Taking control

Great moments in megaengineering.

Gregory Benford

2000–2150: Earth stewardship

The runaway greenhouse effect forced Green Puritans to consider planetary management. TwenCen objections to wise human intervention faded as the existing impact of human actions became obvious. Stewardship became essential, following several human diebacks costing more than a billion lives in total.

Changes of cities' reflectivity eliminated the 'heat island' effect, cutting air conditioning costs. The next stewardship stages stimulated cloud generation over tropical oceans, where reflected sunlight efficiency is highest. This went hand in hand with political necessity: economic investment in developing, tropical economies created manufacturing plants that sent particle-rich, cloud-seeding plumes downwind. Capturing carbon dioxide from the air, principally by depositing farm crop waste in the deep oceans, offset the fossil fuel burning of the developing nations. Climate management became routine by 2140, when signs of a coming ice age demanded new measures. Averting this crisis required the spreading of dark soil on polar caps.

Once taken up, managed guidance of a biosphere that supported 12 billion humans could not be renounced without the demise of whole societies. Geospheric stewardship became the greatest moral imperative, and the Puritan Enviro movement was outlawed.

2100–2900: new atmospheres

Similar initiatives on Mars melted the poles, releasing carbon dioxide and water. Discovery of water reserves deep in the martian crust stimulated widespread pumping. Greenhouse build-up in the thin atmosphere further melted some surface deposits, driving a slow accumulation of gases. Funded by the Fogg Foundation, this continued until people could walk the surface wearing only pressure masks.

On the Moon, pioneer drilling uncovered deep ice beds, and exposure of these led to a thin atmosphere. Nanotech agents ferreted out further light elements, releasing them for the first time in 4 billion years. Capping of this atmosphere with a spherical lunar monolayer trapped more, while allowing free transport through gate-gaps.

By this time the most valuable bulk commodity in the inner Solar System had become light elements, gathered from cometary nuclei. Harvesting of volatiles from objects in

the Kuiper Belt and, later, the Oort Cloud, led to the 'Wild West' phase of water prospectors, lighting Earth's night skies with thousands of outgassing tails. Water-rich objects were sold to development firms on Mars and the Moon, flown by their own gas pressures to landing sites, and dropped to create crater-basins. These were domed and outfitted, their soils cultured with nanobacteria, and condominiums opened within 100 days of impact. This proved to be the biggest driver in atmospheric accumulation.

2345: the supernova catastrophe

Early warning that a star 92 light years away was to become a supernova prompted extensive defence measures. To block line-of-sight effects, engineers moved the Moon closer to Earth through artful gravitational flybys of asteroids. While the Farside observatories got a good view of the supernova, projected impact effects upon Earth itself demanded new stewardship measures to offset particle and photon fluxes, and increased cosmic ray heating.

2600: the hydrogen wall

Earth had spent several million years serenely gliding through the low-density Local Bubble, a hole blown by an ancient supernova. Abruptly crossing this edge into a high-density molecular cloud brought a sudden intrusion of interstellar hydrogen into the inner Solar System. Imminent disruption of commerce with the outer, water-rich provinces fuelled a new understanding of both particle and magnetic pressures throughout the heliosphere. This prompted the discovery that the electrodynamic forces of large magnetospheres, principally of the Sun and Jupiter, could be tuned to short-circuit certain current paths. This brought the flowering of magnetospheric engineering. Closure of cosmic current loops brought protection to the Martian Free States and saved the Asteroid Anarchy. This protection came at the expense of the energy needed to maintain the Jovian discharge, now used to cleanse and mine valuable ices from the Jovian moons, as well as regulating hydrogen intrusion.

2800–present: solar stewardship

The puzzling lack of neutrinos from the solar core was explained when the effects finally percolated to the surface, forcing a re-examination of our understanding of the Sun's evolution. A damping of the interior fires lay ahead, and only intervention could avert a fractional decline in solar emissions. Construction of a plasma torus inside the orbit of Mercury took a century: activation of inductive currents in the torus produced a magnetic field centring on the solar core: cyclic tuning of these fields drove convective circulation between the core and outer shells, refreshing the solar furnace. Transfer of these energies to the surface through magnetic zone effects enabled engineers to overcome the slowing effect of photon diffusion from the core, so that immediate warming of the corona appeared within half a century.

After that, it was a short step to finer tuning, so that emissions could be directed at specific targets in the Solar System. This allowed further warming of Mars and cometary communities which had set up housekeeping in the inner solar system, greatly expanding the human prospect.

3000+: whither the species?

Interstellar travel now promises to extend the human habit of stewardship to the galaxy as a whole. The more radical megaengineers advocate further experiments in the Solar System, but resurgent Puritan Enviros vehemently oppose tinkering with planetary equilibria already struck. In particular, the recent proposal of a 'day without sun' — turning off sunlight as a laboratory experiment, to test new theories — faces widespread opposition. As always, the boundaries of the human reach remain our most vexing moral problem. Yet somehow, the perimeter keeps increasing. Perhaps that is the most enduring lesson. ■

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