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FLIGHT 7 – EXCITEMENT BUILDING …

Excitement (and tension) is building about Flight 7 of the Starship - the next, crucial step in the rocket system's development. The flight could take place as early as mid-January.

Find out what's in store…

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MARSWORLD – CHAPTER ANALYSIS

Owen Louis David gives an overview of Chapter 3 in his book *Marsworld* which is focussed on the huge potential of the Mars economy. Owen is what he calls a "rational super-optimist" about Mars's economic prospects. From selling TV rights, to selling life support services to agencies like NASA, from a drive for self-sufficiency using industrial 3D printers, to universities setting up campuses on the Red Planet, this is going to be a miracle economy growing at unprecedented rates. Per capita levels of capital investment will be off the scale compared to Earth. Expect success!

(See page 3)

Geothermal breakthrough

Could a new fusion drill technology provide easy access the geothermal rock layer and provide a new energy source that could be used across Earth? More importantly could this also be used on Mars as an alternative energy and as a way of accelerating terraformation? Mary Khan investigates

There's lots more inside including all your favourite features.

Online Bust-Up

By Victor Samuels

Sabine Hossenfender is a You Tuber who has gained a lot of followers by explaining some of the more rarified aspects of physics, cosmology and the like to what you might call a "popular science" audience.

More recently, though, she's been publishing videos on climate change and then the other week she posted one on the subject of Mars colonisation. Hmmm… It's a pretty odd video to be honest. It purports to be an honest and balanced assessment of whether Musk's plans for a Mars Mission to establish a colony are ethical and achievable. Amongst other it uses pronouncements from Bill Maher (the US Talk Show host) and Neil de Grasse Tyson.

She comes to the conclusion (very much like the Weinersmith's in their awful book, *A City on Mars*) that we shouldn't go yet, that we should wait until we have all the technological answers in the palm of our hands – in the meantime we can address all the pressing problems back on the home planet. Even more recently she's published a video on Bezo's idea for creating artificial orbital worlds. However, he gets a free pass on that.

Our very own Owen Louis David has been posting a lot of comments on the video on her channel. I think I am in total agreement with the points he's been making.

Essentially the people he calls "Stay-Putters" exaggerate the dangers of Mars while underplaying all the many dangers of Earth (eg hurricanes and tsunamis). They fail to explain how long it's going to take to sort out Earth's problems (which they don't define in detail in any case). They also fail to say to who is going to decide what constitutes a problem and when it's been resolved.

In my view Earth is unlikely to achieve a final resolution of problems like climate change, industrial and plastics pollution, social inequality and extreme poverty for decades. So this would probably mean putting off a Mars Mission until after 2100. Musk isn't going to accept that and neither do I!

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In the News...

Geothermal breakthrough.

By Mary Khan

We know that solar power will work on Mars as the prime energy source for Mars colonisation. But it would be cool if we could find some other ways of ensuring Mars has the energy it needs. Longer term solar won't be good for terraformation because you won't be putting more energy into the surface and atmosphere than is already absorbed through insolation (unless you use orbiting solar reflectors).

We know geothermal works on Earth but only at sites where superheated rock is pretty close to the surface.

Dr Ben Miles has a video on his You Tube channel explaining how this could be about to change.

The problem up to now has been that drilling down to where the superheated rock is, in most locations (about 10 kms to 20 kms below the surface), can literally take years – about 2 kms a year from what I have seen and read. That's way too long, remembering that time is money and this all translates into high cost.

But now a company called Quaise could be about to change all that. It has developed a fusion drill that uses fusion power to melt rock, allowing it to drill down at incredibly fast speeds. If the technology lives up to its billing, it could mean we can drill down to 10 kms in just 100 days. Once there (and beyond) we can reliably begin tapping into geothermal energy to power electricity generators and heat water.

The consensus is that Mars also has geothermal energy below the surface like Earth. Wouldn't it be cool if we could tap into it using this new technology!

But I had a "light bulb" moment as well...couldn't we also use this technology to simply release heat and gases to the surface and into atmosphere. Could this technology be used to help make terraformation a reality? There's a (nice) thought.

Maybe we could have tens of thousands of these drill holes releasing heat and gas into the environment on Mars. Totally brilliant!

MARSWORLD

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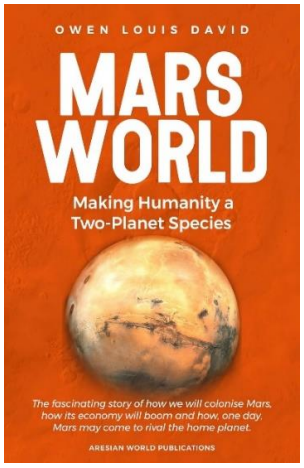

MARSWORLD – CHAPTER BY CHAPTER

By Owen Louis David

***EACH MONTH OWEN LOUIS DAVID IS SUMMARISING AND EXPLAINING A CHAPTER IN HIS BOOK,* MARSWORLD**

CHAPTER 3 – THE MARS ECONOMY

The Mars economy will be the key determinant of how successful we are going to be in our new role as a *"multi-planetary species"* which is why in a way this Chapter is the most important part of this book. A Mars civilisation that is entirely dependent on the Earth economy would essentially mean that we had *not* achieved that status of being a "multi-planetary species". We would simply be an *"Earth-Plus"* species. Were we just an Earth-Plus species, then, should civilisation on Earth collapse for some reason, the likelihood is that it would also collapse on Mars, certainly as long as Mars was in the pre-terraformation stage and dependent on a wide variety of imported artificial systems to keep life going on the Red Planet.

For humanity to be a truly "multi-planetary species" there has to be on Mars an extremely high degree of replication of advanced Earth-based civilisation, most especially in relation to the economy. Self-sufficency is key.

Self-sufficiency can be thought of as an ideological goal, to provide an insurance policy for the survival of human civilisation. But it will also be driven by internal economic logic.

For instance, if the colonists relied on importation from Earth, the food bill would be something like $1200 per person per ***sol*** on Mars (before you add on costs of storage and distribution on Mars). That would make the food bill

for just one million people a staggering $438 billion per Earth annum, minimum. It's easy to see how those sorts of economics will push the people of Mars to create their own "in-house" agricultural sector and stop importing food from Earth. Every billion saved on the imported food bill makes the Mars colony a billion richer.

This chapter explains that the Mars economy will need to be effective on three levels: agriculture (keeping people alive by feeding them), industry (providing all the things that people need) and services (ensuring that the full range of services is provided). Of course, self sufficiency on Mars doesn't equate to a complete replication of what is being produced and serviced on Earth. If you go on Amazon you might find 200 electric kettle design. Perhaps the people of Mars can get by on 20.

In this Chapter I argue that we need to change our perceptions of Mars. Once Australia was written off as a mostly desolate wasteland of little use to anyone. Now it one of the richest and most successful countries on Earth. When we look at Mars we should see opportunity. He is a planet with virtually the same land surface as Earth and a range of mineral resources that are very similar to Earth's.

Mars has many economic advantages that too few people take into consideration. Most importantly, Mars does not experience truly destructive weather events as we see occurring with alarming frequency on Earth. On Mars the weather is cold but otherwise kind and clement. The absence of major rain storms, snowstorms, ice storms, floods, tornadoes, hurricanes, lightning strikes and so on means

Mars avoids major detrimental costs. Mars also has very little seismic activity and what there is seems to be very mild. Contrast that with Earth where quakes can devastate whole cities and regions. Of course, no oceans there is no risk of super-destructive tsunamis either. A win-win.

One fact about Mars that often surprises people is that heat retention in buildings will be far superior to equivalent buildings on Earth. This is because the very low pressure of the atmosphere makes Mars air a poor conductor of heat.

The fact that there are no large bodies of liquid water on Mars, such as oceans, lakes and rivers means that there is no

requirement to spend trillions of dollars every year on building and maintaining bridges, dams and sea defences or indeed creating deep water ports, dredged channels and the like. This will remain the case for probably hundreds of years on Mars before terraformation begins to generate flowing water.

On Earth, road building and maintenance eats up huge chunks of public expenditure (which has to be paid for by tolls or taxes). On Mars there will be no need to build and maintain weatherproof roads of the type that dominate the home planet. Roadways on Mars can be simple affairs – routes over firm ground swept clear of boulders, rocks or accumulations of sand, being marked out by light-coloured rocks either side or with transponders sending radio signals to vehicles. These roadways can then be used by automated rovers so there will be a very minimal direct labour cost to the transportation system.

On Mars self-drive vehicles will be the norm. The urban environment will be built to make self-drive vehicles practical and outside the urban areas, traffic will be very light and non-complex. This again will represent a huge saving as the labour costs associated with driving transport vehicles can be eliminated entirely. Another gain is that the lower gravitational force on Mars, combined with the low-density atmosphere will mean it takes much less energy to move goods around on Mars.

Businesses on Earth, quite rightly, are now expected to devote significant proportions of their budgets to pollution control and other environmentally-friendly policies. Compared with Earth, pollution control on Mars will be a far more minimal exercise since, for instance, many gases regarded as pollutants on Earth will be positively welcomed on Mars as contributing to the terraformation process. Also, there are currently no water courses on Mars to pollute (though there will no doubt be controls over activities in the water icefields). So, as Mars is as yet unterraformed, we can also expect there to be savings on general "green-policy" expenditure.

Mars is virgin territory when it comes to mineral acquisition, which is another clear advantage. This means that there will be more mineral resources available near the surface than there currently are on Earth (where easily accessible sites have long since been exhausted) and so deep mining or large-scale open cast

mining will not be necessary on Mars in the early colony period, especially as the tonnages required will be modest. This represents a significant cost saving.

When we look at socio-economic conditions in the early colony, we can see Mars will enjoy huge advantages. In an advanced economy on Earth, you might find that as few as 60% of the population are economically active. On Mars the figure will be closer to 99% giving it a huge per capita productive advantage. In addition, whereas on Earth up to 25% of the employed population might be engaged in part-time work, this isn't going to be the case on Mars in the early period: in fact, I would expect nearly all of the 99% to be engaged in full time employment in the early years. Moreover the workforce will be younger and healthier compared with equivalent workforces on Earth. All this points to extremely high labour productivity on Mars.

Another important socio-economic factor on Mars will be the much lower health and welfare support costs. This will reflect the fact that the early inhabitants of Mars will constitute a much younger adult population, who will already have been screened for good health.

Mars will also not have to lavish vast sums on defence, police, criminal justice and a host of other public services, as we see on Earth.

When it comes to trade with Earth, Mars will Mars enjoy a huge comparative advantage in trade. For any given item made on Earth you have to add a huge margin for the cost of transport from Earth. So this will be a huge stimulus to industrial growth and self-sufficiency.

In this Chapter I set out in detail how a Mars economy will flourish.

The initial Mars landings will create a media firestorm. In turn, this will generate all sorts of marketing and merchandising opportunities: TV specials, advertising on Mars, computer games, sponsorship deals, toy branding deals, coffee table books and so on. Also, note that artefacts from Mission One to Mars (and also later missions) will have tremendous auction value back on Earth. Just think of all those Starship parts and interiors that could be sold back on Earth. Just imagine all those items that could be sold to museums back on Earth that would make them centrepieces of their collections (space suits, rovers, habs – everything can be brough back by later Starships).

So, the Mars economy will get off to a flying start in terms of generating billions of dollars of revenue. What follows? Well I think we will then see the era of life support services being the bedrock of the Mars economy. Organisations like NASA and a range of other space agencies, together with major companies, charities (eg climate change institutes) and universities will want to undertake hundreds of missions on Mars researching a wide range of phenomena – the planet's geology and mineral resources, the atmosphere, ancient or existing life forms, and how climate has changed on the Red Planet. Space X or a Mars Development Corporation will earn billions of dollars in revenue from selling transit, accommodation and life support services to these agencies. This will be an ongoing revenue stream. We will no doubt see major elite universities setting up elite post-graduate institutions on Mars.

Once a base has been full established on Mars, we will see the Mars economy receive another boost from the drive for self-sufficiency. This will go hand-in-hand with the creation of Mars's first planned city. Mars will develop a small scale (but less complex) version of Earth's economy covering agriculture, mining, industry and services. Technologies developed in recent decades such as 3D printing, industrial robots and humanoid robots will all be integral to this process. Think of the process as being like Mars working its way through the Amazon list building up stores of all sorts of products from domestic appliances to bedding to power tools – all the millions of products we take for granted. Behind this self-sufficiency will be really big mining operations, undertaken largely by robots, and major processing units where ores will be purified and a range of chemicals extracted.

By the time the Mars city is established Mars will enjoy its own very vigorous economy. This is a point sometimes lost in the mix: it's not simply a question of Earth supplying Mars. As the number of people on Mars grows, their needs have to be fulfilled just as on Earth and they will be fulfilled by Mars-based entities and individuals.

This Chapter in my book also notes how important the level of capital investment (expenditure on things like transport systems, factories and machines) on Mars is going to be. Whereas in the USA the annual per

capita level of capital investment is something like $11,000, on Mars it will be measured in the millions. Remember firstly, how few people there will be to begin with. Capital investment is one of the keys to developing a highly productive and therefore wealthy economy. Mars will attract huge investment from Space X, personal donations from Musk and external agencies such as Universities.

STARSHIP FLIGHT NO. 7 – COMING SOON…A VITAL STEP ON THE PATH TO MARS.

By the Editorial Team

Flight no. 7 is coming soon! Space X have FAA approval for the flight which will consist of Booster 33 and Ship 13. It's possible, if all goes well, that the flight could take place in mid-January.

So what can we expect from Flight 7? Well, some of you may be disappointed to learn that it is again a sub-orbital flight. That can sound a little unambitious. But Space X have adopted a very methodical approach and each flight takes us closer to the goal of a Mars-ready Starship. Getting from sub-orbital to orbital is probably one of the easiest steps in the whole business. So, for the time being, the emphasis is on getting things like heat resistant tiling right for the re-entry.

Ship 14 has been spotted with some unusual red tiles around the nose cone. The speculation is that these are special tiles that will be use to boost heat resistance at various critical locations on the Starship.

Ship 14 has already completed its own engine testing. Booster 33 has recently been put through its paces with static fire tests in preparation for launch.

The launch pad is close to being ready after some fairly substantial refurbishment.

So it really does look good for a mid-January launch with 11 January being mentioned as the earliest possible date.

New tanks have been installed in the orbital tank farm but these will not be used for Flight 7. Essentially Space X are increasing their ability to store propellant and fuel at the launch site, obviating the need for multiple tanker deliveries.

THE LATEST WEATHER ON MARS

Here's your update for the weather on Mars provided by the Curiosity Rover in Gale Crater.

For the nearest Sol to 17 December **2024** we have a *high* of **minus 21 degrees Celsius** (minus 6 degrees Fahrenheit). The low for the same date, at **minus 74 Celsius** (or minus 101 degrees Fahrenheit), is a degree colder than the the measurement last month. The record low on Earth (minus 89.2 Celsius) was registered at Vostok on Antarctica in 1983. We haven't got down to that temperature yet at Gale Crater since we've been covering the weather there,

EARTHLINGS ALSO WELCOME AT

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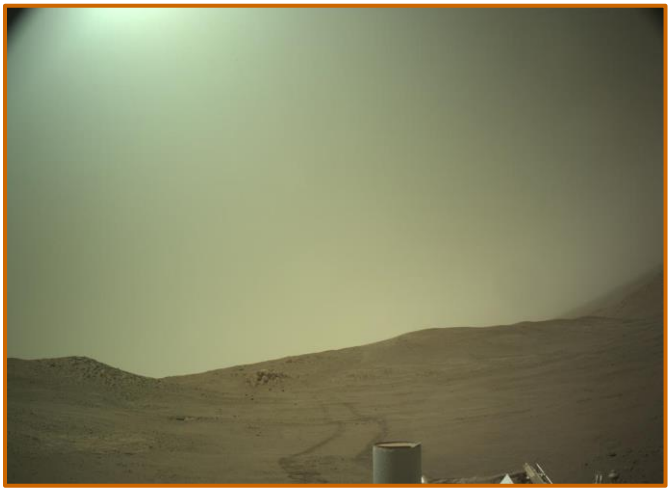
PICK OF THE PICS



Credi: NASA

A lovely image from the Mars Perseverance Rover from this month showing it hard at work (look at the tracks it's made in the sandy surface).

Credit: NASA

This issue's pic was picked by the Editorial Team.

Do send us your favourite Mars pics.

REMEMBER - NOT LONG NOW TILL THE MARS MISSION BEGINS FOR REAL.