Two Planets: Challenges of Living and Prospering on Earth and Mars

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ABSTRACT

As the challenges of living sustainably on Earth grow ever more dire because of environmental constraints on unlimited growth of population and demand for energy and material resources, many visionaries promote the idea of a new start for a subset of humans by colonizing Mars. But is getting to Mars and living there as feasible as portrayed by certain captains of industry and directors of science-fiction movies? Earth and Mars differ in their surface gravities and in their distance from the Sun, which result in many disadvantages for Mars settlers:

- Lack of magnetic protection against galactic cosmic rays
- Multiple-year time scale to go from low Earth orbit to Mars and back
- Lack of substantial atmosphere for parachutes to descend to the surface
- Lack of oxygen in low-pressure atmosphere that is mostly carbon dioxide
- Disappearance of feeble sunlight during Martian dust storms
- Lack of gravity-induced stresses that lead to muscle and bone loss

Many of these disadvantages can be overcome by having access to nuclear power on Mars. Indeed, traveling to and surviving on Mars for many months at a time, without ready access to fresh water or air, is a problem similar to surviving in a sea-faring submarine that stays submerged under the ocean for months at a time. Unlike a nuclear submarine, the optimum nuclear reactor uses molten salt rather than water as a coolant, is a breeder that runs on the thorium fuel cycle rather than uranium-235 or plutonium-239. On board the spacecraft, the reactor can function as a fission-fragment rocket engine, rather than as a driver of a turbine, that can propel a payload from low-Earth orbit to Mars orbit that more resembles the spacious International Space Station than a cramped automobile. We outline how access to ample nuclear heat and electricity can help terraform Mars to be more like Earth, and how to detoxify the soil of Mars with porous charcoal made by the rapid immersion of biomass under hot (non-radioactive) molten salt that is a by-product from running a molten-salt nuclear reactor. Thus, the same technologies that can make an inhospitable planet like Mars habitable can reverse the lasting industrial damage from modern economies that now threatens an eminently habitable planet like the Earth.