BY MATT LUNDY

The Road to the Red Planet

For humanity to secure its survival in the unforeseen future, we must go to Mars. At least, that's what Elon Musk, leader of space exploration company SpaceX, believes. Indeed, if humanity were to become a multi-planet species, it would increase its chances of long-term survival. However, establishing a self-sustaining colony on Mars would be one of the greatest challenges humanity has ever faced. There are a number of potential issues that must be addressed, from technological and economical concerns to psychological and political ones. Nevertheless, the advantages behind such an undertaking may be too great to forfeit.

There are at least two incentives for a long-term human settlement on Mars. First, an interplanetary species has immensely higher odds of long-term survival. If we were to live on two (or more) planets, we would have a backup in case of doomsday events such as super volcano eruption, giant asteroid impact, nuclear holocaust, or resource depletion. As Musk argues, "One path is we stay on Earth forever, and then there will be some eventual extinction event… The alternative is to become a space-bearing civilization and a multi-planetary species, which I hope you would agree is the right way to go."[6] In choosing to become interplanetary, humanity would be declaring its will to survive, even in the face of possibly apocalyptic circumstance.

From a more grounded perspective, the technological advancements that would result from pushing humans deeper into space are also immense. Past space ventures have generated vital technologies ranging from LEDs to solar energy acquisition and water purification advancements.[11] The strict and severe parameters that accompany space travel push engineers working on such projects to innovate in ways unseen in earthly projects. A Martian colony would be the greatest space undertaking yet, so the advancements that accompany it could be expected to be of similar magnitude.

Even if the motivations of going to Mars were unquestioned, reaching the Red Planet is still quite a challenge. Most proposed plans at this point share a similar overarching structure. Multiple missions of people and rockets would be sent to Mars in relatively quick succession. The ideal colony would be self-sufficient as soon as possible, as that would remove the risk of the

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colony failing due to problems on Earth.[4] This means that the colony would need enough people and materials to operate independently, from building replacement parts and gathering its own resources, to even producing its own rocket propellant.[6] A sustainable colony would then be able to grow into a fully developed civilization and the mission would be a categorical success.

Yet, such a complex and demanding undertaking is sure to be rife with problems. As it stands, a Martian colony would be outrageously expensive. For comparison, the Apollo program cost a staggering $100-200 billion to send just twelve people to the Moon, despite including no plans of long-term or permanent residence for its astronauts.[6] Current rocket technology makes a Mars colony unviable for any single party, and unlikely even for a group. Another issue would be the well-being of the colonists. A long spaceflight followed by an entire life spent within the confines of a spacesuit or a close-quarters Martian residence, with severely limited human contact, would be a gargantuan psychological undertaking.[2] This could then breed larger social problems, such as an in-group/out-group dichotomy, where new colonists would be met with hostility from their seniors who might perceive them as lesser due to their lack of experience.[4] The legal status of such a colony would also have to be addressed, preferably before the colony's creation. There is very little legislation that concerns property in space; a budding civilization would no doubt have great need for such laws. A final problem to consider would be how to deal with the fatality of prolonged dependency on Earth, which would render the benefit of Mars as a backup useless.

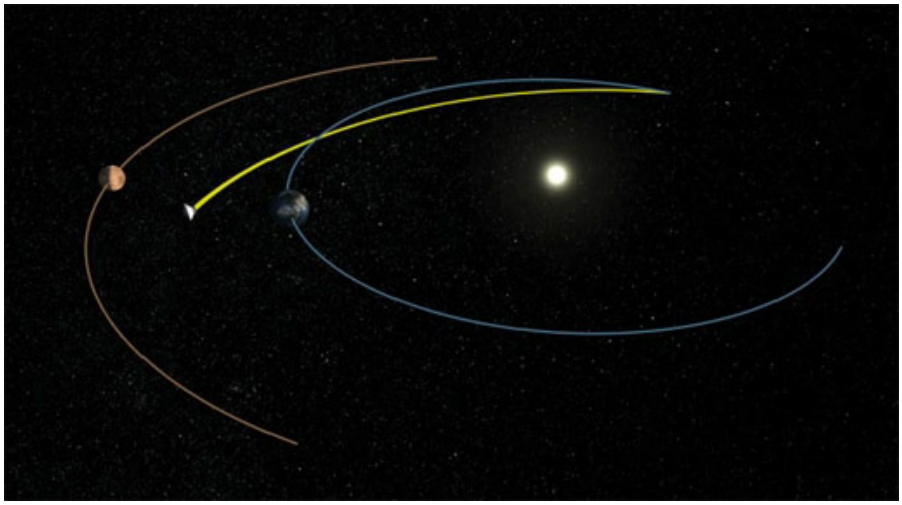

Figure 1. The best time for a mission to Mars would be when the orbits of Earth and Mars are closest, minimizing the distance the rockets have to travel.[12,13]

Although these are several significant issues, solutions are being theorized, and some are already in production.

In response to the exorbitant cost of a mission to Mars, SpaceX is investing heavily in creating sustainable and reusable rockets. Through technological progressions like this and in-orbit flight refueling, SpaceX estimates (in a best-case scenario) that the price could be reduced to $100,000-200,000 per trip. While this is expensive, it is quite cost-effective for such a huge mission, especially when compared to the Apollo missions.[6]

To facilitate a self-sustaining colony, initial missions could be outfitted with the extra material needed to construct infrastructure and repair machinery, something that would be made possible by lower costs.

Regarding further enabling self-sufficiency, the SAM (sample analysis) instrument on NASA's *Curiosity* rover found sufficient amounts of reduced sulfur to envisage sulfur redox chemistry as an energy source for supporting life on Mars. In other words, sulfur on Mars can undergo a chemical reaction that would release energy which could then be captured and used to support the energy needs of our potential colony.[8]

Unfortunately, there are not yet many unique solutions to indirect problems such as the psychological well-being of colonists or the potential political issues of a colony. There is some precedent in extensive training for astronauts and the current setup of the diplomatic International Space Station that we can look to for guidance, but as of now, these are underdeveloped solutions that must be improved upon significantly for an actual colony mission.

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However, there is one final motivation to make the voyage to the Red Planet, which once inspired millions of everyday people to earnestly yearn for humans to step foot on the moon. In the words of the man who spoke it into existence 56 years ago, former President John F. Kennedy:

> *We choose to go to the Moon! We choose to go to the Moon in this decade... not because [it is] easy, but because [it is] hard; because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one we intend to win...*[15]

We can now find this impulse in our pursuit of traveling to Mars. The mission will be long and difficult. At the current time, we assuredly cannot achieve it, but we are getting closer.

Figure 2. SpaceX is on the road to reusable rockets with their Falcon Heavy boosters, shown displaying the ability to land safely after a launch.[14]

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IMAGE REFERENCES

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