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A Multi-Planet Species: Ethical and Environmental Impacts of Privatized Space Travel

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ABSTRACT: This paper examines private exploration and colonization of space, inspired by the growing interest and advancements in developing space by private industries, notably SpaceX. Marx's theory of primitive accumulation and David Harvey's theory of "spatial fix" provide a framework from which to understand why billionaires are attracted to the business of space. Matters of legality are considered in the regulation of space including treaties, their applications, and the unforeseen gaps in the law left by unanticipated private sector growth. Economic feasibility is discussed through cost and revenue estimates of possible marketable products. Environmental impacts, both on Mars and Earth, are reviewed regarding physical landscape and biological contamination. Finally, it explores the ethics of a developing colony in a stressful environment and seeks to unpack the term colonization in a celestial setting. This paper concludes that bringing capitalist ideals and methods into space is not a solution for problems created by capitalism on Earth. Given the concerns identified, it may well exacerbate them.

KEYWORDS: Mars, space, colonization, primitive accumulation, private industry

Introduction

In 2018, SpaceX launched its rocket *Falcon Heavy*. A reflection of Elon Musk's propensity for a dramatic flair, the rocket carried a Tesla and played David Bowie's 'Space Oddity' on repeat (Shamas and Holen 2019, 1). Along with the eccentric stowaways, the *Falcon Heavy* is the world's most powerful operational rocket to date and can carry up to 140,660 pounds of payload (SpaceX 2021). With this achievement, Elon Musk wants humans to be a "multi-planet species," a goal that is integral to SpaceX and central in its mission (SpaceX 2021). The progress in rocket science technology reflected by this launch is astronomical, and our society is closer than ever to the possibility of a Mars colony. However, critics note the legal, economic, and environmental impacts of such a colony. A massive leap like this requires critical thinking and a risk assessment. Why is there such a push towards privatized space travel, and what are its impacts? This paper seeks to examine privatized space travel and colonization through theoretical, legal, economic, environmental, and ethical perspectives.

Theoretical Background

To understand why the private industry is so adamant about Mars colonization, one must analyze the roots of capitalism as explained by Karl Marx. His theory of primitive accumulation explains that capitalism begins with a capitalist taking away a person's natural resources in order to turn it into private property and sell it back to them (Marx 1887). "The whole movement, therefore, seems to turn in a vicious circle, out of which we can only get by supposing a primitive accumulation (previous accumulation of Adam Smith) preceding capitalist accumulation; an accumulation not the result of the capitalist mode of production, but its starting point" (1887, 507). There are limits to this application when it comes to Mars colonization because it could be argued that no one currently owns or has a livelihood on Mars, and therefore privatization would not involve taking something away from the people. To apply Marx's work, outer space would need to be reframed as a communal public and educational space. In this way, the privatization of Mars would be taking capital away from the people in order to sell it back to them.

David Harvey (2001, 24) expands Marx's concept of primitive accumulation through a geographical lens with his theory of the 'spatial fix.' He defines the 'spatial fix' as the acquisition of new land as a temporary solution for overaccumulation in an area. "Fresh room for accumulation must exist or be created if capitalism is to survive. If the capitalist mode of production dominated in every respect, in every sphere, and in all parts of the world, there would be little or no room left for further accumulation" (Harvey 1975, 13). The problem with the spatial fix is contained within its definition, it is temporary. Capitalism requires a consistent influx of land to continue its' cycle of sale and profit, and countries and corporations fill this need by conquering new territories, extracting natural resources and selling them. Using this logic, it makes sense why billionaires are thinking multi-planetary. Practically every corner of the globe has been developed by or put under conservation by humans. Just as Europe colonized the globe in its many conquests for natural resources and slave labor, capitalists have started to look beyond the Earth for new land to consume. The question is, should we let them?

The Legality of Space Colonies

Beyond why private industry is interested in space colonies, there are questions of legality and feasibility. As of now, the answers are complicated. The "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies" is a United Nations (1967) treaty stating that outer space should fall under maritime law and be treated as international waters. This means no one country can claim planets or moons as their territory. It also means that companies are bound by the laws of the flag they fly. So, in theory, SpaceX missions would be governed by United States law even though the territory is considered international (Levchenko, Xu, Mazouffre, Keidar, and Bazaka 2018). Currently, rocket launches of any kind require government approval, and some activities (like launching a satellite) require further licensing (Fecht 2016).

This treaty, however, does not mention private industry or colonies of any kind, most likely because that seemed unfeasible in the late 60s when it was created. Using the laws in place now, it is possible that a company like SpaceX could create a base on Mars that was open internationally for tourism but fell under United States law. It is a stretch, but the few regulations make it feasible that billionaires with a team of lawyers could make it happen. The coming era of capitalistic space travel, dubbed 'NewSpace' by Shamas and Holen (2019), requires much more extensive legal protections than are in place now.

Costs and Revenues

Currently, the cost of flying a crew of four colonists to Mars is estimated at 12 billion US dollars, with a cumulative cost of about 100 billion US dollars (Levchenko, Xu, Mazouffre, Keidar, and Bazaka 2018). That is an exorbitant amount of money, but people like Elon Musk and Jeff Bezos have reached a hundred-billionaire status, so it is not unattainable for them.

Although some exceptions exist, most revenues for companies like SpaceX are estimated to be from tourism, not mining. That being said, there is a 2km long asteroid, Anteros, that is estimated to pass Earth at about 7 million miles away (which is 25 times closer to Earth than Mars) in 2038 (Kramer 2017, 131). Anteros is believed to contain 5.5 trillion dollars' worth of magnesium silicate, aluminum, and iron silicate that companies are already competing over to mine (Kramer 2017, 131).

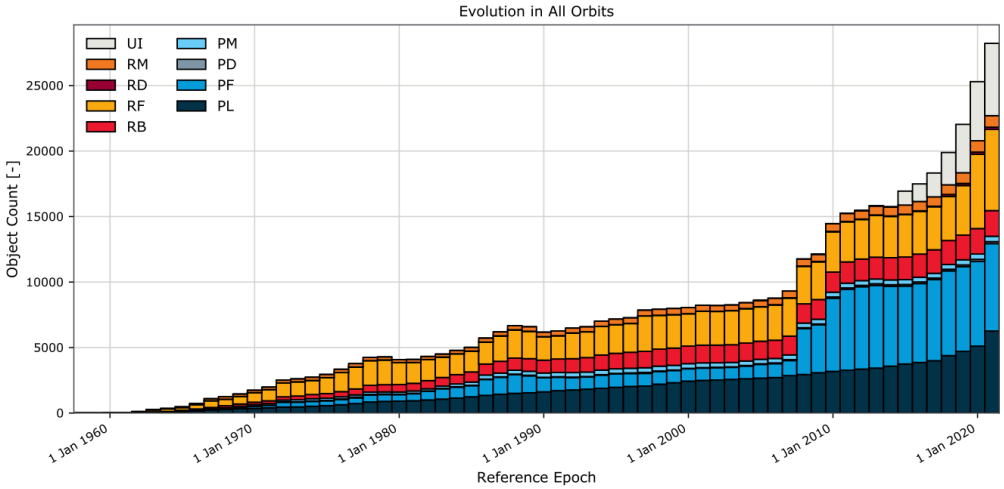
Mining on Mars, however, would be a difficult task. The amount of energy and money it would take to ship mined materials from Mars to the Earth regularly would outweigh the amount of profit made from selling those materials, as Elon Musk explains himself, "I do not think it is going to be economical to mine things on Mars and then transport them back to

Earth because the transport costs would overwhelm the value of whatever you mined, there will likely be a lot of mining on Mars that's useful for a Mars base, but it is unlikely to be transferred back to Earth. I think the economic exchange between a Mars base and Earth would be mostly in the form of intellectual property" (Levchenko, Xu, Mazouffre, Keidar, and Bazaka 2018). While this might seem like it contradicts the resource exploitation contained in Marx and Harvey's theories, it could be argued that tourism does not subvert this theory but rearranges it. Instead of bringing the resources to the buyers, companies bring buyers to the resources, and environmental damage can be done without the invasive practice of mining.

Environmental impact

When thinking about the environmental impact of space travel, there are two concerns: the protection of Earth environments and the protection of Celestial environments. Starting with the former, SpaceX uses kerosine and methane-based engines for their rockets, which are greenhouse gasses. There are not frequent enough rocket launches for this to be a significant problem yet, but if colonization is the ultimate goal, then the move to Mars would damage the Earth's atmosphere. Rocket and satellite launches also create space debris, which are objects of human origins that orbit the Earth (Miller 2001). The first space debris was detected in 1960, and since then, that number has grown to over 25,000 objects (shown below).

Graph 1: Evolution of Number of Objects in Geocentric Orbit by Object Class



Source: European Space Agency Space Debris Office

This debris causes collisions and explosions of ships in orbit, and the more debris that is created, the harder it will become to send astronauts into orbit safely.

For the second concern, Environmental protection of celestial bodies, or astroenvironmentalism, considers the possibility of extraterrestrial life as a reason not to colonize Mars (Miller 2001). Spacesuits, as they are constructed now, are not made to prevent biological contamination, they are meant to protect humans from space. In the event that Mars is colonized, and some form of extremophile is discovered on the surface, how will scientists be able to determine if it is alien life or human contamination? International Institute of Space Law award winner Frans Von der Dunk says, "If Earth microbes take root on Mars or Europa, we may never have the chance to find out if those worlds ever hosted alien life. So, the major space agencies have a sort of 'gentleman's agreement,' to decontaminate their spacecraft as much as possible before sending them to other worlds. But human bodies are much harder to decontaminate since our health depends on our microbes" (Fecht 2016).

There is the possibility of contaminating Mars with terrestrial organisms, but there is also the possibility of killing extraterrestrial life on Mars. Elon Musk is a believer in Mars terraforming, what started as an idea to launch nuclear bombs on the surface of Mars to simulate artificial suns, after receiving scientific backlash, turned into a collection of satellites to warm Mars' atmosphere (Hamilton 2019). Transforming Mars to fit human needs is a huge threat to potential microbial alien life. Some might argue that humans kill microbial life all the time on Earth for human safety, like in our food and water systems. However, that argument implies that Mars colonization is necessary for human survival, which is untrue (Levchenko, Xu, Mazouffre, Keidar, and Bazaka 2018).

The (Un)Ethics of Colonization

Following questions of why and how leave questions of ethical implications. Beginning with the logistics of sending people to colonize Mars, there are immediate ethical issues. Besides the obvious physical life-threatening situations that come with space travel, the psychology associated with being in confined spaces with a limited amount of people in high-pressure situations is complex, especially when the survival of the group or success of the mission is the priority, not the safety of individuals (Levchenko, Xu, Mazouffre, Keidar, and Bazaka 2018).

Sustaining a Mars colony would also require some form of pregnancy and birth in order to sustain the colony. Currently, NASA policies forbid sex in space, and there are no confirmed reports of it happening (Schuster and Peck 2016). Considering astronauts are technically coworkers, this makes sense. Beyond that, the threat of pregnancy in space is another challenge. Based on experiments done with rats in the international space station, scientists discovered that low gravity pregnancy results in more stillbirths and disrupts the development of the vestibular system that affects balance (2016). Astronauts are also affected by cosmic radiation because there is no ozone layer in space to protect life from the harmful rays. This increases the risk of astronauts developing cancer, and no scientific studies have been done to see how cosmic radiation would affect fetus development (2016). Despite all these risks, intercourse and pregnancy (natural or IVF) would be required in order to sustain a mars colony. This would require a balance of intimacy between coworkers that is ethically fraught.

Beyond the ethics of individuals in space, there are ethical questions about how colonization will affect the community on Earth. Starting with the word "colonization" itself, it is a method to spread capitalism, and it is inherently unethical. There is so much work to be done to end the ongoing colonization on Earth, and expanding those violent actions into space will only cause harm, as explained by Levchenko and others in their deep dive into Mars colonization:

> "Indeed, at its early stages of settlement, the small colony is likely to be composed of altruistic, selfless, technologically savvy individuals who may thrive in an equitable and libertarian society and may be prepared to sacrifice individual desires and benefits for the greater good of the group. However, it is far less likely that such a system can be sustained once the population of colonists grows to thousands and millions and becomes more diverse. Inevitably, a socio-economic and political order will emerge, and it is likely to be different from the initial system. Would it be possible not to repeat mistakes that we have made when colonizing continents here on Earth?" (Levchenko et al. 2018)

However, the comparison of space colonization and colonization on Earth is not perfect; space colonization is not built on genocide and the erasure of culture. However, framing colonization as a method from which to spread capitalism, and going back to Marx and Harvey's theories, it is fair to say that space colonization would cause harm in order to make a profit. "Our history tells us that colonists, no matter how responsible, would inevitably affect the environment they colonize" (2018).

Conclusions

Elon Musk wants humans to be multi-planetary; he even suggests that the acceleration of climate change will leave Mars as the only option for human survival. But a solution that only saves the richest and most politically powerful is not a solution at all. Capitalist logic deems billionaires as the smartest and most qualified among us, and therefore can and should get things done more effectively and efficiently than the collective. While there may be some truth to the speed at which private industry can innovate, it does not guarantee ethical practices or long-term protections. Private corporations like SpaceX might be able to move and innovate faster, but is that a good thing? Is space travel something that needs to be rushed?

It is incredible that humans have come to the point where the debate laid out in this paper is even possible. However, framing space colonization as a solution to problems caused by capitalist destruction of the environment is foolish. Colonizing Mars will not solve human-created problems; in fact, these problems are only multiplied when considering the legal, economic, environmental, and ethical impact that Mars colonization could have.

Still, there is an air of romanticism that surrounds space travel. There is even a trope in science fiction that space travel or the discovery of alien life has a unifying effect on the human population, what Levchenko (2018) calls a "naïvely humanistic vision." But how universal is space travel if only the wealthiest countries or individuals can participate in it? We should use the childlike wonder associated with space travel as inspiration to treat outer space as a communal wilderness, a place to be studied and appreciated, not a place to expand violent practices, or as Sinha (2016) writes, "Do we deserve to become multi-planetary? Let us become productive participants in the glorious dance of life. If we can dream of the insurmountable task of becoming multi-planetary, then surely, we can fathom expending the energy, resources and willpower that come with making mindful purchase and waste decisions."

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