Welcome to space 4.0, the infinite frontier

There I was, as a boy, my eyes riveted to the television my mind expanding by the second, and my imagination tingling, as music began over a starfield screen and William Shatner voiced those famous opening words, “Space, the final frontier…” So begins the introductory monologue to Star Trek, the original series, and so too did my obsession with the opportunity and possibility of humanity expanding beyond earth into space.

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Gene Rodenberry’s vision of future humanity changed history and has inspired millions across the globe and over generations to look to the stars for hope. Star Trek showed us a version of ourselves to which we could aspire - one of an egalitarian meritocratic utopia of humans free from suffering and want. The problems were no longer within us, they were all out there, in that great big universe. That was also where all the possibilities were to be found.

What underlay that onscreen society was not simply human social enlightenment but a core set of technical capabilities that had eliminated the fundamental driver of conflict throughout human history: scarcity of resources.

The limitations on peace between people have historically been directly related to the limitations on people’s ability to achieve food, shelter, and physical security – the bottom rungs of Maslow’s heirarchy of needs. The inability to satisfy those basic requirements, due to a scarcity of resources has parasitically sapped effort from advances in health, art, and social

well-being, not to mention non-violent technologies of all kinds.

Hegel, Marx and their derivatives, saw this as a cause for revolution resulting in a socialist or communist state as the solution. History has proven them to be wrong, but capitalism, while preferable is not perfect. Regardless of the method, the point of these systems is to create a structure for access to resources upon which society can agree. What Star Trek showed us was a universe so full of resources just ready and available for the taking that it made more sense for humanity to work together to develop the technology to acquire those resources and revel in the abundance than to engage in conflict for resources on Earth.

It showed us a future of humanity in which scarcity of resources had been eliminated and thus the greatest driver of conflict in our civilization no longer existed. Now, in 2023, humanity is poised to take its first steps towards eliminating scarcity. Many factors are driving this but foremost is technology, not just in space but also artificial intelligence, the availability of data and storage, computational speed, and key advances in materials. The environment is another factor. We need to learn to be productive off this world in order to save it. The opportunity to leverage the space environment is also a key factor that will affect many human endeavours. Finally, the education and awareness of people around the world, which was previously considered a happy by product, has become a driver for us to go beyond, as people and nations of all sizes and technological sophistication look to capture space benefits for themselves. As is typical of human endeavours the path and process has so far been messy, although led by the most powerful and resourced groups.

What some see emerging is yet another tragedy of the commons, in space instead of on Earth. However, such thinking is ultimately small minded. Even as nations such as Luxembourg and Canada rush to create structures for ownership of space resources and China attempts to create their own monopoly in space, other companies and national agencies are

attempting to create a paradigm of open access. We must hope that the latter win out in a way that still promotes private enterprise to go and capture resources.

An asteroid such as Psyche, to which NASA will send a probe, launching later this year, could completely disrupt and flatten the nickel and cobalt commodity markets if the ore there could be captured. Other asteroids of which there are tens to hundreds of thousands are each worth trillions of dollars by today's market prices but would effectively eliminate the scarcity of critical metals that exists today on earth.

Closer still, the moon is rich with so called rare-Earth metals deposited there by asteroid impacts. Furthermore, through the capture of these resources we would eliminate horrific mining operations around the world – a major benefit both to the environment and to the people working in near slave conditions to extract resources such as cobalt from mines in Africa.

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To enable access and capture of space resources, significant in-space infrastructure is needed e.g., spacecraft to go to and from the asteroid, ore extraction technologies, in space processing, in space foundries, and finally in space manufacturing. While that sounds like a lot, today, there are nearly 100 investor funded companies around the world creating that exact ecosystem, with additional support both financially and through mentorship from agencies such as NASA, ESA (and its participants), ISRO, and others. The Space Team at investment bank Morgan Stanley, estimates that the global space industry worth roughly $447B in 2022, could surge to over $1T by 2040.

The environmental and human benefits of processing and manufacturing off-Earth are also tremendous. The infrastructure is now being developed

to access the resources in our planetary system. Phil Metzger is a planetary scientist at the University of Central Florida. He spent 30yrs at NASA where he cofounded Swamp Works, a lab that develops tech for space mining and interplanetary living; “we would be able to promote healthy societies all over the world at the same time that we would be reducing the environmental burden on the Earth.”

Estimates suggest that even if our consumption increased a thousand-fold, we would still have centuries if not millennia of resources available to us just in our system alone! As robotic missions move out to other star systems we discover an effective infinity of resources. The recent sky survey from Chile showed that with 3.3 billion stars and galaxies in the milky way alone, there is a lot out there, beyond our system.

This new frontier is not final, as Roddenberry wrote, but infinite. A frontier of infinite resources and infinite possibilities simply waiting for us to go capture them. A frontier that like the American West of long ago, is capturing the hearts, and minds of humanity, and could open the door to us realising all the potential we have.

Horace Greely, of the New-York Daily Tribune once wrote “ Go West, young man, go West and grow up with the country.”

Today I update that to be: go to space young human, go to the stars and grow up with humanity.

> *Welcome to Space 4.0 – the Infinite Frontier.*

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