and thus their ability to travel between stars in a timely manner. Intergalactic space travel can never be obtained relying on propulsion type engines alone. It will require development of field engines that can tap into the energy fields available in the universe to attain relativistic speeds.

Let us consider boat design for a moment. There are jet boats and there are sailboats. Jet boats have speed and can run circles around sailboats. But they consume fuel. Whereas sailboats have *mobility* because they can tap into the wind and as a result can sail around the world. A jet boat would quickly run out of fuel, should it try.

We will never achieve interstellar space travel unless we first learn how to harness fields. To put it simply, up to this time, our space program has been almost entirely focused on jet boats. We need to diversify and develop sailboats.

D. Physics Open House

Anti-gravity has become the *holy grail* of science fiction. Scientists have been unsuccessfully searching for this mysterious force for well over 30 years. But suppose such a force doesn't exist. Suppose it will remain in the realm of fiction, never to materialize as scientific fact. Does that mean the concept of interstellar space travel is forever doomed. The answer this question might lie in the old corridors of a college building.

Once each year, Indiana University at Bloomington Campus sponsors a Physics Open House. The event provides a number of science exhibits and demonstrations in the mysterious world of physics to spark excitement and curiosity in children and young adults. I thought it was a good way to introduce my two daughters by bringing a little sparkle and the magic of physics into their hearts and minds so that they might someday grow up and become the next generation of young scientists. So off we went!

As we went helter-skelter from one demonstration to the next, one particular demonstration caught my attention. A young physics Teaching Assistant (TA) was demonstrating one of the unusual properties of a superconductor. He placed a magnet on top of a superconductor and then slowly poured liquid nitrogen onto the superconductor to cool it into a superconducting state. The magnet magically rose an inch above the superconductor, floating in midair.

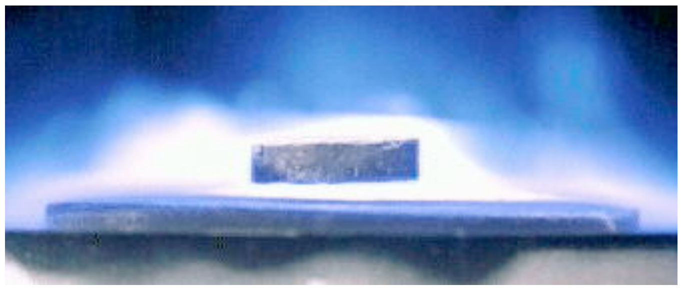

Figure 1. A high temperature superconductor in magnetic suspension.

Later that day, I wandered into a lab that housed electromagnetic experiments. The room was filled with a variety of weird looking devices such as Van de Graaff generators but the lab was almost empty of people. It seemed like most of the young gifted minds had gravitated down the hall to the lab containing robotic demonstrations. In one corner was the TA that had earlier given the demonstration on superconductors. He seemed like a nice young lad. I asked him what would happen if he used a super magnet (rare-earth neodymium magnet) instead of a normal magnet in the experiment. He said he didn't know, but was willing to give it a try. We repeated the experiment. But this time when he cooled the superconductor, the super magnet, moving faster than a speeding bullet, shot into the ceiling and ricocheted off the floor and walls of the room. They say that when you face death, your whole life passes before you in a split second! Well that didn't happen. I only made it as far as the first grade. I did a quick check. I was alive and ticking. My two young daughters were unharmed. That was good! And the teaching assistant seems very startled but none the worse for wear. One of the properties of a superconductor is that it is anti-magnetic. It repels from either pole of a magnet. The stronger the magnet, the more it repels.

The effect that was demonstrated in the experiment is called the Meissner effect. When a superconductor transitions into a superconductive state, it expels nearly all magnetic flux. Superconductors in the Meissner state exhibit perfect diamagnetism.

All known forces in the universe from the perspective of Physics can be grouped into four basic types. These are the strong force, the electromagnetic force, the weak force and the gravitational force. These forces are listed in order of decreasing strength. Strong force is responsible for binding the protons within the nuclei of an atom. Electromagnetic force is the force between all particles with an electric charge. Weak force is responsible for nuclear beta decay. Gravitational force occurs when physical bodies attract with a force proportional to their mass. The gravitational force is extremely small, approximately 10^{-38} times that of the strong force. The reason why this is important is because an anti-gravity field engine may not hold the potential when compared to an anti-magnetic field engine in spacecraft design. A superconductor produces an anti-magnetic field and this process is switchable using temperature. Anti-magnetism is real whereas anti-gravity is theoretical. Electromagnetic force is the second strongest whereas gravity is dead last, the weakest. Our galaxy is awash with magnetic fields. It contains some objects that project magnetic fields several orders of magnitude greater than our sun, such as black holes. Magnetic fields permeate our galaxy and many are fairly strong actors.

The gateway to interstellar space travel is intrinsically tied to advances in superconductors because they will be used in fabricating anti-magnetic field drives.

E. Field Driven Spacecraft Design and Operation

The shape of the spacecraft would most likely take the form of a circular disk or the shape of a saucer. This shape would expose the largest surface area consisting of an array of imbedded superconductors to the magnetic fields and charged particle streams.

When the spacecraft is placed into a magnetic field or moving stream of electromagnetic particle, the superconductor would block the fields from passing through the spacecraft in the same manner that sails block the wind. These charged particles and magnetic fields will be forced to flow around the superconducting craft propelling it through space.

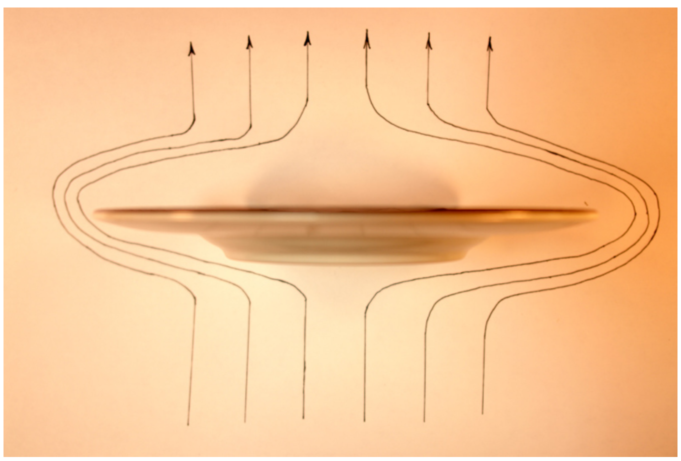

Figure 2. Representation of magnetic field lines flowing around a superconducting spacecraft.

After building a spacecraft incorporating a field engine [anti-magnetic field drive], the next step is learning how to operate it. That can be a fairly daunting task. By applying a small angular spin to the disk, it could provide a degree of stability to the craft similar to a gyroscope. This would permit the use of tilt-to-control spacecraft maneuvers.

Initial design will require the spacecraft be launched into Low Earth Orbit [and Earth's radiation belts] using conventional rocketry. Once in orbit, the craft will use the Earth's magnetic field and imbedded particles to begin its journey. The craft will utilize the magnetic fields and charged particle streams of the sun, the planets, other stars, black holes and our galaxy. The craft will also use gravity to perform orbital and sling maneuvers.

Since superconducting is switchable, the craft's blocking capability can be turned on-and-off by controlling the temperature of the imbedded superconductors. This adds one more dimension to control.

Our sun is constantly in motion. Because the sun rotates, the magnetic field it produces is shaped like an Archimedean spiral. As the Sun's magnetic field is carried outward, these magnetic fields become frozen in the solar winds. The magnetic field lines and charged particles forming the solar winds move at an average speed of 0.9 million miles per hour (400 km/sec).

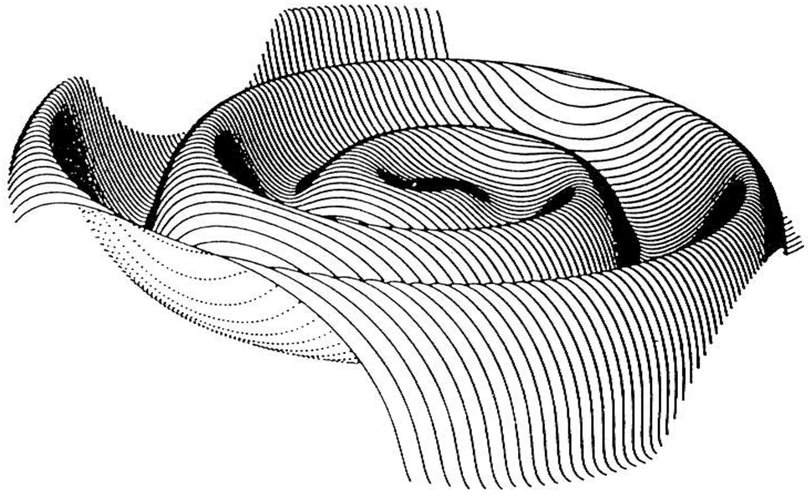

Figure 3. A three-dimensional image of the spiraling current sheet mapped out into the heliosphere. Jokipii and Thomas (1981)

Spacecraft design will undergo many revolutionary upgrades during its initial years of operation, and that will permit the evolution of spacecraft navigational approaches. There will be many navigational approaches that must be tested and learned. These might include:

* Accelerate initially using the Earth's magnetic field. When sufficient speed has been reached, take a trip or two around the moon returning to the Earth through a slingshot maneuver to increase speed. Then drive towards the sun with the superconductors off in the inbound pass and then turn the superconductors on and accelerate using the sun's magnetic fields with imbedded solar winds on the outbound pass to exit the solar system.

* The sun's magnetic field spirals outward. Leaving our solar system may be analogous to a surfboarder riding the leading edge of an ocean wave but, in this case, it may be riding the leading edge of the solar winds.

* Rather than straight point-to-point travel when crossing over to the other side of our galaxy, it might be safer to travel into the galactic halo and perform a midcourse change to return to the plane of the spiral arms. This would avoid the massive black holes that populate the center of the galaxy. These may pose a threat to the safety of the mission.

* When traveling through space, it may be beneficial to pair off with an advanced robotic spotter ship that signals the main ship of upcoming destinations in order to begin the deceleration phase.

F. Spacecraft Shielding

Space can be a dangerous and brutal place. Fast moving particles and various forms of radiation abound. Although the anti-magnetic field engine may provide some protection from high-energy charged particles, not all particles are charged and some particles may have sufficient energy to break through the anti-magnetic shielding and penetrate the craft. As a result, the spacecraft may require physical shielding from this type of threat. To this end, I recommend the incorporation of salt water shielding in hull design.

Not all radiation is alike. High-energy nuclear radiation (from protons, neutrons and ions) can be one of its deadliest forms. Figure 4 depicts how protons, heavy ions (such as carbon ions) and photons (such as X-Rays) interact as they travel through a column of water. The heavy charged particles (protons & ions) are able to cut easily through objects and dissipate significant energy at a penetrated depth (referred to as Bragg peak). When the particles are slowed down at their penetrated depth (for 148 MeV protons, the Bragg peak is at approximately 140 mm [5.5 inches]), the interaction time becomes larger and the value of the energy transfer is at its maximum. Now consider the above graph as a living organism. Water is a basic chemical component in the human body. At the Bragg peak depth, a large amount of high-energy electrons are produced that cause multiple ionization events at the end of their range in a distance that corresponds to the cross section of a deoxyribonucleic acid (DNA) molecule. This ionization produces cluster damage at the DNA level. Energetic protons, neutrons and ions have a greater biological efficiency than X-rays and Gamma Rays to induce genetic damage. X-rays can produce isolated single and double DNA strand breaks, which can be repaired by the cells rather quickly and cleanly. But high-energy nuclear particle radiation produces complex cluster damage to the DNA strands that are significantly less repairable.

Salt water is a natural barrier to these particles. Fast nuclear particles (protons & neutrons) must be slowed down before they are captured. Light nuclei, such as hydrogen, are effective at slowing down these particles through elastic scattering. That is the reason why water (which contains hydrogen) makes an effective shield. Other atoms (boron, cadmium, chlorine, iron, fluorine, lithium and potassium) are very efficient at absorbing nuclear particles once they have been slowed. As a result adding salt (which contains chlorine atoms) to the water dramatically improves its efficiency in shielding design.

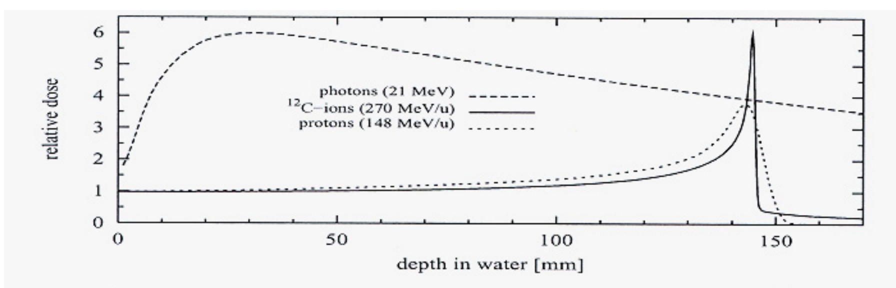

Figure 4. Proton, ion and photon radiation penetration through water. [2]

Robust salt water shielding incorporated into spacecraft design could provide a significant degree of protection. A double hull design on the leading edge of the spacecraft could provide a shield of salt water, two feet thick, which would filter out most of the high-energy particles below 0.5 GeV. The shield may look like a flat disk approximately two feet thick, a type of water storage tank. The designed shield area could protect the sleeping compartment within the spacecraft. This compartment could also house the main computers and sensitive electronics so as to provide protection to those critical components. The water contained within this tank could also serve as a drinking water supply for the crew of the spacecraft. This storage tank could be integrated with wastewater capture, water recycling, and water desalination and treatment systems. Another advantage to this concept is that if the craft should sustain minor damage from particle collision, the effects could be self-healing because (due to the cold temperatures present in space), the exposed water would freeze sealing the origin of the leak.

G. Noah & Johnny Appleseed

There is another facet to *mobility* and that is *destination*. It profits us little to travel to dead planets on the far side of space. Once life got a foothold on Earth, it clung to the planet with great tenacity. This planet is the way that it is, a habitable planet, not because of the right mix of chemicals but because it was transformed by life. Space exploration is not finding or should I say stumbling onto habitable planets, but rather creating habitable planets.

In America, we have an unusual folk hero. He travelled the American frontier raggedly dressed and mostly barefoot in the summer. Sometimes he wore a tin pan on his head because it served as both a hat and a cooking utensil. But the reason why he is remembered and cherished is because he planted thousands and thousands of apple seeds in large parts of Ohio, Indiana, and Illinois and tended these young trees as they grew. He reasoned that apples would provide the early settlers with something other than wild meat and fish found in the forest and streams. Johnny Appleseed was real. His name was John Chapman. He provided fruit in the new frontier. This is the approach to follow as we travel to the new frontiers of space.

In the story of Noah and the Ark; Noah was instructed on building a large ship, a wooden ark. His world was about to end. A global extinction was about to descend upon the world in the form of a Great Flood. But the instructions went further than just saving the lives of Noah and his family. He was told:

> *And of every living thing of all flesh, you shall bring two of every kind into the ark, to keep them alive with you; they shall be male and female.*
> *Of the birds after their kind, and of the animals after their kind, of every creeping thing of the ground after its kind, two of every kind shall come to you to keep them alive.*
> Genesis 6:19 & 20

Man has a natural role in protecting life on our planet from planetary extinction (such as extinction from comet impacts). Noah's ark is not only a story of man's survival but also a model of his role in the universe. Noah did not travel alone but in an ark filled with life.

In the future, if we are forced out of our home world because of a cataclysmic event far beyond any which the Earth has experienced to date *(Doom on a Truly Cataclysmic Scale)*, then the solution is to (1) have the means to travel between stars and (2) prepare other worlds for human habitation.

H. Natural Terraforming

One of our missions should be to make other worlds habitable, to make them steppingstones to space travel. Terraforming is the first word that comes to mind. Terraforming is planetary engineering on a grand scale. This concept might take several forms. On frozen planets; large orbital mirrors might be installed to heat the surface of the planet. On overheated planets; solar shields might help to cool the surface. Radioactive ore might be mined for nuclear fuel and energy. Comet trajectories could be diverted to impact the planet to release ammonia rich volatiles into the planetary atmosphere. And many other ideas fall into this category. Let's take this concept of terraforming and toss it into the rubbish heap.

Living organisms transformed the Earth over billions of years from an unlivable wasteland to a biosphere capable of hosting advanced forms of life. It is living organisms that possess the capacity to efficiently transform planets. Living organisms should be the core of terraforming, not the periphery.

Life on Earth is composed of a complex array of organisms forming a layered design that produces a very robust ecosystem. By robust, I mean that life has been essentially snuffed out on the planet several times through great cataclysms but it has come back with a vengeance, in radically new forms, each time spawning new features that enhance the robustness of the next design.

Currently life on Earth is composed of Bacteria, Archaea, and Eukaryotes. I suspect that Archaeans hold one of the keys to transforming other worlds. Archaeons are among the earliest forms of life that appeared on Earth billions of years ago. Archaeons are single-celled creatures that join bacteria to make up a category of life called the Prokaryotes. Prokaryotes' genetic material, or DNA, is not enclosed in a central cellular compartment called the nucleus. All other life forms are Eukaryotes, creatures whose cells have nuclei. Many archaeons thrive in conditions that would kill other creatures: boiling water, super-salty pools, sulfur-spewing volcanic vents, acidic water and cold deep in Antarctic ice. These types of archaea are often labeled "extremophiles," meaning creatures that love extreme conditions.

Extremophiles incorporate a variety of protective molecules and enzymes. Some archaeons live in highly acidic environments. If the acid got into the archaeal cells, it would destroy their DNA, so they have to keep it out. But the defensive molecules on their cellular surfaces do come into contact with the acid and are uniquely designed not to break apart in it. Archaeons that live in very salty water (Halophiles) are able to keep all the fluid from dissolving out of their cells by producing or pulling in from the outside solutes such as potassium chloride that balance the inside of the cells with the salty water outside. Other enzymes allow other archaeons (Thermophiles and Psychrophiles) to tolerate extreme hot or cold. Another type (Methanogens) produce methane gas as a waste product of their "digestion," or process of making energy.

Another key is the life that preceded these life forms. The earliest of life may no longer be present on our planet. It is theorized that one of these life forms was LUCA (Last Universal Common Ancestor).[3] These ancestors were probably single-cell forms of life.

So in order to make other planets habitable, specific forms of life must be introduced to these dead planets. Where these forms of life no longer exist on Earth, they must be recreated. Some of these early forms may be specifically tailored to survive the individual planet's destructive nature. Genetic engineering provides this tool. These early life forms are the prime catalyst in spawning this transformation process.

I. Experimental Planets

Venus and Mars are our two closest neighboring planets. Venus is ~ 72% closer to the sun than Earth. While Mars is ~ 52% further away from the sun than Earth. Venus and Earth are approximately the same size. The diameter of planet Venus is 7,500 miles while Earth is 8,100 miles. But Mars is significantly smaller. It's diameter is only 4,200 miles and Mars only has ~11% the mass of Earth. Earth and Venus have almost identical gravitational pull on the surface of the planet, whereas Mars has ~ 38% the gravity of Earth.

All three planets spin on their axis. On Earth, this rotation takes 24 hours (1 day). Mars is very similar to Earth. Mars completes one rotation in 24 hours 37 minutes. But Venus is very anomalous. It spins retrograde (in the opposite direction) and it spins extremely slowly. Venus completes one (synodic period) rotation in 117 (Earth) days.

A magnetized planet creates a cavity in the solar wind around itself called magnetosphere, which the solar wind cannot penetrate. Earth's magnetosphere protects the planet from solar winds and solar storms. But both Venus and Mars lack a minimal planetary magnetic field. This is very important because solar radiation energizes atmospheric particles so that they accelerate and escape from the planets. This is also important because any life on Venus and Mars would be subjected to high levels of radiation during solar storms.

Venus has an atmosphere made of 96% carbon dioxide (CO_2) and 3.5% nitrogen (N_2). The atmosphere on Venus is oppressively thick; the air pressure is 92 times the Earth's surface atmospheric pressure. This crushing pressure is the same as would be experienced ~1 kilometer under the ocean surface on Earth. The atmospheric composition of Mars is similar to Venus. Mars has an atmosphere made of 95% carbon dioxide (CO_2), 3% nitrogen (N_2) and 1.6% argon. Mars on the other hand has a very minimal atmosphere, only about 0.7% of the atmospheric pressure on Earth. This is equivalent to the thin atmosphere present in the Earth's stratosphere, 35 kilometers above the surface of our planet. The atmosphere of Earth is very different than that of Mars and Venus. Earth's atmosphere is 78% nitrogen (N_2) and 21% oxygen (O_2). In part, this is due to the presence of Earth's magnetic field. But I also suspect, life has played a significant role in molding our atmosphere.

The average temperature of Venus is fairly constant ~864º F both day and night. It is a hellish place. The average temperature on Mars is 20º F during the day and -120º F during the night. On Earth, our average temperature is 75º F during the day and 40º F during the night.

Venus and Mars have been given to us as experimental planetary way stations. These planets allow us to explore evolutionary shortcuts. Granted without a magnetic field, these planets may be a hard nut to crack. But if we could transform a toxic wasteland such as Venus into a habitable planet in a wink of the eye in geological time, then we would be well on our way to seeding life throughout the known universe and beyond.

III. THE PRIME

Environmental extremist speak all the time about *saving the planet*. They theorized that the miniscule amount of carbon dioxide generated by man's industries and inventions has tipped the natural balance and generated massive global warming that will soon cook our world like an oven. But sit back and take a pause! The world is not in danger from this imaginary threat. To say that this theory is scientifically implausible is an understatement.

Earth faces real threats. We don't need to waste our time and energy combating imaginary ones. Asteroids and comets over millions of years have taken a deadly toll on life on our planet. We are the first species capable of developing technologies to preclude this from ever happening again; of shielding the diverse range of fauna and flora that make up our world. A true environmentalist would understand these real threats. All living creatures on Earth from eagles to polar bears, from dragonflies to the mighty whale are relying on us to *save the planet* from future doom!

Man is not the threat! Rather, great cataclysmic events are. They roar from the sky and then comes death. This impact threat is not imaginary. It has happened before and will happen again.

That is the PRIME. It is why we are here. Our mission is to protect our home, our planet Earth from great natural cataclysms.

And our second PRIME is to seed the universe with life.

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