Making Humans a Multi-planetary Species Why? Where ? How?

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***Abstract*—I think there are really two fundamental paths, History is going to bifurcate along two directions. One path is we stay on Earth forever, and then there will be some eventual extinction event. I do not have an immediate doomsday prophecy, but eventually, history suggests, there will be some doomsday event.The alternative is to become a space-bearing civilisation and a multi-planetary species, which I hope you would agree is the right way to go. If you look at things over a broad span of time the things that are less important kind of fall away and if you look at things from the broadest possible span of time as it relates to life itself and the evolution of life has been primitive life started around 3.5 to 3.8 billion years ago and what are the important steps in the evolution of life, is obviously there was the advent of single celled life then there was differentiation to plants and animals, there was life going from the oceans to land there was a mammals, consciousness and I would argue also on that scale should fit life becoming multi-planetary and in fact I think consciousness is the next step actually because you really kind of need consciousness to design vehicles that can transport life over hundreds of millions of miles of irradiated space to an environment that they did not evolve to exist. It would be very convenient of course if there was another planet just like Earth nearby but that's unlikely and as it turns out not the case I think if one could make a reasonable argument that that something is important enough to fit on the scale of evolution then it's important and may be worth a little bit of our resources.As everything in this universe even us humans might get extinct if we don't do what is required to be done to avoid human extinction.So how do we figure out how to take you to Mars and create a self-sustaining city, A city that is not merely an outpost but which can become a planet in its own right, allowing us to become a truly multi-planetary species.There really is a way that anyone could go if they wanted to.**

Keywords—doomsday, extinction, mars, evolution, self-sustaining city .

I. INTRODUCTION

Imagine a universe in which 1 million human beings have constructed a high-tech civilisation on Mars and are living out their lives on the Red Planet, around *225 million Kilometres from Earth*. If Elon Musk's dream comes true, this will be *our universe* within the next 100 years.As early as 2040, Musk hopes to have thousands or tens of thousands of people living in a city-like colony on Mars. From there, he hopes to continue to increase the colony's size until it exceeds one million people, at which point he believes there will be a sufficient number of people to "recreate the entire industrial base," resulting in a sustainable civilisation on Mars."Why in the world would he want to do that?," you might ask. I would like to answer this question in a different way , "Why in the world wouldn't he want to do that?,".

II. WHY?

What would we do if asteroid comes and hits earth or aliens invade us or there is collapse of the ecosystem we need a backup plan, and going to mars is our backup plan. One thing is for sure that not all of the humanity would be saved if something like this would happen but at least we can avoid the extinction of the greatest species of the universe we've ever known.

And there's another reason we should go, exploration is in our DNA. Two million years ago humans evolved in Africa and then slowly but surely spread out across the entire planet by reaching into the wilderness that was beyond their horizons. This stuff is inside us. And they prospered doing that. Some of the greatest advances in civilization and technology came because we explored. Yes, we could do a lot of good with the money it will take to establish a thriving colony on Mars. To make a stronger point and get "Why?" answered here are the 10 ways how the life on earth could come to end .

III. 10 WAYS WORLD COULD END

President George W. Bush said in one of the press conference Whatever it costs to defend our security, and whatever it costs to defend our freedom, we must pay it.I agree with the president. He wants two trillion dollars to protect us from terrorists next year, a two-trillion-dollar federal budget, which will land us back into deficit spending real fast. But terrorists aren't the only threat we face. There are really serious calamities staring us in the eye. I would propose, therefore, that if we took 10 billion dollars from that 2.13 trillion dollar budget which is two one hundredths of that budget and we doled out a billion dollars to each one of these problems the vast majority could be solved, and the rest we could deal with. So here are 10 ways world could possibly end.

10 . We loose the desire to live

People around the world are getting better medicine - but mentally, we're falling apart. The World Health Organisation now estimates that one out of five people on the planet is clinically depressed. The WHO also says that depression is the biggest epidemic that humankind has ever faced.
Our life longevity is going up almost a year for every year that passes. Now the problem with all of this, getting older, is that people over 65 are the most likely people to commit suicide.

9. Aliens Invade Earth

There must be millions of planets in the Milky Way. It’s becoming obvious that the chance that life does not exist elsewhere in the universe is a fairly remote idea. And the chance that some of it isn’t more intelligent than ours is also a remote idea. Remember, we’ve only been an advanced civilisation , an industrial civilisation, if you would for 200 years. There is likelihood that we will confront a civilisation that is more intelligent than our own. Now, what will happen? What if they come to suck up our oceans for the hydrogen? And swat us away like flies, the way we swat away flies when we go into the rainforest and start logging it.

8 . The Ecosystem Collapse

According to recent studies of oceanographers, Oceans are not in trouble, they’re near collapse. Many other ecosystems on Earth are in real, real danger. We’re living in a time of mass extinctions that exceeds the fossil records by a factor of 10,000. And when one ecosystem collapses it could take a major ecosystem with it, like our atmosphere.

7. Particle Accelerator Mishap

Ted Kaczynski, the Unabomber.One of the things he raved about was that a particle accelerator experiment could go haywire and set off a chain reaction that would destroy the world.
There's a collider at Brookhaven, it's going to have an experiment in which it creates black holes.They are expecting to create little, tiny black holes.They expect them to evaporate.I hope they're right. Most physicists say that the accelerators we have now are not really powerful enough to create black holes that we need to worry about, and they're probably right.But, all around the world, in Japan, in Canada, there's talk of building very big accelerators.

6. Biotech Disaster

Bt corn is a corn that creates its own pesticide to kill a corn borer.This stuff was supposed to only be feed for animals in the United States, and it got into the human food supply. This brings back a skepticism that has gone away recently, that superweeds and superpests could spread around the world, from biotechnology, that literally could destroy the world's food supply in very short order.

5. Reversal of the Earth's magnetic field

Believe it or not, this happens every few hundred thousand years, and has happened many times in our history. North Pole goes to the South, South Pole goes to the North, and vice versa. But what happens, as this occurs, is that we lose our magnetic field around the Earth over the period of about 100 years, and that means that all these cosmic rays and particles that are to come streaming at us from the sun, that this field protects us from, are well, basically, we're gonna fry.Scientists think now our magnetic field may be diminished by about five percent. So, maybe we're in the throes of it.

4. Giant solar flares.

Solar flares are enormous magnetic outbursts from the Sun that bombard the Earth with high-speed subatomic particles. So far, our atmosphere has done, and our magnetic field has done pretty well protecting us from this. Occasionally, we get a flare from the Sun that causes havoc with communications and so forth, and electricity. But the alarming thing is that astronomers recently have been studying stars that are similar to our Sun, and they've found that a number of them, when they're about the age of our Sun, brighten by a factor of as much as 20. Doesn't last for very long. And they think these are super-flares, millions of times more powerful than any flares we've had from our Sun so far. Obviously, we don't want one of those.

3. A new global epidemic

People have been at war with germs ever since there have been people, and from time to time, the germs sure get the upper hand.
In 1918, we had a flu epidemic in the United States that killed 20 million people. That was back when the population was around 100 million people. The bubonic plague in Europe, in the Middle Ages, killed one out of four Europeans. AIDS is coming back. Ebola seems to be rearing its head with much too much frequency, and old diseases like cholera are becoming resistant to antibiotics. We've all learned what the kind of panic that can occur when an old disease rears its head, like anthrax.

2. We meet a rogue black hole

Our comprehension of the way the universe works is really has just gained unbelievably in recent years. We think that there are about 10 million dead stars in the Milky Way alone, our galaxy. And these stars have compressed down to maybe something like 12, 15 miles wide, and they are black holes. And they are gobbling up everything around them, including light, which is why we can't see them. Most of them should be in orbit around something. But galaxies are very violent places, and things can be spun out of orbit. And also, space is incredibly vast. So even if you flung a million of these things out of orbit, the chances that one would actually hit us is fairly remote. But it only has to get close, about a billion miles away, one of these things. About a billion miles away, here's what happens to Earth's orbit: it becomes elliptical instead of circular. And for three months out of the year, the surface temperatures go up to 150 to 180. For three months out of the year, they go to 50 below zero.That won't work too well for us.

1. A really big asteroid heads for Earth.

The important thing to remember here this is not a question of if, this is a question of when, and how big. In 1908, just a 200-foot piece of a comet exploded over Siberia and flattened forests for maybe 100 miles. It had the effect of about 1,000 Hiroshima bombs. Astronomers estimate that little asteroids like that come about every hundred years. In

1989, a large asteroid passed 400,000 miles away from Earth. Nothing to worry about, right? It passed directly through Earth's orbit. We were in that that spot six hours earlier. A small asteroid, say a half mile wide, would touch off firestorms followed by severe global cooling from the

debris kicked up. An asteroid five miles wide causes major extinctions. We think the one that got the dinosaurs was about five miles wide. Where are they? There's something called the Kuiper belt, which some people think Pluto's not a planet, that's where Pluto is, it's in the Kuiper belt.
So you say, yeah, well, what are really the chances of this happening? 1/20000 equivalent to a person dying in an aircraft. We spend an awful lot of money trying to be sure that we don't die in airplane accidents, and we're not spending hardly anything on this. And yet, this is completely preventable. We finally have, just in the last year, the technology to stop this cold.

I know your head is spinning from all this stuff. But we don't want to get caught flat-footed, we know about this stuff, Science has the power to predict the future in many cases now, Knowledge is power.
The worst thing we can do is say, jeez, I got enough to worry about without worrying about an asteroid.
That's a mistake that could literally cost us our future.

IV. WHERE?

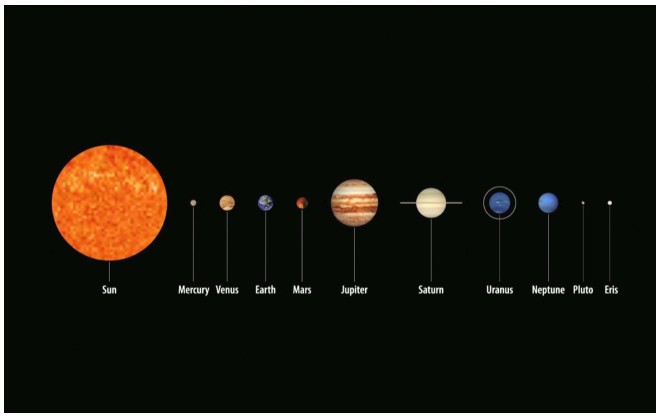

Figure 1. Our Solar System As We Know IT

Our options for becoming a multi-planetary species within our solar system are limited. We have, in terms of nearby options, Venus, but Venus is a high-pressure, super-high-pressure, hot acid bath, so that would be a tricky one. Venus is not at all like the goddess. So, it would be really difficult to make things work on Venus.Then, there is Mercury, but that is way too close to the sun. We could potentially go onto one of the moons of Jupiter or Saturn, but those are quite far out, much further from the sun, and much harder to get to.It really only leaves us with one option if we want to become a multi-planetary civilisation, and that is Mars.

We could conceivably go to our moon, and I actually have nothing against going to the moon, but I think it is challenging to become multi-planetary on the moon because it is much smaller than a planet. It does not have any atmosphere. It is not as resource-rich as Mars. It has got a 28-day day, whereas the Mars day is 24.5 hours. In general, Mars is far better-suited ultimately to scale up to be a self-sustaining civilisation.To give some comparison between the two planets, they are remarkably close in many ways. In

fact, we now believe that early Mars was a lot like Earth. In effect, if we could warm Mars up, we would once again have a thick atmosphere and liquid oceans.

Mars is about half as far again from the sun as Earth is, so it still has decent sunlight. It is a little cold, but we can warm it up. It has a very helpful atmosphere, which, being primarily CO2 with some nitrogen and argon and a few other trace elements, means that we can grow plants on Mars just by compressing the atmosphere.It would be quite fun to be on Mars because you would have gravity that is about 37% of that of Earth, so you would be able to lift heavy things and bound around. Furthermore, the day is remarkably close to that of Earth. We just need to change the populations because currently we have seven billion people on Earth and none on Mars.

There has been a lot of great work by NASA and other organisations in the early exploration of Mars and understanding what Mars is like. Where could we land? What is the composition of the atmosphere? Where is there water or ice? We need to go from these early exploration missions to actually building a city.

	Earth	Mars
Diameter	12,756 km / 7,926 mi	6,792 km / 4,220 mi
Average Distance From Sun	150,000,000 km / 93,000,000 mi	229,000,000 km / 142,000,000 mi
Temperature	−88C TO 58C / −126F TO 138F	−140C TO 30C / −285F TO 88F
Atmospheric Composition	78% N2, 21% O2, 1%	96% CO2, < 2% Ar, <2% N2, < 1% OTHER
Force Of Gravity (Weight)	100 lbs On Earth	38 lbs ON MARS (62.5% LESS GRAVITY)
Day Length	24 hrs	24 hrs 40 min
Land Mass	148.9 MILLION km2	144.8 MILLION km2 (97% OF EARTH)

Table.1 Comparison of Earth and Mars

V. HOW?

Mars is a long way away, a thousand times farther away from us than our own moon. The Moon is 250,000 miles away and it took Apollo astronauts three days to get there. Mars is 250 million miles away and it will take us eight

months to get there I.e 240 days And that's only if we launch on a very specific day, at a very specific time, once every two years, when Mars and the Earth are aligned just so, so the distance that the rocket would have to travel will be the shortest. 240 days is a long time to spend trapped with your colleagues in a tin can.

Meanwhile, our track record of getting to Mars is lousy. The Americans, the Russians, the Europeans, the Japanese, the Chinese and the Indians, have actually sent 44 rockets there,

and the vast majority of them have either missed or crashed. Only about a third of the missions to Mars have been successful. And we don't at the moment have a rocket big enough to get there anyway. We once had that rocket, the Saturn V. A couple of Saturn Vs would have gotten us there. It was the most magnificent machine ever built by humans, and it was the rocket that took us to the Moon. But the last Saturn V was used in 1973 to launch the Skylab space station, and we decided to do something called the shuttle instead of continuing on to Mars after we landed on the Moon.

The biggest rocket we have now is only half big enough to get us anything to Mars. So getting to Mars is not going to be easy and that brings up a really interesting question … How soon will the first humans actually land here? Now, some pundits think if we got there by 2050, that'd be a pretty good achievement. These days, NASA seems to be saying that it can get humans to Mars by 2040. Maybe they can. I believe that they can get human beings into Mars orbit by 2035. But frankly, I don't think they're going to bother in 2035 to send a rocket to Mars, because we will already be there. We're going to land on Mars in 2027. And the reason is this man “Elon Musk” is determined to make that happen. Now, he actually told that we would land on Mars by 2025, Still … you've got to ask yourself, can this guy really do this by 2025 or 2027? Well, let's put a decade with Elon Musk into a little perspective. Where was this 10 years ago? SpaceX had not launched anything, or fired a rocket to anywhere. And now that is SpaceX's Falcon 9 rocket, lifting six tons of supplies to the International Space Station. So I think it's a pretty good bet that the person who is revolutionising the automobile industry in less than 10 years and the person who created an entire rocket company in less than 10 years will get us to Mars by 2027.

Governments and robots no longer control this game. Private companies are leaping into space and they will be happy to take you to Mars. And that raises a really big question.

VI. CAN WE ACTUALLY LIVE THERE?

Now, NASA may not be able to get us there until 2040, or we may get there a long time before NASA, but NASA has taken a huge responsibility in figuring out how we can live on Mars. Let's look at the problem this way. Here's what you need to live on Earth: food, water, shelter and clothing. And here's what you need to live on Mars: all of the above, plus oxygen. So let's look at the most important thing on this list first. Water is the basis of all life as we know it, and it's far too heavy for us to carry water from the Earth to Mars to live, so we have to find water if our life is going to succeed on Mars. And if you look at Mars, it looks really

dry, it looks like the entire planet is a desert.But it turns out that it's not. The soil alone on Mars contains up to 60 percent water. And a number of orbiters that we still have flying around Mars have shown us that lots of craters on Mars have a sheet of water ice in them. It's not a bad place to start a colony Now, Orbiters also tell us that there are huge amounts of underground water on Mars as well as glaciers. In fact, if only the water ice at the poles on Mars melted, most of the planet would be under 30 feet of water. So there's plenty of water there, but most of it's ice, most of it's underground, it takes a lot of energy to get it and a lot of human labor.

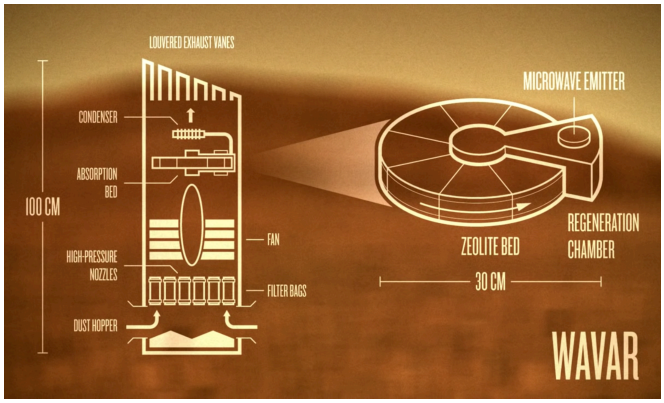

Figure 2. Wavar which is used as a dehumidifier

There is a device made up at the University of Washington back in 1998.It's basically a low-tech dehumidifier. And it turns out the Mars atmosphere is often 100 percent humid. So this device can extract all the water that humans will need simply from the atmosphere on Mars.

Next we have to worry about what we will breathe. NASA has this problem worked out. There is a scientist at MIT named Michael Hecht. And he’s developed this machine, Moxie. It's a reverse fuel cell, essentially, that sucks in the Martian atmosphere and pumps out oxygen. And you have to remember that CO2 carbon dioxide, which is 96 percent of Mars' atmosphere, CO2 is basically 78 percent oxygen. Now, the next big rover that NASA sends to Mars in 2020 is going to have one of these devices aboard, and it will be

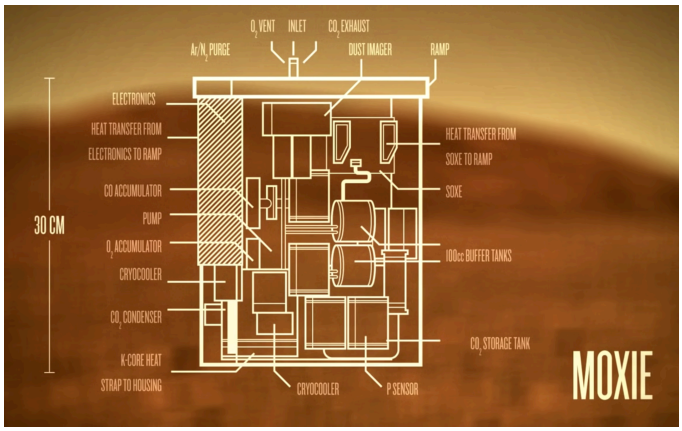

Figure 3. Moxie , Reverse fuel cell to produce O2

able to produce enough oxygen to keep one person alive indefinitely.
Next, what will we eat? Well, we'll use hydroponics to grow food, but we're not going to be able to grow more than 15 to 20 percent of our food there, at least not until water is running on the surface of Mars and we actually have the probability and the capability of planting crops. In the meantime, most of our food will arrive from Earth, and it will be dried.

Then we need some shelter. At first we can use inflatable, pressurized buildings as well as the landers themselves. But this really only works during the daytime. There is too much solar radiation and too much radiation from cosmic rays. So we really have to go underground. Now, it turns out that the soil on Mars, by and large, is perfect for making bricks. And NASA has figured this one out, too. They're going to throw some polymer plastic into the bricks, shove them in a microwave oven, and then you will be able to build buildings with really thick walls. Or we may choose to live underground in caves or in lava tubes, of which there are plenty.

And finally there's clothing. On Earth we have miles of atmosphere piled up on us, which creates 15 pounds of pressure on our bodies at all times, and we're constantly pushing out against that. On Mars there's hardly any atmospheric pressure. So Dava Newman, a scientist at MIT, has created this sleek space suit. It will keep us together, block radiation and keep us warm. So let's think about this for a minute. Food, shelter, clothing, water, oxygen ...we can do this.We really can. But it's still a little complicated and a little difficult. So that leads to the next big, really big step in living the good life on Mars. And that's terraforming the planet: making it more like Earth, reengineering an entire planet. That sounds like a lot of hubris, but the truth is that the technology to do everything I'm about to tell you already exists. First we've got to warm it up. Mars is incredibly cold because it has a very thin atmosphere. The answer lies here, at the south pole and at the north pole of Mars, both of which are covered with an incredible amount of frozen carbon dioxide dry ice. If we heat it up, it sublimes directly into the atmosphere and thickens the atmosphere the same way it does on Earth. As the planet spins, it will heat up all that dry ice, sublime it, and it will go into the atmosphere. It actually won't take long for the temperature on Mars to start rising, probably less than 20 years. Right now, on a perfect day at the equator, in the middle of summer on Mars, temperatures can actually reach 70 degrees, but then they go down to minus 100 at night. What we're shooting for is a runaway greenhouse effect: enough temperature rise to see a lot of that ice on Mars especially the ice in the ground melt. Then we get some real magic. As the atmosphere gets thicker, everything gets better. We get more protection from radiation, more atmosphere makes us warmer, makes the planet warmer, so we get running water and that makes crops possible. Then more water vapour goes into the air, forming yet another potent greenhouse gas. It will rain and it will snow on Mars. And a thicker atmosphere will create enough pressure so that we can throw away those space suits. We only need about five pounds of pressure to survive. Eventually, Mars will be made to feel a lot like British Columbia. We'll still be left with the complicated problem of making the atmosphere breathable, and frankly that could take 1,000 years to accomplish. But humans are amazingly smart and incredibly adaptable. There is no telling what our future technology will be able to accomplish and no telling what we can do with our own bodies.

Conclusion

In biology right now, we are on the very verge of being able to control our own genetics, what the genes in our own bodies are doing, and certainly, eventually, our own evolution. We could end up with a species of human being on Earth that is slightly different from the species of human beings on Mars. But what would you do there? How would you live? It's going to be the same as it is on Earth. Somebody's going to start a restaurant, somebody's going to build an iron foundry. Someone will make documentary movies of Mars and sell them on Earth. There will be software companies, there will be hotels, there will be bars. This much is certain: it will be the most disruptive event in our lifetimes, and I think it will be the most inspiring.

Most importantly, it will make us a spacefaring species. And that means humans will survive no matter what happens on Earth. We will never be the last of our kind.

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